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PROVISION OF SERVICES
RELATING TO THE
RESOURCE RECOVERY AND UTILIZATION OF WASTES IN
METALLURGICAL AND OTHER INDUSTRIES

SI/CPR/85/8o3
PEOPLE'S REPUBLIC OF CHINA

FINAL REPORT

Prepared for the Government of the People's Republic of China by the United Nations Industrial Development Organization acting and executing agency for the United Nationd Development Programme

Based on the work of TESCO / UVATERV - Hungary, as subcontractor

United Nations Industrial Development Organization
Vienna

This report has not been cleared with the United Nations Industrial Development Organization which does not, therefore, necessarily share the views presented.

CONTENTS

GENERAL INTRODUCTION

The efficient recovery, recycling and utilization of waste materiale is of utmost importance in all countries as its organized implementation and continuous functioning can beneficially contribute to the general and particularly to the industrial development of any country.

This has been revealed in the People's Republic of China for decades and vast efforts has already been made to improve the existing facilities.

Based on previous preparatory talks, visits, missions TESCO/UVATERV was assigned by UNIDO to provide services relating to the resource recovery and utilization of wastes in metallurgical and other industries in Shanghai, P.R. of China. The Chinese counterpart has been the Resource Recovery and Utilization Company/SRRUC/ in Shanghai the contribution of which to the project is highly appreciated by TESCO/UVATERV.

The aim of the project was to improve the facilities of SRRUC in four field, i.e. waste iron oxide, aluminium scrap, copper scrap and waste textile through provision of Hungarian expertise, organizing a study mission of Chinese experts to Hungary and summarizing the findings in written form.

The present Final Report includes six parts, i.e.

Part I. Utilization of waste iron oxide.

Part II. Copper and brass scrap utilization.

Part III. Aluminium scrap utilization.

Part IV. Waste textile utilization.

Part V. Study mission of the SRRUC experts' delegation in Hungary

Part VI. Tripartite project review meeting

We trust that the goals of the project has been achieved and the project will contribute to the improvement and further development of the SRRUC's facilities.

PART I.

UTILIZATION OF WASTE IRON OXIDE

Report

C O N T E N T S

1. SUMMARY

On the basis of the UNIDO - TESCO contract NO.SI/CPR/85/803 the Hungarian experts surveyed the quantity of metallurgical iron oxide scale forming at the Shanghai Resource Recovery and Utilization Co. and examined the possibilities of using it as base material for the production of barium ferrite /$BaO6Fe_2O_3$/ for permanent magnets.
In Hungary the magnet plant of the VIDEOTON company has been producing barium ferrite loudspeaker-magnets-basedon metallurgical iron oxide scale - for decades. The survey made in the Shanghai metallurgical works showed that 10.000 tons of iron oxide scale suitable for the production of barium ferrite is formed each year in the metallurgical works. During the next 5 years the Chinese partner intends to increase its barium ferrite production from the present level of 10.000 tons/year upto about 20.000 tons/year. The magnets produced would be sold in the domestic market as loudspeaker magnets for television sets and tape recorders, door magnets for refrigerators, etc.

On the basis of the survey we have worked out recommendation for the technology of magnet production and for its implementation in an economic barium ferrite plant with a capacity of looo tons/year.

2. INTRODUCTION

The subject of this report is the utilization of waste iron oxide. The purpose is to process the iron oxide scale forming in the hot rolling mills of the Shanghai plants into barium ferrite magnets. On the basis of the surveys made on the spot the quality and quantity of the iron oxide scale being formed, the present situatuion of magnet production in the People's Republic of China and the expect ed future demands for magnets have been determined.

On the basis of all these we put forward a recommendation for the establishment of a magnet plant with a capacity of approx. looo t/year to process iron oxide scale.

3. ANTECENDENTS

The Shanghai Resource Recovery and Utilization Co /SRRUC/ held an international conference in 1985 on the utilization of waste materials. After this conference UNIDO signed a contract no.SI/CPR/85/803/ with TESCO for surveying a.o. the quality and quantity of iron oxide scale being formed and for preparing a technical report on the processing of this scale into magnetic material.
It is well known that in Hungary VIDEOTON company has been producing anisothropic barium ferrite loudspeaker magnets/ $/BH/_{max}$ = 3.5 MGOe/ for about 25 years using iron oxide scale as base material.

4. SURVEY

The group of Hungarian experts was working in Shanghai between April 17 and May 7 1986. Much assistance was given by the Chinese experts, who, during the visits to the factories and the consultations, were very active in raising their problems.

The Hungarian group of experts was doing its job according to the working programme drawn up by SRRUC and agreed on the first day of talks. The working programme consisted of visits to the different factories and plants. After each visit a technical consultation was held.

The order of studying the waste utilization activity was as follows:

- Studying the collection system
- Studying the methods of storage
- Studying the processing technology.

The detailed programme of work is summarized as follows:

4.1. <u>Programme of work of the Hungarian experts</u>:

<u>April 17, 1986.</u>

Morning: Discussions in the central office of the Shanghai Resource Recovery and Utilization Company.
Agreeing the programme of work, introduction of the company.

Afternoon: Visit to the Zhabe District Ferrous Metal Processing Company. Sorting of iron scrap, metallurgical preparation thereof.

April 18.

Morning: Visit to the Yanan Dong Lu Purchasing Station, then to the Xing Liang Plastic Products Manufaturing Co.

Afternoon: Visit to the SRRUC stations at Beijung Lu, where the products made of recovered materials are sold.

April 21.

Morning: "The situation, development and application of ferrite magnet production and its market possibilities abroad." A lecture by a Hungarian expert.

Afternoon: "Production technology of ferrite magnets and its equipment". A lecture by Hungarian experts.

April 22.

Morning: "The present situation of ferrite magnet production in China". A lecture by Chinese experts.

Afternoon: Visit to the Xing-hu Iron and Steel production Plant.

April 23.

Visit to the Shanghai Precious Metals Refinery Works.

April 24.

Morning: Visit to the Shanghai No. 3 Iron and Steel Plant.

Afternoon: Visit to the Shanghai No. 2 Iron and Steel Plant.

April 25.

Discussion on the base materials used abroad.

April 29.

Visit to the Shanghai No. 1 Magnetic National Manufacturing Co.

April 30.

Morning: Visit to the Shanghai Iron and Steel Research Institute.

Afternoon: Consultation.

May 2.

Technical consultation in the office of SRRUC Storage and Transportation Department.

May 5.

Technical consultation in the office of SRRUC Storage and Transportation Department.

May 6.

Technical consultation in the office of SRRUC Storage and Transportation Department.

4.2. Chinese partners

During the visits and talks our experts negotiated and met with the following Chinese partners:

Li Bingzhang	Manager
Zhu Ke Xi	Deputy Manager

Zhang Dexing	Deputy Section Chief
Zhao Kai Xian	Vice Manager
Yuan Yonglin	Manager
Jiang Fu Qing	Managing Director
Sun Jong Jie	Vice Manager
Huang Jianging	Engineer
Shen Yimin	Engineer
Fong Je Ling	Engineer
Xi Shi Ming	Engineer
Zhu Rongel	Engineer
Zhang Gnochang	
SUN Xiaolu	
Chen Qinging	
Chang Yanxiao	
Li Zhong Cun	Engineer
Shov Hongxiang	Deputy Director
Shen Desheng	
Cao Chungan	Deputy Director
Cai Guohna	Deputy Director
Pan Zhengtang	
Tong Heng	Deputy Chief Engineer
Xu Ming Da	Vice Director
Feng Shulian	Engineer

4.3. Summary of the survey

During the study-tour our experts visited four metallurgical plants in Shanghai, of which

- in the Shanghai No. 2 Iron and Steel Mill 5000-6000 t of iron oxide scale, and
- in the Xing-hu Iron and Steel Mill 5000 t of iron oxide scale is formed each year.

The above quantities together represent some 10 000 t of iron oxide scale each year, which is formed during the rolling of profiled steel and wire-drawing. Our conclusion is that this material is suitable for barium ferrite production.

According to the analysis performed by the Chinese partner, the composition of the material is as follows:

Fe content	:	69%
C "	:	0.2%
Mn "	:	0.5%
P "	:	0.1%
S "	:	0.1%
Si "	:	0.5%
Humidity	:	8%

In the two plants mentioned above we took samples and had them analysed in Hungary. The result of the analysis is as follows:

	Fe	CaO	MgO	SiO_2	NiO	Cr_2O_3	K_2O	Na_2O	Humidity
1.	74.2	0.42	Tr.	0.26	Tr.	Tr.	Tr.	0.10	0.015
2.	69.0	1.54	Tr.	2.31	Tr.	Tr.	Tr.	0.13	0.10
3.	73.3	0.40	Tr.	0.14	Tr.	Tr.	Tr.	0.10	Ø
4.	74.0	0.41	Tr.	0.83	Tr.	Tr.	Tr.	0.08	0.04

On the basis of the analysis data samples No. 1, 3, and 4 can be processed into barium ferrite.

At present, one part of the scales being formed in metallurgical plants is used in steel production, and the other part is used for pigment production, powder metallurgical purposes and as an additive for ferrite production. Some of the scales in collected and not used for anything. The scales being formed can be treated and collected by types and its utilization as a base material of full value in ferrite production is justified from the economic point of view.

At present approximately 10 000 tons of ferrite magnet is produced each year in China in several hundred different magnet plants. During the seventh five-year plan this quantity will be increased to 20 000 t/year by 1990 according to the estimates. The application of ferrite magnets will increase primarily in the field of loudspeakers and motors. The television production is planned to be increased to 15 million TV/year by 1990 and the tape-recorder production to 10 million/year.

In order to fulfill these plans anisothropic barium ferrite loudspeaker magnets are essential. To the direct current electric motors/e.g. wind generators, cars, tractors/ anisothropic segment ferrites are required. Refrigerator production requires plastic bonded barium ferrite strip magnets/door lock/. For other purposes isothropic barium ferrite is needed, for which the demand is also expected to be increased.

The energy content of the present Chinese barium ferrite products is $/BH/_{max}$ 3 MGOe or less.

Using the more up-to-date Hungarian technology the following requirements are placed on the barium ferrite products made of iron oxide scale:

Anisothropic ferrite:

B_r = 3800 - 4100 Gauss

$_BH_C$ = 2000 - 2700 Oersted

$/BH/_{max}$ = /3.5± 0.2/ MGOe

Isothropic ferrite:

B_r = 2000 Gauss

$_BH_C$ = 1700 - 2000 Oersted

$/BH/_{max}$ = /0.9 - 1.2/ MGOe

By means of the technology used in Hungary it is possible to produce 3.5 MGOe anisothropic and 0.9 - 1.2 MGOe isothropic barium ferrites. On the basis of the above we recommend the establishment of a barium ferrite plant with an annual capacity of 1000 tons for the utilization of the fine rolling mill scale being formed in the Shanghai metallurgical plants. One third of the plant's capacity would be devoted to the production of each of the following products:

- anisothropic loudspeaker and segment magnets

- plastic bonded strip magnet
- isothropic barium ferrite magnet.

All these products would be used demostically for the production of television sets, tape recorders, refrigerators and motors.

5. RECOMMENDED TECHNOLOGY

The VIDEOTON company in Hungary has been producing anisothropic barium ferrite magnets with an energy content of $/BH/_{max}$ = 3.5 MGOe out of iron oxide scale in its ferrite plant for decades.
Therefore, the technology for a demonstration plant to be established with a capacity of 1000 t/year has been chosen on the basis of the VIDEOTON plant.

The base materials/iron oxide scale, $BaCo_3$ and bentonite/are mixed after being analysed. After removing the excess water the average particle size is checked, then the material is presintered at a temperature of 1300-1320°C with a holding time of 4-6 hours.
The presintered material is pre-crushed in a jaw-breaker and roll-breaker, then the material is ground to a grain size of 0.8-1.3/um in a ball mill. The

grain size is checked. After the operation the material is stored for 24 hours.
After this point the production technology is different according to final products/anisothropic, isothropic, plastic-bonded magnet/.
In case of producing anisothropic magnet the wet and ground sludge is pressed to shape in a magnetic chamber with a specific pressure of about 1 t/cm². After drying for 2-5 days the anisothropic magnets are finish-sintered at 1240 °C. Then the required machining operation and the final quality control follows.

Before the production of isothropic magnets the wet sludge is first dried, then mixed with lubricant. Pressing is done without a magnetic chamber. The operations after this step are the same as in the case of the anisothropic magnets.

For the production of plastic-bonded magnets dry powder is required as well, which is mixed with the plastic bonding material, then extruded by the hot extruder. The last extrusion is followed by the magnetization and control of the strip.

5.1. Base materials

Base material requirement of the plant with a capacity of 1ooo t/year is as follows:
8oo tons iron oxide scale /8o-1oo juan/t/
2oo t $BaCO_3$ /8oo-1ooo juan/t/
1.6 t bentonite /no price/.

The above base materials ara availale in China. The plant would be working in continuous operation/36o working days, 3 shifts per day/, daily base material consumption is 3 tons.

5.2. Equipment with specifications

In order to ensure a continuous operation a base material quantity sufficient for about 2 weeks /approx. 5o tons/ must be stored in a covered area.

1./ Analysis: To control the cleanliness of the base materials a quick analysis is required. The quick analyser "Dithermanal" produced by VASKUT ensures the rapid determination of the required components.

2./ Measuring: For the measuring of the base materials the following are needed:

1 scale with a measuring range up to 5oo kg

1 scale with a measuring range up to 2o kg

/Potential manufacturer of the scales: Metripond, Hódmezővásárhely, Hungary./

3./ Mixing: To prepare 3 tons of mixture per day 1 rubber-lined ball mill with a capacity of 3.5 m^3 is needed. 500 kg base material, 6 tons of steel balls with a diameter of 1o mm each and 5oo litres of water should be put in the mill. Mixing time is 1.5 hour, filling and emptying take about 2 hours. The capacity of the mill is 3 tons per day. Manufacturer: Jászberényi Aprítógépgyár, Hungary. Type Gd.18o/16o.

4./ After pouring out the wet sludge, the excess water is removed by means of a revolving filter. The revolving filter consists of a perforated cylinder the size of which is Ø o.6 x 1 m and which is covered by a filtering canvas outside. The removal of water from the internal part of the cylinder is done by a vacuum-pump. This pump is manufactured by VIDEOTON, Hungary.

5./ The average grain size is checked with an FSSS instrument made by the American Fischer company.

6./ Pre-sintering: For the pre-sintering of 3 tons of base materials each day,a 37 m long through-type furnace heated electrically with 3 superkanthal resistance elements with trolleys is needed.
Engineering: UVATERV, Hungary.
Operating temperature: 1320 °C.

7./ Grinding: The pre-sintered lumpy material is first crushed in a jaw-breaker, then in a roll-breaker and finally it is ground in a ball mill to a grain size of about 1 μm. The required equipments are as follows:
1 jaw-breaker, type PFo2/Jászberényi Aprítógépgyár, Hungary/
1 roll-breaker, with rolls ∅ 400x600 mm /Jászberényi Aprítógépgyár, Hungary/

3 rubber-lined ball mills with a volume of 3.5 m^3 each
/Manufacturer: Jászberényi Aprítógépgyár, Hungary/
Feeding of the mill is the same as in the case of mixing. Grinding time: 2 x 5 hours. Water must be circulated in the meantime.

8./ Storage: Before pressing, the material must be stored for 24 hours. One third of the sludge will be used for making anisothropic magnets, one third for making isothropic magnets and one third for making plastic-bonded magnets. For the production of the latter two types, the sludge must be dried.

9./ Drying: Drying is done in 2 atomizing-drying units type Niro Atomizer. Their capacity is 40-50 kg/hour. /Niro, Denmark/

10./ Mixing: In the case of isothropic magnets the additive which enables pressing easier /10 % PVA/ and in the case of plastic-bonded magnets the plastic is mixed in separate mixers. /Type: Eirich, Germany/

11./ Pressing: For the production of the anisothropic magnets 3 multi-moulded presses with a capacity of loo t each, are used. For the pressing of the isothropic magnets 3 automatic pressing machines with a capacity of 15 t each have been planned./Type: DORST, Germany/

12./ Sintering: For the sintering of the dried magnets 2 superkanthal-heated through-type furnaces are used. The type of the furnaces is the same as that used for presintering./UVATERV, Hungary/

13./ Machining: For the machining of the magnets 6 vertical surface grinders and 1 centerless grinder have been planned. /CSSZGY, Hungary/

14./ Control: For plotting the demagnetization curve and for the determination of the magnetic characteristics 1 Permagraph is used. /Dr. Förster, Germany/

15./ For the production of the plastic-bonded magnet the following are needed:

2 extruders

1 cutter

1 magnetizer

/IOS, Italy/

5.3. Location of the machines, plant location

The summary list of machines is gien in the table below.

As regarding the location of the plant itself, the Chinese experts made no proposals. So that the transportation distances can be reduced to a minimum, we recommend to erect the plant near Shanghai, in the vicinity of the metallurgical plants where the iron oxide is being formed.

LIST OF MACHINES

	Pieces
1./ Ball mill, 3.5 m^3	4
2./ Revolving filter	2
3./ Niro atomizer, pwder dryer and storing unit	2 + 2

4./ Eirich powder mixer	2
5./ Press with rectifier	3
6./ Press without rectifier	3
7./ Extruder	2
8./ Cutter	1
9./ Magnetizer	1
1o./ Winder	1
11./ Furnace	5
12./ Jaw-breaker	1
13./ Roll-breaker	1
14./ Quick analyser	1
15./ Grinder	6
16./ Scales	2
17./ Centerless	1
18./ Average grain-size checking unit, magnetizer	1 + 1

6. COST ESTIMATE FOR THE PROPOSED PLANT

6.1. Investment costs

6.1.1. Building costs

2400 m^2 workshop-building, 3oo juan/m^2

Total: 72o ooo juan

6.1.2. Equipment, machines: 21 ooo ooo juan

/for the process described in section 5/

Total investment cost: 21 72o ooo juan

6.2. Operating cost for one year of operation

6.2.1. Labour force

The labour force requirement for the barium ferrite plant with a capacity of 1ooo t per year in case of continuous operation is 8o persons.

Avarage cost for 1 person/wage and tax/: 15o yuan per month.

Total labour cost is 144 000 juan/year

6.2.2. Base material costs

8oo t iron oxide scale, 1oo juan/t	8o ooo juan
2oo t $BaCO_3$, 1ooo juan/t	2oo ooo juan
1.6 t auxiliary material, 1ooo juan/t	1 6oo juan
Total:	281 6oo juan/year

6.2.3. Energy costs

12oo KW, in continuous operation for 36o days, o.12 juan/KW

/12oo x 36o y 24 x o.12/

Total: 1 244 ooo juan/year

6.2.4. Water consumption

14 ooo m^3 , o.o7 juan/m^3

Total: 1 ooo juan/year

6.2.5. Amortization

Amortization for the building/2o%/ 144 ooo juan/year

" for the machinery/2o%/4 2oo ooo juan/year

Total amortization: 4 344 ooo juan/year

6.3. Turnover tax: 1o%

6.4. Profit: 2o%

Summary assessment of the production costs/year

Labour force	144 ooo	juan/year
Base material	281 ooo	" "
Energy	1 244 ooo	" "
Water consumption	1 ooo	" "
Amortization	4 344 ooo	" "
Total operating cost	6 o14 6oo	juan/year

Turnover tax 10 %	601 460 juan/year
	6 616 060 juan/year
Profit 20 %	1 323 212 " "
	7 939 272 juan/year

Avarage price of 1000 tons of finished product:

7 940 juan/kg.

This corresponds to US $ 2.49 kg

7. CLOSING CHAPTER

According to the tasks laid down, the Hungarian experts examined the quantity and quality of metallurgical iron oxide scale suitable for the production of barium ferrite magnets. According to the examinations carried out the scale being formed in the Shanghai metallurgical plants is suitable for the production of barium ferrite. Based on the demands arising a proposal is made for the establishment of a ferrite demonstration plant with a production capacity of 1000 t/year. On the basis of the cost estimate the plant would ensure economic production. The preparation of a detailed bankable feasibility study is recommended.

PART II.

COPPER AND BRASS SCRAP UTILIZATION

Report

CONTENTS

1. SUMMARY

During its visit to the People's Republic of China, the delegation found that there is a well-organized and efficient system of brass and copper scrap collection. Scrap processing technology could, however, be substantially improved in the areas of melting and metal content recovery from slag.

2. INTRODUCTION

The collection and utilization of waste materials has a great tradition in the People's Republic of China. In China's most important industrial center, Shanghai, this activity is carried out by the Shanghai Resource Recovery and Utilization Company/SRRUC/.
In 1983, at the request of the World Bank, the UNIDO organized a European study-tour for specialist of the SRRUC to study smelting and other waste processing facilities in Belgium, West-Germany and Hungary.
In 1984, at the International Resource Recovery and Utilization Conference organized in Shanghai by the World Bank, the Hungarian delegates and the representatives of the SRRUC agreed to further develop their cooperation

under the auspices of the UNIDO and the World Bank in the following four areas:

- magnet manufacturing, utilizing iron-oxide waste
- aluminium scrap processing
- copper scrap processing
- carpet manufacturing, utilizing waste textile and synthetic fibres.

In November, 1984 the government of the People's Republic of China applied to UNIDO, through the Peking office of the UNDP, to support Hungarian participation in the technology transfer requested. The UNIDO then asked TESCO to send specialists in these four subjects to China to carry out the objectives defined in the contract.

The task of the Hungarian specialists consisted of sharing the Hungarian experience in waste utilization with their Chinese partners and, after studying Chinese processing technology at various scrap metal processing sites, to formulate proposals aimed at improving Chinese processing technology.

The brass and copper experts with the aluminium experts sent to Shanghai for the task worked side by side from April 17 to May 7, 1986.

We received a great deal of help in our work from our Chinese colleagues who were quite open in exposing their problems to us both at the visits to the plants and at the consultations that followed.

3. WORK DONE BY THE BRASS AND COPPER TEAM

The team worked according to a work program which the SRRUC had drawn up and then discussed on the first day of the meetings. Our work method basically consisted of making visits to individual plants or facilities, with each visit being followed by a professional consultation.

Our study of waste material utilization was carried out in the following order:

- Study of the system of collection
- Study of storage methods
- Study of processing technology.

The detailed work programs is summarized as follows:

3.1. The team's work program

April 17.

Morning: Discussion in the offices of

the Shanghai Resource Recovery and Utilization Company.
Coordination of work program, presentation of the company.

Afternoon: Visit to the Zhabei District Ferrous Metal Processing Company. Sorting of scrap iron, preparation for melting.

April 18.

Morning: Visit to the Yanan Dong Lu Purchasing Station/scrap metal and other waste material purchasing/, then a visit to the Xing Liang Plastic Products Manufacturing Company/plastic processing plant/.

Afternoon: Visit to the SRRUC shops on Beijung Lu, where products made from recovered waste are sold.

April 21.

Morning: Visit to the Sha Jingang Metals Warehouse storage facilities.

Afternoon: Consultation in the offices of the

SRRUC Storage and Transportation Department.

<u>April 22.</u>

Visit to the Zhoupu Secondary Aluminum Smelter.

<u>April 23.</u>

Visit to the Yang-Pu Copper Smelter.

<u>April 24.</u>

Visit to the Zhoupu Secondary Aluminum Smelter.

<u>April 25.</u>

Consultation in the offices of the SRRUC Storage and Transportation Department.

<u>April 29.</u>

Consultation in the offices of the SRRUC Storage and Transportation Department.

<u>April 3o.</u>

Visit to the Yang-Pu Copper Smelter.

<u>May 2.</u>

Consultation in the offices of the SRRUC Storage and Transportation Department.

<u>May 5.</u>

Consultation in the offices of the SRRUC Storage and Transportation Department.

<u>May 6.</u>

Consultation in the offices of the SRRUC Storage and Transportation Department.

3.2. <u>Chinese partners</u>

During the visits and talks we met and had discussions with the following Chinese partners:

Cha Jie	Chief of the Foreign Economic Relations and Trade Division
Cuo Jang Kany	Section Chief, Foreign Economic Relations and Trade Division

Li Bingzhang	Manager
Zhu Ke Xi	Deputy Manager
Zhang Dexing	Deputy Section Chief
Ren Debao	General Manager
Tien Kai Yavang	Vice Manager
Zhao Kai Xian	Vice Manager
Fan Yang Fen	Factory Director of Trade
Zhao Ahi Gang	Factory Director Vice Manager
Fan Yong Qing	Factory Director of Production
Zhang Limin	Assistant Manager
Yuan Yonglin	Manager
Jiang Fu Qing	Managing Director
Sun Jong Jie	Vice Manager
Huang Jianging	Engineer
Shen Yimin	Engineer
Fong Je Ling	Engineer
Xi Shi Ming	Engineer
Zhu Rongle	Engineer
Zhang Gnochang	
Sun Xiaolu	
Chen Qinging	
Chang Yanxiao	

3.3. Collection and storage system

The waste and scrap collection system of the SRRUC is well organized. SRRUC has 291 collection points in the twelve districts of the city of Shanghai. It is mainly household waste and scrap that is bought up at these facilities, where the scrap is sorted upon collection. The relatively high prices paid ensure an active participation of the population in the collection of re-usable waste. Industrial scrap and waste is delivered by the various companies directly to the processing plants of the SRRUC.

The quantity of scrap collected annually is as high as 1.5 million tons. Only a relatively small proportion of this contains copper, however.

The annual quantitis of copper-containig scrap are as follows:

- Brass chips and cuttings	1,266 t	62.8%
- Brass scrap	251 t	12.5%
- Copper chips and cuttings	116 t	5.8%
- Copper scrap	143 t	7.1%
- Copper waste	240 t	11.8%
Total copper-containing scrap and waste:	2.016 t/1985 statistics/	

Chemical composition

- The average chemical composition of scrap brass:

Cu	content	69.35%
Zn	"	18.47%
Sn	"	2.38%
Fe	"	2.1%

- The average chemical composition of scrap copper:

Cu content	96.0%

This scrap is processed at the Yang-Pu Copper Smelter.

Copper-containing scrap is stored either directly at the processing plant or in interim district storehouses, where it is delivered from the collecting plants. In these district storehouses the scrap is sorted and then it is transported to the processing plant.

3.4. Present method of copper and brass scrap processing

3.4.1. The plant

The copper processing plant of the SRRUC, the Yang-Pu Copper Smelter, is located in the Yang-Pu district of Shanghai on an area of 7,032 sq. meters. The plant, built in 1958, has a staff of 1o7 people and fixed capital in the value of 86o,ooo juans. Its annual production is worth 1.o5o.ooo juans. The composition of the staff is as follows:

- productive staff 83 persons
- supporting staff 6 persons
- administrative staff 8 persons
- engineering staff 1o persons.

The Yang-Pu plant processes all copper-containing waste from the twelve districts of Shanghai, but it also receives scrap from the ten distributive districts of Shanghai Shi. The plant's main products are brass and copper ingots, sold to copper works for further processing.

The plant's buildings suit the requirements of the presently employed technology. Any substantial expansion would be difficult, due to the limitations of the present area.

3.4.2. <u>The technology presently employed</u>

Scrap and waste material arrives at the plant already sorted out.

Brass and copper chips are stored in a store-room on the ground floor of the building No.1/see photo No.1/ until processing.

/For the plan of the plant, see Appendix No.1, for the photos, Appendix No.2./

The cuttings are compressed into bales on a bailing press, model SP 25, located in the warehouse itself./Photo No.2/

In cases of occasional unsorted shipments, sorting and removal of copper and brass items from the rest is done manually. The removal of steel cuttings from brass and copper chips is also carried out manually. The copper scrap is transported in batches from the store-room to the charging area of the melting furnace, located in workshop No.4 /photo No.3./.

The furnace is a coal-dust fired, box furnace, with a door for charging and skimming.

There is a casting band set up at the tapping hole. Over the charging door and the tapping hole there is an exhaust screen, the efficiency of which, however, is not sufficient to ensure an acceptable air quality in the work area. Flue gases leave the furnace through a flue gas channel.

The capacity of the furnace is: 5 tons/shift.
The copper-containing chips are loaded into the furnace by hand, and slag is skimmed off manually as well/photo No.4/.
Melting is done in batches and the molten metal is discharged onto the casting band which carries the finished product to the finished product storage area/photo No.5/.
The slag is crushed on jaws and roll crushers, then it is sorted manually and washed, to remove slag dust and achieve a higher metal content /photo No.7/.
The dressed slag is transported to an area next to the finished product storage room and is charged back into the furnace by a conveyor belt /photo No.5/.
The washed out slag dust is left to settle and then sold.
Flue gases pass through a water heater/photo No.8/ into a bent-tube heat exchangeer/photo No.9/.
After they are cooled down under 100°C, they pass through a sack-type dust filter and a water bath /photo No. lo/ before being released into the open air.

