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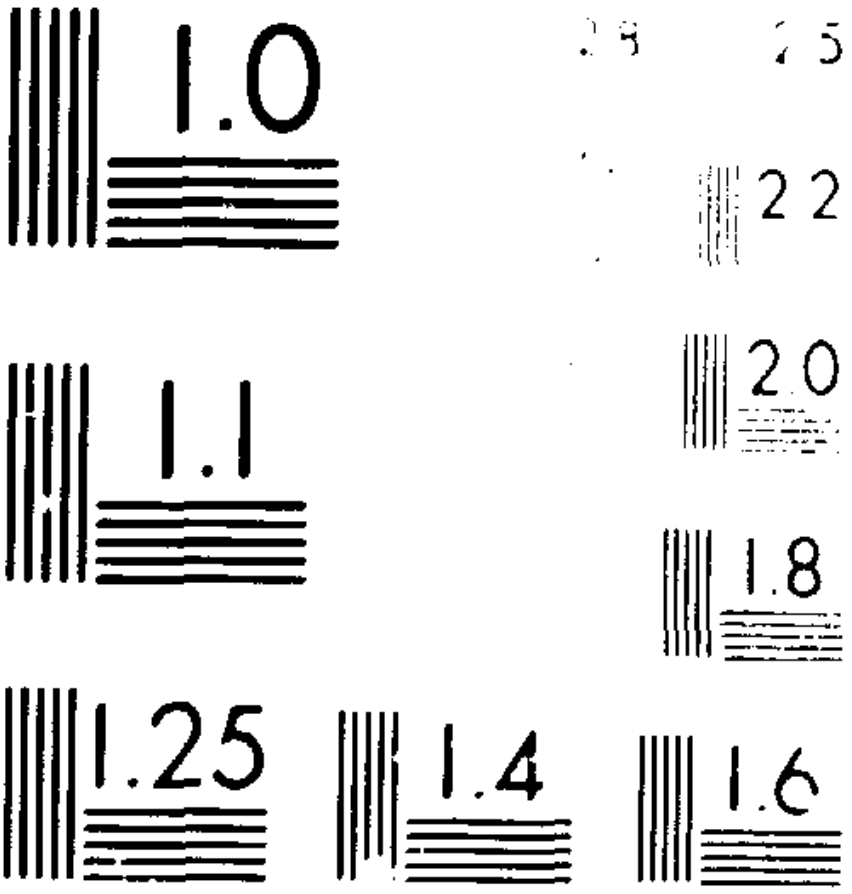
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ASSISTANCE TO THE COTTON TEXTILE INDUSTRY IN BANGLADESH - STAFF TRAINING - FINAL REPORT.

00319

Ten Cate **Consultants**

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ASSISTANCE TO THE COTTON TEXTILE INDUSTRY IN BANGLADESH
- STAFF TRAINING -
FINAL REPORT.

00219

July, 1982

Contract No. 79/120

Project No. DP/BGD/73/049

Activity Code 10.22.31.5

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INTRODUCTION

Responding to a request of the Bangladesh Textile Mills Corporation (BTMC), made in 1976, the UNIDO decided to sponsor a survey of the national textile industry in Bangladesh. In 1977, the International Consulting Division of the Royal Textile Mills Nijverdal-Ten Cate N.V. of Almelo, now operating under the name Ten Cate Consultants, was commissioned to carry out this survey. During May, 1977 a mission visited Bangladesh and subsequently a report [1] was prepared.

One of the items of the Terms of Reference of the above mentioned mission was: "to make suggestions for the placement of Bangladesh technicians for training abroad". In the report it was recommended that a group of technicians of the BTMC should receive an overseas training course. In 1979, Ten Cate was requested by the UNIDO/UNDP to design a suitable course. Ten Cate approached the Polytechnical College "De Maere" in Enschede to take care of the theorectical part of the course. Initially it was agreed that 36 officers of the BTMC would be trained in four successive courses, each counting 9 trainees. However, it soon became apparent that, due to the Summer holidays, it would be difficult to organize four successive courses. After due consultations it was decided to set up two courses of 18 trainees each.

While the first group of 18 technicians was being composed, it became apparent that, within the framework of the existing fellowships' programme of the Netherlands, the Ministry of Foreign Affairs of the Netherlands was willing to take the travelling and living expenses for its account.

It was the intention to run two courses totalling 36 trainees. However, for a variety of reasons only 24 participated. For this reason it was decided to extend the programme with a third group. The third group finished its course at the end of April, 1982. This report should be seen as an evaluation of the training programme as requested by the contract (section 2.05).

1) Assistance to the Cotton Textile Industry in Bangladesh - ICD, November 1977.

1. SUMMARY OF CONCLUSIONS

1.1. The Post Graduate Course for Textile Technology and Management, as organized by Ten Cate Consultants in close collaboration with the Polytechnical College "De Maere" at Enschede, is providing an unique experience for overseas students in combining lectures and practical exercises under mill conditions.

1.2. The thirty-four fellows from Bangladesh, who have participated in this course in three groups, on the whole have been able to benefit from this experience.

1.3. The lack of working knowledge of the English language of the majority of the fellows caused difficulties for both parties. The incorporation of a two-week language course at the Language Laboratory in Enschede for the last group has proved benificial.

1.4. With very few exceptions almost all fellows had to be persuaded to carry out manipulations on the machinery during practical exercises. An attitude of keeping one's hands clean, also described as a "white collar" attitude persisted.

1.5. The advisers of the UNDP Textile Industry Development Programme in Bangladesh reported that the first group of fellows were unable to formulate a proposal for the training of their subordinates in the various mills.

2. DEVELOPMENT OF THE COURSE

2.1. Scope

On 18th October, 1979 the contract 79/120 for the Assistance to the Cotton Textile Industry in Bangladesh - Staff Training and Tuition - was signed by the United Nations Industrial Development Organization in Vienna and the Royal Textile Mills Nijverdal-Ten Cate N.V. in Almelo, the Netherlands. The Contract commanded, amongst others:

a. To set up and organize a theoretical and practical training course of Textile Technology and Management.

b. The course to be adapted to the level of experience and education of trainees selected from the staff of BTMC mills.

c. The subject matter and time table to be chosen in such a way that the fellows after completion of the course will be better equipped for both operational management and instruction.

d. To procure facilities for 36 trainees, preferably in four overlapping groups of 9 during six months each.

e. To start the first course in the Autumn of 1979.

As already mentioned briefly in the Introduction, Ten Cate requested the Polytechnical College "De Maere" in Enschede to participate in the programme. This co-operation was not new; already before, similar courses had been organized. In 1973, '74 and '75, "De Maere" and Ten Cate have held courses for groups of mill managers from Indonesia. As before, it was decided that "De Maere" would mainly look after the theoretical part of the course, while Ten Cate would provide the possibility for practical work by the participants of the course.

When working out the programme, the requirement to organize four successive courses proved to be difficult. During the holiday period it was not possible to provide a course. After discussions with the UNIDO it was decided to adapt the programme and to provide two courses, each lasting 20 weeks.

2.2. The Theoretical Part of the Course

2.2.1. General Remarks

The course was to be conducted in close collaboration with the Polytechnical College "De Maere" in Enschede. This college has departments for textile technology, textile marketing, process engineering, computer science and business administration. The college was to carry the responsibility for the theoretical tuition, whereas the Fellows would be able to gain practical experience in the mills, workshops and laboratories of Nijverdal-Ten Cate. Here they would also receive tuition in subjects such as plant maintenance and airconditioning.

The total duration of the course was planned to be 20 weeks. The tuition programme at "De Maere" would take 240 hours (20 weeks of 12 hours). These hours were to be spent on the following subjects:

- economics : 96 hours
- textile technology : 96 hours
- statistics : 24 hours
- case studies : 24 hours.

2.2.2. Economics

The following subjects were to be covered:

- cost accounting, standard costs and standard costing, variable costs and fixed costs, direct and indirect costs, break-even chart, direct costing;
- organization and management, management theories, factory organization, multi moment observation theories with practical exercise in the mills of Nijverdal-Ten Cate.

