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FINAL REPORT*

SUPPORT TO THE INTERNATIONAL TEXTILE AND APPAREL CONFERENCE CITC '95

Rio de Janeiro, 18-21 July 1995

XP/INT/95/037
SF/INT/95/001

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Agro-based Industries Branch

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In 1987, with the support of the United Nations Industrial Development Organization (**UNIDO**) the Applied Research Unit of CETIQT was strengthened with respect to its capacity to provide technical services in the area of computer applications in the textile and garment industry, especially in computerized colour matching, dyehouse automation and computer-aided design and manufacturing (CAD/CAM).

The International Textile and Apparel Conference (**CITC '95**) was organized within the framework of the successful UNIDO-SENAI/CETIQT co-operation. The Conference was held at the premises of SENAI/CETIQT[*)] in Rio de Janeiro, BRAZIL between 18-21 July 1995. A total of about 800 participants attended the four-day events. he main topics were: Quality and Management; Technology and Environment; Fashion and Marketing. The programme consisted of papers, workshops, mini-courses, panels and a textile machinery exhibition.

UNIDO invited seven leading international experts to deliver papers in the specific fields of quality and management, spinning, weaving, finishing, ecolabelling and apparel marketing, lead seminars and panel discussions at the Conference, and covered the costs of twenty participants from Latin America and Asia to expose the latter to new technologies and to the Brazilian experience in the textile and garment sector, as well as to UNIDO's activities and services.

Presentations were given by UNIDO staff members at the plenary to some 500 participants on "UNIDO's contribution in Technology Transfer to the Textile and Garment Industry" (Mr. John-Peter Moll) and "The Self-Financing Trust Fund Programme: a tool for the Development of the Textile and Garment Industry" (Mr. Luis E. Rojas Montero). In addition, the UNIDO stand in the exhibition hall promoted UNIDO's services to the industry throughout the whole duration of the conference. The stand was well visited and material on UNIDO's services was widely distributed.

*) **SENAI/CETIQT (Serviço Nacional de Aprendizagem Industrial/Centro de Tecnologia da Industria Quimica e Têxtil)** is the largest textile school and research centre in Latin America. It trains annually over 1200 technicians in regular courses and some 4000 persons in specialized, short-term courses, operates a graduate school in textile engineering jointly with the State University of Rio de Janeiro and provides technical assistance to the textile industry in all fields of textile technology from spinning to garment manufacturing, fashion and marketing.

The papers presented by UNIDO's staff members and the international experts invited by UNIDO are listed below and the full report as well as individual annexes are available upon request.

Annex I - "UNIDO's Contribution to Technology Transfer in the Textile and Garment Industry" by Mr. John-Peter Moll (UNIDO)

Annex II - "The Self-Financing Trust Fund Programme: a tool for the Development of the Textile and Garment Industry" by Mr. Luis E. Rojas Montero (UNIDO)

Annex III - "Trends in Quality and Management" by Mr. Patrick Towsend (USA)

Annex IV - "ECOLABELLING: Marketing Gimmick, Trade Barrier or Care for the Environment?" by Dr. Jürgen Rieker (Germany)

Annex V - Development in Finishing" by Dr. Ian Holme (UK)

Annex VI - "The Revolution in Apparel Marketing/Manufacturing and the Changing Technologies" by Dr. Joseph Off (USA)

Annex VII - "A New Approach to Quality: The Most Important Component in the Profit Profile" by Mr. Werner Klein (Switzerland)

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Annex IX - "New Developments in Weaving Preparation" by Mr. Kurt Georg Nick (Germany)

Annex I

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

INTERNATIONAL TEXTILE AND APPAREL CONFERENCE

C I T C '9 5

RIO DE JANEIRO, 18-21 JULY 1995

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UNIDO's Contribution to Technology Transfer in the Textile and Garment Industry

by

Mr. John-Peter Moll (UNIDO, Austria)

Mr. Chairman, Ladies and Gentlemen,

Nearly seven years ago, I visited **CETIQT** for the first time to discuss the modalities for the implementation of a joint **CETIQT/UNIDO** project.

My organization - and of course myself - are proud to be associated with the rapid development and upgrading of **CETIQT** during this time to become the most important textile and clothing training and service centre in South America and one of the best worldwide.

While **CETIQT** is known to most of you - and to the other it will be known at the end of this conference - let me please give you a short overview of the Organization I am working for.

UNIDO

The **United Nations Industrial Development Organization (UNIDO)** wasestablished on 1 January 1967. It became the 16th specialized agency of the United Nations on 17 December 1985, with the mandate to act as the central coordinating body for industrial activities within the UN system and to promote industrial development and cooperation at global, regional, national and sectoral levels.

UNIDO is the UN agency specializing in promoting and accelerating industrialization in developing countries. As an international organization with 167 member countries, UNIDO assists both Governments and the public and private sectors through technical cooperation, investment promotion services, and policy advice. Its services are available to developing countries and to countries in transition to a market economy wishing to strengthen their industrial base. Over the past 20 years, UNIDO has averaged an annual technical cooperation delivery of around $ 118 million, and investment projects worth approximately $ 1 billion.

UNIDO's constitution calls on the organization to assist in the formulation of development, scientific and technological programmes and plans for industrialization in the public, cooperative and private sectors. This gives the organization a unique advantage, allowing it to mobilize a broad spectrum of industrial cooperation. It enables partnerships with development finance institutions, governmental agencies and Non-Government Organizations (NGOs), public and private manufacturing plants, and industrial associations. Through such partnerships, UNIDO makes technology and state-of-the-art expertise more readily available to developing countries.

Objectives: The most recent General Conference (December 1993) focused on five development objectives:

- **Industrial and technological growth and competitiveness**
- **Human resource development**
- **Equitable development through industrialization**
- **Environmentally sustainable industrial development**
- **International cooperation in industrial investment and technology**

Working at three levels - policy, institution and enterprise - UNIDO acts as a:

* **Focal point for industrial technology**

* **Honest broker for industrial cooperation**

* **Centre of excellence on industrial development issues**

* **Global source of industrial information.**

UNIDO h s the following staff: 794 in the General Service category and 384 in the Professional category out of which 240 have an engineering degree.

UNIDO complements its in-house capability by using the services of an average of 2.000 experts from over 100 countries each year - around 40 per cent from developing countries. In implementing its technical cooperation programme, UNIDO awards annually some 200 contracts with a value in excess of $ 14 million and places equipment orders in the magnitude of $ 20 million. Expenditure on training in the form of fellowships, study tours and group training is about $ 14 million annually.

After this familiarization with my organization I would like now to focus on its role in the promotion of cleaner technologies in the field of textiles. Due to its environmental impact the processes related to dyeing, printing and finishing were selected for this presentation rather than spinning, weaving and knitting.

In certain parts of the world, medieval techniques are still being used while in their neighborhood most modern factories with latest technology are operating.

The multitude of different processes, recipes and the technological level of the equipment combined with a varying degree of knowledge and experience of the involved personnel makes it therefore impossible to recommend "off-the-shelf" solutions but only a systematic approach to overcome the inherent environmental problems of the textile wet processing industry.

To assist especially the small and medium-scale wet processing factories - which generally create more pollution per kg of goods produced - UNIDO developed and implemented the **DESIRE** project, which was first executed in India.

One of the basic misconceptions amongst dyers and printers has been that environmental protection is only a cost-incurring activity and cannot sustain without permanent expenditures. As this view is also frequently shared by authorities responsible to supervise the implementation and adherence to environmental policies these are done often only half-heartedly. While it is not denied that especially the effluent treatment process - also known as end-of-pipe is expensive various measures to achieve waste minimization are reducing operational costs as well as reducing the negative environmental impact. In order to institutionalize and propagate the concept of waste minimization in the small and medium-scale sector, a practical demonstration project was necessary. The overall objective of the project for the wet processing industry were:

1. To develop and test a waste audit methodology adaptable to small and medium-scale industries in developing countries;

2. To demonstrate the potential and opportunities of waste minimization in respect of cost savings;

3. To identify obstacles in the introduction of waste minimization and show ways to overcome theme;

4. To disseminate the results to initiate more desire for DESIRE projects.

Waste minimization can be broken down in three major activities:

- **source reduction**
- **product modification**
- **recycling**

After exhausting source reduction opportunities the second step should be to recycle waste and as a final step a product modification might be considered.

Product modification can be done by eliminating excessive product packaging, or utilization of off-specification fabrics in the furniture industry as bottom covering for sofas and chairs. However, it is felt that waste minimization through useful by-products is rather limited in textile wet processing.

Recycling can be broken down into recovery and useful by-products.

Possibilities for recovery and reuse at site are mainly through ultrafiltration for indigo and PVA. Another example is print paste recycling and reutilization .

However, these technologies require relatively high investments and were therefore not considered in the project. An example for useful by-products is the extraction of wool grease by centrifuging effluents coming from the woolwashing process. The wool grease is then refined to lanolin, a product used in the cosmetic industry.

The **DESIRE** project dealt therefore mainly with source reduction which can be achieved through good house-keeping practices and process changes. Examples for good house-keeping are:

- **Proper mounting of printing screens and adjustment of usable screen width in accordance to cloth width to avoid excessive soiling of the printing belt, thus reducing the consumption of print paste;**

- **Proper inspection and maintenance of steam pipes, traps and valves to minimize steam loss and conserve energy;**

- **Proper maintenance and buffing of squeeze rollers to reduce energy consumption for drying, and to increase the washing effect by reducing carry-over of polluting chemicals from one washing department to another.**

- **And last, but not least simple measures like the closing of water taps if not in use should be adhered to for water conservation purposes.**

The process changes are mainly consisting out of input material change, better process control, equipment modification and technology change. Examples for input, material change are:

- **Replace chlorite and hypochlorite with Peroxide in bleaching;**

- **Replace acetic acid by formic acid in polyester dyeing or citric acid in printing;**

* **Replace anionic APEO-based (alkylphenylethoxylate) detergents by detergents based on fatty alcohol sulphates;**

* **Replace dyestuffs containing free heavy metal like ions, copper, chrome, cobalt and nickel with environmentally friendlier one with similar coloristic characteristics;**

* **Replace dyestuffs which require potassium bichromate as fixing agent.**

Give preference to dyestuffs and auxiliaries with none or low content of sulphur, halogen, formaldehyde, nitrogen and phosphor.

Inputs material changes are a demanding task and require a dyehouse manager with sound knowledge in textile chemistry. Hiring of consultants specialized in wet processing might be in most cases a viable proposition. Recipe optimization can be strongly assisted by using computerized colour matching.

Unfortunately, this technology requires investment and specially trained personnel. UNIDO is in the preparation of a project focussing especially on the strengthening of instrumental colour measurement and computerized colour matching in India. With the establishment of centrally located extension service centres we will be able to provide optimized recipes to the small and medium scale dyeing and printing industry. For bigger companies having their own CCM systems calibration services and training of their personnel are foreseen.

Better process control is mainly achieved through the application of computerized process controllers. These controllers are able to affect predetermined changes in temperature, pressure, cycle time, dosing of dyestuffs and auxiliaries, etc. They are a pre-condition to reap the economic benefits of using the new high exhaustion dyestuffs but they are also able to maximize the exhaustion rate of the normal dyestuffs.

Improvements through equipment modifications were - inter alia - made by:

* **Installing displacing elements in kiers and jigs to achieve lower liquor ratios;**

* **Change from the overflow to counterflow in washing machines;**

* **Change from overflow to fill-wash-drain by washing in jigs and kiers;**

* **Change "direct heating" through steam injection to indirect heating using closed pipes;**

Examples for recommended technology change were:

* **Cold - pad - batch technology for dyeing and bleaching;**

* **Wet-on wet processing eliminating costly and energy-intensive drying operations;**

* **Dyeing with low liquor ratios.**

The problems experienced during the implementation of the project were:

* **Emphasis on production**

- **High turn-over of technical staff**
- **Poor record keeping and reporting**
- **Ad-hoc production planning**
- **Lack of preventive maintenance**
- **Absence of employee training**
- **Limited access to technical information**
- **Fear of failure (NMF syndrome - NOT ME FIRST)**
- **Government emphasis on end-of-pipe approach**
- **Lack of enforcement of environmental regulations.**

The results of the **DESIRE** in terms of Waste Minimization (WM) were impressive and can be summarized as follows:

RESULTS	**TEXTILE PROCESSING**
No. of units participating	4
Options identified	119
Options implemented	51
Options under implementation	36
Investment made by units in implementing WM measures	Rs. 1.4 million
Monetary savings achieved during first year	Rs. 7.1 million
Pollution load reduced	Effluent Vol. 30%, COD 16%

I was informed that SENAI signed this week a new agreement with UNIDO for the establishment of a cleaner production centre in Porto Allegre. Part of the activities of the centre will also be focussing on the textile industry. I am certain that this centre with the competent assistance from CETIQT will have similar results and achievements than our DESIRE project in India.

Ladies and Gentlemen.

Environmentally-related projects which are currently in the "drawing board" of the Textile Unit of UNIDO:

1. **Possibilities of substituting heavy metal containing dyestuffs;**

2. **Expert system to determine dye recipes with the lowest environmental impact under consideration of installed equipment, production planning and cost;**

3. **Utilization of stack and flue gases for neutralization of alkaline effluents;**

These projects have a global character meaning that they are not restricted to one country or region only.

I hope that their implementation will assist in reducing the pollution emanating from the textile wet processing industry.

John-Peter Moll
(Speech held on 19 July 1995)

Annex II

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

INTERNATIONAL TEXTILE AND APPAREL CONFERENCE

C I T C '9 5

RIO DE JANEIRO. 18-21 JULY 1995

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The Self-financing Trust Fund Programme: a tool for the development of the textile and garment industry

by

Mr. Luis E. Rojas Montero (UNIDO, Austria)

MR. CHAIRMAN, LADIES AND GENTLEMEN:

Firstly, let me express my appreciation to our host - SENAI - for giving me the opportunity to address this Conference.

In my presentation, firstly, I will briefly describe the role of UNIDO in industrial development in light of the evolving challenges. Secondly, I will describe the Trust Fund Programme, which is the mechanism that enables UNIDO to cooperate with the public and private sectors of industry through the provision of high quality services.

UNIDO has been providing technical assistance and industrial services for over 25 years. However, within the last two years, the Organization has embarked on one of the most far-reaching reform programmes within the United Nations system. In response to changing economic conditions throughout the world, the Organization has refocused its activities to concentrate on key industrial services essential for developing countries and economies in transition. UNIDO has also introduced an organizational structure that has eliminated cumbersome administrative procedures and streamlined the Organization's work.

Industrial development is more crucial than ever to developing nations and economies in transition if they are to reverse declining standards of living and become more equal partners in the global market. UNIDO's services and new priorities are aimed at meeting these evolving needs by providing a complete package of services for technical assistance, policy advice, institution building, human resource development, investment promotion and access to technology and information. **The new restructuring of UNIDO is in line with our changing times.** These reforms will be a continuing process; the Organization will continue to sharpen its focus aiming at becoming more efficient and responsive. The new UNIDO is concentrating on providing quality services and on getting things done when they need to be done.

Mr. Chairman: now, let me turn to UNIDO's Trust Fund Programme. The traditional activities of UNIDO were conceived to provide technical assistance mainly to the governments of developing countries and their institutions, and not necessarily

to respond to the crucial and urgent needs of private companies and their industrial plants. The Trust Fund Programme, therefore, was created to respond to these needs, and enable the industrial sector in developing countries to become more efficient and more competitive. However, given the profit-making character of private companies, normally, it is not possible to offer multilateral funds directly to such companies. As a result, Trust Fund projects are financed entirely by the recipient/beneficiary companies or organizations who request the UNIDO assistance; we called projects of this type "Self-Financed Trust Fund Projects. Projects may also be financed by third-party donors which could be, among others, government-aid agencies normally from industrialized countries, foundations or international development finance institutions; these organizations provide UNIDO with funds usually for very specific purposes; projects of these type are called "Third-Party Trust Fund Projects".

The objective of the Trust Fund Programme is to provide direct support to industrial plants in developing countries in order to improve their performance; their selection and acquisition of technology; their procurement of equipment and supplies; their human resource development schemes; and to support their proposals for diversification, rehabilitation and expansion.

In general terms, the Trust Fund Programme can cover the whole project cycle: from project identification to completion of the industrial plant, and its operation.

Let me mention some types of services offered by UNIDO which can be implemented through the TF scheme:

Project Planning: Pre-investment studies and services

Industrialists/entrepreneurs in developing countries require quick service from UNIDO to carry out work that will strengthen their projects and put them on a sound technical and commercial basis. UNIDO's long experience with pre-investment studies, together with the reliability of its computer-assisted methodology - COMFAR (Computer Model for Feasibility Analysis and Reporting) - encourage project planners in developing countries to seek UNIDO's help. The many aspects of UNIDO's assistance in the project planning stage, include advice on technology sources,

technology selection and acquisition - license negotiations and the identification of technical and financial partners.

A word on COMFAR; the Computer Model for Feasibility Analysis and Reporting is a programme package which facilitates and accelerates the work of financial analysts and economists. It is an interactive, computerized, cash-flow oriented model - a very flexible tool for financial and economic evaluation; it has been developed and licensed by UNIDO and is now being used by major consulting companies and financial institutions including the World Bank.

Advice and Assistance on project financing

This is a service of crucial importance to project planners who increasingly turn to UNIDO for help. They expect UNIDO to widen their options and suggest the financial arrangements that are most favorable to them. They also expect that UNIDO's involvement in project preparation and implementation could facilitate loans from finance institutions and raise the confidence of potential foreign investors. Normally, UNIDO's involvement in preparation of pre-investment studies, gives more confidence to financial institutions in their consideration of requests for financing.

Improving the performance of industrial plants

Better utilization of installed capacity and improvement of plant output are priority concerns for public and private companies. UNIDO can provide effective solutions through the assignment of experts - individually or in teams - at considerable savings of time and money to the company. Projects of this type have been carried out mostly in the cement, fertilizers, iron and steel and petro-chemical sectors.

Procurement of equipment and spare parts

Many companies turn to UNIDO for the purchase of equipment; this widen their procurement options and increase their bargaining power, Suppliers, for their part, are willing to cooperate with UNIDO because they know that the necessary funds are available and they will be paid promptly upon delivery of goods. UNIDO's impartiality

gives confidence to buyers, who know that the equipment specifications will match their requirements.

Specialized training services

Many companies in developing countries require tailor-made training programmes for on-the-job training as well as for special group training at industrial plants or at specialized institutes abroad. UNIDO has excellent contacts with a large number of training institutes in both industrialized and developing countries, and has long experience in organizing tailor made training programmes in most industrial sectors.

CORE PROGRAMMES

UNIDO is developing specialized or core programmes that respond to the needs of companies and institutions in developing countries and economies in transition. To illustrate, the Organization has developed a comprehensive approach in the areas of quality improvement, standardization and metrology and has numerous projects in Latin America, Asia, Africa, and the countries of the former Soviet Union. The role of quality has become a critical variable influencing an enterprise's competitiveness. UNIDO can assist groups of enterprises in cost effective implementation of the procedures required for certification in ISO 9000 quality series, and can assist individual enterprises in implementing total quality management programmes and practices for continuous improvement, assessing conditions for ISO 9000 certification and implementing corrective actions.

Core programmes are also being designed in other important industrial fields, such as in technology transfer, whereby UNIDO can assist companies to gain access to technology, and can provide support to technology transactions including such innovative forms as Strategic Business Alliances and Built - Operate - Transfer (BOT) arrangements. Industrial Information is another core programme of UNIDO. In fact, some of these core programmes are interelated; in order to undertake a technology modernization programme for example, a company needs rapid access to a permanent flow of technological and economic information. UNIDO assistance can be provided effectively in these and other fields directly to enterprises or their federations.

How the TF Programme works

The client and UNIDO analyze the problem, determine the needs and requirements and define the projects inputs. Once a consensus has been reached on what needs to be done, a contract and a project document are prepared; the project document specify the services to be provided, the activities to be undertaken and the budget, as well as the time-schedule for carrying out each activity. The client then transfers to UNIDO the funds to cover the real cost for the agreed inputs; plus a small percentage to partially cover the administrative costs of the Organization according to the services provided. UNIDO holds the money in a Trust Fund account, administers it and manages the operations in close coordination with the client.

Next, UNIDO finds suppliers or experts as the case may be and negotiates terms and conditions with them. As part of its global network of contacts, UNIDO has close relations with major consulting and engineering companies for provision of expertise, technology and equipment. Sometimes, the best offer comes from a developing country.

Advantages

What are some of the advantages of working with UNIDO through the Trust Fund Programme as opposed to the companies doing their projects on their own?

1 First and foremost - Quality - UNIDO is now stressing quality in all aspects of its operations. We believe that providing the right kind of service to meet the customers requirements, at the right time, is highly beneficial to all parties.

2. Savings:

By delegating tasks to UNIDO, companies save time and management resources, and can also save money in the process: UNIDO's strong negotiating position means that it can usually obtain highly attractive terms which are passed on to its clients.

3. Impartiality:

The role of UNIDO as honest broker is well known; the Organization has no

commercial interest. It provides advice and the widest possible choice of expertise and suppliers. In fact, UNIDO has several computerized rosters containing (1) approximately 12,000 individual experts in nearly all sectors of industry; (2) close to 2,200 consulting companies, and (3) some 6,700 manufacturers and distributors of machinery and equipment. **There is probably no other organization or company in the world who can match UNIDO's accessibility to sources of industrial know-how and equipment.**

4. Flexibility:

The range of options is very wide; coordination of all project activities is very close between UNIDO and the client; the client can modify the agreed package according to his or her needs.

5. Minimum risks:

The risks and uncertainties existing with contracts entered into with parties from foreign countries are minimized when the transactions are carried out through UNIDO. Similiarly, suppliers of technologies, services and equipment know that by having UNIDO as intermediary, their risks are reduced. They welcome UNIDO's transparent recruitment and contracting procedures, and the knowledge that payments are made on time.

Accessibility/Field Network

6. UNIDO offers the logistical and administrative support of its specialized personnel working at Headquarters in Vienna, Austria, as well as the support of the UNIDO representatives working in the field which are located in the local offices of the United Nations Development Programme (UNDP).

Examples of Projects

Examples of Self Financed Trust Fund projects are plenty and cover a variety of industrial sectors: **a good number of success stories can be cited.** Among them, I would like to stress our excellent cooperation with SENAI where technical support has been provided for the upgrading of skills in the textile, clothing and leather industries, as well as support to the marble and granite sector, and most recently for the establishment of a Cleaner Production Center in Porto Allegre.

UNIDO began cooperating with SENAI in 1987 when a project was launched to strengthen the Centro de Technologia da Industria Quimica e Téxtil (CETIQT) under a Trust Fund arrangement. Another six UNIDO/SENAI self financed Trust Fund projects have since been initiated. The first of these, in 1991, supported the introduction of computer-aided-design systems at CETIQT and SENAI textile colleges in Blumenau, Porto Allegre and Sao Paolo. The second project focused on strengt..ening CETIQT's International Technical Assistar e Units and was funded partly by CETIQT and partly by the cooperating companies.

Another project supported the leather and footwear industry in the northern parts of Brazil through the SENAI Regional Center for Leather and Footwear technology; this project introduced clean technology rather than end-of-pipe solutions. In 1994, a project was signed to provide support to the Marble and Granite industry through the provision of advisory services and training programmes and to assist the industry in its technology acquisition programme; these functions are now ensuring the rational exploitation of national resources and are leading to improved efficiency in all steps of extraction.

Regarding the most recent Self Finance Trust Fund project between SENAI and UNIDO, I am very pleased to report that on 17 July (day before yesterday), a ceremony took place in Rio Grande do Sul for the signing of a Trust Fund Agreement for the Establishment of a National Cleaner Production Center in Porto Allegre. This project is part of an existing cooperation between UNIDO and the United Nations Environment Programme (UNEP) which proposes to support National Cleaner Production Centers in approximately 20 developing countries during a five year-period. The project in Brazil will ensure that the cleaner production approach of UNIDO becomes an integral part of the countries' industrial pollution abatement programme. The signing ceremony was mastered by the Governor of the State of Rio Grande do Sul, together with the President of the local Federation of Industries and the Regional Director of SENAI. It was also attended by several national authorities. This shows the great importance that SENAI and the Government attach to this project. For UNIDO, the project is equally important, it strengthens the Environment Programme of the Organization where the concept of "clean industry" is top priority.

The Self-Financing Trust Fund approach of UNIDO has been successful in all developing regions of the World. In countries like Egypt, Nigeria and Libya, for example, UNIDO has been supporting industrial plants by providing technical advice to optimize plant utilization and efficiency. The cement subsector is a case in point, where UNIDO's teams of experts have assisted the cement plants in those countries to increase capacity utilization, in some cases, from around 40% to well over 85%. This has resulted in positive substantial changes in the financial position of the companies, far outweighing the cost of the UNIDO services. Training of human resources has been emphasized by UNIDO in these projects. We believe that provision of the right kind of training for the technical personnel who are in charge of running these plants, is an important pre-requisite to enable the sustainability of these companies.

In terms of dollar figures, I am pleased to report that between January 1986 (when UNIDO became a specialized agency of the United Nations System) and June 1995, UNIDO had processed close to 100 self-financed trust fund projects amounting to approximately 85 million dollars. This figures demonstrate the effectiveness of the trust fund mechanism and the confidence that the public and private sectors of industry are placing on UNIDO. In fact, a good number of companies and institutions who have realized the advantages of working with UNIDO, have signed, not only one Trust Fund Agreement, but have returned, seeking additional services from the Organization - a case in point: our excellent cooperation with SENAI, who has become a major partner of UNIDO.

Mr. Chairman, Ladies and Gentlemen,

Perhaps you are asking yourselves, why UNIDO, being a non profit organization, is advertising its services? The answer is plain and simple: because UNIDO has a very important mandate to fulfil "to promote and accelerate industrialization in developing countries". We believe that the private sector is the central motor that drives any economy, and therefore is a key player in the acceleration of industrialization; UNIDO must lend its expertise and accumulated experience to enable the private sector to reach their maximum efficiency.

To summarize: The Trust Fund Programme is a mechanism that enables UNIDO to provide high quality, objective and cost-effective services to the public and private

sectors of industry. The programme is now more important than ever- The new global economic environment is placing tremendous pressure on private companies in the developing countries and economies in transition. We must help these companies to become more efficient and competitive in order to enable them to enter the global market successfully. Successful companies accelerate industrialization, while at the same time, UNIDO meets its intended purposes as the leading United Nations organization responsibie for supporting industrialization in the developing countries.

Thank you.

Annex III

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

INTERNATIONAL TEXTILE AND APPAREL CONFERENCE

C I T C '9 5

RIO DE JANEIRO, 18-21 JULY 1995

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Trends in Quality and Management

by

Mr. Patrick Towsend (USA)

I. ABSTRACT (SUMMARY)

My role in the conference was to (1) present an overview of the progress and status of the world-wide quality revolution and some of its implications for the textile industry and (2) offer some ideas on the actual implementation of a quality process within a particular organization. I was originally scheduled to be the second keynote speaker on the first morning of the conference but due to travel difficulties experienced by the speaker scheduled to be first, I was offered the opportunity to be the opening keynote speaker — an opportunity I was very happy to accept. I had a very large audience for that initial presentation and I was pleased to see that very few people left in the course of the presentation. For my second, longer presentation the next afternoon, my classroom was full and again, the audience appeared to be following the topic closely. Only one member of the audience left — and he returned before the presentation was completed. Judging both by the questions asked in the classrooms and by the informal questions I received outside of the classrooms, it would appear that there was a high degree of interest in my topics, with particular interest in the idea of how to actually go about initiating a quality process that actively involves 100% of the employees of the organization. I am afraid that many people throughout the world have been convinced that quality is extraordinarily difficult and crushingly expensive to achieve. In fact, it is achievable without spending excessive amounts or taking several years to initiate — and in the world economy, it becomes more necessary every day. In the terminology of gambling, excellent products are now the "table stakes" necessary to just get into the "game," quality of product and service is needed to win.