A block sketch of the technological process is given in diagram No. 1, and diagram No. 2 shows the process of flue gas treatment. The composition of the finished product produced with the present technology is as follows:

Brass ingot:

Copper content	:	75.2%
Zinc "	:	15.1%
Tin "	:	2.54%
Iron "	:	4.7%
Other	:	2.46%

Copper ingot:

Copper content	:	94.0%
Other	:	6%

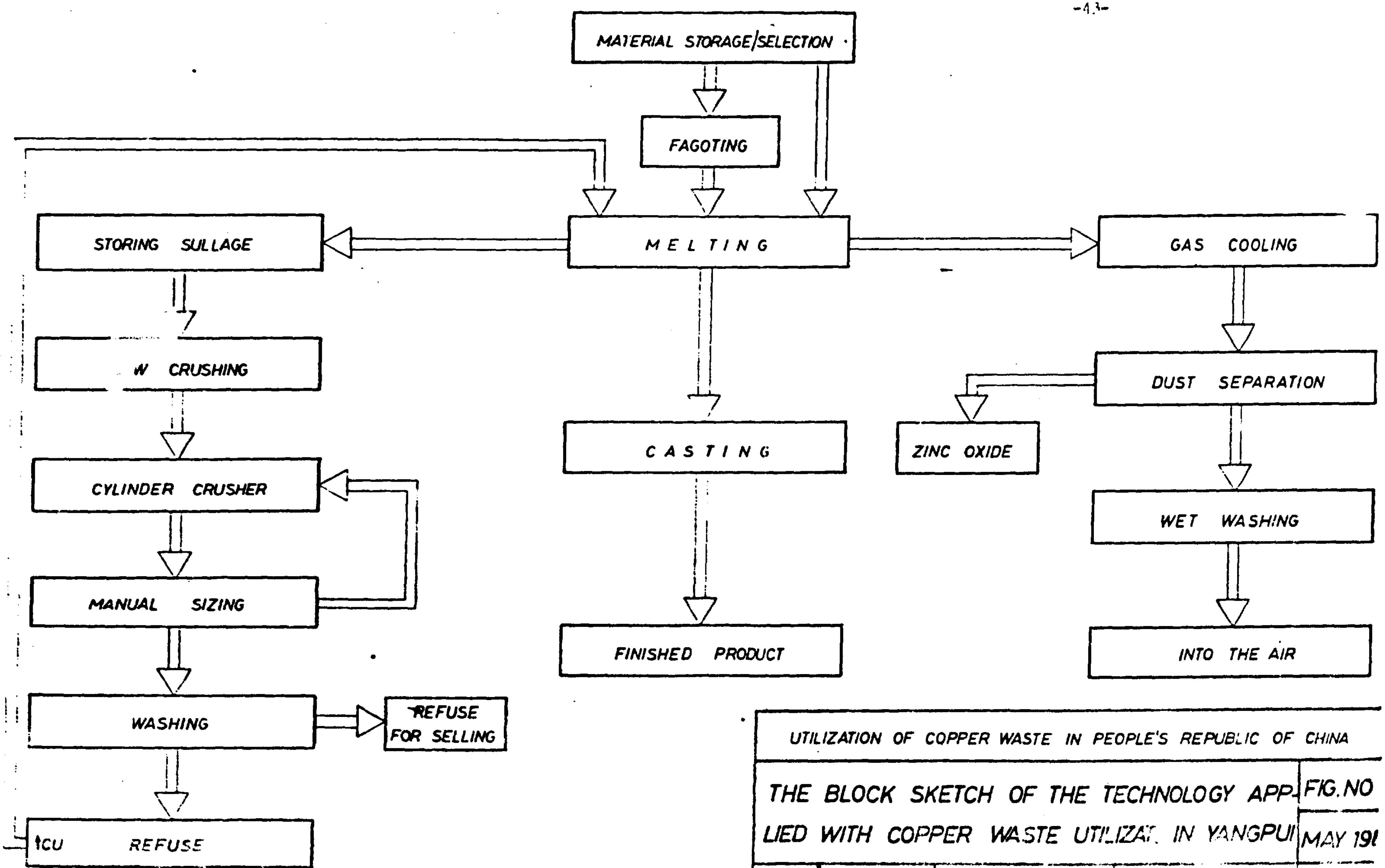
Total output in 1985: 8o3 tons

3.4.3. Remarks on the technology presently employed

On the basis of our visits to the plants, our consultations and written data we received, it is our conclusion that modifications at a number of stages of the presently employed technology would result in a substantial improvement both in the quality of the finished product and in the recovery ratio.

Improvement possibilities in the technological process:

- With mechanization of slag dressing and with the adoption of appropriate technology the metal content of recycled slag could be maintained at a higher constant value and the proportion of recycled material could be increased.

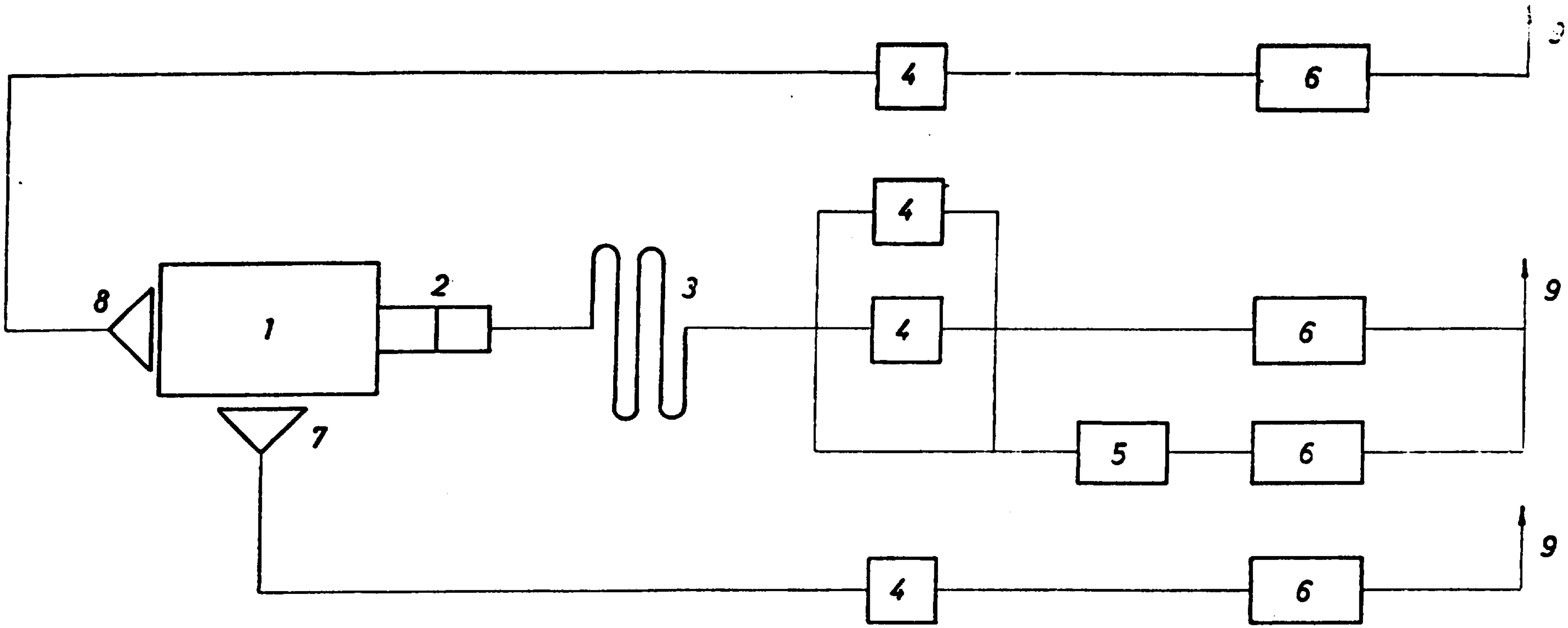


UTILIZATION OF COPPER WASTE IN PEOPLE'S REPUBLIC OF CHINA

THE BLOCK SKETCH OF THE TECHNOLOGY APPLIED WITH COPPER WASTE UTILIZAT. IN YANGPUI

FIG. NO

MAY 19[illegible]



1 FURNACE

2 HORIZONTAL FUNNEL

3 GAS COOLER

4 SACK DUST FILTER

5 WET WASHER

6 VENTILLATOR

7 DRAW SCREEN ABOVE THE RUNNER SLIT

8 DRAW SCREEN ABOVE THE FEEDING GATE

9 FUNNEL

UTILIZATION OF COPPER WASTE IN PEOPLE'S REPUBLIC OF CHINA	
TREATMENT OF FURNACE GAS	FIG. NO 2
	MAY 1986

- The present rate of recovery is low. According to the data received, the metal content of scrap processed in 1985 was as follows:

  Copper: 1,285 tons

  Zinc : 280 tons.

  The total metal content of the finished product in 1985 was:

  Copper: 638 tons

  Zinc : 108 tons.

  Copper recovery: 49.6%

  Zinc recovery : 38.5%

  The above figures illustrate the relatively high rate of melting and slag loss.

- The flue gas tratment system does not ensure an acceptable air quality in the workshop. This deficiency results in a particularly high level of air pollution inside the workshop when the furnace is being charged. It would be advisable to check the horizontal flue gas channel for leaks, to re-examine the capacity of the exhaust fans and to check the condition of the cooling and dust separation system.

- The quality both of the raw material used in the process/chips, dressed slag/ and of the finished product should be subject to more extensive analyses.
  Information gained from these analyses would help to control the quality of the finished product.

3.5. Recommendations for improvements in the present technology

On the basis of an analysis of the presently employed technological process, there are direct possibilities of improvement at the melting stage, at the slag dressing stage and in the field of quality control. Direct metallurgical processing of the slag presently produced/about 5oo tons/year/ would not be economic.
It would not be practical to install furnaces designed for processing slag with a low copper content at the plant studied.

3.5.1. Increasing the efficiency of chip melting

In the light of energy saving efforts being made world-wide, the use of electric induction

furnaces is becoming more and more widespread in the field of non-ferrous metallurgy.
The advantages of electric induction furnaces are as follows:

- large melting capacity
- low melting loss
- greater temperature uniformity
- favorable conditions for alloyage
- environment protection features
- economic operation.

Here is the technical description of a furnace that could possibly be installed at the Yang-Pu plant:

Model recommended: RICU-7oo.

Specifications:

Holding capacity:	1,000 kg
Melting capacity:	525 kg/hour
Pouring capacity:	7oo kg
Electrical rating:	15o kW
Tilting:	hydraulic.
Transformer:	auto transformer, dry
Primary voltage:	3 x 38o V, 5o Hz

Taps on secondary voltage:	13o V, 17o V, 23o V, 27o V, 32o V, 36o V, 38o V, 4oo V
Mode of operation:	motor-driven, remote control
Heating of capacitor bank:	18o kVAr
Type of circuit breaker:	dry
Power of blower motor:	2.8 kW

Technical description:

a/ Furnace

The furnace body consists of two parts: the furnace shell and the inductor unit. The shell is an upright standing steel cylinder, reinforced with rolled steel sections. The inside is fitted with refractory lining. The inductor unit is fitted directly underneath the furnace shell. On the front side of the furnace shell a pouring spout of suitable size and length is provided. A hydraulically operated door on the top of the furnace shell provides for speedy slag removal. The furnace shell is fitted with hydraulic jacks which connect it to the support frame.

b/ Inductor unit

The inductor unit consists of a triple-strand coil surrounding an iron core of specially reduced magnetic flux reluctance. The unit is air-cooled.

c/ Tilting gear

The tilting gear consists of the following:

- a set of tilt cylinders
- hydraulic power pack, complete with pump, motor, starter, oil reservoir and filters,
- a control panel with pilot lights, switch-off, pressure gauge and hand-operated tilt valve.

The furnace can be tilted about an axial shaft located near the pouring spout and connecting the furnace to the support frame. The contents of the furnace are discharged by lifting the cover and tilting the furnace about the shaft.

Maximum angle of tilt: 95 degrees.

d/ Cooling unit

A motorised blower unit is provided for cooling the inductor coil and core.

e/ Transformer

Three-phase, dry, self-cooled, complete with fittings.

f/ Control panel

Complete with controls, adapter, voltmeter, ammeter, kWh-meter, pilot lamps, relays, switches and remote control equipment.

g/ Temperature control

An optical pyrometer is provided for measuring the temperature of the molten metal.

h/ Safety equipment

All the necessary safety equipment is incorporated.

i/ Phase balancing

Effected by a choke-coil and a capacitor.

j/ Refractory chamotte lining

Chamotte, insulating material, ramming tools, moulds.

With this furnace melting loss is reduced, there is less slag. The metal recovery ratio can be increased to over 8o per cent. The furnace is also well-suited for in-vat metallurgical interventions and blow-off, with which copper can be recovered from brass. At the same time this feature of the furnace also makes it possible to adjust the composition of batches as desired by introducing alloying materials into the vat. This furnace is also a good basis for long-term development, such as the introduction of brass casting, etc.

3.5.2. Increasing the efficiency of slag enrichment

The slag produced when copper and brass scrap is melted contains a significant amount of metallic components. The recovery ratio can be substantially increased if these are separated from the slag and are charged back into the melting furnace. Efficient separation of the metallic components from the slag can best be done when the slag is crushed to the extent that separation by specific gravity becomes possible. Before choosing the most suitable slag-dressing equipment, laboratory experiments must be carried out. These laboratory experiments will provide the answers to the following questions:

- optimum grain size
- size, specifications and number of flotation units
- optimum recovery ratio
- kind of flotation agent and specific dosage
- kind and size of water separator equipment.

In the absence of any such experiments, it is impossible to make any specific recommendation as to the equipment or the technology to be used. The following is a generally applicable technological sequence:

- crushing on jaw-crusher
- crushing on roll-crusher
- milling in autogenous mill
- flotation and/or slurry separation
- straining
- homogenization
- briquetting.

A schematic sketch of the process is given in diagram No. 3. The amount of slag to be processed annually is relatively small, so the equipment required should also be of relatively small capacity.

We recommend two alternatives for carrying out the development project:

- Laboratory determination of the optimum technological process, preparation of drawings for the equipment in Hungary on the basis of the laboratory results, manufacturing the equipment on the basis of these drawings in China and installation on the site.

The above appears to be the more economic approach.

- Laboratory experiments, preparation of drawings and manufacturing the equipment in Hungary, installation on site in China.

Advantages of the technology recommended:

- higher metal recovery rate from slag
- uniform quality
- savings in labor
- lower dust loss/the concentrate to be loaded into the furnace is shown in photo No. 11/.

3.5.3. Development possibilities in the field of quality control

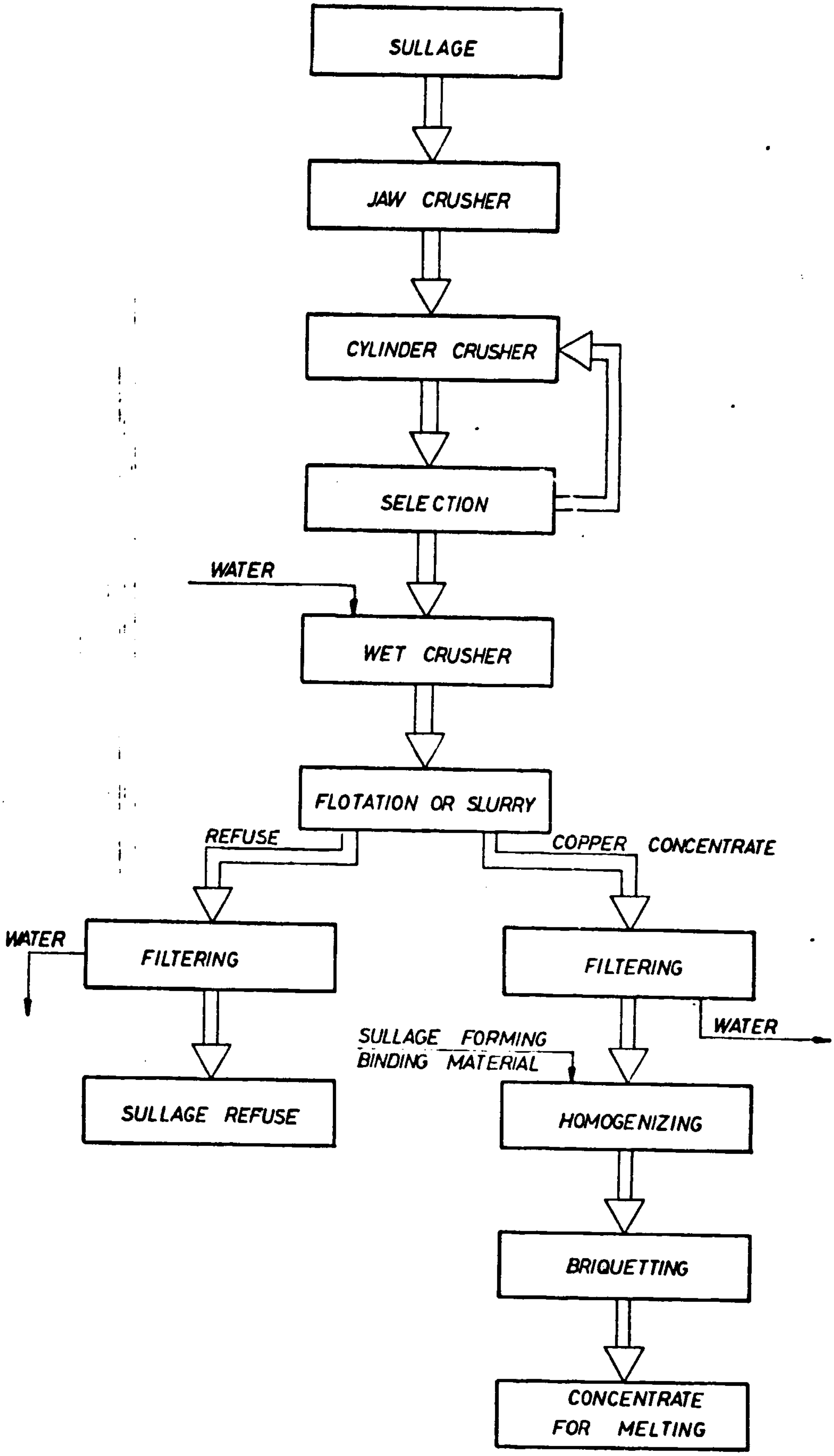
To produce good quality products it is essential to have a precise knowledge on the composition of the raw materials, semi-finished and finished product. Quite often the technology itself requires prompt chemical analysis which, however, cannot be achieved by the traditional methods. /E.g.: adjustment of component ratios before tapping./ Here is a description of an analytic instrument widely used in Hungary for promp analyses:

Model recommended: Ditermanal 00506/25.

Technical description

The instrument is based on the principle of calorimetry, a great advantage of which is its universas character. The optimum field of its application is within a concentration range which, in the case of other automatic methods, falls outside the optimum range.

The principle of its operation is the following: at the output terminals of an appropriately designed measuring bridge a voltage signal is generated which is proportionate to the level of concentration. The voltage value appearing on the digital voltmeter can be fed into an on-line computer which evaluates the reading within the fraction of a second.



UTILIZATION OF COPPER WASTE IN PEOPLE'S REPUBLIC OF CHINA

BLOCK SKETCH OF SULLAGE UTILIZATION

FIG. NO 3

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The instrument is linked up to a multi-memory, multi-program computer which not only evaluates the readings, but also directs the mechanical steps of the analysis program. Each step of the analysis is programmed in advance, so the equipment executes all the work relevant to the analysis and eliminates the possibilities of subjective error.

Absolute analytic error margin: o.3%.

Areas of application:

- analysis of metallurgical basic materials and additions
- analysis of non-ferrous metals
- analysis of white metals
- analysis of slag
- analysis of refractory materials
- analysis of ferro-alloys
- analysis of silver-alloys
- analysis of pickling solutions and galvanic baths.

The operating principle of the instrument is shown in diagram No. 4.

3.5.4. Long term development possibilities

Insofar as the recommended furnace model replaces the one used at present, in-vat metallurgical treatment as well as precise adjustment of alloyage ratios become possible. Analysis of the composition of the scrap shows that the copper content is quite high/76%/. The combination of these two factors provides favourable conditions for the production of cast copper products/e.g.; faucets, tap-sets, and other bathroom fixtures/. With the introduction of copper casting the proportion of scrap processed on site could be increased, engendering an increase in profits as well.

3.6. Economic evaluation of the project

In our calculations we set the cost factors of the furnace and the control instrument against the probable increase in profits resulting from a higher metal recovery rate.
As regards the slag-dressing equipment, cost and benefit calculations can only be done once the

laboratory experiments have been carried out.

The calculations are based on the following figures:

Estimated cost of project: $ 280,500 /US/

¥ 898,000

Scrap processed/in 1985/: 2000 tons/year

Present output/in 1985/:

brass ingot: 701 tons/year /A_t/

copper ingot: 112 tons/year /B_t/

Probable output after realization of project, from 2 000 tons of scrap yearly:

brass ingot: 990 tons/year /A_f/

copper ingot: 207 tons/year /B_f/

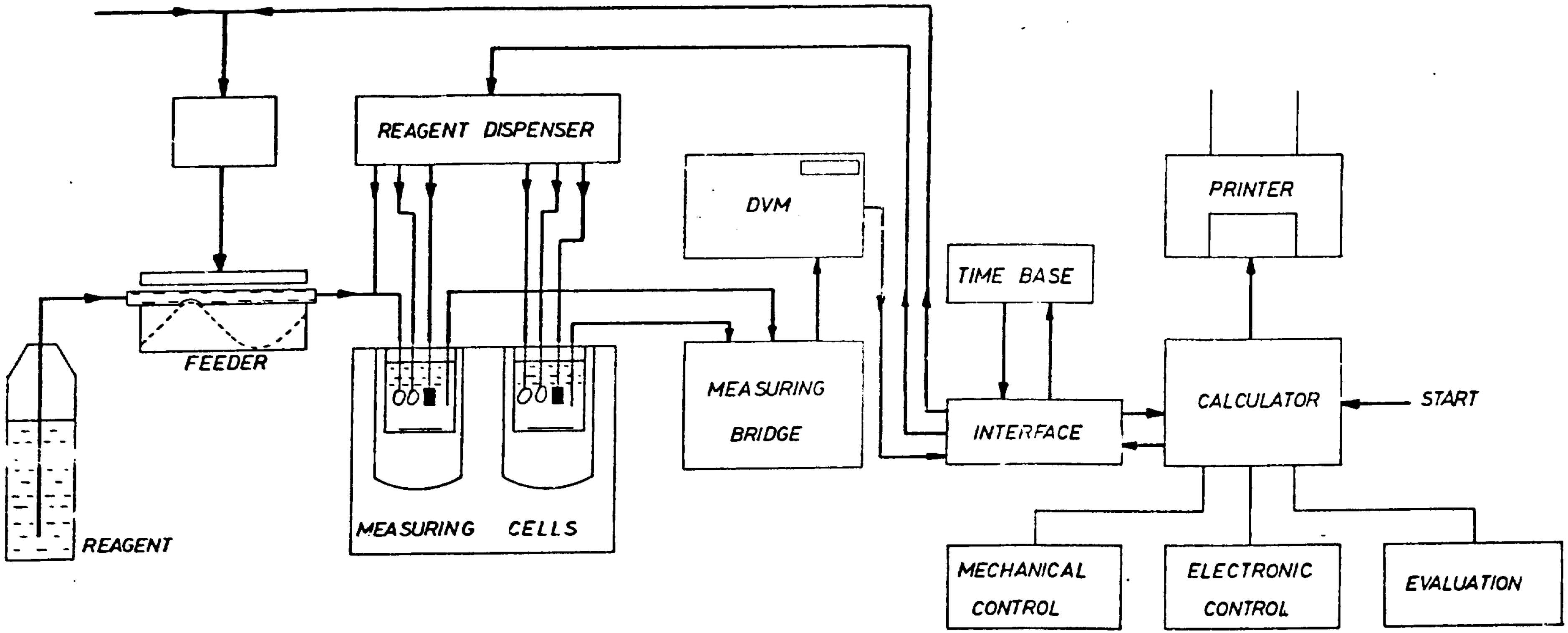
Market price of brass ingots: ¥ 4,000 per ton/C_A/

Market price of copper ingots: ¥ 5,200 per ton /C_B/

Pay-back period of the investment

$$\frac{C}{/A_f - A_t/C_A + /B_f - B_t/C_B} = \frac{898{,}000}{/990-701/4000+/207-112/5200}$$

= 0,544 years



UTILIZATION OF COPPER WASTE IN PEOPLE'S REPUBLIC OF CHINA	
BLOCK SKETCH OF THE AUTOMATIC ANALYZER	FIG. NO 4
	MAY 1986

3.7. Environment protection and safety

The present air- and water-purifying equipment can, with certain modifications, be adapted to the technology recommended in this report and the resulting pollution levels will not exceed Chinese environment and health protection standards being in force at the time of the visit of our experts. Pollution contents of stack gases discharged into the atmosphere will not exceed the following values:

- total dust content:	1,8 kg/hour
- lead:	50 grams/hour

Air pollution levels in work area:

- lead:	0,04 mg/m³
- copper:	0,2 mg/m³
- CO:	20,0 mg/m³
- zinc:	5,0 mg/m³

Effluent pollution levels will remain below the following values:

- zinc:	5 mg/liter
- lead:	1 mg/liter
- Cod:	100 mg/hour

- suspended matter: 5oo mg/liter
- copper: 1 mg/liter

Noise level in the work area will remain below 95 dB.

4. CONCLUSION

The technology employed at the Yang-Pu scrap copper processing plant of the Shanghai Resource Recovery and Utilization Company has several stages which should be improved. The metal recovery rate of the plant is low.

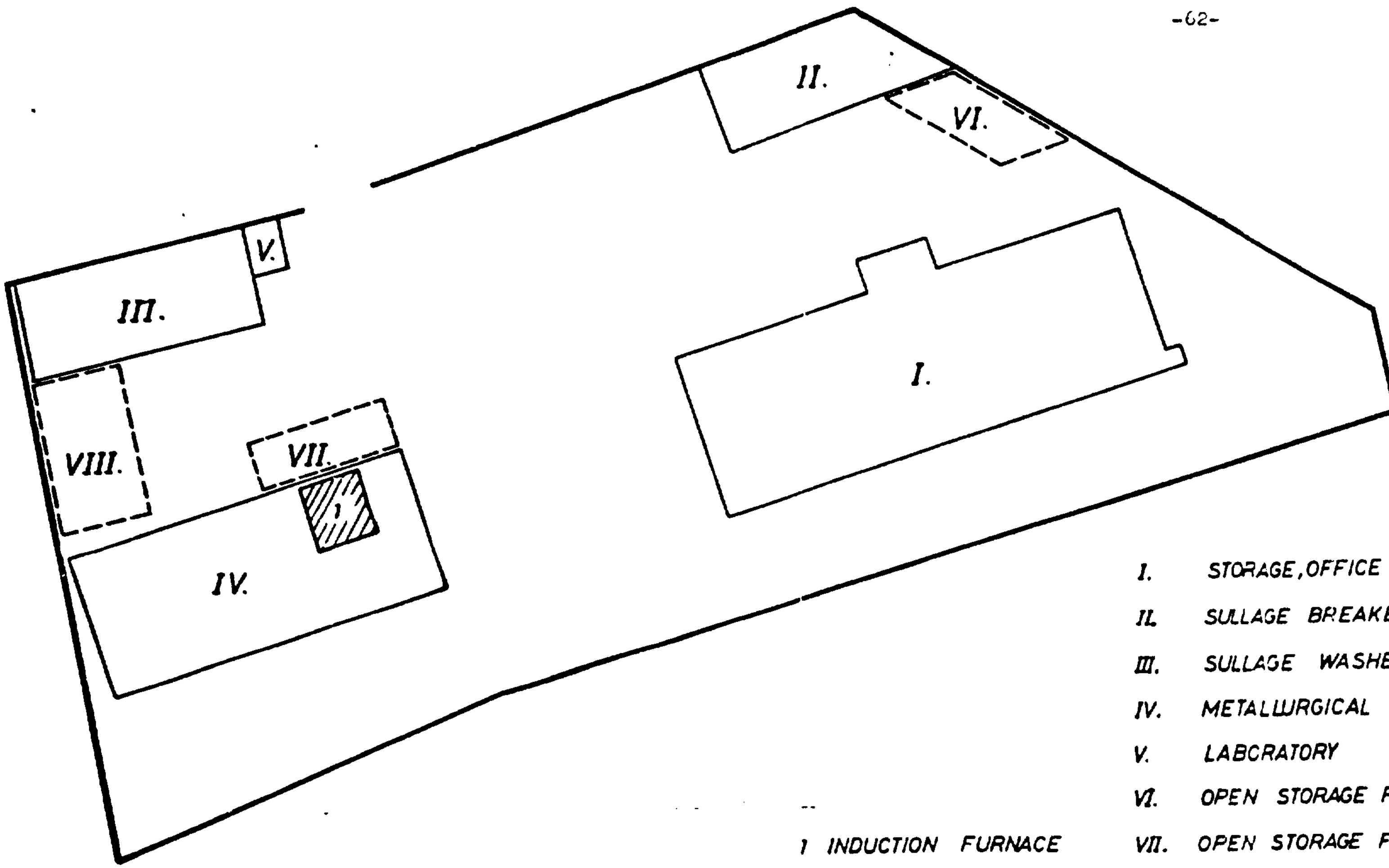
The areas where improvement is desirable are as follows:

- The presently used coal-dust fired box furnace should be replaced by an induction type crucible furnace, thereby reducing melting and dust loss and substantially improving the metal recovery rate.
- The efficiency of slag dressing could be improved through mechanization. The choice of the most suitable equipment should be made on the basis of laboratory experiments. Slag could be enriched either by floatation or slurry separation.

- Quality control standards could be improved through the use of an automatic calorimetric analytic instrument. The instrument ensures a prompt supply of information on the chemical composition of the material, thereby providing the conditions necessary for timely interventions in the technological process.
- The fabrication of cast-brass products, which would further increase the value of the technology recommended, could be the subject of a long-term development project.

The recommended improvements can be realized with favourable economic results.

We would like to express our thanks to the employees of the Shanghai Supplying and Marketing Cooperative and the Shanghai Resource Recovery and Utilization Company for their help in our work.