2.2.3. Textile Technology

The following subject were to be taught:

- spinning technology, spinfibres, cotton and man-made fibres, spinning properties, staple and staple diagram, micronaire and maturity, fibre strength (Pressley), machine settings, blends;
- modern spinning methods: open-end spinning, advantages and limits, trash problems and yarn properties;

- other new spinning methods: Repko, Dref, Twilo;
- process and quality control, philosophy, managerial measures, tools and testing;
- weaving, fabric structure, coverage, effect of direction of twist on fabric, fabric construction;
- bleaching, dyeing, printing and finishing, physics and chemistry, oxidation and reduction, surface tension, wetting and re-wetting, theory of the washing process;
- pre-treatment of cotton and polyester/cotton fabrics: desizing, boiling-off, bleaching and mercerizing;
- dyeing of cotton fabrics (direct, vat and reactive dyes) and polyester/cotton blends with disperse/vat and disperse/reactive dyestuffs;
- printing: cotton and cotton/polyester fabrics, rotary printing and transfer printing;
- practical research;
- textile testing, use of microscope, fibre testing, yarn properties, regain and relative humidity.

2.2.4. Statistics

The following subjects had to be dealt with:

- frequency, probability, distributions (normal, binomial and poisson), sampling, significance;
- textile application, sample space, venn-diagram, relative frequency, control charts, statistical tests.

2.3. Practical Work during the Course

2.3.1. General

In the original planning the theoretical part of the course was to take 12 hours, i.e. one-and-a-half day per week. The remaining hours of the week (approximately 28 hours per week) were to be spent in one of the mills of Ten Cate. The programme of the practical work should be suited to the requirements of the individual student.

In total approxiamtely 500 hours are available; in consultation with the fellows and in accordance with their individual interests, these hours

should be used for tuition and exercises in the following subjects:

- practical textile technology;
- organizational structure and managerial controls;
- time and motion study, efficiency and rate setting;
- production planning, production control, material control and mill administration;
- budgeting and budgetary control;
- preventive maintenance, spare parts, inventory and control;
- quality control, setting of standards and specifications, control of raw materials and in-process inspection, use of control charts, organization of quality control;
- utility services, power and water supply, steam and compressed air installations, air-conditioning, auxiliary services.

The fellows were to be attended by a mentor, who had to review the progress of their work regularly.

2.3.2. Exercises

The practical exercises were to be carried out in the various sections of the main departments of the mills, viz.:

a. Spinning department,
opening; carding; drawing; combing preparation; combing; pre-spinning; spinning; winding; and spinning laboratory;

b. Weaving department,
winding; warping; sizing; drawing-in; weaving (plain weaving, dobby weaving, jacquard weaving); grey cloth inspection;

c. Dyeing and Finishing department,
singeing; desizing; scouring; mercerizing; bleaching (rope & open width); jig dyeing; winch dyeing; beam dyeing; jet dyeing; continuous deying; yarn dyeing (cone & beam); sanforizing; finishing; calendering; scrubbing; raising; inspection and laboratory.

2.3.3. Additional Tuition

To supplement the theoretical course to be given at "De Maere" it was decided that Ten Cate would run a course on two specialized subjects, viz.:

a. Plant Maintenance, and

b. Air-conditioning for Textile Mills.

The curriculum for these two courses was to cover the following subjects:

a. Plant Maintenance,

functions of maintenance within the organization; failure behaviour; preventive maintenance; corrective maintenance; planned maintenance; running maintenance; break-down maintenance; maintenance costs; maintenance management; inspection; stores; workshop.

b. Air-conditioning for Textile Mills,

Mollier psychometric chart; dry bulb and wet bulb temperatures; enthalpy; dew point temperature; Dalton's Law; relative humidity; humidification in air washer; dew point control; humidification with super saturation; heat load; basic types of humidification plants.

2.4. Excursions

To allow the fellows to familiarize themselves with modern methods of textile manufacturing, some visits to manufacturers of auxiliary products and textile machinery were to be included.

2.5. Time Schedule

The whole course was designed to take 20 weeks; the following programme was envisaged:

Week 1 : - arrival in Almelo, introduction, arrangement of housing, etc.;
- visits to the mills of Nijverdal-Ten Cate;
- presentation of the programme and schedule, assessment of individual requirements of the fellows;
- introduction of the mentors.

Week 2-19 : Working programme, each week 12 hours of tuition at I.H.B.O. "De Maere", rest of the week tuition and practical exercises in the mills of Nijverdal-Ten Cate; during this period several visits to major European textile machinery manufacturers (in total approximately 2 weeks);

Week 20 : - summary and evaluation;
- closing ceremony and presentation of certificates.

2.6. Requirements for Admission

Although the course was to be adapted to the level of experience and education of the trainees to be selected, it was decided that certain minimum requirements would have to be met. These minimum requirements of admission to the course were formulated as follows:

- graduated from a textile engineering college,
- several years of practical experience,
- good working knowledge of the English language,
- age between 24 and 40 years,
- being in good health.

3. IMPLEMENTATION OF THE COURSES

3.1. General Remarks

The first course was planned to start on 3rd December, 1979. A group of 18 officers of the BTMC had been selected by the office of the UNDP in Dacca. Due to a number of unforeseen problems only 14 fellows arrived in the Netherlands, to attend the first course, which lasted until 28th April, 1980.

During the evaluation of the first training course it was suggested by Mr. A. Eräneva of the UNIDO, Vienna, to divide the remaining 22 candidates into two groups, each of 10 to 12 persons, and to organize two more courses instead of only one. This suggestion was accepted and a second group of 10 fellows participated in the second course, which was held from 1st December, 1980 till 2nd May, 1981. The third course started on 12th November, 1981 and lasted until 1st May, 1982. Again 10 fellows took part. The names of the fellows and their positions within the BTMC are mentioned in annex I.

3.2. Selection of the Fellows

The selection procedure was as follows: the BTMC would propose names of officers. These applications were first vetted by the UNDP officers in Dacca and officials of the Netherlands Embassy, using the criteria for admission, formulated by "De Maere" and Nijverdal-Ten Cate, as mentioned in section 2.6. of chapter 2.

The names and credentials of the proposed fellows were then sent to the Netherlands, where they were scrutinized by "De Maere" and Ten Cate.

When the first group arrived in the Netherlands, a few facts became obvious. The theoretical knowledge of most of the fellows was of a reasonable level, as could be expected from the level of education. However, their practical know-how and grasp was much less than hoped for, and certainly far below the level which might be considered as normal for people with their kind of mill experience. When this matter was discussed with the fellows, this phenomenon was explained by the fact that they had to spend a disproportionate amount of time on labour problems. There may be some truth in this explanation, but we are now of the opinion that the white collar attitude, which was predominant with almost all fellows, had a considerable bearing

on this matter.

Another persistent problem was the lack of working knowledge of the English language of the majority of the fellows. Especially the tuition at the polytechnical college was hampered. Two methods of testing the language ability were in use. Some of the applicants had been tested by the UNDP, Technical Co-operation Division, while others were tested by the English Language Testing Service, conducted by the British Council, jointly with the University of Cambridge. The latter tests gave more information and in general were more useful when screening applicants.

When the third group was formed, it appeared that the language ability was even less than with the two previous groups. Most candidates were classified as marginal users of the English language, which was considered insufficient to be able to follow the proposed lectures. After consultation with the Netherlands Government, it was decided to send this group to an English language course at a language laboratory in Enschede.

3.3. Composition of the Groups

Although the first group showed a predominance of spinning technicians, the other two groups were reasonably well balanced. This was important, because it was not possible to train fellows of one specialization only. In table 3.1. the composition of the three groups is shown. The composition of the groups also reflects the importance of spinning for the BTMC.

Table 3.1: Composition of the three groups

	Spinning	Weaving	Finishing	Total
Group I	9	2	3	14
Group II	5	3	2	10
Group III	5	3	2	10
Total	19	8	7	34

3.4. The Lectures at the Polytechnical College "De Maere"

The course for the first group was held as described in chapter 2. When the course was evaluated there was a general consensus under the fellows

that the time available for the curriculum had been insufficient and a strong plea was made to extend the time for the theoretical part. Since it was impossible to extend the course, this meant that the time available for practical work had to be reduced.