II. ASSIGNMENT

As a UNIDO expert (and published author and frequent in the USA), I was asked to provide both the general state of affairs in the field of quality (and total quality and associated topics such as ISO 9000) and a more specific description of the underlying principles and first steps needed to establish and initiate a quality process.

III. STRUCTURE OF REALIZATION

The structure for the presentation of my material was, I think, quite good. The information that was of general interest — no matter what a person's role within their organization might be — was scheduled for an early keynote presentation and, I think, may have served to help frame out the conference for many of the people in the audience. The information that was of specific interest to those people charged with investigating how to actually "do quality" was scheduled for a longer time period, allowing more details — and allowing for more questions.

IV. THE REALIZATION

I was very pleased with the way the scheduling of my presentations was arranged. Based on audience reaction, I think that the material was well received.

V. ASSISTANCE AND FACILITIES

My primary contact for this conference was an old friend, Dr. Gabor S. Aschner. He made everything easy for me. I was also assisted by Professor Ana Filipecki. The hotel was a delight, with a wonderful view of the beach. Bus service was dependable. The translators appeared to do a first rate job (based on the reactions of the audience). There was obviously a great deal of effort put into the hosting of the conference — and the result was a very pleasurable experience on both a professional and a personal basis.

VI. SHORTCOMINGS

In all honesty, I saw no significant shortcomings. If required to list one, I would have to point to the fact that my seminar session on the second day began ten minutes or so late because the previous speakers ran over their allotted time. The people who are assigned to monitor the presentations have a difficult job and perhaps the most difficult thing is getting speakers who are determined to keep talking to stop on time.

VII. RECOMMENDATIONS

This may be interpreted as self-serving, but my primary recommendation is that UNIDO include the topic of quality/total quality/ISO 9000 in all conferences designed for industry audiences. Countries and organizations who wish to enter the world market need to know that addressing quality problems is not optional if they intend to survive. Specific to this conference, I would have liked to have had translation available for the session the evening before the conference formally began.

Annex IV

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

INTERNATIONAL TEXTILE AND APPAREL CONFERENCE

C I T C '9 5

RIO DE JANEIRO, 18-21 JULY 1995

XP/INT/95/037

SF/INT/95/011

ECOLABELLING:

a Marketing Gimmick, Non-tariff Trade Barrier or Care for the Environment

by

Dr. Jürgen Rieker (Germany)

INTRODUCTION

This report was written by Dr. Jürgen Rieker as a result of the mission index number E-683 232 PFS/APP/No. 95-477/GL .

The mission was planned and carried out within a total duration of three weeks including travel time and preparation. It commenced at May 22nd 1995 and ended at August 15th 1995.

The objective of the mission was to provide technical assistance for the Brasilian textile and apparel industry in relation to eco-labelling and questions concerning this matter. This objective was attained by the following activities.

I. ACTIVITIES

A. Situation at the outset

Due to growing environmental awareness more and more people in buyer countries like Germany think more about their immediate environment namely their clothing. The consumer is particularly interested in human ecology and especially sensitized in this respect. Therefore particularly environmentally and health-conscious consumers voice the request for ecologically designed products, that are "environmentally acceptable and compatible" clothing.

Since there is no way of seeing whether clothing is environmentally acceptable or not, such environmentally acceptable textiles can be marked with special labels called eco-labels. These labels signalise to the consumer, that the corresponding textiles are "different" textiles, that is such that are largely free of harmful substances or whose content of harmful substances lies within very close, acceptable tolerances in accordance with the

present state of the art. A conceivable, potential health hazard from these clothing textiles can thus be ruled out.

Because Germany is an important buyer country for the Brasilian textile and apparel industry in Brasil one has to deal with all questions concerning eco-labelling.

B. Analytical account of activities

During the mission in order to provide an overall picture about all what is eco-labelling, according to the job description the following activities were carried out:

- Preparation of a keynote paper on "Eco-labelling: a marketing gimmick, trade barrier or care for the environment" (enclosed);
- sending the paper to CETIQT within a certain time limit;
- preparation of high quality visual presentation material for the presentation;
- participation in the work of CITC '95 by presenting the paper, participating at the podium discussion, being present as resource person at all the conference activities and preparing a technical report.

II. CONCLUSIONS AND FINDINGS

The podium discussion revealed two opposite opinions. The opponents of eco-labelling argued for example Brasilian legislation were difficult enough and it would be impossible to follow legislation in other countries. The advocates of eco-labelling emphasized responsibility of the industry to environment and consumers. Maybe in the first group there is a

underestimation of great consequence concerning the influence of eco-labelling upon export chances, therefore much persuasive power will have to be invested emphasizing aspects of export.

There were complaints about too many eco labels existing on the market. It must be printed out that those eco-labels will be the "winner" which achieve to be internationally well known and to afford high credilibility. The Oeko-Tex Standard 100 of the "International Association for Research and Testing in the Field of Textile Ecology" ("Oeko-Tex") is an international label because there are 13 laboratories in 15 European countries qualified and authorised to carry out the tests. The other labels to be found more or less have adopted the principal criteria and limiting values of the Oeko-Tex Standard 100 without having achieved international acceptance. An eco-label of the European Union short term is not available.

The question how many applications for Oeko-Tex label were rejected seems to aim at apprehensions the extend of rejections would be very high. Actually according to my experience the rejection quota is very low because applicants feel bound up with ecology and for their own interest intensely take care for selection of processes, dyestuffs and auxiliaries from the ecological point of view.

III. RECOMMENDATIONS

According to my observations and experiences at the conference I would like to recommend:

1. To initiate ecological measures for eco-labelling in the Brasilian textile and apparel industry. Starting with human ecology to meet requirements of important customers in buyer countries like Germany. Thus to stabilize and to improve export capability and chances. Persueing with production and disposal ecology ("green technologies") the importance of which will increase in the next years.

2. Education and training of managers and potential specialists in textile and apparel companies of Brasil on the comprehensive field of textile ecology.

   Goals:

   - To understand sense and objective of ecological thinking.
   - To understand real ecological needs in their companies.
   - To introduce ecology as a component of management.
   - To become able to educate and to train own personal staff the long run.

3. To install facilities and to train personal staff for laboratory testing in compliance with human ecological criteria of a specific label like Oeko-Tex Standard 100. Assistance to be given by the parent label laboratory.

4. Starting eco-labelling work with one laboratory being located near Brasilian textile industry centres. It would be advantageous in the first step to select an existing laboratory preferably a such with structure, personal staff and experience available to maintain a routine service for the Brasilian industry. Because of my observations during the conference, I made sure CETIQT could be able to start eco-labelling work in Brasil.

   When this laboratory is fully functional further laboratories could be established if there is need for them.

   Besides I want ro refer to existing arrangements between Forschungsinstitut Hohenstein, Germany, and University of Blumenau, Brasil, in order to set up an Oeko-Tex-laboratory.

(Dr. Jürgen Rieker)

- Dr. Jürgen Rieker, Forschungsinstitut Hohenstein -

ECO-LABELLING: MARKETING GIMMICK, TRADE BARRIER OR CARE FOR THE ENVIRONMENT?

1. Overall Ecological Situation

For some years now it has been possible to mark certain textiles with an eco-quality label. A knowledge of the overall ecological situation in Germany is necessary to understand the idea behind eco-labelling. That is why this point is to be dealt with first.

In Germany there are a large number of laws to **protect the environment**. They refer to the environmental media surrounding us, namely

- water
- air and
- soil.

Water, air and soil are environmental treasures on which the human being depends, and for whose benefit the laws were made. These laws address each one of us, but especially industry, which must organise production so as to satisfy the environmental standards imposed by legislation. There are tight controls and severe penalties if this is not the case.

There are also numerous laws to **protect the human being**. Examples of this are

- the laws to protect people at work (Protection of Workforce)
- the laws to protect the consumer (Consumer Protection).

All these laws, only two examples of which are given here, are also extremely important for the textile sector, as will be shown later on.

In Germany, the state takes environmental protection legislation very seriously. There are some **principles** to be found in all environmental laws:

- the duty of the state to ensure the welfare of its citizens,
- the protection principle of the laws, and
- the minimization of risk for the human being.

Legislature in Germany has the duty to protect its citizens from environmentally-related harm, and to minimize the risk of environmental hazards which they could be threatened with. Something that is often noticed where legislation is concerned is that an environmental hazard has not yet been scientifically proved, but it is sufficient for there to be a certain supposition and a definite suspicion. Then the "worst possible case" is assumed, that is, that the suspicion is confirmed, whereupon a law is resolved and enacted. The fact that this often leads to some laws being based on exaggerated assumptions should not be concealed.

Here are some examples to characterize **environmental legislation in Germany**:

- On food packets exact details must be given of the contents, especially the chemical additives. The oldest food law in the world was enacted by Duke William IV of Bavaria (figure 1) in 1516 for Bavarian beer. This law forbids beer being brewed from anything other than hops, malt, yeast and water. Even today, the German beer producers still maintain this standard voluntarily.

- The air quality in German cities is subject to ... monitoring, the readings being published in the daily newspapers in a "smog indicator" (figure 2). Pollutants such as sulphur dioxide, nitrogen dioxide, carbon monoxide and ozone are measured. In weather conditions with a poor exchange rate, there is a change in the pollutant burden in the air, the socalled smog, which can impair health. A preliminary warning or standard value is also given to show the reader to what extent the concentration has approached the limiting value at where the well-being of the human being is impaired. If specific limiting values are exceeded, the population must be informed, and the authorities can

impose driving limits (for example speed limits, driving bans) (figure 3). Only recently, this happened in the German states of Lower Saxony and Bremen, when the ozone concentration rose above the limiting value of 180 μg per cubic metre. A more stringent "Summer Smog Law" is in preparation.

Compared with the seventies, the people of Germany have developed a strong **environmental awareness**. The "Green Party" which, when founded, was the first party to place the environment in the centre of their party programme and, at that time, was tolerated more than accepted by the established democratic parties, today shares the government of several German federal states. Regardless of what attitude one has to this party, it must be admitted that, at that time, they gave the incentive for environmental awareness to develop in the population. Terms like "environment" and "environmental protection" today belong to the vocabulary of every citizen.

How seriously environmental protection is taken is shown by the fact that in the ecological assessment of foreign products, social aspects play an ever increasing role. Since environmental protection is, in particular, supposed to serve the working man or woman, where certain foreign products are concerned, there is a growing tendency for politicians and consumers in Germany to ask who had produced these products and in what social conditions. The German Federal Minister of Labour and Social Issues, Blüm (figure 4), recently proclaimed that child labour should be outlawed worldwide and called on consumers not to buy products, such as hand-knotted carpets, which had been made by children.

2. Textile Ecology

Ecology in the textile and clothing sectors, namely textile ecology, is a very complex subject. It is usually divided into three areas (figure 5):

- **Production ecology** concerns the pollution of soil, waste water, exhaust air and the human being involved in the manufacture of textiles and clothing.

- **Human ecology** refers to the effect of clothing on the human body, as being the nearest environment.

- **Disposal ecology** concerns what happens to textiles after use, and the possibilities of further usage, reacceptance, utilization, recycling and thermal disposal (incineration).

Owing to the direct relation between production ecology and human ecology to eco-labelling, these two areas are to be looked at more closely.

2.1 Production Ecology

Production ecology concerns the effect of cultivation and manufacturing processes for fibres, textiles and clothing on the environment. It includes all production links of the "textile chain" (figure 6).

It is, in particular, the **textile dyeing and finishing industry** which keeps having to bear the brunt of criticism. The reason for this is the fact that here it is necessary to work with chemicals, in the form of auxiliaries and dyestuffs. The critics forget that it is precisely processes like dyeing and finishing that are necessary to initially improve the textile materials in their greige or untreated state, so that they can be sold at all. The finishing process is what makes the greige textile fabric fit for use and gives it a fashionable appearance.

In the last few years, under pressure from the general public and legislature, the textile finishing industry has greatly improved its production methods from an ecological point of view. In Germany, this industry is subject to the most severe environmental laws and controls in the world. But on a voluntary level also, a lot of money has been invested in environmentally friendly machines, with the result that it has been possible to drastically reduce emission - that is, the pollution of soil, water and air. Thanks to these industries, the environment in Germany is considerably less polluted than it was just ten years ago.

A great hindrance as regards consistently following a policy of production ecology is the fact that the **production conditions in foreign mills**, for example, in developing and almost developed countries, can only be monitored with great difficulty or not at all. Frequently, in such countries no consideration is given to the environment. And it is in just such countries that the German clothing industry and German commerce (importers) buy on a large scale, because the goods are cheaper than in Germany, where the mills have to spend a lot of money for environmental protection measures. This means considerable drawbacks for the German textile finishing industry.

2.2 Human Ecology

The definition of human ecology is the effect of clothing on the human being, or, to put it more clearly: his or her health when in contact with textiles, on the one hand when used in a new state and, on the other, when used after washing or dry cleaning. The following figure (figure 7) shows what human ecology entails.

Human ecology attempts to give answers to the following questions:

- What chemical substances ("chemistry") are present in textiles? In what concentrations are they present? What is their composition?

- How do these chemical substances affect the human being?

- Are the chemical substances the possible or actual cause of damaged health, that is, are they "harmful substances"? Are there empirical values and scientifically based findings available?

As the figure shows, the effects of texiles and clothing on the human being vary widely. The toxic, irritation and allergic reactions are also known as "skin incompatibility".

2.3 Laws and Regulations

The following figures (figure 8/1 - 8/4) give a list of some of the numerous German laws and regulations that serve to protect the human being and the environment. All of these laws can be allocated to the three areas of textile ecology. Laws for Protection of the Workforce, Consumer Protection, Environmental Liability Law and Environmental Criminal Law cover the area of human ecology.

The Toxic Substance Control Act (figure 8/1) prohibits pentachlorphenol (PCP) on textiles in concentrations over 5 ppm (PCP Prohibiting Regulation).

The Dangerous Substances Regulation (figure 8/1) includes a labelling obligation for formaldehyde, if it is present on textiles in concentrations over 1500 ppm.

Recently, companies exporting to Germany from abroad have been alarmed by the **Food and Commodity Law** and the **Commodity Regulation** (figure 8/2). These laws and regulations prohibit the manufacture, import and trading of certain textiles and clothing in Germany as from a specific date. These are textile and clothing articles containing azo dyestuffs, which can form certain carcinogenic amines by splitting up one or more azo groups.

In this case, the "worst possible case" is assumed, that this splitting-up takes place while the textiles dyed with such azo dyestuffs are being worn. The exposure model should serve to illustrate this (figure 9). Where the garment is in contact with the skin, dyestuffs could be mobilised in body fluids such as perspiration and natural grease and will be absorbed to the skin and enzymes could trigger this socalled azo-reduction. The carcinogenic amine thereby released would then be bioavailable and could penetrate the human body via body fluids and cause damage to health.

This regulation is an example of just how serious legislation for the welfare and prophylaxis principle is taken in Germany: So far, such an exposure mechanism has only been proved in individual model [1 - 3] or animal experiments [4]; evidently, according to the

present state of the art there is no proven danger. Merely the theoretical possibility and the apparently minor but existing, remaining risk is reason enough for this ban to be imposed and deadlines to be made for its enforcement.

In Germany, the **Environmental Liability and Environmental Criminal Law** (figure 8/2) is part of an independent legal area, namely Environmental Law. In accordance with civil law, the Environmental Liability Law provides for compensation for damages in the event that, for example, the health and property of a person is unlawfully damaged. The Environmental Criminal Law punishes the violation of environmental laws by fines or imprisonment.

For the sake of completeness, the figures 8/3 and 8/4 list the laws and regulations for the protection of water and air within the scope of production ecology, and for the regulation of waste disposal within the scope of disposal ecology. Here, the strict originator principle applies, that is, the person or persons who are responsible and the companies which have caused the waste water, exhaust air and waste products must arrange or pay for the appropriate disposal.

The **Water Resources Laws** (figures 8/3) stipulate which chemicals may still be present in waste water and in what concentrations for individual fields of industry, including the textile finishing industry.

The **Waste Water Tax Law** (figure 8/3) determines the taxes to be paid for certain waste substances permitted in the effluent, the level of the taxes being dependent on the quota of polluting load in the waste water.

The **Self-Control Regulations** (figure 8/3) commit the finishing mills to carry out continual analytic examination of component currents from their production and the waste water as to the content of certain substances, and to keep account of same.

The **Federal Immission Protection Act** (figure 8/4) stipulates which substances may be emitted into the air in gaseous form and/or in which concentration or the quota of polluting load.

Within the scope of waste and disposal ecology, the German government is at present preparing a law; the socalled **Cycle Economy Law** (figure 8/4). This will demand from manufacturers of new products that even in the development stage, the disposal of these products must be planned, for example, by recycling, and the manufacturer is obliged to carry out the ultimate disposal of said products and bear the costs of same.

3. Eco-Labelling

3.1 Purpose and Prerequisites

The growing environmental awareness has led to more and more people thinking more about their immediate environment, their clothing, etc. Reports by the media concerning poison and chemicals in textiles, presented in melodramatic headlines (figure 10), intensify this development. Thus the consumer is particularly interested in human ecology and has also been especially sensitized in this respect. Particularly environmentally and health-conscious consumers voiced the request for ecologically designed products, that is "environmentally acceptable" clothing.

Now since there is no way of seeing whether clothing is environmentally acceptable or not, such environmentally acceptable textiles are marked with special environmental labels called Eco-labels. These labels signalise to the consumer that these are "different" textiles, that is such that are largely free of harmful substances or whose content of harmful substances lies within very close, acceptable tolerances in accordance with the present state of the art. A conceivable, potential health hazard from these clothing textiles can thus be ruled out.

Now it just will not do that any company, institution or laboratory can stipulate a catalogue of requirements of any kind, without being able to guarantee that the limiting values set up can be reliably maintained, and that the Eco-label really deserves the confidence placed in it and does not merely serve for marketing purposes. It does not bear to think about the damage that would be caused if a consumer were to find that the whole thing is only a publicity gag with no truth at all! The main priority for a certification, therefore, is the **credibility of the Eco-label**.

To achieve this, some important **prerequisites** must be fullfilled (figure 11):

- Certain standards must be maintained: Test criteria are understood to be those properties of textiles that can be relevant to human ecology. Moreover, substances that may be on textiles which present a certain potential health hazard and are, therefore, classed as harmful substances. The properties must thus be within certain limits, and the concentration of the pollutants or harmful substances must not exceed specific limiting values. To enable all these requirements to be fulfilled, reliable testing methods must be available.

- These tests must be carried out by a reputable laboratory with trained personnel and suitable analytical instruments. What is especially important: it must be an independent laboratory.

- The tests must be "reconstructable", that is, anyone who wishes to do so, should be able to carry out the same tests. This is to ensure that the test results can be counter-checked by someone else.

- Goods that have been certified and marked with such an Eco-label must be checked by the test laboratory. Since it is not possible to check all of the goods, random sample checks are made. These are necessary to exclude abuse of the label.

Only clothing textiles that have been certified by means of such a label can be termed as proven to be "environmentally acceptable" and "real" Eco-textiles.

3.2 Oeko-Tex Standard 100

3.2.1 Test Criteria and Limiting Values

Hohenstein's answer to the question of human ecology is as follows [5, 6] (figure 12):

- The "International Association for Research and Testing in the Field of Textile Ecology" (called: "**Oeko-Tex**") was founded by the Hohenstein Research Institute and the Austrian Textile Research Institute.

- A standard was set up and test criteria worked out. The general conditions are set out in the "Oeko-Tex Standard 100". The test specification are described in "Oeko-Tex Standard 200".

- The manufacturer, supplier or distributor of a commodity which has passed this test, can mark this with the Eco-label "Confidence in textiles - passed for harmful substances according to Oeko-Tex Standard 100" (figure 13/1).

The label "Oeko-Tex Standard 100" is international. In 15 European countries there are 13 laboratories authorised to carry out the tests (figure 13/2). The labels are, therefore, available in many languages.

The following looks into **test criteria and limiting values**. The Eco-label "Oeko-Tex Standard 100" differentiates between a larger number of **product groups** (figure 14). Their test criteria, limiting values and testing methods differ somewhat and are set out in the individual standards 101 - 116. Thus, the standards 101 - 103 cover textile fabrics and clothing and their accessories, and the standards 104 - 106 cover the corresponding products for baby clothing. In the latter case, more stringent limiting values are applied. The standards for textile floor coverings, textile wall coverings, furnishing fabrics and curtains, upholstery fabrics, etc. are covered by the standards 107 - 115. The requirements for leather are set out in standard 116.

What are the **criteria** and their **limiting values**?

The following figures (figure 15/1 - 15/6) show the criteria and limiting values of the Oeko-Tex Standard 101 - 106, that is the standards for clothing textiles for adults and babies, in tabular form. The tables also give details of testing methods.

The **pH value** (figure 15/1) should be neutral, so as to avoid remains of acids or alkalines, which would have a caustic effect on the skin of the wearer, being left in textiles.

Formaldehyde (figure 15/1) can occur on finished fabric. It is usual to differentiate with different limiting values for clothing with no skin contact and clothing with skin contact. The limiting value for baby clothing is deliberately set much lower (20 ppm).

Some **heavy metals** (figure 15/2) are toxic. For the test, a special extraction method is used: The textile specimen is treated with a solution of artificial perspiration and the metal detected in the extract. This simulates the possible migration of heavy metals from dyed textile fabrics while clothing is worn. In the case of baby clothing, an articial saliva solution is used for extraction, because babies and toddlers often put textiles in their mouths. Thus, the object is not to carry out a total analysis of heavy metals in textiles, but to find out the proportion of heavy metal that could become bioavailable when wearing clothing.

Where **pesticides** and **pentachlorphenol (PCP)** (figure 15/3) are concerned, however, a total analysis is carried out. The extraction process is such that the entire substances present on the textile material are analysed.

The Commodity Regulation has already been mentioned. According to this **azo dyestuffs** (figure 15/4), which can be split up into carcinogenic amines of the MAK (maximum admissible concentration at workplace) groups III A1 and III A2, must not be detectable.

Dyestuffs, which have been proved to be carcinogenic (figure 15/4), must not be used in manufacture and must not be detectable.

Dyestuffs, which are known to be **allergenic** (figure 15/5), must also not be used in manufacture and must not be detectable.

Chlororganic carriers (figure 15/5)are also subject to total analysis and must not be detectable.

Biocidic-finishing (figure 15/5) and **flame-retardant finishing** (figure 15/6) must not be applied in production.

The **colour fastness properties** are characterised with the mark for staining and should have a certain minimum grade. This avoids clothing being certified which releases the dyestuff during wear so that this becomes bioavailable. For this reason, with baby clothing, besides fastness to perspiration, the fastness to saliva is also determined; in both cases, the tested garment must be colour fast.

3.2.2 Certification Procedure

The certification procedure is as follows (figure 16):

- When **making the application**, the applicant gives the test institute detailed information on the product that he wishes to have certified.

- A **consultation** takes place, in the course of which the extent of testing is discussed and determined.

- In a **declaration** or **confirmation of statement**, the applicant confirms the correctness of his statements.

- Then the product is tested and an **expertise** is issued.

- The applicant must inform the institute of the precautions he has taken within his company to ensure that the product that he manufactures or distributes corresponds at all times with the tested goods (i.e. is conform). To do this, he must give a **declaration of conformity** in accordance with EN 45 014. To be able to guarantee conformity, the applicant must set up an effective quality control system, which must be maintained for the entire period of validity of the label. The applicant is responsible for the quality assurance of the quality-labelled product.

- If in the course of testing the product it evolves that the standard has been maintained, a **certificate** will be issued. The right to use the Eco-label on a product is restricted to one year.

In the interest of the credibility of the Eco-label "Confidence in textiles - passed for harmful substances according to Oeko-Tex Standard 100", **random checks** are carried out to determine whether the product still corresponds to the tested goods on which the conformity declaration is based. Thus, random checks are carried out during production, in the marketplace or by other means. If it is ascertained that the statements made in the declaration are not or no longer correct and/or that changes in the technical quality and/or manufacturing conditions have not be reported immediately, the right to use the label is withdrawn.

3.2.3 Advantages

Goods certified with the Eco-label "Oeko-Tex Standard 100" are environmentally acceptable clothing textiles which have been optimised from the point of view of human ecology (figure 17). Human-ecologically optimised clothing textiles are entirely different from natural textiles, the manufacturers and distributors of which claim to use only natural fibres, biological cotton growing methods, no chemicals, and only natural dyestuffs, etc., with terms like "eco", "bio" and "nature" being applied for short. Experience has shown that with "natural textiles" the fashion component and some of the serviceability is lost. Turning to such natural textiles brings with it a certain "asceticism" as far as the fashion

aspect is concerned, and this naturally leads to the consumer circles showing a certain reluctance to buy. The majority of the consumers selects textiles according to their fashion appeal. Fashionable clothing brings with it a "joie de vivre", is fun and makes one feel good.

In contrast, human-ecologically optimised clothing textiles are open to both natural and man-made fibres, most chemical finishes and dyeings, but free of certain, defined contaminants, or the content of any harmful substance lies within a human-ecologically defined standard, which rules out that the product in question poses any kind of health hazard for the human being. Thus, in addition to the fashion-related qualities and serviceability, the fashion-conscious and critical consumer also has an ecological benefit. The fashion-fun aspect and good serviceability are maintained, so that the willingness of the population to accept human-ecologically optimised clothing textiles is much greater than with natural textiles.

The **advantages** of the human-ecologically optimised clothing are summarised here (figure 18):

Besides the properties "fashionable", "serviceable", "tested for harmful substances" and the acceptance on the part of the consumer,

- the many years' application and experience,
- the international certification and acceptance of the Eco-label,
- the international exchange of information between the test institutes,
- the conclusive certification procedure, and

- the integrated quality assurance,

are the points in favour of this labelling system.

4. Summary and Outlook

In this section, some essential questions that have arisen in this paper are summed up and answered (figures 19/1 - 19/6).

4.1 High testing costs? (figure 19/1)

- Testing costs can be saved by the formation of **product and/or article groups**. This is possible when individual products are manufactured from or treated with defined raw materials, on process-technologically comparable machines with chemical recipes that do not vary in the human-ecology sense.

- Costs can also be saved by taking advantage of **pre-certification**. This is elucidated in figure 20.

  The trader and importer are in the strongest position where pre-certification is concerned, because, on account of their market position, they are able to demand certificates from the manufacturer of the clothing textiles.

  Regardless of whether, from a German point of view, it is a question of foreign production or domestic production, the same applies: At any stage in this textile chain, the manufacturer can demand certification according to the "Oeko-Tex Standard 100" from his supplier; for example, the textile and garment manufacturer will request certification for the finished fabrics from the finisher. Then, the garment manufacturer merely needs to have the accessories, such as, buttons and zip fasteners and the sewing yarn certified, or he demands certified merchandise from the supplier in question.