I. STORAGE, OFFICE
II. SULLAGE BREAKER
III. SULLAGE WASHER
IV. METALLURGICAL WORKS
V. LABORATORY
VI. OPEN STORAGE FOR SULLAGE
VII. OPEN STORAGE FOR FINISHED PRODUCT
VIII. OPEN STORAGE

1 INDUCTION FURNACE

UTILIZATION OF COPPER WASTE IN PEOPLE'S REPUBLIC OF CHINA	
LAYOUT PLAN OF YANGPU COPPER SMELTER	ANNEX I.
	MAY 1986

ANNEX II.

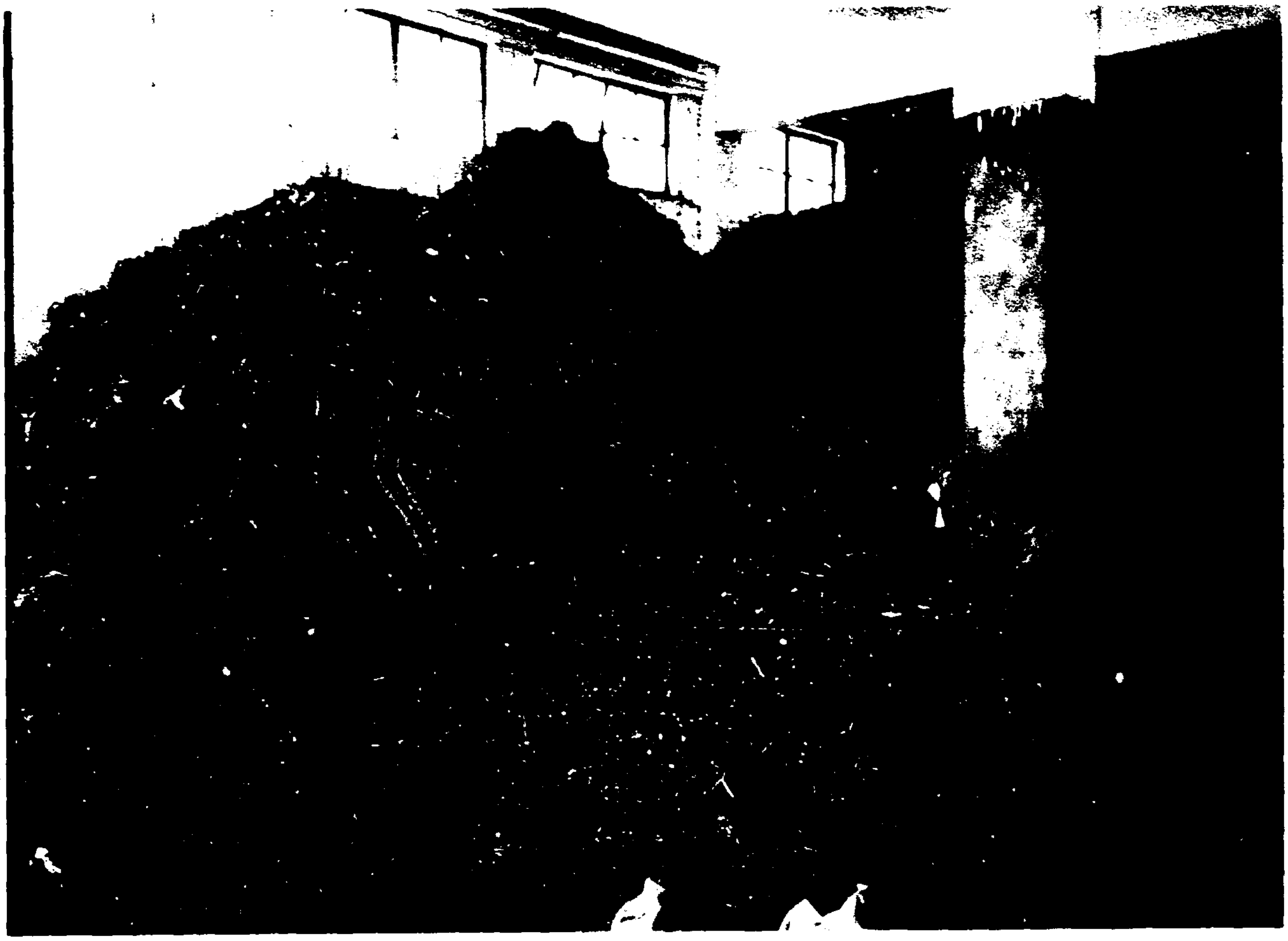


Photo 1.

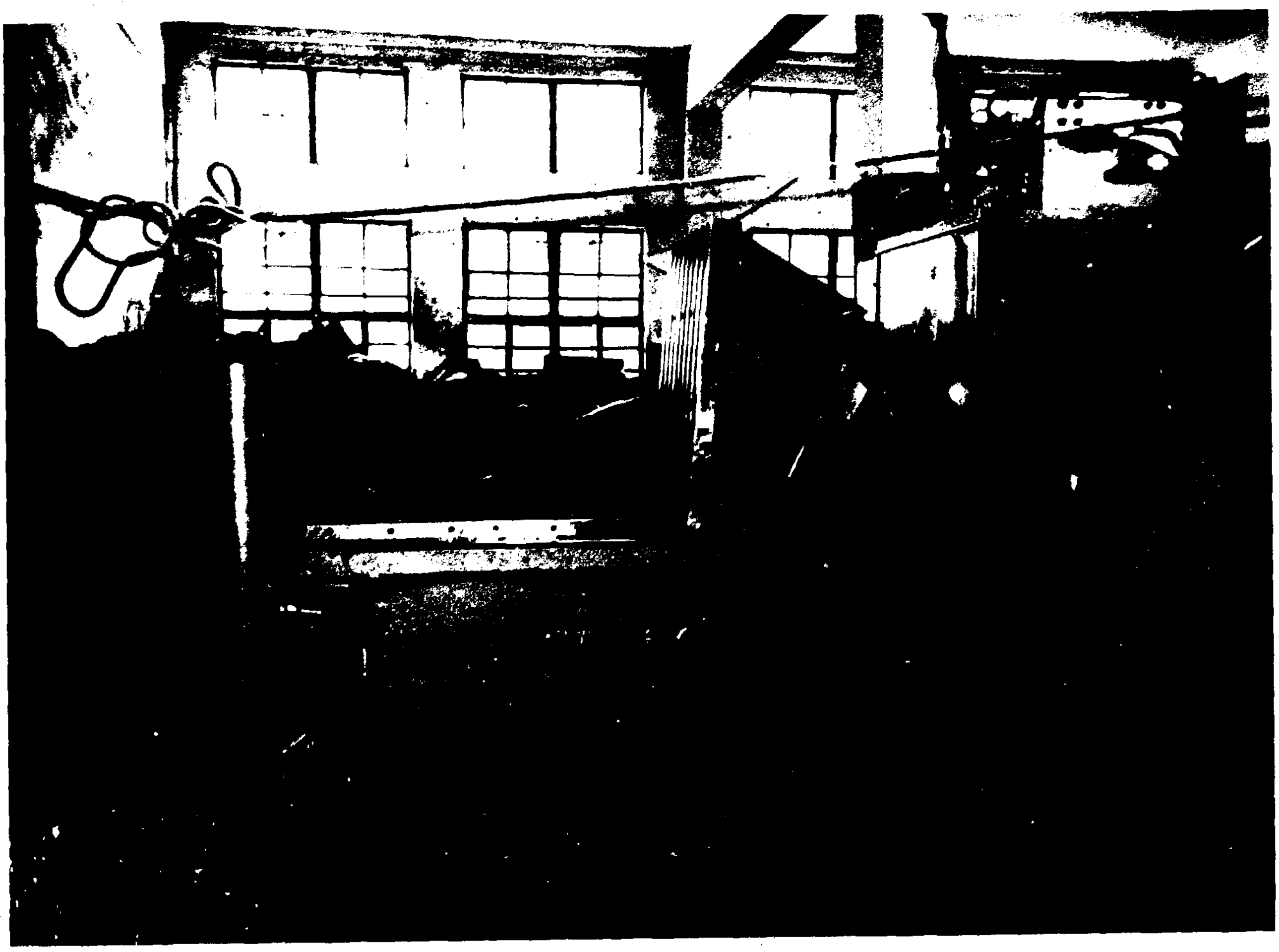


Photo 2.

ANNEX II.

Photo 5.

Photo 6.

ANNEX II.

Photo 3.

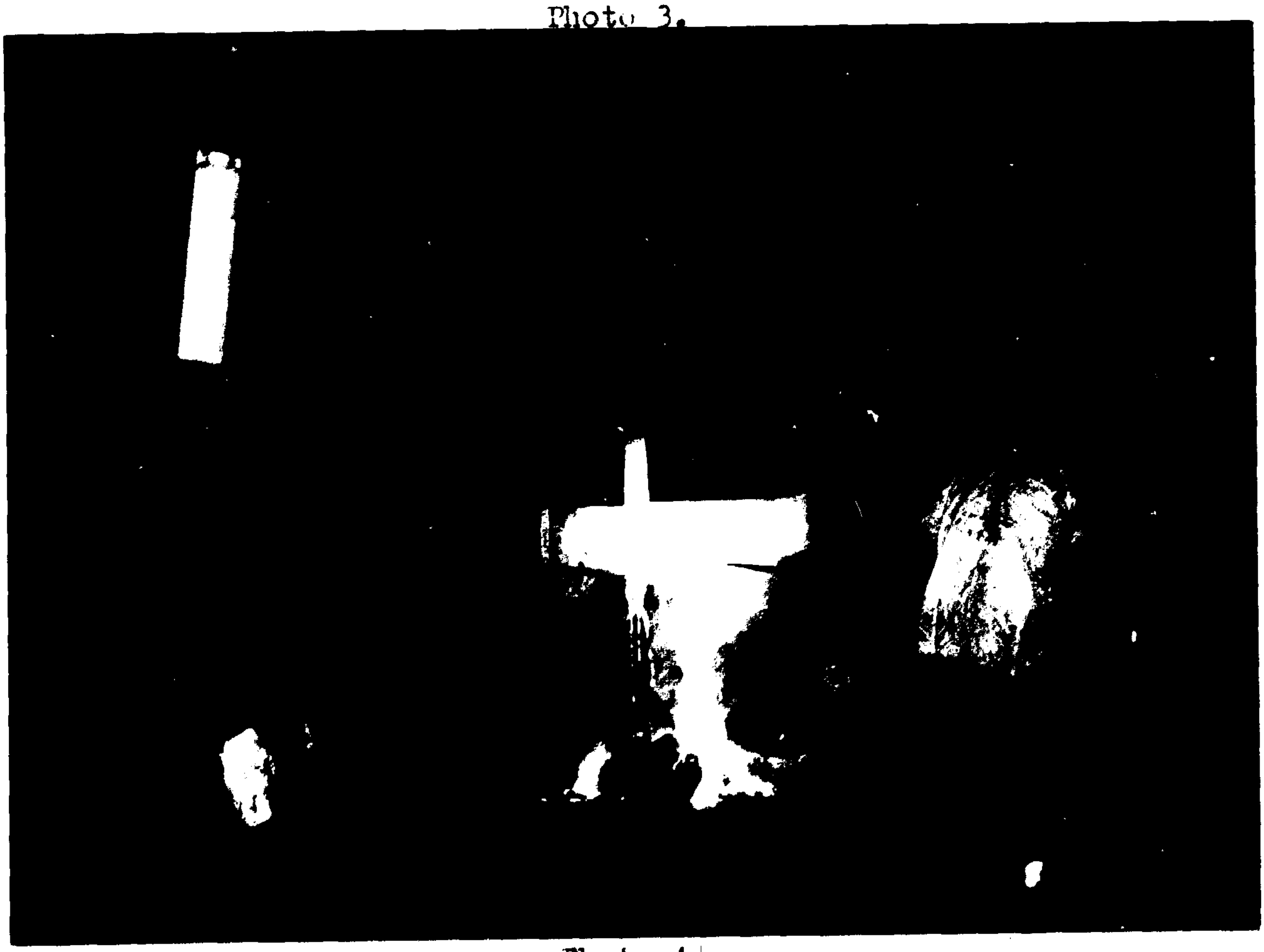


Photo 4.

ANNEX II.

ANNEX II.

Photo 8.

ANNEX II.

Photo 9.

ANNEX II.

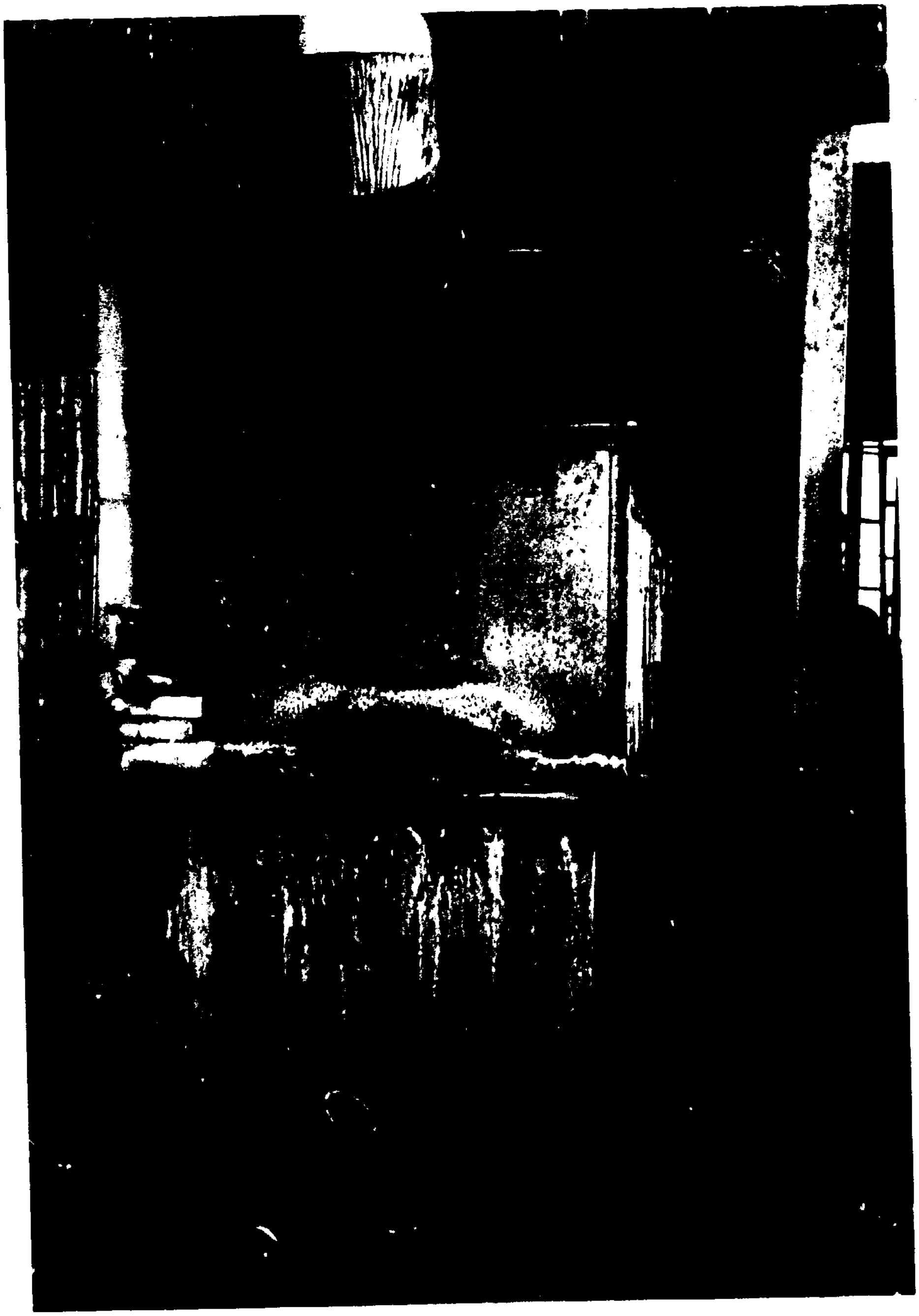


Photo 10.

ANNEX II.

Photo 11.

PART III.

ALUMINIUM SCRAP UTILIZATION

Report

1. SUMMARY

The delegation visiting the Chinese People's Republic stated in the course of its work that there have been and are considerable efforts in the field of collecting and utilizing aluminium scrap. However, it is necessary to take further initiatives in certain partial fields.

These are the following:

small weight household waste and chips melted in rotary drum furnace;

processing casting wastes into finished products.

The introduction of the above technologies would make it possible to have wide-range utilization of aluminium scrap.

2. CONTENT

4.11. Examining future development possibilities

4.12. Environment protection - work safety

5. Closing ter

6. Enclosures:

Outlay drawing

Workshop establishment drawing

3. INTRODUCTION

The background of the project

In 1983 UNIDO organized a study-tour in Europe for the experts of the Shanghai Recource Recovery and Utilization Company/further on: SRRUC/ on the request of the World Bank.
They visited Hungary, the Federal Republic of Germany and Belgium.
The Hungarian visit was followed by another one in 1984 in order to get information about the Hungarian waste utilization experience as this seemed suitable for China.
A representative of UNIDO accompanied the delegation in both cases. At the same time China and the World Bank invited a Hungarian expert on waste collecting and utilization to give a lecture on ironoxide, aluminium and copper waste collection and recycleing at the International Conference for Waste Recovery and Utilization organized in Shanghai in November 1984.

During the conference the representatives of SRRUC and the Hungarian delegates came to an agreement that they are going to widen cooperation with the support of UNIDO and the World Bank in the following fields:

- the production of magnets with using iron-oxide waste
- aluminium scrap utilization
- copper scrap utilization
- carpet manufacturing with using textile and synthetic waste.

Following this, the Government of the Chinese People's Republic sent a letter to UNIDO on 27th November, 1984 through the representation of UNDP in Beijing and asked UNIDO to support the matter and examine the possibility of the Hungarian participation in the required technological transfer.

In May 1985 the UNDP representation, UNIDO, the Chinese Government and the Chinese partners drew up a protocol in Shanghai and agreed on the field and financial framework of the project requested from UNIDO by the Chinese Government: on the basis of this the acknow-

ledgement of the final request was sent to UNIDO in a letter of 16th May, 1985 signed by UNDP Resident Representative in Beijing.
On the basis of the invitation UNIDO assigned TESCO to send experts to China in connection with the four topics mentioned above.

The task of one of the groups of the Hungarian experts was to provide experience on the Hungarian aluminium scrap utilization and after getting the local circumstances known to support the waste utilization technologies to be developed in the People's Republic of China with proposals.
It was also their job to estimate the existing scrap according to type and quantity, to examine the present collecting, storing, separating and processing equipment and to work out proposals for modernizing the existing scrap utilization technologies and introducing new ones.

4. WORK CARRIED OUT

4.1. The work programme of the group

April 17.

Morning: Discussion at the Headquarters of the Shanghai Resource Recovery and Utilization Company.
Harmonizing work programmes, introducing the company.

Afternoon: Visit to the Zhabei District Ferrous Metal Processing company. Separating and metallurgical preparation of iron waste.

April 18.

Morning: Visit to the waste purchasing shop of the Yanan Dong Lu IU Purchasing Station then to the plastic processing plant of the Xing Liang Plastic Products Manufacturing Co.

Afternoon: Visit to the SRRUC shop of Beijung Lu where products made of waste utilization are sold.

April 21.

Morning: Visit to the Sha Jingang Metals Warehouse basis.

Afternoon: Experts consultation at the office of SRRUC Storage and Transportation Department.

April 22.

Visiting the workshop at the Zhopu Secondary Aluminium Smelter.

April 23.

Visiting the workshop at the Yang-Pu Copper Smelter

April 24.

Visit to the Zhopu Secondary Aluminium Smelter.

April 25.

Experts consultation at the office of SRRUC Storage and Transportation Department.

<u>April 29.</u>

Experts consultation at the office of the SRRUC Storage and Transportation Department.

<u>April 3o.</u>

Visiting the workshop at the Yang-Pu Copper Smelter.

<u>May 2.</u>

Experts consultation in the office of the SRRUC Storage and Transportation Department.

<u>May 5.</u>

Experts consultation in the office of the SRRUC Storage and Transportation Department.

<u>May 6.</u>

Experts consultation in the office of the SRRUC Storage and Transportation Department.

4.2. Chinese partners

During the visits and discussions our delegation met the following Chinese partners:

Cha Jie	Chief Foreign Economic Relation and Trade Division
Cuo Jang Kany	Section Chief Foreign Economic Relation and Trade Division
Li Bingzhang	Manager
Zhu Ke Xi	Deputy Manager
Zhang Dexing	Deputy Section Chief
Ren Debao	General Manager
Tien Kai Yavang	Vice Manager
Zhao Kai Xian	Vice Manager
Fan Yang Fen	Factory Director of Trade
Zhao Ahi Gang	Factory Director Vice Manager
Fan Yong Qing	Factory Director of Production
Zhang Limin	Assistant Manager
Yuan Yonglin	Manager
Jiang Fu qing	Managing Director
Sun Jong Jie	Vice Manager
Huang Jianging	Engineer

Shen Yimin	Engineer
Fong Je Ling	Engineer
Xi Shi Ming	Engineer
Zhu Rongle	Engineer
Zhang Gnochang	
Sun Xiaolu	
Chen Quinging	
Chang Yanxiao	

4.3. System of collecting - the quantity and quality composition of the collected aluminium scrap

Scrap comes to the utilizing plant partly from the population and directly from companies. Purchasing from the population takes place through well-divided waste puchasing places. Collection in the shops takes place selectively. This contributes a great deal to further processing. Scrap originating from manufacturing companies is delivered directly to the processing plant. The quantity of the aluminium scrap collected annualy:

5.500 t/year.

Composition of the scrap:

household/from the population/	19% - 1.o45	t/year
production/from plants/	45% - 2.475	"
casting	21% - 1.155	"
chips	15% - 825	"

The features of scrap:

sheet scrap thickness max. 4 mm

its size is 1ooo x 2ooo mm from panel;

bar scrap small quantity

bar ends of max Ø 1oo mm;

casting: its max size Ø 4oo weight per piece 1o kg

chips: sinewy and the variation of sinewy and broken.

The purity of scrap:

Household and production scrap:

pure from other materials because of selective collection.

Casting: scrap, pure from other metals, casted other metals are removed by hand.

Chips: Pure from oil, but other chips, first of all steel and copper may mix with them.
Steel chips can be removed with magnet, but copper remains in them and this should be considered later.

On basis of what we have seen on spot collection and storing is acceptable for further utilization demands.

4.4. Aluminium scrap processir :hnologies applied by S R R U C at present

Production technologies applied presently.

4.4.1. Sheet rolling, cutting

4.4.2. Bar casting

4.4.3. The production of metallurgical auxilliary materials

4.4.4. Melting tubes

4.4.1. Sheet rolling

400 mm wide sheets are rolled from blooms cast

on spot. Sheets are cut to measure and they immediately get to the cutting presses in order to cut pre-products from them mainly for pan production.

Cutting scrap is recycled to the furnace.

4.4.2. Bar casting

Takes place in two sizes:

under Ø 6o mm by horizontal bar casting machine

between Ø 6o-2oo mm into ingot moulds placed into the earth vertically, directly from the furnaces. The cast bars are taken out from the ingot mould and faulty parts are sawn by circular saw. The parts that remain after it are processed further.

4.4.3. The production of metallurgical auxilliary materials

Deoxidation products are manufactured for metallurgical purposes. The plant is new. We were not able to visit it while operating as it was out of operation when we were there.

On basis of what we heard the applied technology is acceptable.

4.4.4. Melting tubes

Household scrap . mainly tubes/toothpaste, shaving foam, etc./ and other types of scrap like folia and packing material are melted in chamber furnace under salt. The scrap fed into the furnace is floating on top of the salt bath. This is pushed under the salt bath by manual pu: -bars. Thisway burning loss may even reach 5o%. This technology must be definitely changed.

4.4.5. The chamber furnace is already in operation in the new hall and blocks are cast in accordance with the requirements. The line of ingot moulds put in the earth is in front of the furnace where blocks are cast with the size of 64o x 17o x 45 mm.

Cooled ingot moulds are tilted to the floor of the workshop by fork truck and the ready blocks are taken apart, lifted and are later sold.

This technology is up to the requirements.

4.5. <u>Information on the present technological developments:</u>

The hall for the equipment is ready. Installation of the equipment is being carried out now. Modernizing the technology includes the increase of rolled sheet width and the introduction of hot rolling.

Against the earlier sheet width of 4oo mm, now the width of rolled sheets increases to 1ooo mm. The first stage of the sheet mill is the hot rolling mill.

The cast bloom gets to the sheet mill warm through a rolling line where rolling temperature is set in the electric roll-over type heating furnace and then rolling takes place continuously first hot and then cold in the necessary thickness. After the rolling line alligator shears and cutting presses are installed. The alligator shears cut the sheets to the necessary width.

Sheet are cut to the necessary shape, mainly for pan menufacturing, by the presses. This way cutting scrap is returned to the furnace immediately.

On basis of information and what we have seen on spot this technology is suitable v'en it willbe ready.

4.6. Technological proposals

4.6.1. Fagoting

Melting and storing the light thin sheet scrap is more suitable if fagotted.

It would be necessary to install 1 pc. fagoting press on the plant.

The character of the scrap requires the installation of a fagoting press with the max. capacity of 1oo t. The proposed place of installation for the machine is shown in enclosure No. 1.

The fagoting press also helps with storing problems apart from feeding ones, as fagoted scrap takes 5o-6o% smaller place as scrap in bulk.

Fagoting press:

Type: SP 1oo

Size of waste: 14oo x 6oo x 45o

Size of fagot: 6oo x 2oo /its length depends on the material fed in/

Wight of fagot: 4o-8o kg

Speed of fagoting: 16-32 fagots/hour

Frame sizes:

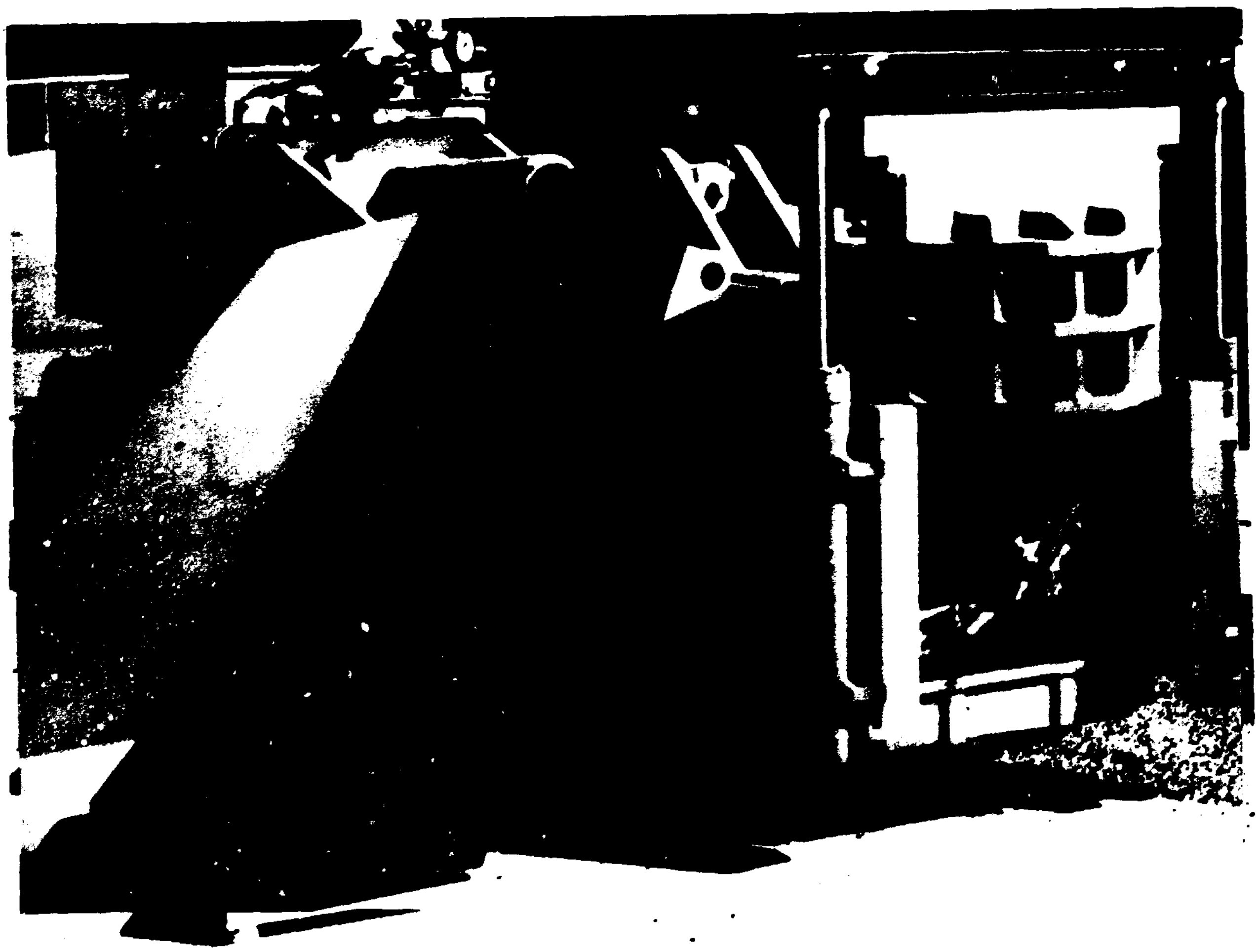
length: 6ooo mm

width: 14oo mm

height: 21oo mm

Weight: 83oo kg

Electric energy requirement: 15 kW



4.6.2. Melting under salt in rotary drum furnace

Light scrap must be fed fagoted. The scrap to be melted gets under the salt bath as a result of rotation in the rotary drum furnace.
The scrap that does not get under the salt bath after the first rotation still get a salt coating that burning loss may be decreased even to 25 %. On the other hand with the application of fagoting and rotating drum furnace it can be achived that the present staff/manual feeders, the ones who push waste under the salt bath/ is saved from hard physical job, radiating heat and work hazards originating from poisonous gas.