The matter was duly discussed with all parties concerned and it was decided that for the second group the time for the theoretical part of the course would be extended by 4 hours per week, bringing the total to 16 hours per week, or for the whole course to 300 hours, divided as follows:

- economics : 120 hours
- textile technology : 120 hours
- statistics : 36 hours
- case studies : 24 hours.

No change in the curriculum was made.

This new set-up proved to be successful and no further changes were made. In Annex II, the reports of the actual lectures, given to the fellows at the Polytechnical College "De Maere" are presented.

3.5. Practical Work in the Mills

In order to direct the fellows in their practical exercises each fellow was given a training programme for the department he was attending. These programmes are reproduced in Annex III.

When the first group returned to Bangladesh, the advisers of the UNDP Textile Industry Development Programme were disappointed in the performance of these trainees. The main complaint was the inability of the fellows to formulate a proposal for the training of their subordinates and their unwillingness to undertake any formal training in their departments or mills.

Furthermore a number of observations and suggestions were made to improve the course. The recommendation to spend more time on practical work in the mills was in direct conflict with the wish voiced by the fellows themselves to give more time to the theoretical part of the course.

The suggestion of the UNDP advisers to give each fellow a specific project to be completed during their fellowship in the Netherlands was welcomed by Ten Cate. The fellows were required to prepare a written project report on their return to Bangladesh. Furthermore they were requested to send a

brief monthly progress report to the Chief Technidal Adviser of the Textile Industry Development Programme of the UNDP in Dacca. The projects were adapted to the needs of the trainees as much as possible. In Annex IV a short description ot the various projects is given. Especially the projects given to the spinners and weavers were considered to be very useful, bearing in mind conditions prevailing in Bangladesh. On the contrary, the projects for the finishers showed a lack of reality, which made these projects less useful. Unfortunately, the fellows of the third group did not receive similar instructions.

One general observation, which applies to almost all fellows, with very few exceptions, should be made: it appeared to be very difficult to get the fellows to carry out manipulations on the machines. There was a general attitude of keeping one's hands clean, which has, elsewhere, been described as a "white-collar" attitude. It must be assumed that this is connected with the values prevailing in the Bangladesh society. It will not be easy to change this, which is a pity, because it will hold back progress in industry.

3.6. Additional Courses

All the courses, which were planned, have been provided. However, some trainees showed interest in subjects, which were not provided in the programme, others had additional requirements. As already mentioned before (section 3.2 of this chapter), it was judged necessary to provide a special language course for the third group. From the test results, which were received from Dacca, it appeared that almost all candidates were below average and their working knowledge of English was considered insufficient to be able to have full benefit of the lectures in the Polytechnical College "De Maere".

Fortunately it appeared to be possible to organize a short course at the Language Laboratory in Enschede. The Language Laboratory has a considerable experience in this type of education, since they regularly run courses for students of the International Institute ITC in Enschede. A course of 2 weeks was planned, but after 2 weeks it appeared that 5 fellows required another week. This course was paid for by the Netherlands Government.

Three fellows put in a request for additional information concerning budgetting and cost control. It was possible to satisfy these trainees

within the framework of the courses. Two other fellows expressed interest in distribution systems for power, steam and compressed air. Although this subject was too difficult for the majority of the fellows, it was possible to meet the wishes of these two.

It appeared that there was considerable interest in the waste control in a spinning mill. With the help of a flow diagram (Annex VI) the phenomenon of non-usable and reworkable waste was discussed. As a matter of fact, spinning mills in Bangladesh experience great problems with the control of the use of the spinfibre, waste figures often become twice as high as is acceptable under normal conditions. Furthermore, it was possible to discuss a systematic method of calculating machine capacities for the various yarn counts (see Annex VII) with the spinners.

3.7. Attendance Record

Both in the mills and at the college the attendance records of the trainees were good.

The fellows soon discovered that the excuses for being late, they use in their home country, where the circumstances are far from ideal with public transportation not running on time and being inadequate and mill transportation coping with traffic congestions, etc, are not valid in Holland.

Two groups arrived in December and one in November, which are cold and wet months and have, on top of it, a short daylight period. This phenomenon was a burden all fellows. However, when the fellows saw that everybody in the factory at school arrives in time despite of the , they needed no persuasion to be in time themselves.

The sickness records of the fellows was very low. Altogether, the company physician was consulted 10 times only. 2 fellows actually used their health-insurance, provided by the Dutch Ministry, viz. 1 fellow developed a light case of diabetes at the end of the course and 1 fellow suffered from kidney trouble.

In spite of the fact that most fellows caught a common cold at the end of the winter, the attendance remained good.

After 2 weeks of closely controlling the attendance of the fellows, it was decided not to make a personal attendance record. It turned out that, due to the fact they discovered that, notwithstanding their rank of position,

everybody arrives in time, the fellows were convinced that they simply could not be late at work or in school. Moreover, nowhere in the factories time recorders are used - this system has been abandoned some 10 years ago - which was an extra stimulus. Needless to write that the fellows could hardly believe their eyes as this seems to be unthinkable in their own working place.

3.8. Assessment of the Trainees

Due to the fact that the course was clearly divided into a theoretical and a practical part, it was decided to assess the activities of the fellows in each of these two fields. Table 3.2 gives the assessment of the activities of the fellows during the theoretical part of the course, table 3.3 gives the assessment of the activities of the fellows during their practical exersizes.

In respect of the subjects Plant Maintenance and Air-conditioning the fellows were required to complete a test paper at the end of the course. These test papers are shown in Annex V. The results of these tests were reasonably satisfactory.

An endeavour has been made to assess the benefit of the course accruing to each of the fellows. This assessment is also incorporated in the tables 3.2 and 3.3. However, it is a well known fact that it is very difficult for an individual, even if he fills a key position in the organization, to implement new techniques and ideas on his own.

The writer of this report had the opportonity to meet several fellows in Bangladesh, when he was on a mission for the Netherlands Government [1)]. All these fellows reported the difficulties they faced to convince management as well as their subordinates to change methods and procedures.

In one case two fellows were placed in one mill and they had the definite intention to put into practice what they had learned in the Netherlands. Unfortunately it was too early to see whether they would succeed, but it was clear that these two had a better chance.

3.9. Excursions

To give the trainees a broader outlook on textile manufacturing, a number of excursions to other textile manufacturers, manufacturers of textile machinery,

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1) Feasibility Study for the Rehabilitation of Spinning Mills in Bangladesh, August/September, 1981.

Table 3.2: Assessment of the Training Activities, theoretical part

Name	Entry level	Interest	Partici-pation	Benefit
FIRST GROUP				
Abdul Karim	++	++	++	+
Abu Monzur Elahi	+	+	+	+
Momtazuddin	-	+	+	-
Mirza Abdul Wahid	++	+	++	+
Reazul Islam	+	+	+	+
Ahmed Ullah Khan	++	+	++	+
Jiaul Islam	+-	+	+	+
Shamsul Alam	+-	+	+	+
Alauddin Ahmed	+-	+	++	+
Sayed Sayefullah	+-	+	+	+
Abdul Quddus	++	++	++	++
Shaheed Ahmed Chowdhury	++	++	++	+
Enamul Hoq	++	++	++	++
Shaheedur Rahman Chowdhury	+	+	+	+
SECOND GROUP				
Khan Rashidur Rotab	++	+-	++	++
Shibu Pada Dutta	++	++	+	++
Ali Noor Rashid Khan	+	++	+	++
Subhash Chandra Paul	+	++	+	+
Mahbubul Alam	+	++	+	+
Mohammad Dosth	+-	+	+-	+
Miah Abdur Rouf	+	++	+	+
Nurul Islam	+	+	+	+
Mahafuzur Rahman Idgani	+	++	+	+
Nazrul Islam	+	++	++	+
THIRD GROUP				
Ashutosh Bhowmik	+	++	++	++
Mahtab Uddin	+	+	+	+
Hashu Nuruzzaman	++	++	++	++
Shahjahan Miah	+	+	+	+
Islam Habibul	++	++	++	++
Mobarakul Islam	+-	+	+	+
Harun Siddiqui	+	+	+	+
Abdul Halim	+	+	+	+
Khawaja Ahmed	+	+	++	+
Ashraf Hossain	-	+-	+-	+-