- It is not quite so easy for the textile dyeing and finishing mill to save test costs, because most of the test criteria concern the production processes in this sector. As far as the azo dyestuffs are concerned, testing for amines in accordance with the Commodity Regulation can be dispensed with, if one is in possession of the confirmation of a reputable dyestuff manufacturer, that such azo dyestuffs do not occur in the recipes used.

- Finally, thanks to the label, marketing of the additional ecological benefit is possible, as described above (figure 19/1).

4.2 Why not: "free from harmful substances"? (figure 19/2)

- Seen from an analytical point of view, there is no such thing as complete absence of harmful substances. Contaminants in one form or another, but at least from the air, are to be found on any object, and traces of these can be detected with the aid of sufficiently sensitive analytical measuring instruments. It is, therefore, more honest to use the term "passed (tested) for harmful substances" on the Eco-label.

4.3 Trade barrier? Marketing gag? (figure 19/3)

- This does not apply to the "Oeko-Tex Standard 100". It is the result of the increasing environmental awareness and environmental legislation.

- Moreover, anyone can have tests carried out without prerequisites.

4.4 Discreditation of conventional merchandise? (figure 19/4)

- To avoid discreditation, the additional human-ecological benefits of a certified, fashionable collection must be established by means of marketing-orientated argumentation.

- Naturally, one should not argue in a negative way, for example: "The non-certified merchandise contains harmful substances", but take a positive approach, rather like this: "The labelled goods have also been tested for harmful substances". In this way, it is possible to gain the confidence of the consumer, who still wants to buy fashionable clothing, yet is especially environmentally and health-conscious.

4.5 Too many Eco-labels? (figure 19/5)

It is necessary to differentiate:

- **Company labels**, that is, special environmental marks connected to a trademark. There are already a number of these on the market, because every reputable manufacturer wants to somehow improve his image where textile ecology is concerned.

- **Labels of independent institutions**, such as the "Oeko-Tex Standard 100". There are, in addition, the labels of various other institutions, like Tox proof, Eco proof and Eco Tex.

4.6 What about production ecology? (figure 19/6)

- The "Oeko-Tex Standard 100" is specially devised for human ecology.

- There is no Oeko-Tex Label for production ecology as yet. This is, however, in preparation and will be given the name "Oeko-Tex Standard 1000". Nevertheless, it was,

the right decision to give preference to creating a label relating to human ecology first, because the environmentally and health-conscious consumer is mainly interested in human-ecological issues. This also takes account of the fact that it is not merely a case of the clothing being environmentally acceptable from the point of view of human ecology, but also concerns how ecologically the clothing is manufactured.

With that, the further envisaged development is indicated: In future, the Eco-labelling system will also include production ecology. In the medium term, innovations can be expected.

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Annex V

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DEVELOPMENT IN FINISHING MACHINERY

by

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DEVELOPMENTS IN FINISHING MACHINERY

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INTRODUCTION

In this lecture it is intended to discuss application methods of chemical finishing, dewatering, drying and heatsetting machinery and associated environmental pollution control equipment. Mechanical finishing machinery based upon calendering, compressive shrinking, raising, emerizing and rotary cutting machines will then be discussed in the light of recent developments and what might be appearing at Itma 95 in terms of general trends and developments.

APPLICATION METHODS FOR CHEMICAL FINISHING

In the 1970s there was considerable interest in topical methods of application such as foam finishing to apply a low wet pick up for chemical finishing in order to conserve water and energy (1) Dynamic foam generators are available from many companies and the blow ratio and the total volume of foam delivered can be controlled to give a precise fabric wet pick up. At Itma 91 there was an almost total absence of foam finishing equipment, other than that for foam backing of carpets. Problems of the compatibility of the foaming agent with other auxiliaries of different ionicity, and the rewetting properties of the foaming agent can restrict the range of chemical treatments that can be applied. However the Datacolor International (formerly Texicon) Autofoam system (Fig 1) is a robust system that has been widely used worldwide The foam is produced by a fishtail system and the height of the foam bank is monitored by a probe (2).

The Stork RSF (Rotary Screen Foam) system (Fig 2) uses a completely open mesh rotary screen application system on to the fabric as the latter passes in contact with a backing roll (3). The foam generation is microprocessor controlled and the excess foam delivered to the backing roll is collapsed and recirculated back for reuse. However it seems unlikely that many

novel foam application systems will be on view at Itma 95 because simple knife-over-roll coating techniques for foam finishing have proved very satisfactory, as well as being relatively simple to control and cheap to manufacture

Interest continues in low wet pick up (or so-called low add-on) application systems such as the lick roll applicator now marketed by Monforts, the Triatex MA (minimum application) system (4) The essential feature of this advanced system is the use of beta-gauges to monitor the mass per unit area of the incoming and the outgoing fabric after passage in contact with the rotating lick roll partly immersed in the pad bath (Fig 3). This enables the wet pick up to be monitored and is linked to a control system to ensure a constant wet pick up.

The Goller Eco Pad applicator is another variant on a lick roll system (5). A doctor roller is controlled by electromagnets and presses against the applicator roll which rotates in the small pad bath (Fig 4) Thus a thin film of liquor on the surface of the roll is passed upwards and the dry fabric is brought into contact with the liquor under the action of a pressure roller thereby picking up the liquor It is possible that there may be some other lick-roll systems on show at Itma 95, but the principles are likely to be similar.

Now that spray systems are becoming more controllable we may well see more applicators of this type, although for environmental reasons these are likely to be enclosed One machine of this type was the Farmer Norton SD (Spinning disc) applicator in which fabric passes in an N-shaped fabric configuration and is simultaneously sprayed by two banks of spinning metal discs, the liquor being metered into the centre of high speed spinning discs (6) Different finishes can be sprayed on to the face and back of the fabric by this method, the excess liquor hitting the walls of the enclosing chamber and draining to a sump (Fig 5) If the same finish was used on the face and back of the fabric then the chemical finish liquor may be recycled and reapplied Another spray application method is the Weitmann and Konrad WEKO rotor spray applicator (7) This is often used for applying low levels of moisture to fabric, for example, 5-10% wet pick up simply to condition the fabric, but a number of spray banks would be required for substantially higher levels of wet pick up (Fig 6)

While a large number of topical methods of application exist it may be that some novel applicator may appear at Itma 95. However interest has grown in the saturation (or impregnation-removal) systems such as the use of porous bowls (rollers) and vacuum extraction systems. The advantage of such methods is that they can be used to either dewater a fabric prior to drying or to apply chemical finishes prior to drying or drying and curing, whereas topical application methods such as foam, lick roll and spray systems can only apply a specified quantity of liquid to textile fabrics (1).

The microporous nature of the Modern Rollers Roberto rolls (Fig 7) is well-proven for dewatering all types of fabrics and a new roll, the Roberto 2, now utilises its millions of tiny rubber-coated fibres to absorb and suck liquor out of the fabric even more effectively (8). Compared with the original Robert roll, itself outperforming conventional rolls by as much as 60%, the new Roberto 2 shows approximately 12% greater water removal running against a stainless steel roll. For tubular knitted fabrics or thick pile fabrics, where a twin Roberto 2 system is recommended, the average increase in water removal is 18% over the original Roberto system. Roberto rolls may be produced to withstand different pH conditions and are widely used in many companies worldwide. The Roberto 2 roll should be capable of achieving a lower wet pick up than hitherto obtained with the original Roberto roll.

In the field of vacuum extraction there have been many improvements introduced by EVac, Mandtex and TVE (Textile Vacuum Extractor). The EVac system (Fig 8) has been configured not only for water removal in dewatering, and application of chemical finishes with recycling of the extracted finish liquor but also for lint removal (removal of loose fibres) from fabric prior to printing to prevent streaks and other faults (9). The vacuum extraction systems are extremely compact and fitted with highly effective slot edge sealing systems. The slot geometry may be parallel-sided or a converging-diverging orifice may be used to increase the discharge coefficient in the EVac system. For sensitive fabrics a series of holes or slots arranged in a herringbone pattern may also be used. It will be interesting to see the further developments in vacuum extraction systems at Itma 95, as the technique is proving to be very versatile.

DEWATERING

Dewatering is the mechanical removal of liquid from textile materials. As already mentioned the use of microporous rolls such as the Modern Rollers Roberto, and the improved Roberto 2 version, as well as the technique of vacuum extraction are widely used for dewatering as well as for low wet pick up application (8). The Monforts Matex-Vac system utilises an impermeable rubber blanket which presses the fabric to be dewatered against a nonwoven fabric which covers the surface of a rotating perforated drum connected to a vacuum extraction system (Fig 9). The squeezing action of the blanket, the capillary action of the nonwoven fabric and the vacuum extraction combine to effectively dewater the fabric (10).

In the past there have been attempts to use compressed air and high pressure steam to dewater fabrics, but these systems are usually extremely noisy and expensive to operate and it is not a simple matter to recycle the compressed air or high pressure steam. At Itma 91 the Tubetex Jet Extractor was the only novel dewatering device combining high pressure steam blown at the fabric with a vacuum extraction system underneath the fabric (11). A breakthrough in this area at Itma 95 would be welcome, but at this point in time seems unlikely to occur.

DRYING AND HEAT SETTING

The removal of water as moisture vapour requires some form of energy to provide conduction, convection or radiation, for example, hot air circulation as in stenters and perforated drum dryers, infra-red radiation for predrying, steam heated cylinder drying, or microwave or radiofrequency (RF) drying

The advances being made in the use of infra red radiation seem likely to provide some interest at Itma 95 and one machine maker in the UK, Bates, already makes an infra-red fabric stenter (12). Microwave drying in general has a lower power than radiofrequency drying and RF drying is now solidly established as a technique for drying packages, hanks and all forms of bulky materials. The combined use of RF drying linked to the use of a vacuum is the principle

of the Fastran Cool Dry process which ensures the drying temperature is below 60°C, decreasing fibre yellowing and fibre damage (Fig 10). In addition moisture regain can be controlled to ±1 5% throughout the textile material (13)

The main advances in RF drying at previous Itma exhibitions have been involved with the automation and robotization of the materials handling for loading and unloading the machine (14) Maybe the introduction of individual package hydroextraction linked to robotic loading/unloading in an RF dryer will be one development at Itma 95

However the problems of using RF for fabric drying stem from the way in which fabrics are conventionally held to width by metal pins or clips in stenter drying machines The electrical field strength of radiofrequency waves is such that electrical arcing on to the metal can occur leading to fires In addition the RF drying effect decreases as the moisture in the fabric is evaporated and it is not feasible to dry and heat set fabric using RF energy It seems likely therefore that stenter drying and heat setting of fabrics will continue to use hot air circulation at Itma 95

In the field of stenter drying and heatsetting there are now some very advanced stenters and stenter control systems available from major machine makers such as Babcock, Brückner and Monforts (Fig 11) (15) In recent years all stenter manufacturers now locate the VDUs (often up to 5 screens) in an overhead control panel at the stenter entry Some stenters have been operated at speeds over 200 metres/minute on some fabrics, and for periods of 5 hours or so at temperatures up to 350°C at lower speeds for high performance synthetic fibre fabrics However the stenter must then be cooled to overcome potential lubrication problems in the latter case

Normal running conditions are well below such high operating conditions Particular attention has been paid to the fabric entry Monforts, for example, in their low profile stenter (Fig 12) provide the means to move the fabric entry point away relative to the stenter chain and a coating unit can then be brought into use (15) On modern stenters automatic control of the process is achieved through a computer control system that also provides a data logging, production analysis system Control of module air temperature, fabric temperature, fabric moisture content after drying, and the moisture content in the hot air in the stenter are all

possible using appropriate measurement techniques (16) Attention has been directed towards energy conservation by recycling the air, cooling the hot exhaust gases, and at the same time, preheating the fresh air inlet Modern standards of thermal insulation on stenters are very high, and losses due to radiation and leaks are very low due to efficient sealing of the insulated panels

Overall the major features of the stenters in respect of energy saving (17) relate to

- the energy saving design of the process flow in the stenter,
- minimization of heat losses;
- achievement of high energy efficiency and utilization rates;
- heat recovery within the range,
- avoidance of waste heat

Environmental considerations have led to the introduction of a range of approaches for removing lint, lubricants, etc, effectively Automatic cleaning of lint screens is important for efficient air circulation Removal of lubricants is usually by some type of condensation/scrubbing system, for example, such as the techniques used by Radscan (18), or alternatively feeding the contaminated air into the SPARAL afterburner system of Koenig where the organic materials are incinerated with other fuel to generate steam in a boilerhouse (19)

Automatic weft straightening using expanding rollers such as the Krantz Concavex S roller (20), or the use of pin wheels such as the Bianco Tramatex system (21) have been particularly useful on weft knitted fabrics where distortions are prevalent, particularly in the lighterweight fabrics In the Rye Tex system the roller curvature may be deformed at will continuously while the roller rotates (22)

Relaxation dryers have been widely used to decrease the fabric shrinkage on subsequent washing and also to soften the fabric handle (23) Fabric is normally overfed on to brattice or conveyor units and then agitated mechanically usually through the action of high velocity air jets striking the fabric from above and below alternately Most of the fabric shrinkage occurs after the fabric moisture content decreases below 50%, so that other forms of thermal drying such as perforated drum drying which utilises the through-flow principle may be used to decrease the moisture content down to 50% more efficiently

MECHANICAL FINISHING MACHINERY DEVELOPMENTS

Mechanical finishing treatments traditionally rely on the use of heat and moisture to plasticise fibres and enable them to be moulded or shaped into new positions under the influence of pressure, tension and time Calendering and compressive shrinking fall into this category while raising, emerizing and cutting are associated mechanical finishing treatments

In general terms modern mechanical finishing machinery is now constructed in compact modular units that offer a greater reproducibility of effect and a higher productivity Process integration where possible, or conversion of one style of finish to another by simple rapid changes on the machine are often possible Sophisticated process monitoring and microprocessor control systems are increasingly extending the range of effects obtainable (24)

The use of modular plug-in process control units that can be pre-programmed off-line and machine networking using computers should enable plant management to download production information for scheduling purposes or abstract production data for process monitoring and analysis Fault analysis can be facilitated by sensors and detectors that initiate alarms in mimic diagrams of the machine Wherever possible the process is being deskilled and speeded up Considerable thought has been given to friction and lubrication problems, to energy saving machine drives, and to obtaining uniformity of the finish over the whole width of the fabric

CALENDERING

The traditional calender for consolidation of woven cotton fabrics consists of a number of bowls, the bowl coverings which may differ widely Thus fabrics may be chintzed, friction calendered, Schreiner calendered or embossed, for example, moire finishes Modern calender designs involve the use of bowls with superior surface finishes and the machines are designed with specific finishes in mind, rather than being universal calenders

Ramisch Kleinewefers Nipco Star five bowl calender consists of a Y-shaped arrangement with three independently-controlled pressure zones on the central bowl (25) The Nipco system is designed to provide a uniform pressure across the bowl width

One innovation at Itma 91 was the introduction of a novel calender bowl by the David Bentley company (26) This consisted of a copper-plated centre shaft carrying a number of copper discs at right angles to the bowl surface The discs are of a narrower diameter than that of the bowl and are connected by a series of copper tubes running below the bowl surface in the direction of the bowl axis Cold water is circulated through the tubes and through holes bored in the main shaft and this arrangement provides a very uniform bowl surface temperature and a more uniform calendered surface finish

In such a traditional field as calendering it is likely that developments at Itma 95 will show only minor refinements in existing designs rather than radically novel approaches Improved control over the heating systems used are a likely feature together with energy conservation

COMPRESSIVE SHRINKING

Compressive shrinking of woven fabrics (or compacting of knitted fabrics) is an extremely important finishing treatment that allows a much greater measure of dimensional stability to be achieved in 100% cotton fabrics and in polyester/cellulosic fabrics It is of great importance for highly dimensionally unstable weft knitted cotton fabrics The major machine design for woven fabrics is that of the rubber belt machine, and this can also be used for weft knitted fabrics

In the Monforts Toptex/W the knitted fabric is spread efficiently by two driven spreading rollers before being steamed by passage over a steaming drum driven by a variable speed DC (direct current) motor (27) The condensate film on the fabric surface substantially reduces the frictional resistance and facilitates fabric shrinkage. The rubber belt is then compressed to the preselected shrinkage value of up to 15% by means of a powered pressure unit featuring a compression roller. On leaving the compression zone the elongation in the rubber belt is removed and the fabric is pushed together in the length direction and compressively shrunk. The fabric is then passed over a drying cylinder driven by a variable DC motor where the moisture is removed and the shrinkage stabilised. A special low tension winder/unwinder system is used, the central rotary drive being computer-controlled.

An alternative method is embodied in the Tubetex Kompactor where a feed roll and retarding roll are used in conjunction with a heated shoe. Usually two compacting zones are used in order to achieve a high level of compressive shrinkage in a uniform manner.

In the latest Tube Tex CDS (continuous dimensional stability) process the tubular fabric may be detwisted, wet spread, hydroextracted, followed by chemical application and relaxation drying. The Tube Tex Pak-nit II Compactor may be used to complement this sequence to achieve high levels of dimensional stability (28).

RAISING

Raising machinery is more important in woollen fabric finishing, but some cotton fabrics are raised. The machine design has not fundamentally altered since the introduction of the cardwire raising machine, but the modern trend is towards machines with varying amounts of pile and counterpile rollers, and often tandem (or double drum) machines for greater productivity (29) In any raising machine an essential criterion is the zero point raising condition above which successively higher applications of torque to drive the rollers leads to a greater raising action

Reproducibility in raising has greatly improved with the introduction of improved torque control drive systems and with microprocessor control systems for programming the production conditions. Modular plug-in microprocessor control units are also available on some machines. The selection of the most appropriate type of cardwire and of the raising conditions are important in achieving optimum raising conditions. Modern raising machines can be made more versatile in their applicability. Some machines, for example Maria de Crosta, may be converted into a sueding (sanding or emerizing) machine within a matter of hours (29). Alternatively some machines are fitted according to customer requirements with both raising and sueding rollers.

EMERIZING

The technique of emerizing (sueding or sanding) has developed considerably with the introduction of microfibres where the peach skin effect has been widely emulated. Both multi-roller and single roller machines are available such as the 4, 6 or 8 roller machines from Sperotto Rimar (SM4, SM6 or SM8), the Sucker and Muller SF4 (4 roller), or the single roller machine (Sperotto Rimar SM NR1) (30, 31).

The multi-roller machines are usually more productive, typically operating at 12-15m/min and very effective for spun yarn fabrics. The emerizing grit paper may be changed more easily on this type of machine when the machine is in operation compared with the single roller machine. The single roller machine may use a refrigerant-cooled abrasive roller and a pressure roller and is very versatile. Although not as productive at 7.5m/min a wider range of surface finishes may be generated than on the multi-roller machine. If an engraved roller is used to replace the rubber-coated pressure roller then patterns may be produced on the sueded surface.

The effect on the fabric is of course determined by the number of rollers in use, the direction of roller rotation (ie. with or against the fabric), the fabric angle of wrap on the rollers, the fabric speed and the grade of abrasive grit paper used. In some machines wooden slats may be used to vary the type of surface finish produced, but this may be noisy and require a sound absorbing hood. In emerizing machines it is important to have a self-cleaning dust exhaust and

collection system Emerizing machines have reached a high degree of development in terms of control over the effect obtained Developments at Itma 95 may be directed towards higher operating speeds, lower energy consumption and attempts to produce a more versatile machine in terms of the range of surface finishes that may be obtained

ROTARY CUTTING

The modern rotary cutting machine is now a compact modular unit that enables precise cut height adjustment to ±0.02mm on some machines to be achieved Environmental considerations have led to improved self-cleaning fibre exhaust and collection systems and health and safety considerations have led to interlocked safety features. Vollenweider with their Super-Duplo machine provide a compact design with four cutting positions using only two rotary blades (32). Other machines may be of modular design but arranged sequentially in line to cut progressively closer to the fabric surface.

Automatic adjustment of the cutting height and features such as brushing and beating systems, ferromagnetic detectors and automatic seam detection with lifting/lowering of the cutting assembly are essential features for reproducible high speed rotary cutting of fabrics Microprocessor control units enable preprogamming of the machine for various styles of fabric

CONCLUSIONS

At Itma 95 it is hoped that some novel applicators for application of chemical finishes may be shown The design of stenters and other dyring/heatsetting equipment will continue to evolve, with greater emphasis upon environmental pollution control systems Few advances in raising and cutting may be anticipated, although there may be some developments in emerizing machines and other machines for surface finishes. Flexibility, versatility, greater attention to decreasing energy consumption and energy recycling will be important features of most of the machines on view Particular importance will be attached to high levels of process monitoring

and control through the application of improved sensors linked to computer and microprocessor control systems Automation and process control to deskill the operations in finishing and leading to higher levels of reproducibility will be importance features of the machines on view at Itma 95

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DEVELOPMENTS IN DYEING AND PRINTING MACHINERY

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SUMMARY

This paper presents an overview of current trends and developments in textile dyeing and printing, with the focus on possible developments on view at Itma 95. A brief survey is presented of developments in package dyeing, jig, winch and jet dyeing, continuous dyeing and garment dyeing. Computer aided design and laser engraving for printing, automated colour kitchens, rotary and flat screen printing and print fixation methods are also discussed.

INTRODUCTION

The dyeing and printing of textile materials are extremely important processes because of the variety of colours and patterns that may be imparted to generate visual impact and variety in loomstate and knitted materials. Fibres, yarns, fabrics and garments may be dyed in many forms, but principally by batchwise exhaustion methods or continuous impregnation-fixation methods. In both these systems the philosophy of quick response has forced the pace of technological development, coupled with efforts to decrease environmental pollution (1).

DYEING MACHINERY DEVELOPMENTS

In association with right first time, right on time, right every time dyeing there has emerged the concept of blind dyeing, i.e. dyeing in bulk without prior sampling in the dyehouse laboratory (1). This has imposed much higher levels of control upon practical dyeing that now higher levels of process control, monitoring and automation (including robotics) have been introduced to avoid the errors involved with purely manual control of dyeing. Amongst the many developments that can be cited in the last decade are:

- the introduction of advanced colour measurement and colour match prediction systems for fibres and fibre blends;

- computer based total colour management systems;
- automation in the dyehouse laboratory;
- automation in the dye kitchen;
- check-weigh dispensing systems for dyes and chemicals;
- automated materials handling and robotics;
- automated dye cycle control;
- dyebath exhaustion monitoring;
- on-line colour measurement;
- off-line hand-held (portable) spectrocolorimeters;
- pass-fail colour batching for cutting/garment manufacture;

In addition the design of batchwise exhaustion dyeing machinery has seen a number of changes In the pursuit of lower water, energy and effluent treatment costs a prime factor in the design of fibre, yarn and fabric dyeing machinery has been the reduction of the liquor ratio (2) This has enabled shorter dyeing cycle times to be achieved through higher hot fill temperatures, and more rapid heating and cooling rates. The lower liquor ratio leads to increased number of liquor bath cycles per unit time, and the dye concentrations are higher leading to higher diffusion rates into the fibre. There are however limits to decreasing the liquor ratio, and at the current time values in the range 5-6:1 are commonly used on cotton and other cellulosic fibre materials to prevent linting and surface distortion.

A particular problem is the production of a coloured effluent after dyeing, especially when using reactive dyes, because this class of dyes is removed only to the extent of 0-25% in conventional wastewater treatment plants (3) It is hoped that this problem will be addressed

at Itma 95 by a variety of techniques which were clearly not in evidence at Itma 91. However a low cost solution to the aesthetic problems of colour in dyebath effluent seems unlikely at this point in time.

Continuous dyeing methods have exhibited refinements in technique rather than radically novel approaches to dye fixation. Some novel fabric application systems have appeared together with intelligent padding systems.

In the batchwise fabric exhaustion dyeing systems there have been many refinements in the design of jigs and high temperature jigs to produce higher speed operation and facilitate level dyeing. The winch has rarely featured on dyeing machine maker's stands largely because of the introduction of the lower liquor ratio soft-flow or overflow jet dyeing machines which are now the industry standard worldwide, particularly for dyeing cellulosic knitwear, and microfabrics (i.e. fabrics composed of microfibres or microfilaments less than 1dtex/f) (4).

Garment dyeing has moved progressively away from the long liquor ratio overhead paddle machines to the more compact rotary cage garment dyeing and finishing machines which are capable of full microprocessor control. High temperature pressurised rotary cage dyeing machines were also to be seen at Itma 91, specifically for dyeing polyester garments at temperatures up to 130°C but atmospheric machines are far more common because of the importance of cotton and wool knitted materials dyed by this route which do not require temperatures above 100°C (5).

Because of the quick response philosophy dyeing machine makers have concentrated their efforts much less on dyeing fibre and tows because the decision on coloration is usually taken at a later stage in the manufacturing sequence. As a result there has been a great intensity of effort towards innovation in the yarn dyeing field where great strides have been made in robotics and automated handling procedures (6). Especial interest has been devoted to the design of soft-flow and overflow jet dyeing machines to enable lightweight sensitive fabrics to be dyed economically and successfully without excessive fibre linting, surface distortion or abrasional damage (4, 7).

The necessity for dyers to provide dyeings of high fabric quality matched to within small colour tolerance limits has created severe pressure on the dyeing machine control systems employed, because of the added requirements of quick response This has proved to be of importance not only in exhaust dyeing machinery but also in continuous dyeing where the requirement is for greater flexibility when dyeing shorter production lots, necessitating rapid changeover times (8) Quick colour change facilities together with automated cleaning/washing down systems are therefore demanded in order to maximise the productivity of the dyeing range On some advanced continuous dyeing systems on-line colour monitoring can be linked to the control of colour in the pad bath and to down stream computerised fabric cutting, where lengths of fabric of the same colour are batched for laying up prior to cutting and garment assembly

PACKAGE DYEING

Modern package dyeing machines have dispensed with four-way valves and external pipework, shortening the liquor ratio (Fig 1) The kier is situated immediately above the pump and in many cases flow reversal is dispensed with, using only in to out flow This eliminates having to have a fully flooded kier and lowers the liquor ratio further Very rapid liquor circulation rates coupled with high rates of heating and cooling can be achieved (9)

Both horizontal and vertical spindle machines are manufactured and robotic loading, pressure packing and robotic unloading are possible (Fig 2) The shape of the kier is often altered to minimise the volume of liquor in the machine (10) The linking of package dyeing to rapid drying can be accomplished, with the dyebatch only being unloaded after rapid drying The trend by some machine makers has been towards complete dye cycle control and the use of larger size coupled machines with a common pump Microprocessor control of the liquor flow to minimise distortion and damage has been used on loose stock machines and may be incorporated in other types of dyeing machine, such as package dyeing machines (11)

JIG DYEING

Jig dyeing continues to be used worldwide because of the ability to process many styles of fabric at open width in a more or less tensionless state (Fig 3). High temperature jigs are not common but are used for relatively impermeable fabrics such as polyester sailcloths. The developments in jig dyeing are typified by the recent development by Vald Henricksen of the Futura jig (12)

The Henriksen Futura jig is supplied in three versions to suit the requirements of dyers worldwide. Versatility is built into the three models, with batch sizes from 800-1200 mm in diameter dyeable on the same machine and a special design of the dye vat to achieve a liquor ratio as low as 1:2. All types of woven fabrics may be dyed, there being special versions of the three models: Basic, Automatic or Dyematic, available for silk, velvet and high temperature dyeing

A prime feature of the Henriksen Futura jig is that it can be equipped with the novel HighSpeed control (12). This revolutionary control system allows fabric speeds of up to 200 metres/min, enabling, it is claimed, to save up to 30% of the production time compared with traditional speed control systems. This is clearly a significant technical advance of interest to many woven fabric dyers,.

