OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

This document has been produced without formal United Nations editing. The designations employed and the presentation of the material in this document do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations Industrial Development Organization (UNIDO) concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries, or its economic system or degree of development. Designations such as "developed", "industrialized" and "developing" are intended for statistical convenience and do not necessarily express a judgment about the stage reached by a particular country or area in the development process. Mention of firm names or commercial products does not constitute an endorsement by UNIDO.

FAIR USE POLICY

Any part of this publication may be quoted and referenced for educational and research purposes without additional permission from UNIDO. However, those who make use of quoting and referencing this publication are requested to follow the Fair Use Policy of giving due credit to UNIDO.

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

We regret that some of the pages in the microfiche copy of this report may not be up to the proper legibility standards, even though the best possible copy was used for preparing the master fiche

08199

Distr.
LIMITED

UNIDO/IOD. 139/Add.3
3 June 1977

English

UNITED NATIONS INDUSTRIAL
DEVELOPMENT ORGANIZATION

EGYPTIAN INDUSTRIALIZATION SURVEY:

SOME SALIENT ASPECTS*.

VC/EGY/73/059.

ARAB REPUBLIC OF EGYPT.

Volume IV:

Transfer and adaptation of technology.

Prepared for the Government of the Arab Republic of Egypt
by the Institute of National Planning, on behalf
of the United Nations Industrial Development Organization

* This document has been reproduced without formal editing.

id.78-2954

PREFACE

This is one of a series[1/] of four studies on some aspects of industrial development in Egypt undertaken by the Institute of National Planning (INP) in Cairo at the request of the United Nations Industrial Development Organization (UNIDO). It is expected that these descriptions of the Egyptian experience will prove useful to developing countries at all levels in formulating industrial programmes and setting policies to achieve development goals. They may also be of interest to developed countries and international organizations, giving them a better perspective of the fields of activity covered by their different types of programmes.

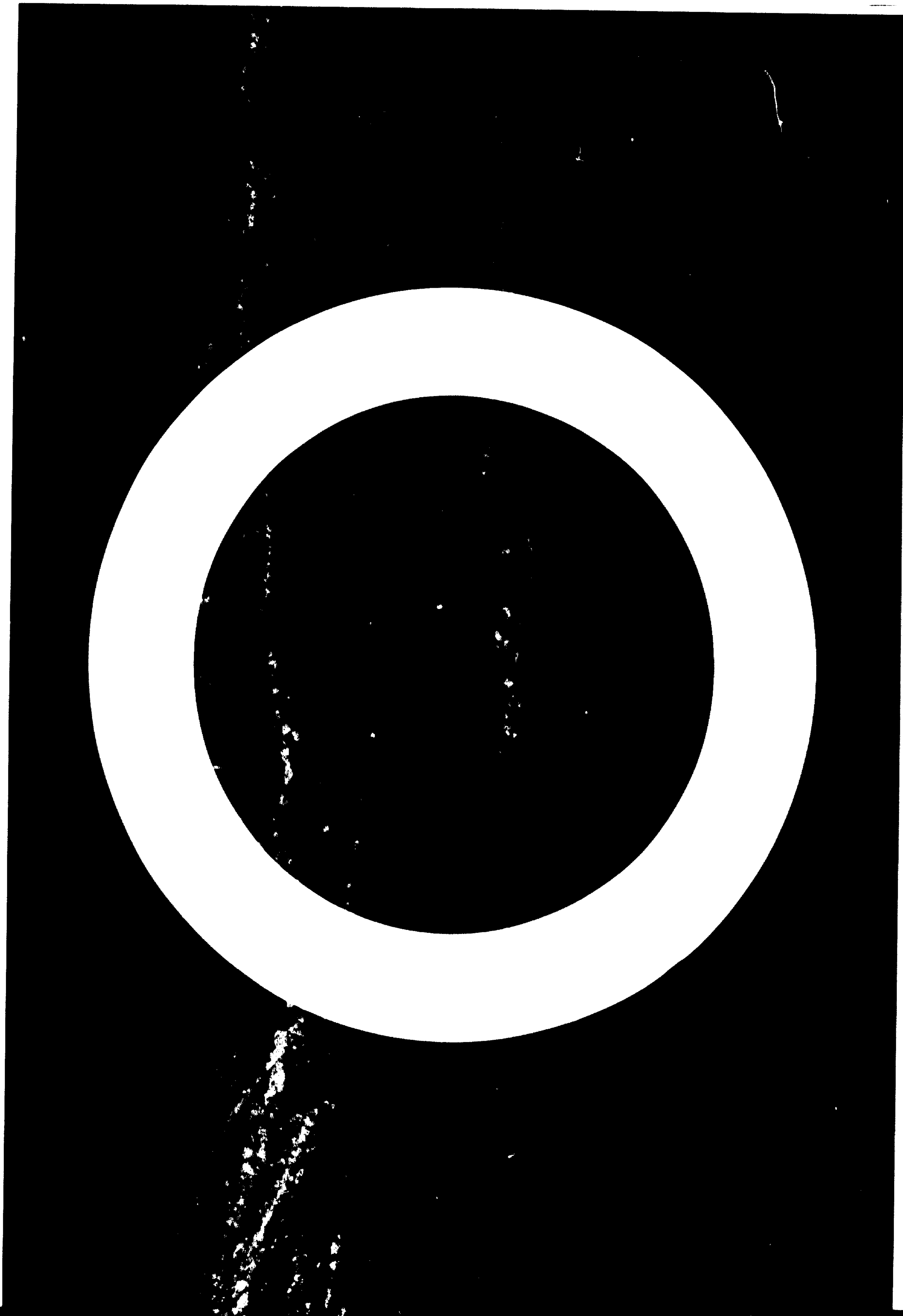
The present study deals with the transfer and adaptation of technology. The RAKTA pulp mill is the subject of a case study.

The study was prepared under the supervision of Maurice Macramalla, Director of the Social Planning Centre, INP. Two INP Industrial Planning Experts were charged with the analysis of data and preparation of the study, Saleh Moghieb, the Project Rapporteur, who prepared the introduction, chapters I, II, III and VI, and the bibliography, and Hosam Mandour, who prepared chapters IV and VII.

In the preparation of this study the Institute received assistance from the General Organization for Chemical Industry and the RAKTA pulp mill.

The authors wish to express their thanks to Ahmed Shukry Salem, Director of the General Organization for Chemical Industry, for participating in the formulation of the research plan, supervising some of the work, and reviewing, editing and translating some of the chapters; the managerial and technical personnel at RAKTA, who helped collect and prepare data and participated in discussions, especially M. Nosseir, M.A. Mostafa, H. Ibrahim, A. El-Toyal y. El-Haki, who prepared the technical annex; Ahmed Shalaby for translating the report; M. El-Garhy for helping in the editorial work; Atef Omar and Zihab Kandil for their assistance; and to all other individuals who extended their assistance during the course of the study, especially M. Fahmy, Secretary General of INP and his assistants, who efficiently handled administrative and other matters.

1/ The other three studies published under symbol UNIDO/IOD. 139 deal with the following aspects: Volume I with "The structure and organization of the Egyptian manufacturing industry since 1945", volume II with "Manufactured exports - development since 1950 and their future prospects" and volume III with "Small-scale" industries".



CONTENTS

Tables

Figures

INTRODUCTION

Transfer of technology can be effected in various ways. Its acquisition takes in the main, the following forms:1/

Purchase of machinery and equipment
Provision of human expertise in certain techniques
Provision of information of technical or commercial nature

Concern with the problems of transfer of technology from developed to developing countries has been increasing in the last few years. This concern involves the effects of transfer of technology on the national and project levels. On the one hand, developing countries are unable to produce the whole range of knowledge and experience necessary for the accomplishment of their productive and social activities; this necessarily implies resorting to the more advanced countries to obtain the needed technology. On the other hand, it is believed that, if left to the prevailing market forces, the transfer of technology would aggravate rather than alleviate problems of inequality and dependence in international social and economic relations.

Through the experience of RAKTA company in producing paper pulp, the characteristics of technology transfer to developing countries will be reviewed. The concept of technology here covers advanced techniques, systems, methodologies, experience and skills necessary for economic production in industry. Chapter I deals with general outlook on the choice of industrial technology and the role of government institutions. Chapter II clarifies the main economic features of the RAKTA company and the reasons behind its choice as a case study. Chapter III discusses the various channels for acquiring foreign technology. Chapter IV focuses attention upon the problem of the adaptation of raw material and the role of the pilot plant. Chapter V deals with the development of labour power required for absorbing, adapting and improving the master process. Chapter VI discusses the economic effects of adaptation. For those who are interested in the technical analysis, annex I discusses the process of adaptation and the development of technique.

1/ Ahmed Shukry, "Problems of transfer of technology to Arab countries", unpublished paper.

I. GENERAL OUTLOOK: CHOICE OF INDUSTRIAL TECHNOLOGY AND THE ROLE OF GOVERNMENT INSTITUTIONS

A. The economic impact of the transfer of technology

Importation of technology and adapting it to local conditions has been given considerable attention in the last few years in both theoretical and applied economic and mangerial thought. This attention - especially in developing countries - may be explained by several factors.

On the national level

Transfer of technology is receiving attention on the national level for the reasons stated below.

Interest in economic development

The problem of economic development has become a central concern for economists in both developed and developing countries since the Second World War. The attainment of independence by many developing countries was followed by attempts on their part to achieve economic independence and economic development in order to reach a higher standard of living for their citizens. The new national leaders had to face all the manifestations of underdevelopment like the low level of national product; rapidly increasing population with the concomitant reduction in income per capita; the imbalance among different economic sectors where agricultural and live stock production is characterized by low productivity, sensitivity to natural conditions, and a demand that is easily saturated.

To achieve sectoral balance and increase the national product, countries had to move towards industrialization because industry is characterized by high labour productivity, high sensitivity to technical and technological progress and highly elastic demand due to the fact that technical progress helps in increasing present needs and creating new ones. All this contributes towards increasing capital accumulation and multiplying the national product. However, we note that most developing countries suffer with varying degrees from the lack of capital and foreign currency, surplus of unskilled labour, and from a shortage in skilled labour. In order to exploit scarce resources and achieve national goals, it was decided to carry out an industrialization programme which depends to a large extent on importation of machinery, equipment and technological knowledge. This requires:

(a) Survey of available economic and productive resources and their alternative uses, and studying these alternatives analytically. Just as alternative uses of resources are analyzed, alternative objectives are analyzed to select the most important among them;

(b) Determination of those sectors for which transfer of technology is necessary;

(c) Stud of alternative means of technology importation and comparing those means c he bases of ne ds, costs and returns. In this process of comparison, consideration should be given to the society's technical, economic and social conditions;

(d) Even though the transfer of technology is a basic need that should be protected and encouraged by the governments of developing countries, these governments should establish some controls to organize the transfer of technology in such a way that it contributes to development without creating serious technical, social or economic problems for the society.

Enterprises' indirect effects on the national economy

The allocation of societal resources for a particular project may result in some indirect effects in addition to the direct effect of creating a production capacity. The effects vary from one project to another and may take several forms:

(a) Necessitating new investments in other fields of production - a project does not exist in vacuum. It is a production unit interconnected with other parts of the economy and may have indirect backward effects. The new project may require the expansion in the production of raw materials necessary for it. It may also have indirect foreward effects like building new related or complementary industries. Another example of such indirect effects is the increase in labour income from the new project which results in demand expansion for a variety of products;

(b) Building new projects is usually accompanied by increasing imports. This may originate from the direct construction and establishment needs of the new projects and the indirect demand caused by the increase in consumers wage income generated by the new projects;

(c) If the project is aimed at import substitution, or if some of its production is aimed at export markets, it will create direct and indirect effects on the balance of payments and the country's foreign currency resources. If the project succeeds in exporting a part of its output, it will reduce the balance of payments deficit caused by the establishment of the project. This may be followed by a surplus in the balance - depending on export quantities and prices. If the output of the new project is planned to replace imports, it should result in saving foreign currency that would have been directed towards imports. These saved funds can be directed towards importing other products or capital equipments that enhance the value of the national product. It should be noted however, that export or import substitution projects may create other indirect effects the nature of which depends upon the nature of economic interrelationship between the new projects and other projects. For example, the new project may result in increasing imports for industries providing the new project with its production requirements;

(d) In most developing countries facing less than full employment of labour conditions, the study of alternative techniques takes a special significance. Comparison of labour-intensive and capital-intensive techniques is essential in achieving technological balance at the national and sectoral levels. The use of labour-intensive techniques enables us to increase the employment of unskilled labour. This increase in employment results in a chain of reactions. The increase in wages leads to increased demand which results in turn in increased employment. The final result should be the flourishing of the national economy as a whole. Using capital-intensive techniques results in reducing costs, improving quality, advancement in knowledge and production art, and increasing reinvested capital. In comparing the two techniques, a balance between them should be sought in such a way that is consistent with societal conditions and objectives.

On the project level

Characteristics of investment decisions

Investment decisions are long-range decisions. After a project is established, its financial results - good or bad - will continue for the many years which constitute the productive age of the project - that is until it is completely depreciated, or until its management liquidates it. The transfer of capital from one project to another is far from easy, it may take several years and result in great losses if the decision to establish the project, and the techniques used in its execution have not been based upon sound technical and economic analysis. Mistakes in such decisions are different from mistakes in other managerial decisions, such as determining the level of inventory, or the level of employment. These latter mistakes can be corrected relatively quickly and easily. As a matter of fact, a wrong investment decision does not only tie up fixed capital and other related expenses,2/ but also ties up part of the working capital. However, this latter element can be transferred easily to other uses.

As soon as an investment decision is made, the remaining total available investment funds and means of allocating these funds are immediately affected. The investment decision also affects future investment possibilities. When

2/ Like expenses for study and research registration, experimentation, and interest on capital.

the investment is efficient, an economic surplus is created, national product is increased, and available reinvestment funds are increased. The opposite results if the original investment is unsuccessful.

A part of the investment for importing machinery, equipment, and technology is financed by way of foreign loans or credit facilities with interest. This interest represents the cost of capital. Consequently, the efficiency of these new investments has to be measured to ensure that the new project will generate returns to the enterprise and the society after paying the loans and their interests.

Technological progress

In most cases, the same product or service can be produced by more than one technique or method of production. Each of these alternative methods involves using a different mix of capital, labour, and materials. Consequently, each alternative has financial and economic consequences which are different from those resulting from other methods. Fast technological progress in modern times results in multiplication of methods of production and means of executing these methods. This makes it imperative to:

(a) Determine and study alternative methods of carrying out these projects, compare them, and make a choice among them;

(b) Determine and study alternative procedures for applying the method chosen above, compare them, and choose the most economically efficient among them;

(c) Study problems involved in implementing these techniques, and modify them to fit local conditions and capabilities. It may seem that the probability of choosing the best course increases as the number of alternatives increase. However, the freedom of choice among alternatives is not absolute.

There are usually limits or constraints on the choice. These constraints may be technical like the necessity to co-ordinate different production programmes; financial concerning the limits of local or foreign currency available; managerial concerning the inability of technical or managerial personnel to use a certain production technique; or finally they may be political concerning the refusal of the government to make a long term commitment to the country producing a particular new technique.

B. Government promotion and regulation

Since the inflow of new techniques and technology is a prerequisite for an accelerated rate of growth in various industrial sectors, the Government should promote this inflow. In the meantime, the Government should play an active role in ensuring that an adequate flow of technology into key industrial sectors takes place on terms that are in the country's interest. Government authorities in the Arab Republic of Egypt which play both a promotional and regulatory role, are many, and in various fields such as:

(a) The field of choice of technique and project evaluation;
(b) Contribution of foreign capital;
(c) Scientific research;
(d) Development of necessary skills.

Choice of technique and project evaluation

In the industrial sector, this is the role of the department concerned at the level of the project, and the General Organization for Industrialization.

General Organization for Industrialization[3]

This is a central agency under the supervision of the Minister of Industry. It collects information about industrial activity, helps in providing technical and economic studies about industrial projects, and in designing and executing industrial plans. No project is included in the national economic plan without the prior approval by the organization's board of directors. The organization has the following goals:

(a) Supporting, strengthening, and encouraging industrial production; directing it along technically and economically sound lines; attainment of the highest degree of self sufficiency;

(b) Achieving integration and co-ordination among various industrial projects, and between these projects and the country's comprehensive plan;

(c) Developing and modernizing the methods of establishing industrial projects on scientific bases, and according to modern international experience;

(d) Helping to increase the local processing content in machinery and equipment used in Egypt by making the necessary designs and allocating the work to suitable enterprises;

(e) Provide developing countries with technical assistance regarding the establishment of industrial projects.

3/ Presidential decree no. 1055 for 1967, Ministerial decree no. 744 for 1971.

Contribution of foreign capital

Most developing countries suffer from the inadequacy of their local resources to meet the financial needs of economic development programmes. Consequently, they seek the assistance of foreign capital, either in the form of direct investment, loans and bank credits, or gifts.

Recently, increasing amounts of funds have been transferred from developed to developing countries. Total loans and gifts from the United States, Europe, and Japan to developing countries have doubled in the period 1960-1970. On the other hand, loans and gifts from centrally planned to developing countries amounted to 3,981 millions in the period 1954-1967.

Funds are provided by centrally planned and developed market economies in the form of assistance or loans. Assistance funds are aimed at strengthening of country's defense potential, and the provision of services (e.g. education, health, and family planning). Consequently, such funds are supposed to provide, indirectly, funds necessary for industrialization since they make available other funds which would have been used for defense and services. However, the availability of assistance funds may create problems for industrial development. The availability of defense funds may encourage the increased expenditure on armaments and armies. Such expenditures are hard to cut back, and have to be met from local sources when the assistance is stopped. Furthermore, assistance provided in the form of consumer goods creates new consumption patterns which are hard to stop or modify after assistance stoppage.4/

The experience of developing countries shows that the real cost for loans and bank credits is much higher than the agreed upon interest rate. This is due to adding a group of expenses that take different names like project studies, and expert fees. Furthermore, some lending agencies increase the prices of goods financed by loans. The "price" of funds is usually high and may exceed the return on invested funds. This is due to using part of the funds in non-productive services necessary for the new project, or to management and operating conditions. In such circumstances, loans show results opposite to what was intended. So, they put additional international burdens on the economy. Furthermore, in many cases, funds available from foreign lending sources have not been enough to meet new project needs, a fact which made the lack of foreign funds a serious impediment to industrial expansion. It may be asked in this regard why should not foreign capital, looking for investment opportunities outside its borders, be encouraged to participate independently, or in partnership

4/ Atef Ebied "Industrialization - its rationale and problems in developing with local investors, in the process of economic development. In this regard, the Egyptian Government has on one hand issued a special law to promote and organize foreign investment, and the transfer of technology related to it and on the other hand established special agencies to promote and regulate the transfer of technology, such as the organization for Arab and International co-operation and the general organization for Arab and Foreign Investment and free zones.

The law No. 43 for 1974[5]

This law concerning the investment of Arab and foreign capital is aimed at achieving the following objectives:

(a) Securing the common interests of the national economy, and the Arab or foreign investor;

(b) Enabling local public and private capital to enter into partnership with Arab and foreign capital;

(c) Providing the economic environment which would facilitate the movement of Arab capital;

(d) Providing the environment that would make Egypt a financial center providing investment outlets for Arab funds in the Arab area;

(e) Providing enough guarantees against non-commercial risks, and proper incentives to encourage investment;

(f) Overcoming managerial and procedural obstacles to the growth of investment;

(g) Giving a special priority to these projects which increase the country's foreign currency resources, and those that bring with them advanced technologies.

5/ Article No. 2 of this law defines invested foreign capital to include:

(1) Free foreign currency transferred to Egypt at the official rate through any of the banks registered with the Central Bank of Egypt, for its expansions. Machines, equipments, means of transport, raw materials, and

(2) commodity necessities, imported from abroad which are necessary for the construction of the projects or their expansion, provided they are in accordance with the recent technical developments and had not been used before, unless the board of directors of the organization (for Arab and Foreign Investment) decrees an exception from this condition.

(3) Incorporated rights, such as patents and trade marks registered in any of the member countries of the Industrial Ownership International Federation, or in accordance with the international registration princip included in the international agreements concluded in this connection, and which are owned by residents abroad and are relevant to the projects

(4) Free foreign currency which is expended, such as the expenses of preliminary studies and researches, and the foundation expenses incurred by the investor, within the limits approved by the organization board of directors.

Organization for Arab and International Co-operation[6/]

This organization is directly under the supervision of the State Minister for International Economic Co-operation. The organization aims at organizing, developing, and supporting economic and technical co-operation between Egypt on one side; and Arab and foreign countries, technical aid agencies, national, regional and international financing agencies on the other side. The organization undertakes those activities which contribute towards accomplishing the above tasks. In particular, it undertakes the following tasks:

(a) Suggesting policies for technical and foreign co-operation with Arab and foreign countries; designing plans and priorities for implementing approved policies; and co-ordinating following up, and evaluating these policies;

(b) Supporting and encouraging Arab and foreign investment in Egypt and in the free zones in particular - in accordance with the economic and social development plan;

(c) Proposing laws and procedures for encouraging Arab and foreign investment;

(d) Making decisions regarding proposals by government agencies, public and private sector firms to participate in joint Arab and foreign investment projects to be built in or outside Egypt - all within the framework of a comprehensive economic and social development plan;

(e) Preparation and supervision of bilateral, regional, and international agreements concerning Arab and foreign investment; and following up the ratification and execution of these agreements;

(f) Preparation and supervision of technical and economic co-operation agreements with Arab and foreign countries; and following up the ratification and execution of these agreements;

(g) Undertaking official representation of Egypt, directing, and following up Egyptian relations with all national, regional, and international financing and investment insurance agencies; and also relations with national, regional and international technical and economic aid agencies;

(h) Representing Egypt in the Economic Council and the Economic Unity Council of the Arab League and following up Egyptian relationships with these councils;

6/ Presidential decree No. 337 for 1974.

(i) Preparation for loan and loan rescheduling agreements with Arab and foreign Governments, and following up their ratification and execution;

(j) Deciding on all issues concerning the payment of compensation for foreigners, ending the custody on their funds; preparation of agreements to be concluded with foreign Governments, and following up the ratification and execution of these agreements;

(k) Making a decision on all proposals made by different ministries in the fields of technical and economic co-operation and aid, all within the framework of a comprehensive plan of economic and social development;

(l) Publicity in foreign countries regarding investment opportunities in Egypt, and the Egyptian policy of strengthening economic and technical relationships with the outside world.