++ good
+ fair
+- doubtful
- insufficient

Table 3.3: Assessment of the Activities during Practical Work

Name	Entry level	Interest	Partici-pation	Benefit
FIRST GROUP				
Abdul Karim	++	++	++	++
Abu Monzur Elahi	+	++	+	++
Momtazuddin	-	+	+	+-
Mirza Abdul Wahid	++	++	++	++
Reazul Islam	+	++	+	+
Ahmed Ullah Khan	++	++	+	++
Jiaul Islam	+-	+	+	+
Shamsul Alam	+	+	+	+
Alauddin Ahmed	+-	+	+-	+
Sayed Sayefullah	+	++	+	+
Abdul Quddus	+	++	+	++
Shaheed Ahmed Chowdhury	++	+	++	++
Enamul Hoq	++	++	+	+
Shaheedur Rahman Chowdhury	+	+	+-	+-
SECOND GROUP				
Khan Rashidur Rotab	++	++	++	++
Shibu Pada Dutta	++	++	+	++
Ali Noor Rashid Khan	+	++	++	++
Subhash Chandra Paul	+	++	+	++
Mahbubul Alam	++	++	+	+
Mohammad Dosth	+-	+	+	+
Miah Abdur Rouf	+	++	+	++
Nurul Islam	+	+	+	+
Mahafuzur Rahman Idgani	+-	++	+	+
Nazrul Islam	+	++	++	+
THIRD GROUP				
Ashutosh Bhowmik	+	++	++	++
Mahtab Uddin	+-	+	+	+
Hashu Nuruzzaman	+	++	++	++
Shahjahan Miah	+-	+	+	++
Islam Habibul	++	++	++	++
Mobarakul Islam	+	+	+	+
Harun Siddiqui	+-	+	+	+
Abdul Halim	+	++	++	++
Khawaja Ahmed	+	+	++	++
Ashraf Hossain	+	+-	+-	+-

++ good
+ fair
+- doubtful
- insufficient

etc. were organized.

EXCURSIONS

Visits to several textile machinery factories formed part of the course.

The following excursions were made:

1. Visit of Picanol, Yper/Belgium, manufacturer of looms
2. Visit of Schlafhorst, Mönchen-Gladbach/West-Germany, manufacturer of textile preparation machines and open-end spinning machines.
3. Visit of Stork, Boxmeer/the Netherlands, manufacturer of textile printing machines.
4. Visit of Brugman, Almelo/the Netherlands, manufacturer of textile finishing machines.
5. Visit of "AVEBE", Veendam/the Netherlands, potato-starch factory.
6. Visit of Texoprint, Roermond/the Netherlands, a rotary printing operation, printing on paper (transfer-printing) and cloth.
7. Visit of Twilo BV, Almelo/the Netherlands, research department of the Twilo spinning system.
8. Visit of Ten Cate Fashion Fabrics, Almelo/the Netherlands, corduroy finishing plant.
9. Visit to Ficatex, Nijverdal/the Netherlands, waste spinning - Arachne plant.
10. A sightseeing trip through Holland, visiting Rotterdam, The Hague, Amsterdam and the Zuyderzee-project.

4. ACCOMMODDATION OF THE FELLOWS

4.1. Private Hotel

The first group of fellows was accommodated in a hotel in Enschede. Usually, the fellows of this course, are staying in the Guesthouse of the International Topographical Centre in Enschede. Unfortunately this guesthouse was fully booked, so the Ministry in The Hague contracted a private hotel in Enschede and made up for the difference in cost.

Some disadvantages were attached to this accommodation, viz.:

- They were staying in double bedrooms, so there was hardly any opportunity to study after work. More privacy would be recommendable;
- The illumination of the rooms was not sufficient to read and to study. Inserting more powerful bulbs caused problems during the night, because of their habit to sleep in a lighted room;
- The town of Enschede is not centrally situated in respect of the location of the various mills. More travelling time was needed, which caused, especially in the early morning, some trouble in the beginning;
- Cooking to the Bangladeshi taste was only possible after the Ministry agreed to pay additionally for cooking facilities in the hotel. This proved to be a considerable improvement in the motivation of the entire group.

4.2. The Hostel of Nijverdal-Ten Cate

The next groups were accommodated in the hostel of Nijverdal-Ten Cate in Almelo. Each fellow had his own room with a possibility to study. Moreover a central kitchen was available, where the fellows could prepare their own food to their own taste and with their own kitchen utensils.

Although also the hostel had disadvantages, under the circumstances, it finally turned out to be the best solution. The rooms are anything but sound proof, and, since the other occupants of the hostel, often are shift-workers, some tolerance is required.

ANNEX I

FIRST GROUP OF FELLOWS (3rd December, 1979 - 28th May. 1980)

Mohammad Abdul Quddus	Spinning Manager	Head Office of BTMC
Shaheed Ahmed Chowdhury	Spinning Director	Chishty Cotton Mills
Abdul Karim	Assistant Manager	Muslin Cotton Mills Ltd.
Sayed Sayefullah	Dyeing & Finishing Manager	The Chittagong Textile Mills Ltd.
Jiaul Islam	Assistant Manager Dyeing Department	Luxminarayan Cotton Mills
Abu Monzur Elahi	Spinning Master	Meghna Textile Mills
Alauddin Ahmed	Weaving Master	Luxminarayan Cotton Mills
Ahmed Ullah Khan	Weaving Master	Head Office of BTMC
Reazul Islam	Spinning Master	Luxminarayan Cotton Mills
Enamul Hoq	Spinning Manager	Head Office of BTMC
Mirza Abdul Wahid	Assistant Manager	Head Office of BTMC
Shaheedur Rahman Chowdhury	Spinning Master	Sharmin Textile Mills Ltd.
Momtazuddin	Technical Manager	Mohini Mills Ltd.
Shamsul Alam	Assistant Manager Dyeing	Al-Haj Textile Mills Ltd.

SECOND GROUP OF FELLOWS (1st December, 1980 - 2nd May, 1981)

Shibu Pada Dutta	Assistant Manager Dyeing	The Chittagong Textile Mills Ltd.
Mahbubul Alam	Weaving Master	National Cotton Mills
Mohammad Dosth	Assistant Manager Dyeing	Sharmin Textile Mills Ltd.
Miah Abdur Rouf	Spinning Master	Rajshahi Textile Mills
Nurul Islam	Spinning Manager	Muslin Cotton Mills Ltd.
Mahafuzur Rahman Idgani	Assistant Spinning Manager	Pahartali Textile & Hosiery
Nazrul Islam	Spinning Master	Al-Haj Textile Mills Ltd.
Rashidur Rotab Khan	Spinning Departm.	Head Office of BTMC
Subhash Chandra Paul	Weaving Departm.	Textile Industry Development Centre (UNDP)
Ali Noor Rashid Khan	Weaving Departm.	Textile Industry Development Centre (UNDP)

THIRD GROUP OF FELLOWS (12th November, 1981 - 1st May, 1982)

Mahtab Uddin	Spinning Master	Mowla Textile Mills
Ashutosh Bhowmik	Spinning Master	Chand Textile Mills Ltd.
Ashraf Hossain	Assistant Manager Spinning	Ashraf Textile Mills
Hashu Nuruzzaman	Spinning Master	Barisal Textile Mills
Khawaja Ahmed	Spinning Master	Quasem Textile Mills
Abdul Halim	Weaving Master	Jalil Textile Mills
Sjahjahan Miah	Weaving Master	Luxminarayan Cotton Mills
Harun-Al-Rashid Siddiqui	Weaving Master	The Chittagong Textile Mills Ltd.
Islam Habibul	Assistant Finishing Master	Muslin Cotton Mills
Mobarakul Islam	Finishing Master	Al-Haj Textile Mills Ltd.

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ANNEX II-1

SUBJECT: ORGANIZATION & MANAGEMENT

TEACHER: Drs. H. ten Thije

1. Objective

The objective of this course was to teach the different organization and management theories, such as:

- scientific management by Taylor
- social psychological movement of Mayo - Likerd & McGregor
- economic approach: theory of span of control
  quantitative economics
  control techniques
- sociology of contribution
- decision making movement, such as the theory of March & Simons
- cybernetic approach
- system concept.