In the Henriksen Basic model the bath and hood temperature, oscillation and the number of passages are controlled via the control panel. Manual control of fill, drain, roller alignment, and speed adjustments are carried out. The Henriksen Automatic jig is designed for programmable control of the dyeing cycle. Computer control, circulation system level for fill and drain, and automatic valves are all standard features with the revolutionary HighSpeed control system being optional

The most advanced Futura jig from Henriksen is the Dyematic which is a full computer-controlled jig dyeing machine with an extensive list of standard features including the HighSpeed control system. Control of fabric speed and mixing and dosing of dyes and

chemicals, with a circulation system, an extra filter and selvedge displacement make the Henriksen Dyematic an extremely sophisticated fabric dyeing machine - an intelligent dye jigger

All the Henriksen Futura jig dyeing machines are equipped with the Henriksen gearbox which enables the tension to be held constant throughout the entire process time, the tension being adjustable in the range 0-100kg The machines are fitted with a tight seal to ensure optimum control of the interior temperature The new top cover is operated pneumatically and designed to avoid condensate dripping on to the fabric

There will be some jigs on view at Itma 95, and with the increasing interest in silk fabrics, there should be improved low tension running systems available for high speed operation, decreasing dyeing cycle times, complete dye cycle control and vacuum extraction are likely to be fitted to some machines

WINCH DYEING

The design of the winch or winch beck has changed little in recent years, and the popularity of the winch has suffered through the introduction of many types of jet dyeing machines However some companies continue to introduce refinements in design to provide a more gentle mechanical action and eradicate running creases High temperature winches have been replaced by jet dyeing machines and hence it is expected that all the winches on view at Itma 95 will be of the atmospheric type

In the Krantz Blow-Dye machine, for example, all the advantages of the classic winch beck are combined with the essential components of modern dyeing machines (13) Designed for operation under atmospheric pressure (maximum dyeing temperature 98°C) the Krantz Blow-Dye can be utilised on all tubular fabrics with fabric speeds up to 130 metres/min (Fig 4)

The Krantz Blow-Dye machine is offered in a choice of 1-6 scrays, with a nominal capacity per fabric rope of 110kg depending upon the fabric weight and the fibre substrate The liquor ratio, at 1 5 - 1 8, is eminently suitable for processing cellulosic fibre fabrics and the separate

liquor feed uses a pressureless overflow system. Controlled fabric deposition in the storage zone is achieved through the use of a driven plaiter unit. The fabric transport system is continuously adjustable by virtue of the frequency-controlled roller system.

A major feature of the Krantz Blow-Dye machine is the self-regulating inflation system for tubular knitted fabrics (13). This prevents running creases during dyeing and may be used to optimise residual fabric shrinkage. The wide range of programme control systems include time-temperature control and microprocessor-controlled fully automated process management as well as the facility to interface with a master computer system.

JET DYEING MACHINERY

Since the introduction of the jet dyeing machine there has been a continuous evolution of the machine design including circular jets, the long machine, the introduction of soft-flow jet dyeing machines, and the use of the aerodynamic fabric transport system (14). Machine designers have produced fully flooded as well as extremely low liquor ratio dyeing machinery, but there is no doubt that the increasing emphasis on the reduction of water consumption is now a major influence in exhaust dyeing machinery.

At Itma 95 it is expected that there will be further refinements in the design of soft-flow or overflow jet dyeing machines. In these machines fabric transportation is mainly achieved by fabric passage over a driven lifter reel followed by passage through a soft-flow jet. This provides a gentle liquor action on the fabric and some interesting developments have taken place in the last five years.

At Itma 91 the Sclavos Apollon Twin Soft Flow jet dyeing machine (Fig 5) demonstrated an innovative approach in that the liquor flow is divided between two jet nozzles (15). The inlet water pressures in the overflow nozzles are very low at about 0.17 bar (about 2psi). This is claimed to be as low as one quarter of that normally used in other single overflow nozzle jet dyeing machines. The highly effective and gentle action gives effective liquor interchange and fabric stretching, distortion, pilling and linting are thereby avoided. There is no need to change the nozzles for different styles of fabric, and fabric for the body and the collars of

garments may be processed on the same rope Fabric speeds at up to 280m/min are combined with a precise elbow plaiting system synchronized with the lifter reel speed Another valuable feature is the automatic surplus liquor by-pass This enables some of the liquor in the fabric to be channelled away from the perforated J-box which is lined with low friction poly(tetrafluoroethylene) Such features enable a very wide range of cotton, cotton blends, cellulosic and man-made fibre fabrics to be processed, particularly weft knit fabrics

In the Gaston 824 a lifter reel operates in harmony with a jet nozzle to transport the fabric lengths through the machine (16) The internal chamber has a Teflon coating which minimises the drag on the moving fabric The Gaston 824 is designed for light to medium weight fabrics, operating effectively at a liquor ratio of 5 1 which is low for a conventional type machine (Fig 6)

An interesting feature of the Gaston 824 is the ability to operate in a low wash mode, which satisfies the requirements for much quicker rinsing of dyed fabrics, so essential on reactive-dyed materials (16) In the Gaston 824 the wash weir is lowered to approximately 10 inches (25 4cm) above the kier floor This enables the vast majority of the used bath to be immediately flushed when the low wash option is brought into operation The opening of the drain valve when the low wash step is started allows the bath to drain until the low wash level is reached Fresh water is then metered in at a decreased flow rate for 10-15 minutes to obtain satisfactory rinsing

The Henriksen Air Jet (Fig 7) has been designed for dyeing microfibre fabrics and other medium-lightweight woven fabrics as well as synthetic fibre knitted fabrics (17) The Air Jet machine uses a blower to circulate air at a controlled rate to give constant fabric speed throughout processing Using the standard nozzle, fabric weights up to 210g/m^2 have been satisfactorily processed, depending on the fabric voluminosity Fabric speeds between 300 to 700m/min have been achieved Synthetic fibre fabrics can be dyed at liquor ratios down to 3 1 and cotton materials at 5 1 Available with a fabric capacity of 300kg with two compartments the dyes are applied with the fabric in a spread out form through a dual piping system The Henriksen Logic microprocessor control system is user-friendly and is used to provide complete dye cycle control

For dyeing microfabrics the Longclose Ventura Rapide Micro-Tech (Fig 8) uses a dual rope operation per tube, halving the rope lengths and turnaround times with lighter weight fabrics (18) Tangle-free fabric transportation at speeds up to 500 m/min is possible using specially designed instantly variable, interchangeable transport nozzles to cater for all types of microfibres. The fabric lift to the lifter reel is limited and the variable speed winch drive provides slip-free traction over the drive reel The Longclose SeamFinder provides instantaneous seam detection and real time fabric turnaround time monitoring of every batch. The Longclose SmartDrive flow control optimises the process to decrease tension creases and save electrical power An automated overflow level rinse control decreases the water consumption. The Longclose CAS (Controlled Addition System) for dosing is a standard facility, matched to ideal circulation for critical addition requirements

Ever since the introduction of the Then AirFlow machine (Fig 9) and the Béné Alizée machines (Fig 10) which use an aerodynamic fabric transportation system, the use of air within dyeing machines has increased as it can enable liquor ratios to be lowered substantially on 100% synthetic fibre fabrics However the requirements of gentle action at lower running speeds of cellulosic fabrics have required a higher liquor ratio Nevertheless it will be interesting to see the further developments in the aerodynamic type jet dyeing machines. The Then Airflow AFS has been equipped with a complete drying and tumbling installation, a modular additional device '+T' for batch tumbling and drying A heavy duty heater with a special control valve for heating, as well as control butterfly valves for the alternation of the air flow in the blower circuit are employed (19).

CONTINUOUS DYEING

So far the major method of dye liquor application for continuous dyeing has continued to be padding, often using intelligent pad roll systems that ensure a very uniform squeezing action. The introduction of the Küsters Flexnip system however has stimulated developments to decrease the size of the pad bath, and hence decrease the loss of expensive dye liquor at the end of the production run (20) The move to shorter run lengths has meant that machine makers are incorporating rapid washing systems on the machine to clean down in minutes in between colour changes.

At Itma 95 it will be interesting to see if any novel dye liquor applicators are on view, linked to automatic monitoring and control of fabric pick up, with rapid wash down facilities and rapid dye liquor preparation for quick colour changes On-line monitoring of colour at the end of the process is possible using the Macbeth Eagle Eye and this can be used for quality control and for decisions on pass-fail batching for fabric cutting (21)

Continuous dyeing has generally produced better repeatability at a lower unit cost on large batches of fabric However lot sizes have decreased from 3000-5000 metres a decade ago down as low as 200-600 metres Machine makers have responded by decreasing liquor contents in the pad trough, enabling quick changeovers, and automating the cleaning in between production lots A significant innovation has been the introduction of automated control of the range, recipes and dosing together with the recording of production data

In the new Ramisch Kleinewefers pad-steam range for woven fabrics of cotton and mixtures with polyester and viscose all aspects are supervised to ensure reproducibility in dyeing (22) The Kleinewefers Bicoflex padder is used for vat and sulphur dye application (Fig 11) This system features an internal maintenance-free pneumatic alignment and pressure system This has a built-in capacity for even or variable linear addition of dyes and chemicals An individual chemical additive station uses a hydrosulphite dissolving unit and frequency-controlled pumps and inductive flow meters to deliver exact pre-determined quantities of chemicals Only that quantity of chemicals required for production is mixed and any recipe is available at the touch of a button On the range every function and valve is checked including faults, optical control of production, constant improvement of recipes and it provides a record of statistical production data and preventive maintenance Intensive sprays are used for cleaning down the pad trough and rollers

In another field the new Kusters pad-batch system (Fig 12) incorporates a low pad bath volume (10 litres for a fabric width of 1800mm) and an immersion distance of 425 mm (22) Pressure pulsation ventilation of the fabric web penetration of the dyeing liquor in the fabric is promoted by high turbulence in the liquor The fabric moisture content before padding in the Kusters swimming roller and the pick up are both monitored as well as the dye liquor and its

composition Set values can be stored and production parameters recorded within a central control system based on a PLC capable of extension by modular elements, or integration within a central master production system

In the Kusters Pad Flex Steam Process for continuous wet-on-wet woven fabric dyeing (Fig 13) the Flexnip's maximum addition capability is utilised (22) This is claimed to yield improved dyestuff penetration and uniformity, low soiling of guiding rollers, and minimum tailing (5-10 metres) as well as other benefits

Evac have developed their LVLM (Low Volume Low Moisture) system for dye application in order to provide a system that could be used for cold pad batch, pad-dry (with pigments, disperse, reactives and vat dyes) and pad jigger with development and washing on the jigger (or jig) (Fig 14) The low volume of liquor (12 litres for a 2 metre wide system) leads to an automatic quick clean system and quick change system (23)

For continuous dyeing of weft knitted fabrics the emphasis is likely to continue with machines like the Bruckner (Fig 15) and the Vald Henricksen machines in which impregnation of the tubular fabric is followed by ballooning of the tube to avoid creasing (24) Novel applicators for impregnation of tubular knit fabrics seem unlikely, because of the dominance of the jet dyeing route for weft knitted fabrics.

GARMENT DYEING MACHINERY

The rotary cage machine seems now to be firmly established as the leading type of machine (25) This is unlikely to change at Itma 95 However it is likely that spray systems for such machines may be developed that could further decrease the liquor ratio Refinements in the internal mechanical arrangements and further developments for more rapid loading and unloading of garments may be seen High temperature garment dyeing machines for dyeing

synthetic fibres will also be on view (Fig 16) Complete automation of all aspects of the process cycle will be available using microprocessor control systems which are user friendly and extremely versatile in terms of their programming capacity.

DYEING IN SUPERCRITICAL CARBON DIOXIDE

A revolutionary development at Itma 91 was the demonstration on the Josef Jasper stand of a process for waterfree dyeing (26, 27) Carbon dioxide has a critical point at a temperature of 31°C and a pressure of 74 bar Above the critical point carbon dioxide is a hypercritical or supercritical fluid state which is similar to solvent character at low viscosity Above the critical point the system cannot be liquefied and supercritical CO_2 possesses solvent properties similar to those of liquid hydrocarbon solvents.

A pilot CO_2 dyeing range was demonstrated dyeing polyester fabric with disperse dyes which were manufactured by Ciba-Geigy Ag, Basle, in an adulterant-free form The diffusion coefficients of disperse dyes in supercritical CO_2 are higher than in water leading to very short dyeing times, in the order of minutes The dyeing of polyester, secondary cellulose acetate, cellulose triacetate, aramid, nylon 6 and nylon 6.6 is possible using disperse dyes and there are significant advantages claimed for the process, namely

- no pretreatment of processing water,
- no waste water,
- low energy requirements for heating up the liquor;
- no drying - leading to energy savings,
- CO_2 recycling with no harmful air emission,
- considerably shorter dyeing times,

- environmentally friendly dye formula - no dispersing agents/adulterants required,
- no chemicals, for example, levelling agents, pH buffers, etc, required,
- dyestuff that is not exhausted on to the fibre is recovered in powder form,
- no waste,
- no reductive after cleaning necessary

Clearly this technique will be scaled up at Itma 95 and many synthetic fibre dyers will be keen to evaluate the practicality of operating such an attractive dyeing process However the very high operating pressure (> 250 bar) in 1991 is a problem from the machine maker's viewpoint as the very high pressure requires an extremely robustly built machine A diagram of a pilot CO_2 dyeing range is given in Fig 17 The dyeing time for polyester at 130°C is decreased by 50-70% compared with aqueous dyeing, with energy costs about 80% lower than conventional dyeing systems

PRINTING MACHINERY DEVELOPMENTS

The developments in the design and engineering of textile printing machinery over the last decades has been principally directed towards a significantly enhanced level of process control coupled with a high degree of automation This has led to a marked decrease in setting up times, to a reduction in the amount of second quality printed fabric and to higher standards of printing (28)

The sophisticated process control systems now available provide the textile printer with improvements in repeatability, quality and flexibility, essential factors in the fabric printing sector in which the concept of quick response has now taken hold Particularly within Western Europe there has been a trend towards shorter print run lengths which has put additional strains upon textile print production

Printers have had to consider the optimum way in which the production utilisation of their capital-intensive printing machinery may be maximised Accordingly nearly all aspects of the print creation and production process have been streamlined, and here the use of CAD/CAM (computer aided design/computer aided manufacture) systems, laser engraving, computerised setting up, automated colour kitchens, and improved screen washing facilities have often been utilised

In some fields such as furnishing prints the number of colours in a design may exceed twenty, and hence there is a demand by some companies for 25 colour machines This increases the length of the printing machine and increases the necessity to be able to specify precise process control of each individual colour being applied Textile printing machine makers have responded to the challenges facing fabric printers and some of the more recent developments in textile printing machinery will now be briefly described.

Over the last three decades engraved roller (intaglio) printing has declined dramatically in importance as the advances in the quality of printing achievable using rotary screen printing have been introduced The cost and time required to prepare a rotary screen using CAD/CAM design creation linked to laser engraving is considerably less than that required for engraved rollers The increasing width of fabrics has also favoured the rotary screen method of production Automatic flat bed (flat screen) printing has also received attention in a similar manner and some very advanced machines are now available (29).

Ink jet printing, while theoretically capable of some exciting technical benefits is still restricted to relatively coarse line work for carpet tiles and logos, and considerable advances in the speed of printing are required to achieve further penetration in the market Dry-heat-transfer printing has maintained a relatively low profile since the late 1970s because of the restriction to synthetic fibre-rich fabrics One advance that could appear at Itma 95 is the Holy Grail of the cotton printer, namely a dry printing process for printing cotton However at present most of the attempts still require a relatively high moisture level to achieve satisfactory results and we may have to wait until Itma 99 to see marked improvements in this technique Dry-heat transfer printing of polyester warps featured on the Lemaire and Stork stands at Itma 91 and this technique produces an interesting range of effects in woven fabric form (30)

One possibility for the future is that of printing using reprographic techniques such as those used in photocopying. Research has been carried out on this technique but it is perhaps too soon to expect to see such a radical development at Itma 95.

While the finest types of printing still rely upon using dyes and print thickeners followed by steaming to effect dye fixation, washing and drying, there is now considerable progress in the use of pigment printing techniques particularly for polyester/cellulosic fibre blends.

Here the emphasis has been upon the substitution of white spirit, kerosene or other solvents in emulsion thickenings away to aqueous-based synthetic binders and cross-linkers. This has dramatically lowered the emission of VOCs (volatile organic compounds) in drying and curing and decreased environmental pollution, a problem that is assuming considerable importance within European countries. The trend is towards the production of machine washable, soft and flexible binder systems to produce a higher quality of fabric or garment print (31).

COMPUTER AIDED DESIGN SYSTEMS

CAD (computer aided design systems) are now widely used for high resolution electronic photo-retouching and image manipulation for design generation in textile printing. Line art design can be scanned at up to 4000 dots per inch (dpi) on the Barco Graphics Creater system using laser recorders which also function as input scanners (32). Designs may be digitised via the user friendly image both vertically and horizontally enabling the edges to be clearly visible (Fig 18). Barco have recently introduced their Arabesque CAD system allowing the user to digitise large size originals (1.2 x 1.2 metres) at high resolution and in full 24-bit colour (35).

At Itma 95 it is anticipated that the scanning resolution, and the ability of the expandable modular CAD systems on view to provide easy design manipulation, for example, painting, brush, water-colour, masking techniques, warping high resolution images by bending, twisting and stretching into any shape, will be powerful tools in the hands of the trained operator. In addition the ability to create electronic colour separations digitally for direct engraving or generate film separations will be further enhanced.

LASER ENGRAVING

There is no doubt that one of the fastest growth areas in textile printing has been the introduction of laser engraving systems by Zed and by Stork (Fig 19) suitable for engraving lacquered rotary screens (33). It has been estimated that some 20% of all rotary screens are now produced by laser engraving. At Itma 95 I expect to see further developments in this novel technique which will enable the range of designs that can be laser engraved suitably expanded, with shorter laser engraving times. The extension of laser engraving to wider and larger rotary screens may well be another trend

One novel laser engraving system available for flat screen work is that of Macchine e Sistemi srl (32). The screen size of 2200 x 2200mm (engraving area 1600 x 1600mm) in the larger version is complemented by a smaller screen version 800 x 800mm with an engraving area of 650 x 650mm at a resolution up to 508dpi. Design information may be input from a CAD driven system or black and white scanner. A variety of methods may be employed and the design manipulation is extremely versatile with sealing, positioning, rotation, flip and mirror functions, together with a pattern repeat option (Fig 20).

At present laser engraving systems are costly, but it is hoped that at Itma 95 some advance will be made to offer lower priced versions perhaps more limited in their versatility, but nevertheless suitable for most print designs.

AUTOMATED COLOUR KITCHENS

Many types of automated dispensing systems are available. The main designs are usually based on overhead bulk storage tanks, feeding by gravity to a central cluster of precision dispensing valves (34). These dispense dyes, thickeners etc gravimetrically at the appropriate rate in to a plastic tub placed robotically, or manually on to an electronic weighing scale. Alternatively dispensing may be via a track system. Here the dispensing valves are mounted in line and the tub, mounted on a movable weighing platform, stops at the appropriate dispensing heads. Both systems are microprocessor-controlled check-weigh systems and

dispensing can be linked to computer match prediction systems such as in the Stork IPS 2000 system Movement of the tubs of colour and all aspects of the mixing cycle, including cleaning of the mixing head, can be automated according to a predetermined sequence (Figure 21)

Another feature on modern dispensing systems is the use of low cost software systems such as the RAP (Recipe Administration Package) of the Vanwyk Direct Compact Dispenser DCD (32) This can be integrated into an existing PC (personal computer) network or linked to a host computer system (Fig 22) RAP is designed for use on IBM or Compaq PCs in a multi-tasking multi-user environment and is available in a number of languages The Vanwyk DCD system with RAP software enables the system to reuse return colours in an optimal manner, thereby decreasing material costs and pollution problems It is anticipated that such features will be more widely available on the systems on view at Itma 95 Modular, compact dispensing systems for rapid dispensing can be supplied pre-tested and requiring only the connection of services

ROTARY SCREEN PRINTING

Most rotary screen printing machine makers now offer a variety of options on their sophisticated printing machinery Stork on their RD Direct Drive Wide machine offer 18-24 printing positions and printing widths from 2450mm up to 3250mm (Fig 23) An open bearing system with roller squeegees, or a closed bearing system suitable for blade, roller or airflow squeegees may optionally be chosen The drive system for both consists of an electronically-controlled stepping motor at each printing position This provides an extremely accurate drive system Laser systems for setting screens into repeat will continue to be more widely used (32)

The fashion for increased numbers of colours in some printed fabrics has led to machines such as the Reggiani Revolution HiTec rotary screen machine available from 6-36 colours from 1600 - 3200mm width (36) The printing units are both electronically and mechanically separated from the printing blanket drive to eliminate the main component of repeat inaccuracy (Fig 24) A feature that we may see on other machines at Itma 95 is the washing-on option, a revolutionary system by Reggiani permitting a change of colourway without

removing the screens and the squeegees from the screens The display on the video controller shows machine settings and information on operational conditions The optical fibre signal transmission system is immune from electronic problems caused by industrial environments Computerised management systems will feature on most printing machines and incorporation into a CIM (computer integrated manufacturing) system should be possible through a variety of communication networks

FLAT SCREEN PRINTING

Flat screen (or flat bed printing) machinery will benefit from many of the computerised control systems set up for rotary screen printing, suitably modified Typical of the types of features likely to be seen are those on the Buser Hydromag 7M and the more technically advanced control method of the Buser Hydromag 7E (32,33) Toothed belts now replace the oscillating conveyor system providing a highly accurate registration system Both machines incorporate an exclusive 'floating system' (Fig 25) This ensures that the blanket is in continuous motion giving perfect adhesion of man-made fibre fabrics using the Thermoplast adhesive system There are no marks with continual glueing systems and completely tensionless fabric transport Blanket cleaning is uniform ensuring a longer blanket life

In the advanced Buser Hydromag 7E a touch-sensitive VDU (visual display unit) control screen is fitted, similar to that on the Buser Rotamac 4E rotary screen printer The Hydromag 7E features extended software, incorporating servicing instructions, fault-finding programs, and printing unit functions Colour application data and screen positioning can be stored on the system and the control system can be integrated into a printworks computer network if required A push button control panel controls squeegee travel, stroke number, speed and penetration parameters and after data entry the data may be transferred from one printing unit to another allowing greater production flexibility and versatility

In the Ichinose Rainbow production system (Fig 26) the flat screens may be removed from the printing position, automatically turned over and washed, dried and returned to a position just above the printing position (9, 37) The use of a video camera scanning device also allows a direct comparison to be seen on a VDU between the original design image and the actual

image being printed, all in colour. The use of such scanning systems for rapid automatic correction of printing faults continuously on-line could therefore be a development that appears at Itma 95

PRINT FIXATION

The use of high temperature loop steamers is now common worldwide and the machines, such as those by Arioli (Fig 27) and Stork are now technically well developed. Apart from improved control over fabric temperature, and enhanced monitoring systems, and mechanical developments relating to the internal mechanisms there are likely to be few developments at Itma 95

CONCLUSIONS

Major developments at Itma 95 are likely to be seen in the further development of dyeing in supercritical carbon dioxide and in automation and robotizaton of package dyeing machinery. Jet dyeing machines of advanced design will be exhibiting some major refinements to decrease water and energy consumption with controlled addition of dyes and chemicals. There will be many CAD systems on view for textile prints design capable of linking to laser engraving. Very advanced rotary screen and flat screen printing machinery will be shown with management information systems built in to the system

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DEVELOPMENTS IN CHEMICAL PRETREATMENT MACHINERY

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SUMMARY

A review of some of the major trends and developments in the chemical pretreatment of cotton and polyester/cotton fabrics is presented, looking towards likely developments at Itma 95. Developments in singeing, desizing, scouring, bleaching, open width washing, mercerizing and anhydrous liquid ammonia treatments are discussed

INTRODUCTION

Chemical pretreatments are carried out on textile materials to prepare them for subsequent dyeing, printing and finishing. Chemical pretreatment is thus the first part of the textile wet processing operations that provide a vital service sector to the textile industry. Wet processing transforms the often harsh, dirty and unattractive products of textile manufacture into aesthetically attractive products with greater added value because of the improvements in fabric appearance, handle and performance. Because chemical pretreatment forms part of a service sector it must respond rapidly to the fresh challenges posed by the continual demands imposed by fashion changes in fibres, yarns, fabrics and garments and the demands of retailers and consumers for high quality products allied with a quick response to market demands (1)

The globalisation of the textile industry and the emergence of the developing nations as major textile manufacturing centres are exerting effects upon developments in textile wet processing machinery. Cotton and polyester/cotton blends continue to dominate the market for commodity textile fabrics and the chemical pretreatment of such fabrics has been at the centre of attention for most textile machinery makers (1). Cotton, polyester/cotton, and polyester/cellulosic fabrics seem certain to grow in importance well beyond the year 2000 as the worldwide population grows, particularly in the developing nations where cotton is grown, and where polyester fibre manufacturing plants are increasingly being installed

Over the last three decades the average weight per unit area of textile fabrics has decreased by up to 30% The use of lighter weight woven fabrics, and the widespread use of thermoplastic polyester fibres in polyester/cotton blends have forced chemical pretreatment companies to change to continuous open width processing This avoids many of the problems associated with batchwise rope processing operations, particularly problems associated with creasing However the problems associated with the open width handling of circular weft knitted fabrics have meant that tubular fabric processing on jet machines or continuous ranges (with continual ballooning of the knitted tube to remove running creases) has remained a dominant processing method (2)

The challenges for all textile wet processing units remain the same, namely, to minimise the costs for the consumption of all utilities, i.e. water, energy, chemicals etc. while maintaining a high fabric quality The chemical pretreatment machinery used must be flexible in terms of productivity and economy and must be versatile in terms of the variety of fabrics that may be processed Uniformity of chemical pretreatment and reproducibility of effect in repeat producing runs are essential to satisfy the demands of right first time, right on time, right every time processing (3)

From the fabric quality viewpoint a zero defects philosophy is required, while from the environmental viewpoint a zero waste philosophy is the ideal In the case of the environment there is no doubt that concerns over environmental pollution have been driving the direction of chemical pretreatment, particularly over the last five years (1) Chemical pretreatment companies are now mainly using hydrogen peroxide as the major bleaching agent Chlorine-based bleaching systems based on sodium hypochlorite and sodium chlorite have fallen out of favour, irrespective of some technical and cost merits, largely because of environmental factors, such as loss of chlorine-based products into the air giving a poor bleaching environment and the release of AOX (absorbable organo halogen compounds) into the waste water (4)

Overall there are a number of discernible trends in chemical pretreatment machinery

- continuous open width route for woven fabrics,

- tubular processing route for weft knitted fabrics;
- automated chemical dosing;
- high wet pick up application systems;
- hydrogen peroxide is the dominant bleaching system;
- process integration to decrease water and energy consumption;
- process control, monitoring and automation;
- computer control of chemical pretreatment ranges

At Itma 95 it is anticipated that there will be some innovations in terms of the machinery for singeing, desizing, scouring and bleaching, but these are likely to be evolutionary rather than revolutionary in concept. It is likely that we shall see refinements in some of the designs shown at Itma 91, while some more recent chemical application systems will also be on view The developments in mercerization machinery will also be discussed in this lecture, because of the importance of this pretreatment for cotton fabrics in improving lustre, strength and apparent colour yield after dyeing Anhydrous liquid ammonia treatments can be used on cotton fabrics but this treatment is relatively uncommon outside the USA, because of the high capital cost of the machinery

Turning now to specific fabric pretreatments, it is intended to discuss the latest advances in machinery for singeing, desizing, scouring, bleaching, mercerization and anhydrous liquid ammonia treatments It is however unlikely that anhydrous liquid ammonia treatment machinery will be on view at Itma 95

SINGEING MACHINERY

The removal of unwanted protruding surface hairs from woven or knitted fabrics is mainly accomplished by using direct or flame singeing, or alternatively using infra-red radiation singeing machines. The most popular method is gas singeing in which the width of the gas flame can be adjusted to the fabric width being processed (5). Modern singeing machines are often preceded by brushing/beating machines to raise the fibres on the fabric surface and in some pretreatment lines rotary cutting may also be used to decrease the load on the singeing machine. However in all gas singeing machines the main singeing parameters are controlled, namely

(i) flame intensity;
(ii) fabric speed;
(iii) distance between burner and fabric,
(iv) singeing position.