Rotary drum furnace:

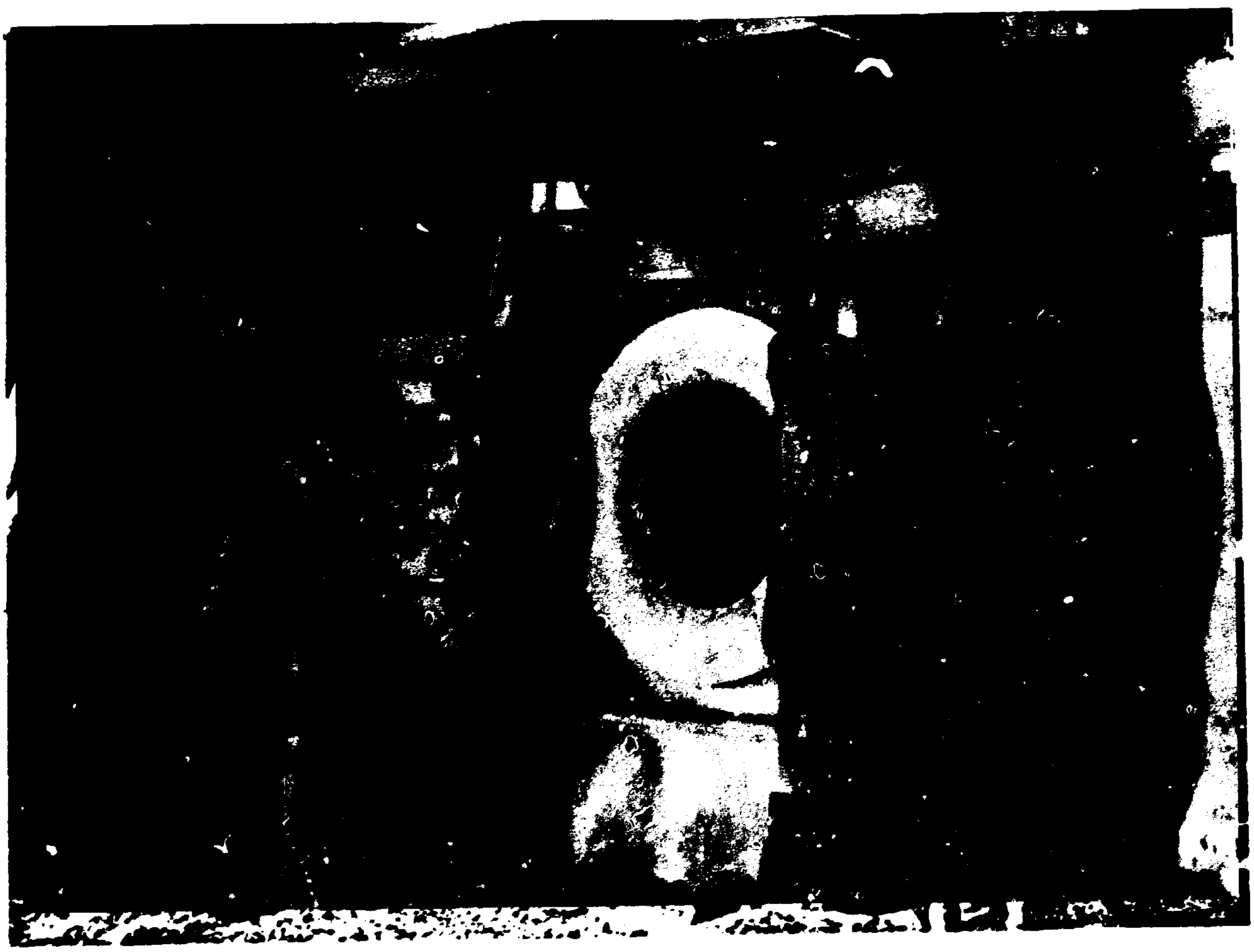
Capacity:	2.4 t/shift
Energy requiremen:	990.000 kcal/hour fuel oil
	16 kW electric energy
	380/220 V 50 Hz

Frame sizes:

length:	5.000 mm
width:	3.000 mm
height:	3.000 mm

Weight: iron structure: 12ooo kg

lining: 12ooo kg



4.6.3. Casting

On basis of what we saw on spot and the negotiations thereafter, the foundry fits in very well into the modernization of the technology. There are some 500-1000 t of scrap that represent a type that can be processed into castings with high value of usage. On the basis of the pre-studies prepared by the experts of the factory it can be stated that there is demand for castings between the weight limit of 0.1 - 1.0 kg. As we have no information in connection with the size, shape, material and number of the pieces to be cast we propose establishing a foundry that is capable of producing wide-range of castings, including small, medium and largeseries ones directly from scrap. Casting directly from scrap requires high demand in connection with quality control. For this reason we have made proposals for improving quality under point 2.6.4.

Brief description of the proposed casting technology:

Metal supply of the foundry:

2 pcs of tilting tank furnaces will be installed into the foundry. These are the places where the melting of aluminium casting scrap takes place together with performing occasional other alloying.
Liquid metal is delivered in portable ladles assembled on trucks from here to the holding furnaces in the casting places. Melting and holding temperature may be changed between 680-780 °C in accordance with casting requirements. Purifying liquid metal may take place in TCAL furnace.
Grain refining of liquid metal may also take place here. In order to decrease burning loss, melting should take place under salt cover.

Ingot mould casting:

The suitably formed ingot moulds must be heated up to 150-200 °C before casting and they must be coated with form coating material.

There is a further possibility for the partial or total heating of ingot moulds either by electric or gas heating. Ingot moulds may be assembled into ingot moulding machines according to requirements. This makes it possible to have multi-direction tool movement with pneumatic or hydraulic control manually, considerably decreasing hard physical work. Liquid metal is poured into the ingot moulds by manual casting ladles filled up from melted aluminium kept on suitable temperature from the TCAL furnace.

Production of castings:

The end phasis of casting production is the preparation of castings consisting of removing the runner systems and burring.
Removing the runner systems takes place either with band saw or rapid piece cutter depending on the type and shape of castings.
Surfaces are cleaned by grinding machine, and sand blasting equipment.

Burring the castings would take place on the tumbling barrel.

In case of sophisticated castings, clearing of castings can be carried out manually with suitably developed tools for this purpose.
In case of casting it is important to ensure casting ingot moulds so that preparation activities can be reduced to the minimum. The principal lay-out possibility of the proposed equipment is included in enclosure No.2.
When preparing the lay-out plan we considered the fact that after the installation of the new sheet mill, the old one will be remored. The present one can be made suitable for the purpose of the foundry with a minimum cost, so this seems to be the cheapest solution.

<u>The proposed foundry equipment:</u>
/Numbers equal with those of the drawing enclosure No.2./

1. Tilting tank furnace	2 pcs
2. Casting holding furnace	9 pcs
3. Ingot mould machines	3 pcs

4.	Central high-pressure hydraulic station	1 pc
5.	Fork truck	1 pc
6.	Band saw	2 pcs
7.	Rapid piece cutter	2 pcs
8.	Band sanding machine	2 pcs
9.	Stand gr: ing machine	2 pcs
1o.	Sand bla:	1 pc
11.	Tumbling rrel	1 pc

1. <u>1 ton t. ing tank furnace:</u>

Type: Sk.ener-Qualitál

Capacity:	1 t/shift
Metal capacity:	1 t liquid aluminium
Energy requirement:	66o.ooo kcal/hour fuel oil 6 kW/38o/22o V 5o Hz electric energy

Frame sizes:

width: 1.85o mm

length: 4.1oo mm

height: 2.9oo mm

Weight: iron structure	5 tons
lining	13 tons

2. Casting holding furnace:

Type: TCAL 15o electric heated crucible melting furnace

Capacity: 15o kg of liquid aluminium

Energy requirement: 4o kW/38o/22o V 5o Hz

Max. temperature: 8oo°C

Sizes: diameter: 12oo mm

height: 11oo mm

Weight: 18oo kg

In case there is a demand oil or gas heated furnace may also be applied.

3. Casting stand:

Type: UNI-Qualitál

Frame sizes:

length: 15oo mm
width: 278o mm
height: 245o mm

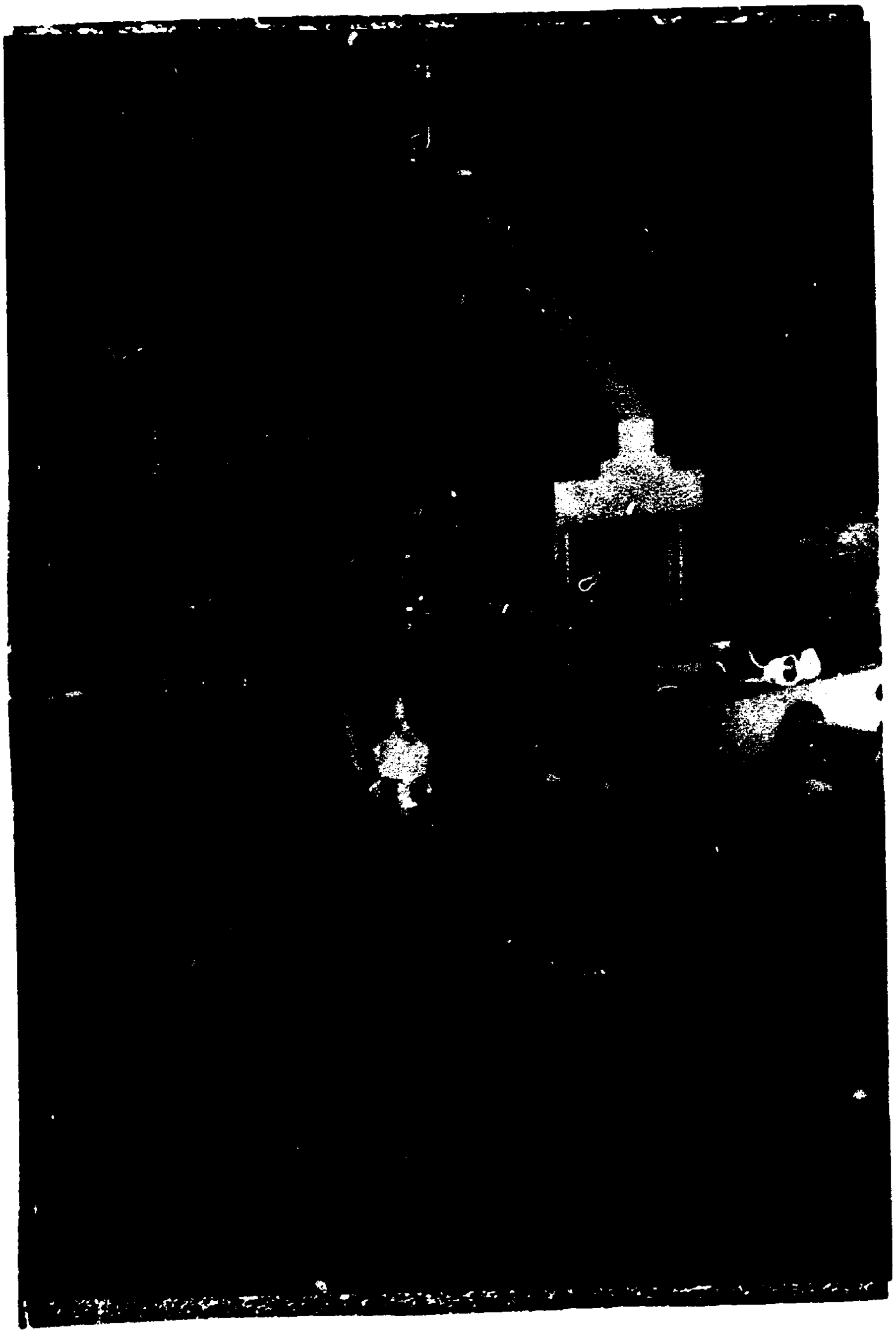
Size of receiver plate: 4oo x 5oo mm

Distance between receiver plates: min. 1oo mm
max. 9oo mm

Moving possibility of tools: in 6 directions

Weight: 1 1oo kg

Energy demand: hydraulic energy from the central station



4. Central high pressure hydraulic station:

Type: Qualitál

Hydraulic pressure system.

Nominal liquid capacity:	63 l/minute
Nominal pressure:	1oo bar
Electric energy demand:	15 kW

Accumulator:

Nominal volume:	2oo litre
Nominal pressure:	16o bar

5. Fork truck:

Type; EV-687

Load capacity:	1ooo kg
Lifting height:	33oo mm
Frame sizes:	
length:	184o mm
width:	96o mm
height:	22oo mm
Outside turning radius:	15oo mm
Driving speed with load:	13 km/h
without load:	14 km/h
Self-weight:	225o kg

6. <u>Band saw:</u>

Type: SF-04

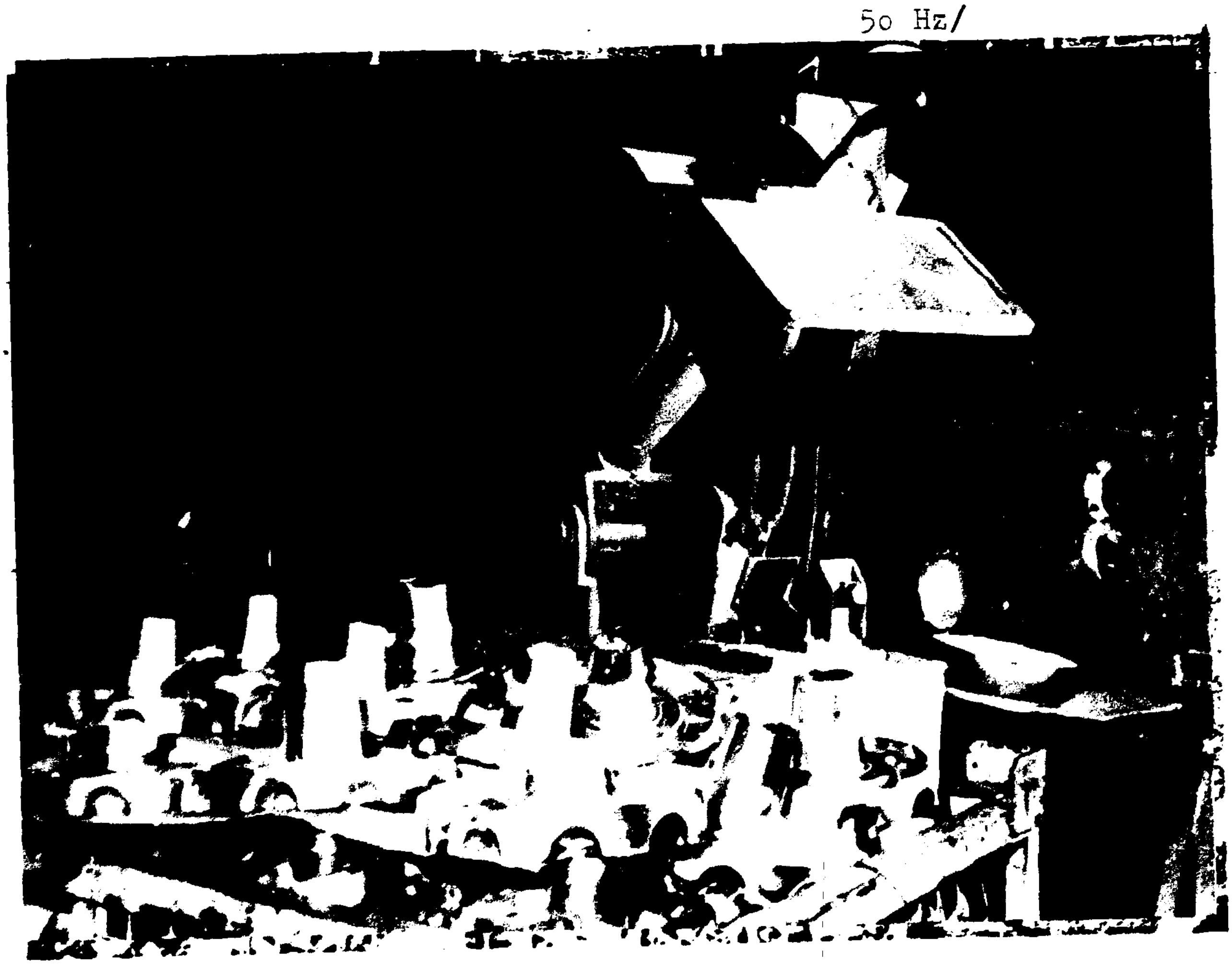
Frame sizes:

length:	8oo mm
width:	18oo mm
height:	24oo mm
Size of table:	8oo x 8oo mm
Height above table:	95o mm
Tilting capability: max	30°
Cutting speed:	23 m/sec
Weight:	84o kg
Electric energy demand:	2.8 kW/38o/22oV 5o Hz/

7. Rapid piece cutter:

Type: Qualitál

Diameter of disc:	3oo-5oo mm
Maximum cutting height:	1oo mm
Revolution number of the wheel:	15oo rev/min
Frame sizes:	
length:	12oo mm
width:	8oo mm
height:	9oo mm
Weight:	3oo kg
Electric energy demand:	3 kW/38o/22oV 5o Hz/



8. <u>Band sanding machine:</u>

Type: Qualitál

Frame size:

length: 46o mm

width: 17oo mm

height: 1o7o mm

Width of grinding material: loo-15o mm

Weight: 67o kg

Number of work place: 2

9. Stand grinding machine:

Type: AKS	
Size of grinding wheel:	4oo x 5o x 127 mm
Revolution number of grinding wheel:	15oo rev/min
Frame sizes:	
length:	12oo mm
width:	68o mm
height:	96o mm
Electric energy demand:	3.5 kW/38o/22o V 5o Hz/
Number of work places:	2

1o. <u>Sand blaster:</u>

Type: UVATERV

Size of work cabin:

length: 117o mm

width: 9oo mm

height: 63o mm

Pressured air consumption: 3oo l/min

Pressure of pressured air: 3-6 bar

4.6.4. Quality control

Casting production that takes place directly from waste requires increased expectations from quality control. The requirement does not only mean that components and pollutants must be defined exactly, but at the same time this activity should be carried out quickly, within a few minutes.

Before casting each portion quality must be defined at least two times.

First the composition of the metal bath must be defined after melting the scrap.

In the knowledge of this the quantity of the alloys to be added must be defined.

After melting the alloys the composition of the metal bath must be defined. If you cannot manage to define the composition of the metal bath in the first step exactly, alloy feeding and supervision must be repeated. We propose the installation of one piece rapid spectrometer with digital display. The precision instrument may be placed in the present quality control laboratory.

It can be operated by the present laboratory staff.

Spectrometer:

Type: Spectrolab

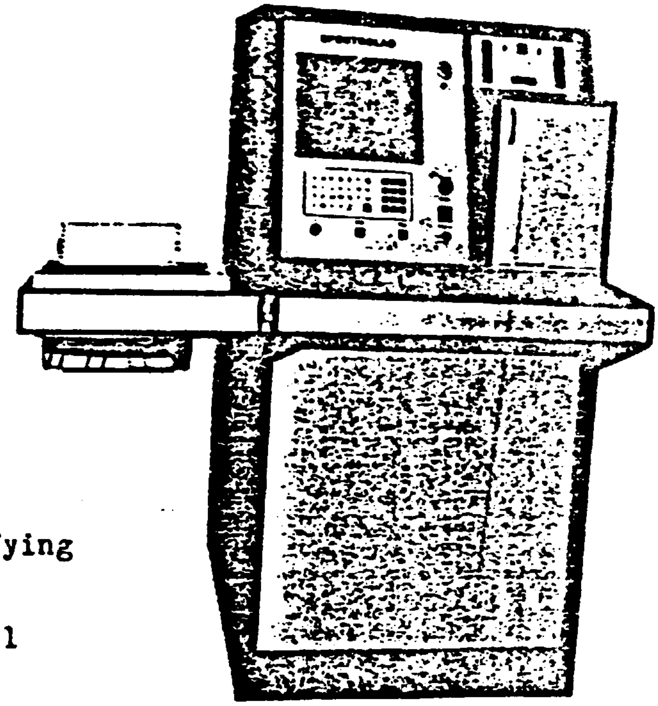
Frame sizes:

length:	14oo mm
width:	75o mm
height:	1111 mm
Weight:	25o kg

Current input: 15oo kW/22o V 5o Hz/

Examining gas: argon

SPECTROLAB

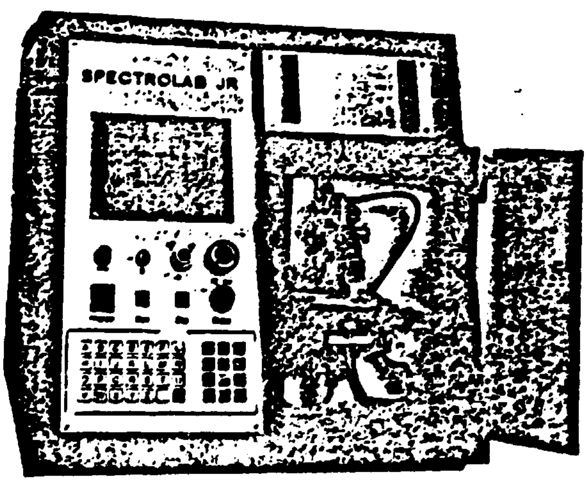


Laboratóriumi spektrométer helyszini minősitő vizsgálatokhoz:

- öntöttvas és acél
- aluminium, horgany, réz, nikkel, ólom és ezek ötvözetei
- különleges ötvözetek

Laboratory spectrometer for qualifying examinations on spot:

- cast iron and steel
- aluminium, zinc, copper, nickel lead and the alloys of these
- special alloys



SPECTROLAB Jr.

Egyszerü kivitelü laboratóriumi spektrométer vasötvözetek, könnyü- és nehézfémötvözetek, egyes különleges ötvözetek helyszini, üzemszerü elemzéséhez

Simple design laboratory spectrometer for the operational analyses of iron alloys, light and heavy metal alloys and certain special alloys on spot.

4.7. Defining the necessary fields of work

1. Installing fagoting press.

   It does not need a separate building. It may be placed in the present storing area, open-air. /See drawing enclosure No. 1./

2. Rotary drum melting furnace, operating under salt

   It can be installed in place of the presently operating tank furnace, using the connection points and funnel of the latter one. /See drawing enclosure No. 1./

3. Foundry

   This may be installed in place of the presently operating sheet mill and bar foundry. The building is suitable for installation after certain renovation and reorganization. /See drawing enclosure No. 2./

4. Spectrometer

   It should be installed in the present quality control laboratory after small changes and climatizing.

4.8. Energy requirement

The capacity of the foundry of 1 ooo t/year finished product. This makes necessary the use of 115o - - 12oo t/year cast aluminium scrap.
When defining the energy demand we considered the following basic data:

For the production of 1 t cast aluminium product it is necessary to have:

1.622 kg oil
2.292 kWh electric energy.

4.9. Manpower requirement and capacity

From the 1.155 tons of casting scrap collected annually 1 ooo tons of finished castings can be manufactured annually at good efficiency.
156 working hours are necessary for the production of 1 ton of finished casting. Considering the loss time of 3o% and the annual capacity of 1 ooo tons the working hour requirement is:

$$t = 1\ ooo \times 156 \times 1.3 = 2o2.8oo \text{ hours.}$$

If we take 192 hours as the monthly working hours the necessary nember of employees is:

$$L = \frac{t}{12 \times t_1} = \frac{2o2.8oo}{12 \times 192} = 88$$

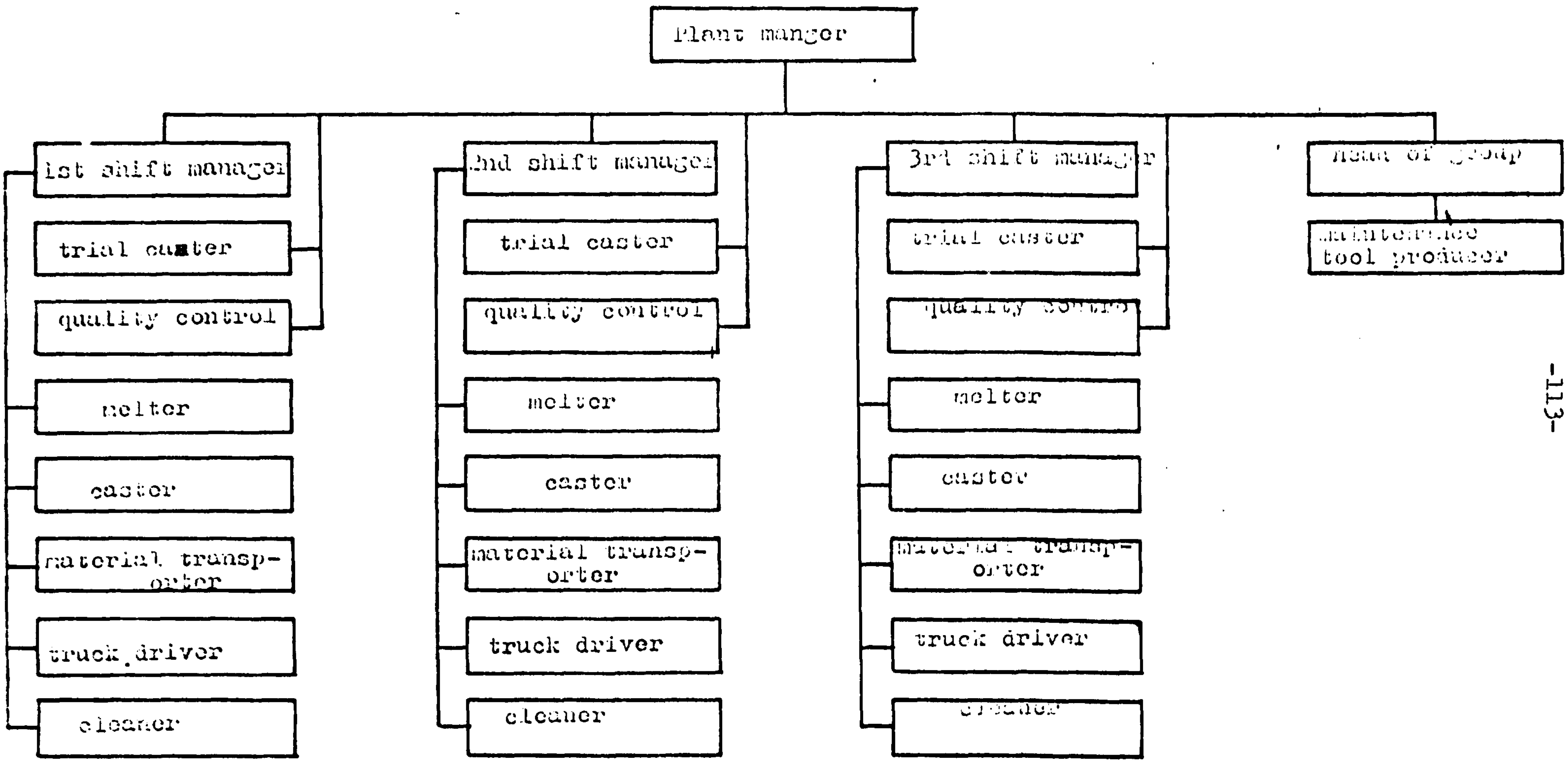
with three shifts, and with 29 workers per shift. The proposed composition of manpower on basis of that of similar European plant with the same capacity:

Plant manager	1 person
Shift manager	3 persons
Trial caster	3 persons
Quality control	3 persons

Melter	6 persons
Caster	45 persons
Material transporter	6 persons
Truck driver	3 persons
Metal treater	3 persons
Cleaner	3 persons
Maintenance staff, tool producer	12 persons
Total	88 persons

The present employees at the factory are able to deal with connecting execution and other activities without increasing the manpower.

Proposed organizational setup



4.1o. The estimation of efficiency

4.1o.1. The investment of the foundry

The production costs of 1 ton of finished casting.

Fuel oil	1622 kg	o.49 ¥/kg	778 ¥/t	251 US D/t
Electric energy	2292 kWh	o.12 ¥/kg	275 ¥/t	89 US D/t
Alu.waste	1.2 t	118o ¥/t	1416 ¥/t	457 US D/t
Auxilliary mat.	0.1 t	22oo ¥/t	22o ¥/t	71 US D/t
Wages	202 hours	15o ¥/t	15o ¥/t	48 US D/t
Tax/on finished product	1o%	5o5o ¥/t	5o5 ¥/t	163 US D/t
Amortization	20%		42o ¥/t	135 ZS D/t
Tools		3oo ¥/t	3oo ¥/t	97 US D/t
T o t a l :			4064 ¥/t	1311 US D/t

Examining the annual profits:

Income	1ooo t/year	5o5o ¥/t	5.o5o.ooo¥/year 1629 US D/year
Annual costs	" "	4o64 ¥/t	4.o64.ooo¥/year 1311 US D/year

Annual profit 1ooo t/year 986.ooo¥/year
3318 US D/year

Estimated investment costs: 2.1oo.ooo ¥ / 68o.oo US D

Investment costs include the costs of foundry equipment and the machines for quality control.

$$\text{Time of returns} = \frac{\text{Investment costs}}{\text{Annual profit}} =$$

$$= \frac{680.000 \text{ US D}}{318.000 \text{ US D/year}} = 2.13 \text{ year}$$

4.1o.2. <u>Investment of fogeting machine and rotating drum furnace</u>

The quantity of scrap considered:

Household scrap	1.045 t/year
Chips	757 t/year
Total:	1.702 t/year

Estimated burning loss at present	4o%	68o t/year
Loss in the rotatingdrum furnace	2o%	34o t/year
Saving:		345 t/year

The value of saving
/Selling price 5o5o ¥/t/ 1.742.ooo ¥/year
561.935 US D/year

Investment costs for
equipment 1.6oo.ooo ¥
516.ooo US D

We have not taken wages into consideration as manpower may be decreased with the investment compared to the present situation. The same applies to energy cost, as the energy consumption of the rotating drum furnace is almost the same as the existing tank furnace.