1.1. Instruments of Management

The above mentioned theories gave the opportunity to mention the different instruments of management that are available and applied in industry. One of these, rate setting, was treated extensively in theory and practice. In order to arrive at a justified rate for repetitious work the following items have to be determined:

- o the best work method
- o the time required for the various manipulations of the worker, when carrying out his duties
- o estimating the work tempo.

1.2. Multi Moment Observation

Time setting by means of the clock is easy to understand but difficult to be applied in a mill. However, the multi moment observation method is an objective method in determining a work load. This method has been developed by Mr. Tippett and is called the ratio-delay method of work sampling or multi moment observation.

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This method has been treated during the theory lessons, then illucidated by means of a motion picture and finally put into practice by the fellows themselves in the mill.
Particular elements in this procedure were highlighted, such as:
- insight in statistics
- the ability to work with tables of random numbers
- the knowledge of the rules during the application in the mill.

The ultimate goal of this method is to obtain a kind of "x-ray" picture of the department concerning the proportion of the actual working time spent in the organization and to find a way to organize the total amount of work efficiently.

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ANNEX II-2

SUBJECT: THEORY SPINNING

TEACHER: Ing. S.J. Roorda

1. Fibre Knowledge

1.1. Spinning properties of cotton:
Importance of staple and staple-diagram, fibrecount (micronaire) and maturity, strength (Pressley).
SI-units.

1.2. Man-made fibres:
Viscose and modal fibres (CV and CP).
Poly-ester fibres (PES).

Spinning properties.
Machine settings.
Blends with cotton, blends PES/CV and PES/CP.

2. Modern Spinning Methods

2.1. Open-end spinning:
Advantages, limits in spinning.
Trash problem.
Yarn properties.

2.2. Short survey of other new spinning methods:
Repko spinning, Dref spinning, Twilo spinning, a.o.

3. Quality and Process Control

Philosophy.
Managerial measures.
Tools, quality testing.

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ANNEX II-3

SUBJECT: THEORY WEAVING AND COMPOSITION

TEACHER: Ing. P.J.M. Domsdorf

1. A General Knowledge of Fabric Structure

1.1. Plain weave

1.2. Variations in plain fabric structures

1.3. Matting, basket or hopsack fabrics

2. Twill Fabrics

2.1. Twills of fourty-five degrees

2.2. Twills of sixty degrees

2.3. Some variations in twills of fourty-five degrees, e.g. herringbones and honeycomb twills

3. Satin Fabrics

3.1. Damask and check satins

3.2. Beaverteen weaves

4. The Effect of Floating Threads and the Density on the Quality of a Fabric

5. The Effect of the Twist Way of Warp and Weft on the Appearance and the Quality of a Fabric

5.1. Twist and twill direction in twill weaves

5.2. Twist and twill direction in satin fabrics

6. Crêpe Weaves

7. Colour Pattern and Weave

8. Backed Fabrics

8.1. Warp backed fabrics

8.2. Weft backed fabrics

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9. Double Fabrics

10. Terry or Turkish Toweling

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ANNEX II-4

SUBJECT: BLEACHING, DYEING, PRINTING AND FINISHING

TEACHERS: Ir. C.A. Theusink (theory)

H.A. Bouwmeester (practical laboratory work)

1. Physical-chemical Background Knowledge

- built up of materials, atoms, molecules, ions, cohesion, adhesion, mixing, solving, adsorption, absorption
- water, specific properties
- acids, hydroxides and salts
- oxidation and reduction
- surface tension, wetting and rewetting
- theory of the washing process

2. Pretreatment of Fabrics

Pretreatment of cotton and polyester/cotton blends; desizing, boiling-off, bleaching, mercerizing

3. Dyeing

Dyeing of cotton with direct, vat and reactive dyestuffs, and polyester/cotton blends with dispers-vat and dispers-reactive dyestuffs.

4. Printing

Cotton, cotton/polyester, especially rotary-printing and transfer-printing.

5. Practical Research with Respect to Dyeing and Finishing

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ANNEX II-5

SUBJECT: TEXTILE TESTING

TEACHERS: W. Grooters

J. Hofstra

1. Theoretical Background

1.1. Fibres and material knowledge

1.2. Microscopic research

1.2. Chemical resistance

1.4. Burning-test, characteristics and observations

1.5. The construction (composition) of several woven or knitted fabrics

1.6. Determination of the tensile strength of fabrics and yarns

1.7. Scour or rubbing test

1.8. Flexibility test

1.9. Calculating the percentage of moisture

1.10. Pilling test

2. Specific Tests for Spinners, Weavers and Dyers/Finishers

2.1. Spin-technological and Quality Research

- twist test
- micronaire tests
- mature and inmature cotton fibres
- fibre length and fibre diagram

2.2. Treatment of Characteristics of Cellulose-, Wool- and Synthetic Fibres

2.2.1. Cellulose Fibres

- cotton
- flax or linen
- viscose
- jute
- di acetate
- tri acetate

2.2.2. Wool Fibres

Several sorts of wool were tested:

- cross bred
- mohair
- merino
- alpaca

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- camel
- angora
- wool waste (descending from ready made clothing waste and spinning mill)

2.2.3. Synthetic Fibres of the Thermoplastic Type

- polyamide
- polyacryl
- polyester
- polyvinyl

Blends

- polyester/cotton
- polyester/viscose/wool
- polyester/wool
- and other blends

3. Quality Control Woven Fabrics

a. Household textiles
b. Leisure wear
c. Fashion Fabrics

All tests are carried out according to the relative standards: a.o. NEN, DIN, ASTM, ISO.

3.1. Decomposition

a. ends per 10 cm
b. yarn counts
c. weight per m^2 ---------- (determination of weight)
d. fibre structure --------- (microscopic research)
e. fibre structure --------- (chemical solubility)
f. cover factor ---------- (cover factor)
g. pattern design
h. finish

3.2. Examination of

a. tensile strength
b. tearing strength/resistance
c. test for abrasion resistance
d. stiffness test

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e. flexural rigidity
f. stress relaxation
g. shearing
h. pilling
i. resinfinish and silicon finish, fastness against washing, shrinkage, perspiration

4. Microscopic Research

Structure of the fibre of natural, blends, and man-made fibres:
a. cotton
   flax or linen
   jute
b. wool: cross-bred, merino, mohair, angora, alpaca wool, waste wool
c. man-made: viscose rayon, di and tri acetate, polyester, polyamide, polyacryl, polyvinyl
d. blends: cotton/PES, wool/PES, etc.
Identification of fibres with specific burning properties,the percentage of moisture, and solubility in chemicals.

5. Weaving

3.1. Pattern Design

Designing various patterns for handlooms with single lift dobby and weaving of these patterns.
Types of pattern design: twills, weft and warp twills, satins, combined twills, crow-twills, broken satins, broken twills, matts and fancy matts, ribs, warp ribs and weft ribs, etc.
Various patterns for powerlooms with double lift dobby and double lift dobby with crossborder.
Designing of: whipcords, gaberdine, gabercord, crepe, double satins

3.2. Training

Exercises in finding the weft, repairs of broken picks and ends.
Punching of cards for dobby and jacquard machines for self designed patrons.

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Working on the jacquard machine (144 and 400 gauge).

Designing for the jacquard machine.

Tuning of the loom: shedding, tension of warp and weft, and picking.

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ANNEX II-6

SUBJECT: STATISTICS

TEACHER: Ir. N. Bakker

1. Theoretical Background

1.1. Descriptive Statistics Subjects:

Frequency tables and graphs

Center of a frequency distirubtion: mean
mode
median

Spread of a frequency distribution: mean squared deviation variance,
standard deviation range.

1.2. Concept of probability and probability distributions

Sample space

Events and their probabilities

Conditional probability

Independence - dependence of events

Random variables - discreet
- continuous

Mean and variance of a distribution

Binomial distribution

Poisson distribution

Normal distribution.

1.3. Sampling

Testing of hypothesis (significance)

Quality control.

2. Practical Exercises in the Preparation and Evaluation of Statistics

2.1. Exercises were chosen from textile-applications, notions:

sample space, Venn-diagram, complement, union, intersection of sets.

Binomial distribution

Poisson distribution

Normal distribution

Control charts, statistical tests.

ANNEX III-1

TRAINING PROGRAMME
IN SPINNING MILL ALMELO/NIJVERDAL

for Mr.