At Itma 95, major singeing companies such as Parex-Mather and Osthoff will have advanced machines on view. The new Parex-Mather Mark IX singeing machine will maintain the Parex patented threading system in which the fabric is exposed to up to four singe effects during a single pass through the machine (see Fig 1). Parex-Mather have used a unique crossed flame burner system together with precise control over the gas pressure to ensure that the gas is burned as efficiently as possible (6). Osthoff will no doubt be using their well-proven Double Jet burner, and both companies will offer machinery for singeing at different angles to the fabric surface, as well as over water-cooled rollers (7). The latter, usually coated with poly(tetrafluoroethylene) to prevent adhesion, are widely used on polyester/cellulosic fabric, particularly knitted fabrics where the gas flame can penetrate through the open fabric structure to singe the back of the fabric (Fig 2). The water from the cooling rollers absorbs the heat from the polyester fibres and may be reused in wet processing.

At Itma 91 singeing machinery for singeing weft knitted fabric in tubular form was exhibited by Osthoff and by Dornier (8). In the Osthoff Ring-Jet singer the tubular fabric at its full diameter was singed using a Ring-Jet singer incorporating their Double Jet gas burner (Fig 3)

The Dornier system used a series of eight swivelling gas burners arranged in a ring around the fully opened fabric tube (Fig 4).

Control over the singeing effect has in the past been highly empirical, but Osthoff have introduced their Sengmatic control system that regulates the singeing effect by monitoring and controlling the fabric temperature after singeing using an infra red pyrometer. At Itma 91 Osthoff demonstrated an opto-electronic hairiness tester that could be used on-line to measure and directly control the singeing effect (8). There was also an off-line version, the Osthoff Hairiness Tester Type 690 that could be used on small stationary fabric samples.

The odours produced from the singeing of natural and man-made fibres can be removed using systems such as that shown by Osthoff which create a more pleasant environment (Fig 5). A Siemens catalytic converter with a ceramic mixed oxide is used to deal effectively with atmospheric pollutants from singeing. The system is claimed to have a high resistance to catalytic converter poisons and also to have a long service life (9). Overall it is likely that we shall see refinement of the monitoring and control systems for singeing machines, together with further attempts to minimise environmental pollution and conserve energy, but it is unlikely that any radically novel singeing machinery will be shown at Itma 95 unless some innovation appears for singeing tubular knit fabric. Process integration is possible, for example on the Parex-Mather system by passing the fabric from singeing into an enzyme desizing solution (5, 10) followed by mangling and batching on an A-frame (Fig 6). The heat of the fabric is absorbed by the desizing liquor, increasing the liquor temperature. The desize liquor also acts as an effective quench unit, extinguishing sparks.

DESIZING, SCOURING AND BLEACHING MACHINERY

It is appropriate to consider machinery for desizing, scouring and bleaching together, because in most cases the process involves fabric impregnation followed by steaming. This is then followed by a thorough hot wash off in some continuous open width washing machine (11). The developments in the latter will be considered in the next section.

Chemical pretreatments for desizing, scouring and bleaching fall into two main categories, namely, processing in jigs, winches and jet machines, or on rotating beam machines (such as the Rotowa system) or continuous rope or open width systems using the pad-steam-wash off approach The main types of chemical pretreatment systems on view at Itma 95 are likely to be continuous open width systems for woven fabric and continuous tubular preparation for weft knitted fabrics The steaming system used may employ saturated steam at atmospheric pressure (100°C) or saturated steam under pressure (up to 130-140°C) but it is likely that combination steamers operating on the tight strand-roller bed or conveyor bed principle will be mainly on view at Itma 95 (Fig 7)

Cold pad batch chemical pretreatment is still favoured by many companies whose production does not warrant the expense of purchasing a continuous open width preparation range (12) Sir James Farmer Norton and Co Ltd market a highly effective steam-purge impregnation system wherein fabric is passed vertically down a narrow insulated steaming chamber in which a counter current of dry steam is passed through the fabric, displacing the air (Fig 8) The fabric emerges at the bottom of the compact steaming chamber through the fabric outlet of the unit, ter the probe, which is immersed in the bleach liquor in an impregnation tank The dry steam collapses to form a minute film of water and the partial vacuum created causes the fabric to be instantaneously and thoroughly saturated with liquor The fabric is squeezed and wound on to an A-frame, covered with polyethylene film to prevent evaporation and batched for several hours or overnight with continuous slow rotation of the batch, followed by a very hot open width washing at 95°C or higher The energy costs are extremely low and heat recovery from the hot wash decreases the energy consumption to very low values

Rope bleaching systems based upon kiers, J-boxes and U-boxes are still used in some parts of the world but have lost ground compared with continuous open width desizing, scouring and bleaching systems Continuous open width systems with relatively short reaction times are more likely to be seen on many stands at Itma 95 A particular trend at Itma 91 was the introduction of high wet pick up applicators to give a fabric pick up of around 150% With many bleachers moving away from sodium silicate stabilisation of hydrogen peroxide liquors to organic-based stabilisers the high wet pick up application method provides a more dilute peroxide liquor which is more stable and the high wet pick up aids fibre swelling and the

removal of fabric impurities. This gives higher fabric reflectance (whiteness) values coupled with lower levels of fibre damage, and moreover there is an improvement in seed removal, an important factor in cotton bleaching (13)

In the Babcock Super-Sat the open width fabric is loaded alternately on both sides via a weir of chemical pretreatment liquor (Fig 9) (6). This results in a high liquor exchange and thorough penetration. The liquor troughs ensure that the liquor flowing from the serrated edge weir is equalised on the bottom roller. Hence only the liquor volume required for a uniform nip penetration needs to be supplied. If necessary the excess liquor may be stripped by two metal blades forming a slot, the width of which may be varied. The Super-Sat can be operated with any metering system but optimum results are said to be achieved with Babcock's Polykomat chemical metering system. This is a sophisticated computer-aided control system utilising high precision volume adjustment values (14)

In the Mezzel Optimax application system the fabric is passed upwards at open width through a horizontal two-bowl pad mangle fed by liquor metered on both sides of the fabric (Fig 10). As the fabric leaves the liquor flooded nip of the horizontal two bowl pad mangle the fabric entrains excess liquor on both sides (6). The rate at which the liquor flows off against the cloth run direction is slowed down by the fabric running through a narrow shaft. The fabric thus runs through this narrow shaft between the impregnating nip and an overhead pair of Rowatex rollers to strip off the excess liquor.

In the Goller Dip-Sat Vario application system (15) the fabric is coated with a film of liquor in the half-nip between the fabric running on and the roller they wrap around (Fig 11). The excess liquor not absorbed by the fabric is stripped off at the same point and is then returned to the liquor stream which is supplied to impregnate the fabric.

The Benninger Ben-Bleach system incorporates the Benninger Ben-Impacta fabric impregnation system which is a wet-on-wet impregnation method in which fabric is guided through two narrow casings (Fig 12). A heavy cross-current of liquor at up to 60°C gives high turbulence and effective liquor exchange with an adjustaole liquor pick-up controlled by the final squeezer (16). Chemicals are individually metered into the circulation pumps, flow

meters, and control valves to give a fabric pick-up between 110-130%. This ensures that in the Ben-Steam combination steamer (tight strand with plaiting on to a roller bed) the impurities are removed and effectively dispersed or dissolved in the liquor without any liquor loss during dripping. Reaction times for bleaching up to 60 minutes are possible at speeds up to 100m/min, the automatic steam conditioning and regulating station ensuring constant steaming conditions with the exclusion of air. The bleached fabric is then washed in the high liquor exchange Ben-Extracta open width washer with a low water consumption of 2-5L/kg compared with the more normal 5-10L/kg used in conventional washers.

The Sir James Farmer Norton VAS200 Vacuum Application System operates by exposing fabric to a high vacuum removing the entrapped air followed by the addition of the liquor to give full saturation (Fig 13). A second controlled vacuum slot is then used to extract surplus liquor from the fabric to return it into the feed system to leave an optimum pick-up of 110-130% (17). With a liquor content of only 40 litres compared with a conventional 600 litre saturation tank there is rapid replenishment of liquor, as well as very little wastage at the end of a production run. Where single stage processing is carried out, the dry fabric is impregnated with up to 120% pick-up, and with the high volume of liquor addition, the bleach liquor is of low concentration. This enables a premixed solution of all components to be applied, without the need for wetting agents or expensive multi-component metering stations. A tight-strand stabilising section typically for 30 seconds dwell in the steamer is followed by a multi-roller bed. The low capital costs and small space requirements of the Farmer Norton VAS200 applicator may be used to advantage in existing bleaching range, replacing the existing saturation tank to enable a single stage preparation treatment to be achieved.

In the Kusters Flexnip impregnation system their unique Flexnip consists of a V-shaped trough formed by two foils and sealed at the sides and at the bottom by pneumatic pressure systems (Fig 14). Fabric entering at the top of the V-shaped trough passes vertically downwards through the low volume liquor impregnation bath followed by squeezing at the bottom of the trough (18). Impregnation is thus completed in 0.15 seconds at 100m/min in a purely additive manner without any recycling of mixed or depleted liquors. With a fabric 1800mm wide and a weight of 200g/m^2 at 100m/min the standard trough content of 9 litres is renewed entirely every 18 seconds. In wet-on-wet applications the high addition of liquor, approximately 70-

80%, permits low bleach concentrations to be used and the high liquor volume on the textile fabric provides a cushioning effect, improving fabric transport, minimising problems due to marks and enhancing safety in the steamer.

In the innovative Ramisch Kleinewefers GmbH "Raco Yet" technology a heated aerosol of water vapour and chemical liquor is produced and sprayed on to the fabric (19) using the standard two nozzle beam arrangement (Fig 15). Soft water, sodium silicate, sodium hydroxide solution, hydrogen peroxide and a multi-functional auxiliary agent are mixed with steam to form the aerosol. The activated aerosol has a high specific surface, whereby acceleration of the phase transfer is achieved using the novel multi-functional auxiliary agent. Water and the individual chemicals are fed to the nozzle via one feed line to meet at the outer nozzle tip with steam supplied by a second feed line. The liquor is thus spontaneously heated within an atomised aerosol.

Individual two-fluid mixing nozzles of this type are arranged on a beam system, mounted to give a uniform liquor application to the fabric, using a system of overlapping flat spray jets. Less liquor volume is contained within the outer zone of a flat spray jet than in the inner area. Hence overlapping provides the uniform volumetric flow of aerosol over the fabric width by overlapping on the right and left side of the spray and spraying on both sides of the fabric. For very heavy fabric a four beam nozzle system may be used. Aerosol losses in treatment of about 7% may be expected through slight loss at the selvedges and the discharge to the saturated steam in the tight strand steamer.

The Ramisch Kleinewefers "Raco Yet" technique is novel and is designed to achieve desizing, scouring and bleaching in a single operation, with an average liquor application of 130% based on dry fabric weight and a treatment time between 1-3 minutes, typically as low as two minutes. The "Raco Yet" technique can be used for wet-on-wet or wet-on-dry chemical pretreatment and the use of filters on both the steam and each individual component ensures that clogging of the spray nozzles cannot occur.

It seems probable that the use of spray application systems for shock bleaching may increase if the systems can provide satisfactory single stage desizing, scouring and bleaching within a relatively short time.

One innovation that might become reality at Itma 95 is the use of radio frequency combined with steam for continuous pretreatment of fabrics. Krantz and Sandoz were working on the SANKRA pretreatment process at Itma 91 which utilised this concept. It remains to be seen if a new system will be shown at Itma 95.

CONTINUOUS OPEN WIDTH WASHING MACHINES

At Itma 95 one can expect to see examples of both vertical and horizontal cloth run machines. In the vertical roller vat machine there are bulkheads after each fabric loop or twin loop with countercurrent flow both within and between tanks. Top rollers improve the squeezing effect and high efficiency porous bowls or vacuum extraction systems are used in between wash boxes to improve the hydroextractive effect. At Itma 91 there were two main trends away from the conventional vertical and horizontal roller machines. Firstly more suction drum machines were shown suitable for woven and knitted fabrics, and secondly a variety of machines that utilised sprays or vacuum extraction appeared. It is anticipated that there may well be more innovation in the design of continuous open width washing units, with the main objectives being to increase liquor interchange and to dissolve and remove impurities faster using less water and less energy.

The Babcock Convi-Tex C open width washing machine for woven fabrics uses a vertical fabric path with single or double loop threading system and single or double web operation (Fig 16). Counterflow of liquor is achieved by overflowing down a cascade from one compartment to another (20). The counterflow can be bypassed in individual compartments, if desired, whence a treatment liquor inlet at the fabric entry end of the compartment can be used with the treatment liquor following the same direction as the fabric transport. Spray lines with flat section jets are employed instead of intermediate nips to ensure liquor separation between the compartments. The jets can be fed with either recirculated liquor from the compartment or

heated fresh water. A nip unit is however used at the exit from the washing zone. The low bath volume is forced to follow an alternating transverse path across the fabric width by the bulkheads in the compartments. The bulkheads are removable for cleaning purposes.

In the Babcock Convi-Tex C double loop system the tangential current washing action may be reinforced by a through-flow washing action. The liquor entrained from the bath by the fabric drips down from the upper rollers and/or is collected by doctor blades. It is directed down into the nip angle between the fabric and the inner roller, which is not immersed in the liquor in the compartment, giving increased liquor movement through the fabric as it passes around the roller.

Benninger, with its Injecta machine, designed specifically for desizing and washing off prints, introduced a novel intensive action system at Itma 91 (Fig 17). The Injecta consists of a double shaft in a tower that stands above a liquor collecting area and contains guide rollers for a reverse fabric loop (21). A mixture of steam, air and water is injected into the fabric in its passage up the first shaft and then down the second shaft. High turbulence, rapid heating of the fabric and a highly effective washing action are thereby attained.

The TVE (Textile Vacuum Extractor Co) has developed a spray-suction and optionally a dip-suction, open width washing device (Fig 18). Thus fresh water is applied to the fabric which can then be removed by vacuum extraction. Dip-suction functions in a similar manner but allows more water to be passed through the fabric (22). Both systems may be supplied in combination in the one tank if required. On existing washing machines it is claimed that an overflow channel and vacuum extraction unit, retrofitted, can improve washing efficiency in the entry and between the first few wash boxes. It should be noted that vacuum extraction can be used instead of squeezing at the fabric exit of the washer, particularly for synthetic fibre fabrics where lower moisture retention values are obtained.

The Sir James Farmer Norton and Co Ltd Jetvac open width system uses a combination of vacuum extraction and high pressure sprays (Fig 19). The system draws small quantities of strong searching liquors through the fabric at high velocity, greatly assisting the removal of

impurities (23) Designed originally for continuous oper width wool fabrics, the range is claimed to perform well on cotton and blended fabrics for removing size and other impurities, as well as for the removal of caustic soda in chemical pretreatment and mercerizing processes

Drum type washing machines seem to be favoured as general purpose open width washing machines and there are now many designs that use suction drums, fluted or slotted drums with internal pulsators or eccentric vibration, engineered to promote high liquor interchange. In the Babcock Spray-Tex system the fabric is passed over a perforated drum and sprayed by flat jet nozzles over two thirds of the drum circumference (Fig 20) The tank below is partitioned into two, giving two collecting troughs to catch the wash water following from these spray nozzles above the first and second halves of the wash drum, which are fed by separate pumps The collecting troughs are arranged in a cascade manner in the cloth run direction, permitting a countercurrent overflow The Spray-Tex may be coupled with the Traflo-Tex suction drum washing machine for diffusion washing and also the Store-Tex may be used to provide a conveyor belt dwell chamber with a liquor spray for washing with chemicals (24)

MERCERIZING

Fabric mercerizing has conventionally been carried out using cold impregnation in caustic soda lye followed by control of the fabric width (stabilization) in a chain or chainless machine, washing out the caustic soda and neutralising/rinsing following by drying in a steam-heated cylinder drying machine However in the last two decades the advantages of hot impregnation at 60-70°C have led to some interesting developments and it is anticipated that there will be attempts to decrease the size of mercerizing machines by increasing their effectiveness and at the same time decrease the costs for chemicals, energy and water consumption

The use of hot mercerization in the Farmer Norton chain mercerizing machine has been claimed to decrease the caustic soda cost by up to 30% because of the high effectiveness of the hot impregnation/fabric swelling process (25). A high efficiency mangle or vacuum extraction system can be fitted for wet-on-wet applications, eliminating the need for fabric predrying In the chain mercerizing machine the fabric is held by two sets of clips which hold the fabric under tension, whereas in the chainless machine the fabric is impregnated whilst

traversing over rollers in a serpentine manner, the rollers being slightly cambered or grooved to prevent weft way shrinkage occurring. However in the Zittauer system the rollers are arranged in two banks, one vertically above the other, increasing the impregnation/swelling time through the longer fabric path length. In the chainless machine the control of the fabric dimensions is usually achieved by exerting warp way tension through appropriately located tension rollers.

In the Küsters Ecomerce machine the fabric after prewashing with a wet pick up of 70% is impregnated wet-on-wet with hot caustic soda in a Flexnip unit to give a wet pick up of 150-160% on the fabric being impregnated simultaneously from both sides (Fig 21). A stronger concentration of caustic soda is used (about 35° Bé compared with 28-30° Bé in conventional mercerizing) to yield 280g NaOH per kg fabric after impregnation (26). This decreases the mercerizing time down to 12-15 seconds compared with 20 seconds for conventional hot mercerizing and 50 seconds for cold mercerization. The Flexnip system uses a volume of only 9 litres compared with the conventional 2000 litre tank used for conventional fabric impregnation, which decreases the pollutional load at the end of a production run. The alkali liquor removed from the fabric by squeezing at the end of the diffusion section is used to dilute the highly concentrated lye in the mixing tank which is used to feed the appropriate concentration of caustic soda to the Flexnip impregnation system.

A novel idea introduced by Küsters in their Ecomerce machine is the insertion of a fabric expansion zone between the mercerizing/diffusing zone and the stabilising zone. Specially curved and dimensioned expander rollers ensure an even expanding effect over the whole fabric width. The expansion depends upon the roller diameter, the roller curvature and the angle of wrap and expands the fabric both in the width and the length. The expanding zone consists of five curved expander rollers and four driven cylindrical rollers driven by one motor via a differential gear unit. Pressure gauge sensors at the entry and exit to the expansion zone compare the pre-set nominal lengthwise tension value with the actual value and the control system then ensures the appropriate tensile conditions in the expansion zone. This gives an even expansion over the whole width without differences between the selvedge and centre of the fabric.

In the Benninger Dimensa (Fig 22), a short hot chainless impregnation is followed by a cooling and reaction zone (27). Squeezing hot to 70% wet pickup compared with 100% cold impregnation, leaves the fabric with 220-240g NaOH/kg fabric compared with 300-350g NaOH/kg fabric using cold lye. At the start of the stabilisation zone there is a chain section with the fabric held on a pin stenter system. Hot weak lye is introduced and the shock-like increase in temperature coupled with partial lye extraction considerably decrease the shrinkage forces in the fabric. The fabric, now in a plastic state, can be given the desired length and width dimensions. When used on knitted fabric the fabric lengthwise tension is ratio-metered over the whole range. Optimum control over fabric dimensions is achieved by width control in the chain zone and the ratio-metered AC (alternating current) drive control system. Ultimate stabilization is in a conventional, highly effective stabilizing compartment with chainless guidance. The final section comprises a high efficiency washing and neutralising zone consisting of the well proven Benninger Extracta double threaded cloth run compartments.

Overall it is clear that the benefits of hot mercerization coupled with novel methods of fabric stabilization should lead to improved control over the fabric length and width and should diminish side-centre variations. Improved removal and recovery of the caustic soda solution (the lye) will also be required to facilitate recycling and decrease pollution.

Both Lindauer and Sperotto Rimar produce tubular mercerizing machinery for weft knitted cotton fabrics. Dornier have progressively introduced tubular singeing and at Itma 91 introduced the concept of using the range for bleaching by installation of a J box above the saturator. At Itma 95 the integration of a continuous dwell zone and preheat chamber in the mercerizing line by Dornier will enable continuous bleaching and mercerizing of tubular weft knitted cotton fabric to be carried out (28,29).

ANHYDROUS LIQUID AMMONIA TREATMENT

With few manufacturers of such equipment, coupled with the necessity to pad the fabric in anhydrous liquid ammonia at -38°C, followed by a short swelling zone, and stabilization and removal of the ammonia by dry heat followed by steam, there seem unlikely to be large scale units on show at Itma 95.

However it may be that equipment designed for garment treatment might be shown, but it is not known how advanced this technique is at the current time. The benefits of anhydrous liquid ammonia treatment can be broadly similar to the improvement in quality expected from mercerization, although the rapid swelling and quality benefits have to be balanced against the high capital costs for the machine, for refrigeration of the liquid ammonia, and for dealing with the recovery of the ammonia and limiting the airborne pollution from the process

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Annex VI

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

INTERNATIONAL TEXTILE AND APPAREL CONFERENCE

C I T C '9 5

RIO DE JANEIRO, 18-21 JULY 1995

XP/INT/95/037

SF/INT/95/001

The Revolution in Apparel Marketing/Manufacturing and the Changing Technologies

by

Dr. Joseph Off (USA)

THE APPAREL MARKETING/MANUFACTURING REVOLUTION
THE CHANGING TECHNOLOGIES

International Textile and Apparel Conference
Rio de Janeiro, Brazil
By: Joseph W. A. Off
Textile/Clothing Technology Corporation
July 20, 1995

The Apparel Marketing/Manufacturing Revolution
The Changing Technologies

Thank you for inviting me back to beautiful Rio for a third visit and thank you for the opportunity to renew old acquaintances.

Today, as in the past, I will discuss change in the marketplace, and the support services of manufacturing and communications that are growing exponentially because of the integration of technology and people -- a marketplace where change is quickly becoming revolution.

Throughout my career, I have been involved either in the machine tool industry or soft goods industry, and have been fortunate throughout this time to be able to work with leading edge technology.

These few years of my career have spanned the time from the first use of single chip transistors to today's multi-media world that will change our lives more in the next five years than it has in the last 25 years.

Computer power/Micro processors and a new type of technology-focused people are the drivers and truly the new tools and revolution of the information/technology age.

The proper implementation of these new tools -- and they are nothing more than tools -- can, if properly used, change a third world country to modern and progressive society in one generation.

Conversely, the disregard or lack of implementation of technology can turn a modern society into a third world nation overnight and push present third world countries further down the economic ladder.

My presentation today deals with only one of the three basic needs of man -- clothing -- but spans the broad range of tools (technologies) that are used to produce -- not only clothing -- but to meet most of our needs and at the same time enhance our individuality.

1993 CETIQT Presentation
- Technology
- Computers
- Internet
- Consortia to drive change
- Education
- People technology
- Simulation
- Agility

In my 1993 presentation: Technology, computers, Internet, consortia to driving change, education, people technology, simulation and the emerging agility concepts were covered. At that time, many of these concepts and technologies were in their infancy and have since quickly matured and are in full use.

AGILITY

Today, I will start with the word AGILITY, a business enterprise concept that was introduced only four years ago when the Iacocca Institute at Lehigh University finished a multi-industry study for the U. S. Department of Defense Mantech Program.

21st Century Enterprise Strategy

This industry/government paper and

subsequent ones obsoleted the words Quick Response and JIT and replaced them with Agility.

AGILITY

The concept of QR and JIT are only 15 years old today, and are now being replaced because mass customization and mass personalization that are a part of agility offer much higher levels of time compression and customer service.

The soft goods industry is particularly well prepared for the move to agility, because of its early adoption of QR and JIT.

Soft Goods Chain

The soft goods industry, as I will use the term, is made up of fiber, textile, apparel, retail, with --

- Fiber/textile being the most automated on this continent.
- Apparel is least among the automated, is an important end user of textile, and its loss would be followed by textile.
- Retail is the important interface between manufacturing and consumer.

and -- The consumers, though not part of the industry, are the end users that we must always consider as part of the competitive equation, because they create the demand that drives the industry.

Consumer Demands

The consumer today is looking for more quality, higher fashion, better fit, better prices, and is buying many more categories of products than years ago.

This is readily apparent as we study the demand and growth of leisurewear, skiwear, sporting wear, boating wear, roller-blade wear, and

New Retail
Consumer Products

many other types of specialty garments that in many cases have a very limited time to market window.

Further, the consumer is also demanding the right product at the right time and wants to buy closer to the time of need. The present practice in the U.S. and many parts of the world of manufacturing products four and five months ahead of need and selling summer goods in February and winter goods in August is quickly changing. Retailers are beginning to understand the new time compression technologies and new merchandising methodologies are pushing change at an ever-increasing pace.

Time Compression
- 30 - 45 weeks

Today's Presentation
- Merchandising
- Technology
- Agility
- Training

Today we are going to look at merchandising, then we will review technology and agility working together to compress time, and finally we will look at training as the key to competitiveness in the global marketplace.

Merchandising and retailing is usually a foreign subject to many manufacturers and are not things they consider in running their businesses -- when -- on the other hand they should be very knowledgeable of merchandising and retailing, because they drive consumer demand.

In order to bring merchandising into perspective, the following short video tape from the 1995 Store Fixture Show will demonstrate how retailers and the fixture manufacturers are using new marketing techniques to increase competitiveness and separate us from our money.

1. VIDEO - Merchandising "Store Fixture Show"

Store Fixture Show

1994	197 exhibitors	3,000 attendees
1995	590 exhibitors	17,000 attendees

The excerpts from this fixture show become very relevant when we consider that there were only 197 exhibitors and 3,000 attendees in 1994, and 590 exhibitors with 17,000 attendees in 1995 (Health - lighting - future mall - interactive mall) computers, entertainment, smart cards, Lionel trains. Discuss Brazil store.

What you have seen is only one side of marketing. On the other side is the catalog world that has been growing exponentially over the last few years.