General Organization for Arab and Foreign Investment and Free Zones

This organization is charged with the implementation of the law for Arab and Foreign Investment.[7/] Specifically it has the following duties:

(a) Study of the laws and regulations regarding Arab and foreign investment in Egypt, and making any proposals in that regard;

(b) Making lists of activities and projects in which foreign capital is invited for investment. These lists are approved by the Council of Ministers after their approval by the organization's board of directors;

(c) Announcement of specific projects open for Arab and foreign investment, and providing technical advice concerning them, informing the international capital market, and capital exporting countries of the projects open for Arab and foreign investment and the advantages and guarantees provided for projects to be established in Egypt and its free zones;

(d) Study of foreign investment proposals. The board of directors makes the final decisions;

(e) Registration of foreign investment capital whether in foreign currency form, or in the form of incorporated rights which are evaluated on the bases of documents, international prices, and opinions of specialized experts; and evaluation of invested capital when it is transferred or liquidated for purposes of exportation abroad;

(f) Approval of transfer of profits abroad after careful examination of the firm's financial condition, and especially after ensuring that adequate depreciation and other allowances have been deducted from profits according to accepted accounting practices, and ensuring that due taxes have been paid (after the tax exemption period expires);

7/ Law No. 43 for 1974, Part II.

(g) Facilitating the process of obtaining the necessary permits for establishing Arab and foreign investment projects and for their regular operations.

Scientific research

The recent period has witnessed the intensive use of scientific research results in industry. Such research has contributed to the reduction in production cost, producing new products, and/or improving the quality of many products. This period is also witnessing continuous development in machinery and equipment for the purpose of improving their performance, or devising new labour saving production methods. No country entering into the industrialization stage can ignore these developments.

However, the response of developing countries to these developments depends upon their capacity to undertake scientific research. Such research requires both adequate scientific personnel and adequate funds. Furthermore, the experimental application of scientific research results in industry requires funds, expertise and a minimum level of management acceptance of the principle of experimentation for development.

The main problem facing the developing countries in this regard is their lack of scientific capabilities. Even when these capabilities exist, the general and scientific environments necessary for the exploitation of these capabilities are lacking in most of these countries. Unfortunately, many scientific centers in these countries have become isolated due to the lack of necessary financial resources, the irregularity in securing scientific books and periodicals, the cutbacks in equipment maintenance and renovation appropriations, and finally the restrictions on the travel of scientific personnel for the attendance of scientific conferences.

Developing countries attempting to import modern technology need scientific research capable of:

(a) Studying and absorbing new techniques and adapting them to local conditions;

(b) Product development for the purpose of improving the products' competitive position in the international markets;

(c) Studying production methods and processes for the purpose of reducing production costs;

(d) Reducing the incidence of idle capacities which is a common problem of developing countries;

(e) Modifying or adapting local raw materials to make them suitable for industrial usage.

In spite of the efforts made by developing countries to increase industrial production, it is typical to find part of their productive capacity idle due to the lack of necessary intermediate goods, services, skills or other reasons relating to industrialization strategy.

All of the above considerations lead Egypt to establish:

(a) The National Specialized Board for Education, Scientific Research and Technology;

(b) The Academy for Scientific Research and Technology;

(c) The Institute of National Planning.

The National Specialized Board for Education, Scientific Research and Technology

The main consideration in transfer of technology is that the technology must be correlated with the locally available inputs and with present and projected demand, also with culture, mores, values and human relations system. So a policy for transfer of technology is necessary for creation, development or reinforcement of the scientific technological, societal system so as to enable it to contribute to the selection and absorption of the acquired technology. This meant the foundation of the National Specialized Board for Education, Scientific Research, and Technology.

This board is charged with the following duties:

(a) To study and propose general policies for developing the national capabilities in education, research, and technology;

(b) To study and propose scientific plans concerning education, research, technology, and international co-operation in fields; to make use of human resources and to increase their efficiency in adapting to technological progress; to enhance the application of scientific research in problems of production development, and in other national problems;

(c) To co-ordinate various policies in those areas within the board's jurisdiction, to follow-up and evaluate the execution of plans in order to improve future policy in light of the national objectives.

This board is directly under the supervision of the president of the republic.

The Academy for Scientific Research and Technology[8]

The academy aims at supporting scientific research, and applying modern technology in economic and social development plans. It designs the policy which provides links between the research and technology agencies, and the main scientific and technological directions required by the total economic development plans. The academy is a public agency and is under the jurisdiction of the council of Ministers.

The Institute of National Planning[9]

The institute plays an important role in the adaptation of technology both managerially, and economically. The goals of the institute are:

(a) Carrying out, directing, and supervising planning, economic, social, statistical, and technical studies;

(b) Granting fellowships and stipends to encourage research;

(c) Organizing training and educational programmes, and issuing certificates for those that pass them;

(d) Sending scientific and practical missions outside and inside the country;

(e) Holding scientific conferences and meetings;

(f) Writing, translating, and publishing planning books and references;

(g) Giving opinion on drafts of laws, decisions, or projects relating to national planning.

The institute has carried out several studies relevant to various projects, has given advice in solving problems facing those projects, and contributed to the development of planning skills for the personnel of those projects.

Development of necessary skills

Developing countries suffer from a low level of national income together with a high rate of increase in population. This results in a low level of *per capita* income. Furthermore, the high rate of increase in population results in increasing the number of persons capable of and willing to work. Developing countries hope that industrialization would solve these problems, or at least reduce their intensity.

8/ Presidential decree No. 617 for 1971.

9/ Presidential decree No. 231 for 1960.

Referring to the population census of Egypt in 1960 - the year when most projects in the first five-years plan were started - we find that the total population was 26,130,000 out of which 47% were in the non-productive age groups (43.1% less than 15 and 3.9% more than 65 years old). The productive workforce did not exceed 6,391,000. The table 1 gives a percentage distribution of the workforce on the various job levels.

The existence of a labour force which has a potential use in industry does not mean that it is suitable for such use at present. Due to the nature of the educational system in Egypt, most of the surplus labour force do not have the ability to manage and operate factories. Studies on labour productivity in Egypt showed a low level of productivity, compared with developed countries, especially in the field of chemical industry.[10/] Furthermore, some of the skilled persons employed showed a tendency in the last few years to emmigrate from Egypt to other Arab countries like Kuwait and Saudi Arabia, due to the higher wages in these countries.

In this early stage of industrial planning, the Government was faced with two basic problems:

(a) The scarcity of skills which are necessary to manage and operate the new factories, and the shortage of these skills in the existing projects. The previous table shows that the percentage of persons in the first five job levels (managers technicians and supervisors, specialists, assistants, and skilled workers) is only 23.41% of the total workforce;

(b) A surplus of unskilled labour and the necessity for creating new job opportunities to absorb them.

Available studies point to considerable local, regional and international efforts to provide the necessary skills, and to adapt the surplus labour for use in the new industries. However, this effort fell short of what was required especially in the field of skills necessary for management and other main

---

10/ Magdi El-Kammash, Economic Development and Planning in Egypt (New York, Prager, 1968).

Table 1. Percentage distribution of workforce on the various job levels and types of economic activities in 1960

Type of activity	Agriculture	Mines and quarries	Transformation industries	Building and construction	Electricity, gas and water	Commerce and finance	Transportation and communication	Services	Total	Unclear or unknown	Grand total
Managers	0.01	0.52	0.55	1.9	0.9	0.5	1.5	3.4	0.85	-	0.83
Technicians and Supervisors	0.02	1.94	1.14	2.6	1.2	1.0	4.9	8.6	2.08	1.10	2.05
Specialists	0.06	2.66	0.76	1.4	2.1	0.4	1.3	5.9	1.34		1.37
Assistants	0.22	4.96	4.00	1.9	9.3	56.6	8.3	11.8	8.32	6.38	8.26
Skilled workers	0.22	9.59	70.76	11.6	19.7	0.9	2.1	12.7	10.83	11.62	10.90
Workers of average skill	41.66	12.60	18.59	65.9	9.1	38.4	46.4	33.0	37.90	11.52	37.12
Unskilled workers	57.76	67.04	3.82	14.4	56.8	2.1	15.9	23.0	38.19	10.82	37.38
Unclassified	0.06	0.69	0.38	0.3	0.9	0.1	0.6	1.6	0.44	57.88	2.14
Grand total	100	100	100	100	100	100	100	100	100	100	100

Source: Institute of National Planning, Manpower Planning (Cairo, Eguét, 1971).

activities. Since the supply of factories contracted for could not wait, and since manpower planning was not given due attention in the past, several measures were taken:[11]

(a) Selection of a group of government employees with administrative experience and training them for periods of 3-6 months. The value of such training was rather limited, since most trainees were between 40 and 60 years old. It has been scientifically established that the capacity for behaviour change and acquisition of new skills is very limited in this age group. Furthermore, giving responsibility for the new industrial projects to individuals in the early stages of their management career - their previous experience notwithstanding - proved to be rather risky;

(b) Employment of some successful businessmen with long experience as owners of small factories. Some believed that giving those people responsibility for managing the new projects will guarantee efficient management. However, this belief proved incorrect for two reasons. First, the skills that these persons had in running small enterprises were in many cases different from the experiences necessary for running large modern enterprises. Second, these businessmen used in their new jobs the same management style they were accustomed to in their small enterprises - i.e. extreme centralization and subjective rather than objective bases for decision making. The management of the new enterprises required a completely different management style;

(c) Enlisting the help of university professors in chairing the boards of the new projects. However, this was not entirely a successful experience since the professors had to divide their time between their new responsibilities and their university responsibilities.

As a result of the above problems and attempts to solve them, the Government finally realized that providing the management and operational skills necessary for the new projects required relatively long range training which could be considered an investment expenditure. Furthermore, it was realized that developing the necessary skills depends in the first place upon the existence of employment opportunities, and that the level of productivity is dependent upon the level of skill. For these reasons and beside the training departments the Government established:

The Higher Board for Training[12]

The National Institute for Management Development.

The Higher Board for Training

This Board has the following duties:

11/ Atef Ebied, "Industrialization: Its rationale and problems in the developing countries", unpublished study (in Arabic).

12/ Presidential decree no. 797 for 1972.

(a) Drawing the national policy for direction, training, technical and professional development of manpower at all levels for the purposes of increasing production efficiency, adapting to technological progress, and meeting the development needs in various areas of production and services;

(b) Co-ordination of various means used by different agencies in determining the levels of skills and abilities needed for different professions on the basis of accurate job descriptions;

(c) Co-ordination between various agencies responsible for design and development of training programmes;

(d) Drawing a plan to provide training requirements in all work sectors; and co-ordination between training budgets and investment, production, and development requirements.

This Board is headed by the Minister of Labour, and includes 14 deputy ministers in addition to represenatatives of other ministeries and agencies.

The National Institute for Management Development

This Institute is a public organization concerned with research, consultation, and training activities that serve the purpose of management development in all sectors of the national economy. To achieve its purposes, the institute carries out exchange visits and co-operation programmes with other countries, international agencies, and foreign institutes. The Institute is under the supervision of the state Minister of Management Development.

II. RAKTA MILL

A. The main features of RAKTA

Local demand for pap has increased as a result of the expansion in education, and the general improvement of the cultural and social levels of the population. In February 1958 a presidential decree was issued establishing the General Company for Paper Manufacturing (RAKTA). Nominal subscribed capital was LE 1,195,000 and was increased to LE 6,000,000 paid in full. Initial studies of the project were carried out first by the National Production Commission and then, by the Ministry of Industry. The project was included in the first five year plan (1960/61-1964/65). The site was selected in Tabia area in Alexandria.

Using the limited date at our disposal, this chapter reviews the basic features of the company at present. Our review is divided into two parts: (a) the production of the final product - paper;
(b) the production of the intermediate product - pulp.

Paper production

This section includes:

(a) Types of paper products;
(b) Total fixed assets;
(c) Regular production;
(d) Annual profit and value added.

Types of paper products

RAKTA produces several types of paper products, the most important of which are:

	g/m^2
Writing and printing paper	40-150
Printing offset paper	70-120
Writing paper super calendered	70-150
Sparta paper	70-100
Coloured paper	50-80
Azure paper with/or without water lines	100-120
Absorbant paper with/or without water marking	60-80
Ink absorbant paper	100-120

In addition to the above, the mill produces photo-copying paper, and air mail envelopes with/and without water marks.

Fixed assets

Total fixed assets in RAKTA were LE 15,875,000 on 31 December 1973. The sum is distributed according to the nature of assets as follows (in thousand LE): buildings 3,745, machinery 11,186, transportation means 552, tools 122, furniture 200. According to the activities, the share of pulp mill was 2,758, paper mill 7,704, service activities and non-productive activities 5,343, distributed as 5,044 for services, 171 for marketing and 128 for managements as represented in table 2.

Table 2. Total fixed assets for paper production on 31 December 1973 (in thousand LE)

	Pulp	Paper	Services	Marketing	Management	Total
Building	534	1537	1471	133	70	3745
Machinery	2221	5947	3018	-	-	11186
Transportation means	-	193	331	28	-	552
Tools	-	2	120	-	-	122
Furniture	3	25	104	10	58	200
Total	2758	7704	5044	171	128	15875

Regular production

The regular production of the paper mill in January 1962 amounted to 18,727 tons in 1962/63 and to 22,027 tons in 1965/66, increased again to be about the double in 1968/69 and reached 40,082 tons in 1973 as table 3 shows.

Table 3. Annual production of paper, 1961/62-1973 (tons)

Year	Production	Year	Production	
1961/62	11,874	1967/68	25.894	
1962/63	18,727	68/69	35.071	
1963/64	23,137	69/70	—	
1964/65	23,175	70/71	40,602	
1965/66	26,027	71/72	63,807	(18 month)
1966/67	26,109	1973	40,082	

Annual profit and value added

In 1963/64, the total profit was LE 753,000 and the total value added was LE 1,441,000. They increased to LE 984,000 and 1,643,000. In 1965/66, the total profit increased to LE 1,105,000, but the total value added decreased to LE 1,490,000. In 1967/68 the two items increased again.

Table 4 indicates the figures of total annual profit and total value added from the year 1963/64 to 1973.

Table 4. Total profit and value added for paper production, 1963/64 - 1973
(LE)

Year	Total profit before taxes	Total value added
1963/64	753,000	1,441,000
1964/65	984,000	1,643,000
1965/66	1,105,000	1,490,000
1966/67	1,247,000	1,650,000
1967/68	718,000	1,512,000
1968/69	1,423,000	2,416,000
1969/70	1,467,000	2,132,000
1970/71	1,386,000	2,246,000
1971/72 (18 month)	3,644,000	5,160,000
1973	2,137,000	3,266,000

The structure of employment of RAKTA will be discussed in chapter VI.

Pulp production

This section includes:

(a) Total fixed assets;
(b) Regular production;
(c) Value added;
(d) Effects on the balance of payments.

Total fixed assets

The contract which was signed on 22 December 1958 included a supply of an integrated mill for the production of straw and reeds bleached pulp with a contractual capacity of 65 tons/day of straw dry bleached pulp, and 9 tons/day of reeds dry pulp: for the purpose of expanding the bleaching capacity, to make use of the bagesse supplied by the Sugar Company at Idfu, a new bleaching unit was added with a capacity of 60 tons/day of dry bleached pulp which started production in 1970. The total investment in fixed assets both for the original and the new bleaching units was as clarified before LE 2,758,000, financed locally by LE 1,012,000. The rest is obtained by foreign credit facilities. The share of the original project in the total fixed assets was LE 201,800 and for new unit was LE 740,000 as table 5 indicates.

Table 5. Total fixed assets for the pulp millon on 31 December 1973 (thousand LE)

Item	Original project		Reed bleaching unit	
	Local	Foreign	Local	Foreign
Buildings	353	-	181	-
Machinery and equipment	345	1317	130	429
Furniture and office equipment	3	-	-	-
Total	701	1317	311	429

Regular production

Trial production runs in the pulp mill started in September 1961, and the regular production in January 1962. The annual production in 1962/62 was 12,779 tons, increased to 29,715 tons in 1965/66, then decreased to 27,491 tons in 1970/71 and to 25,778 tons in 1973 as table 6 shows.

Table 6. Annual production of straw and reeds bleached pulp, 1962 - 1973 (tons)

Year	Production	Year		Production
1962/63	12,779	1968/69		22,041
1963/64	19,483	1969/70		25,628
1964/65	19,604	1970/71		27,491
1965/66	29,715	1971/72	(18 months)	41,636
1966/67	22,933	1973		25,778
1967/68	21,341			

Figures do not include production of bagasse pulp, which started in 1970 and amounted to 9,382 tons of bleached pulp in 1973.

Value added[13/]

The value added amounted to LE 851,000 in 1963/64. Due to higher prices, and lower average cost of the raw and intermediate material, the

13/ Value added = value of production - (cost of raw materials + cost of intermediate products).

value added increased to 1,019,000 in 1964/65. As a result of high average cost of raw and intermediate material accompanied by a lower price of products, the value added decreased to 932,000 in 1965/66, to 894,000 in 1966/67. Due to high product price, volume of production, lower average cost of raw and intermediate material, the value added return increased to 1,389,00 in 1968/69, to 1,820,000 in 1969/70, to 2,172,000 in 1970/71 and to 257,000 in 1973, as table 7 shows.

Table 7. Value added from the production of straw and reeds bleached pulp, 1963 - 1973

Year	Production volume (tons of dry bleached pulp)	Selling price/ton (LE)	Cost of raw and intermediate materials (LE)	Value added	
				Per ton (LE)	Total (thousand LE)
1963/64	19.483	90	46	44	857
1964/65	19.604	96	44	52	1019
1965/66	20.715	96	5[illegible]	45	932
1966/67	22.932	90	51	39	894
1967/68	21.341	90	52	38	811
1968/69	22.041	107	44	63	1389
1969/70	25.628	113	42	71	1820
1970/71	27.491	121	42	79	2172
1971/72 (18 months)	41.636	113	47	66	2748
1973	25.778	150	50	100	2578

Note: The selling price for a ton of bleached pulp was based upon the purchase price for a ton of short fibre wood pulp. The rationale for this was the following: on the one hand, the company has no internal pricing policy for pulp as an intermediate product, on the other hand increasing the production by a ton of reeds and straw pulp means reducing the imports of wood pulp by a ton which reduced payments abroad by the value of that ton. Consideration was given, however, to the cost of raw and intermediate materials.

Effects on the balance of payments

The production of pulp represents an important substitution, which has direct and indirect effects on the balance of payments and the annual foreign currency saving.

The pulp mill had unfavourable effects on the balance of payments (see table 8) due to its dependence on the transfer of technology and partly on the imports of some raw and intermediate materials in the operation period. These effects amounted to LE 118,000 in both 1958/59 and 1959/60, to LE 176,000 in 1960/61 and 1961/62. They increased in the next three years as a result of large instalment payments and importation of raw and intermediate material and decreased later as a result of stoppage of credit facilities.

Despite this negative effect the pulp mill had priorities as an import substitute; its saving in foreign currency amounted to LE 520,000 in 1962/63 increased to LE 1,591,000 in 1965/66 as a result of instalments stoppage and reached LE 3,171,000 in 1973. Table 9 shows that savings in the first two years is more than the total foreign investment cost of the mill.

Table 8. Affect of straw and reeds bleached pulp production on the balance of payments, 1958-1973 (thousand LE)

Year	Instalments	Production needs	Effect on balance	Year	Instalments	Production needs	Effect on balance of payments
1958/59	118		118	1966/67		19	19
1959/60	118		118	1967/68		21	21
1960/61	176		176	1968/69		38	38
1961/62	176		176	1969/70		49	49
1962/63	188	59	247	1970/71		64	64
1963/64	188	38	226	1971/72		169	169
1964/65	249	18	267	1973		51	51
1965/66	-	60	60				

Table 9. Annual foreign currency saving from the production of straw and reeds bleached pulp, 1958 - 1975
(thousand LE)

Year	Production value	Effect on balance of payments	Foreign currency saving	Year	Production value	Effect on balance of payments	Foreign currency saving
1958/59		118	118	65/66	1651	60	1591
1959/60		118	118	66/67	1702	19	1683
60/61		176	176	67/68	1613	21	1592
61/62		176	176	68/69	1964	38	1926
62/63	767	247	520	69/70	2411	49	2362
63/64	1461	266	1235	70/71	2786	64	2722
64/65	1588	257	1321	71/72 (18 months)	3932	169	3763
				1973	3220	51	3121

B. <u>The pulp mill as a field for the research</u>

In a broad sense, this study deals with the transfer of technology in the RAKTA Co. RAKTA was chosen as a field of research for the following reasons:

(a) The RAKTA pulp mill is the largest mill producing pulp from agricultural residues in the world;

(b) In the early stages of planned industrialization in Egypt, i.e. during the first five-year plan, this type of industry was predominant and aimed at:

(i) Import substitution, in order to save foreign currency which is needed in other development projects;

(ii) Using locally available raw materials, especially when their prices are relatively low compared to processed materials;

(c) In this experiment of using agricultural residues, Egyptians were able to import, absorb, adapt and improve the new technology, and then it as a technical expertise in the field. The supplying firm gained new technical know-how in the process, which enabled it to reap substantial profits in other developing countries, even though it lost in its pioneering experiment in Egypt;

(d) The main problems of technology transfer in this industry are fairly common to the general ones in developing countries; these problems are:

(i) Multiplicity of means of transfer of technology;

(ii) Shortage of foreign currency;

(iii) Lack of skilled labour;

(iv) Lack or inadequacies of agencies which promote and regulate the transfer of technology;

(e) Finally, RAKTA mill satisfied the major conditions for a good study of transfer of technology. The data was - to a certain extent - available, the technicians were co-operative, and, most important, this mill succeeded in integrating imported technology and know-how with local capabilities.

III. TRANSFER OF TECHNOLOGY IN RAKTA MILL

The transfer of foreign technology to developing countries can take various forms depending on the kind of technological assistance that is needed, and the level of industrial development. Very often a combination of more than one method is used. The technology was transferred to RAKTA mill by:[14/]

(a) Providing technological expert assistance in pre-investment studies;

(b) Arranging for supply of machinery and equipment;

(c) Providing engineering and technical services;

(d) Employing individual foreign experts at the following stages: erection, tests and acceptance, putting the mill into operation;

(e) Providing training opportunities abroad;

(f) Internal and external co-operation for the adaptation of techniques, material and labour power;

(g) Utilization of local manufacturing capacities.