Date:

Opening & Carding Department

- working methods
- quality control
- production control
- waste control
- organization
- preventive maintenance
- overhauling
- reworkable waste control

ANNEX III-2

TRAINING PROGRAMME

IN SPINNING MILL AIMELO/NIJVERDAL

for Mr.

Date:

Drawing and Roving Department

(Combing)

- working methods
- quality control
- assessment of ends down
- production control
- reworkable waste control
- preventive maintenance
- organization

ANNEX III-3

TRAINING PROGRAMME

IN SPINNING MILLS ALMELO/NIJVERDAL

for Mr.

Date:

Spinning & Winding Department

- working methods
- quality control
- assessment of ends down
- preventive maintenance
- production control
- overhauling
- waste control
- organization

ANNEX III-4

TRAINING PROGRAMME

IN WEAVING MILL ALMELO/NIJVERDAL

for Mr.

Date:

Winding-Beaming-Sizing Department

- maintenance
- job allocation
- production
  - kg/machine hour
  - kg/man hour
- ends down per 10^6 metres
- administration
- quality control

ANNEX III-5

TRAINING PROGRAMME

IN WEAVING MILL ALMELO/NIJVERDAL

for Mr.

Date:

Drawing-in-Weaving Department

- maintenance
- job allocation
- production
  - kg/machine hour
  - kg/man hour
- ends down per 10^6 picks
- administration
- quality control

ANNEX III-6

TRAINING PROGRAMME
IN GREY CLOTH INSPECTION DEPT. NIJVERDAL

for Mr.

Date:

- cloth measurement
- classification of defects
  - defects in warp
  - defects in weft
  - spinning defects
  - yarn preparation defects
  - weaving defects
  - correct inspection speed
- administration

ANNEX III-7

TRAINING PROGRAMME
IN FINISHING PLANT NIJVERDAL

for Mr.

Date:

laboratory	all control procedures
washing dept.	singeing, de-sizing, scouring, rope bleaching, open width bleaching, mercerizing recipes, production and process control, and preparation of recipes
dyeing dept.	continuous dyeing pe/cot, pad roll dyeing, jig, winch and jet dyeing, recipes, dye kitchen, production and process control, colour matching
finishing dept.	heat setting, curing, sanforizing, raising, calendering, tentering, final inspection

ANNEX III-8

TRAINING PROGRAMME
IN FINISHING PLANT OLDENZAAL

for Mr.

Date

laboratory	all control procedures, colour matching
preparation dept.	singeing, desizing, washing, open-width bleaching, causticizing, production and process control
dyehouse	jig, winch, jet, beam and pad dyeing, thermofixation, dyeshop, production and process control, inspection
finishing dept.	heatsetting, stentering, curing, sanforizing, calendering, scrubbing and final inspection

ANNEX III-9

TRAINING PROGRAMME
IN YARN DYEHOUSE HENGELO

for Mr.

Date:

laboratory	all control procedures
	colour matching
preparation	cone-winding and beaming
dyehouse	cone dyeing and beam dyeing
	yarn drying

ANNEX IV

PROJECTS OF THE SECOND GROUP

Mr. Mahafuzur Rahman Idgani

Process details of polyester cotton blends, opening points, machine settings, for every machine from blowing room to cone winding. Suitable for use in Bangladesh under local conditions with local problems.

Mr. Nurul Islam

A full maintenance programme for a 25,000 spindle mill, cleaning, overhauling, dismantling and re-setting every machine opening to cone winding. With particular reference to conditions in Bangladesh, for example. a shortage of spares, that people are available to do the jobs. The programme should be judged by conditions which obtain in Bangladesh.

Mr. Miah Abdur Rouf

Quality control in spinning mills. How lap weight is controlled and why, what to test from cards. e.g. nep count weight per unit length of sliver, fibre content of trash. Drawframe tests how frequently, what to look for, flyer frame how often material is tested, yarn tests.
The details required are simply, how to do the job, how to present the results, when to take action, when not to take action. Reference to conditions and output levels in Bangladesh.

Mr. Rashidur Rotab Khan

Cost centre details for each process bale to cone, how much each process adds to the value of the material. The real cost of waste. This has to be done with reference to work loads in Bangladesh.

Mr. Nazrul Islam

Effective waste control, how much material should be converted into waste at each process. For example, waste due to machine waste due to people not doint the work properly. This should be done with conditions and output

levels that exist in Bangladesh.

Mr. Mahbubul Alam

Waste Control in the Weaving Department

The areas to be covered are: cone winding, pirn winding, warping, sizing, drawing-in, weaving.

The trainee should investigate the reasons for getting waste in each of the above areas, how it can be minimized, their acceptable standards, calculation of the cost of waste in each section and compare the findings with the conditions existing in the BTMC Mills.

Mr. Subhash Chandra Paul

Sizing of polyester/cotton blends

a. The ingredients used and the reasons;
b. Method of preparation of sizemix and the percentage of ingredients used;
c. Viscosity of size, sizebox temperature, squeeze rolls pressure, depth of immersion of warp sheet;
d. Types of drying cylinder used and their temperatures;
e. Controlling of stretch and moisture content;
f. Quality control method used.

Mr. Ali Noor Rashid Khan

a. New development in foam dyeing including details information about dyestuffs, machineries and processes of dyeing;
b. Solvent dyeing, dyes used, machine, dyeing procedure, recovery of solvent.
c. Report should include advantages fabric suitable for each process.

Mr. Shibu Pada Dutta

Heat transfer printing

Dyes used in heat transfer printing; printing papers; thickners; technique of printing and transfer; transfer printing on cotton (how to prepare cotton substrate for heat transfer printing).

Nonionic disperse dyes for printing

Advantage over regular anionic disperse dyes; chemistry and applications; synthetic thickner (Carpobal thickners based on polyacrylic acid thickners).

Screen making technique

Flat beds screens; rotary screens; roller screens.

Mr. Mohammad Dosth

Dyeing Blends

Polyester/cotton blends; polyester/rayon blends; polyester/wool blends; cotton/jute blends.

- Advantages of these blends over single fibre type of fabric;
- Preparation for dyeing (continuous and non-continuous);
- Technique of dyeing;
- Dyeing machines used at its economics for woven and knitted goods;
- Finishing of these blends;
- Recent developments in dyeing blends in respect of producing heigh quality fabrics, economizing processing and ease of handling.