Catalogs deluge

In fact, today in the U.S., over 16B catalogs per year are invading our homes and are influencing our buying habits. That's 70 catalogs for each individual in this country. This will soon change, because technology will drive a reduction in the number of catalogs produced because:

- production costs are high
- paper cost is growing
- mail costs are also increasing
- recycling of paper because of the inks used

- multi-media technology in the form of CD's and video are changing buying patterns -- and -- finally
- new digital printing is growing and will allow printers to customize catalogs to individual consumer buying trends.

QVC Video Home Shopping is already a $3B/year business and growing. Imagine -- on November 2, 1994, 400,000 orders were taken in one day. Further, in an experiment with Sax Fifth Avenue, one of the most expensive U.S. retailers, over $500,000 in high priced merchandise was sold in 30 minutes. This is revolution, because just one year ago no one would have believed that Saks would even consider such an experiment.

What has been discussed are but a few marketing strategies that drive businesses whether you are large or small. Technology ranging from lighting to video is influencing how we do business -- And this is just the beginning.

RF Technology
(coin, grain of wheat)

Barcodes are growing in popularity around the world -- while simultaneously RF devices are replacing barcodes. RF devices are being used in industrial laundries to track garments, while at the same time, our wildlife services are implanting these devices in fish and wild animals. These electronic chips are getting smaller and information will soon allow every garment -- in fact, every product -- to have its own imbedded serial number, or as I like to call it, a fingerprint -- and will become a data point on the information superhighway. The uses of this technology will explode soon and will be used as:

RF Technology

- counterfeiting countermeasure
- security device
- information center for life of garment
- receipt
- environmental catalog
- inventory control - laundry tracking
- as an import license

Now let's look at a shopping cart concept that is being designed to use RF technology.

2. Video - Electronic Shopping Cart

This shopping cart is only a beginning and the RF chip will play a major role in the developing agile enterprise. It will significantly influence how we reduce the 30 to 45 weeks apparel design to delivery cycles to 2 to 3 weeks.

Truck heading to plant,satellite

Just imagine, already today trucks are being tracked by global positioning satellites so that companies can forecast almost to the minute when shipments will arrive at the user's dock, or to guide drivers to their destination within 100 meters. (FED EX)

Jumbo Jet

Jumbo jets are growing in size and soon will carry pay loads 2 to 3 times bigger. The goal again is time compression, reduced inventory, and greater customer service --- and again, like the truck, satellite communications

control the process.

At the same time we work on planes, new high speed ships capable of 40 knots -- twice the speed of present ships -- and capable of unloading 1000 cargo pallets per hour are being designed with delivery schedules set for the late 1990's.

These are but a few examples of why I like to refer to this as a revolutionary age and not just change, and want to emphasize that many of these new tools to competitiveness are in service now or will be soon in support of the soft goods industry.

Now let's move on to something closer to soft goods, the retail, -- manufacturing -- consumer cycle, the subject that we are all interested in.

At this time, I would like to start with a video of a live presentation that took place at the 1994 Bobbin show. Please notice the range of subjects that will be discussed in this short video because they emphasize the need for seamless communications and demonstrate many of the technologies and concepts covered in this paper of everything we do.

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3. Video. Profiles of America. Short Version

This Video is a demo of the available tools/technologies and how they work together to make us more competitive. This demo was based on the principles of AGILITY, the subject we are now going to quickly explore. Notice that I use the word quickly, because I had better be quick before the

concept becomes obsolete.

The process in this video ran for four days and demonstrated that small, medium, and large companies can benefit from the principles of agility, and that it is driven by new marketing techniques, technology and people.

Agility Defined

Agility has been defined for our industry as being: "Trust based partnerships, able to make information driven decisions at the last possible moment in time, prior to the need to execute the decisions with flexible systems, driven by an empowered, cross-trained work force."

Agility - Trust Based Partnerships

Now, to expand on this definition, we will define agility -- one attribute at a time -- and look at some examples of actual implementations. To start with, Trust Based Partnerships really says:

Work together

Minimum legal documents

Handshake whenever possible

AGILITY DEFINED
Information Driven Decisions

Next we have information driven decisions. That is to say that there should be a free flow of information between partners. The retailer should make all sales information available to his suppliers on demand so that they can participate in maintaining inventories at the store, and simultaneously keep flowing raw product when needed. Conversely, the supply chain should keep retailers apprised of availability of raw and finished materials.

AGILITY DEFINED
Last Moment in Time

When should a decision be made to produce a product ????

Well, as defined here we really shouldn't produce anything until it is sold. I realize it is easy to say but not so easy to do, but it can be done if the proper data handling tools and communications systems are in place to make it happen.

To illustrate this we will look at a few examples that address both the information and the decision issues and how some companies are reducing inventories, and manufacturing only what is needed.

To start with, let's look at the VF/Wal-Mart partnership that has proven to be extremely effective for both companies.

VF/WALMART
Building

They have achieved a new level of efficiency and set new yearly inventory turns benchmark in some of their stores. They are turning jeans at a rate of over 25 turns per year instead of the slow 2.5 to 3.5 that has until now been considered good. They have doubled their sales because they do not suffer from out of stock problems like so many other retailers and they have done this by sharing point of sale information seamlessly. In fact, they communicate and replace merchandise automatically as it is sold. This new approach says that the inventory is either in the store, on a truck to the store, in manufacturing, or in the warehouse but in much smaller quantities that you would ever dream of or has been the norm.

VF/WALMART
EDI Daily
No Stockouts
25 turns/yr.

25 turns a year. Think of it, what could it do for you??? This is almost a full order of magnitude greater than anything we have ever seen before in retail. This is revolution, —not— evolutionary change.

Levi Article

Another great example is Levi Strauss and custom jeans. Imagine, the largest jeans maker in the world moving into the custom jeans market. Mass personalization is the term and is being practiced in 3 of their Original Levi stores. They are manually measuring the customer, electronically transferring the information to their manufacturing plant and shipping within 2 to 3 weeks. Just remember that this is just the beginning and they will get better and better very quickly. Don't be surprised to see the delivery times compressed to just a few days, and this will be followed by electronic body scanning that will soon be available.

LEVI
MASS
PERSONALIZATION
Hips,
Waist, Inseams

Again, -- like VF and Walmart -- sales are up, turns/year are up, the customer is happy and recommending the process to friends.

50/25/25 Rule
50% Fit
25% Needs Alteration
25% Must be Altered

Many people are asking --Why mass customization/personalization??? The answer is simple when you consider ego and real need. Consider the 50/25/25 rule that seems to be in effect today. 50% of the outerwear (shirts, coats, slacks, etc.) fit off the shelf, 25% need alteration but doesn't get altered, and 25% must be altered or custom made to fit the customer. Further -- we have a great way to deliver quality and customer service like never before and at the same time increase consumer demand for products.

Now let's look at a short video that takes what we have discussed beyond mass personalization.

---

4. VIDEO - Body Scanning and Consumer Choice - Morphing

The kiosk is a fact of life and in use today.

The body scanner is close to commercialization, and the video try-on system is in development and will someday become a reality.

These technologies are almost ready for consumer testing and will be supplemented soon by direct fabric digital printing. The printing revolution that is probably going to sneak up on us and suddenly allow us to make decisions at the very last possible moment.

Digital Printing/Wall

What I am saying is that the silk screen printing that you saw a few minutes ago in the video is on the verge of obsolescence. Digital printing will allow different multi-colored garments of any size to be produced one right behind another. The printing will be done in the cutting plant or the sewing room after cutting or wherever it is needed. Imagine the benefits of this new technology:

- Buy only white goods
- Print only what is needed
- Reduced inventories of finished goods
- Greatly reduced markdowns because you sell as you manufacture
- Higher in stock position

DIGITAL PRINTING

DIGITAL PRINTING
BENEFITS
- Buy white fabric
- Print only what is needed
- Reduced inventories
- Greatly reduced markdowns
- Higher in stock position
- Higher sales
- Customer gratification

- Higher sales
- Customer gratification

Imagine that soon we will be able to -- take orders -- adjust sizes to customer preference, cut what the customer orders, print, sew and ship -- all in just a few days.

We have just spent a considerable amount of time discussing how information systems, timely decisions and technology work together in compressing time as a competitive strategy.

The next two phases of the agility process are flexibility in manufacturing and the people that make the process work.

AGILITY DEFINED
Flexible systems

To start with, before we talk about people, the most important ingredient, let's look at flexibility.

Flexibility starts with management, and its ability to observe, evaluate and make decisions that will affect the long term growth of the company.

Flexibility is having a thorough knowledge of the industry drivers that have been discussed.

Flexibility is understanding how knowledge and decisions will affect the company in its bid to grow and become more competitive.

FLEXIBILITY
Management
Industry knowledge
Ability to observe, evaluate and decide.
Understand cause and effect
Use communications
Use reconfigurable systems
Cross trained empowered people

Flexibility is implementing change before it is needed. In other words, fire fighting will not work in the future.

Flexibility is being able to use communications systems to assure a smooth flow of information and finished product between you and your partners.

Flexibility is having programmable equipment that is multi-purposed. (ex. electronic tackers, programmable sewing machines, computers that eliminate handwritten work, communications that are copied over and over and sets us up for transaction errors.

AGILITY DEFINED
Empowered employees

Flexibility is having cross-trained empowered people at all levels. Please note here that people surround everything that takes place in your business. Management and cross-trained employees at all levels must work together as if they were only one person.

People and their use are without a doubt one of the truly great challenges, because most of the employees in our industry are single purpose people that are not using their brain power to help expand our businesses.

Is this is a tall order? You bet it is -- and everyone can participate if they do not overlook the final step in the agility processes -- cross-trained flexible, empowered employees. All I can say about this is that the work done at Federal Express, Motorola, Levi, Nissan, Toyota and many others is a great testimony of how cross-trained, empowered employees can drive a

company's competitiveness.

I know that some of you are tired of hearing about the employees taking over the business – that's not what its all about. The real story is that we can't continue to have single purpose people that can do only one operation and believe that they are dummies – because – they aren't. Employees are a business's most valued asset.

Look at what is happening in other industries where technologies and people are working together. Motorola manufactures around the world, trains in at least 25 languages and they must re-train all 140,000 employees every couple of years because products are changing that fast. Another example is Federal Express – they must train 70,000 plus employees every 2 years in order to be competitive.

Another great example of employee training is the Ritz Carton Hotel chain. Their employees are empowered to help anyone that even has a puzzled look on their face. In fact, if you ask for directions from a maintenance person changing a light bulb, they will stop what they are doing and escort you to your destination.

I can hear it now---that's the Ritz and you would expect that. Well, this approach is being adopted by several medium-priced hotel chains and you can already notice the difference in attitude in service. I even experienced this in the middle of New York City in a prominent hotel that I thought had the worst service in the city. They are changing and adopting the Ritz approach to customer service and people at every level are making it happen.

Change and revolution always starts because of an unmet need and in the case of the soft goods industry, agility is being picked up and copied and is spreading very quickly. Because of the need to compete, already 15% of manufacturers (LMS) use some type of modular, flexible pull system with very little in process inventory. They are approaching agility one step at a time, in most cases from manufacturing into retail.

To summarize the process we will now review the characteristics of Agility and look at training as a separate supporting set of tools.

Agile Production System
- Management Commitment
- Pull
- Small batch size
- Minimal work-in-process
- Cross-training
- Teamwork from top to bottom
- Active employee involvement
- Alternative pay systems
- Organizational Culture Change
- Continuous Improvement

AGILE ENTERPRISE
- INFORMATION SYSTEMS
- PARTNERSHIPS
- FLEXIBLE TECHNOLOGY
-KNOWLEDGEABLE WORKFORCE

In summary, the agile enterprise is not just an idea but a growing movement among many manufacturing sectors and there is an international organization in place called the Agility Forum that is charged with the responsibility of delivering the message of Agility to all business sectors. This group is made up of manufacturers such as: Texas Instruments, General Motors, Ford Motors, Chrysler, Motorola, Westinghouse, IBM, Mac Trucks, Hughes Aircraft, to name a few.

5. VIDEO - Agility Video - 3 minutes

The ability to compete in the future global marketplace will only occur in those companies with enlightened Management that make strategic decisions to include revolutionary change as a business strategy and educate the workforce and management simultaneously.

Training can take place over a period of time but should be something that everyone can use on a daily basis. Management must stick to its decision and not falter when the going gets tough. Training can be done in the plant or off site and it is extremely important that both management and employees hear many of the same things. Training should include everyone -- even the educators who are teaching the leaders of tomorrow.

Lifelong continuous education is the only road to a technological competitive future and educators must -- must produce industry-ready students while simultaneously offering advanced courses that allow employees to grow educationally as technology moves forward.

An example of industry sponsored training is what is being done by the U. S. soft goods industry for apparel manufacturers. The training starts with:

Education - Mgr./Svr.

Education - managers/supervisors. Courses such as engineering, ergonomics, costing, management practices, agility, activity based cost management, etc.

Education - Sewing Specialists (Shut-ins)

Education - Sewing Specialists

- Interpersonal skills
- Team Training
- Cross-training
- Technical Training
- Creative Thinking

Education - Technician

Education - Technicians - (Shut in's)

- Interpersonal skills
- Team Training
- Cross-training
- Technical Training
- Creative Thinking

Education - Students

Education - Students

- Internships
- Co-op programs
- Lab Practicums

Education - Faculty

Education - Faculty

- Industry supported Fellowships
- Post-fellowship support
- Advanced degree support
- Joint University/Industry Seminars

Educational Delivery Systems

Education - Delivery Systems

- Trade shows
- Seminars

Educational Delivery Systems

- Seminars
- Workshops
- Instructorless Interactive Video Training
- Interactive Distance Learning
- Videos
- Games

Nintendo is about to release a new $250.00 computer game. If it had been released in 1980, it would have cost $14.5 million.

This overview of the soft goods industry and the revolution that is taking place is just the beginning and is only a small sample of what is happening around us today.

We have seen how merchandising and retailing are using technology as a tool to convince customers to buy products. They are using new concepts like kiosks, direct video sales, catalogs, and technology driven selling techniques and are moving away from the trained sales clerk.

These new approaches are challenging the imagination and capacity of the apparel, textile, and fiber manufacturers because of the growing number of styles, colors, and time compression needed to compete in today's global marketplace. The road forward will have more curves than ever before because of the increasing number of decisions that must be made every day. The way forward includes new technologies, both hard and soft, new strategies and new sophisticated merchandising methods that must be understood by even the small and medium manufacturers, because they will have to merchandise their products and capabilities to the merchandisers.

the soft goods revolution that is upon us – and – how it is getting more difficult to identify the technological challenges that are developing at an ever increasing rate.

I would like to leave you with this thought –

"If you can see your path"...

"If you can see your path clearly laid out before you, it's not your path!"

Thank you for inviting me, for your time and attention.

c:\cetiqt.95

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C I T C '9 5

RIO DE JANEIRO, 18-21 JULY 1995

XP/INT/95/037

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A New Approach to Quality: The Most Important Component in the Profit Profile

by

Mr. Werner Klein (Switzerland)

Quality Consciousness and new Management Structures

Building Blocks for Company Success

Werner Klein

Ladies and Gentlemen
to prevent misunderstandings I would like to clarify the scope of this presentation right at the beginning: I shall discuss the clearly visible needs and requirements of the coming decades with regard to quality and management to face the foreseeable hard competition for this time frame. I will try to show, what is expecting us, what measures need to be taken and how the management structure has to be adapted accordingly. This presentation is a starting point to conquer this kind of future challenges and will not present a collection of solutions. Therefore the focal subject is the „What" and not the „How". The latter would go far beyond the time allocated to this presentation.

Based on the boundary conditions presented today you shouid be in a position to set the relevant goals for your company. You will find sufficient and competent support from consulting companies, machinery manufacturers or instrument producers for the not so easy realisation of these goals. Zellweger Uster certainly is one of these competent partners in the area of quality management.

My special thanks goes to this company for the support in typing, translating and realising the transparencies of this presentation.

Content

1. Requirements for a textile company in the next decade

One of the significant developments in the textile industry in the next decade will be the inevitable globalisation of markets. The essential advantage of this will be the immense entrepreneurial potentials for dynamic, highly qualified companies. The disadvantage, mainly for sluggish companies, will be the highly increased competition in the market. From these facts it can be deduced, that only companies will survive the hard competition, that not only dispose of (fig. 1):

- high-tech production equipment
- absolute technology competence
- up-to-date management structures
- highly qualified personnel on all hierarchical levels
- competent partners,

but also are in a position to exploit the production factors:

- raw material
- production facilities
- personnel

to an even higher degree than in most cases today.

In a spinning mill the most dominant factor is the raw material, which accounts for 50 % to 75 % of the production cost (fig. 2). Since this is common knowledge it is amazing, how careless this important cost driver is treated today. The reasons for this fact are mainly:

- lack of raw material know-how
- lack of control over production processes
- outdated quality philosophy.

2. But what is Quality?

Quality is more than ever one of the most important competition factors [2]. It is therefore astonishing, that in most companies quality is still looked at as an absolute dimension, which can be described by fixed maximum allowable values, levels, etc. The understanding, that quality is relative, always dependent on situations and requirements, is not very wide spread yet. If a company today is still governed by the rule:

"Quality is, when the customer comes back and not the goods"

it will be very soon in the red [3].

Therefore, one of the first adjustments to the manufacturing methods of the 21st century, which will decide over success or failure of a company, is a change in the quality consciousness of the entire staff, from machine operator to top manager. A change, away from absolute, maximum quality to:

"always assured, optimised quality".

According to Crosby and in similar form according to ISO standards, the following definition of quality applies [8]:

"Quality is the fulfilment of the specified requirements for a product or service"

not more, but not less either. A prerequisite for this is that the management has a masterly command over the instrument of quality optimisation with an absolute loyalty to quality [4].

3. The dimensions of Quality

Different degrees of quality levels are known. If they are brought together in a common, standard scheme, three clearly defined classifications emerge:

3.1 The overdimensioned quality

Today this is still the most common type of quality found in the marketplace, by far also the most uneconomical. Fig. 3 visualizes such an overdimensioned quality. The actual quality level, i.e. the quality of a yarn, is much above the required level. This span between the requirement and the measured actual quality, as it is shown in fig. 4, results in considerable cost for the producer [5]. Such a situation often comes about, when the spinning mill is not considering the end use of the yarn. In most of the cases the lack of raw material- and process know-how is the base of the problem, and there is no comprehensive raw material management [6]. Often the exact knowledge of the requirements for the yarn is missing, frequently as a result of the non-existing product engineering.

3.2 The underdimensioned quality

This situation is not an exception. As shown in fig. 5, this case is very often not a result of insufficient average quality levels, but of exceptions, which happen with a certain frequency [7]. These exceptions often render a yarn useless for certain applications due to the high loss of efficiency of downstream production equipment. Such yarns are typical for spinning mills which are not in control of their production process, starting with the raw material blending up to the unsystematic equipment maintenance. Reasons for this lack of control are either the insufficient process management or more often the lack of an efficient quality management.

3.3 The dimensioned quality

This quality level can also be described as the optimum or the economical quality, i.e. all requirements are fulfilled, not more but not less either. Fig. 6 indicates, that this quality can only be achieved, if raw material and process are very well under control [7]. Since in this case the quality is right at the borderline of practicality, no exceptions can be tolerated, since they render the yarn useless. For the production of such yarns the requirements regarding personnel and equipment are very high. Any incompetent person, inadequate piece of equipment, every wrong organisational decision or insufficient know-how will result in a failure. Spinning becomes applied science in this case.

The production performance of "dimensioned quality" will also result in a selection process for management performance. Only companies which are capable of producing "dimensioned quality" will survive the hard competition of the future [8].

Besides the conditions mentioned above, the production of "dimensioned quality" also requires:

- exact knowledge of the requirement profile of the product
- competent product engineering (in this case yarn engineering).

The first part can only be fulfilled, if the information regarding "Quality" is freely exchanged between the various interfaces of the process (fig. 7). Without detailed agreements between producers and users of yarns regarding quality parameters the production process for the 21st century cannot be realized. An example for such an agreement is shown in the following yarn quality specifications of a leading European knitter [9]:

Yarn count	Ne_c 30 20 tex	Ne_c 34 17.5 tex	Ne_c 38 15.5 tex
Evenness CV_m	max. 12.3 %	max. 13.0 %	max. 13.5 %
Count deviation CV. 100 m	± 1.5 % ≤ 1.8 %	± 1.5 % ≤ 1.8 %	± 1.5 % ≤ 1.8 %
Turns per m	755 ± 38	826 ± 38	910 ± 38
Thin Places/1000 m (-50 %)*	max. 5	max. 5	max. 8
Thick Places/1000 m (+50 %)*	max. 20	max. 25	max. 35
Neps/1000 m (+200 %)*	max. 40	max. 60	max. 80
Tenacity $F_{...}$/tex	min. 13 cN	min. 13 cN	min. 13 cN
$CV_{...}$	≤ 10 %	≤ 10 %	≤ 10 %
Elongation at break $E_{...}$	min. 5.8 %	min. 5.6 %	min. 5.5 %
Classimat faults remaining A1/B1/C1/D1 per 100 km **	average 100 max. 200	average 125 max. 250	average 150 max. 300
Classimat faults remaining A3/B3/C2/D2 per 100 km **	average 3 max. 5	average 4 max. 7	average 5 max. 8
Classimat faults remaining E per 100 km **	max. 1	max. 1	max. 1
Classimat faults remaining H2/I2 per 100 km **	max. 3.5	max. 3.5	max. 3.5

* Test settings at USTER® TESTER 3
** Classification of USTER CLASSIMAT®

An efficient product engineering as mentioned above again requires new management structures in manufacturing, which will be deduced in several steps in the following.

4. Quality Factors

4.1 Structures of influences

According to fig. 8 the quality of a product is the result of:

- **Raw Material**
- **Process**
- **Personnel**
- **Know-How**

These factors have different degrees of importance, but quality only emerges from an interaction of all factors. The goal is to fulfil the requirements at any time, i.e. reaching zero deviation from the agreements with the customer [7,9]. Quality assurance today therefore is a very complex task. The time-honored department of "statistical quality control" can not fulfil this task any more, a **quality management** is needed. The difference can be described as follows:

Quality Assurance is based on statistical methods and techniques, which detect irregularities in processes and allow for their correction or elimination. **Quality Management** in contrary is based on the principle of prevention, i.e. irregularities are prevented from the very beginning and in all phases of the development of a textile product [2].

4.2 Quality Factor: Raw Material

For yarn production the raw material is the most dominant quality factor and determines to a considerable extent the quality of the product, but it is also the largest manufacturing cost factor. Errors or negligence in the selection and the composition of the raw materials can not be corrected by any means in the subsequent processes. Optimisations of individual processing steps in the spinning mill are only possible, if the processed raw material has constant properties within defined tolerance limits [10]. Carefully directed, meaningful savings in the purchase of raw materials are still the most efficient cost reduction method for a spinning mill. Selection and optimum use of raw materials are decisive for the success and the competitiveness of a spinning mill.

The traditional raw material purchasing offices are out-dated in most cases. To meet all the requirements in connection with the raw material an adequately structured and ~~competent raw material management~~ is needed.

4.3 Quality Factor: Process

Normally the processing steps in a spinning mill are predefined; nevertheless the possibilities of the manufacturing department to influence quality and cost are considerable, i.e. by means of:

- selection of adequate machinery
- selection of adequate machine components
- machine settings
- systematic upkeep and maintenance
- organisational measures regarding processes
- quality monitoring

Also in this area the potential for optimisation is not used to its fullest extent yet. The competence of the management can be quickly assessed in this sector. The purchase of low price, but not price-worthy equipment will negatively influence the competitiveness for years. The same is true for spinning com-ponents such as top roll covers, spinning rings and travellers, etc. Maintenance and upkeep are often neglected with a very detrimental long-term effect on quality. To apply a process at optimum conditions, a competent **process management** is required.

4.4 Quality Factor: Personnel

Quality can only be achieved with excellently trained, responsible and motivated personnel. The permanent persuasion of the personnel in this sense is one of the main tasks of the **personnel management**, which will not be covered within the scope of this paper [3].

4.5 Quality Factor: Know-How

Besides the raw material this is very likely the most important factor. Know-how in a high-tech environment like a modern spinning mill encompasses the initial acquisition of the required knowledge and skills, followed by the permanently continued education. The latter can be performed by internal research, development and studies, but also with the help of external sources such as institutes, conferences, consultants, contacts to know-how carriers such as machinery manufacturers or producers of instruments.

The specialized knowledge is needed in different form and extent on all hierarchy levels, from the machinery operator to the executive technical director. The purpose-oriented application of the company know-how starts with quality and requirements definition; every modern spinning mill needs a **product engineering department** for this task.

5. Modern Management Structures

5.1 Deduction of the management structure

The analysis in the previous paragraphs of the different management requirements to achieve quality and cost efficiency automatically leads to the management structure needed today, as shown in fig. 9 [5]. Not only clear duty assignments and delegation of competence, but also the smooth cooperation between the individual departments is of utmost importance. It shall be repeated in this context, that a single intriguing or egoistic person can impede the proper functioning of a modern management structure and severely harm the company.
Only two components of this structure will be dealt with in this paper - the two components with the greatest influence on product assurance: Product engineering and quality management.

5.2 Product Engineering

With regard to yarn manufacturing, this department has mainly the task - beside the continuous development of yarns ahead of market trends - to deduct the yarn quality specifications based on downstream processing and requirements of the end product. Supported by this knowledge the yarn has to be engineered with respect to raw material, processing and company-specific considerations. All the relevant information has to be passed on to the departments involved. The product engineering develops the quality goals and defines the applicable general quality guidelines.

Product engineering is the first and one of the most important components for success. The requirements are very high and an in-depth, versatile proficiency of the personnel and especially of the department manager is needed.

5.3 Quality Management

The quality management is responsible to assure in a preventive way the exact and permanent fulfilment of quality requirements on all processing levels from raw material purchase to shipping. It retains the quality parameters within narrow limits, defined by product engineering. Furthermore, the permanent task of approaching the zero defect goal with simultaneous optimisation of cost is one of the main responsibilities and requires a close cooperation with the process management department.

To fulfil this task, quality management and quality assurance need thoroughly trained technologists and laboratory or testing personnel, who are familiar with the textile process and its specific requirements from the raw material to the end product. Efficient quality management has the following advantages:

- permanent assurance of quality
- building of a company quality image
- fewer faulty goods
- less waste
- less reworking
- less trouble
- reduction of end break cost
- increased competitiveness
- general cost reduction
- increased customer satisfaction
- survival in a tough economical environment

6. Conclusions

The contest in the textile industry is not only decided by the wage level, but also by skills and knowledge of personnel as well as the quality of the management on all levels. To produce optimum and not maximum quality a new management system is also required in the textile industry. The so-called "dimensioned quality" demands a preventive and closed-loop quality management. This starts with raw material selection and furthermore encompasses tight process control, personnel know-how, product engineering and product-oriented quality assurance. Required are excellently trained technologists with an all-round knowledge from raw material to end product and its application.

Furthermore, competent partners with specific, in-depth know-how are needed, such as institutes, machinery manufacturers, instrument producers, suppliers and also customers.

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8. List of figures

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C I T C '9 5

RIO DE JANEIRO, 18-21 JULY 1995

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NEW DEVELOPMENTS IN WEAVING

by

Mr. Kurt Georg Nick (Germany)

New Developments in Weaving

1 Introduction

When we look at the weaving technology one must be surprised how many possibilities are offered to produce cloth which is suitable to cater for all demands for our personal needs, for household and apparel fabrics, indoor decoration, highly sophisticated cloth for fashion dresses made from pure cotton and blends with other fibres. Also synthetic multifilaments, microfibres for garments, high tenacity fibres for safety purpose (airbag), as well as aramids, carbon fibres (bullet proof vests, reinforcements for air-planes, cars), polypropylene (geotextiles, agrotextiles, industrial fabrics such as primary and secondary carpet backing) are woven for technical fabrics.