A. Technological expert assistance in the pre-investment studies

In this phase, the following techno-economic aspects were considered:

(a) Raw materials to be utilized in the production of pulp. In this connection, consideration was given to different alternative agricultural residues. For each alternative data were obtained regarding availability, technological feasibility, the type of pulp it produces and the cost of production. In carrying out these studies, reference was made to all research and development work in developed countries, especially in the United States of America and Europe. It was clear from the beginning that the technology and expertise related to rice straw, reeds and bagasse was rather limited. All parameters related to this raw material were gathered and scrutinized very carefully;

(b) Utilization of the pulp produced, knowing beforehand that it is short-fibre pulp. The percentage of imported long-fibre pulp to be used for different types of paper was considered. A decision was made concerning the proper system of bleaching. The decision on which type of paper to produce was based on many considerations: the needs of the country, the low percentage of imported long-fibre pulp needed, commercial and national economic profitability etc. As a result of all these considerations, it was decided to begin with producing writing and printing paper;

14/ The analysis is based mainly on articles of the contract and several discussion meetings with the experts of the General Organization of Chemical Industry and RAKTA Co.

(c) Availability of needed manpower. This involves the sources of recruitment, possibilities for the labour to suit the requirements of new industry, and methods of promoting the needed skills through local and foreign training programmes;

(d) Optimum size of the project according to technical and economic parametres;

(e) Economic, financial and commercial aspects. These included the size of financing needed, its sources, and the possibilities for obtaining credit from abroad. Financial analysis was carried out, the cost of production was assessed, and returns and revenues were calculated. The effect of the project on the balance of payments was studied. Furthermore, the indirect effects of the project on the national economy and on the industrial sector were also considered.

In carrying out all the above-mentioned pre-investment studies several visits to similar concerns were done. Local and foreign firms participated in these studies. Foreign experts were needed due to the lack of sufficient knowledge regarding the new technology to be utilized and its related economics. Local experts were needed because of their familiarity with local conditions, laws, regulations and standards, because they are capable of deciding to what extent the proposed technologies are applicable and of determining the needed skills and methods of obtaining or developing them.

B. Arrangements for supply of machinery and equipment

In developing countries, the inflow of technology is often viewed as a corollary to imports of machinery and equipment. The suppliers[15/] agreed, according to the contract,[16/] to deliver all machinery and equipment required for a complete pulp and paper mill with all its subsidiary plants for the production of 80 tons of pulp per day, with 10% moisture content, using Egyptian rice straw and reeds (phragnities communis), and the production of 60 tons of writing and/or printing paper with 6% moisture content.

Suppliers guaranteed that the machinery and equipment contracted for are of good quality and first-class workmanship and that they will show no defect for a period of one year, irrespective of the daily working hours, from the date of acceptance of every section or integral sub-section. However, the suppliers guaranteed all the

---

15/ The German group of manufacturers (hereinafter referred to as "suppliers") represented by F. Krupp Industriebau, Essen, as the leading company and comprised the following firms: Aschaffenburger Zellstoffwerke AG., Redenfelden; Escher Wyss GmbH, Ravensburg; Krauss-Maffei-Imperial GmbH and Co., Munich.

16/ The contract has been signed on the 22 December 1958.

delivered vehicles only for 6 months. They undertook to replace or repair all parts which have become defective within the guarantee period stated above, if those defects are caused by defects of material and/or workmanship. Such replacement or repair must be done by suppliers in the shortest possible time after having been informed by the purchaser.[17/]

This guarantee does not apply to damaged or broken parts. The above mentioned guarantee period will end, however, not later than 32 (thirty two) months from the date of the f.o.b. delivery of the last consignment of machinery and equipment contracted for. If defective parts are replaced, the period of guarantee of one year applies to the new parts also. If stoppages occur due to the above mentioned defects or due to replacement or construction of defective parts, the period of delay shall be added to the guarantee time of these parts. Also the suppliers shall submit to the purchaser within a reasonable period a list of all small special tools and instruments to be supplied by them. The purchaser shall be responsible for the punctual transport, at his own expense, of the tools and equipment from the supplier's work to the site and back, and he shall in particular secure any official approval required for import into and export from Egypt of the tools and equipment and exempt the suppliers from any fees or charges. All deliveries contracted for[18/] are made f.o.b. Northern Germany, according to the incoterms 1953.

C. Engineering and technical services[19/]

Since production of pulp does not have an established technological base, engineering and technical services were necessary to cover certain

---

17/ The general organization for executing the five-year industrial plan, hereinafter referred to as "purchaser".

18/ The price of the deliveries contracted for is DM 45,000,000. This total price includes: DM 1,818,012, for spare parts and DM 750,000 for auxiliaries. The supplier has granted the purchaser credit facilities which enable the latter to make instalment payments during a period of six years from the date of signing the contract according to the following schedule: 10% after two weeks, 10% after 12 months, 15% after 24 months, 15% after 36 months, 15% after 48 months, 15% after 60 months, 20% after 72 months.

19/ The price of the engineering and technical services to be furnished is DM 2,075,000. The supplier has granted credit facilities to the purchaser to enable him to pay the amount in instalments according to the following schedule: 20% after 30 days, 20% after 12 months, 20% after 24 months, 20% after 36 months, 20% after 48 months.

specific gaps in the technological knowledge regarding the installation and operation of new manufacturing techniques and processes. The outflow of the engineering and technical services has been greatest from the Federal Republic of Germany. An agreement has been reached with Reflex Papierfabrik, Felix Heinrich Scholler GmbH, who thereby undertook to make available to the purchaser, through the suppliers, their experience and know-how in the production of pulp using rice straw as a raw material.

Scope of engineering and technical services

The following information and data were to be supplied within 12 months after the contract had been signed:

1. Process description and technical data covering:

Fibrous raw materials (rice straw and reeds)

Baling
Binding
Transportation
Stockpiling and removal from stockpile

Straw and reed preparation

Chopping of straw
Dedusting and washing
Pilling of chopped straw
Transport of chopped straw to digester house

Digesters

Digester house and preparation of the cooking liquor
Blowing of digester
Pulp washing
Heat recovery

Pulp preparation and bleaching

Screening of unbleached material
Bleaching
Washing
Screening of bleached material
High density stock chests
Wet machine

Paper mill

Pulp preparation and refining
Screening
Preparation of purchased fibrous materials
Preparation and proportioning of filler, alum and size

Paper making

Operation of the paper machines
Winding
Calendering
Cutting
Sorting
Counting
Packing and weighing
Storing

Service departments

Treatment of boiler feed water
Treatment of process water
Waste water disposal

Steam and power

Steam generation
Electricity generation
Energy distribution
Condensate return

2. Laboratory and inspection - procurement of raw materials: Delivery of specifications for all raw materials used in factory, particularly as regards imported cellulose fibres, fillers, dyes, chemicals, lubricants, mechanical equipment (felts, wires), detergents, cleaning agents etc.

3. Operating instructions and technical data: Complete engineering of the mill including:

Process calculations and completely balanced process flow sheets
Complete detailed equipment lists and complete engineering flow sheets
Complete preliminary layouts and plot plans
Complete mechanical layout drawings and details
Complete piping drawings and details where necessary
Complete electrical drawing and details
Complete architectural structural, and civil engineering drawings and details but not including foundations
Calculation sheets for all building sheets of the statistical calculations in German and English should be prepared by the supplier, together with explanatory sketches and diagrams, in duplicate
Complete bills of materials, sector lists, pump lists, value lists, wiring schedules, piping schedules, reinforcing steel bar lists, structural steel lists etc. all in complete detail

Complete specifications for all machinery, piping, electrical equipment, materials, and buildings

Complete building quantity surveys

Preparation of final as-built drawings

The suppliers have to forward to the purchaser triplicate copies of all the general process drawings to be revised, and approved by the purchaser

Assembly drawings for individual machines

Detailed drawings will be supplied for parts that are subject to increased wear, or require special maintenance service

Operating and maintenance instructions shall be in the form of complete manuals describing - in detail - operating and maintenance procedures for all machines and departments, and will indicate the spare parts probably required within one year of operation.

4. Organization:

This involves the supply of an organization chart for all stages of administration and production, particularly with regard to accounting, cost accounting, flow of raw materials and finished products as well as keeping records thereon. In particular:

Job procedures manuals for the various phases of production in the whole plant

Job description and evaluation

Description of maintenance recording system

Inventory set-up for machinery, equipment and spares

D. Employment of individual foreign experts

The arrangement for technology transfer ensured the flow of technology that is considered adequate to meet the gaps in technological knowledge by employment of foreign experts in the stages of construction, tests and putting the mill into operation.

Advisory services

It is conceded by mutual agreement of both parties that an advisory engineer will supervise the execution of the construction work. This engineer shall have a solid background in establishing paper mills. In addition, his obligations are specified as follows:

(a) Scheduling of construction, and equipment installations;

(b) Checking of all work done by constructors to ensure conformity to drawings and specification;

(c) Checking of materials, quantities and labour used by contractors;

(d) Preparation of progress reports;

(e) Maintenance of co-ordination and progress of construction in conformity with established schedules;

(f) Expediting.

He shall also co-ordinate both, erection and construction.

Erection services

Suppliers carried out through their experts the erection and undertook to terminate the erection within 8 months after arrival of the last major piece of the machinery and equipment contracted for.[20]

Preliminary tests and acceptance

As soon as the erection of a section of the plant is completed, the suppliers shall notify the purchaser of their readiness to proceed with the preliminary tests, which are to prove that the section is fit to be operated. For these preliminary tests, a period of about two months after completion of erection is envisaged. Suppliers shall determine dates and procedure of such tests, bear all the costs of the members of their staff. During the test runs the operation of the mill shall be carried out in accordance with suppliers instructions.

According to the contract, the purchaser must send the suppliers his written acceptance or non-acceptance giving his reasons within two weeks from the suppliers notification. The acceptance of each section automatically transfers all risks and responsibilities to the purchaser, except for their responsibilities, obligations, and guarantees stated in the contract.[21]

Putting the mill into operation

In connection with starting up the erected plant the suppliers undertook to operate and test the mill, at purchaser's risk and responsibility, in such a way that a qualified staff of 35 persons shall guide and advise purchaser's qualified labourers who shall take into consideration requests and recommendations made by the suppliers team. The activities of such staff shall begin after acceptance of the plant and are limited to four months.

20/ This is against DM 2,616,067 plus air and/or mail way tickets, and DM 1,500 per person for preparation to leave the Federal Republic of Germany.

21/ Guarantees mentioned in the contract covered machinery and equipment, power station guarantees and guarantee of production (quantity-quality-consumption).

Suppliers team comprised the following professions: team leader, engineer, chemist, laboratory assistant, work superintendent, digester foreman, bleaching foreman, stock preparator, papermachine superintendent, salle foreman, calender operation, mechanic and electrician. It is understood that the mentioned persons have solid long practical experience or special training in manufacturing plants for pulp and writing and printing papers made from such pulp.22/

E. Training abroad

One of the basic elements in the production process is the availability of trained personnel to carry out direct and indirect operations. This is particularly critical for this industry which is new to the national economy. A well planned training programme is extremely important for adequate absorption of the new technology. This programme has been planned and implemented by the company in co-operation with the supplier and other scientific establishments abroad. This programme included:23/

(a) In the construction phase: The contract specified that the suppliers shall employ in their works some members of the purchaser's staff; the persons shall be trained in the regular production processes. None of the costs incurred in connection with the training will be born by the suppliers. According to this, the company sent 10 persons for training in the pulp production factories for periods of six to seven months;

(b) In the operational phase: In spite of scarcity of foreign currency, the company was able to send some of its employees abroad for training in pulp and paper production. Training grants (three months to two years) were obtained and employees were sent to several countries including Norway and Sweden.

F. Internal and external co-operation for the adaptation of technology

The company was able to overcome the problems of preliminary studies by using foreign experts and foreign studies, and the problems of financing

22/ The price of the above-mentioned services for the first four months was DM 500,000. Payment is made both in DM and LE according to be following schedule: 25% when the group starts to work; 25% after two months; 25% after three months; 35% after four months.

23/ See also chapter V.

by obtaining credit facilities from the supplier. However, after the beginning of operation, the company was faced with two problems:

(a) The adaptation of technology to local conditions in such a way as to achieve maximum production efficiency and internal balance of different manufacturing stages. Company operations experts and suppliers experts co-operated in discovering causes behind the problems, and in suggesting solutions for them. Areas of this co-operation included raw materials, consumption of chemicals, machinery design, and development of technical skills;

(b) The need to keep up with recent technical developments in the field. In this regard, the company decided upon obtaining subscriptions in specialized scientific periodicals, participating in scientific conferences in pulp production, and exchanging visits and communications with supplier's experts, and with the similar factories abroad.

G. Utilization of local manufacturing capacities

The contract specifies that "the suppliers undertake to make use, as much as possible, of the local workshops to manufacture machinery and equipment or parts of them, provided that this shall not impair the quality or the efficiency of such machinery and equipment or cause a delay in the completion of the plant".

However, including such a provision and emphasizing it results in the following:

(a) Increasing the percentage of local processing of machinery and equipment necessary for new industrial projects, hence expanding the local manufacturing base;

(b) Continuous development of techniques of operating and managing these projects;

(c) Development of industrial design skills, according to modern international scientific principles and experience;

(d) Co-operation with foreign consulting firms in the fields of designing and manufacturing these parts.

IV. ADAPTATION OF RAW MATERIALS AND THE ROLE OF THE PILOT PLANT

A. Fibrous raw materials utilized for pulp production

Wood is the principal raw material used in pulp production. Other non-wood plant fibres such as sugarcane, bagasse, straws, reeds, bamboo and grasses are also being used in pulp production. Although these non-wood plant fibres now constitute only about 5% of the raw materials utilized for pulp and paper production on a world-wide basis, the output of non-wood pulp, on a percentage basis, has been increasing faster than the output of wood pulp. The world-wide average annual increase in the use of these fibres has amounted to about 10% over the past ten years, with average annual increases in Latin America, Africa, and the Asia-Pacific areas amounting to about 20%. By contrast, the world-wide average increase in the use of wood pulp has amounted to about 5.6% over the past ten years.

We can see that the last decade has witnessed an increasing interest in the utilization of agricultural residues. Developing countries, by and large, have taken the most interest, for several reasons:

(a) Basically most of these countries, by reason of their economic structure, suffer from a shortage of foreign funds to purchase imported pulp. To be able to establish their paper industry they cannot depend on foreign sources of pulp. At the least they have to produce locally a good part of their needs of pulp;

(b) These countries, or most of them, lack the species of wood suited for pulp making. Their only alternative is to substitute for wood some unconventional source of cellulosic fibres, whether it may be agricultural residues, tropical wood, bagasse or one of the many other similar raw materials;

(c) In general, developing countries tend to give preference to industrial projects which yield the highest value added. The utilization of a cheap agricultural waste to produce a fairly costly product such as pulp is certainly a temptation. At the same time they save the foreign currency they would otherwise have to spend on importing their needs of pulp or paper. Paper is of course most necessary for their educational programmes;

(d) An additional reason driving the developing countries to build their own paper mill based on local raw materials is the sudden and successive changes in the price of pulp and paper in the last few years. Such changes make long-term planning very difficult.

This trend to utilize agricultural residues has met several impediments. Perhaps the most serious one is the comparatively primitive technology of pulping these residues, when compared to the new and sophisticated developments in pulping wood. This may be attributed to the fact that most of the developing countries lack know-how, research and development facilities, as well as trained personnel.

Moreover, the diversity of these agricultural residues, and consequently the differing technologies involved in the treatment of each one of them add to the difficulties met in their utilization.

Nevertheless, most of the developing countries will have to overcome these impediments should they want to establish a local pulp and paper industry.

Rice straw is available in large quantities in many countries of Asia, Africa and South America. It is generally a cheap raw material because it finds less use than most other straws on the farm, a fact which under certain circumstances, gives it a distinct advantage.

Egypt is one of the countries which decided to utilize rice straw as the major raw material for its largest pulp and paper mill. In the mid-1950s the Egyptian Government started a study of its local agricultural residues to choose the most suitable one for pulp and paper making, both technologically and economically.

Extensive studies indicated that rice straw has certain economic advantages. It is cheap and since it is not usually used as cattle fodder, its price is not likely to rise appreciably in the future. Moreover, rice plantations are concentrated in certain areas of the country, a fact which makes collection and transportation relatively simple.

The mill included some new features especially designed to cope with the special nature of rice straw. The most important of these features is the wet-cleaning process, which was used for the first time and which has gained wide use since. In addition many of the standard machines used in the mill were modified to suit this new raw material.

All these features were introduced on the basis of pilot plant development work done by suppliers from the Federal Republic of Germany and by RAKTA technicians in the USDA laboratories in Peoria, Illinois, United States.

In spite of the amount of work accomplished prior to the building of equipment, it was expected that the start-up of the operation would meet with difficulties, due to using a fairly unfamiliar raw material.

Perhaps it is necessary to give an account of the nature and characteristics of non-wood plant fibres when used as a paper making raw material as an introduction to the experiences encountered in pulp and paper mill based on these raw materials.

B. Characteristics of non-wood plant fibres

Based roughly on chemical composition, fibre dimensions, density of raw material and ease of pulping, those plants that have received most industrial attention as raw materials for pulp making are conventionally classified into five groups as shown in the following list:

Group	Fiber	Plants chiefly used as pulp sources
1	Straws and esparto	Wheat, rye, rice, esparto
2	Canes and reeds	Sugarcane bagasse, Arundo Donax, cornstalks, phragmites communis Trin
3	Woody stalks with bast fibers	Flax, hemp, cotton, soybean.
4	Leaf fibers	Abaca (manila), sisal, henequen, pineapple, caroa
5	Bamboos	Various varieties.

Chemical composition of non-wood plant fibres

Table 10 shows the approximate variations in the principal chemical components of these plants or plant fibres. From the data it will be noted that the annual plants contain more ash than the pulp-woods. The cereal straws, particularly rice straw, have high ash contents.

In lignin content, the bast and leaf fibres are quite low. It is high in all pulpwoods, bamboos, and woody stems of plants producing bast fibres. The cereal straws and esparto contain less lignin than the stalks and reeds, but the plants of groups 1 and 2 are lower in lignin than the pulpwoods, bamboos, and woody plant stems. These differences are reflected in the amounts of chemicals required for producing fine bleached pulps from the members of the various groups.

The pentosan content of the bast fibres is very low while the straws, esparto, stalks and reeds analyse highest in this component. However, the deciduous pulpwood and the leaf fibres approach the straws in pentosan content and decreasing amounts are found in the woody stems, bamboos and coniferous pulpwoods.

The alpha-cellulose contents are highest in the bast and leaf fibres, decreasing slightly in the order, bamboos, coniferous woods, stalks and reeds. The deciduous woods contain slightly more cellulose consituents than straws and esparto and woody stems contain the least. Pith-free bagasse fibre compares favourably in cellulose contents with coniferous woods. The cellulose content of pith (parenchyma) is lower than that of the fibre. Bamboos analyze higher in cellulose than the coniferous pulpwoods.

Physical properties and dimensions of non-wood plant fibres

Variations in fibre dimensions are listed in table 11. As is well known, the bast and leaf fibres are much longer than those of any other groups. Coniferous woods (softwoods) and bamboos possess fibres of substantially the same length. Such fibres produce high tear resistance in paper and, in fact, possess near the maximum length practiced for good papermaking. The deciduous woods (hardwoods), straws, esparto, stalks, and reeds have somewhat shorter fibres. They vary about the same in

Table 10. Agricultural fibres and pulpwoods: principal chemical components (percentages)

Group	Fiber	Ash	Lignin	Pentosans	Alpha-cellulose
1	Straws and esparto	6–8	17–19	27–32	33–38
	Rice straw	14–20	12–14	23–25	28–36
2	Stalks and reeds	3–6	18–22	28–32	33–43
	Sugarcane fibers	2	19–21	30–32	40–43
3	Woody stalks with bast fibers				
	(a) Woody stems	2–3	23–27	15–22	31–33
	(b) Bast fibers	1–2	1–6	2–6	60 +
4	Leaf fibers	0.6–1.2	7–10	17–24	53–64
5	Bamboos	1–2	24–29	16–18	50 +
6	Coniferous woods	< 1	26–34	7–14	40–45
7	Deciduous woods	< 1	23–30	19–26	38–49

Table 11. Wood and non-wood fibres: fibre dimensions and ease of pulping

Group	Fiber	Average lenght (mm)	Average diameter (mm)	Ratio length to diameter	Relative density	Relative ease of pulping
1	Straws and esparto	1,100-1,500	9-13	110-120:1	Open	1
	Rice straw	1,450	8.5	170:1	Open	1
2	Stalks and reeds	1,100-1,800	8-20	80-120:1	Open	2
	Sugarcane fibers	1,700	20	85:1	Open	2
3	Woody stalks with bast fibers					
	(a) Woody stems	200-300	10-11	< 30 :1	Dense	4
	(b) Bast fibers	20,000-25,000	16-22	>500 :1	Open	3
4	Leaf fibers	6,000-9,000	16-18	250-300:1	Open	3
5	Bamboos	2,700	14	200:1	Dense	4
6	Coniferous woods	2,700-3,600	32-34	75-90:1	Dense	4
7	Deciduous woods	1,000-1,600	38-50	<50 :1	Dense	4

length among the various groups as do the individual fibres within the groups. The tearing strength of papers made from them also is low and such papers is not so suited for wrapping and bags, when papers made of longer fiber is available. Fibres of the woody stems of plants in group 3 are very short and entirely unsuited for tear-resistant paper.

The ratio of fibre length to fibre diameter, the so-called "slenderness ratio", is one of the most important criteria for evaluating papermaking fibres. With the exception of the fibres of the woody stems, this ration is higher for all non-wood plant fibres than those of pulpwoods. The values for bast and leaf fibres are exceptional. The ratios for rice straw and bamboo are about twice those of coniferous woods, which are also exceeded by straws, esparto, and some of the reeds. Sugarcane bagasse fibres compare very favourably with the conifers with respect to this ratio. The fibres of the deciduous woods as compared with those of groups 1 and 2 show less than one half to one third of their ratio, while the ratio in the case of the woody stems is exceedingly poor. The high "slenderness ratio" is believed to give some compensation for the short length of these common nonwood plant fibres.

C. Availability of fibrous raw materials in Egypt and their utilization

Although Egypt is short of wood, it has an enormous supply of non-wood fibres in the form of agricultural residues including rice straw, wheat straw, cotton stalks, corn stalks and sugarcane bagasses. Other non-wood fibres such as date palm leaves and common reed are also found.

As rice straw has become the basis for the most modern pulp mill (RAKTA) in Egypt, its availability and problems encountered in its collection, baling, transportation and storage will be discussed.