ANNEX V-1

MAINTENANCE COURSE TEST PAPER

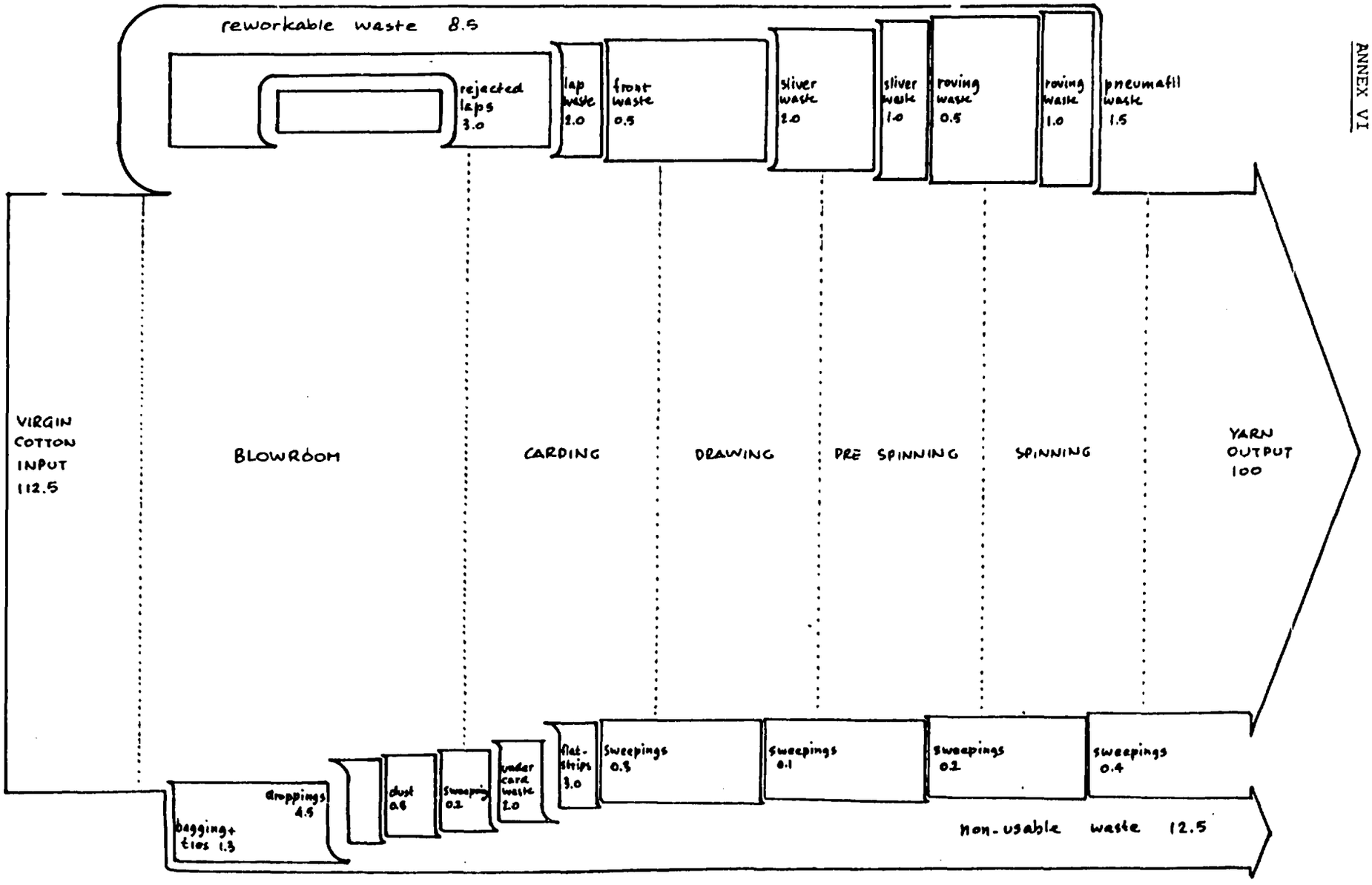
1. What influence can there be on the state of the machines (see the definition of maintenance)?
2. The state that is considered depends on different circumstances; mention some of these circumstances.
3. What are the results, if only corrective maintenance is carried out?
4. What are the results in case of preventive maintenance?
5. In practice both corrective and preventive maintenance are carried out. State the different costs.
6. Draw the diagrammatic graph, illustrating the relationship between these costs.
7. State the contents of a maintenance schedule for an item or major component.
8. From which sources do you collect the instructions and descriptions for the preventive maintenance programme?
9. How can preventive maintenance be carried out in practice?
10. What does inspective maintenance mean?
11. From which sources do you collect the instructions and descriptions for the inspection sheets?
12. How can inspective maintenance be carried out in practice; mention some subjects.
13. What causes can there be to introduce corrections to the maintenance programme?
14. In a number of situations, the maintenance programme has to be altered to more or less preventive maintenance; mention some of these situations.
15. State some of the reasons for modifications by constructive improvements.
16. What is the purpose of maintenance records and which activities are based upon these records?
17. What are the different actions taken by the stores department of the spare parts?
18. What are the influences for altering the amount of the minimum stock?
19. What possibilities are there to decrease the stock of insurance type items?
20. What are the results of examining used parts and what conclusions are possible?

ANNEX V-2

AIR-CONDITIONING COURSE TEST PAPER

1. Mention the following data of point A:
   1.1. The Dry bulb temperature:
   1.2. The Wet bulb temperature:
   1.3. The Relative Humidity:
   1.4. The Watervapour pressure:
   1.5. The saturated Watervapour pressure:
   1.6. Calculate the Relative Humidity from 1.4 and 1.5:
   1.7. The enthalpy in kcal/kg:
   1.8. The dewpoint-temperature:
   1.9. The specific weight in kg/m^3:
2. 30,000 m^3 air-watervapour of condition A is mixed with 10,000 m^3 air-watervapour of condition B.
   Mark the mixing point in the diagram:
   How much is the Relative Humidity in the mixing point:
3. Air with the condition of point B is humidified in an Air-washer with circulating water. The washer efficiency is 79%.
   How much is the Dry bulb temperature after the washer:
   How much is the Relative Humidity after the washer:
4. Air with condition C (22.2°C and 96% Rel.Hum.) is supplied to a Fine-spinning department. The total heat-load of the spinning department, inclusive of the heat of the air-conditioning itself and so on, is 290 kW.
   4.1. How much is the total heat-load of the spinning department in kcal/h:
   4.2. If we want a relative humidity of 48% in the spinning department and we blow sufficient supply of air of condition C into the spinning department, what will the Dry bulb temperature in the spinning be:
   4.3. How much is the rise of the enthalpy of the supply air, the ΔJ in kcal/kg, if this is heated up in the department until the Relative Humidity becomes 48%:
   4.4. How much is the supply air quantity in kg/h:
   4.5. How much is the supply air quantity in m^3/h:
   4.6. How much is the cross-area of the supply airduct if the air-velocity in the duct is 10 m/sec:

FLOW DIAGRAM OF SPIN FIBRE IN A TYPICAL SPINNING MILL PRODUCING CARDED YARN NE 32,1



TEN CATE CONSULTANTS

ANNEX VII

Type of Spinning Frame	Statement by Spinning Master
Quality to be spun	" " " "
Type of Tube	200 mm
Nominal Ne	Statement by Spinning Master
Effective Ne	" " " "
Ne simplex input	" " " "
Dra.	Ne eff. / Ne input
Material	Statement by Spinning Master (composition of mixing)
1. Twist multiplier	Statement by Spinning Master
2. Turns per inch	code 1 x Ne nominal
3. Twist loss	3%
4. a. Gear E - b. Gear C	a. Statem. by Spinning Master - b. 80.3
5. Twist gear	Statement by Spinning Master
6. Twist factor	" " " "
7. Tin toller gear	" " " "
8. Draft factor	" " " "
9. Draft pinion	" " " "
10. Total draft	code 7 / code 8
11. Input cylinder gear	Statement by Spinning Master
12. Middle cylinder gear	" " " "
13. Break draft gears	" " " "
14. Break draft	1.13 or 1.38
15. Main draft	code 9 / code 13
16. Clip or plate	Statement by Spinning Master
17. Cylinder setting	1°-2° - front 51-42 mm
18. Top roller setting	1°-2° - front 51-47.3 mm

19. Weight on top roller	Statement by Spinning Master
20. Toproller lacquered	" " " "
21. Ring cup diameter	" " " "
22. Ring cup type	" " " "
23. Ratchet setting	" " " "
24. Traveller type	" " " "
25. Spindlewhirl diameter	26 mm
26. Motor R.P.M.	Statement by Spinning Master
27. Starting losses	Ne 20 and finer: 1%
28. Motor pully in mm d/D	Statement by Spinning Master
29. Tinroller dia/whirl dia	9.48
30. Spindle R.P.M.	code 24 x code 27
31. Traveller velocity	$\frac{\text{code 30 x 3.14 x code 21}}{\text{60 x 1000}}$
32. Front roller cylinder diameter	25 mm
33. Front cylinder R.P.M.	$\frac{\text{code 26 x code 4a x code 7}}{\text{code 4b x code 5}}$
34. Frontrol delivery in m/min	$\frac{\text{code 33 x 3.14 x code 32}}{1000} \times \frac{(100-\text{code 3})}{100}$
35. Production/spindle hr in gr.	$\frac{0.5905 \text{ x code 34 x 60}}{\text{Ne effective}} \times \frac{(100-\text{code 27})}{100}$
36. Spindles per machine	388
37. Running time per 1 doff	$\frac{\text{cops weight x 60}}{\text{code 35}}$
38. Running time 1 Simplex bobbin	$\frac{\text{weight of bobbin}}{\text{code 35}}$
39.	
40.	