Amortization	32o.ooo ¥/year	1o3.ooo US D/year
Tax/on finished products 10%	174.2oo ¥/year	56.ooo US D/year
	494.2oo ¥/year	159.2oo US D/year

Income	1.742.ooo ¥/year	561.935 US D/year
Costs	494.2oo ¥/year	159.2oo US D/year
Annual profit	1.247.8oo ¥/year	4o2.735 US D/year

$$\text{Pay-bach period} = \frac{\text{Investment costs}}{\text{Annual profit}} =$$

$$= \frac{516.ooo \text{ US D}}{4o2.735 \text{ US D/year}} = 1.28 \text{ year}$$

On basis of feasibility calculations it can be stated that both the introduction of the foundry and the rotating drum furnace melting are investments with short returns.
If we take out the costs of the material testing equipment of the investment costs of the foundry the investment of the foundy returns even in 1.5 years. The reason is that the installation of these equipment contribute considerably to the work of the plant.

4.11. Examining the possibilities of future developments

In the factory which is the only aluminium scrap utilizing plant in Shanghai province castings were not produced earlier. In the first step definitely the ingot mould casting should be introduced according to the instructions above. After it becomes clear on basis of casting production experience what type of and how much is the demand for aluminium castings, development is possible in the following directions:

1. Machining of the castings
2. Introduction of press ure casting
3. Introduction of surface treatment

4.11.1. Machining of the castings

Considering the experience of ingot mould casting introduced in the first step, the next phase should be the introduction of machining of raw castings.

With this a double purpose may be reached. Processed castings have a higher selling price. On the other hand the chips with processing may be recycled immediately to the system and this way savings are possible on the costs of collecting and transporting, this way profitability is higher.

4.11.2. Introduction of press ure casting

Also with the consideration of the experience of ingot mould casting a decision can be made on the introduction of press ure casting. For this purppse we need more exact data on the basis, size and production number of the manufactured pieces.

It is possible to decide only in knowledge of the above data whether it is worth introducing press ure casting with much higher investment and operating costs.

4.11.3. Introduction of surface treatment

After the introduction of casting production the demand should be estimated for processing finished casting. Here we think of oxidizing or painting.

4.12. Environment protection - work safety

The proposed technologies can ensure the environment protection stipulations given by the Chinese partner for the work group.

When introducing the proposed technologies there is no sewage. The possible pollutants washed in with rain water are far below the permitted values.

So	Fluor	1o mg/l
	Salt content	5oo mg/l
	cod	1oo mg/l

In case of flue gas the permitted values may also be observed.

Fluor	1 mg/l
Aluminium	1oo mg/m³
Total dust	1.8 kg/h

Air pollution at the places of work also remain under the permitted values.

Fluor	1 mg/m³
Aluminium oxide	4 mg/m³
Co	2o mg/m³

Noise level at the places of work is generally under 85-90 dBA. But when processing castings this may be higher than that. Here individual means of protection must be used/ear-plug, ear-protector/.

5. CLOSING CHAPTER

Oh basis of the information given in the previous passages the following statements can be made.

5.1. In the field of introducing rotating drum furnace melting

Its introduction together with fagoting may decrease losses at least by 20%. Hard physical job under difficult circumstances can be decreased considerably.

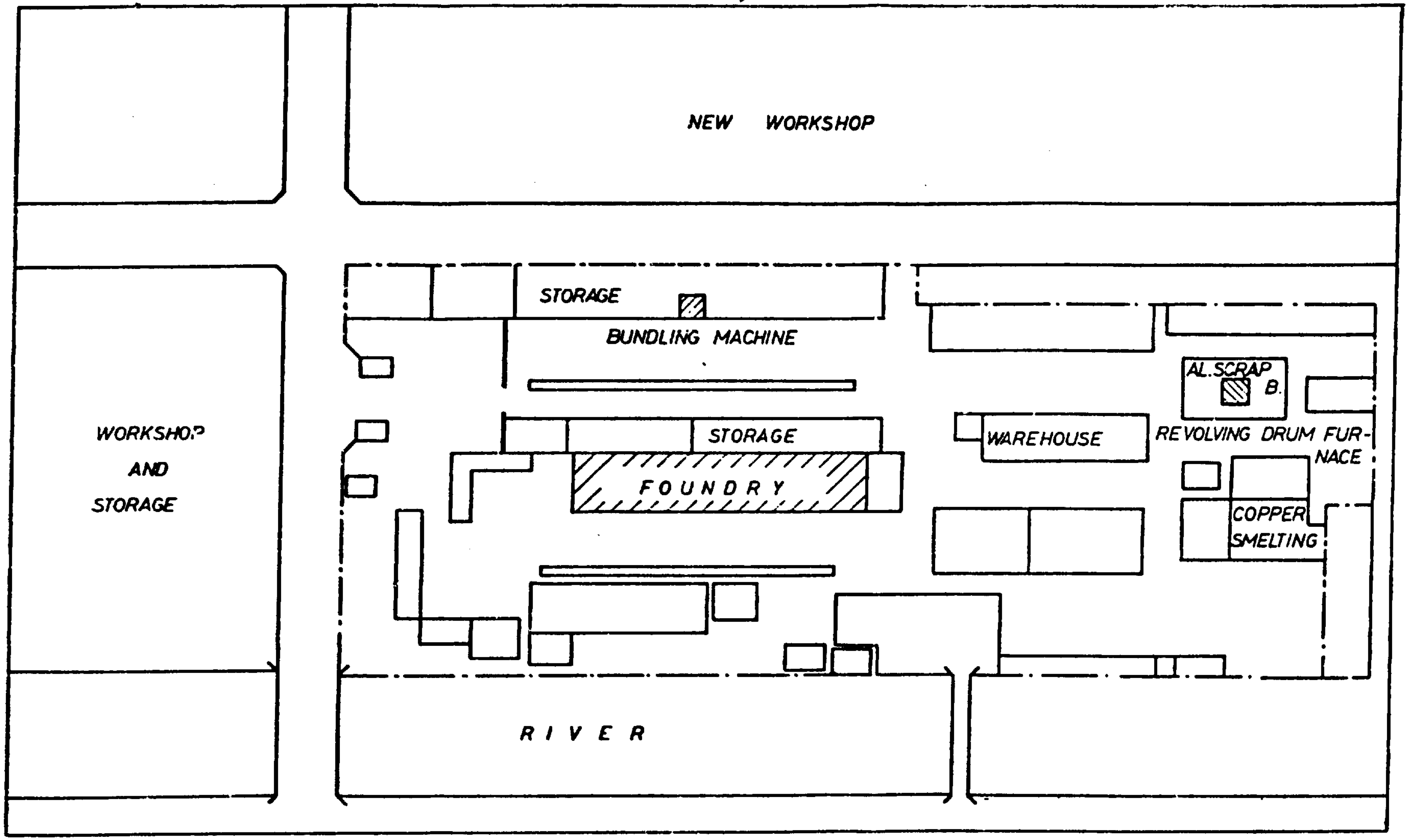
Here we think of manual work withexposureto radiant heat and pushing material under salt bath manually. This investment should be realized even in case if return time would not be so favourable /1.28 year/. Here we did not consider the fact that the usefulness of fagoting is also obvious in the field of storing and material transportation.

5.2. The introduction of casting technolgy

With the realization of this technolgy the selling price of finished products increases considerably and this way profit also increases. Hot casting results in considerable energy savings.

An outstanding part of the investment is represented by the material testing equipment, but this contributes not only to the work of the foundry, but to that of the whole plant as well, as it helps with manufacturing products of a better quality.

We would like to thank the collegues at the Shanghai Supplying and Marketing Co-operative and at the Shanghai Resource Recovery and Utilization Company for the help provided to our work.

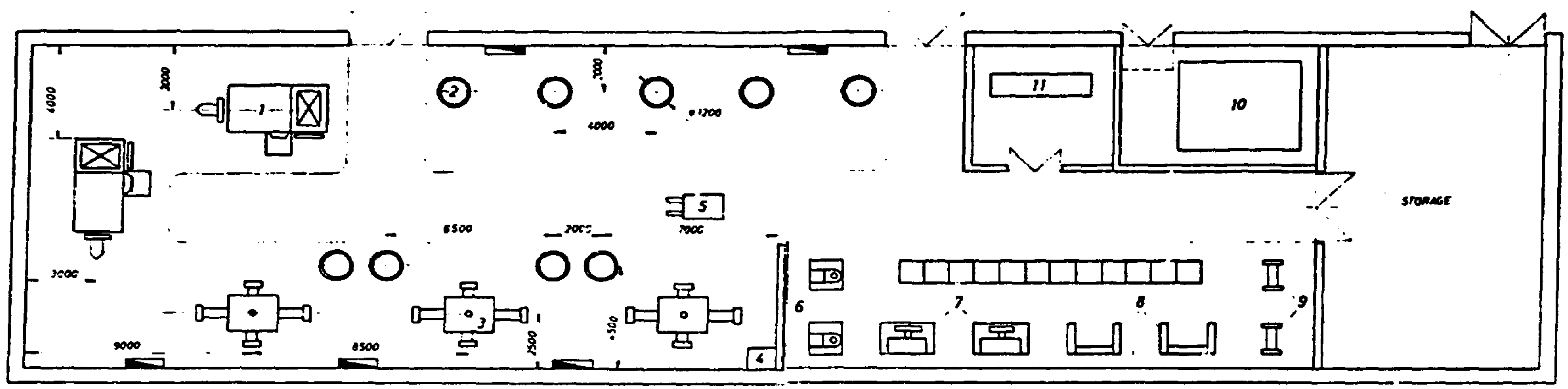


UTILIZATION OF ALUMINIUM WASTE IN PEOPLE'S REPUBLIC OF CHINA

FOUNDRY
LAYOUT PLAN

AL-01

MAY 1986



UTILIZATION OF ALUMINIUM WASTE IN PEOPLE'S REPUBLIC OF CHINA

FOUNDRY
ARRANGEMENT PLAN

AL-02

MAY 1986

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PART IV.

WASTE TEXTILE UTILIZATION

Report

CONTENTS

1. INTRODUCTION

With our life-style, rapid technical development, the growing number of the world's population and with the continuous improvement of the living standards a continuously increasing trend in the textile material consumption per capita can be witnessed. Thus is it quite natural that serious efforts have been taken on one hand to achieve high production quantities and to develop new, up-to-date technologies, on the other hand to process more and more textile wastes due to the price increase of the raw materials, their limited availability and the growing costs of waste disposal. Being one of the most densily populated cities of China and the world and being a centre of textile industry, the above statements are especially applicable for Shanghai, where the collection and recovery of textile wastes have a long tradition. The Shanghai Resource Recovery and Utilization Company /hereafter SRRUC/ collects and processes about 3o.ooo tons of textile wastes yearly. However, at the same time the processing of these wastes to high standard products with up-to-date technology is not yet solved.

Upon the request of the World Bank, UNIDO organized a study-tour for the experts of SRRUC in Hungary in 1983 and 1984, so that they could get aquainted with the Hungarian textile waste processing technologies most suitable for China.

In November, 1984 at the International Waste Recovery and Utilization Conference organised by the World Bank the representatives of TESCO and SRRUC agreed that - besides other projects - the Hungarian party would elaborate a proposal in the field of textile wastes for recovery - supported by UNIDO and the World Bank.

The experts of TESCO responsible for textile wastes - on the basis of negotiations with experts of SRRUC - arrived in Shanghai with a written proposal containing alternative technologies for the work visit to be held between 16 April to 7 May, 1986.

This proposal described the manufacturing technologies of wall-to-wall carpets, geotextiles and textile wall coverings with processing wastes. The proposal aimed at describing the Hungarian waste recovery and utilization experience for the experts of SRRUC and thus helping them to decide which technology is the most suitable for them and can be realized under their circumstances./The description is contained in Annex No. 1./

During the work visit - according to SRRUC's programme - the experts studied and appraised the present situation and process of textile waste collection, selection and processing. /The summary is contained in Annex No.2./

The experts provided information on the Hungarian experience in waste recovery and the productions systems with special view to the field described in the material, then had discussions with the Chinese experts.

At the end it was concluded that the available waste were not suitable for the manufacturing of wall-to-wall carpets and as the main objective of SRRUC was the processing of the available wastes, geotextiles were mentioned as subject of the inquiry.
TESCO agreed to elaborate the manufacturing technology of geotextiles on the basis of the available wastes and Chinese equipment. It was also found that the most appropriate technology would be one of the most dynamically developing fields of textile industry - the nonwoven technology. The nonwoven technology is not a new idea to SRRUC as it has already large-scale production in many of its units. It must be noted that the greater part of the manufacturing equipment is very old, is in bad technical condition and has very low production capacity.
Modern and demanded articles are manufactured as well which have a wide field of application, they are produced with up-to-date principles but with old equipment. In our opinion the equipments are suitable for manufacturing geotextiles at a low efficiency but in the long run they do not mean solution to the processing of the available wastes.

Therefore it will be necessary for SRRUC to put in production new equipment - which can also be purchased in China -, we will describe these during the manufacturing technology in detail.

On the basis of the Hungarian experience we have to note that bearing in mind the future, it is essential to examine the possibility of putting into operation manufacturing equipment representing the world standard, as they can provide those technical and technological requirements, which are necessary for the production of high-standard needle-felted products based on wastes.

2. MANUFACTURING GEOTEXTILES WITH NONWOVEN TECHNOLOGY AND USING WASTE FIBRES

2.1. General description of nonwoven technology

This field of industry has only a history of 4o years and has made a rapid development at the beginning, the production increased by 26% anually as an average. Later on this rate declined between 1975-79 it was around 14% and in recent years around 1o%. Of course, the rapid development was due to beginning the production from the bottom. But the rapid development of nonwoven technology is striking also in this respect, especially if we consider that the textile industry itself had to face many difficulties in this period.

Production in European countries
/nonwovens, in tons/

Country	197o	1975	1978	1981	1982
FRG	14.7oo	2o.5oo	31.2oo	46.6oo	53.2oo
United Kingdom	8.4oo	22.2oo	33.5oo	32.4oo	34.6oo
France	7.6oo	16.9oo	23.ooo	27.5oo	29.2oo
Benelux	6.ooo	21.4oo	37.ooo	41.1oo	44.5oo
Scandinavia	1.9oo	1o.7oo	16.1oo	21.4oo	25.6oo
Others	1.8oo	5.6oo	11.3oo	22.ooo	22.9oo
Totally:	4o.4oo	97.3oo	152.1oo	191.ooo	21o.ooo

In case of nonwoven technology the different steps of yarn production and yarn processing fall out, and fabrics can be manufactured in the most rational way, i.e. fabrics are bonded to each other by phisical or chemical prodecures.
The production procedure can almost always be maintained at a continuous level therefore it is ideal to be automatized.

According to the grooping medium nonwovens can be divided into four groups:

- spunbonded nonwovens/chemical bonding/
- needle-felted " /mechanical " /

- sewn nonwovens /bonded by yarns/
- heat-set binding procedures

The main groups contain several sub-groups - but this material does not deal with the details - proving that the word "nonwoven" means different kinds of technologies.

By nonwoven, a surface structure is understood which consists of fibre layers bonded together totally or greatly by mechanic, adhesion or cohesion procedures.

As to the nonwovens themselves, their production and properties, the following main four factors are characteristic:

- fibre
- hair formation
- stabilizing the hair
- finishing.

As a consequence of more and more severe requirements concerning the quality and the productivity of procedures, nonwoven technology has become very versatile.

One principle is always preceeding i.e. the type, composition and uniformity of the hair has a far larger influence on the inner and outer properties of the products made of them, than in the case of fabrics and knitted fabrics.

Nonwoven technology provides the material properties, which by traditional procedures cannot be achieved, therefore more and more industries and branches apply them successfully, e.g. in the field of constructions, as geotextiles.

2.2. General description of geotextiles

The basic principle of geotextiles as a sheet-like structure, is as old as the water- and soil construction technology itself. Thus different fagot coats and gabions were made of willow and pine twigs, as well as strawlayers. These structural units could be applied only in a limited field. The general use of nonwoven technologies and man-made fibres helped the independent develpment of geotextiles.

Under geotextiles layers of textile character are understood, which is applied as a structural material in soil construction, grounding and water construction, and which have definite tasks in these fields, e.g. insulating layers, filters, protective layers,supporting layers,etc.

2.3. Raw materials of geotextiles

Single fibres, as elementary and flexible fibres being relatively long in relation to their diameter, give the structural units of the hair and thus the main unit of the nonwoven geotextiles. As a consequence of this the available torn single fibres or fibre wastes as well as their size, surface and properties have a decisive influence on the production of nonwovens and their properties as well. It can be stated that contrary to yarn production, in case of nonwovens raw materials of different quality can be processed well. Both fibre fineness and length of fibres may be different.

As far as our expreience is concerned, 3o-15o mm long and 3,3-17 dtex single fibres are suitable for processing.

As to the fibre type, geotextiles made exclusively of synthetic fibres can be used in the field of soil-, water-, road and railway construction, as they have to be corrosion -proof and firm.

On the basis of the above and the survey held at SRRUC the following fibre types are available for manufacturing geotextiles:

fibre-type	tons/year
a/ polyester	1.000
b/ polyamyd	400
c/ acryl	-
d/ polypropylene	100

These fibres can be used as raw materials for geotextiles both alone or blended.

Polyester

Polyester is resistant to all type of soil. 8-10 per cent of its firmness will be lost in 3-5 years, which is due to the change in the crystal structure of the fibres. The inclination to deformation i.e. elongation, resp. irrevocable changes of form at a constant load during a period of time is almost zero. Firmness of the fibre is very good, its resistence to chemicals and UV is also good.

Polyamyd

Their properties depend on the amine they are made of, but they have one common one: they are very resistant to fatigue, beating, wear and chemicals and they are totally neutral. They have also good firmness properties/mainly the elongation at break/.

Their disadvantage, as a consequence of being under water for a long time, that their firmness declines. Their application is proposed only, when they blended with other synthetic fibres/PP, PE, PAN/.

Polyacrylnitrile

They are resistant to fatigue, spherical influences, ultra violet radiation, alaklies, salts and acids, they have high mechanical firmness/flexibility modulus, elongation at break, tensile strength shock resistance/ and they are dimensionally stable.

Polypropylene

They have a high mechanical firmness, they are resistant to alkalics, salts and acids, but their resistance to ultra violet radiation is poor. Tear- breaking- punching and splitting firmness of polypropylene is less that those of polyester.

2.4. Manufacturing technology of geotextiles

2.4.1. Preparation of fibres

Determination of the task:

Torn fibres of different fineness, length and colour coming from different bales or sacks, should be blended to a homogeneous, uniform blend, curls and locks should be divided into fibres or smaller fibre-loops and the whole blend should be cleaned. The firm and fixed contaminations should be separated. The emulsion, which helps further in the process should also be applied.

2.4.1.1. Blending

The aim of blending is to make a homogeneous and uniform blend from the different fibrous materials, which vary according to fibre type, fineness, length and colour.

Steps of blending:

a/ Wighing the individual blending factors
b/ Making the bedding for the blending
c/ Blending and tearing of the different fibres in the bedding by machines/willowing/
d/ Preparation of the blend for further process/by adding the emulsion/.

The above four steps are to be carried out in two stages:
a/ making the bedding
b/ willowing.

The individual tasks can be devided into these two stages and in the practice they cannot be separated.

Making the bedding includes the following steps:

- weighing the components of the blend
- making the bedding
- blending of the fibrous materials.

The above traditional steps do not have to be described in details as they are well-known, but we should like to call attention to a few important points.

- While bedding, thickness of the layers is optimal, when between 1o-2o cm.
- Height of bedding should be made so that it facilitates handling for the workers. This height is about 1,2 m.
- Should some factors have a smaller weight proportion, it should be blended with other factors having larger weight proportion.
- When making the layers, it is advisable to get the same raw material from different bales, thus differences between the bales will be compensated.
- When making the bedding the layers are put down horizontally, but the blending machine, i.e. the willow must be fed in a vertical direction from the bedding. Thus it is provided that raw materials of the same quality are fed into the willow but layers above each other, i.e. different qualities.

2.4.1.2. Willowing

The task of the willow is to blend mechanically the prepared materials in the bedding, durls and locks should be divided into fibres or smaller knots, and to clean the material as well, Willowing alone cannot do the blending. Precondition of the good blending is the right bedding which we described above. Prerequisites for the good work of the willow are the following:

- Uniform feeding, by the help of a feedbox.
- Right adjustment of the working surfaces, i.e. perpheral speed and the distance of the surfaces working together. Adjustments are subject to experience, there are no standard for it.
- Maintenance and cleaning of the machine is of special importance. Broken down or contaminated parts can make the opening uneven and poor.
- Opened materials should not be drawn away from the machine free, as materials of different specific weight may be divided.

The willow is generally used as blending machine with high efficiency. The machine consists of a feeding-opening and a separating unit.

Short description of the working principle of the machine

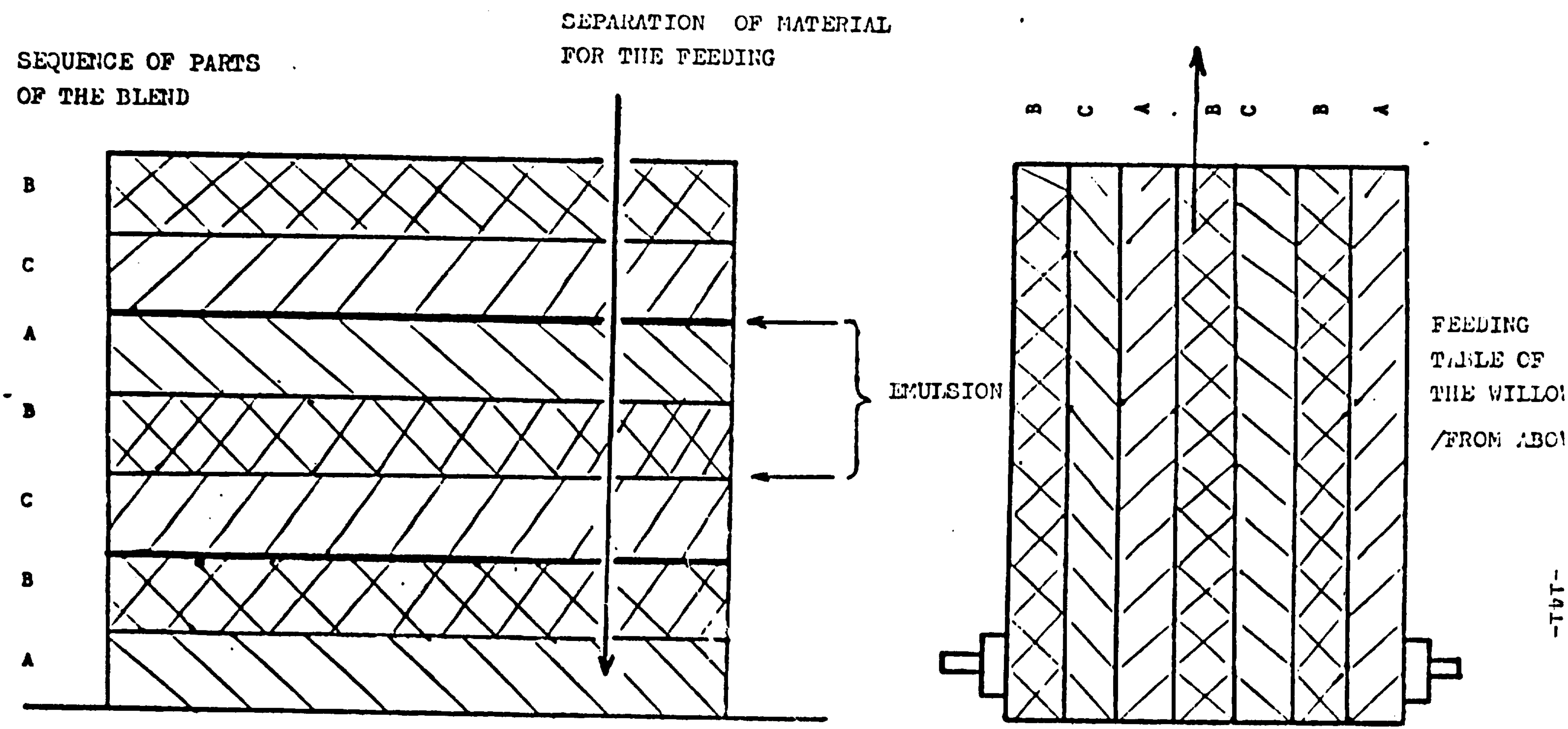
The feedbox feeds uniformly the willow on the basis of the volume regulation. The pressing roll presses and leads the material between the feeding rollers. Then the material goes to the "gullet teeth" of the main drum. At the directiron of the feeding roll's coating and teeth is contrary to the direction of the movement, the teeth hold back the curls got by the main drum thus giving an intensive opening effect. The direction of revolution of the drum is clockwise the teeth are in this direction, therefore there is a separating effect between the lower feeding roll and the drum and an opening effect between the higher feeding roll and the drum.

The lower roll gives the whole material to the drum, the higher feeding roll takes a part of the material with it, and then the cleaning roller separates the material from it and leads it to the drum.
The contamination separated during opening will be collected under the main drum, it falls through a gate.
The nails of the blending roller separate the material from the main drum then the blend is blown by the help of the ventillator into a storage box in pneumatical way.
It is advisable to apply the emulsion during the pneumatical blowing of the material.
It is very important that the emulsion be applied in a uniform, fine distribution,

i.e. vaporized.
Vaporization is carried out by the help of a pump at a pressure of 3 atm, through an atomizer.
If the emulsion is not applied uniformly, the individual parts of the blend may change their weight, adhesiveness and ability to open, therefore the end product, that is the quality of the nonwoven geotextile may also be uneven.

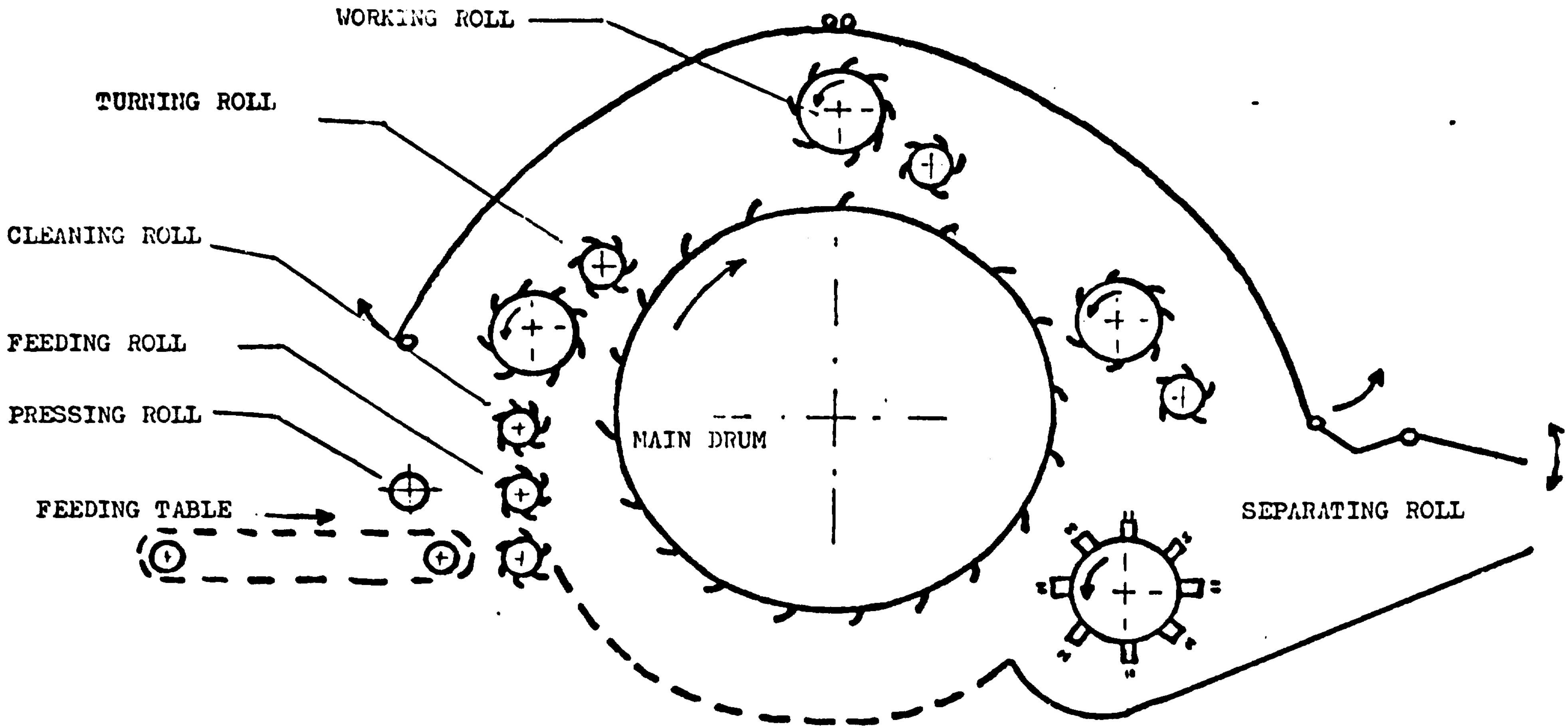
Vaporization of the emulsion, i.e. aim of the emulsion:
the aim is to diminish the surface friction, it is to be achieved in the case of man-made fibres by the application of antistatic chemicals.
Due to their chemical structure antistatic substances play a double part:
they decrease the static load and have also a softening effect:
increase the flexibility of fibrous materials therefore better results can be achieved during processing.