Rice straw

In Egypt, rice cultivation covers about 1.2 million acres, which is about 17% of the cultivated area. The northern part of the delta is the main rice belt, it includes 95% of the rice cultivated area. Table 12 shows the distibution of rice plantation in Egypt in 1958. The estimated amount of rice straw available per year is about 2 million tons. However,

Table 12. Percentage of rice acreage in Egypt (crop 1968)

Province	Percentage of rice acreage
Alexandria	0.59
Behira	21.0
Gharbia	6.06
Kafr El Seikh	20.90
Dakahlia	27.80
Damieta	4.87
Sharkia	15.68
Esmailia	0.40
Suez	0.02
Menufia	0.30
Kaliobia	0.70
Cairo	0.03
Giza	0.14
Beni Suef	0.14
Faium	1.31
Menia	0.06
Total	100

it is incorrect to assume that the quantities available as a by product on the farm could all be collected and used by the industry. In reality, only a small part could be procured. This part is estimated to be between 5 and 20% with the higher percentage being under the best conditions. This unavoidable loss is due to many factors, mainly the lack of roads transportation, normal loss on the farm during harvesting and storing (especially in the case of small farms) and long distance between the farm and the mill which makes transportation costs prohibitive.

The sequence of operations which rice straw undergoes from the farm to the mill is the following:

(a) Collection on the farm: Rice when ripe is cut either by hand or machine, made into bundles, stored in farmyards to dry and then threshed. All these operations are usually carried out by the farmers;

(b) Baling: Since the transportation of bulky loose straw is quite costly, it is much better to carry out baling on the farm as long as road conditions will allow. Several types of balers can be used for this purpose. However, in regions where the maintenance of elaborate machines is difficult, such as fully automatic balers with tying devices, it may be more prudent to use simpler equipment. When deciding on the kind and size of bale, it is necessary to choose a weight which can be handled manually, i.e. about 50 kg. As to size, the only real consideration is dimension of the chopping machine in the mill. Another important factor to be considered is the density of the bale. A density of 0.15 to 0.2 has to be reached. A bale with lower density cannot stand up to handling during transportation and causes excessive waste. The baling season extends to about four months after threshing;

(c) Transportation: The choice of transport from farm to mill is a matter to be decided on the basis of local conditions. In Egypt, trucks are invariably used since river or railroad transportation would involve double handling and result in higher cost. However, this may not always be the case elsewhere;

(d) Storage: Since the baling and transportation operations are seasonal, only a part of the straw coming to the mill is used directly, the remainder has to be stored in piles for off-season use.

It is to be stated here that RAKTA had initiated and developed such new activities and techniques of collection, baling and transportation of straw.

Cereal straws

Of the various cereal straws, wheat and barley straws contribute a substantial source of fibrous raw materials in Egypt. Wheat straw is favoured for the best paper pulp, while barley straw is said to be unsuitable because of poor drainage and poor strength of the pulp. However, the competitive uses of wheat and barley straws for cattle fodder and other agricultural uses, could hardly leave any substantial amount of these straws for the pulp industry.

Sugarcane bagasse

Bagasse, the fibrous raw material remaining after the juice is pressed from the sugarcane in sugar mills, is abundant in Egypt. About 600,000 t/year bagasse (dry-basis) are available from sugar mills located in Upper Egypt. However, the amount of bagasse that could be made available for pulping from the amount currently utilized as fuel would result from either improved thermal efficiency in the sugar mills or the use of an alternate fuel. It is estimated that improved thermal efficiency in the sugar mills can result in 20% of the bagasse production being excess of the fuel requirements of the mills. If the domestic pulp and paper industry requires more than the amount of bagasse released by improved thermal efficiency in the sugar mills, the use of a substitute fuel becomes the significant factor.

At present, bagasse is used in one mill at Edfu (Upper Egypt) for producing about 16,000 t/year of unbleached chemical pulp. This pulp is used in various grades of paper including writing and printing paper, wrapping paper and linerboard. Another mill using bagasse for particle board production is also running in Com Ombo (Upper Egypt).

Projects for the utilization of more bagasse for the production of chemical, semichemical and mechanical pulps to be used in making news-prints, writing and printing paper, wrapping paper and board are under study. This is due to the fact that bagasse is considered a promising fibrous material as it is suitable for making various grades of paper and board and presents less problems in collection and transportation.

Cotton stalks

In Egypt about one fourth of the cultivated area is given to cotton growing. Estimated annual output of cotton stalks is approximately 4 million tons. For the time being, cotton stalks are mainly used by the farmers as fuel. However, through continual social and economic development, other fuels such as oil and gas would substitute cotton stalks, thus making a substantial amount of cotton stalks available for pulp industry.

Extensive studies and research work carried out at RAKTA Pilot Plant have shown that debarked cotton stalks could be used for making various grades of paper and board. Debarking of cotton stalks is essential for producing high quality pulp. However, complete debarking of the stalks is not achievable by the available barking machines and thus an elaborate barking machine has to be developed to suit this raw material. Nevertheless, partially debarked or undebarked (whole) stalks could be used for making semichemical pulp for board as well as for chemical pulp for various grades of paper including writing and printing. In the latter case, more pulping and bleaching chemicals are required than for debarked stalks.

An advantage of cotton stalks is that it contains low ash-content of 2 - 2.5% and very low silica content which makes the recovery of heat and chemicals in the sulphate pulping process possible.

Reeds

The predominant species found in Egypt is Phragmites communis which grow wild along the shores of the lakes in the northern parts of the Delta. Estimation of the available quantity in 1957 was 10,000 t/year. Although the reed is a good papermaking fibre, as has been experienced by RAKTA and other pulp mills for several years, the difficulties encountered in its collection, transportation and storage has led to stop its use in Egypt. Another disadvantage is that the growth rate of reed after renewed harvesting may decrease so that its reliability as long-term economic fibre supply can be seriously questioned.

Date palm leaves

Date palm trees grow in Egypt in considerable numbers. Statistics of 1960 indicated that the total number of date palm trees grown in lower and Upper Egypt was approximately 7 million trees. Estimated amount of palm leaves produced were about 70,000 t/year. At present, almost all these leaves are used for making containers for vegetables and fruits as well as for other uses.

Industrial experience in utilizing palm leaves as a fibrous material for pulp and paper is not available. However, investigation at the RAKTA pilot plant has shown that the leaf midribs of date palm trees are considered a potential source of fibre for making various grades of paper including fine and wrapping papers. The pulp produced from data palm leaf midrib under favourable pulping conditions had good yield and quality. The pulp strength compares favourably with that of long-fibred pulp from softwoods.

D. The role of the pilot plant at RAKTA pulp and paper mill in the adaptation of raw materials

One of the outstanding features of RAKTA project was the instalment of a pilot plant and a complete laboratory to carry out research and development work on pulp and paper making from agricultural residues and other non-wood plant fibres. The lack in world knowledge and industrial experience in that field at the time of planning and executing RAKTA project in the 1950s, has made the role of this pilot plant in technological development in pulping such raw materials of vital importance to the pulp and paper industry in Egypt and in other developing countries.

The role of RAKTA pilot plant has been directed towards:

(a) Technological development in pulping of rice straw; reed and bagasse which are the main fibrous materials utilized in Egypt;

(b) Investigation of the other local fibrous materials such as cotton stalks, flax straw, date palm leaves and the like for future utilization in pulp and paper industry;

(c) Technical suitability studies on local and external fibrous materials to provide data required for the design of pulp and paper mills in Egypt and in foreign countries, e.g. India, Iraq and Pakistan. Examples of the research and development work achieved at RAKTA pilot plant will be mentioned below.

Pulping of rice straw

Wet cleaning of rice straw

The specific nature of rice straw makes it unique among the straws. Rice straw contains a high proportion of non-fibrous cells and extraneous materials in addition to its high silica content. Because of these ingredients, which adversely affect its pulping, bleaching, and papermaking characteristics, the use of rice straw was restricted to the production of semichemical pulp for making corrugated board and lower grade wrapping papers.

For the production of bleached pulp for fine paper, it is essential to remove a substantial part of the nonfibrous cells and extraneous materials from rice straw. Dry-cleaning of rice straw by the currently-used techniques was unsatisfactory to give a good quality pulp. Therefore, an elaborate technique for cleaning rice straw had to be developed. Through their extensive research work, RAKTA technicians have succeeded in developing a new technique for efficient cleaning and up-grading this raw material. This made the production of bleached pulp for fine paper possible. This new technique "the wet-cleaning" of rice straw was first applied at RAKTA Pulp Mill in 1961 and further developed since then. Over the past 13 years of mill experience, the wet-cleaning technique has proved the following advantages:

(a) An increase in the overall pulp yield by about 2%;

(b) A reduction in cooking chemical by about 2% based on straw;

(c) A better use of the capacity of the digester by about 15% is achieved. Moreover, the packing of the digester is higher than when using dry straw;

(d) A reduction of the silica content of the straw due to the removal of a good part of the leafy and extraneous materials in the wet-cleaning system;

(e) The resulting pulp from the wet-cleaned straw has a higher freeness, which leads to easier washing of the pulp in ensuing processes such as the brown stack washers and bleaching washers;

(f) The wet-cleaning system opens up the straw, which makes the pre-impregnation with cooking liquor efficient;

(g) The removal of leafy and extraneous materials from the straw leads to better bleaching of the pulp, these desired materials if still present would have consumed bleaching chemicals uselessly. Practically, about 15% of the chlorine consumed in the bleaching process is saved by introducing the wet cleaning system;

(h) The strength properties of the pulp are appreciably improved.

Although the initial cost for wet-cleaning facilities is about $US 2,000 greater per daily ton of production than for dry cleaning, the advantages of wet cleaning at Rakta mill surpass their greater expense.

Pulping of rice straw

Based on his previous experience and research work, the contractor proposed to use a long-cycle cooking of 6 h at low temperature of 128°C and low pressure of 2.7 atm to achieve a satisfactory pulping of rice straw. He also proposed to use not less than 13% NaOH based on dry straw in order to produce a pulp with low silica content and better strength.

These pulping conditions were applied at RAKTA pulp mill at the starting-up period and resulted in lower production of about 45 t/day compared to the design capacity of 65 t/day. In addition, higher amounts of cooking and bleaching chemicals were consumed.

As a result, RAKTA technicians decided to increase the production capacity of the pulp mill and at the same time to reduce the cooking and bleaching chemicals consumed without considerably affecting the pulp yield and quality. Therefore, an extensive research and development work was carried out first at the pilot plant and then applied to the mill in order to achieve this target.

The outcome of these efforts has been the development of the short-cycle pulping process (3 h at 7 atm) which resulted in raising the production capacity of the pulp mill to about 90 t/day. In addition, the cooking chemicals were reduced to about 10% NaOH on straw (instead of 13%). Furthermore, the bleachability of the pulp was improved and thus the bleach chemicals were reduced. Another advantage of this process is that the pulp produces more opaque paper sheets, by virtue of the higher silica content retained in the pulps. This has led to cut down the fillers added in papermaking and to save hard currency in importing such fillers.

Consequently, the cost per ton pulp had been considerably reduced.

Bleaching of straw pulp

At the start-up of RAKTA pulp mill, the contractor failed to fulfil the guarantee figures regarding the production capacity of the bleach plant and the consumption figures of bleach chemicals, water, steam and power. That was because of the slower drainage property of rice straw pulp, compared to wood pulps, which reduced the efficiency and capacity of the pulp washers and thickeners.

Studying the bleaching and physical characteristics of rice straw, reed and bagasse pulps on the pilot-scale, it has been found that these pulps differ appreciably in their dewatering property. The read and bagasse pulps are much freer and drain more easily than rice straw pulp. By blending rice straw pulp with reed or bagasse pulp and studying the bleaching characteristics of such pulp blends the following results were reached:

(a) Improving the dewatering property of rice straw pulp;

(b) Increasing the capacity of the bleach plant;

(c) Raising the efficiency of the pulp washers and thickeners;

(d) Reducing the bleach chemicals, water and power;

(e) Producing uniform bleached pulp blends with better strength properties.

V. ADAPTATION OF LABOUR POWER

The economics of developing countries, in general, are characterized by unbalanced structure of labour power as a result of having large numbers wanting to work and small numbers qualified to work. Ordinary non-skilled workers are prevalent but skilled workers are lacking.

It was stated before that scarcity of capital, especially foreign capital, is a major constraint on the process of development. Here it can be added that scarcity of high standard technicians able to cope with most advanced technologies is a more serious constraint. A developing country can ultimately find sources of financing in the form of agreements or credits which permit the importation of machinery and equipment, even specialized labour power for some period of time, but it cannot afford to import skilled labour continuously.

That is why RAKTA considered it imperative to draw out and execute the necessary policy to recruit, develop and adapt the labour power needed.

This policy envisaged the following major methods to develop and adapt its labour force:

(a) Sending groups to be trained abroad;

(b) Training on site during the period of construction, erection and start-up of the plant;

(c) Making use of some foreign experts during the first period of operation;

(d) Training in local scientific and training centres and institutions;

(e) Indoor training.

Table 13 represents the structure of the labour force in the company on 1 January 1974. This is the structure which has emerged as a result of the company's programme for labour force adaptation and development.

A. Training abroad

RAKTA mill construction started in 1958, it was decided that test-runs would begin in 1961. The management of RAKTA decided to utilize this

Table 13. Structure of employment in the Company, 1 January 1974

Level	Number	Percentage
Top management	15	0.6
Middle management	71	3
Specialists	171	7
Technicians and foremen	195	8
Skilled workers	490	20
Clerical employees	151	6.7
Semi-skilled workers	479	20
Unskilled workers	839	34.7
Total	2411	100

Source : Company records.

construction and erection period for the proper training of skilled personnel, who shall ultimately operate the plant.

The contract stated the following in relation to training abroad:

"The suppliers shall employ in their works 40 members of the purchaser's staff. Some of them shall be employed in a factory producing pulp from annual plants and making paper from such pulp. These persons shall be trained in regular production processes for an average period of 6 months. The Suppliers shall submit to the purchaser Progress reports at reasonable intervals informing him about the stage of training achieved. Should the necessity arise for the Purchasers personnel to be sent to a near-by institute for learning the German language, the Suppliers, at the Purchasers expenses expense shall make all arrangements necessary for such lessons. None of the costs incurred in connection with the training of the Purchaser's personnel shall be born by the Suppliers. This concerns in particular travelling expenses, living expenses, charges and fees for accomodations, insurance, school and university courses, medical treatment or any other fees and expenses.

"Training of the Purchaser's personnel shall be carried out in the following divisions:

Pulp mill

Straw preparation: Weighing, unloading, piling, reclaiming, transport to chopping section, chopping, cleaning. Piling, transport to digestor house

Digestor house: charging the digestors, digestor cooking, discharging the digestors, cooking chemicals preparation.

Pulp making: washing, screening, thickening

Bleaching: preparation of bleach liquor, bleaching, screening, wet machine, baling, packing, weighing, shipping

Paper mill

Preparation of pulp: repulping, refining, preparation of filler alum and size, proportioning

Paper machines: papermaking, maintenance of paper machine, changing wires and felts

Paper finishing: welding, calendering, cutting, sorting, counting, wrapping, packing, weighing, shipping

Auxiliary departments

Boriers, steam turbines, power generation, energy distribution, water treatment, maintenance of machinery and equipment."

In 1960 RAKTA sent to the Federal Republic of Germany, to the factories chosen by the suppliers, 10 people to be specialized in the pulp mill. Four engineers stayed for seven months and six foremen stayed for six months.

It is to be noted here that:

(a) The place of training abroad was chosen to give the proper training in processes similar to those which shall be adopted in RAKTA;

(b) The engineers and foremen chosen to be trained abroad were qualified for receiving such training and became ultimately responsible for operating the pulp mill;

(c) The training was concentrated on the pulp and paper making, as new industries and techniques, other areas as auxiliary departments being available in Egypt and thus local training is possible;

(d) The training period, although generally considered short, is ample for such industry as pulp and paper making.

After starting operation of the mill, RAKTA encouraged deputing some of its engineers to get specialized in pulp and paper industry through grants given by international organizations. In 1963 one engineer was sent for one year to Norway and in 1973 another was sent also to Norway for two years. Two others were sent on grants forwarded by UNIDO to Sweden for three months each.

It can be generally stated that developing countries, especially in relation to new technologies, need to send people to be trained abroad. This assists in realizing the following aims and advantages:

(a) Developing, at least partly, labour power trained on operating equipment similar to the one contracted for and on assimilating technologies similar to the ones to be adopted;

(b) After operating the plant and through the different stages of its development, such training is also useful in realizing a certain link between the local industry and the new trends related to such industry abroad. A continuous relationship between local and foreign experts is always helpful in solving problems facing that industry;

(c) During such training the local personnel acquire developed industrial discipline in relation to respecting time, taking care of the machines, diminishing waste and clear definition of different jobs;

(d) Such training with all that it entails related to proper conditions of operation, proper maintenance, the proper needs of spare parts, may lead to better conditions of contracting in the future;

(e) It leads to proper knowledge of a new language which will, certainly, help in knowing more about the relevant technology from books and pamphlets dealing with that technology;

(f) It is not an expensive way to acquire knowledge especially is done through grants from international organizations.

Nevertheless, there are many problems related to training abroad which can be enumerated as follows:

(a) Contractors, in general, do not agree to train, except a limited number which does not cover the actual needs;

(b) Contractors very seldom accept to bear the expenses of training. Moreover, in many cases they ask for training fees over and above the expenses of the trainees;

(c) Unless a detailed training programme is mutually agreed upon between the purchaser and supplier, training may not be really effective;

(d) The different ambiance and working conditions in the country where training is effected may lead to problems facing the trainees after coming back and working in their local conditions;

(e) Sometimes the foreign experts abroad are reluctant to give technical knowledge to trainees. This very problem was, at least partly, solved through regular progress reports, regular meetings and establishing a certain office dealing with training on site;

(f) The language presents a real constraint and the trainees are obliged to spend appreciable time to learn it;

(g) Problems related to financial arrangements for the families of the trainees as a result of not permitting them to have their families accompany them;

(h) In some cases the trainees would prefer not to return and stay to work in the country where training was effected.

Anyhow, it can be fairly said that training of RAKTA people in the Federal Republic of Germany was very useful and effective.

B. Training on site during construction, erection and start-up

During the period of construction, erection and start-up, an appreciable number of technicians was trained as a result of working under the leadership of foreign experts who supervised the erection and start-up of the mill, also under the leadership of Egyptian experts who were trained abroad.

The contract specified the number of skilled, semi-skilled and unskilled labourers needed for the construction, erection and start-up jobs as follows:

	Number
Foremen	42
Skilled erection fitters	185
Semi-skilled fitters	5
Skilled oxy-acetylene and electric are welders with experience in sipline and process equipment	70
Skilled electricians	26
Semi-skilled electricians	5
Skilled brick-layers	15
Skilled carpenters	3
Unskilled labourers	390
Total	741

The contract specified, furthermore, that these labourers shall receive their instructions and orders from the representative of the suppliers.

A substantial number of the workers who participated in the construction, erection and start-up phases remained in RAKTA as regular employees. This applied, especially, to the skilled and semi-skilled workers.

C. Making use of foreing experts during first period of operation

During the first four months of operation RAKTA made use of services of ten foreign experts in the pulp producing mill "to guide and advise purchaser's qualified labourers who shall take into consideration any requests and recommendations made by the experts" - as stated in the contract.

RAKTA considered it imperative to do that because this was a new technology. In doing that the management of RAKTA has the following considerations in mind:

(a) Training abroad is not sufficient as far as the number of people is concerned;

(b) Problems which appear in the first period of operation need to be solved by people with long experience in this sort of technology;

(c) In case of need for any sort of adjustment in the design, such experts would assist positively;

(d) Machinery that may work in Europe with high efficiency may meet some problems in a developing country like Egypt. Foreign experts may assist in coping with these problems;

(e) Foreign experts working under local conditions may assist in developing the most efficient conditions of running the plant and maintaining it;

(f) Foreign experts during this period would assist in training of local personnel through direct supervision and through participation in elaborating local training programmes.

It goes without saying that some problems in that respect were encountered such as the willingness of the foreign experts to give their experience in the most proper manner. The fact that these experts knew German and/or English meant that they needed interpreters when in contact with workers who do not speak any foreign language. Establishing the proper relation between these experts and the local executive staff was an additional problem.

Nevertheless, it can be fairly stated that these experts assisted to a substantial extent in raising the standard of the local people during the first period of operating the plant.

D. Training in local scientific and training centres and institutes

Table 14 shows how training was effected in different organizations and institutes during the period 1970-1974 in relation to the pulp mill.

Meanwhile, RAKTA encouraged the employees to attend courses and to undertake studies at the university by granting paid leave to attend examinations. RAKTA also utilized the system of group visits to other companies using advanced techniques.

This co-operation between RAKTA and local experts was very useful and effective for the following reasons:

(a) The trainees came in contact with experts from outside RAKTA, made use of new theoretical and practical knowledge in new areas and spheres. They also came in contact with trainees from other mills with different experience;

(b) The change of environment and atmosphere added to the capacity of the trainees to digest new experiences;

(c) The cost of this training was rather low compared with what RAKTA would have had to spend if such training courses were done in the mill. Furthermore training was effected in specialized organizations, institutes and centers.

Nevertheless, it was noted that training programmes outside RAKTA were rather inclined to theoretical aspects and general outline. Experiments to formulate joint training programmes for various pulp and paper mills in the country were carried out, and the results were encouraging. Training institutes for chemical industries were established to assist along the same lines.

Table 14. Training in local institutes, 1970-1974 (pulp mill)

Programme	Number of persons	Level	Place of training
High management	1	High management	Arab original
Labor effectiveness study	1	Specialists	Efficiency
Industrial costing for non-economists	1	Specialists	Efficiency
Ways of raising production	1	Specialists	Efficiency
Paper and cellulose	4	Specialists	National Center for Research
Conference of industrial researchers	1	Middle management	National Center for Research
Third training conference	1	High management,	original for production
	1	foremen	efficiency
Rationalization of labour	2	"	Original for product efficiency
New ways of supervision	1	"	Original for product efficiency
Industry security in cases of emergency	1	Specialists	National Center for Ind.
Industrial security	3	Foremen, technicians	Institute of Industrial Security
Industrial security	2	Foremen, technicians	Institute of Industrial Security
Training of members of Prod. Committee	1	High managment	Institute of Economics of labour
Trade Union Studies	3	Foremen	Cultural Labour Original
First aid	1	Labourers	Red Crescent
Firefighting	2	Labourers	Civil defence
Civil defence	20	Labourers	Civil defence

E. Internal training

It was clear, from the very beginning, that training in the plant could not be dispensed with. Thus RAKTA established internal training programmes to raise the efficiency of the people working there at all levels.