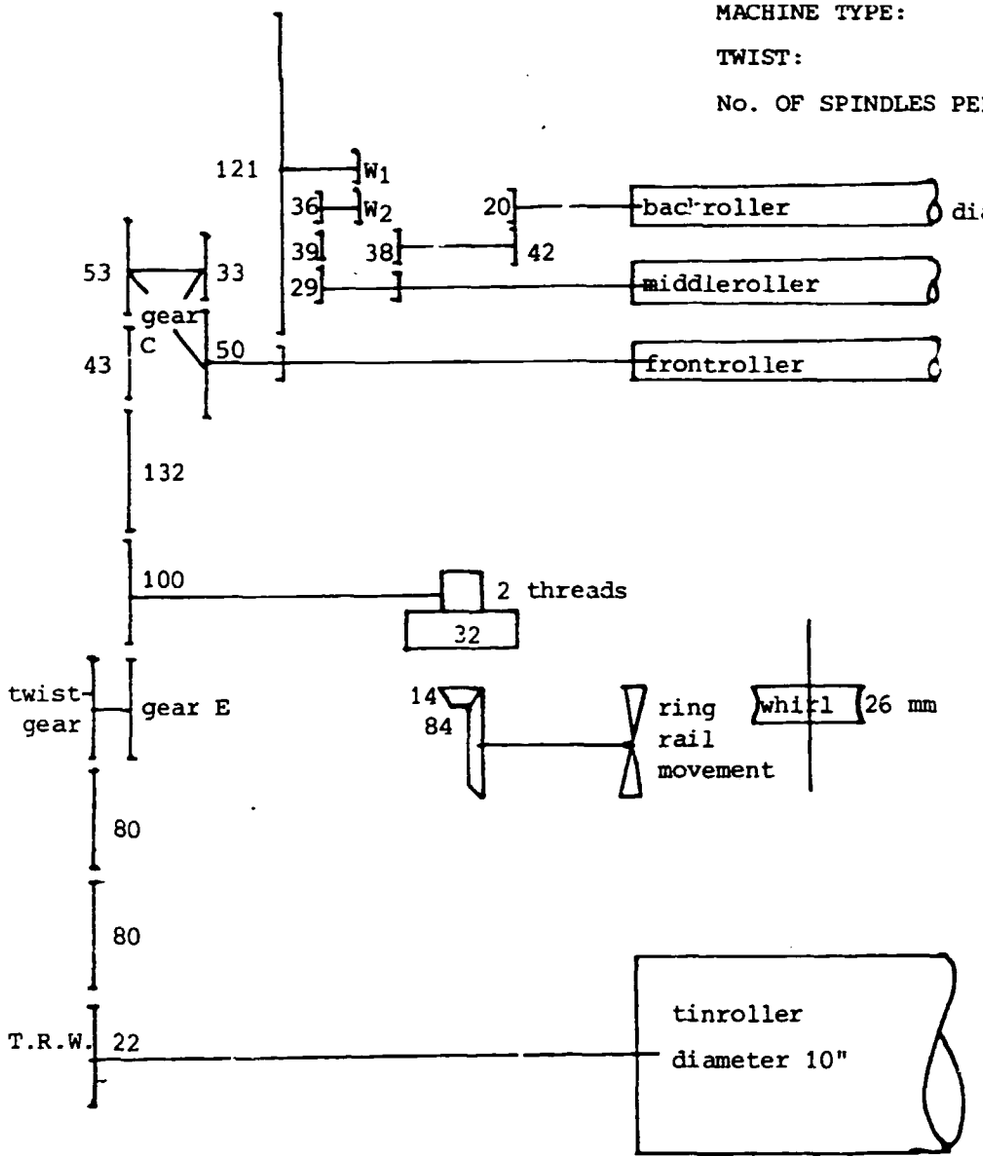
QUALITY:				
Activities Operator	Units	Time in centimin. per unit	Freqency/mach.hour	Time in centimin. per mach. hour
41. Repair of end down	end down	33	end down/1000 sp.hr.xcode 36	time x fr.
42. Changing Simplex bobbin	bobbin	25	code 36 / code 38	time x fr.
43. Running and control	machine	59	code 35 / grams last Simplex layer max. patrol 45 min. = 1.33	time x fr.
44. Cleaning	mach.hr.	78	1	time x fr.
45. Doffing	doff	2300	60 / code 37	time x fr.
46. Sweeping	mach.hr.	11	1	time x fr.
47. Central oiling	mach.hr.	2	1	time x fr.
48. Simplex bobbin transport	bobbin	18	freq. code 42	time x fr.
49. Cleaning Simplex bobbin	bobbin	5	freq. code 42	time x fr.
50. Pneumafil	machine	40	.....-Ne 15 : 4/8 Ne 16-..... : 3/8	time x fr.
51. Fitter	mach.hr.	15	1	time x fr.
52. Max. production	$\frac{(\text{code 36} \times 60) - (\text{Fr. code 41} \times 0.75 \times 60 : \text{freq. code 43}}{\text{code 36} \times 60\ (= 23280)} \times 0.99$ (1% of spindles idle)			
53. Required eff. in %	$\frac{\text{code 37} \times 100\%}{\text{code 37} + 8\text{ min}}$ - 7% (interference)			
Occupation/machine with req. eff. in %	$\frac{\text{total time in centimin.} \times \text{code 53}}{6000}$			
54. 100% clocknos/hour (proportion 1:10,000)	$\frac{\text{code 33} \times 60}{1000} \times \frac{100\% - \text{code 27 in \%}}{100}$			
55. req. numbers/hour	$\frac{\text{code 54} \times \text{code 53}}{100}$			

56. effective prod./mach. in 120 hours	$\frac{\text{code 35 x code 36 x 120 hr x code 53 x code 52}}{\text{1000 x 100 x 100}}$
57. eff. kg/clockno. at max. prod. eff.	$\frac{\text{code 56}}{\text{120 hrs x code 55}}$
58. 100% manhours/ 1000 kilos of yarn	$\frac{\text{total time in centimin x 1000 x 1000}}{\text{6000 x code 36 x code 35}}$ or $\frac{\text{total time x 0.4269}}{\text{code 35}}$
59. eff. mach. hours/ 1000 kg yarn/req.eff.	$\frac{\text{1000 x 1000 x 100 x 100}}{\text{code 35 x code 36 x code 53 x code 52}}$
60. eff. mach. hours 1000 kg yarn/100 eff.	$\frac{\text{code 59 x code 53}}{\text{100}}$

MACHINE TYPE:

TWIST:

No. OF SPINDLES PER MACHINE: 388



Klockax = Frontcylinder

1 No. = 1000 revolutions

$$\text{Turns per inch} = \frac{\text{R.P.M. spindle}}{\text{delivery frontcylinder in inch/min}} =$$

$$\frac{\text{R.P.M. motor} \times \frac{\text{dia tinroller}}{\text{dia whirl}} \times \frac{(100\% - \%\ \text{twistloss})}{100\%}}{\text{R.P.M. motor} \times \frac{\text{T.R.W.}}{\text{twist-gear}} \times \frac{\text{Gear E}}{\text{Gear C}} \times \text{pi} \times \text{dia frontcyl. in inches}} =$$

$$\frac{\text{twist-gear}}{\left\{\frac{\text{pi} \times \text{dia frontroller} \times \text{T.R.W.} \times \text{gear E} \times \text{dia whirl}}{\text{dia tinroller} \times \text{gear C} \times (100\% - \%\ \text{twistloss})}\right\}} =$$

The part between accolades is called Twist Factor.

$$\text{T.P.I.} = \frac{\text{twist-gear}}{\text{twist factor}}$$

$$\text{R.P.M. frontcylinder} = \text{R.P.M. motor} \times \frac{\text{T.R.W.}}{\text{twist-gear}} \times \frac{\text{gear E}}{\text{gear C}}$$

Converting factor from R.P.M. motor to R.P.M. spindle:

$$\frac{\text{Dia tinroller}}{\text{Dia whirl}} \times \frac{(100\% - \%\ \text{twistloss})}{100\%} = \frac{10 \times 25.4}{32} \times \frac{100 - 3}{100} = 7.70$$

Twist factor:

Formula:

$$\frac{3.14 \times \frac{25}{25.4} \times 22 \times \text{gear E} \times \frac{32}{25.4}}{10 \times 80.3 \times 0.97} = 0.11 \times \text{gear E}$$

Gear E = 20 20 x 0.11 = 2.20

Gear E = 27 27 x 0.11 = 2.97

Gear E = 32 32 x 0.11 = 3.52

Gear E = 36 36 x 0.11 = 3.96