The next step in the manufacturing is the transformation of the fibre blend to veil.
This is performed by the traditional carding process.



BEDDING AND FEEDING THE MATERIAL INTO THE WILLOW

DRAWING OF THE WILLOW



2.4.2. Mechanic hair formation

This principle has been taken from the traditional spinning preparations, the hair quantity necessary to manufacturing nonwovens comes from these process. In the case of mechanic hair formation the carding beams are the main parts of the equipment for making the veil, and in our opinion, in its classical "tandem" finish, by the help of the cross section it is suitable for making the hair structure of geotextiles.

The task of carding is:
- to open further the fibres of the blend being still in curls,
- to homogenize the blend consisting of single fibres of different types, qualities and colours,
- to remove contamination clung from the individual fibres,
- to place the single fibres paralel to each other and thus to make a uniform fibre-veil.

Further opening of the blend

After tearing, bedding and willowing the fibres are still in smaller curls and knots. In order to get a uniform fibre distribution, opening must be continued till the independent single fibres. This can be achieved and performed by carding, because the carding machine has much finer opening instruments, carding nails, than the previous machines, these nail can penetrate into the knots and between the knots as they are smaller and have larger density.

Blending

Both tearing and willowing can blend the material consisting of more components and different qualities only to some extent.
With its finer instruments the carding machine can open up the material to single fibres and due to the different speeds of the different beams, it unites and separates other layers of fibre, thus it gives a better blending.

Removing the contamination

The material already cleaned from dirt may still hold smaller impurities. These can be removed when opening the material up to single fibres, smaller impurities are removed from the fibres in this process.

Veil formation

The blend is opened up to fibres and cleaned from impurities, should come out of the machine in the form of a uniform, thin card veil, then the machine will form the hair structure of the nonwovens by the help of the cross section.

Working of the carding beam

After describing the functions of carding we should like to describe the parts of the carding beam and their working.

The parts of the carding machine:
- feedbox with weighing unit
- pre-opening unit
- 1st carding unit
- 2nd carding unit
- horizontal veil formation/cross section/.

2.4.2.1. Working of the feedbox with weighing unit

The fibrous material in curls and locks comes to the feedbox, from where due to the movement of the askew band with nails, which forms the bottom and inside of the machine, the curls get stuck to the nails and by the help of a high-revolution mixing beam they get into the scale. Thickness of the material layer can be adjusted by the distance of the comb mounted above the naily band.
Depending on the previous adjustment, the scale stops the band after reaching the given weight, thus feeding also stops. At adjustable intervals the scale opens and lets the material fall onto the feeding table. In order to decrease the unevenness of falls there is an askew material pressing plate on the table moving simultaneously with the scale.

2.4.2.2. Pre-opening unit

The material from the feeding table comes through the double feeding rolls - finished with stiff coating - onto the pre-opening beam. There are a cleaning and a working rollers above the pre-opening drum. Opening effect is provided by the difference in peripheral speeds of the feeding rollers and the opening beam, and the coatings of all rollers as well as the coating of the cleaning and working rollers. These coatings are made of saw-teeth, i.e. they are stiff.

By the help of a roller the material comes to the main drum of the 1st carding unit, where carding is performed by the drum and its working and turning roller-pairs.

2.4.2.3. 1st carding unit

The two main tasks of carding, opening and blending are performed by the main drum and working and turning rollers. The single fibres coming to the main drum arrive at the touching of the working roller and drum, where curls open. A part of the fibres remains on the drum while the other part comes to the working roller. This is why the different peripheral speed of the drum and rollers have a separatin effect. The material from the working roller comes to the turning roller. The teeth of the rollers and in contrary direction, the turning roller removes the

the material from the other, the peripheral spedd of the turning roller is greater than that of the working roller.
The main drum takes over the material from the turning roller on the basis of the same principle.
The performance of the above depends on the following:
- distance between the working rollers and the drum
- relation between the pripheral speeds of the working rollers and the drum
- sequence of working rollers along the movement of the material
- loading the drum.

From the main drum of the 1st carding unit the material comes by the help of a roller to the main drum of the 2nd carding unit.

2.4.2.4. <u>2nd carding unit</u>

Its working principle is the same as that of the 1st unit. The lifting roller placed after the last working roller facilitates the removal of the single fibres. Its task is to lift the single fibres left between the teeth of the drum onto the level of the coating.
This is a double function. In the first place it prepares the single fibres for the material overtake from main drum to removing roller and in the second place it provides cleaning to main drum so that it should not be full of fibres.
The speed of the lifting roller is 1,1 - 1,5

times larger than that of the drum, its nails reach between the teeth of the drum, thus lift the fibres onto the surface of the drum, then the fibres come to the removing roller. The task of the removing roller is to press the veil formed on the drum, to take it over and to lead it further to horizontal veil layer by the help of a vibrating blade.

2.4.2.5. Hair formation

There is a continuous transport band in front of the carding machines in a 9o ^{o} angle, onto which the endless fibre veil is laid in cross direction - fron and back - as many times as it is necessary for the required hair wight. This machine is called cross-section machine. The feeding band of the cross section unit is directly connected with the removing band of the carding machine, the veil coming under the blade of the carding machine is taken over by the cross section's band. These bands are in accordance with the peripheral speed of the removing roll of the carding machine. The veil-laying unit/car/ has also the smae speed. It is important that the laying unit should lay the veil in 9o^{o} angle to the original. This means that the width of the carding machine does not limit the width of the endprodict. The same carding machine can be used for the manufacturing of both 2 m or 5 m wide geotextiles.

In practice, the width of the cross section should be formed in accordance with that of the needle-felting unit. After there are the layers of the hair of the required weight, the next step is the fixing and bonding of these structure by needle-felting. This is the task of the needle-felting machine.

2.4.2.6. Needle felting

In order to increase the adhesive firmness of the single fibres it is essential to stabilize the hair. Besides the applied fibres and hair formation the fixing process also have a large influence on the physical properties of the nonwovens and the geotextiles. As for geotextiles, we recommend only mechanic stabilization, i.e. needle-felting process.

The ground principle of needle-felting is that the needles go through the hair prependicularly/askew direction is also possible/ while they pull fibre cuts with their "key-bits" to the other side of the nonwoven, thus it gets more dense, the friction force between the fibres increases ensuring firmness for the nonwoven.

Factors influencing the stabilistaion of hairs

- The single fibres processe:	type of fibre fibre length and fineness curling
- The carded hair:	orientation of fibres evenness thickness surface density
- Needle-felting machine:	direction of needles arrangement of needles on the needlepad speed of needles density of needles depth of needles
- Felting needle:	type fineness quality profile, arrangement, number of key-bits

Working principle of the needle-felting machine

The needle-felting process of the hair consists of three steps:

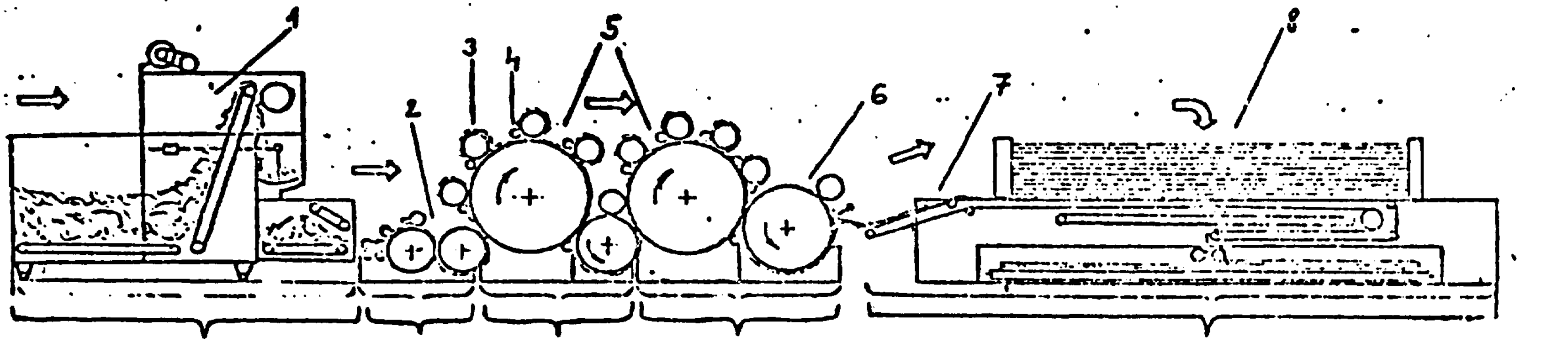
- leading the hair into the machine
- needle-felting
- pulling the hair.

From the transport band of the carding machine to the feeder of the needle-felting machine and then to the pulling beams after needle-felting the way of the hair should be continuous.
Needle-felting is done by the felting needles, which are in the needle bed. The needle bed performs movements up and down.
When the needles penetrate into the hair, the latter is held by the ground plate. The ground plate is perorated in accordance with the needle-pattern of the bed, thus needles can penetrate but the hair is held firmly. There is the smoothing plate between the bad and hair, it is also perforated and when the needles leave the hair its task it to remove the fibres from the needles thus ensuring a perfect conveyance of the hair. The advantage of the prependicular process is that it has a relatively simple construction, the duration of the machines is long and also fine needles can be used for needle-felting.

2.4.2.7. Adjustment

Its task is to cut the uneven sides of the mechanically stabilized, needle-felted nonwovens, i.e. cutting longwise, to ensure the required length of rolls, rolling the nonwovens. These can be performed by the usually applied machines.

CARDING BEAM WITH HORIZONTAL VEIL LAYER



1, feedbox with scales

2, pre-opener unit

3, working roll

4, turning roll

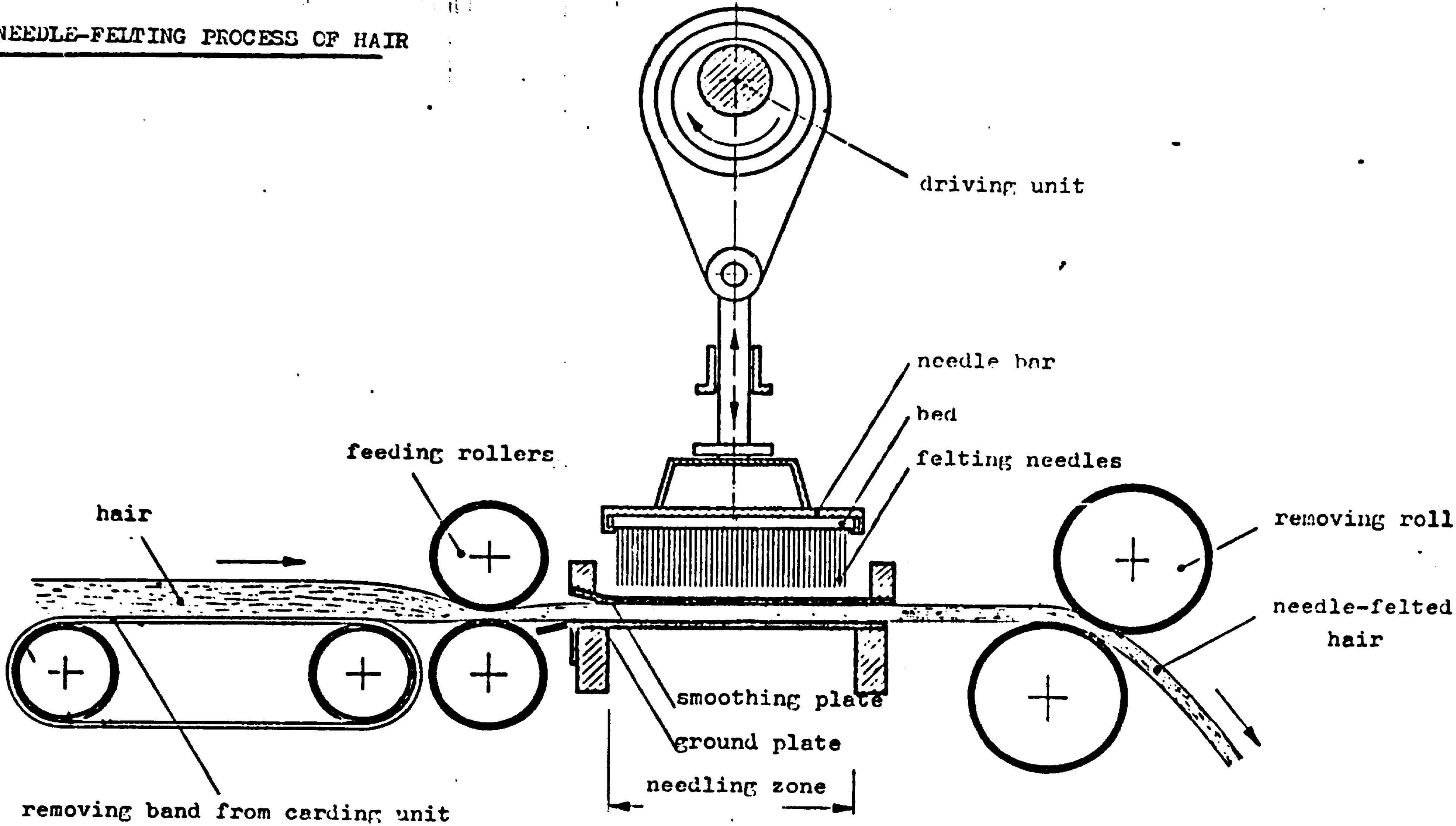
5, carding unit

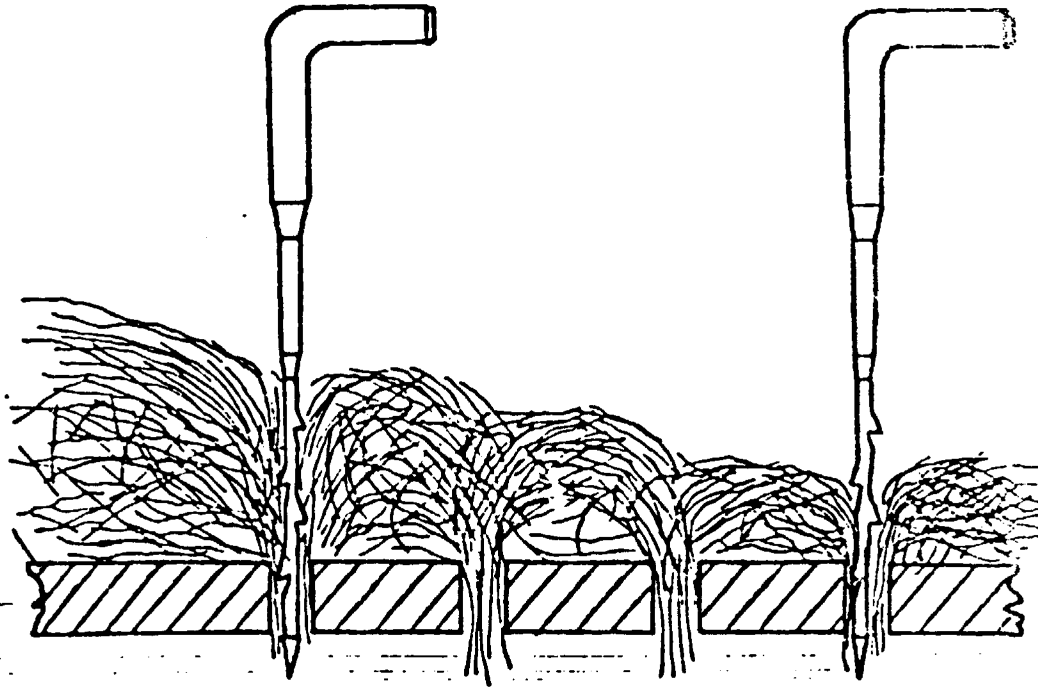
6, removing unit

7, veil transport band

8, horizontal veil layer

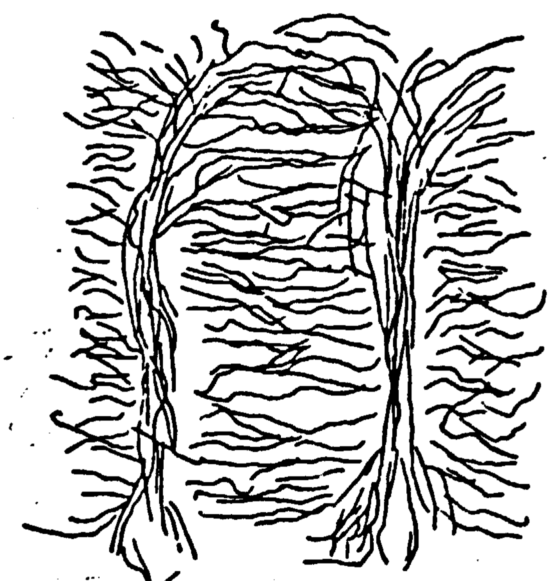
NEEDLE-FELTING PROCESS OF HAIR





FORMATION OF NONWOVENS BY NEEDLE-FELTING

1.a ábra



1. b ábra

STRUCTURE OF NEEDLE-FELTED NONWOVENS

2.5. Manufacturing parameters and requirements of geotextiles

During their application geotextiles must meet several demands. That is why it is important to determine the manufacturing parameters, chemical, physical, mechanical and hydrological properties, because without knowing these properties their field of application cannot be properly decided. The following table shows the main properties of some foreign and Hungarian geotextiles.

Some characteristics of foreign and Hungarian geotextiles

Name material country	type	weight g/m2	thickness mm	width m	lengthwise firmness kp/ 5 cm	elongati %:
BIDIM	U 14	15o	1,5		3o	
polyester	U 24	21o	1,9	5,3	5o	
France	U 34	27o	2,3	4,2	7o	5o-7o
	U 44	34o	2,8	2,1	95	
	U 64	55o	4,4		165	
FIBERTEX polyester Denmark		17o	1,14	5,2	4o	6o
LUTRADUR	725o	5o	o,28		8	35
polyester	H 721o	1oo	o,38		2o	4o
	H 722o	2oo	o,8o	4,2	48,5	5o
FRG	H 7225	25o	o,84		73	5o
TERAFIX polyester Yugoslavia		138	2,5	2,2	72	74
TERRAM 33 % polyester 66 % polypropylene England						
LINZ PP polypropylene Austria	TS 4oo	36o	4,6	2,5 4,8	6o	8o
TYPAR polypropylene France		136 2oo		3,5 4,2 5,2	34 43	72 69
MITOP	SI 42/3o	3oo	3,1		63	12o
polypropylene	SI 5o/35	35o	3,1		77	75
Czechoslovakia	SI 48/4o	4oo	3,2	max.7,5	11o	95
	SI 43/4o	8oo	5,3		14o	88
Szegedi KSZV	F 6o7	35o	3		2o	7-8
PP, resp. PA	F 6o1	5oo	5	1,45	4o	7-8
Hungary	F 61o	5oo	5		2o	25-3
TEMAFORG	TERFIL	15o	1-2		2o-3o	
PP	" I.	25o	2-3		5o-8o	
Hungary	" II.	4oo	3-4	2,5	7o-1oo	5o-8o
	" III.	5oo	4-5		13o-19o	

2.5.1. Manufacturing oarameters of geotextiles

From textile technological point of vew the following is charachteristic to geotextiles:

fibre type, i.e. determination of the ground material, surface density, thickness, width and sizes of length.

There are no standards in this respect, they have to be determined by tests in the practice, but the ground material, its quality, the structure and field of application of the nonwoven have a great influence. As for width and length of geotextiles, in the field of application optima. precisely joinable sizes are required, but the product can not always meet these requirements. As geotextiles can be sawn and welded as well the continuity can be solved by these methods - with 5-lo cm wide overlapping.

2.5.2. Mechanical and dynamical loads

Great pulling and pres g forces are operative on the geotextiles, they may be effective periodically or constant. at certain points only or on the whole surface. This is the case when stones or rubble-stone is grinded onto the geotextile, rail groundings cause loads at certain points or during road constructions, when geotextiles have to comply with different

tensions. In the case of cushions the relation of force and elongation has a great importance. The deformation modulus is also very important, i.e. what constant force is needed for the geotextile to be capable of elongation over the initial load, i.e. it can resist breaking.
The thickness of nonwovens is also of special importance, first of all from point of view of fultering effect. In order to be used as a separating layer, themechanical fuletrin stability should be provided, i.e. the pole-opening of geotextiles should be so small, that fine material parts cannot penetrate into the soil.

2.5.3. Hydrodynamic requirements

In this case it is important that geotextiles have two contrary properties. This is the mechanic and hydraulic filtering stability, i.e. on one hand retentivity of the fine parts, on the other hand water permeability. In this case the permeability prependiculat to the surface is just as important as the horizontal water conveyance of nonwovens.
Nonwovens are specially suitable for complying with these requirements. Besides the structure of the nonwoven, hydraulic filtering effect will be provided by the mechanic stabilizing, i.e. the needle-felting process, which gives a pole size large enough to drain off water.

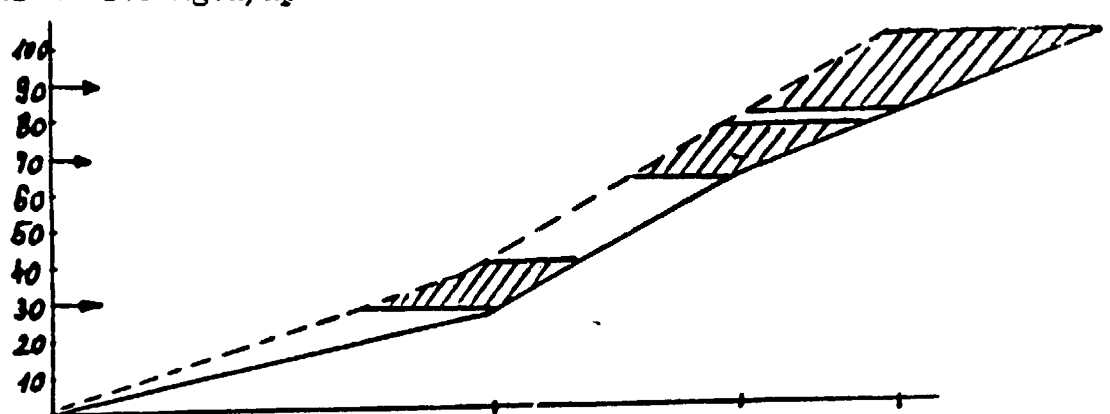
2.5.4. Chemical influences and ultra violet effect

These requirements apply to fibrous substances. Should geotextiles get in touch with concrete, lime or cement, they should be alkali-proof. Ultra violet light deteriorates the quality of geotextiles in the case of polyolefine fibres. Experiences have proved that nonwoven geotextiles made of man-made fibres can be applied without risks.
Technical parameters influencing application in relation to surface density.

Remark:
The following parameters refer to the Hungarian Teofil-geotextile listed in the table as well.

Weight g/m2	25o	4oo	5oo
tensile strength kp TMI grab test /longwise/	min 3o	min 7o	min 9o

tensile strength/kp .

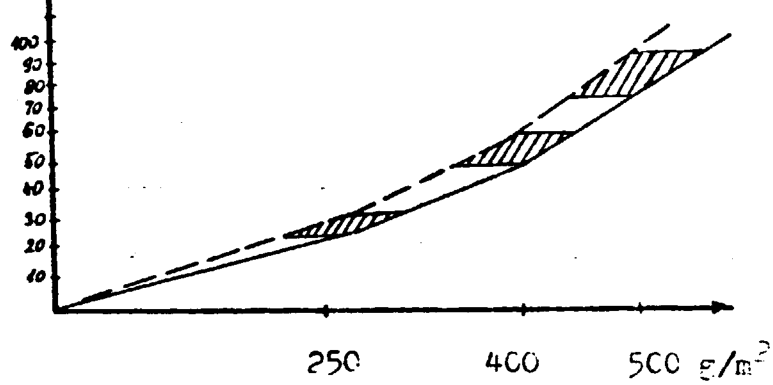


minimum - lengthwise
maximum - lengthwise

Tensile strength:

weight g/m2	25o	4oo	5oo
/THI Grab Test/			
transversal	min. 25	min. 5o	min. 7o

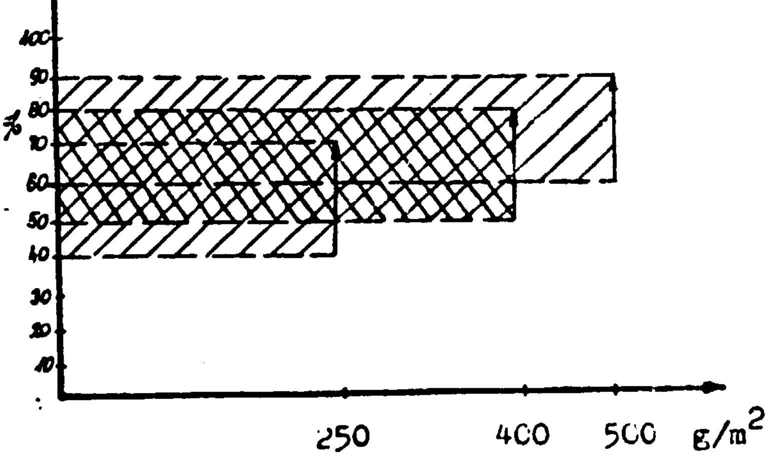
tensile strength/kp



min - transversal
max - transversal

Elongation at break, %	TERF g/m2	4oo	5oo
lengthwise	4o-7o	5o-8o	6o-9o
transversal	7o-11o	7o-11o	7o-11o

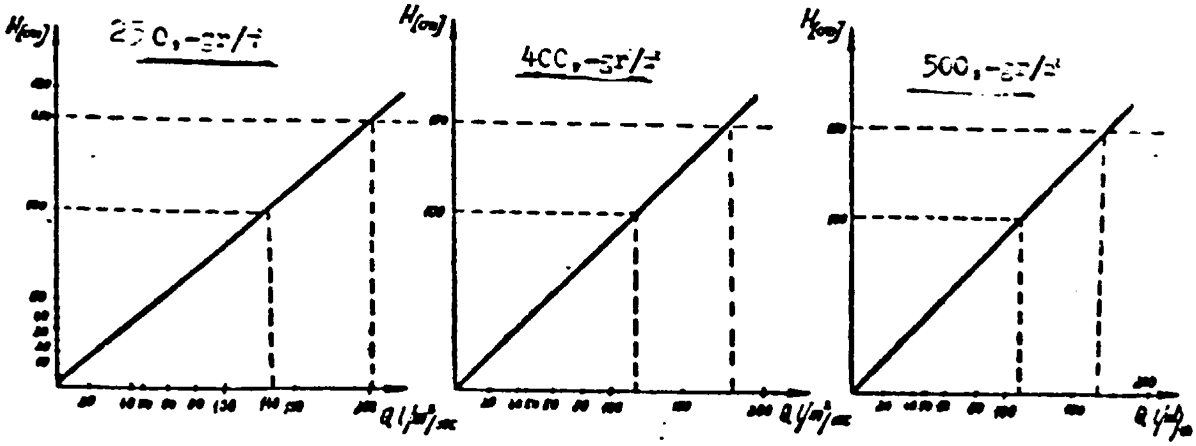
elongation at break, %



lengthwise

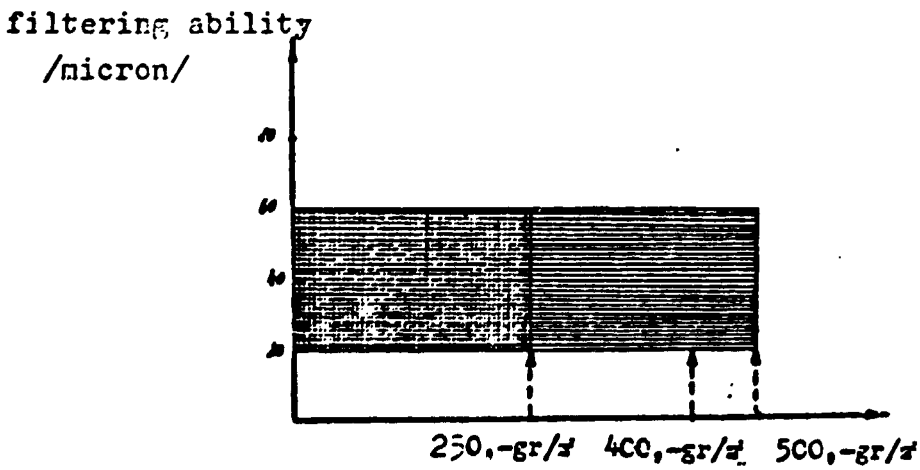
Remark: tarnsversally at all the three: 7o-11o %

Water permeability:



Filtering ability:

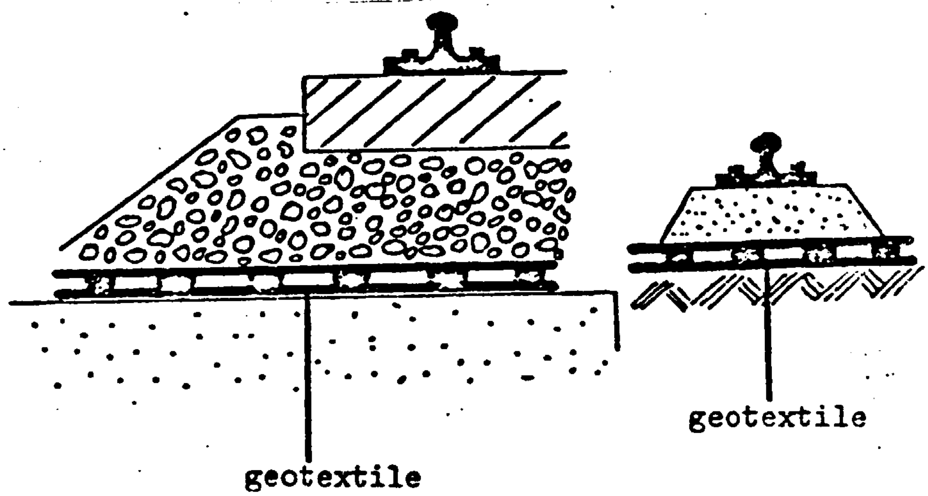
Filtering ability:	250,-gr/m²	400,-gr/m²	500,-gr/m²
/micron/	20 - 60	20 - 60	20 - 60

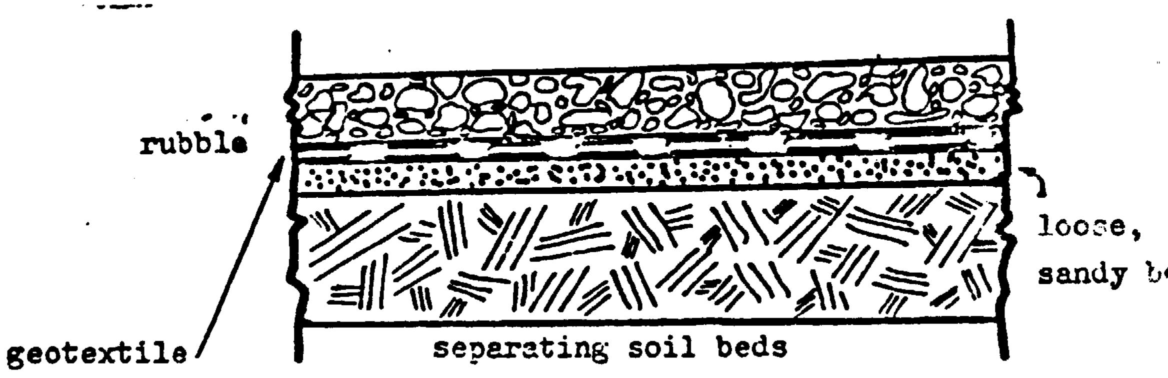


3. FIELDS OF APPLICATION AND FUNCTION OF GEOTEXTILES

3.1. As separating layer

By the help of geotextiles different soil beds and layers of different structural properties can be separated permanently and their mixing with each other can be avoided. By separating the supporting bed from the base - e.g. in the case of road construction - the mixing of the beds can be prevented and the supporting ability can also be increased. Nonwoven geotextiles can be put between the bank level and the freeze preventing layer as well. The separating effect is of special importance in the caso of fine soil or sand, on top of which rough material /stone, broken stone or rubble/ will be laid as for example when construction roads or railways. Without the geotextiles, due to the dynamic a periodical traffic load rubble would penetrate into the sand and vica versa, fine soil would get into the stone and rubble layer.


geotextile
geotextile

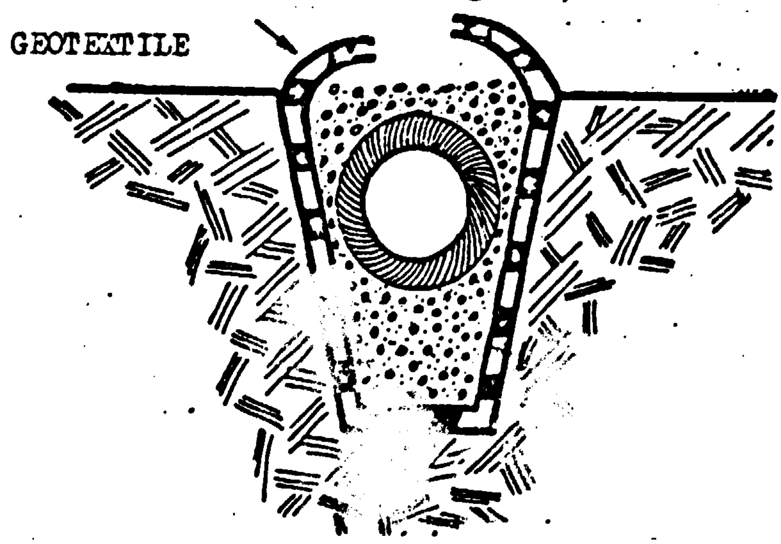

rubble
loose,
sandy be
geotextile
separating soil beds

3.2. Filtering function

a/ Two properties of geotextiles ensure on one hand the mechanic filtering stability, which is the pre-condition high soil retentivity and on the other hand the water permeability, which makes possible draining off the water. By the help of geotextiles erosion can be prevented in water projects, caused often by water movement depending on ebb and flow, the current of water or breaking of the waves.

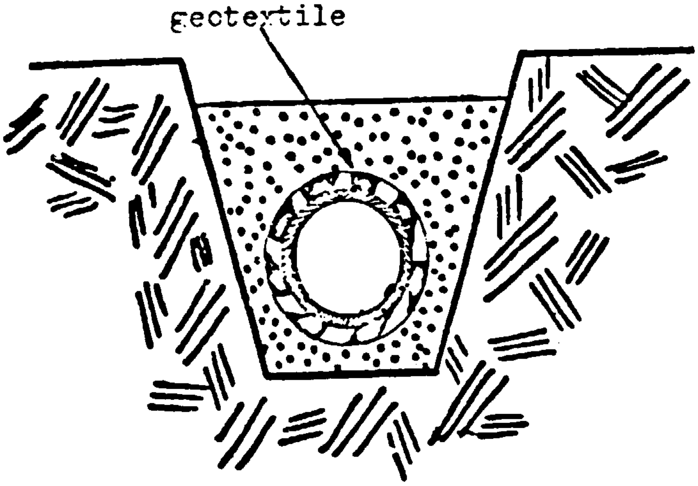
b/ When draining of soil the aim is to drain off water from flood areas and other areas with high soil water at a regulated level. Earlier a rubble filtering layer changing alternatively with the size of the parts was built around the drainage with enormous costs. By using geotextiles, resp. perforated plastic pipe - which today come more and more to the fore - water can be drained off without letting the pipe get muddy from the fine soil parts. A very interesting and important point of view is the changing of water permeability in the long run, i.e. due to water filtering - containing also mud and clay - to what extent the water permeability of geotextiles change. At the beginning of filtering the water permeability of geotextiles falls back, until the so-called filtering lobe is formulated/it is also called reverse filtering layer/.

Several tests proved that soil parts of greater diameter than that of the whole between the fibres, are caught on the surface of the geotextile while the smaller ones penetrate into the geotextile, where they can beoome struck or can go throug it in a very small per cent, this ensuring the so-called "whole formation".
The so-called formulated reserve filteing layer ensures the safe function of the filter, preventing the possibility of getting plugged. Geotextils function as catalyzer and enable the formation of a self-filter on the penetration side of the material. Besides this field of application, geotextiles play an important part also in construction dams and suporting bank. Oldest and most natural way of embankment support is to place plants on the embankment. The roots function here as armings, which taking up the pulling tension, increase the inside friction, this formulating a cohesion force which keeps together the embankment against the surface water. Geotextiles promote this solution as well, they drain off surface and leaking water without damageing the earth together with the plants/grass, bushes etc./.



Drainage

The use of geotextiles as
layer to draining pipes

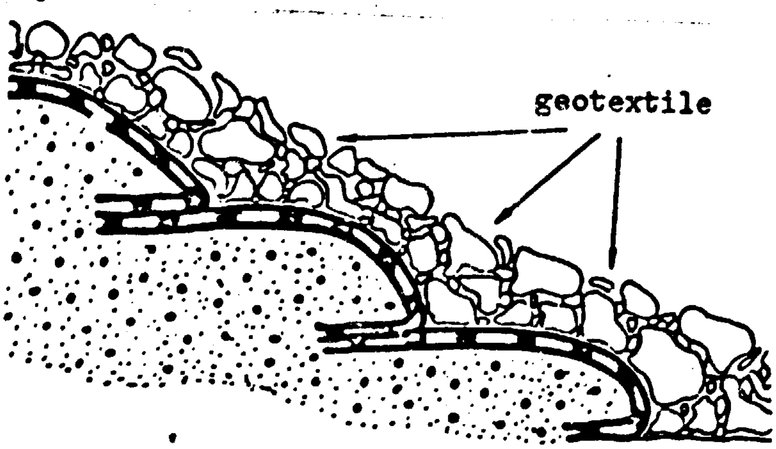


drainage

3.3. Geotextiles as intermediary layers

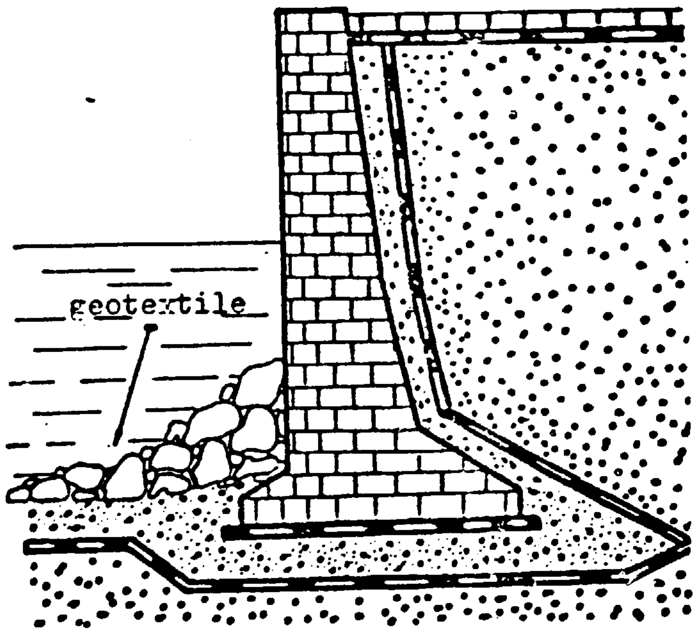
The property of geotextiles is very important that the operative force is periodical, point-like static, prependiculat or diagonal. By distributing the force or load the stability of railway banks or embankments can be impr
By decreasing the pressing force loads at certain points, breaking of the soil can also be prevented. The modulus of certain textiles, i.e. in spite of the most severe load the elongation remains very low, and this is the property which is required in this field of application/taking over of pulling forces due to the structure/.

Thus geotextiles are suitable for application at building works, constructing roads, in a way that geotextiles are laid directly into the ground, then a thin layer of gravel or rubble/25-3o cm/ comes on it.
By this solution a very expensive and strong grounding can be saved. Similarly, farming roads with low traffic in agriculture or sylviculture can be built, and they mean a reasonable solution for years.



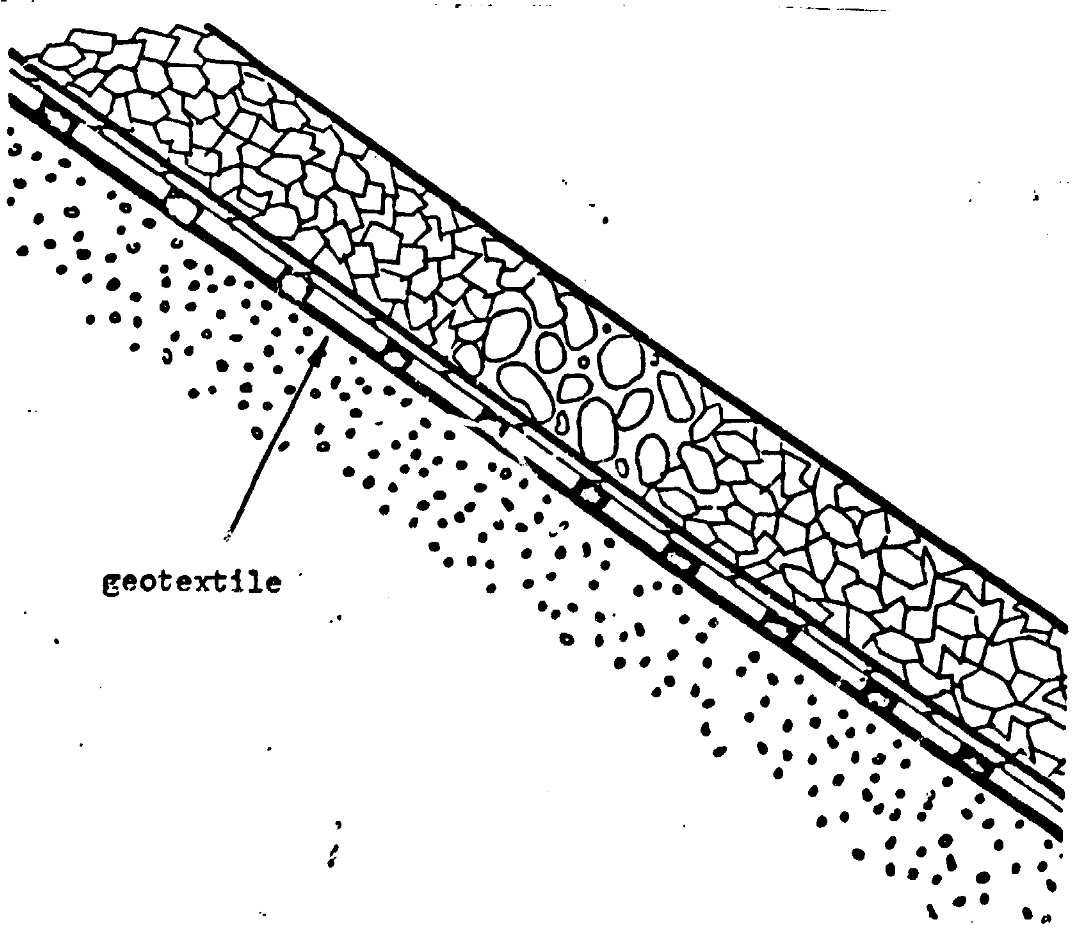
The application of geotextiles

as intermediary layer

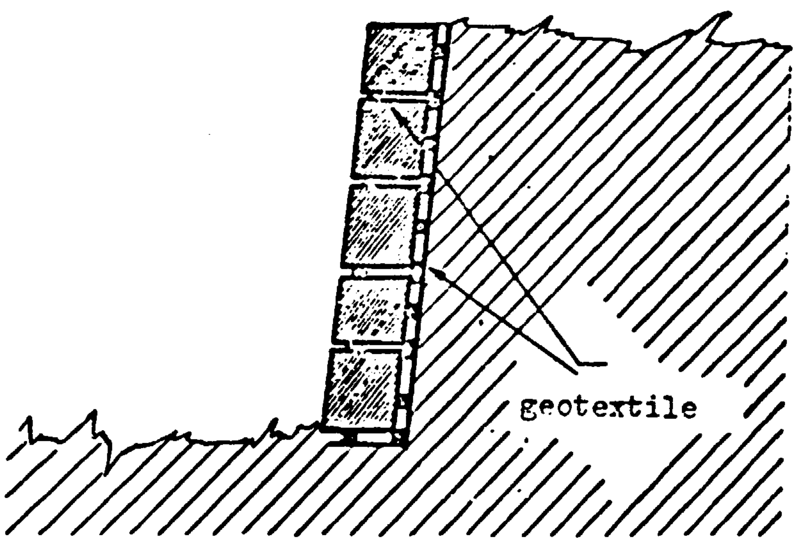


3.4. Geotextiles as protective layers

By the help of geotextiles materials can be protected, which on direct surface contact with mechanic forces sustain injuries. The task of geotextiles in cases laki this is to prevent the taking over of frictin force by the building materials to be protected.
Usage: to prevent injuries caused by sharp stones to structural units in the soil as supporting walls, cellar walls, tunnels etc. Geotextiles can also be applied when building flat roofs or balconies, because on one hand they protect the insulating from the sharp structural units and on the other hand the pressure from pointlike loads will be distributed on a larger surface.



Geotextiles as protective layers



4. POSSIBILITIES FOR THE FURTHER DEVELOPMENT OF GEOTEXTILES

As we have already explained in the introduction the technical level of the present manufacturing line is not suitable, its capacity does not meet the requirement of processing the available man-made fibre wastes at high efficiency. Taking into consideration that in Shanghai over the quantity of 1.5oo t/year collected by SRRUC there is a further amount of 3.2oo t/year fibre waste, in the long run the present low level of recovery will not meet the requirements.
Thus it is advisable to think over the possibility of erecting an up-to-date geotextile manufacturing line complying with all the present technical requirements.

The technological line would be like this:

miscellaneous synthetic fibre waste

↓

selection

↓

cutting, tearing, baling

↓

opening the bales, bedding, willowing, carding

↓

needle-felting

↓

heat-treatment, finishing

↓

weighing, packing

Characteristics of the production

The raw material:

quality:	miscellaneuos synthetic fibre waste /polypropylene, polyamyd, polyester/
fineness:	8-12 dtex
length:	6o-9o mm

The product:

surface:	4oo gr/m²
width:	4-6 m

Manufacturing line:

principal capacity:	576 kg/hour /1.44o m²/hour/
capacity in practice:	5oo kg/hour /1.25o m²/hour/
efficiency:	85-9o%
capacity:	3.ooo t/year /7.5oo.ooo m²/year/

Costs of the investment: 4,5 - 5,8 million US D

Rate of return of equipments: 1,8 year

Rate of return of the complete factory: 3 years.

5. FINAL CHAPTER

Our report does not comprise all the details but it was our endavour to describe tha manufacturing technology of geotextiles - nonwovens, their properties, requirements put forward against them and some of their fields of application.

Bearing in mind the objectives of SRRUC to recover the available wastes it was our aim to render assistance by describing a dynamically developing technology and product.

We think that the right decision was taken on the field of recovering synthetic fibre wastes as this coincides with the endeavour of UNIDO as well, i.e. to elaborate an alternative solution by the help of which the available wastes can be processed at a high technical level to high quality product.

List of annexes:

Annex No. 1.: Technological possibilities for processing textile wastes

Anney No.2.: Local information

References

Schneider Andor /Temaforg/
Description of products "TERFIL" /1978/

ANNEX NO.1.

Technological possibilities for processing textile wastes

Manufacturing technology of needle-felted wall-to-wall carpets /II.1.-II.4./

Manufacturing technology of needle-felted geotextiles /II.5./

Manufacturing technology of textile wall covers /II.6./

I. Description of needle-felted wall-to-wall carpet production process

The structure of the needle-felted carpet consists essentially of a mass of tightly compacted fibres in a layer of a thickness of 6 to 8 mm with a reinforcing base, fixed by means of a synthetic resin adhesive.

The specific density of the finished product ranges between 800 and 1800 g/m².

In the present case, production of wall-to-wall carpet of a specific density of 1500 g/m² is recommended.

I/1. Surface layer material

The surface layer called also used surface consists of fibres cut to a length lf 6o to 7o mm, produced of PP granulate by spinning.

Carpet yarn ends/synthetic/ sorted by colour, if available, can also be used to produce the surface layer after appropriate preparation.

I/2. Intermediate layer materials

The intermediate layer contains the available mixed waste/containing cotton lf 65%, polyester of 25%, and other materials of 10%/ in a ratio of

7o%, and cut natural PP fibres admixed with the Chinese product to facilitate processing in ratio of 3o%.

Specific density: 9oo g/m².

I/3. Bottom layer/base/ material

The base of the carpet is a woven fabric made of split polypropylene fibre.

Specocofoc density: 1oo g/m².

The weight of the fibres amount to about 85% within the total weight of the carpet, the rest resulting from the synthetic resin used for impregnation.

Synthetic resin adhesives of different types are used to stick the fibres together and to the reinforcing base. Styrene-butadiene and cross-linking acrylic resins in emulsion are used most frequently.

II. Production process of needle-felted wall-to-wall carpet

The processing system/for textile waste/ is suited for the production of the wall-to-wall carpet described above.

II/1.a/ Synthetic fibre production unit required for the production of the surfacr layer of the carpet as well as for geotextile production SFP.

Machine type: FE 1/... synthetic fibre production machine.

The machine has been designed for PP fibres of a fineness of 3.3 to loo dtex.

Machine output: 7o kg/h per spinning position.

The capacity of the machine can be gradually increased by adding additional spinning positions to it at any time, each added spinning position resulting in a capacity increase of 7o kg/h.

Machine specifications:

Fibre fineness:	11 dtex
Fibre length:	8o mm
Output:	7o kg/h per spinning position

II/1.b/ Preparation of fibre

Materials, collected, sorted and baled by colour, type, and quality, get into the bale store. From here, the bales containing materials of different quality each get to the feed tables/A/ from where they are delivered by means of manual rollers to the feed table of the cutting machine 1,2, type: 199.30/ in such a way that an appropriate blend of the different wastes will be obtained on the tables.

The cutting unit consists of 2 cutting machines arranged at right angles to each other in order to cut the textile waste to the required size in both transversal and longitudinal direction.

An electric metal detector/M/ is built into the roller feed table/A/ of the first cutting machine to stop the cutting machine when different metallic matters/zip-fasteners, snap fasteners etc./ are detected so that such metallic matters can be manually removed.

The cutting blades are arranged cantwise to the rotor of the cutting machine in order ot ensure best cutting effect by means of the fixed blades.

The cut material is then disintegrated in five steps into fibres of increasing fineness by means of a heavy-duty tearing machine/3/. The material gets into the machine by pneumatic exhaust. Pre-web containing fibres of still acceptable length is produced by the last stage of the tearing machine.

Parts of the tearing machine:

- Collecting unit/type 34/ with a driven material distributor at the inlet.
- Feed hopper equipped with ultrasonic inhibitor against overfilling.
- Fan /15 kW/ with sound-proof cover, and with air cooling.

- Tearing machine:
  A special feeder is provided for the feed belt of the first roller, by means of which the material can be spread into the machine. A special feeder is provided for each tearing unit. Pneumatic material delivery is used in the machine, delivering the material through a rotary perforating drum and a discharge roller. The fifth roller operates mechanically.

  The rate of feed can be continuously regulated in the range of 1 to 6 m/min.

The pre-web recovery unit /tearing machine/ is designed in such a way that the recovered pre-web can be drawn from the last roller directly.

The recovered pre-web is drawn pneumatically to the baling press.

The torn /disintegrated/ material is fed pneumatically into the continuous baling presses /4/ of type 28o/8oo.

- Baling press of type 28o/8oo /2 baling presses/
  The material delivered pneumatically from the tearing machine is pressed into bales of a size of 64o x 1loo mm.

  The fully-hydraulic baling press is suited for both continuous and intermittent operation as well as for baling natural and synthetic fibres.
  The baling press consists of the following parts:
  - frame
  - press
  - hydraulic system
  - electric control unit
  - feed tank.

The bales of textile waste are stored in the bale store from where they are fed to the fabric processing line in accordance with the process.

II/2. Fabric production for needle-felted carpet in general

Fundamentally, the quality of a nonwoven fabric is in best case the same as the quality of pile used for its production, which can be improved only slightly, or not at all, in the further phases of processing.

Therefore, the following parameters shall be optimized as early as in the first phases of the production process:

- blend
- degree of loosening
- longitudinal and transversal density
- fibre oriention in pile and in nonwoven fabric.

Considering the structure of the fabric for wall-to-wall carpet, the conditions and requirements have been taken into consideration in elaborating the offer for both the plant and production process.

Because of the difference of the available fibrous materials /one layer including colour cut fibres while the other waste in a ratio of 7o%/, an independent production line is recommended for the production of the surface layer called also used surface while another production line shall be used for production of the intermediate layer and bottom layer in combination.

II/2.1. <u>Production line and process for the surface layer</u>

Recommended materials:
polypropylene fibre of a count of 8 to 11 dtex produced of colour granulate by spinning, or cut, torn, baled synthetic carpet yarn, amounting to 1oo% of basic material.

II/2.1.1. <u>Preparation of fabric production</u> /surface layer/

The tightly compacted, baled fibrous material containing fibres of identical count and length shall be loosened to obtain soft, loosely connected flocks. Further operations of the preparation process /such as cleaning and blending/ are less important because of the fibrous material used, however, any defect within a bale, resulting from fibre production, shall be corrected, that means that the entire batch shall be homogenized so that no mechanical, physical, or coloureistic defects will occur in the finished product.

Use of the following machines is recommended for fibre preparation:

- <u>Bale opener</u> /BO -0202/ with feed table /pc.1/
  Capacity: 36oo kg/h.

Function: the unpacked bales shall be placed onto the feed table which delivers the bales to the bale opener.

The layers of material pressed together are loosened, and the bunches of a mass of 1 to 2 g are delivered pneumatically through a pipeline at a uniform rate into the mixmaster by the bale opener.

- Mixmaster /MMN-0306/ /pcs. 2/

Function: since the bale opener is a hogh-capacity machine which, owing to its function, is unsuited for the production of a homogeneous mass of fibres, it is necessary that a mixing machine be included in the production line to produce a uniform mass of fibres of the bales in the batch to be processed and, on the other hand, to serve as a buffer unit between the bale opener and fine opener.

Feed and discharge of the fibrous material take place volumetrically and continuously.

- Fine opener /FO-0205/ with built-in condenser and metal detector /pcs.2/

Function: fibrous material from the mixmaster is delivered pneumatically through pipeline into the fine opener.

The condenser serves to separate the material arriving in the pipeline.

The primary function of the condenser is separation of the material between openers and cleaners. A secondary function, but of similar importance, of the condenser is dust exhaust from the fibrous material, and collection of the exhausted dust in a filter system.

The condenser is built on the top of the fine opener and, in addition to the functions described above, it also serves to feed the fine opener.
As suggested also by its name, the fine opener serves to continue loosening of the fibres grpviously loosened by the bale opener and homogenized by the mixmaster.
Intake rollers and the opening roller serve for this purpose.

The unit also serves to separate metallic impurities possibly present in the fibrous material. The fibres are deliverd to the feeder of the fabric production line continuously.

The emulsion facilitating fabric production, containing in the present case anti-static agent because synthetic fibres are processed, shall be applied to the material while it is pneumatically forwarded.

Uniform application of the emulsion to the fibres is very important. The uniform distribution of the emulsion shall be ensured by spray apply.

II/2.1.2. Fabric production line /surface layer/
VF-, V-21/R, K-12, NL-9, C-127, C-131. Sh
/2 pcs of each/

a/ Feed
The fundamental requirement of uniform density of both the pile fabric and stitched nonwoven fabric in longitudinal and transversla direction can be met only if the pile fabric production line is fed at a most uniform rate. No instabilities in the rate of feed are permissible, and uniform distribution is required along full width.

Accordingly, uniform and continuous attendance is of particular importance.

Uniform feed can be accomplished by means of the feeder of type VG. Two feeders are provided for the production line.

According to experience, the VF system, ensuring uniform feed rate and high performance, eliminates short-time instabilities in mass density both longitudinally and transversally.

The bunches of fibres, loosened and blended by the preparation machinery, are uniformly distributed along full width, and delivered to the filling shaft and to the blending rollers through the intake rollers by the travelling consdenser supplied continuously by the fine opener /FO-2/.

The material is loosened, and delivered towards the lattice feeder by the blending roller. The lattice feeder in co-operation with jack rollers delivers the bunches into the swivel filling shaft where the maximum level is kept constant by an ultrasonic gate. A rocker plate in the system provides for the required amount of material by switching on and off the travelling separator. If the level of preset value in the filling shaft is reached, material feed of the preparation machinery will be automatically stopped.

The feed rate of material to be processed is controlled in the VF system. The rear wall of the swivel filling shaft, spring-loaded and rocked by a cam serves for this purpose. The feed rate can be adjusted in accordance with the bunch density.

b/ Pre-pile forming unit /V-21/R/ /pcs.2/
Pile coming from VF is delivered to the opening roller of the V-21/R unit by a device consisting of an intake roller and a trough-type table under it.
Flight of the fibres leaving the opening roller can be controlled by means of an adjustable quadrant located above the top cover of the roller.

The fibres leaving the opening roller get to a perforated belt conveyor with intake air acting upon it from below. The intake pipe can be regulated by means of a throttle. The belt conveyor can be infinitely regulated and it shall be adjusted in such a way that a pile fabric of a specific density of 300 to 600 g/m², depending on the type of the fibre, will be obtained. The pre-pile produced by the V-21/R unit is delivered to the carding unit of the production line by the perforated belt conveyor.

c/ <u>Carding and pile forming unit</u> /K-12/ /pcs. 2/

The intake unit of the equipment consists of two compacting rollers and a combined intake roller and trough-type table. Optimum compacting can be adjusted by means of a chain wheel at the end of the intake roller.

The carding machine consisting of a main drum and two rollers, one being the clearee while the other the working roller, is continuously supplied by the unit described above.

From the main roller, material is removed by a cross-flow blower, forming at the same time a pile fabric of the fibres, disintegrated into staple fibres, on the lattice feeder moving along the main drum, in co-operation with intake air under the conveyor.
The lattice belt conveyor can be infinitely regulated that means that the mass of the pile fabric cna be varied linearly as a function of the speed of the conveyor in the range of 2o to 2ooo g/m².

In the phase of pile forming, the surface mass can be determined also automatically by means of a radiometric measuring system/available optionally upon request/.