The internal training in RAKTA can be divided into the following types:

(a) Specialized training;
(b) Industrial apprenticeship;
(c) Training of youngsters;
(d) Teaching reading and writing;
(e) Civil defence and industrial security.

Specialized training

This training deals with specialized operational activities as well as maintenance, electrical works, financial administrative activities and public relations etc. Generally such training takes place during the working hours, but sometimes programmes are given after working hours. The period for such training is between two weeks and three months.

Industrial apprenticeship

In this type of training students spend the first year in a training institute, and then two years in RAKTA to be trained on specific jobs like machining, fitting, welding etc. The number of persons trained in this way amounted to more than 130 workers.

Training of youngsters

This type of training aims at having semi-skilled youngsters in different branches. Sons of people working in RAKTA were specially admitted to this training which lasts for four years. The number of youngsters trained in this way was more than 40.

Teaching reading and writing

RAKTA was interested to have all workers know writing and reading. This teaching was given to more than 700 workers. Teaching was effected for two hours daily during working hours and fully paid. RAKTA also furnished all facilities needed.

Civil defence and industrial security

In addition to the training programmes which were given in the premises of the National Center for Industrial Security Studies, the Institute of Industrial Security, the Organization of Production Efficiency, the Organization for Civil Defence, the Red Crescent etc., RAKTA organized courses along these lines and trained its personnel for these purposes.

Systems of training utilized in RAKTA are not confined to lectures and practical training during the course of work; other sytems like the following are used:

(a) Group discussion meetings to exchange views in order to solve a certain problem;

(b) Flying groups which can be utilized to fill any gap encountered as for example when a number of people are chosen for training RAKTA;

(c) RAKTA's school where workers are given full-time courses to raise their standards and acquire new capacities permitting them to have higher level jobs.

It can be said that inside training in RAKTA proved to be useful and advantageous for the following reasons:

(a) It permitted specialized training which is difficult to get outside;

(b) The training programmes were in harmony with the needs and potentialities of work and also with the existing training policies;

(c) Due evaluation of the results of training was clear and immediate;

(d) Relatively low cost if large numbers are trained;

(e) Making use of the foreign experts, wherever they were, to assist in these training activities.

Yet, it was always the opinion of RAKTA to arrive at the proper balance between training outside in specialized bodies and in-door training in order to achieve the best results and maximum benefits.

F. Technical assistance presented by RAKTA

As a result of the efforts exerted by RAKTA to raise the technical level of the staff, it could utilize the experience gathered to assist locally and abroad.

In the local sphere RAKTA receives every year during the summer period about 50 students from the universities and high schools to get practical training. Rakta even pays for each LE 6 per month and offers transportation and one free meal. In addition, RAKTA carries out training programmes for workers from other Egyptian companies. RAKTA also participates in all the techno-economic studies related to pulp and paper planning for the whole country.

As far as serving other countries is concerned, RAKTA receives every year four to seven university students from abroad for training, assists in training workers and technicians from Iraq and Sudan. RAKTA also assists in international conferences related to pulp and paper production. Lately RAKTA assisted Uganda in operating its paper mill.

VI. ECONOMIC EFFECTS OF ADAPTATION AND DEVELOPMENT OF TECHNOLOGY IN THE RAKTA PULP MILL

In order to measure properly the economic effects of the continuous adaptation and development processes in the pulp mill, it would have been necessary from the beginning to compare separately the economic returns of each adaptation or development process with the additional costs resulting from it. The economic returns include both direct effects of increased production rates, and indirect effects representing savings in the consumption of raw materials, chemicals and energy.

However, considerable difficulties were encountered in proceeding along the methodology outlined above. The company's financial and cost accounting systems did not provide the precise, or adequate information necessary to evaluate each development process separately. Furthermore, it was difficult to determine precisely the dates of all the development processes. Consequently, in our treatment we used aggregate data without necessarily treating the effects of each process separately. We selected a group of measures which indicate the extent to which the enterprise achieved some economies as a result of the technological processes.

It should again be pointed out that these aggregate measures lead us to a general evaluation of the improvement in the economic status of the pulp mill. These improvements, however, have resulted from a large number of factors, the most important of which is technological development and improvement, according to our field study. Other factors include, for example, the labour training policy discussed in a previous chapter, and the improvements in work and management methods. Some of the improvement in the economic status of the firm is due to price relationships between inputs and final paper products. These relationships are not treated separately in this report.

It is believed that one of the main reasons for the improvement in the firm's economic indicators is due to adaptation of technology and labour. In studying the economic effects of adaptations of techniques the following measures were selected:

(a) The increase in daily production rate;

(b) The total production in the pulp factory as it relates in time to major changes and improvements in the pulp mill;

(c) The effects of technological developments on the consumption of basic chemicals (caustic soda, chlorine, and hypochlorite) for every ton of pulp.

A. The effect of the main technological changes and improvements on the daily production rate

The experimental production period ended and regular production started in the pulp factory in January 1962. Table 15 shows average daily production rates for bleached pulp given in periods of six months from January 1962 to December 1973.

Table 15. Average daily production of bleached pulp, 1962 - 1973

Period	Bleached dry pulp (t/day)	Period	Bleached dry pulp (t/day)
Jan-June 1962	29	July-Dec. 1968	59
July-Dec. 1962	38	Jan.-June 1969	65
Jan-June 1963	44	July-Dec. 1969	75
July-Dec. 1963	57	Jan.-June 1970	75
Jan-June 1964	60	July-Dec. 1970	75
July-Dec. 1964	57	Jan.-June 1971	83
Jan-June 1965	58	July-Dec. 1971	78
July-Dec. 1965	56	Jan -June 1972	82
Jan June 1966	63	July-Dec. 1972	82
July-Dec. 1966	64	Jan -June.1973	79
Jan-June 1967	68	July-Dec. 1973	68
July-Dec. 1967	61		
Jan-June 1968	64		

A review of the figures of average daily production for 144 months reveals the following facts:

(a) Production started at 29 t/day, and continued to increase to 81 t/day in 1971, 82 t/day in 1972, and 74 t/day in 1973. The drop in 1973 was due to the failure to supply the firm with its needs of caustic soda and other intermediate materials. Caustic soda represents a serious bottleneck because it is produced only in one factory in Egypt, while the demand for it is continuously increasing. There are plans at present to expand the production capacity for this product. The company also experiences difficulties in obtaining its needs of chlorine, especially in summer because of its increased use in purifying drinking water;

(b) The contractual capacity of the factory amounts to 64 tons/day of dry bleached pulp. In the early stages of its life, the enterprise was unable to reach this capacity because of a multitude of technical problems. At that time, the company was compensated for this shortage. The enterprise did not reach its contractual capacity before 1969, that is after seven and a half years, which is a relatively long period. By that time, the technicians in the company were able to solve many technical problems by adapting the production technology used. At that point, production exceeded the contractual capacity;

(c) With the beginning of 1970, work started in executing modifications concerning the removal of bottlenecks in the bleaching process.

Consequently, production increased from 75 t/day in 1970 to 81 t/day in 1971, and 82 t/day in 1972;

(d) It is worth noting that productivity is continuing to increase, even after the expiration of the accounting age (10 years) of machines and equipment. This is due to the maintenance policy which attempts to protect the fixed capital, since large scale replacement of machinery requires large amounts of foreign currency which is always in short supply in a developing country like Egypt. This is particularly critical since the firm does not export any of its output. Hence, any foreign currency needs would have to be obtained from the national foreign currency budget;

(e) In spite of some irregularities in productivity - which are due for the most part to nonproduction problems like the lack of raw materials and chemicals - the general trend indicates continuous increase in the rates of daily production;

(f) Productivity figures indicate some spurts (jumps) in the average daily production. These spurts are worth studying, because they correlate in time with the basic technological developments in the enterprise.

The following statistical analysis was carried out in order to discover the spurts in daily production rates (see figure I):

(a) The regularity of the daily production rate at a certain level for a minimum period of six months was considered as an indication for a change in the productivity level;

(b) Actual average daily production rates were replaced by moving averages based on 12 months (the six months preceding and following the months in question). The rate of change in productivity from one month to the next was based upon these moving averages;

(c) On this basis, two points exhibit the largest rate of increases in the daily production rate. These points were August 1963 and July 1969. The increase in the daily production rate for the period September 1963 - February 1964 over the previous six-month period amounted to 14 t/day. Daily production increased from 45 t/day to 59 t/day. The increase in the daily production rate for the period August 1969 - January 1970 over the previous six-month period amounted to 10 t/day. Daily production for this period increased from 65 t/day to 75 t/day;

(d) It is worth noting that the increased productivity in the previously mentioned periods was not accompanied by any significant changes in the specifications of the produced pulp. Average bleaching and average grade indexes during the second productivity period are given in table 16:

Figure I. **Monthly average daily production of bleached straw and reeds pulp, July 1962 - December 1973**

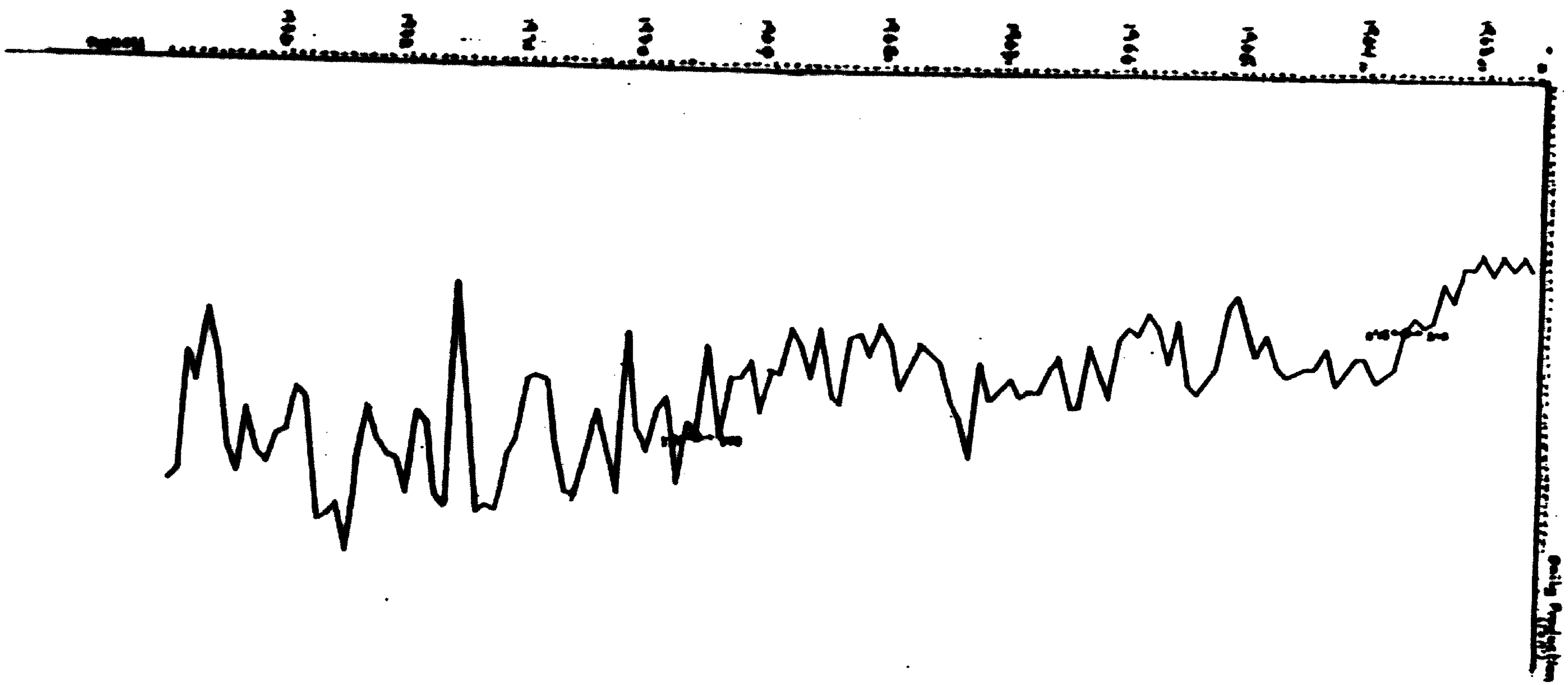


Table 16. Average bleaching and grade indexes

Period	Average bleaching index	Average grade index
February-July 1969	72.7	1826
August 1969 - January 1970	74.2	1781

Table 17 shows the economic effects of the productivity improvements in the two previously discussed period.

Table 17. Economic effects of the productivity improvements

Economic effect	First period September 1963 - February 1964	Second period August 1969 - January 1970
Increase in daily production rate (t/day)	14	10
Yearly increase in production (t) a/	4760	3400
Value of the yearly increase in production (thousand LE) b/	424	384
Yearly increase in the value added resulting from increased production (thousand LE) c/	206	244
Foreign currency saving d/	419	379

(a) Average number of production days in a year is 340.

b/ The selling price for a ton of straw bleached pulp was LE 90 in 1963/64 and LE 113 in 1969/70.

c/ Added value for a ton of straw bleached pulp was LE 44 in 1963/64 and LE 66 in 1969/70.

d/ The foreing currency saving per ton is calculated as follows: alternative cost of imports - average cost of the imported raw material per ton (see table 3 chapter II).

The daily production rate was increased in the two periods under study for the reasons explained below.

The plant was originally designed for long cooking cycle (6 hours) at low pressure (4 kg/cm^2) which was believed to be the best conditions to get the best quality and highest yield of pulp. Trial runs showed that by using this method the mill did not achieve either quantity or quality guarantee figures.

The temperature and pressure were automatically controlled by a special control system which operated successfully with digestors dealing with other raw material, but it gave trouble in the mill due to the high silica content in the black liquor resulting from rice straw.

The original device of steam admission into the digestor caused non-homogeneous cooks and accordingly high alkali consumption with lower yield.

Trials and studies in the pilot plant and the mill led to the following successful method of cooking.

The short cycle at high pressure (4 hours) without affecting pulp quality

This method resulted in an increase of 30% of the digestor house's designed output, and it allowed for ample time to be used in repair jobs. In addition to that, the method of steam admission was redesigned locally which resulted in homogeneous cooking, and accordingly lower alkali consumption together with higher yield of screened pulp.

Due to the design of the short cycle cooking method it is possible to produce 86 tons/day of straw bleached pulp. At present, there are 8 digestor houses. Each digestor house performs 6 cooking cycles/day. Each cycle is performed in 4 hours only and produces 1.8 tons. Thus, the new adjusted capacity using the short cycle cooking method is computed as follows:

8 digestor houses x 6 cooking cycles x 1.8 t/cycle

The designed capacity was computed as follows:

8 digestor houses x 4 cooking cycles x 2 t/cycle = 64 t/day

It should be noted that the daily production figure did not surpass the 80 t/day mark except after 1970. The introduction of the short cycle cooking method early in 1963 increased production only by 14 t/day (from 45 t/day to 59 t/day). The full effect of the new method was not immediately achieved, because some adaptation processes in the digestor houses - mainly processes of redistribution of vapour - were not carried out except at a later stage. In addition to this, technological processes preceding the cooking process still caused many problems for the total technological process, a fact which resulted in not feeding adequate amounts of washed straw into the cooking process. Specifically, these problems involved chopping and wet cleaning processes.

The increase in productivity in the second period under study (February 1969 - July 1969) - where production increased from 65 t/day to 75 t/day - was achieved partly by developing those processes preceding the cooking process, and partly by clearing bottlenecks in processes following the cooking process (washing, screening and bleaching).

To fully understand these developments, the major changes during that period can be explained as follows: Due to the special nature of rice straw being different from other kinds of straw, chopping machines, ducts, cyclones, suction fans and conveyors failed to operate smoothly without stoppages and trouble for 24 hours as designed. As a result of these troubles and stoppages, the chopping plant failed to produce the designed capacity efficiently.

The following measures were taken:

(a) Chopping machines originally used were changed to a bigger size unit. Also the individual machine components of the bigger size units were modified locally and the supplier was informed afterwards to supply RAKTA with spare parts accordingly;

(b) Suction fans were newly designed and manufactured locally to overcome blockage problems in suction ducts of chopped rice straw;

(c) Dust removal system and dust collecting cyclones were redesigned and relocated outside the plant to achieve better dust removal and efficient dust collection;

(d) Conveyors, ducts arrangement and components were modified to avoid blockage and down time for repeated repairs.

The wet cleaning system was a new patent applied for the first time in RAKTA pulp mills. Therefore the design of the delivered system was executed with drawbacks which caused a lot of trouble. Many modifications were carried out locally in order to overcome these troubles and to secure continuous and smooth running of this system at its best efficiency.

As mentioned before, this new system of cleaning straw was developed to cope with the specific nature of straws, especially those containing a high percentage of leaf materials. Over many years of operation the wet cleaning system has proved to be very valuable. In fact it has become difficult to run the mill without it.

Like any other addition to a conventional industrial operation, the cleaning system has many advantages, but it also entails additional operating costs and a higher initial investment.

The main advantages of this system, proved over 12 years of operation are:

(a) The cooking chemical ratio used for pulping is lowered by about 21%;

(b) A better use of the capacity of the digestor by about 15% is achieved. Moreover the packing capacity of the digestor is higher than when using dry straw;

(c) A reduction of the silica content of the straw due to the removal of a great part of the foreign material in the wet cleaning system;

(d) The wet cleaning system opens up the straw, which makes the pre-impregnation with cooking liquor efficient;

(e) The removal of the leaf fraction and foreign material from the straw leads to better bleaching of the pulp. Practically, about 15% of the chlorine used in the bleaching operation is saved by introducing the wet cleaning system.

On the other hand, a study was made to assess the additional operating cost and initial investment made necessary by introducing the wet cleaning system. The results have shown that:

(a) The initial investment needed to purchase the equipment for a chopping and dry-cleaning system is estimated at $800 per daily ton of production of straw. In the case of a combined chopping and wet cleaning system the initial cost would be $1,000 per daily ton of production;

(b) As far as operating costs are concerned the only extra cost is the increased power consumption, since practically no fresh water is used except at start up. The power consumption per ton of chopped and cleaned straw is about 62 kWh when using the conventional chopping and dry cleaning system. In the case of a combined chopping and wet cleaning system the power consumption per ton of chopped and wet cleaned straw is about 213 kWh.

By and large it was found at RAKTA that the advantages of the system surpass by far the added cost. However, this should be studied for each case since circumstances may vary.

In another part of this chapter we indicated that the modifications regarding the removal of bottlenecks in the bleaching process were carried out early in 1970. Consequently, production increased from 75 t/day in 1970, to 81 t/day in 1971 and 82 t/day 1972. These modifications were explained before. Nevertheless, we summarize these modifications here to indicate their effects on the daily production rate.

When the bleaching plant was originally designed the considerably low freeness of rice straw pulp was not taken into consideration. As a result of this fact, the washers and thickener in this plant which were originally designed to handle at least a capacity of 65 t/day of B.D. pulp were incapable of handling this quantity efficiently. This resulted in bad washing and high chemicals consumption, and also lower quality of pulp produced.

The thickener itself was incapable of handling more than 45 t/day and gave a lot of mechanical trouble due to overloading.

The rice straw pulp proved to have low affinity to chlorine gas in chlorination stage. This phenomenon, combined with downflow-action of the chlorination tower, resulted in accumulation of unabsorbed chlorine gas in the upper part of the tower, which leaked to the surrounding atmosphere and caused chlorine corrosion.

By mixing the free reach pulp with rice straw pulp before bleaching it was possible to improve the freeness of the pulp in bleaching and accordingly to improve the washing efficiency of the pulp on washers.

When ordering the new bleaching plant upflow chlorination and hypochlorite towers were ordered and the filtering area per t of pulp as washers was increased; also special equipment for chlorine water dosing was ordered for the old bleaching plant.

B. The effects of technological development on total production in the pulp mill

As mentioned in chapter II, the project was contracted for in 1958. The contract involved supply and installation of an integrated mill to produce straw and reeds bleached pulp, writing and printing paper, and the provision of all services and facilities attached to it. In this study, we focussed upon the pulp mill, since the production of pulp from agricultural residues, especially rice straw, was a pioneering project for this area of the world at that time. Regular production started in January 1962. A new bleaching unit was operated in January 1970. As table 18 indicates we find that annual production increased by 55% in the period from 1962/63 to 1963/64. However, it should be noted that the number of production days (production day = 24 hours) is not the same for the two periods above. This is illustrated in the table below.

Table 18. Number of production days for the years 1962/63 and 1963/64

Year	Number of production days	Yearly production (tons)		Daily production (tons)	
1962/63	313	12,779	55%	40.8	42.4%
1963/64	334	19,483		58.2	

The relatively low number of working days in 1962/63 is due basically to delays resulting from technical problems, rather than shortages in raw materials or chemicals. Hence, technological development and solving technological problems did not only increase the operational efficiency of each of the technological departments, but also contributed to the continuity of the technological process (which is a mechanical-chemical process).

During the period under study, as table 18 shows, the daily production rate increased by 42.4%. This increase is a more direct indicator of the effect of technological improvements in different departments of the pulp mill, especially in the digestor houses.

The second period in which the mill experienced a noticeable increase in productivity is the period from 1968/69 to 1969/70, where annual production increased from 22,041 to 25,628 tons (17.6%). However, the daily production rate increased from 61.8 to 75 tons in the same period (21.2%). The percentage rate of increase in daily production exceeded that for total production, because the number of production days was higher in 1968/69 than in 1969/70 as the table 19 indicates.

Table 19. Number of production days for the years 1968/69 and 1969/70

Period	Number of production days	Yearly production (tons)		Daily production (tons)	
1968/69	356	22,041)		61.8)	
		)	17.6%	)	21.[illegible]
1969/70	342	25,628)		75.0)	

Table 19 shows that technological developments increased the daily production rate by 21.2%. However, yearly production increased only by 17.6% due to the decline in the number of production days in 1969/70. After solving some technical problems which caused this decline, the number of production days reached 351 in 1973. This high number of production days still allowed for annual maintenance without having any undesirable effects upon production.