As there is a permanent development in textile machinery it is most likely, that new developments in weaving machinery will be presented at ITMA 95.

What are the fields to look at today?

I would like to limit myself to weaving technics only, dispite the fact that systems in combination with weaving and loop forming open a wide range of possibilities to produce fabrics.

- loop forming system in weft direction
- loop forming systems using two systems for weft insertion (knit pick and weave pick)
- loop forming systems utilizing threads in warp direction

But let us have a closer look at the weaving systems, what do they offer us? What can we expect in the near future? How important is cloth quality?

1.1 Quality of woven fabrics

Fabrics used for filtration in the paper industry are expected to have zero defects. The same applies for worsted fabrics. Who wants to wear a dress with stitches and floats? But here we still have a possibility to mend and repair defects with a costly mending exercise

Foil 1 development of quality standards

If we look at the denim market the allowed demerit points have been lowered over the years. At the same time the production speeds increased.

Foil 2 quality development

The machine manufacturers have to meet the demands of their clients to produce high quality fabrics. This target can only be achieved if the yarn in spinning, yarn preparation is of high quality to allow shed formation and weft insertion at high speeds.

2 Weaving Systems

There are 2 weaving systems on the market.

2.1 One phase flat weaving machine

2.2 Multiphase weaving machine

Despite the fact that most of the weaving machines installed world wide are shuttle weaving machines of different makes, they have reached their limits and higher weft insertion rates above 500 meters per minute cannot be expected in the future. Experts however believe that the one phase weaving technic more than 1000 years old will be phased out by the year 2010 - 2020 despite the tremendous technological and economical improvements..

Foil 3 relation of contrariety of weaving systems

In a paper presented by Prof. Dr. Ing. G. Egbers in 1994 he refers to 2 patents applied by 2 leading weaving machine producers.

Quote:

Patents of Dornier describe a flat multiwave weaving machine. The transport of the yarn carriers is assisted with the aid of magnets.The heddles are equipped with feet like knitting needles, the control is carried out with a system similar to knitting machines.

Foil 4 Development of weft insertion

A patent of Sulzer Rüti protects a multi linear shed weaving technic which is closely related to the well known Gentilini-Ripamonti principle. It works with a weaving rotor, which forms with multiple rows of warp positioners and weaving reeds a multiple number of weaving sheds. Quote

3 The Projectile Weaving Machine

The Sulzer-Rüti high performance projectile weaving machines type P 7100 and P7200 are characterised by its very wide range of applications. Its weft insertion rate amounts for P 7100 to 1200 meter/min and can reach with P 7200 up to 1400 meters/min, depending on type of weft yarn employed. The machines are available with tappet motion, dobby or Jacquard machine. Working width 190 - 545 cm. For special fabrics up to 846 cm .

Foil 5 WM 846 cm wide

3.1 Selvedge

A major advantage is that the working width can be varied by displacing the centre tucking units and receiving unit in the required distance (minimum 32,0 cm) in order to weave fabrics with firm tucked-in selvedges.

If required the machine can be equipped with leno devices on picking and receiving side as well as in the centre. This applies for fabrics, where a tucked-in selvedge is not desired, such as denim, corduroy, weft faced satins or in some cases for conveyor belts. For very coarse Nylon or Polyester counts for tarpaulins, very fine Nylon fabrics for umbrellas or bolting cloth a special melting device is available.

3.2 Range of application

For cotton yarns and cotton/blends the machine covers a range from 10 - 250 tex. If coarse counts are used for curtains, cotton hospital blankets, spun acrylic or other synthetic fibres, Polypropylene, PE - tapes , the machine can be equipped with Projectiles D 12 with increased gripping surface or Projectile D 2 with increased gripping surface and weight of the Projectile.

Foil 3

3.3 Colour selection

The colour sequence on 2, 4 or 6 colour machines is controlled by the dobby or Jacquard machine. When a tappet motion is used a special colour selector Q is used.

3.4 Special equipment.

Double weft insertion is restricted to 12 - 40 tex (cotton, cotton/blends, spun rayon, worsteds) but multifilaments up to 100 tex have lately been woven successfully. For special leno fabrics a leno attachment for high/low shed leno or low shed leno is available. Speed restrictions 220 picks/min.

- chain temples advisable for weaving bolting cloth
- full with temple (airbags and heavy duty sail cloth and heavy ducts) can be fitted without problems

3.5 Tire Cord Weaving Machine P 7100

After a piece length of 1000 - 1200 meter is reached a header and short control pieces are woven. This is very time consuming, as the different densities and yarn counts in header and tire cord control pieces where adjusted manually. Today the machine is delivered with an automatic programming system for weft density, colour selection and automatic temple and tucking-in needles adjustment. With the possibility to wind a multiple number of pieces onto a degressive working batching motion up to 1800 mm diameter. The machine stops automatically in the correct position if a piece is ready for doffing. If for any reason the piece length has to be reduced the program can be interrupted and the process starts automatically from the programmed datas. Let-off and take-up with electronic drive.

The encoder controls:

- speed forward and reverse of take-up
- density of picks/cm
- length of piece

Each necessary step in movement can be done stepless without change of gear wheels. The machine can also be used to weave conveyor belts with tucked-in selvedges.

Foil 7 Tire cord WM

3.6 Terry Weaving Machine

The Projectile weaving machine is also available as a terry weaving machine for weaving of 2 pile heights and fringes with a fringe take-up device. The maximal pile height is 8 mm. Pile beams up to 1250 mm diameter.

Foil 8 Terry WM

3.7 Projectile Weaving Machine P lean

If only plain weaves or twill, drills are woven, a machine in 36o cm width with weft mixer and 6 shafts can be supplied in the future. Weft insertion rate up to 1200 meters/min.

3.8 Special Types P 7 M R 3

For special types of fabrics which are dense or over 545 cm wide, special built machines from 280 cm to 545, 600 or 846 cm and if needed up to 1200 cm width will be specially supplied with the desired equipment,

- tappet motion
- dobby
- up to 6 colours
- motor take - up, motor let - off
- automatic pick finding

Foil 8 a

These types specially suitable to weave monofilaments up to 0,8 mm can certainly also be used for cotton or polypropylene tapes. Speeds of a 846 cm wide machine up to 130 picks / min are possible. In actual fact, more than double the production of a conventional shuttle or rapier weaving machine.

3.8.1 Controlled Warp Tensioner

They are primarily built for the use with plain fabrics 1/1. They guaranty however independent from the speed an absolute phase true movement. In addition this control system allows a targeted intervention in warp tension sequence in dependence of shed formation and slay drive movement.

Foil 9 course of warp tenacity

Possibilities for optimisation are:

- Improvement of separation of yarn entanglements with high warp density or high yarn hairiness.
- Reduction of thread tension to a minimum tension when yarns with low elongation or yarn with many weak spots are woven.
- Increase of the weft density and reduction of the fell of the cloth.
- Improvement of cloth structure and cloth cover.

Foil 9

4 Pneumatic Weaving Machines

For many years pneumatic weaving machines were only available with one insertion system. Today however air-jets with 4, 6 or even 8 colours are on the market. Vaupel one of the leading Label Weaving Machine suppliers reaches weft insertion rates of 1250 meters / min. with 180 cm wide air-jets supplied by Dornier Lindau. There are quite a number of suppliers of air-jets such as, Dornier, Picanol, Sulzer Rüti, Toyoda, Tsudakoma, Nissan, Ishikawa, Nuovo Pignone, Somet, Hirawa, Günne and Draper.

Foil 10 Dornier air - jet, Foil 10 Dornier PICANOL

The machine speeds reach already 900 - 1600 rpm and weft insertion rates vary between 1200 to 2700 meters / min. These are speeds shown at the last exhibition. It will take a few years before these figures can be realised in practice. Foil 11 shows the development of performance in weaving of shuttleless weaving systems over the last 25 years.

Foil 11 Development of Performance in Weaving

What should we consider, when we look for new equipment?

- Versatility
- Flexibility of machinery
- High production
- Quality of final product
- Wastage of material

Foil 12

4.1 Two Phase Air-Jet

Will a 2-phase air-jet where the yarn is inserted from the centre of the weaving machine be even more productive and can we achieve 4000 meters weft insertion per minute?

4.2 Air-Jets for Terry Towels

Many companies manufacture also air-jet machines where terry towels in combination with different shedding motions, tappet, dobby, jacquardmachine can be produced.

4.3 Jacquardmachines for high speeds

Sulzer - Rüti will most likely present an air - jet L 5200 operating at a speed of 1000 picks / min equipped with a jacquardmachine with 6100 hooks.

Foil 13 JM Bonas

4.4 Electronic shedding motion

Due to the increasing speeds and possibility of electronically changing of a weave pattern Tsudakoma has developed a new electronic shedding motion. Shed timing and dwell can be freely set. For frequent quality changes a further advantage as no cams have to be replaced and the weave pattern can be exchanged electronically.

Foil 14 ECM electronic shedding motion Tsudakoma

4.5 Programmable weft tensioners.

It has been realised that with high weft insertion rates weft stops can increase. In order to reduce peak tension, machine producers try to solve the problem differently. The weft tensioner is programmable (Picanol). We can see in Foil 15 that the weft loading increases significantly with increased weft insertion rate, but can be reduced with a controlled weft brake as installed at an air-jet Sulzer Rüti L 5200.

Foil 15 weft loading max. values

Similar results can be achieved with pre-acceleration of the yarn with air on a Projectile weaving machine, were the peak of tension reaches the highest level when the spare length between weft feeder and weft tensioner has been used up and the yarn is pulled direct from the weft feeder or weft package. The pre-accelerator who is blowing in direction of weft insertion reduces peaks and assists to insert irregular weft yarn with thin and weak places more efficiently.

Foil 16 weft tension with acceleration

4.6 Automatic weft repair.

This becomes more important too with high weft insertion rates. Most manufacturers equip now the machines with automatic pick finder who frees the broken pick and removes the remnants. The machine restarts automatically. Picanol, Nissan, Tsudakoma, Sulzer Rüti, Toyoda.

Foil 17 automatic weft repair

5 Rapier Weaving machines

5.1 Rigid Rapier Weaving Machines

Dornier offers 18 different widths of rapier weaving machines; 150, 180 to 260 cm in steps of 10 cm; 280 to 320 in steps of 20 cm; 330 to 360 in steps of 10 cm and 380 to 400 cm.

Fold 12

5.1.1 Equipment

The machines can be equipped with tappet motion, dobby or jacquard heads. The colour selection is carried out with electronic controlled step motors. If a weft brake occurs all thread feeders are lowered, only the feeder where the weft stop occurred moves in a raised position. This helps to thread-up the broken pick. The heads of the electronic colour selection can be exchanged and can be built up from 1 to 8 colours according to the demands of the user. Up to 12 colours can be selected in case jacquard machines are used.

Eight different weft densities can be programmed. The weft density is kept constant by the electronic controlled cloth take-up as well as the warp tension. Storage over panel, memory card or on-line is possible. The machine covers a wide range of application.

5.1.2 Terry Equipment

The machine is also available for terry weaving. The pile is formed by synchronized movement of the backrest roller and cloth take-up roller so the reed movement remains unchanged.

5.2 Flexible Rapiers

5.2.1 Sulzer Rüti Weaving Systems

With their type G 6200 Sulzer Rüti has the third type of modern weaving systems. Where the flexibility is required the machine offers 2 up to 8 colours selection with an electronically controlled colour selector.

The machine can be equipped with cam motion up to 10 shafts, positive electronically controlled dobby for 16 or 28 shafts or a electronically controlled jaquardmachine.

Warp let-off and cloth take-up are fully synchronised to avoid starting marks. The weft density from 6 - 200 picks / cm is programmable on the microprocessor terminal. This allows to program different weft densities in plain fabrics and satinstripes as well as borders.

Machines are available in widths from 140 cm to 280 cm.

The grippers pass the front shed without any contact with the warp ends. Thus warp ends are exposed to less friction and it also shows advantages in cloth appearance.

Up to 8 different yarn counts can be inserted in sequence enabling the producer to compete under extreme conditions in weaving high fashion fabrics.

5.2.1.1 Full width temple for airbags or other heavy and dense fabrics can be mounted without modifications.

5.2.1.2 Terry Weaving Machine

It can be equipped with pile beams of 1250 mm flange diameter, 2 to 8 colours in weft 3 or 4 pick terry without change of terry cams. A new generation of terry cams and slay drive opens new possibilities for terry production.

Foil 19 terry WM

Through the dynamic pile control in conjunction with the new terry slay drive the pile height can be changed from one beat-up group to the following beat-up group. The distance of beat-up can be adjusted from pick to pick and is free programmable from 0 to 20 mm with the aid of a high dynamic servo motor.

5.2.1.3 Bi-directional Communication between Microprocessor, Weaving and Jacquardmachine

Information in regard to terry and weave related details are programmable via memory disc or monitoring system.

5.2.2 Somet S. P. A. Colzate, Flexible rapier Thema 11 Excel.

This machine is built in working width of 165 cm, 190, 210, 220, 230, 260, 280, 300, 320, 340, 360, 380, 400, 420 and 460 cm and equipped with electronic warp let-off and electronic take-up motion to guarantee first quality of fabric and to avoid start-up marks. Weft insertion rates up to 1400 meters / min.

5.2.2.1 Shed Formation

The machine can be equipped with outside shedding motion up to 12 shafts and 12 pick repeat. Further possibilities are

- electronic rotary dobby for 12 or 20 shafts
- electronic or mechanical jacquardmachine

5.2.2.2 Selvedges

As the machines are usually equipped with leno devices a fringe selvedge is produced. In addition it can be equipped with a thermal cutter or ultrasonic cutter or tuck-in units for a solid selvedge.

5.2.2.3 Range of application

The machine can be used for coarse counts Nm 2 to Nm 200 for spun yarns and for synthetic filaments from dtex 10 to 4000.

There are many other manufacturers of flexible rapier weaving machines, just to mention a few; Picanol, Nuovo Vamatex, Nuovo Pignone, Tsudakoma, Ishikawa, Hiraiwa, for velvet Van der Wiele.

Fall 1995 CA

6 Water-Jets

6.1 Tsudakoma

The weft insertion rates have been increased. Depending on count for weft insertion up to 2300 meters / min were reached. Similar to air-jets, weft tension systems are in use now. The range of application is however limited. Besides Tsudakoma, Nissan is a major producer of water- jets.

7 Future Trends in Weaving

- Economical benefits
- Ecological benefits
- Development potential

7.1 Population Growth

The world population growth is one of the most important factors for the continuously increasing consumption in fibres at a rate of 1,5 - 2,0 % per year.

Foil 20, World Population

The development shows that by the year 2000 more than half of the world population is living in Asia.

7.1.1 Production and Fibre Growth

It is estimated that the cloth production will increase by 1,0 - 1,5 % annually, but specially in Asia and South America.

Foil 22, Cloth Production

7.1.2 Production of Shuttleless Weaving Machines World

The development in production of shuttleless weaving machines shows that 1990 76'000, 1991 55'000 and 1994 44'600 shuttleless weaving machines have been installed.

As already mentioned growth in production is expected in South America and Asia.

Projection for the year 2000 shows that the production of shuttless weaving machines will level out at 50'000 machines due to the increasing production output of weaving machines

Foil 25, New Installed WM

7.2 Influence of Machine stops on Efficiency and Machine Allocation per Weaver, Economical Benefits

7.2.1 Influence of Machine Speed in Relation to Stops and Efficiency

Production in weaving depends on different factors:

- Quality of yarn

- Preparation of warp and weft

If the production speeds increase and the breakage rate remains the same, the efficiency will drop tremendously and the output will suffer. The following diagram shows the drop in efficiency with increased speed for 2 stops, 4 and 8 stops per 100'000 picks.

Foil 26, Influence Picks/min

7.2.2 Influence of Stops on Assignment of Number of Machines for a Weaver

It is very well known that in synthetic weaving mills stop values below 1 stop per 100'000 picks can be achieved and more than 100 machines are allocated to one weaver. In PP-plants results below 2 stops per 100'000 picks are possible. In denim plants 2 - 4 stops per 100'000 picks are reached in different plants and therefore up to 28 machines can be allocated to a weaver. The desire for high efficiency, high machine assignment and perfect quality is in danger with high stop values. The diagram shows the influence of stops in relation to machine allocation per weaver with different working speeds.

Foil 27, Influence Machine Speed to Weaver Assignment

7.2.3 Automatic Pick Repair and Machine Start-up

The weaving machinery manufacturers know that with higher speeds automatic pick repair and pick finding is very important. High production speeds only would not lead to the desired high production output and first class quality.

7.3 Warp Length on a Loom Beam

Specially with coarse counts, such as denim fabrics, the running time of a warp beam with flange diameter of 1000 mm can vary from 56 -96 hours depending on machine speed. If the stop time of a machine due to frequent warp-out is increased, measures must be taken to reduce idle time for a machine. There are different possibilities to achieve this:

- Warp and quality change in team work
- Warp change with 2 knotting machines
- Increase of warp beam diameter
- Quick Style Change

Foil 28,

In 1987 I spent some time in Brazil. Being involved in productivity improvement over many years we managed to make a quality change in worsted mills in 90 Minutes already 20 years ago. We also drew up plans how to achieve a fast warp change. To my surprise I experienced the first warp change with 8200 end in 30 minutes in Brazil. With videos taken, the team work of the Brazilian team was shown all over the world. It is important that people work together, only in this way the set targets can be reached.

7.4 Warp Beam Diameter 1000, 1250 and 1600 mm

Depending on the size of the weaving mill we theoretically have to change with a warp beam flange diameter of 1000 mm:

6,5	warp beams per shift	with 50 machines
12	warp beams per shift	with 90 machines
17	warp beams per shift	with 130 machines

If we would use 1600 mm flanges, the warp changes would drop significantly to:

2	warp changes per shift	with 50 machines
3	warp changes per shift	with 90 machines
4,3	warp changes per shift	with 130 machines

Foil 29, Warp Change per Shift

7.4.1 Warp Beam Displaced from Weaving Machine

There are different ideas where to locate the warp beam. One plant is already in operation where the beams are displaced from the machines. With electronically controlled let-off this works well. The disadvantages as I see it, is that the access to the warp ends is limited.

Foil 30, Weaving 2000

7.4.2 Warp Beam 1600 mm Placed in High Position

Further tests are carried out with beams placed in a raised position similar known from the terry weaving, where the pile beam 1250 mm is placed in top position. The idea is however to integrate a lifting device into the warp beam support so that each machine can individually be loaded. The advantages compared to 1000 mm flange diameter are:

- Increase of warp length by 146 %
- Reduction of warp changes by 70 %
- Increased output in weaving
- Less personal required for warp change
- Less yarn waste
- Better quality

Foil 31

7.4.3 Quick Style Change

This system is now offered by most companies as part of the new weaving machine generation. It is very important that the machines produce continuously and are only stopped for a longer time when preventive maintenance has to be carried out. It is available for single beams and 2 half beams. The complete change of a drawn-in set

can be carried out by one person on single width machines in 15 - 20 minutes, on double width machines with one or two persons in 30 minutes.

Foil 32, System for Quick Style Change
Foil 33, PWM with drawn-in Warp

7.5 Investments for production of Fabrics

7.5.1 Machine Requirements

Assuming a customer wants to produce a certain type of fabric, he has to work out his machine requirements. As denim is a fabric still much in favour of the consumer and a growth rate of 5 - 6 % is expected I would like to bring the following machinery requirement figures for the production of 23 million meter fabric per year to your attention:

100 Projectile Weaving Machines
190 Rapier Weaving Machines
130 Air-jet Weaving Machines

Foil 34, Target of Customer

7.5.2 Energy Consumption

If we compare the energy consumption for the production we achieve the following result. The energy consumption per year would cover the demands of:

700 Families with Projectile Weaving Machines
1400 Families with Rapier Weaving Machines
2000 Families with Air-jet Weaving Machines

Foil 35, Power Consumption

7.5.3 Waste Caused in Processing (Weaving)

A further important factor is process waste. The comparison shows the following results. Compared with the rapier weaving machine with the same amount of yarn it would be possible to produce on the projectile weaving machine 647'000 pairs of jeans more and compared with the air-jet 270'00 more pairs of jeans.

Foil 36, Waste / Year

7.5.4 Cost Comparison Difference / Year

The advantages of the projectile weaving machine shows following yearly cost differences in regard to power consumption and waste:

Projectile Weaving Machine	0,9 Million CHF
Rapier Weaving Machine	2,3 Million CHF
Air-jet Weaving Machine	2,4 Million CHF

Foil 37, Difference in Cost

7.5.5 Waste Reduction

Waste through selvedge trimming-off amounts to 7 - 14 cm on rapier weaving machines. Costs savings can be achieved by reducing waste. This is even more important if expensive worsted yarn is processed. The waste saver now installed on Sulzer Rüti rapier weaving machines reduces waste to 4 cm. The diagram 38 shows how much could be saved by reducing waste. (Example cost 15 CHF/Kg. Drop from CHF 9000.-/ year for 12 cm waste to CHF 3000.-/ year for 4 cm waste)

Foil 38

8 Development Potential

Foil 39, Development of Weft Insertion Rate

As I have already mentioned the conventional one phase weaving systems have reached their limits, multiphase systems show a potential for tremendous improvements. In multiphase weaving we have to differentiate between.

- Multi wave shed and
- Multi linear shed

Foil 39, Schematic Structure of Weaving Technologies

8.1 Multi Wave Shed

For the multi wave shed the weft carrier contains yarn for the width of the fabric. When the yarn has been placed into the shed the weavings sheds are closing and the beat-up of the weft takes place at different times over the weaving width.

8.2 Multi Linear Shed

With the multi linear shed the yarn is pulled-off from normal spools. Every basic weaving principle can be used for the weft insertion, projectile, rapier or air-jet. Even when multiple sheds are formed the weft is inserted over the whole width.

Foil 40, Cloth Structure

The problem with the multi wave she is the repair of broken weft.
Contis already reached 3000m weft insertion.

Multi linear shed development by Ripamonti and Gentilini in 1955.

Foil 41

- Moveable weft package
- Discontinuous weft insertion with rapier heads

Development phase 1

- Weft insertion mechanically
- Shed formation rotative

Foil 42, Multi Linear Shed Weaving

Phase 2

- Weft insertion pneumatically
- Shed formation translatory

Mc Ginley warp wave pioneer uses gripper shuttle for insertion or air-jet

Phase 3

Multi linear shed weaving machine:

- Stationary weft package
- Continuous weft supply without weft feeder
- Individual shed formation and beat-up comb

A very important point in variable costs is power consumption. Single phase air-jets require already again a major amount to produce a square meter of fabric.

Power consumption has not only to be looked at as an economical factor but also from the ecological point of view.

Foil 43, Energy Consumption

8.3 Range of Application

There is for the multi linear shed weaving system a very big development potential. This weaving system will mainly be used to produce plain weave fabrics. Future will require mixed types of weaving machines in a mill. The third development phase of the multi linear shed weaving is characterised by a rotating shed and continuous weft insertion with low air pressure and has many positive aspects.

9 Multi linear shed Weaving

- It is expected to boost weft insertion 2 or even 3 fold
- Its ecological benefits will possibly be significant
- Potential for increased automation can be expected

Foil 44 Multi linear shed formation

9.1 Modular Weaving Machine Architecture

As with any revolutionary tecnology I expect any new weaving system to have basically new architecture and system. This could be possible by; state of the art electronics an mechatronics, a new control generation. The single motoric revolutionary weaving method allows to increase the weft insertion rate tremendously. The system is controlled by blockdiagram.

- Synthetic conduct wave
- Electronic transmission
- Electronic couplings
- Electronic programmable transmission
- Servo amplifiers
- Highly dynamic servo motors

Any multi linear shed weaving could be:

Foil 45 translatory, rotary shed Dec 42

- Translatory or
- Rotating

The system consists of a:

- Weaving rotor
- Stationary weft supply
- Warp positioners
- Beat-up reed

9.2 How does the system work ?

Foil 46

9.2.1 Shed forming

Through multiple warp positioners the warp ends forming the same shed are placed onto a continuously moving weaving rotor. By doing this, weaving sheds are continuously formed over the whole weaving width. They are moved continuously towards the beat-up point and are reduced by the shed closure.The cloth support prevents the escape of the cloth. Between build-up and closing phases the weaving sheds are ready for multiple simultaneously occurring weft insertions from stationary weft packages with low air pressure.

The weft is transported in the airchannel through relay nozzles similar to known air-jet weaving systems. The arrival of the weft at the receiving side is monitored by an electronic weft detector. There are always a multiple number of weft threads simultaneously staggered in operation. Threads are clamped and cut by rotating weft scissors.

The multi linear shed weaving system realises a continuously movement as it would never be possible with a one phase weaving machine. This is however a necessary condition for a weaving machine with very low energy consumption.

The beat-up is activated by beat-up combs which are similar to conventional reeds.

9.3 What are the advantages?

foil 47a view of machine

Warp module:

- Warp supports including warp beams 1000 - 1600 mm diameter
- Back rest
- Warp stop motion
- Shed forming modules including selvedge leno end spools.

This is ideal for quick style change. It allows an extreme fast warp change. The prepared warp module is joined with the weaving module. The change takes 15-20 minutes. An automatic fast pull through system is integrated.

Weaving module:

- Side frame with integrated electronic and pneumatic components
- Warp let-off
- Weaving rotor
- Cloth take-up (big batch)

Weft insertion rates above 5000 meters/min at 20 meters/sec (very gentle insertion). Air-jet 70 m/sec.

Drive concept:

- Single motoric electronic drive
- Independent in allocations of drives
- All movements can be programmed with soft ware
- Intentions of automation are possible without modification

Service:

foil 47b - 47f

- Graphic terminal with touch screen
- Memory card
- Connection to control system
- Bi-directional communication
- Reduced space requierment (up to 40 %)
- Reduced power consumption (up to 50%)
- Reduced noise emmission (10 dBa, only possible on normal weaving systems with complete encapsulation)
- Higher weft insertion rates from 5000 - 10000 m/min
- Reduced weaving costs (30 - 40 %)

9.4 Air conditioning

Different weaving systems are in use in weaving mills since years such as:

- Conventional weave room air-conditioning
- Mixed air-conditioning with condifil
- Direct air conditioning and integrated dust absorption

Foil 48 air-conditioning systems.

The multi linear shed weaving system does cater already for a real machine climatisation with dust absorption in the floor. Only warp yarn is conditioned. Waste disposal ends are pulled off, cut and removed by an automatic central vacuum cleaning system. Dust pollution is minimised. No cleaning of the machine is needed.

9.5 Weaving machine environment

Foil 49 Environment preparation-finishing

The weaving machine fits into the existing weaving machine environment without any changes to be made.

Summary

- For high productive weaving machines, yarn preparation is of major importance. Equipment to achieve this is available.
- New sizing technologies offer new chances for ecological benefits.
- Automation in creel changing in sizing will be beneficial not only for dyed yarn, but also for grey yarn as waste of dyestuff, size and yarn can be tremendously reduced.
- Weaving machines with very good versatility and flexibility with low power consumption, low waste and high productivity guarantee economical and ecological benefits.
- Only future will show how multi linear shed weaving can gain ground as a future weaving system.