C. Effects of technological developments on the rate of consumption of raw materials and chemicals

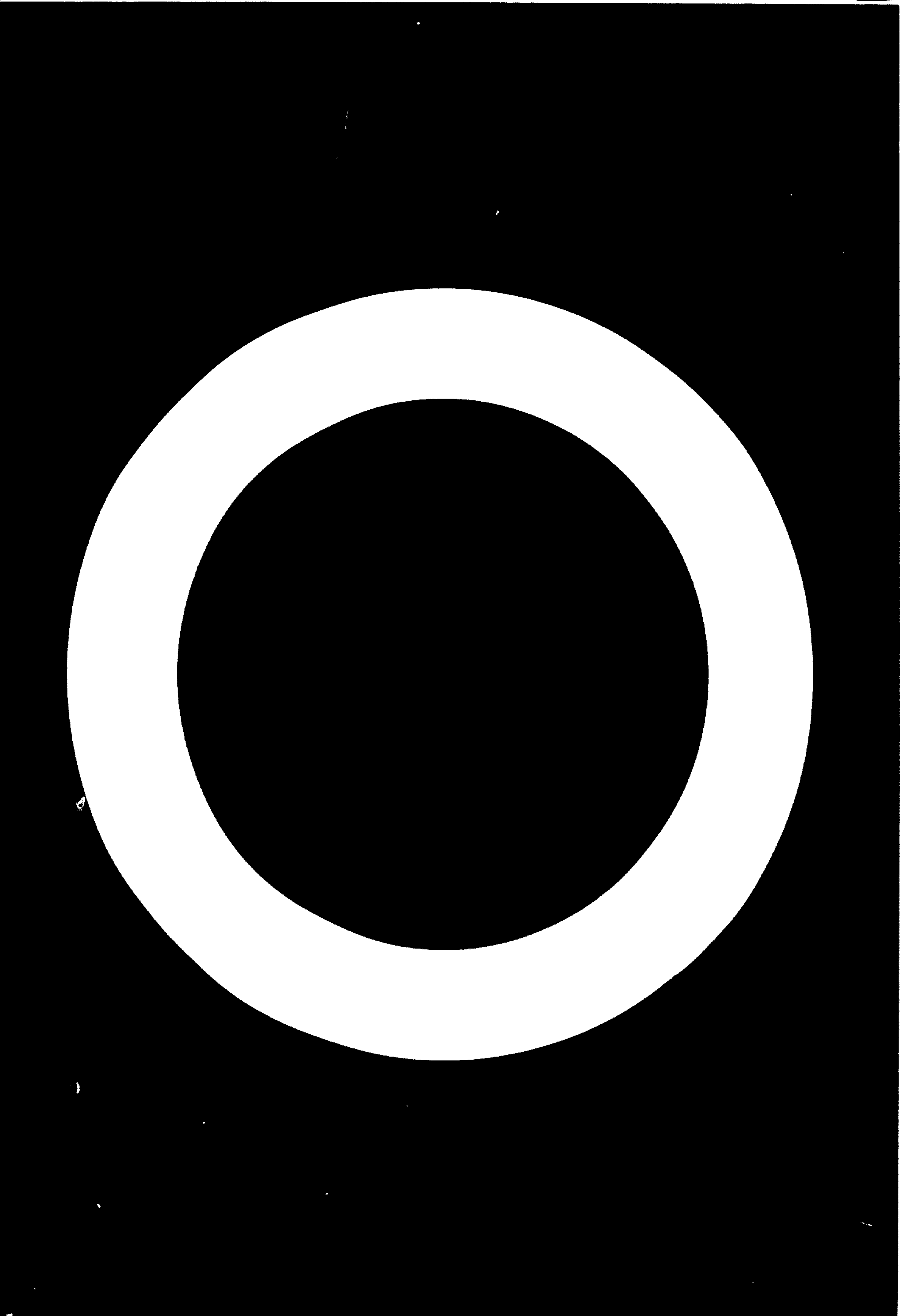
Table 20 indicates the consumption of raw materials and chemicals for each ton of bleached pulp for the period 1962/63 - 1973.

Table 20. Rate of consumption of raw materials and chemicals per ton of dry bleached pulp

Period	Percentage of pulp output to straw and reeds	Consumption			
		Caustic soda (kg)		Chlorine and hypochlorite (kg)	
1962/63	32	380	20%	73	
1963/64	34	315		79	
1964/65	35	311		69	
1965/66	36	302	Average for Seven years (excluding 1967/68) = 301.9	53	
1966/67	35	304		54	Average for the last seven years = 56.7
1967/68	31	351		63	
1968/69	33	306		59	
1969/70	34	290		63	
1970/71	36	301		63	
1971/72 (19 months)	33	312		52	
1973	32	297		43	

From the table we note that the rate of consumption of chemicals per ton of dry bleached pulp has decreased markedly. After the first year, the rate of caustic soda consumption declined by 20%. After that it declined from 315 kg in 1963/64 to an average of 301.9 kg in the period 1965/66 to 1973, excluding the year 1967/68. This decline in the rate of consumption represents 4.3%. The year 1967/68 was excluded in computing the average rate of consumption, since the rate in that year was abnormally high when compared with the preceding or the following years. Including it would have unjustifiably increased that average. Technological development - especially in the bleaching process - resulted in economies in the consumption of chlorine and hypochlorite by 23.7%. The rate of consumption of these two chemicals declined from 73 kg/t in 1962/63 to an average of 56.7 kg/t in the last seven years.

From the above analysis, we conclude that technological adaptation and development played an important role in improving the economic status of the project. These developments resulted in increasing daily and total production by rates which exceeded the original contractual capacity. They have also resulted in economies in the consumption of raw materials although they have partially resulted in an increase in the consumption of water and electricity. The net result of these developments - even though we were not able to measure it exactly - seems to be positive to a large extent.



Annex

PROCESS ADAPTATION AND DEVELOPMENT IN THE PULP MILL

Technical consultants, world known in the pulp and paper industry, were invited by the Egyptian Government and their advice was considered in the design of the pulp mill. Also, when the contract was made and signed, the suppliers made a big effort in studies to develop a mill which can obtain the guaranteed output.

Unfortunately, in spite of all of these efforts, when the RAKTA pulp mill was started, considerable problems arose. The contractor was obliged to redesign some machinery and equipment parts with the co-operation of RAKTA specialists to start the production.

Adaptation in digester house

The digester house contained ten identical cylindrical rotary digesters, with a capacity of 42 m^3 each. Eight out of the ten digesters were made to cook rice straw, while the other two were for reed cooking. Caustic soda and pressure steam (8-10 atm) are used for cooking both straw and read. Rotary digesters were chosen, rather than continuous or non-rotating digesters, because they are much better suitable for straw cooking and are easy to control. With stationery digesters, mixing of liquor and straw is poor, while the pulp produced from straw using continuous digesters, at that time, was of inferior quality due to its bad freeness.

The existing digesters had the steam admitted through one of the bearing gournals and a pressure line (5 in figure II) which extends in the digester and opens near the bottom.

Each digester was equipped with the following fitting and instruments to allow for good operation and control of the cooking conditions:

(a) Peneumatic steam valve (1) on the main steam line to the digester. The valve was activated either automatically by the temperature in the digester, or by a programming system, or manually by remote control from the control room;

(b) An exhaust line (5) to relief the non-condensable gases from the digester. This pipe is fitted with an automatic valve (2) activated against the pressure in the digester. This valve opens only when the digester is in the upright position to exhaust gases, and prevent the escaping of the cooking liquor. Relief of the gases starts and continues on automatically till the

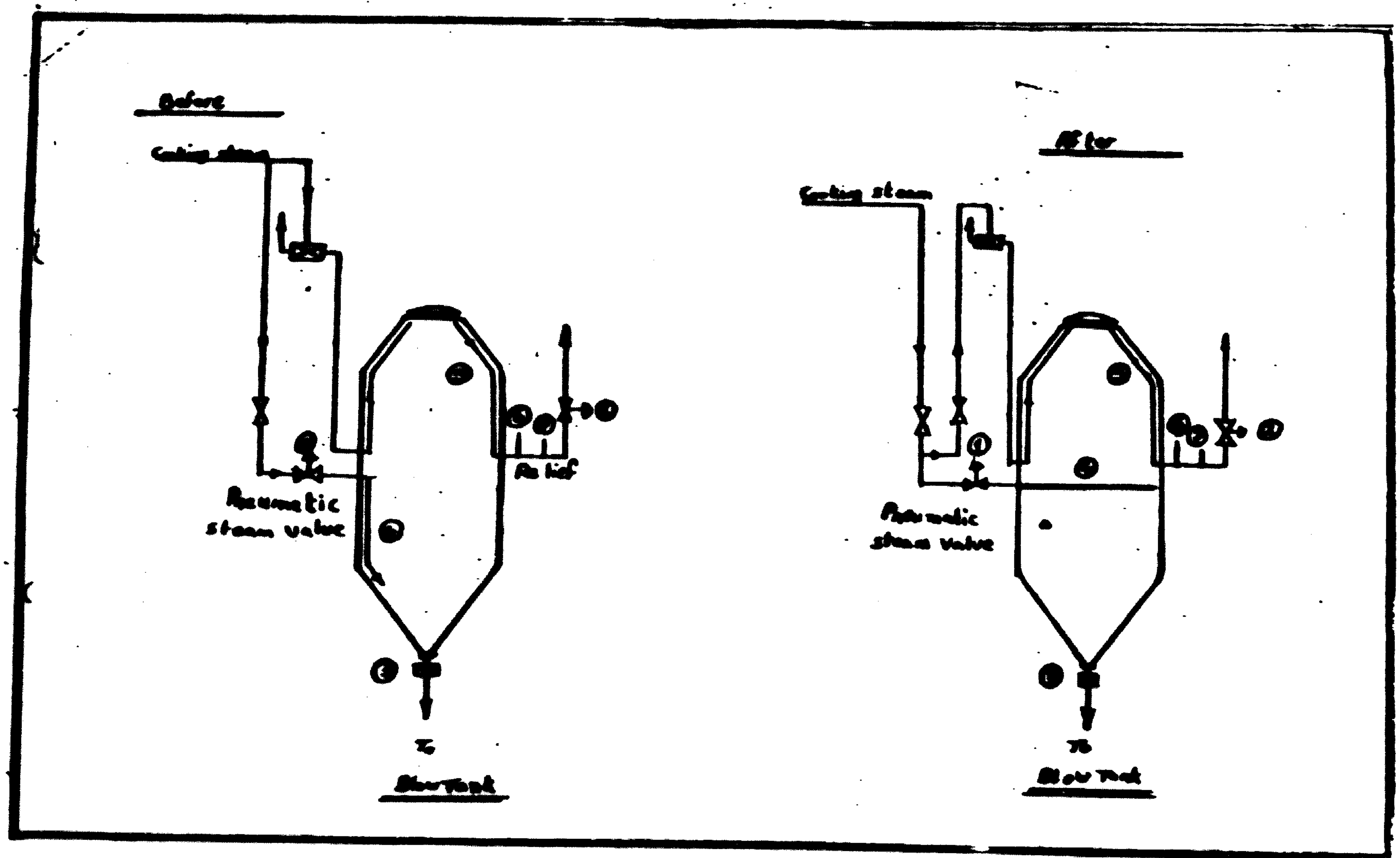


Figure II. Digestor house before and after modification

temperature indicated by the thermocouple (6) is equal to that of the saturated steam having the pressure indicated by the pressure gauge (7). That means no presence of false pressure and, consequently, absence of non-condensable gases. At that stage the exhaust valve (2) is closed;

(c) Pressure gauge (7) and a thermocouple (6) both with indicators recorders. Their sensing elements (7) and (6) are fitted in the exhaust pipe between the digester and the valve;

(d) Special pulp discharge valve (blow valve) (3), which at blowing is coupled, by a quick and tight coupling device, to a high-pressure blow pipe leading to the blow tank.

The cooking conditions were originally designed for a six hour cycle, 4-6 atmospheres maximum pressure, 10-12% chemical ratio and 1 : 3 liquor ratio. In the pilot plant runs by the contractors before design of the mill, these conditions seemed to be the optimal to produce best quality pulp.

In order to reach the guaranteed production (65 t/day) each cooking cycle should result in a minimum of two tons of bleached pulp. The digester charge must not be below 0.13 tons of straw per m^3 of the digester volume, which proved later to a high figure due to the dryness of straw asked for. Moreover the mill will have no time for repair or maintenance, and should run without trouble, otherwise the guaranteed production figures shall never be realized.

When starting the plant, a lot of troubles and interruptions showed up, which greatly affected the production and did not enable it to reach more than half of the guaranteed production quantities, or even quality.

Also the pulp produced under the suggested conditions was not homogenous, containing a considerable quantity of partially cooked or uncooked fibres beside some over-cooked fibres. All factors affecting the cooking were changed within very wide ranges (temperature 140°-170°C, time 5-8 hours, liquor ratio 1:3 to 1:5, and chemicals between 10-18%), but the results were discouraging. Also, manually controlled cooking cycles were not much better than the automatic ones.

Thorough and close studies (executed by the Egyptian technicians) showed that the reasons for this incomplete, unhomogenous cooking output were:

(a) The straw in the digester forms a lump which moves from one side to the other without breaking while the digester tumbles. This resulted in poor mixing of straw, chemicals and steam;

(b) Only part of the steam introduced to the digester was condensed, and the rest channeled through the straw lump and escaped to the empty part of the digester. This resulted in local heating up of parts of the straw;

(c) Steam introduced when the digester is up side down, went to the empty part of the digester and condensed very slowly;

(d) Due to accumulation of steam in the empty zone of the digester, the instruments registered the temperature and pressure of the steam and not those of the liquor. This tended to close the main steam valve, which opened again when some of the entrapped steam condensed;

(e) A considerable amount of liquor and chemicals escaped through the exhaust pipe when it opened. Since that happened at the start of the cooking cycle the chemicals lost were concentrated and not yet exhausted. Those chemicals should be made up for;

(f) When the black liquor came in touch with the sensing elements for temperature and pressure, it caused scaling and consequently isolation of the sensing elements.

The following modifications were made and succeded to eliminate the troubles:

(a) The steam admission pipe was changed to a drilled pipe fixed at the trunions along the axis of rotation of digester. This pipe helped continuous breaking of the straw lump, and hence efficient mixing of straw, steam and chemicals, beside condensation of most of the steam since all the steam openings are always immersed in the straw and liquor. The results of fitting the digesters with that pipe were:

(i) Production of homogenous pulp

(ii) Saving of chemicals (10 to 16%)

(iii) Possibility of cooking at higher temperature and accordingly shorter cycles

(iv) More accurate pressure and temperature readings and accordingly easier control

(b) Trials in the mill lead to a successful short cooking cycle at elevated temperature without affecting the pulp quality. This gave ample time for repair and the very essential maintenance jobs. Also the digester house was increased by 30%;

(c) The complicated control system was modified and simplified. The steam valve was controlled against the pressure. Also the relief gases were cancelled since it was found that the gases evolved from the straw cooked by alkali only are not expensive. This minimized the scaling due to black liquor, avoided the loss of chemicals and simplified the control system without having any harmful effect.

Adaption in heat recovery sector

After the digestion period has been completed, the digester pulp charge is to be blown under its own pressure (the cooking pressure) to the blow tank. During the blowing operation, the cooking steam contained within the pulp charge is flashed at the blow tank entrance tangential pipe. To make use of the sensible and latent heat of such blown steam, the contractor provided the digester house with a heat recovery unit consisting of a fibre separator, a mixing condenser, water filters and a plate heat exchanger.

Fiber separator

Attached to the blow tank top and equipped with pressure safety flap. On the digester charge blowing, the pulp, when entering tangentially the blow tank, swirls near-by the inner wall; but not the contaminated steam which flashes by the central pressure depression phenomena, and leaves the blow tank carrying some fibrous entrainments, which is being trapped in the fiber seperator device and then directed again to the blow tank through a submerged leg, leaving the blown steam without accompanying fibers.

Mixing condenser

The steam leaving the fiber seperator is admitted through the mixing condenser which serves for the condensation of vapours by means of cooling condensate from the condensate tank (from previous blowing operation) or by means of cold fresh water at start of blowing. The condensed steam with the cooling water are preserved in a condensate collecting tank.

Water filters

The hot condensate water is transferred from the condensate collecting tank to a hot water tank through two parallel filters each of which is provided with screen cylinder. The filters serve for seperating any fibrous material in the hot condensate water.

Plate heat exchanger

To make use of the condensate water sensible heat while being transferred to the hot water tank, it is passed counter currently with cold fresh water through a plate counter current heat exchanger of the level type.

The hot water leaves to the hot water tank to be used in pulp washing in washing sector, while the cooling water leaves to the condensate collecting tank to be recycled again and reused for condensation of blown steam in the mixing condenser.

Mill runs showed that many problems arose in the operation of heat recovery section such as:

(a) Fibrous materials accompanied with blown steam did not separate totally in the fiber separator, which often caused blocking of its pipes and resulted in deficiency of the process. This resulted also in increasing steam pressure in its flow line and caused the safety flap to open with the leakage of steam. Interruptions of the blowing operation seemed to be necessary for cleaning of the fiber separator which lead to defficiency of the production rate;

(b) As soon as the fiber separator is blocked with pulp fibers which escape to the mixing condensor, the latter is blocked also with such fibrous material. This phenomenon resulted in defficiency of heat transfer operation in addition to the problems mentioned above;

(c) What has been mentioned for the fiber separator and mixing condenser concerning blocking, can be said too for the filters, heat exchanger, pumps and other accessories.

It was thought that the contractor had designed such heat recovery unit for rice straw pulp according to his knowledge about wood pulp which differs greatly in its properties and affects the efficiency of the heat recovery process. The main differences are the specific gravity and fiber adhesion properties of the rice straw pulp.

To remedy such a problem and to adapt for a better production rate, RAKTA pulp mill technicians improved the heat recovery unit as follows:

(a) Rearrangement of the fiber separator submerged leg in the blow tank;

(b) Blowing at relatively low pressure;

(c) Changing the tubular mixing condenser to a direct surface condenser;

(d) By-passing both of the water filters and the heat exchanger.

Black liquor reutilization in pulping process

After the rice straw is chemically digested in the rotary tumbling digesters at the specified conditions of alkali concentration, liquor, solid ratio, pressure (temperature) and time, the blown digested pulp is moved to the washing sector which uses 2-stage Oliver vacuum filters to wash the pulp thoroughly till it becomes free of the black liquor.

The black liquor resulting from the digestion process, theoretically contains all the consumed alkali and other reaction products as degraded carbohydrate fractions and solubilized lignin, which result as filterate in the pulp washing operation. To make use of such black liquor and of the chemicals it contains, the contractor designer decided to reuse it in the pulp mills different operations and at the same time decrease the fresh water consumption.

The utilization of the recycled black liquor as it was designed by the contractor was as follows.

Utilization of black liquor in wet cleaning sector

The rice straw after being chopped and dry-cleaned in the chopping and dry cleaning sectors, undergoes wet cleaning operation in specified hydrapulpers for a definite period of time at 10% consistency. The wet cleaned straw leaving the hydrapulpers is to be rewashed and dewatered in drum washers at a consistency of 5% and leaves the drums at 20% consistency. The dewatered rice straw is to be conveyed by drilled bottom screw conveyors to be subjected to more dewatering and squeezing in successive special type screw presses to a final consistency of 75%.

The contractor recycled the black liquor to be used in conjunction with fresh water at pulpers, dewatering drums and screw presses to make use of the retained alkali as an effective wet cleaning agent, preimpregnating agent and to decrease the fresh water consumption in the wet cleaning sector.

In fact, such utilization of black liquor did result in better wet cleaning efficiency and decreased the fresh water consumption, but on the other hand, it rendered the pulp produced more difficult to bleach because of lignin condensation and higher ash content, which resulted, in turn, in higher consumption of bleaching chemicals and/or brittleness of the fibers. Besides, the recycled black liquor in the wet cleaning sector gave rise to a foam problem, scale formation, and blinding of the nozzles and screens due to retained alkali, high ash content and presence of degraded carbohydrate fractions.

RAKTA pulp makers stopped the reusing of black liquor by such a way and used instead a portion of the back water from chlorination stage washer. It resulted in pulp superior in quality and remedied the previously mentioned problems.

Reutilization of black liquor in the pulp washing sector

Again, after the rice straw is being chemically digested at the specified conditions, the blown digested pulp is to be washed through two-stage washing operation using two Oliver vacuum filters to make the pulp free of the black liquor containing theoretically all the consumed alkali, degraded carbohydrate fractions, solubilized lignin and other digestion reaction products.

The contractor designer decided to make use of the black liquor in the washing operation to decrease the washing water consumption and to save as much as possible of the fibrous materials contaminated with such black liquor or washing back water.

The contractor designer recycled the black liquor filterated in the washing section as follows:

(a) The black liquor filterated from the first filter was admitted in the dilution of pulp the suspension at entrance of the second filter vat;

(b) The black liquor filtered from the second filter is sprayed through washing nozzles of the first filter.

In fact such utilization of black liquor did result in decreasing the fresh water consumption somewhat and saving of neglegible percentage of fibrous material; but on the other hand, due to the nature of the black liquor since it contains high ash, lignin, degraded carbohydrate fraction etc. it caused foaming problems, blinding and damage of washer nozzles and washer screens, resulted in high-ash pulp of inferior quality and rendered the PH content of the pulp suspension high, so that some other regulations of the PH must be dome before chlorination for successive bleaching.

RAKTA pulp makers stopped the reusing of black liquor by such a way and replaced it by fresh water for pulp washing on the filters. It resulted in pulp superior in quality and remedied the previously mentioned problems.

Reutilization of black liquor in digester house

Generally, when rice straw is to be digested chemically, some important technical factors must be taken into consideration, which are temperature (pressure), time, peroentage of chamicals to dry straw and the liquor : solid ratio.

To save chemicals and fibrous raw materials and to decrease the fresh water consumption, the contractor process designer admitted the black liquor (from pulp washing operation) with the digesters straw charges for regulation of liquor ratio, since the black liquor, theoretically, contains all the consumed chemicals and degraded hydrocarbon fractions. Mill runs under such addition of black liquor resulted in saving of some fibrous materials, some chemicals and some fresh water. But since rice straw black liquor contains also, the solubilized lignin and having high ash content, it gave rise to high ash content pulp of inferior physical properties and higher bleachability requirements.

Therefore, RAKTA pulp makers stopped the reuse of black liquor in digester charge, and the result was the production of rice straw pulp of superior quality, concerning physical properties and bleachability requirements.

Bleaching back water reutilization in pulping processing

The washed rice straw pulp, after being screened by flat, cylindrical screens and centricleaners is to be thickened to a consistency suitable for the bleaching operation.

To produce a fine grade of bleached rice straw pulp, the pulp mill was provided with a three-stage bleaching sequence plant which operates at specified conditions at each stage (percentage chemicals, temperature, mixing, consistency, PH value and retention time). The bleaching stages are chlorination, alkali extraction and calcium hypochlorite bleaching. After the pulp is passed through any of those bleaching stages, it has to be washed thoroughly by means of washing drum filters to make it free of excess chemicals, degraded fibrous materials and other reaction products.

To decrease the washing water consumption needed for the washing operations, the contractor designed the flow of filtrate wash water at any washing stage in the bleaching plant to be recycled to make use of it in consistency regulation of pulp suspension in bleaching towers or at entrance of any washer vat, i.e.:

(a) The chlorination wash water filtrate was admitted in the pulp suspension in both of chlorination tower and at chlorination washer vat;

(b) The alkali (sodium hydroxide) wash water filtrate was admitted in the pulp suspension in both of alkali tower and at alkali washer vat;

(c) The hypochlorite (calcium hypoohlorite) wash water filtrate combining with a portion of alkali back water were admitted in the pulp suspension in both of hypochlorite tower and at hypochlorite washer vat.

Such design of reuse of filtrate wash water (black water) did result in saving of fibrous material, excess chemicals, and decreased the consumption of wash water. But on the other hand, it did result in scale formation, specially in the hypochlorite stage units (towers, washer screens, pumps, pipes and accessories) which gave rise to production interruptions for scale removal.

Technical mill studies made by RAKTA pulp mill technicians during mill runs showed that the introduction of the hypochlorite back water in contamination with the pulp suspension in the hypochlorite tower, after alkali washer caused scale phenomena due to carbonate and silicate formation, when contacted with alkali back water.

To remedy this difficulty, RAKTA pulp makers replaced the hypochlorite -alkali back water mixture by fresh water. Such behaviour resulted in avoiding hazardous scale formation and preserved the production rate of the bleaching plant.

Again, RAKTA pulp makers made use of the filtrate wash water from chlorination washer to regulate the consistency of screened pulp suspension, and at the same time to make use of excess chlorine in such back water to regulate the PH value of the pulp suspension during the chlorination stage, thus saving an enormous quantity of buffering hydrochloric acid used for such purpose. Furthermore, it gave rise to saving of fresh water consumption and production of bleached rice straw pulp of superior quality much more than was designed by the contractor.

Encountering mechanical troubles and modifications and adaptation of equipment

Chopping plant

Due to the special nature of rice straw (abrasive, harsh and springy), chopping machines, ducts, oyclones, suction fans and conveyors failed to operate smoothly.

Frequent stoppages and interruptions during the 24 hours of daily production were due to many mechanical problems which appeared upon putting the mill into operation.

The main problems were the following:

(a) Originally straw balers were delivered by the contractor to prepare small-size bales. These balers were eliminated because of their unsuccessful operation. Locally fabricated balers were used which baled larger bales;

(b) The originally delivered chopping machines were designed to be fed with the smaller straw bales. Upon using the bigger bales many problems and mechanical failures of different chopper components happened, mainly the upper and lower feeding apron chains. The knife drum rotor shaft was subjected to unexpected shock loads and also the knife holder and bolts;

(c) Chopped straw suction conveying ducts were arranged in a way to secure enough flexibility for the production so that any chopping machine with any of the two suction fans and dry cleaning systems can be used.

In this system as it was, were many flanges, flaps, doors and inspection openinings with covers; such a system was the main source of problems of straw blockages due to air leakage into the system which lowered the vacuum inside the ducts.

The three points mentioned caused an interruption of production in at least 25% of the daily working hours and accordingly, the whole chopping plant was incapable of producing the designed daily production of this plant which affected in turn the production of the whole pulp mill.

Studies and technical discussions in which RAKTA technicians and contractor technicians co-operated brought the following results:

(a) Upon request of RAKTA technicians the contractor equipped the rice straw chopping machines with bigger choppers which had the following special features:

(i) Knife drum shaft of 135 mm diameter instead of the 100 mm so that the shaft can withstand the shock loads

(ii) Separately supported driving pulley flywheel with one half of a flexible safety coupling outside the two supporting roller bearings instead of the old design where the pulley was mounted on the knife drum shaft

(iii) The knife drum rotor supported on three roller bearings, two at drum sides and the third at the half safety coupling monuted on the rotor shaft to secure proper alignment of the safety coupling

(b) The contractor provided a third dry cleaning system with a third suction fan so that two choppers can be run alternatively on the dry cleaning systems and suction fans while the third chopper runs only on the third dry cleaning system with the third suction fan;

(c) The speed of belt conveyors was increased; enclosing covers were raised to allow more space for conveyed chopped rice straw and to avoid blockages with firmerly caused severe interruptions; also a higher capacity of conveying rice straw on conveyors was obtained and accordingly a rise in the capacity of chopping which raised the capacity of the pulp mill itself.

But regardless of the above-mentioned transferred and exchanged technology between the two parties, there was still a lot more to be done, modified or replaced by RAKTA technicians after the handover of the pulp mill. A detailed summary of such adapted technology is given below:

(a) The gap between the upper and lower feeding apron chains of the new rice choppers was increased to achieve the following:

(i) Elimination of blockages by straw bales in choppers, thus avoiding damage of the feeding apron chains which happened often in the past

(ii) Elimination of the frequent damages of driving the shafts for the choppers feeding systems, which were subjected to severe stresses resulting from rice straw blockages in choppers

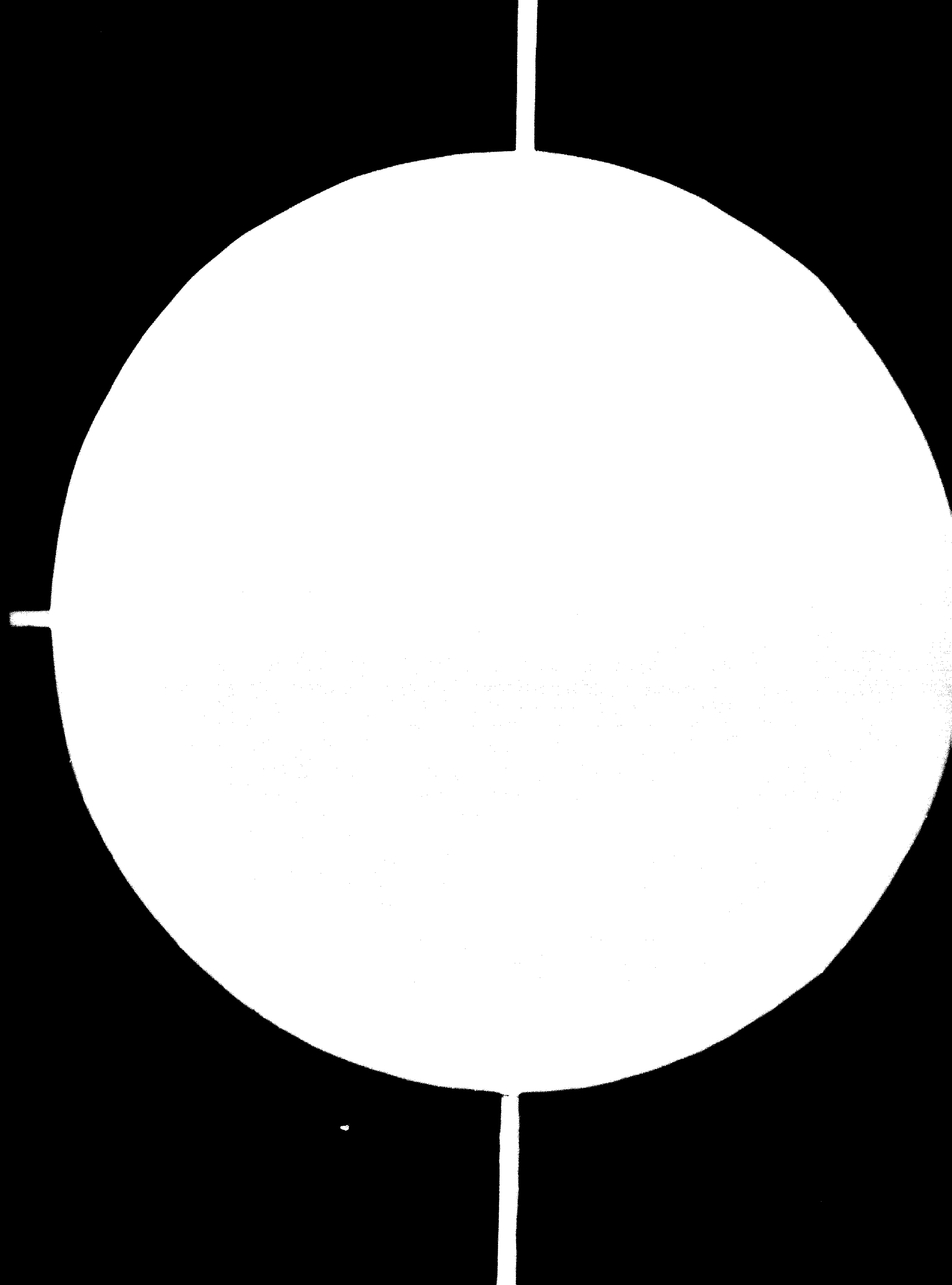
(iii) Replacement of different parts of chopping machine components was consequently considerably lowered which affected directly the time required for repairs and maintenance of each chopping machine (less than 1% of the daily production time)

(b) Chopping knife holders were locally manufactured and also modified to avoid rice straw accumulation under the knives which caused breakages of knives because of the holders effect in changing the angle of attack of knives at cutting point;

(c) Cleaning brushes inside dust chambers were manufactured locally using local natural fibreous material instead of the plastic brushes which increased the efficiency of cleaning the perforated covers of the dust chambers and lowered the consumption of these brushes; interruptions of production due to straw sticking to perforated covers or due to blocking of perforations with dust, which affected also the efficiency of straw pneumatic conveying system, could also be eliminated;

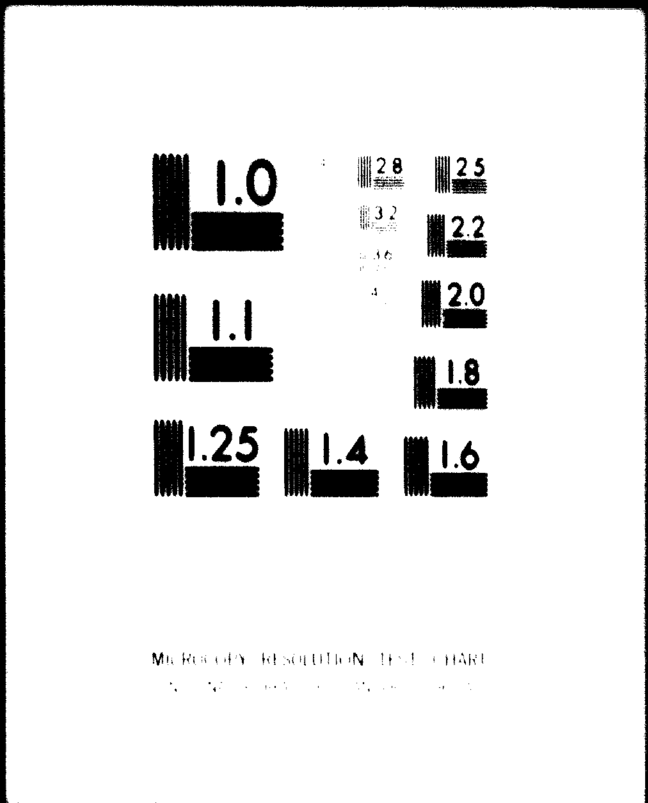
(d) New suction fans were designed and manufactured locally to improve pneumatic conveying capacity of straw and also the method of drive was changed into direct-coupled drive instead of flat belt drive to avoid interruptions of production because belt drives were damaged frequently as the suction fans are located on the top floor in the open air and were subjected to rain and dust;

(e) Pneumatic conveying ducts were rearranged in three separate lines, so that each chopping machine could be operated separately on one of the suction fans and dusting equipment. By this new arrangement the flexible system was eliminated; problems experienced in the past could thus be avoided and the efficiency of straw conveying could be raised;



2 OF 2

08199



24x
C

(f) The dust collecting system was redesigned and manufactured locally; bigger cyclones were located outside the plant, each suction fan feeding separately one of the three cyclones. Water was injected inside dust cyclones to prevent dust from leaking into the atmosphere. Dust mixed with water was collected in a common chamber and recirculated. This modification contributed to a less polluted working atmosphere in the chopping plant.

All these changes and modifications enabled RAKTA to avoid excessive production interruptions, longer down-times for repairs and it was finally possible to run the chopping plant even at higher rates than originally envisaged.

Wet cleaning

The wet cleaning system was a new patent applied for the first time in RAKTA Pulp Mills, therefore the design had certain drawbacks which caused a lot of trouble.

Troubles in this section were partly mechanical due to the fact that some of the equipment could not handle straw as envisaged by the contractor, and other troubles were encountered in the process itself.

Originally, the straw pulpers were designed as batch pulpers. The cycle was 20 minutes: 10 minutes for filling, 5 minutes for washing and 5 minutes for dumping, the two pulpers dumping their charge in succession.

The feeding of fresh water and dry rice straw and also pulpers dump valves were operated automatically with timers, cams and relays of a very complicated design. This automatic system was never run successfully even by the supplier technicians. Moreover, the dust in the area where the switch boards were located added to the troubles encountered with this automatic batching system.

Each pulper was arranged to feed a dewatering drum through a dumping valve and washed straw discharged from dewatering drums is conveyed by screw conveyor to feed the screw presses arranged under the screw conveyor.

Dumping the wet straw from the pulpers through the dumping valve caused successive blockage of this valve and appreciable downtime was lost in clearing the straw at this part.

Neither the screw presses nor the screw conveyor were capable of handling the required quantities of washed straw as designed and therefore unpleasant blockages often happened causing terrible production interruptions which lead finally to the result that this wet cleaning plant was put out of operation for at least eight months at the start-up of the pulp mills.

Co-operation between RAKTA and the contractor technicians again took place to help in solving the previously mentioned problems and troubles as follows:

(a) It was agreed to redesign the pulpers to operate as continuous pulpers instead of batch pulpers and it was also agreed to delete the automatic system and to operate the whole system manually;

(b) The arrangement of feeding dewatering drums with washed straw was modified as follows:

(i) Dry chopped rice straw is fed directly by the belt conveyor to pulper No.1 where raw instead of fresh water is added to the straw continuously;

(ii) Washed straw, upon pulping continuously in paper No.1, flows through an open channel to pulper No.2, where it is pulped again and then overflows continuously to the two dewatering drums. This way the straw can remain longer in the pulpers and a better impregnation of the washed straw can be achieved;

(iii) Pulpers discharge straw to dewatering drums separately which offers more flexibility in operation so that any of the two drums be repaired without stopping the production flow;

(c) The reject drum was relocated outside the building to allow ample space for additional equipment;

(d) The contractor supplied RAKTA with a second screw conveyor, a third complete screw press, a small by-pass belt conveyor and an additional belt conveyor in front of screw presses No.2 and 3. The new arrangement is set up as follows:

(i) Dewatering drums discharge washed straw to screw conveyor No.1;

(ii) Screw conveyor No.1 conveys straw to screw conveyor No.2 which feeds screw presses No.1, 2 and 3 successively which are arranged under it;

(iii) Excess straw is conveyed to the by-pass conveyor arranged perpendicularly at the end of screw conveyor No.22

(iv) The by-pass belt conveyor transports the straw to the other additional belt conveyor arranged in front of screw presses No.2 and 3 and conveys straw to the originally set belt conveyor in front of screw press No.1 and then to the straw silo

(e) The belt conveyor arrangement on top of the straw silo was modified and the contractor supplied RAKTA with an additional mobile belt conveyor on special rails erected on top of the silo bins;

(f) A locally fabricated chute was placed at the far end of the silo to by-pass the silo and raise the rate of charging digestors;

(g) The contractor supplied a second silo discharging equipment to be operated with the originally delivered one so that both discharging units could be operated at the same time to empty different silo bins while feeding the same belt conveyor through the locally fabricated chute.

Modifications (f) and (g) together with some other modifications in the filling equipment of the digestors enabled RAKTA to lower the time required to fill one digester from 40 to 25 minutes which helped indirectly in raising the capacity of the digestor house.

Furthermore, after the mill was handed over to RAKTA, more modifications and new designs were carried out by RAKTA technicians who gained an appreciable experience in the field of pulp manufacturing and pulp equipment.

These changes and modifications which took place after the hand-over of the pulp mill are described below.

Dewatering drums

The driving motor for the dewatering drums was an integral gearbox and motor unit. A chain sprocket with key is mounted on the output shaft of the gearbox while the driven sprocket segments are mounted on the drum rim. The dewatering drum is then driven with a special chain connecting the two sprockets.

This design was some sort of rigid driving arrangement which transfers driving power from the motor to the drum with no allowance or tolerance to take any overloads.

If the dewatering drum stops due to any production trouble, such as straw blockage in the screw conveyor, the dewatering drum stops, filled with straw, and it was a big waste of time to empty the drums by hand to avoid the mechanical failures which usually happened whenever the drums were run after such stoppages. Sometimes the chain would break or jump out, or the gear box casting would break or one of the gears inside would be damaged as a result of running the drum at normal speed with an excessive load. These repeated failures and troubles caused tremendous production interruptions which lowered the capacity of this section and accordingly that of the pulp mill.

RAKTA technicians studied this main problem with other related problems and solved it successfully as follows:

(a) The integral gearbox motor unit was removed. A bigger motor of 15 kW (instead of 12 kW) was used to drive the drum through a hydraulic coupling, a new gear box was mounted to the other end of the hydraulic coupling. This gear box rotates the driving gear through a flexible coupling, while the driving gear shaft is separately supported on two pedestal bearing blocks;

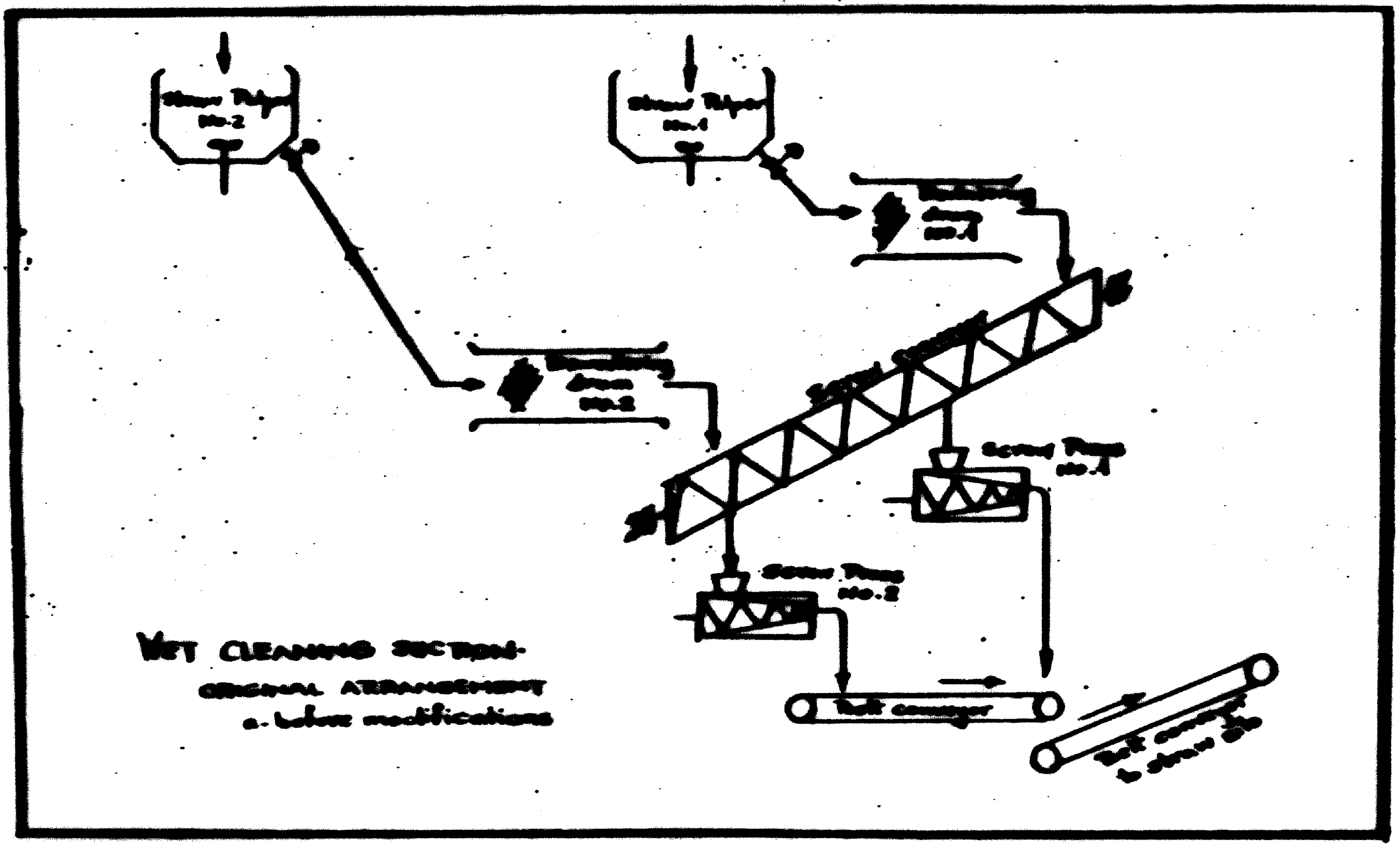


Figure III. Wet cleaning section before modification

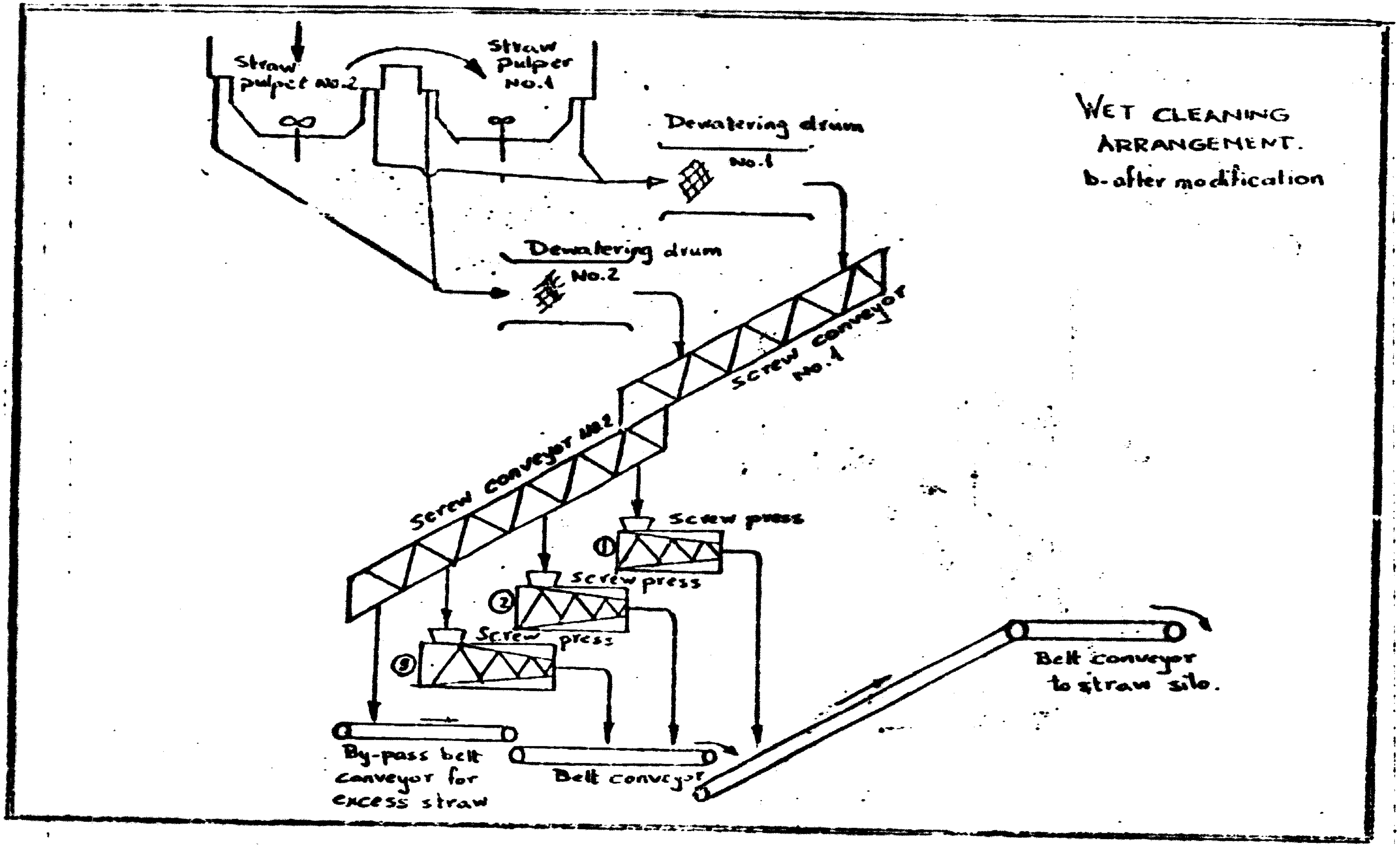


Figure IV. Wet cleaning section after modification

(b) The chains and sprockets used to drive the drum were replaced by a new direct simple gear train. It consists of a driving gear coupled to the output shaft of the new gear box with the driven gear segment mounted on the drum rim;