Annex IX

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

INTERNATIONAL TEXTILE AND APPAREL CONFERENCE

C I T C '9 5

RIO DE JANEIRO, 18-21 JULY 1995

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NEW DEVELOPMENTS IN WEAVING PREPARATION

by

Kurt Georg NICK (Germany)

New Developments in Weaving Preparation

1 Introduction

Weaving technic covers such a wide range of products that I would like to limit the presentation to:

- Cotton and cotton blends
- Synthetic mulitfilaments
- Polypropylene tapes
- Monofilaments

(Foil 1)

Despite the fact that for garment manufacturers, silk is still the in-fibre. Also glass fibres are in increasing demand for printed circuits and for other technical applications for reinforcements etc. Swiss trains will most likely be made in future with fibre glass.

The increasing speeds in production in spinning, warp preparation and weaving attire the interest of the producers of fabrics. What can we expect at the next exhibition?

But we must also be aware that the quality standards increase steadily and the consumer demands do not cease if we have reached the once set goals.

Besides this costs of production are important too. How can we achieve:

- High productivity
- High quality with increased machine speeds

(Foil 2)

Is it right to look and push permanently for higher production speeds or have we already reached now the limits? What can we do to prepare the grounds for efficient working in relation to the fibres to be used on warping, sizing and weaving?

2 Influence of raw material

Last years problems in cotton growing areas in Pakistan put many spinners and weavers in to problems. Shortage of cotton and higher prices forced many mills to close.

The manufacturer of fabrics on high speed weaving machines need a regular spun yarn, eveness and good tensile strength. Before the yarn is even taken to the warping, laboratory test will show whether the short fibre content has increased. By shortening the spinning process and skipping one draw-frame passage, we certainly can

compensate on costs but loose on quality. The breakage rate will increase in warping and the quality of warper and weaver beams will suffer.

(Foil 3, Standard Yarn Breaks)

It is our task to produce good beams for ideal weaving production.

3 Warping

3.1 Direct warping (cotton and cotton blends, spun viscose)

New direct warpers are available with 800, 1000, 1250 and 1400 mm flange diamter. Important is that the warping speed once set, remains constant within certain limits.

(Foil 4, Hacoba)

The drives have short acceleration and stop time. Warping speeds are kept constant by the use of advanced technology e.g. frequency controlled AC motors and CNC and SPC control systems.

(Foil 5, Control Panel)

Why is quick stopping reaction of advantage in warping? Lost ends are not only in weaving production killers, they can already lead in dye-sizing operations, such as continuous indigo dyeing sizing operations to lapppers in dye or washboxes and consequently to tailing in the dyed warps. This can be avoided by quick reacting stop motions with integrated tensioner blow-off in parallel or V-creels in combination with quick stop of the warp beam.

(Foil 6, Parallel and V-Creel)
(Foil 7, Stop Motion)
(Foil 8, Stop Motion and Integrated Blow-Off)
(Foil 9, Principle Operation)

Precise length measuring is a must too. Unnecessary waste through uneven length can be avoided.

(Foil 10, Length measuring)
(Foil 10+11, End Uncrossing Device)

Besides overtensioned ends, crossed ends, lost ends also thread waste and warped-in loose fly influence the performance tremendously of high performance weaving machines. Central suction devices installed at the warper reduce loose fly and dust to achieve better performance in weaving.

(Foil 12, Suction Unit)
(Foil 13, Dust Content)
(Foil 14, Ben-Vac)

Further attention must be given to proper wind-up of the ends at the flanges to avoid build-up of yarn layers at the flanges. This would lead to slack ends and broken or taped ends in sizing and uneven yarn wind up at the beaming process.

3.2 Direct Beaming (Continuos Filaments)

In many cases when bulk production is required, the multifilaments to be used are sensitive they can be warped on single beams. During warping the ends are checked by optical sensors for broken filaments and the machine stopped, the fault removed, the yarn joined by a knot or splicing. The beams can be sized individually and assembled to required number of ends. In some cases it is possible to size direct from a creel (Single End Sizing) and wind the yarn direct onto a warper beam which will be assembled to the required number of ends in a separate operation at speeds over 400 m/min.

(Foil 15, Single End Sizing)
(Foil 16, Assembling)

The method of assembling can also be used for technical textiles used in road construction.

3.3 Sectional Warping

For short orders, coloured warps with stripes, sectional warping is quite common for cotton, cotton/polyester blends, synthetics such as aramides for bullet proof vests, reinforcements, textured and smooth filaments or monofilaments for bolting cloth, filter fabrics, silk and glass fibres.

(Foil 17, Sectional Warping Machine)

3.3.1Warping Principle

In order to have proper reading of the feeler roller from the first layer of yarn wound onto the warping drum, the pin strip in the drum allows the fixing of the yarn sheet at start up. After this the measuring process starts automatically. It calculates the traverse value as the yarn sheet lays flat in full width. The sunken pin strip allows immediate contact of the feeler roller with the yarn sheet and prefect warps can be obtained by direct action on the warp sections as the ends are being wound onto the warping drum. Precise measurement of the traverse is not only purpose of the feeler roller, it also exerts pressure immediately to keep the yarn build-up on the first section and subsequent sections lower than with free run-on thereby reliably eliminating differences in the build-up.

(Foil 18, Feeler Roller Position)
(Foil 19, Pressure Ratios of Warping Sections)

3.4 Beaming

The beaming speed remains constant irrespect of winding diameter. But beaming speed and winding tension can be adjusted at any time.

3.4.1Beaming Tension

The entered winding tension indicated on the display is kept constant by the CNC control irrespect of winding diameter. The CNC controls braking operation and supplies the braking cylinders with the appropriate amount of air pressure. As the diameter of the wound on yarn of the warping drum decreases, the pneumatic pressure applied is adjusted so that the winding tension remains constant throughout the beaming process.

3.4.2Warp Yarn Guidance

The examples on foil 20 - 22 show the possibilities of yarn guidance. The yarn running distance is kept short to a minimum. The risk of yarn displacement can be reduced by the use of grooved deflecting rollers.

(Foil 20, Warp Guidance straight from the Warping Drum to the Loom Beam)
(Foil 21. Warp Guidance with a Deflection Roller and Press Roller Device)
(Foil 22, Warp Guidance with 2 Deflection Rollers, Waxing Unit and a Press Roller Device)

3.5 Cold Size Application instead of Waxing of Yarn

The new cold sizing process has proven that the technology can be applied for various yarn materials such as:

- Polyester / Viscose Nm 18/1, 34/1
- Viscose Nm 50/1
- Acrylic Nm 28/1
- Linen blends Nm 34/1
- Worsted Siro spun 27/1
- Worsted Viscose / Wool Nm 90/2
- Woollen Nm 18/1
- Cottor. Nm 12/1, 68/1 (for terrytowels Nm 28/1, 50/1)
- Synthetics

All demands are fully met:

- Yarn protective sizing
- Surface Coating
- Energy saving
- Less pollution as well as flexibility and cost saving

3.5.1How does it work?

The warp sheet touches the 2 application rollers with a defined wrapping angle. Thus the size is transferred from the application rollers to both sides of the warp sheet. The thickness of the size film is infinitely controlled be the pressure of the rollers.

Each application set has a single motor drive, its speed is automatically adapted to the warping speed.

Furthermore, the differential speed between warp sheet and application rollers is infinitely controllable. Therefore size pick-up and smoothening of warps is achieved. These functions guarantee a constant size pick-up.

(Foil 23, Sizing during the Beaming Process of the Warps on a Sectional Warper)

3.6 Direct Warping of PP-Tapes

3.6.1Creels

Modern creels today are either equipped with a fast working stop motion for single or double end draw-off from the supply package direct after the take-off from the spool holder or with a photocell after the yarn leaves the creel. As fibrilated tapes tend to cause dust and short fibres when drawn off the package, the stop motion must be designed to work properly when this occurs. As the warping speeds vary between 160 -200 meters/min at present, it is very important that the warper stops in case a warp end breaks before the end is wound onto the beam and covered by the neighbouring ends.

(Foil 24, Creel)
(Foil 25, Stop Motion)

A lost end causes unnecessary work for the weaver and sometimes interrupts his machine and quality control cycle to long to trace these lost ends. It is today possible to produce fault free beams as known from the Synthetic Industry.

3.6.2Headstock

Most warping machine suppliers are able to deliver a headstock suited to wind beams 800 - 1016 mm flange diameter. In special cases they can wind up to 1600 mm flange diameter.

(Foil 26, Warper with creel)
(Foil 27, Headstock 1600 mm)

4 Sizing

(Foil 28, Sizing Machine Logo-Comsize)
(Foil 29, Hairiness)

In order to reduce hairiness, especially when warps are sized for air-jets, 2 size boxes and real wet-split should be applied. Size pick-up at normal speed and creeping speed should be the same.

When 2 size boxes are used it is further important that the size pick-up of both size boxes is the same. In order to achieve this, new sizing measuring and controlsystems have been developed. The sizing machine manufacturer state that the "blind" working with constant squeeze pressure is "past".

4.1 Telecoll Sizing Control System

The Telecoll sizing control system of Sucker-Müller saves costs and ascertains a high quality of sizing. Through a microwave measuring head the water absorption of the yarn is permanently measured behind the squeeze rollers. The expert software immediately converts the measured variables into absolute values. From the first meter the operator is informed in regard to size pick-up of the warp yarn. It is displayed in B % = size percent relative to the thread weight. This has tremendous advantages as there is no waiting for laboratory tests.

The measured values of the microwave unit depends on type of fibre, count and thread density. All the expert know how is stored in the software. The advantages of the system are:

- Low start-up costs with new qualities
- No wrong size pick-up with same yarn count from different suppliers or different fibres or cotton growing areas
- Constant size pick-up in creeping speed and normal sizing speed

(Foil 30, Optimum Size Pick-up)
(Foil 31, Size Pick-up Monitoring)

- No oversizing of yarn needed
- No problems when new squeeze rollers are installed
- No undersizing of warps when the machine is started up after a longer stop over a weekend
- Responds to alterations of viscosity

Manual sizing control systems are replaced by modular control systems and data transfer is made very fast by the link of PC and PLC so that production data and diagrams are displayed immediately.

(Foil 31, PLC, and Bus System)
(Foil 32, Software)

4.2 Loom Beam Diameter

The headstock can be laid out to wind loom beam flanges of 800 or 1016 mm or 1250 up to 1600 mm diameter.

(Foil, WS16)

Depending on the warps to be sized a sizing machine with 1 size box

(Foil 33, Single Size Box)
(Foil 34, Individual Drive)

or with 2 size boxes with group drive or individual drive are possible.

(Foil 35, Group Drive)

4.3 Afterwaxing

It improves in general the performance in weaving.

4.4 Overdrying of Warps

This should be avoided in any case. New sizing machines are equipped with:

- Temperature regulation
- Residual moisture regulation
- Drive control, uniform stretching
- Regulation of winding tension

(Foil 36, Tension and Stretch Control)
(Foil 37, Real Wet Split)
(Foil 38, Dry Split Zone)

4.5 Chimgel Sizing

(Foil 39, Functional Diagram)

Similar to mentioned possibilities to apply size in rebeaming of short runs with the tangential size application, it is also possible to equip a sizing machine with 1 or 2 sizing system and with a cylinder dryer or pre-dryer.

(Foil 40, Cylinder Dyer)
(Foil 41, Pre-dryer Chimgel)
(Foil 42, Double Unit)

You may ask which are the advantages of cold size application? Very difficult fabrics such as pin stripes where white, black and blue colours are used in warp, one of the main problems is colour bleeding or fibre migration from dark colours into white fabric. With tangential size application with:

- No squeezing of threads, no problems in wet-splitting occur (less hairiness) as the yarn splits very easy
- Surface coating of the yarn, the size penetrates only into the outer section of the yarn, there is no dusting-off
- Lower size pick-up (35 - 50 % less than with normal sizing)

With Chimgel-sizing significantly concentrated size products are being used. The absorption of size required is reduced to only 32,5 % and thus the water evaporation is reduced to only 20 % of the weight of the warp. (Residual moisture based on 6%)

The drying process is therefore reduced by 80% compared to the conventional sizing process.

(Foil 43, Comparison Conventional Sizing / Chimgel Nm12/1)
(Foil 44, Comparison Conventional Ground Warp)

In Germany one of the leading terry weavers has installed the Chimgel-sizing application into conventional sizing machines replacing the size boxes. Grey as well as coloured terry warps, ground and pile warps, are sized.

4.5.1Finishing

The big advantage in finishing is the fact that during desizing of such fabrics only 50% or less size has to be removed. The process is easy as the size is located only on the outer surface of the yarn. This fact features:

- Fast desizing
- Easy washing
- Less water consumption
- Less waste water pollution

5 Indigo Dyeing

The growth in Denim consumption is estimated to increase 5 - 6 % per year. This would mean that under these conditions the annual demand could reach nearly 3000 million meters in year 2000 compared to approx. 1600 million meters in 1992.

(Foil 45, Future Demands Projection 1992 - 2000)
(Foil 46, Possible Production World Finished Denim)

Present used indigo dyeing methods:
1.) Rope dyeing

(Foil 47)

2.) Slasher or sheet dyeing
3.) Double sheet dyeing
4.) Loop dye 1 for 6 (continuous dyeslashing)
5.) Loop dye 1 for 6 (continuous mercerisation dyeing and sizing)
6.) Loop dye with warp drying and wind up on beams with 2800 mm flange diameter

(Foil 48)

6 Possibilities of Automation in Dyeing and Sizing

Similar to the quick style change in weaving, efforts have been made in continuous dyeing and sizing to improve quality of dyeing and reduce downtime in creel change and save yarn and dyestuff through automatic changing of the creel.

The system can be used for:

- Fully automatic thread - thread connection in line

(Foil 49)

- Fully automatic thread - thread connection with two back beam creels

- Connection line fully automatic thread - fabric - thread
- Automatic thread - thread connecting line for double sheet dyeing
- Automatic yarn take-up connecting line for two yarn sheets

(Foil 50)

6.1 Working principle of Automatic Yarn Take-up Connecting Line

A compensator is placed in front of the take-up winders. They wind beams up to 2800 mm diameter. When the connecting seal tape arrives at the winding station, it is controlled by a sensor which stops the take-up winding and fixes the yarn sheet to an existing sheet, fixed to a core above the sealing unit.

6.2 Advantages of the System in Continuous Dyeing / Sizing

The operation speed is the same from start to finish and change of a dye set. The continuous speed also during the creel change allows an exact control of the chemicals for the mercerising and dyeing process. The result is an even colour take-up within a set, no tailing and therefore same colour on different dye lots. The warp compensator which is used for the continuous creel change, can be used to solve other production problems. Rings on back beams can be removed by the operator without changing the dying speed. The possibility to stop the back beams increases the safety of the operator without loss in dyeing quality.

- When broken ends occur more frequently in the dry split zone, new separation strings can be inserted and an improvement in the dry split zone can be achieved. Therefore good beam quality can be assured within a short time. This is beneficial for weaving and finishing of fabrics. Warps have been produced on these lines with an efficiency of 98 %.
- If a new comb tape has to be passed through the dye and size bath, this can be done with closed squeeze rollers. Therefore no damage on drying cylinders nor rubber covered squeezing rollers will occur.
- In case the line has to be cleaned, waste yarn can be used at the end of a set and left in the dyeing/sizing range.

6.3 Cost Savings through Automatic Creel Change

Savings on costs just taking the raw material gains, showed that the return on investment is 2,7 years. The calculation which takes also the dyeing costs into consideration shows that the return on investment can drop to 1,3 years. Users claim that ROI is 7 to 12 months.

More details you will find attached to your submitted papers.

1 Possibilities of Automation in Dyeing and Sizing

In the following chapters you can see the possibilities for improving quality of dyeing and increasing production in continuous yarn sheet dyeing, dyeing and sizing through automation of different process steps.

1.1 Fully automatic Thread -Thread Connecting in Line

Figure 1

The aim to dye a yarn sheet continuously without machine stop when a creel of back beams runs empty can be achieved with this method. The non-stop Production can be achieved as following:

Whilst the first set of 10 -14 back beams is still in operation, the next following set is prepared in a reserve creel. When all the back beams are loaded, aligned and secured, the 2 yarn sheets of the back beams are secured with a tape or clamp and passed via deviation cylinders to the sewing stations, where 2 sewing machines are allocated separately, for each sheet one. They are guided further to the top and bottom connecting unit and top and bottom clamping device and finally to the special pull-off device / squeezing conveyor. The tapes are clamped and the sealing unit can be started.

The sealed tapes pull both sheets forward to the connecting unit.

The separating strings for the dry split zone are inserted already at the start-up of the set to avoid unnecessary waste of warp yarn. When they are close to the sewing machines, distance approximately 3 meters, the sewing machines are ready to make the comb. How can we make a flexible comb into a yarn sheet?

The yarn sheet (6,8 or more layers of yarn) are sewn onto a 30 mm wide woven polyester ribbon. The distance of a stitch is 3,5 mm which corresponds more or less with the distance of the dents of the expansion comb at the Head stock of the Sizing machine. After the ends of the 2 warp sheets have been sewn onto the ribbons or tapes, the ribbon is approximately 200 mm pulled forward and checked for cut ends. Cut ends are repaired. It is very important, that the warp ends do move within the sewn comb freely when they move through the dye - and size bath.

The separating strings which have been inserted already are secured and the yarn sheet pulled forward approx. 5 meters. The yarn sheet is secured by the top and bottom clamping device. A 70 - 80 mm wide special tape is placed behind the yarn sheet, prior to the clamping device, which will be used for heat sealing for the joining of the 2 separate yarn sheets.

The creel is now brought into working position.

When the last layers of the yarn sheet are visible on the back beams the connecting operation is started by the responsible person by pushing the button for the connecting operation. The compensator is activated, the back beams stopped. The yarn

sheet runs through the dye bath with the same speed. The main clamp secures and fixes the yarn sheet. At the same time the connecting units move together, seal the yarn sheet by heat sealing. As soon as this is completed, the yarn sheet of the outrunning set is cut automatically. The clamping devices open as soon as the pre-set time is reached. (approximately 1,5 minutes)

The ends of the new set are pulled through the dye bath by the ends of the previously running set.

As soon as the connecting sealing tape arrives at the dry split zone, the dry split rods are removed. When the connecting sealing tape has passed the draw - roller the comb tapes are moved forward to the draw-roller till they are in the position of the expansion comb. The yarn sheet is straightened and combed with an auxiliary fix comb. The expansion comb is now pneumatically inserted into the yarn sheet, still controlled in width by the fix comb and comb tapes. The ends are ideally evenly distributed over the whole width of the loom beam.

The separating strings are now inserted. To make it easier for the operator, special designed end pieces are used at the split rods to allow quick insertion of the rods into the yarn sheet. Depending on the allocation of the compensators, dyeing as well as sizing will continue during the change of split rods and weavers beam for the next set. If there is only one compensator installed between dyeing and sizing units, which is normally sufficient, the whole procedure for a set change will take 3 - 3,5 minutes. The compensator should therefor be layed out to take 120 to 150 meters length of yarn.

Waste of yarn can be reduced to a minimum of 2 x 7,5 meters. The system will also allow to remove rings from back beams without interrupting the dyeing process.

1.2 Fully Automatic Thread - Thread Connecting with 2 Back Beam Creels

Figure 2

Depending on the availability of space, the creels can also be placed side by side and the beam change takes place in a similar manor as mentioned before. Time for Creel change 2,5 - 3 minutes.

1.3 Connecting Line Fully Atomatic Thread - Fabric - Thread

Figure 3

When the dyeing shade or colour is changed very often and specially when short runs are necessary, it is possible to reduce the yarn wastage to a minimum by introducing the Thread - Fabric - Thread connecting. Wastage of yarn will be reduced to a minimum of approximately 20 meters. It will also allow to recover more dyestuff as with conventional systems. When a set is finished the yarn sheets will be joined with a fabric automatically, so that no colour variations will occur through stopping of a set to tie a sheet or ropes at the end of a set to the yarn sheet or to leave the necessary yarn length in the dyeing range.

1.4 Automatic Thread - Thread Connecting Line for Double Sheet Dyeing

Same possibilities are given as with Loop - dyeing, sizing or Sheet -dyeing -sizing to change the creels automatically.

1.5 Automatic Yarn Take-up Connecting Line for 2 Yarn Sheets

Figure 4

A compensator is placed in front of the take - up winders. They wind beams up to 2800 mm diameter. When the connecting seal tape arrives at the winding station it is controlled by a sensor who stops the take - up winding and fixes the yarn sheet to an existing sheet fixed to a core above the sealing unit.

1.6 Advantages of the System in Continuous Dyeing / Sizing

The operating speed is the same from start to finish and change of a dye set. The continuous speed also during the creel change allows an exact control of the chemicals for the mercerizing and dyeing process. The result is an even colour take-up within a set, no tailing and same colour on different dye lots.

The warp compensator which is used for the continuous creel change, can be used also to solve other production problems. Rings on back beams can be removed by the operator without changing the dying speed. The possibility to stop the back beams increases the safety of the operator without loss in dyeing quality.

- When broken ends occur more frequently in the dry split zone, new separation strings can be inserted and an improvement in the dry split zone can be achieved. Therefore good beam quality can be assured within short time. This is beneficial for weaving and finishing of fabrics. Warps have been produced on these lines with an efficiency of 98 %.
- If a new comb tape has to be passed through the dye and size bath, this can be done with closed squeeze rollers. Therefore no damage on drying cylinders nor rubber covered squeezing rollers will occur.
- In case the line has to be cleaned, waste yarn can be used at the end of a set and left in the dyeing/sizing range

1.7 Cost Savings through Automatic Creel Change

Savings on costs just taking the raw material gains showed that the return on investment is 2,7 years. Calculations which take also the dyeing costs into consideration show that the return on investment can drop to 1,3 Years.

Comparision of Process Engineering

Conventional Sizing and Chimgel-Sizing

Warpmaterial: Nm 12/1 Cotton OE, 7908 Ends / 280cm Warp Width
Set length: 20'000 m

Sizing Technic		Conventional Sizing	Chimgel-Sizing
No.of Drying Cylinders		12	6
Size Concentration	(%)	9,5	20
Size Pick-up	(%)	11	6
Size Liquid Absorption	(%)	116	27,3
Water Absorption	(%)	105	21,3
Water Absorption	(g/lm)	692	140
Steam Consumption	(kg/set)	20'758	4'210
Theoretical Production Speed	(m/min)	41,5	103
Theoretical Production Time	(h)	8	3,2
No. of Size Cookings / Set		22	5
Water Consumption / Set	(l)	11'000	1'600

Source: Chimitex 15.02.95 HB/ut

Comparision of Process Engineering

Warpmaterial		Pilewarp Nm 28/1 Cotton OE		Groundwarp Nm 19/1 Cotton OE	
Sizing technic		Conventional Sizing	Cimgel-Sizing	Conventional Sizing	Cimgel-Sizing
No. of Drying cylinders		9	1	9	2
Heat Recovery		yes	no	yes	no
Size Concentration	(%)	0,6	15	3,6	20
Size Pick-up	(%)	0,6	0,6	6	6
Size Liquid Absorption	(%)	100	4	167	30
Water Absorption	(%)	99,4	3,4	159	24
Water Absorption	(g/lm)	81,8	2,8	203,5	30,7
Steam	(kg/set)	2'994	100	3'967	598
Theortical Production Speed	(m/min)	181,5	492,8	73,15	89,9
Theortical Production Time / Set	(h)	2,2	0,8	2,96	2,41
No. Size Cooking / Set		4,48	0,17	5,67	1,08
Water Consumption / Set	(l)	1'963,15	67,15	2'679,04	399,36

Source: Chimitex 26.01.95 HB

Figure 1

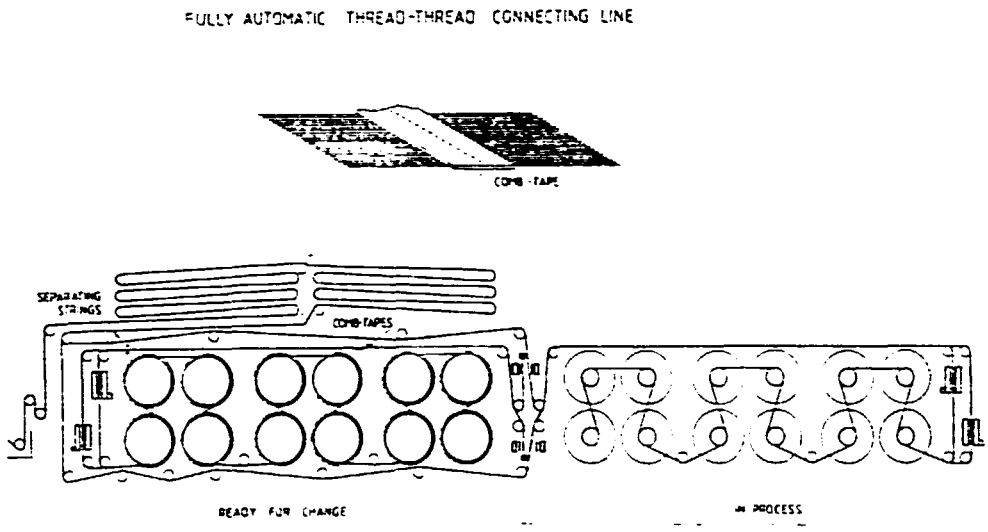

Figure 2

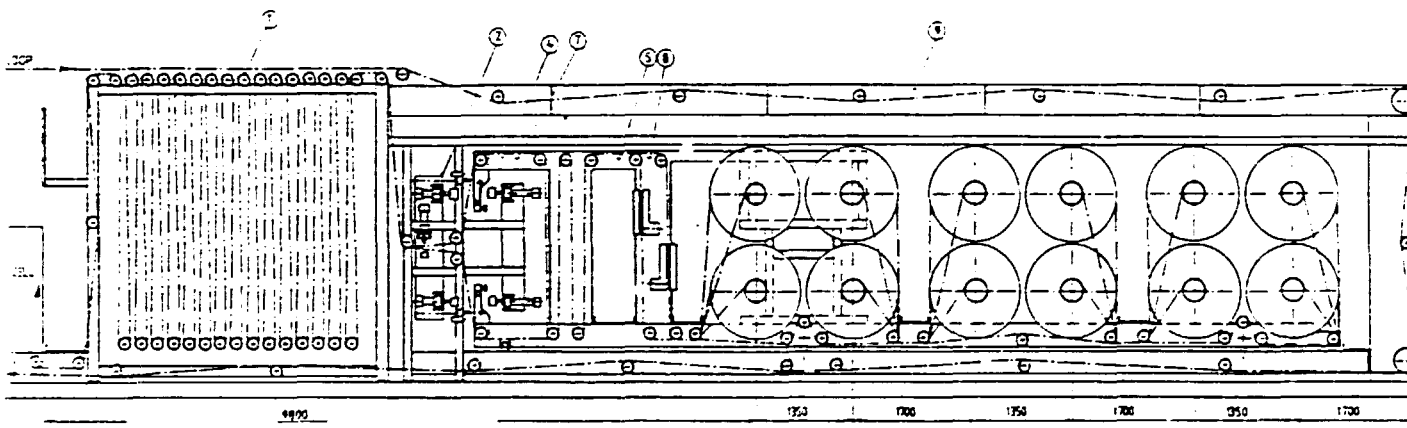

Figure 3