(c) The rollers supporting the drums were redesigned and manufactured locally with bigger shaft diameters and bigger roller bearings to withstand the unexpected shock loads and the severe working conditions;

(d) The speed of the dewatering drums was increased from 60 to 90 r.p.m. to increase the dewatering and wet-cleaning efficiency. Also one third of the dewatering surface was closed at straw entrance to ensure vigorous mixing of water and chopped straw and to increase reject removal.

Straw screw presses

United States defibrator screw presses originally designed for bark, were supplied for the pressing of rice straw. A lot of trouble was caused by the excessive wear of the press components subjected to rub against straw.

The following modifications were carried out to ensure longer life of these parts between refillings:

(a) The holes of the split cover halves were enlarged to reach a higher dewatering rate, so that discharged straw could be of higher dryness;

(b) The clearance between the revolving screw and the split covers was increased to avoid the excessive wear of these elements and also to avoid the excessive rubbing on the straw;

(c) The speed of the screw presses was increased to raise the capacity in order to cope with the increased production of the pulp mill which was nearly double the designated capacity;

(d) The split covers were redesigned and manufactured locally with replacable wearing edges;

(e) The screw press endpiece was redesigned locally after the unsuccessful modifications of the contractor technicians. The main purpose of this mouthpiece is to restrict the flow at the press discharge end thus creating a back pressure inside the press for proper water removal. The latest successful design fabricated locally is a truncated cylinderical piece of pipe with a perforated wall.

All these modifications resulted in the following:

(a) Longer lifetime of screw pressing element between refills (three weeks instead of one week);

(b) Shorter time required for refilling (16 hours instead of 72 hours);

(c) Eliminating the time required for refilling the split covers, as the edges subjected to wear are easily replaceable and are fastened with bolts (instead of refilling, welding and grinding of these edges which was the normal procedure in the past).

Belt conveyors

The following modifications were carried out on the belt conveyors:

(a) The speed of the belt conveyors was increased to meet the increasing demands of the pulp mill. Also, the covers were raised to avoid straw blockages which interrupted the production;

(b) The method of drive was modified to direct couple drive instead of sprocket chain drive which was unsuitable for the new speed of belt conveyors;

(c) Driving and driven main drums were redesigned locally, and also the idler rollers were redesigned to suit the new loads.

All aforementioned modifications, variations and redesigning of the equipment which were executed locally helped to solve the problems and minimized production interruptions or downtime required for repair or maintenance jobs.

Still further studies are carried out by RAKTA technicians from the design point of view to raise the production rates with the existing equipment and aiming for higher rates than already achieved, which is almost 50-60% above the originally deisgned capacity rates.

Digestor house

Steam connections to digestors

The different steam connections for each digestor are as follows:

(a) A 75 mm steam pipe to feed cooking steam to the digestor trunion;

(b) A 25 mm steam pipe to feed the three-way valve for sealing degestor's cover gasket;

(c) A 50 mm steam connection to feed steam through the trunion to clean the screen fitted on the relief connection;

(d) A 25 mm steam pipe connected to the blowing pipe to clear it after blowing the digester.

The supplier arranged to connect the four connections of each digester to the main header in the digestor house. Accordingly there were 40 connections to the main header. This caused a complete shutdown of the steam header, whenever any of the 40 valves fitted on these connections needed repair even when it was necessary to repack valve glands.

Repeated steam shut off caused enormous losses of production time and bad cooking output caused further loss of production.

The steam connections were redesigned, enabling any needed repairs to be carried out without any loss of production.

Steam admission in the digestor

The original cooking steam admission in the digester through a central pipe had to be replaced. This was not easy from the mechanical point of view, and RAKTA technicians had to try out three designs before the successful design was adopted. The excessive stresses acting on the central pipe and the severe working conditions under which this pipe is operated required a very elaborate design.

Modifications made to increase the rate of filling the digestors

The belt conveyors used for feeding the digestors with straw have undergone the following modifications:

(a) The speed of belt conveyors was increased to meet the higher filling rates;

(b) Bigger driving motors with gear boxes replaced the old units. Also a direct couple drive was designed instead of the chain and sprocket drive formerly used;

(c) The main belt pulleys were redesigned and fabricated locally with bigger shaft diameter and bigger bearings to withstand higher loading and the higher speed of the conveyors.

All modifications which took place in the chopping, wet cleaning and straw belt conveyors would have not been profitable, unless the filling door handling equipment and the digestor equipment were also completely redesigned.

The supplier provided RAKTA with a simple frame, carried on four rubber covered wheels and a small winch fitted on top of the frame. This was supposed to be used for lifting the filling doors of the digestors. The filling equipment was also of the same design but fitted with a small conical duct in place of the winch. To feed the caustic soda, a rubber hose connection was fitted to this filling equipment.

The new system, designed and executed by RAKTA technicians, was more practical and facilitated handling and filling the digestors. Along the filling openings on the operating floor, two rails were fitted and a sturdy frame carrying the winch was fitted to run on these rails. The filling equipment was also fitted on another frame, running on the same rails. The rubber hose used for caustic soda connection was replaced by a specially shaped pipe fitted with a quick coupling.

Each row of digesters was equipped with filling and door handling trollies. All this resulted the reduction of the filling time to a minimum of 20 minutes per digestor instead of 45 minutes.

Blow tank

Blow tank mixer trouble

Bales wrapping wire accumulating in the blow tank was one of the early troubles causing an enormous downtime in the pulp mill since there was at first no magnet for picking wires coming with the chopped straw. These wires were accumulating in the blow tank, twisted around the mixer blades and overloading the driving unit.

After 5 or 6 days of operation the mixer had to be stopped, the blow tank man-hole opened and a big effort made to clear the mixer blades and shaft from the wires siezing it in place and hindering completely its mixing action.

The mixer blades were also modified with a view to decrease the bad effect of the wires on the blow tank mixer.

Even with the increased production rate the blow tank is now cleared every 3rd or 4th week. Also, the time needed for clearing the wires, which was at first about 36 working hours, was reduced to nine hours.

However, efforts are still being made to stop this hazard of the wires completely. The possibility of using specially designed magnets at appropriate transfer points of the chopped straw is being investigated. Also, new designs for the shape of the blow tank and the position and the shape of the mixer are being preposed.

Blow tank transfer pump connections

Two pulp pumps were supplied and erected to transfer the pulp from the blow tank to the brown stock washers, one of the two being a standby for the other.

Originally one single discharge connection was coming from the dilution level in the blow tank to a three-way valve operated electrically from upstairs, to connect one of the two pumps to the discharge connection. This complicated connection through this inadequate valve gave trouble during the start-up seizing frequently, and causing a big loss of pulp to the drain, since to remove it, it was necessary to discharge the pulp at a higher level than the level of the drain.

RAKTA technicians eliminated this valve and fitted each pump with a suction connection from the blow tank, equipped with a simple shut-off pulp valve.

Washing and screening

Wire dressing on the wash filters

The first wires which were dressed on the wash filters according to the procedure designed by the suppliers and carried out by their staff, proved to be unsuccessful, particularly on the brown stock washers. To fit one wire, a long stopping time was needed and much human effort required, resulting in a wire showing wrinkles. Due to these wrinkles, the life time of the wire was very much reduced.

The supplier started many trials to improve the procedure, but inspite of all effort, they failed to provide a successful method.

Several months after the supplier's staff had left, it was clear that RAKTA staff had to find a better method and new wire dressing procedure and a special equipment was designed and manufactured locally by RAKTA staff, which is successfully still used. Dressing time was thus reduced from 72 working hours to only 12 hours. The use of this equipment also facilitated correct fitting of the wires. The life time of the wires was very much increased; instead of one to three months at first, it is now normally nine months, and sometimes the wire life time reached up to 24 months.

With the new dressing procedure it is possible to undress old used wires of the brown stock washer 1, pass them through a severe cleaning procedure and dress them again on brown stock washer 2. This means that the wire is used for about nine months on washer 1 (before it gets clogged) and then cleaned and reused on washer 2 for at least another twelve months.

Chlorine handling and storing

Originally, the supplier provided a storage tank for the chlorine liquid with a capacity of 20 tons. From tank-cars carrying the chlorine produced near Alexandria it was transferred to the storage tank. These tank-cars were specially equipped for that purpose.

The transfer of chlorine was supposed to be done by gravity, i.e. by connecting the tank-car to the storage tank through a flexible stainless steel hose. This method proved to be impractical; it took a long time to transfer the content of the tank-car and a complete transfer was never reached. The flexible hose was frequently damaged and it was impossible to procure it locally.

During the start-up much trouble occured in handling the chlorine and in feeding it to the bleaching department. Many times the feed line was clogged, this completely stopping or reducing the chlorine flow. Also the chlorine valves were found to be leaking either due to misuse or because unsuitable valves were provided.

RAKTA technicians made the following charges:

(a) A compressed-air station was developed to generate the required quantity of dry compressed air. It was designed to suit working conditions and to minimize the time needed for the transfer of the chlorine to the storage tank;

(b) The flexible hose was replaced by a locally-made copper pipe of special shape to give some flexibility. This pipe is much more reliable and cheaper;

(c) All connections on the storage tank were revised many times, and the final design proved to be satisfactory as it has been in use successfully for four years;

(d) A specially-designed trap was manufactured locally. It was fitted on the chlorine pipe feeding the bleaching mill to catch impurities and dirt and to keep the chlorine flowing free and at a steady rate.

General remarks on the mechanical adaptation and development

Parts of the RAKTA pulp mill were originally designed for batch production and other parts for continuous production. Some parts were designed as surge areas. As no stand-by units were provided in the original design, this meant that when any part of equipment broke down, the production flow had to be stopped. During the first months of production, it became evident that these stoppages had to be avoided and that a continuous production flow was important not only to increase the quantity but also to improve the quality.

RAKTA staff developed appropriate bypasses, and any special pre-fabricated connections, which enabled the small maintenance shift group (two persons) to keep the production flow uninterrupted. Some of these improvements were already described. The connections from the pulpers to the dewatering drums were designed to allow to continue production with either of the two dewatering drums stopped. In order to increase the rate of filling of the digestors a trough metal chute was developed to bypass the silo and its inefficient discharging equipment. In the pulp screening and washing department, pipe connections were developed to give the possibility to bypass any of the two filters. Production could thus be continued (but at a lower rate) during the time needed for wire dressing in the filter drum or for the repair of mechanical parts of the filter drive.

Even for the bleaching thickener a bypass was developed to give ample time for repair and inspection. Measures were taken to make the best use of the storage capacity of the high-density towers.

The above-mentioned examples do not cover all ideas developed by RAKTA mechanical maintenance staff to reach a greater continuity of production.

The policy of the mechanical maintenance staff was always to reduce the need for imported parts by producing them either in RAKTA workshops or procurring them on the local market. These efforts were made because of the well-known difficulties facing developing countries in procuring hard currency and also because of bureaucratic formalties which delay the receipt of such parts from abroad.

Some parts were redesigned either to facilitate local production or to increase their life time. A good example to illustrate this point is the new design of the split covers of the screw presses in the wet cleaning section. The new design increased the possibility to produce this part locally and at the same time facilitated and speeded up its reshaping whenever its edges were worn out. Reshaping can be carried out at a lower cost and with locally pre-fabricated edges.

Efforts were made by RAKTA technicians to use material available on the local market and to encourage local enterprises to produce pump impellers and pump parts made of stainless steel for the first time in Egypt. Centricleaners needed for pulp screening were produced locally out of a special alloy. This alloy was developed in a local foundry with the co-operation of RAKTA technicians to withstand the severe abrasive action of straw-pulp. These centricleaners are still in service after more than 12 years, while the original centricleaners were completely corroded after a comparatively short period.

RAKTA staff has succeeded to develop and produce locally helical chopping knives to be used on straw choppers. Some 3,000 knives were produced successfully and gave nearly the same results as the imported ones. Efforts are still made to improve these locally produced knives.

In some cases where the production of spare parts was not very successful, RAKTA technicians changed and redesigned them. A new more appropriate and more reliable part which can be produced locally usually replaced the original one.

A good example is the development of the new bearing assembly for the vibrating flat screens used in the washing and screening department. Originally rubber pyramids were used which had a rather short life time. The life time of locally-made rubber pyramids was also short. After redesigning the whole assembly any by using steel coil springs, the life time was very much increased and also frequent repairs and adjustments could be avoided.

BIBLIOGRAPHY

1- Alfred W.Swinyard, Editor "Industrial Development Fundamentals", Michigan Business, Papers No:42, 1965.

2- ______________, "Industrial Development, Studies and Documents", Development Centre of The Organization For Economic Co-Operation And Development, Paris, 1966

3- Wade, Worth, "How to profit from licensing" Ardmore, Pennsylvania, Advance House, 1969.

4- U.S.A.Department of Commerce, "Licensing, Joint ventures aid Technology transfer", By Vincent Travaglini. Washington, 1969.

5- Wallace, Robert. "Licensee's organization for seeking, evaluating and utilizing new technology", Licensing Executive society. Daytona Beach, Florida, 1969.

6- National Industrial Conference, Board, "Appraising Foreign licensing Performance, New York, 1969.

7- National Council of Applied Economic Research, "Foreign technology and investment". New Delhi, 1971.

8- W.N. Agrawal, "Technological Development of Arab Countries, in the Industrial Sector", United Nations Economic and Social Office, May, 1973.

9- ______________, "Choice And Adaptation of Technology IN Developing Countries". Development Centre of the Organization for Economic Co-Operation and Development, Paris 1974.

10- ______________, "Evaluation of The Occupational Training Information System (OTIS)". Macro Systems, Inc, New York, 1974.

11- Dr. Ahmed Shukri Salem, "Problems Related to the Transfer of Technology to Arab Countries", Un published research.

Development Centre Of The Organization For Economic Co-Operation And Development Paris

12- Behari, Bepin, "Genesis, Organization and Action Programme of the Appropriate Technology Cell" No:1

13- Hovemann, H.A., "The Adaptation of Technology to the Situation in Developing Countries" No:3.

14- de Bandt, J; "Some Thoughts on the choice and Adaptation of Techniques in Textile Industries", No. 4.

15- Ranis, Gustav,"Some Observation on the Economic Framework for Optimum Utilization of Technology". No. 5.

16- Thoumi, F. "The International Market of Technology, Direct Foreign Investment Market Structures and Policies for Developed Countries", No. 6.

17- Unido, "Guidelines for the Acquisition of Foreign Technology in Developing Countries with Special Reference to Technology Licensing Agreements". No. 10.

18- Stewart, F. "Intermediate Technology: a Definitional Discussion" No. 11.

19- M.I.T., "Technology Adaptation Projects of the Massachusetts Institute of Technology". No. 12

20- Judet/Perrin, Unido, "The Transfer of Technology in an Inter grated Program of Industrial Development". No. 13.

21- Latham - Koentig, A., "Intermediate Technologies for True Development" No. 15

22- Behari, B; "Appraisal of Industrial Technology Policies" No. 20.

23- Giral, J., "Development of Appropariate Chemical Technology- A Programe for Maxico". No. 22

24- Fax, T.(Vita); "Volunteers in Technical Assistance". No. 23.

25- Boon, G.K. "Report on Choice of Technique in Metal Machining Process". No. 24.

26- Harper, P., "Soft Technology - A Proposal for Alternatives under Conditions of Crisis". No. 29.

27- Fernondes (conacyt), "The Role of Information in the Transfer of Technology - An Experiment in Mexico". No. 32.

28- A.I.D. (TALOST 72-9). "Technology and Economics in International Development - Report of a Seminar". No. 35.

29- A.I.D. (TALOST 72-11), "Appropriate Technologies for International Development " No. 36.

30- Nanjappa, K.L., "Choice and Adaptation of technology in Developing Countries (Indian Experience)". No. 38.

THE INSTITUTE OF NATIONAL PLANNING
CAIRO,

31- Dr. H.W. Singer & Dr. W. Hagemajer, "Choice of Technology". Memo. No. 158. Cairo 1962.

32- The Institute of National Planning, "The Planning of The Labor Power in U.A.R.," Cairo, 1971.

United Nations Conferrence On Trade And Development Geneva (U.N.C.T.A.D.)

33- C.M.G. Oldham and others, "The transfer of technology to developing countries, with special reference to licencing and know-how agreements". Document No: TD/28 and Supp.1 and Supp. 1 /Corr. 1

34- ____________, "Transfer of technology". Document No:TD//06 and Corr. 1

35- ____________ "Policies relating to the transfer of technology of the countries of the A ndean Pact: their foundation". TD/107 and corr.1

36- ____________, "Elements of a programme of work for UNCTAD". Document No: TD/B/310 and Corr. 1

37- ____________, "Report of the Trade and Development Board on the first part of its tenth session". No:TD/B/327 and Add.1

38- ____________, "Report of the Intergovernmental Group on transfer of Technology on its Organizational". Document No: TD/B/365.

39- ____________, "Scope of activities of bodies within and outside the United Nations system in the field of transfer of technology". Document No:TD/B/A.C.11/2 and Add.1

40- ____________, "Works relevant to the transfer of technology being domely the main committees of the Board and other subsidiary orangs of UNCTAD". Document No: TD/B/AC. 11/3 and Add. 1

41- Charles Cooper , "The Channels and mechanisms for the transfer of technology from developed countries". Document No:TD/B/AC. 11/5

42- ____________, "Major issues in transfer of technology to developing Countries", Document No:TD/B/A.C.11/10 and Add.1

43- ____________, "Major issues in transfer of technology to developing Countries", A case study of Ethiopia". Document No: TD/B/AC.11/13

44- ____________, "General Assembly resolution 2726 (xxv) and views of the Advisory committee on the Application of Science and Technology to Development on the proposed work programme for UNCTAD". Document No:TD/B/AC. 11/L.1

45- ____________, "Elements of a programme of work for UNCTAD", Document No:TD/B/L. 224/Add.1

46- ____________, "Guidelines for the study of the transfer of technology to developing Countries". 1972.

47- ____________, "Major Issues Arising From The Transfer Of Technology To Developing Countries". 1973.

United Nations Economic and Social Office.

48- ____________, "Draft Regional Plan Of Action For Application of Science And Technology To Development In the Middle East", Beirut, 1973.

49- Carlos Contreras a, "Toward A Policy of Transfer of Technology". Office of the Coordinator, Lima, Peru. October, 1974.

(UNITAD) United Nations Institute for Training and Research, 801 United Nations Plaza, N.Y, N.J. 10017

50- Terutomo Ozawa, "Transfer of technology from Japan to development" No.7

51- Hal Mason, "Transfer of technology and the factor proportions problems: Philippiens and Mexico". No.10

52- Y.S. Chang, "The transfer of technology: Economics of offshore assembly the case of semi-conductor industry". No.11

53- Robert S.Stobaugh, "International transfer of technology in the establishment of the petrochemical industry in developing countries" No:12

94- Walter A. Chudson, "International transfer of commercial technology to developing countries", No:13

95- Lawrence H. Wortzel, "Transfer of technology in the pharmaceutical industry". No:14.

United Nations Publications

96- ________________, "Foreign investment in developing countries", Sales no 68. II. D.2.

97- ________________, "Guide for use in drawing up contracts relating to international transfer of know-how in the engineering industry", Sales no. 70. II. E. 15.

98- ________________, "Manual on the establishment of industrial joint venture agreements in developing countries". Sales no. 71.II.B. 23.

99- ________________, "The role of patents in the transfer of technology to developing countries", Sales no. 65.II.B.1.

100- ________________, "Guidelines For the Acquisition of Foreign Technology in Developing Countries", United Nations New York 1973.

B-37

79.12.05