The pile fabric is forwarded continuously to the intake rollers of the pre-needle loom of type NL-9/S by means of air noozles.

d/ Pre-needle loom /NL-9/S/ /pcs.2/

A pre-pile fabrice of increasing fineness is produced gradually of the fibres arriving in bunches from the preparation process line /BO, MMN, FO-2/ by units VF and V-21/R while a three-dimensional pile fabric is produced aerodynamically by unit K-12.

Needle-felting is designed to harden this pile fabric by means of felting needles.

The needle-felting process includes three phases, such as

- feed of the pile fabric to the needle loom,
- needle-felting,
- drawing of the stitched nonwoven fabric.

The material passes through the production line continuously. The production line operates automatically from feed to the final phase when the stitched fabric is developing. Of course, the process takes place automatically also in the needle loom from the intake rollers to the discharge rollers.
Needle-felting is made by felting needles located in the needle bed of the needle loom. The needle bed moves up and down, the stroke being infinitely variable in the range of 35o to 12oo r.p.m.

The material is fixed by a baseplate when the needles penetrate into the pile fabrice. The baseplate is perforated in accordance with the arrangement of the needles in the bed, ensuring thus penetration of the needles while fixing at the same time the pile fabric. A smoothing plate is located between the needle bed and the pile fabric, similarly perforated and serving to remove fibres caught by the needles, ensuring thus a perfectly smooth pile fabric. The process where needle-felting takes place at right angles to the plane of the pile fabric is advantageous in that it is simple, and thus the service life of the machine is relatively long, and also fine needles can be used for needle-felting.

In the needle-felting process, the material is forwarded continuously by a pair of discharge rollers at infinitely variable speed.

e/ The next step after needle-felting is to cut off uneven edges by means of the longitudinal cutter /C-127/ operating continuously, and supplying at the same time the edge trim opener /RWO/. By this machine, the cut edges are opened and returned pneumatically to the feeder of VF, ensuring thus that the production waste is minimum.

The fabric gets then through the transversla cutter /C 131/ to the rising roll batch winder /SH/.

f/ The winder /SH/ is capable of producing rolls of a fabric length of about 2oo m assuming a specific density of 4oo g/m² of the surface layer of the wall-to-wall carpet.

g/ A counter is built into the cross cutter /C-131/, ensuring that the length of the fabric in the roll is cut to accurate size without the continuous production process being stopped.

The process described above results in production of the surface layer, or used surface, of the wall-to-wall carpet.

The process and production line specifications:

Specocfoc density of fabric:	4oo g/m²
Production rate:	5 m/min
Fabric width:	4 m
Rated output:	48o kg/h
	122o m²/h
Efficiency:	85%
Actual output:	1o2o m²/h
	4o8 kg/h

II/2.2. Intermediate layer production line and process

Fibres to be used:

70% of Chinese blend including:
- 65% of cotton
- 25% of synthetic fibre
- 1o% of other waste

30% of fibre of a count of 8 to 11 dtex, produced of natural polypropylene granulate by spinning, cut to a length of 6o to 7o mm, or, possibly cut and torn synthetic textile waste.

Note: Fundamentally, the production line for production of the surface layer or used layer is suited also for production of the intermediate layer with, however, some modifications being necessitated by the material to be processed. In description of the production process of the intermediate layer, only the differences are described so as not to repeat ourselves.

II/2.2.1. Preparation of fabric production /intermediate oayer/

In processing the waste, the fact that the material contains foreign matters and impurities such as dirt, metallic matters, sand, etc. in a significant amount in addition to the fibres, valuable in respect of textile production, shall be taken into consideration. Foreign matters and impurities shall be completely removed before the pile fabric is formed, taking care not to damage the fibres while separating the impurities.

The CLEAN-STAR SYSTEM mechanical clean master /CMA/ serves for this purpose, the operation of which is automatically coordinated with the preparation system already described in case of surface layer production.

II/2.2.2. Fabric production line /intermediate layer/

A unit /J/ is built into the production line between the needle loom/NL-9/ and the longitudinal cutter, serving to unwidn the roll of fabric woven of split PP fibre which forms the bottom layer.
The pile fabric produced by the production line for the intermediate layer shall be needle-felted onto this cloth passed through the needle loom.

Completed in this way, the production line serves to produce the intermediate and bottom layer of the wall-to-wall carpet in combination.

II/2.2.3. Fabric production line capacity figures /intermediate layer/

Most important parameters of fabric production, output of production line:

Production rate:	4.5 m/min
Specific density:	9oo g/m²
Fabric width:	4 m
Rated output:	1o9o m²/h
	973 kg/h
Efficiency:	8o%
Stitching speed:	7oo
Actual output:	972 m²/h
	778 kg/h
Stitch spacing:	

II/3. Final needle-felting /double needle-felting/

The NL 12 final needle loom is suited for mechanical hardening of the three layers of the wall-to-wall carpet in vombination.

In principle, the final needle loom operates in the same way as the NL-9/S needle loom described for fabric production. In practice, a difference lies in that two needle beds are provided for the final needle loom that is the number of needles per metre is 65oo and, on the other hand, the basic material for the machine is the fabric including the bottom, intermediate, and surface layer coming from unwinder AR, which is then cut to a width of 2 m by means of longitudinal cutter C-127 for further processing. The finished fabric is wound by rising roll batch winder SH.

The final needle loom is suited to integrate the layers produced by both production lines at a needle-felting speed .

II/3.1. Output figures of needle-felted wall-to-wall carpet production

Specific density:	15oo g/m²
Fabric width:	4 m
Rated output:	981 m²/h
	1472 kg/h
Efficiency:	8o%
Actual output:	785 m²/h
	1178 kg/h

Assuming 6ooo working hours, the plant described above is suited for the production of 4 71o ooo m² or 7 o68 ooo kg of wall-to-wall carpet annually.

II/4. Finishing /impregnation, heat fixation/

Chemical and mechanical finishing after needle-feling is a dual-purpose porcess:
first, to prevent the layers from separating in the course of normal use and, on the other hand, to protect the edges of the carpet formed in confectioning from becoming undone of fringed.

The needle-felted fabric enters in rolls the impregnating and heat treatment unit/HTP/ located reasonably in an independent shop.

In the course of impregnation, the fabric gets from the inwinder through a latex bath to the press rollers where, applying mechanical compression to the fabric, excess emulsion is removed. The needle-felted carpet is dried at a temperature of 14o to 16o °C, the required heat being produced by stem of a pressure of 1o to 13 atm. The drier is a so called drying drum where drying takes place as a result of hot air circulation.

From the drier, the fabric gets to the longitudinal and transversla cutter where uneven edges of the carpet are cut off, and the fabric is cut to the required roll length.

The finishing unit is suited for finishing the amounf of wall-to-wall carpet produced by the fabric production line and integrated by the final needle-feltin unit. /Alternatively, blow-drying and foamed latex coat can be used./

II/5. Geotextile production /alternatively/

With some modification, the wall-to-wall carpet production line is suited also for geotextile production. These modifications allow of a more economic and practicable production of the product within one process.
In practice, this means that the basic material for the product is produced by one production system from synthetic fibre production to the finished product.

II/5.1. Difference as compared with the carpet production line

A buffer tank /mixmaster of type MMN-0306/ shall be built inbetween the synthetic fibre production line and the bale opener/BO-0202/

to ensure continuous fibre production as the fibre preparation system of the fabric production line operates intermittently.

In case the fabric production line is stopped for any reasin, continuous fibre production is ensured by the continuous baling press.

Of course, aldo the fibre production unit may break down or be stopped. In this case, the fabric production system shall be supplied with material from the baled product in the way described for wall-to-wall carpet production.

Since 100% of the basic material of the product cinsist of fibres of a count of 1 to 11 dtex, cut to a length of 60 to 70 mm, and produced of natural PP granulate by spinning, it is possible to build the NL-12 final needle-felting unit and the FLEISNER thermo-fusion heat treatment unit inbetween the NL-9/S pre-needle loom and the longitudinal cutter in order to ensure the required strength of the product. In this case, a buffer tank shall be used between NL-12 and the heat treatment unit to ensure continuous heat treatment and thus avoiding unevenness as a result of intermittent heat treatment/namely, shrinkage may take place in the fabric at the place where it was stopped and exposed thus to heat for a longer period in case of intermittent heat treatment/.

II!5.2. Fabric/geotextile/ production line capacity figures

Specific density:	4oo g/m
Fabric width:	4 m
Production rate:	6 m/min
Rated output:	576 kg/h
	144o m²/h
Efficiency:	85 to 9o %
Actual poutput:	5oo kg/h
	é25o m²/h

Assuming 6ooo working hours, the production line is suited for production of

3 ooo ooo kg

or

7 5oo ooo m²

geotextile annually.

II/6. Needle-felted and sewn-knit wall textile production process /alternatively/

Development towards increased comfort in dwelling units requires that textile be used instead of paper to cover walls. Nonwaven products developed as an advanced version of floor covering represent a significant ratio among these materials.

Similarly to wall-to-wall carpet, wall textile ensures efficient sound apsorption and heat insulation.

The field of application of wall-to-wall carpets and wall textiles is identical. The nonwoven fabric production system described for wall-to-wall carpet production is, after certain modifications necessitated by the requirements imposed upont he product to be produce, suited also for the production of wall textile.

<u>Machinery and process of wall textile production:</u>

II/6.1. Sorting of available waste by bolour and quality:

<u>Note:</u> Sorting by colour is of decisive importance because of the decorative function of the product. Concerning quality of the waste, viscose, acryl, wool, and to a reduced ratio, synthetic fibres shall be used.

II/6.2. Fibre recovery

Torn product as produced by the cutting machine of type 199.3o/1,2/ and the tearing machine/3./.

II/6.3. Fibre preparation

The torn material is prepared in the way described for carpet production, using the same preparation system.

II/6.4. Pile and pre-needle-felted fabric production

The production line include the following untis: VF, V-21/R, K-12, NL-9, C-127, C-131, SH.

Specifications /capacity figures of fabric production line, fabric characteristics/:

Specific density:	3oo g/m²
Production rate:	9 m/min
Fabric width:	2.2 m
Rated output:	1188 m²/h
	356.4 kg/h
Efficiency:	8o%
Actual output:	95o m²/h
	258 kg/h
Stitched speed:	
Stitch spacing:	

II/6.5. <u>Sewing-knitting</u>

Machine type: Malywatt /SKP/

<u>Process:</u>
Hardening of the loosely pre-needle-felted fabric produced by the production line described for wall-to-wall carpet production, then knitting of the fabric by means of infinite fibre of different quality such as e.g. ciscose, polyester, polyamide filament

of a count lf 12o to 16o dtex, using tricot stitch techniques of warp knitting.

<u>Operation of Malywatt sewing-knitting machine:</u>

The fabric, pre-needle-felted by the needle loom and wound in a length of about 1oo m shall be introduced downward from the unwinder inbetween the sewing-knitting tools. Like in case of up-to-date automatic warp looms, here also slide neeles with lock wire are used for looping.

Like in case of warp knitting, the sewing yarn is guided in the guide needles built into the needle bed. The loop forming elements in cast lead blocks of a width of 25mm, screwed on fillets, are moved by eccetric straps by means of drawbars.

By means of the eccentric straps, tricot stitch or fringe stitch can be used and thus a fabric of different properties can be obtained.

When fringe stitch is used, the sewing yarns are processed in isolation like in case of warp knitting, meshing thus the fibres of the pre-needle-felted fabric. In this way, the longitudinal strength of the sewn-knit fabric increases considerably.

However, no appreciable increase occurs in transversal strength. Since the tensile strength in longitudinal direction of the fabric is higher also in case of needle-felted fabric /by 2o to 4o% higher as compared with transversal tensile strength/, therefore the use of tricot stitch is more practicable.

In case of tricot stitch, the sewing yarn led to the next loop rod after a loop has been formed so that a new loop can be formed.

Each yarn forms a loop at two adjacent rods in alternating succession. Due to the cross tie brought about by the sewing yarn, the strength of the fabric will be sufficient also transversally. This strenght can be considerably improved by the use of a properly selected sewing yarn.

In order to facilitate productibility and to increase the efficiency, the use of filaments in the fineness range lf 12o to 14o dtex is recommended.

After eych looping cycel, the sewn-knit product is forwarded over a distance identical with the stitch length by the friction roller. The fabric is then wound by the winder of the machine.

Rolls containing fabric of a length lf 2oo m shall reasonably be produced because the fabric is subjected to finishing in the impregnation unit.

Uneven edges shall reasonably be cut off by means of the edge cuttin blades of the machine The cuttings can then be processed in the edge tearing machines and recycled into the production process.

Capacity figures of Malywatt sewing-knitting machine, sewn-knit fabric specifications:

Fabric width:	2.2 m
Mesh density:	1o needles/25 mm
Stich density:	3o stitches/1o cm
Stitch length:	o.33 mm
Crankshaft speed:	1ooo r.p.m.

Production rate:	3.2 m/min
Rated output:	422.4 m²/h
	126.7 kg/h
Efficiency:	75%
Actual cutput:	95.o4 kg/h
	316.8 m²/h

Sewing yarn: polyester or polyamide silk filament of a count of 12o to 16o dtex

Note: 3 Malywatt machines are required for sewing-knitting of thefabric produced at a rate of 95o m²/h by the needle-felting line.

Assuming 6ooo working hours, the machinery for nonwoven wall textile production is suited for production of 5 7o2 4oo m² or 1 71o 72o kg of wall textile annually.

II/6.6. Finishing

Finishing is similar to the process and plant described in part II/4. a difference lying only in the quality and quantity of the chemical used. Recommonded chemical: soft adryl latex applied in an amount of about 3o g/m²/1o% of finished product./.

ANNEX NO. 2.

The information on Textile Wastes of SRRUC

Referring to the request for textile wastes given by Hungarian experts some relatively important data are provided as follows.

1. The annual rate of textile wastes produced in Shanghai is about 2o.ooo t/year.

2. The annual rate of textile wastes per type:

cotton:	1.ooo t/year
wool:	2oo t/year
polypropilen:	2oo t/year
polyamide:	1.ooo t/year
polyester:	3.ooo t/year
other textile wastes:	1.5oo t/year

3. The annual rate of textile wastes collected by SRRUC is about 9.ooo t/year.

4. The annual rate of textile wastes collected by SRRUC per type:

cotton:	1.ooo t/year
wool:	3o t/year
polypropilene:	1oo t/year
polyamide:	4oo t/year
polyester:	1.ooo t/year
other textile wastes:	6.5oo t/year

5. The annual rate of textile wastes collected by SRRUC per origin:
The wastes produced in spinning mill air about 1.5oo t/year.

The wastes produced in confection are about 3.5oo t/year.
The other textile wastes are about 3.5oo t/year.

6. The collecting system and utilizing methods for the textile wastes can be discribed as follows:

There are 12 urban distric companies,10 rural county companies and one comprehensive business department,which are subordinated to the main company SRRUC.Each brach company or department has several own purchasing stations,one of their collected materials is the textile wastes from habitants. In addition,each urban distric company has his own supplying station /there are five supplying stations and three special business units/,special for collecting textile wastes from industry.
All kinds of textile wastes collected from habitants are selected by certain purchasing stations according to their propertres and colors and baled by them using hands and baling press.The bales have been transported to the corresponding supplying stations, where there are several store houses big or small. Usually each supplying station has his own co-operative processing workshop,which has also some warehouses there.All of these warehouses are separately run by each supplying station where they have stored the textile wastes in both bags and bales.
Eventually most of the textile wastes in Shanghai have been utilized at present time.But some used and inoperable synthetic textile haven't been utilized efficiently since burning them as fuel.
The usages of some important textile wastes can be as follows:

large pieces of confection - for making small daily use articls

small pieces of confection - for opening according to the colors /1.5oo t/year/

long pieces of confection - for making floor-cleaning mops /3oo t/year/

The synthetic fibre wastes are provided for some processing factories as raw materials,the usages are follows:

polyester - for making thread,non-wovens,lowgrade artifical silk fabrics and knitwear

polyamide - for making thread,rope low-grade artifical silk fabrics and knitwear

The quantity of collected textile wastes in 1990 will increase by one-half of this based on the annual growth rate of ten per cent,i.e. about 3o.ooo t/year.

PART V.

STUDY MISSION OF THE SRRUC EXPERT'S DELEGATION IN HUNGARY

4th July - 31st July, 1986

PROTOCOL AND PROGRAM

P R O T O C O L

of the study mission of the Chinese
experts` delegation in Budapest
/4th July - 31st July, 1986/

1. On the basis of the UNIDO Project No. SI/CPR/85/803 on resource recovery and utilization of wastes in metallurgical and other industries, the Chinese experts` delegation lead by Zhu Ke Xi arrived in Budapest on July 4, 1986. The study tour of the experts` team lasted from the date of their arrival till July 31, 1986.

The Hungarian party put the Draft study programmes at the Chinese party's disposal as it was agreed on in advance with UNIDO representatives.

The programme was then finalized by the Hungarian party with the consent of the Chinese party regarding especially the tasks and subjects requested by them at the time of the visit of the Hungarian party to Shanghai.

The programme of the team was scheduled as follows:

- general introduction of the Hungarian scrap collecting/preparing systems and organizations
- special on-the-job training, visit to several Hungarian specialized enterprises, units /aluminium, copper, ferrite, textile/
- exchange of experience, consultations.

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The programme in details is annexed to the present Protocol.

The visit and the study tour of the Chinese experts' delegation is completed this day according to Annex E/c point of the above mentioned Contract.

2. The Chinese party states that the Hungarian party executed its contractual obligations regarding the study tour of the Chinese team in Hungary.

The Chinese party states that all the 4 subjects of the Contract are equally considered important and none of them enjoys priority.

The Chinese party does not consider the subject to be finished by collation and finalization of the Final Report but intends to continue the cooperation. Proposals in this respect are expected as soon as possible in order that it be one of the subjects of the tripartite negotiations due in autumn.

3. Both parties agree that the Working Programme of the Contract should be revised as follows:

a/ Draft Final Report is to be elaborated and submitted by September 25, 1986

b/ Tripartite negotiations in Shanghai must be held until November 20, 1986

c/ Final Report is to be submitted by December 15, 1986.

The Hungarian party appreciates the cooperativeness of the Chinese experts that contributed to a large extent to the execution of the study tour's working programme.

Budapest, 30th July, 1986

TESCO CONSULTING ENG. | S R R U C

M. Horváth	P. Narancsik	Zhu Ke Xi
Director	Project Manager	Deputy Manager

PROGRAMME

04th July, 1986	16.50	- arrival to Budapest International Airport
	19.00	- accommodation in Székesfehérvár
	20.00	- dinner
05th July,	8.30	- leaving for Agárd
	19.00	- arrival back to Székesfehérvár
06th July,	8.30	- leaving for ake Balaton sight-seeing tour
	19.00	- dinner
	22.00	- arrival back to Székesfehérvár
07th July,	10.30	- leaving for Electronics Factory VIDEOTON in Székesfehérvár
	11.00	- visit in the factory, film-show, visit in the magnetic materials production plant
	14.00	- lunch
	15.00	- preliminary programme consultation
	19.00	- dinner
08th July,	8.30	- leaving for Budapest
	10.00	- welcome meeting in the headquarter of TESCO with the participation of all concerned representatives introduction, finalization of the programme
	13.00	- lunch
	15.00	- travel back to Székesfehérvár
	19.00	- dinner

09th July,	9.30-	leaving for KÖFÉM in Székesfehérvár
	10.00-	visit in KÖFÉM Metall Processing Plant
	12.00-	lunch
	13.00-	visit in the Heavy Metals Foundry Plant
	19.30-	dinner
10th July,	8.30-	leaving for Budapest
	10.00-	visit in VASKUT, Iron and Steel Research Company in Budapest
	13.00-	lunch
	14.00-	continuation of the visit, consultation
	19.30-	dinner in Székesfehérvár
11th July,	8.30-	leaving for Budapest
	10.00-	visit in the headquarter of METALLO-GLOBUS, Metall Waste Recycling Company
	13.00-	lunch
	15.00-	visit in UVATERV, introduction of the fields of activity and profile of the Company
	19.30-	dinner in Székesfehérvár
12th July,	18.00-	leaving for Budapest
	10.00-	trip to the Danube-band by ship
	13.00-	lunch in Szentendre
	15.00-	continuation of the sight-seeing tour
	20.00-	dinner
13th July,	8.00-	leaving for Budapest
	10.00-	sight-seeing tour in Budapest by bus
	14.00-	lunch
	16.00-	cultural programme in the City Park of Budapest
	20.00-	dinner

14th July, **ON-THE-JOB TRAINING'S WEEK** starts

8.00- leaving for Budapest
10.00- distribution of the delegation to working groups

A/ aluminium waste recycling
B/ copper waste recycling
C/ iron residue/waste recycling into magnetic materials
D/ textile waste recycling

The detailed programme of the working groups will be distributed during this meeting.

18th July, **ON-THE-JOB TRAINING'S WEEK** comes to end

19th July,
8.00 - breakfast in the hotel in Budapest
9.00 - shopping and leasure time in Budapest
19.00 - dinner

20th July,
9.00 - breakfast in the hotel
10.00 - excursion in the areas of recreation around the hills of Budapest
19.00 - dinner

21st July,
8.00 - breakfast in the hotel
9.00 - leaving for MÉH, Waste Materials Recycling Company
10.00 - visit in the headquarter and the waste recycling plants of MÉH.
13.00 - lunch
14.00 - continuation of the programme
19.00 - lunch

22nd July,	8.00	- breakfast in the hotel
	9.00	- leaving for KOKÖV Metallurgical Materials and Wastes Collecting and Recycling Company
	10.00	- visit in KOKÖV
	13.00	- lunch
	14.00	- continuation of the visit
	19.00	- dinner
23rd July,	8.00	- breakfast in the hotel
	9.00	- visit in MÉH-Tröszt reception of the delegation by the Director General exchange of information on wastes recovery
	13.00	- lunch
	14.00	- continuation of the visit
	19.00	- dinner
24th July,	8.00	- breakfast in the hotel
	9.00	- visit of the Recycling Plant of MÉH in Győr
	13.00	- lunch
	14.00	- continuation of the visit
	19.00	- dinner
25th July,	8.00	- breakfast in the hotel
	9.00	- visit in MOFÉM's /Mosonmagyaróvár Metall Works/, study of recycling of copper wastes and manufacturing of water pipe armatures thereof.
	13.00	- lunch
	14.00	- consultations on induction melting technology
	19.00	- dinner

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26th July,		
27th July,	8.00	- breakfast in the hotel
	9.00	- sight-seeing, cultural programme
	12.00	- lunch
	14.00	- leisure time
	19.00	- dinner
	10.00-18.00	visit in the museums, Zoo-park
	19.00	- dinner
28th July,	8.00	- breakfast in the hotel
	9.00	- visit of the aluminium processing factory of MÉH in Gyöngyös
	13.00	- lunch
	14.00	- continuation of the visit
	19.00	- dinner
29th July,	8.00	- breakfast in the hotel
	9.00	- visit of CSEPEL Metall Processing Works /strip, tube, bar manufacturing out of metall wastes/
	13.00	- lunch
	14.00	- consultation on pirometallurgy
	19.00	- dinner

30th July,	8.00 -	breakfast
	9.00 -	consultations, discussion on the four subjects, on the experience collected, finalization of the report on findings drawing up of the protocol
	13.00 -	lunch
	16.00 -	reception held at the Central Office of TESCO, signing ceremony of the Protocol the delegation received by I. Székács Director General of TESCO, co-president of the Chinese-Hungarian Technical and Scientific Cooperation Joint Committee
31st July,	5.30 -	departure for the Airport
	7.00 -	leave

On-the job Training Programme

o f

the Copper and Aluminium Team

/14th-18th July, 1986/

14th July	10.00	- Visit in METALLOCHEMIA Factory
	14.00	- Lunch
	16.00	- Departure to Salgótarján
15th July	8.00	- Breakfast
	9.30	- Visit to QUALITAT Factory, Apc
	13.00	- Lunch
	14.00	- Consultations
	15.30	- Back to Salgótarján
16th July	8.00	- Breakfast
	9.30	- Visit to QUALITAT Factory, Apc
	13.00	- Lunch
	14.00	- Consultations
	15.30	- Back to Salgótarján
17th July	10.00	- Visit to VASKUT Experimental Plant /study of copper and aluminium castings/
	14.30	- lunch
	15.30	- excursion to Hollókő /old village, museum/
18th July	8.30	- Breakfast
	9.00	- Departure to Budapest
	12.00	- Lunch
	14.00	- Continuation of the consultation and discussion with the representative of UNIDO / E. Balázs/ in TESCO Office

On-the-job Training Programme

of

the Magnetic Materials Team

/ 14-18 July 1986. /

14th July	10,00	Visit in VIDEOTON Ferrite Factory
	13,00	Lunch
	15,00	Departure to Budapest
15th July	08,00	Breakfast in the Hotel
	10,00	Visit in VASKUT - Iron and Steel Research and Development Company
	13,00	Lunch
	14,00	Consultation
16th July	08,00	Breakfast in the Hotel
	10,00	Visit in LÖVAC - Magnetic Materials Co.
	14,00	Lunch
	15,00	Consultation
17th July	08,00	Breakfast in the Hotel
	10,00	Visit in NAGY Ferrite Factory in Vác
	14,00	Lunch
	16,00	Leasure time
18t July	08,00	Breakfast in the Hotel
	10,00	Consultation in VASKUT
	13,00	Lunch
	14,00	Continuation of the consultation and/or leasure time

On-the job Training Programme

of

the Textile Team

/14th-18th July, 1986/

14th July	10.00 - Visit in METALLOCHEMIA Factory
	14.00 - Lunch
	16.00 - Departure to Kunszentmiklós
15th July	8.00 - Breakfast
	9.30 - Visit to TEMAFORG Factory, Kunszentmiklós
	13.00 - Lunch
	14.00 - Consultations
	16.00 - Back to Budapest
16th July	8.00 - Breakfast
	9.30 - Visit to TEMAFORG Factory, Kunszentmiklós
	13.00 - Lunch
	14.00 - Consultations
	16.00 - Departure to Mohács
17th July	8.00 - Breakfast
	9.00 - Visit to TEMAFORG Factory, Mohács
	13.00 - Lunch
	14.00 - Consultations
	16.00 - Back to Budapest
18th July	9.30 - Visit to Lőrinc TEXTILE WORKS [illegible]
	13.00 - Lunch
	14.00 - Continuation of the consultation and discussion with the representative of UNIDO /E. Balázs/ in TESCO Office

PART VI.

TRIPARTITE PROJECT REVIEW MEETING

Minutes

M I N U T E S

OF MEETINGS AND DISCUSSIONS HELD ON 12-14 JANUARY 1987 IN SHANGHAI IN THE SRRUC CONCERNING THE RESULTS OF IMPLEMENTATION AND EVALUATION OF DRAFT FINAL REPORT OF THE UNIDO PROJECT SI/CPR/85/803, EXECUTED BY THE CONTRACTOR TESCO-UVATERV, HUNGARY

Participants:

Ministry for Foreign Economic Relations and Trade, Beijing	Mr. Yao Shenhong, Programme Officer, China International Centre for Economic and Technical Exchanges
Shanghai Municipal People's Government	Mr. Xie Gujun, Section Chief, Foreign Economic Cooperation Division, Foreign Economic Relations and Trade Commission
Shanghai Supplying & Marketing Co-operative	Mr. Guo Yongkang, Deputy Chief, Foreign Economic Relations and Trade Division
Shanghai Resource Recovery and Utilization Corporation (SRRUC)	Mr. Zhu Kexi, Deputy Manager
	Mr. Huang Jianqing, Engineer
	Mr. Xie Shiming, Deputy Section Chief, Shanghai Precious Metals Refinery
	Mr. Fen Qiling, Engineer
	Mr. Zhao Zhigang, Director, Zhou Pu Non-ferrous Metals Smelter
	Mr. Zhang Guochang, Interpretor
UNIDO, Vienna	Mr. E. Balazs, Head, Metallurgical Industries Branch, DIO
UNDP, Beijing	Ms. Li Qiming, Senior Programme Officer
TESCO Consulting Engineering Hungary	Mrs. K.H. Elias, Representative of TESCO in China
	Mr. P. Holczer, Regional Manager
UVATERV, Hungary	Mr. P. Narancsik, Section Manager

The visits and meetings were organized according to the Programme proposed by SRRUC (see Enclosure 1). As a concluding act, the Evaluation and Conclusions on the Prohect, prepared by SRRUC (see Enclosure 2) were discussed.

Representatives of SRRUC confirmed that the Contractor's report was found as fully satisfying the requirements and the recommendations of the report were accepted or would be taken into consideration, according to the following.

As a first step, the reconstruction of the aluminium scrap processing operations on a bilateral basis and preparation of a detailed technological project report and design on reconstruction of copper scrap processing at the Yang Pu Copper Smelter through possible UNDP/UNIDO Technical Assistance, by the Hungarian consulting counterpart TESCO/UVATERV are planned to be undertaken (see para IV. 1 and IV. 2 A and B on pp. 9-10 of the Enclosure 2). Representatives of UNIDO and TESCO/UVATERV are requested to provide information and initiate relevant action on the UNIDO-Hungary Joint Committee Meeting planned to be held to prepare the programme of cooperation for 1987 by the end of January 1987 in Budapest. A draft project proposal to this effect was prepared jointly, envisaging the same financing structure (including financing by UNIDO and by the Government of Hungary and China) which was successfully applied for the implementation of SI/CPR/85/803 - see Enclosure 3.

The final report is expected to be prepared and submitted to/through UNIDO by 15 March 1987.

All participants expressed satisfaction with the good cooperation, resulting in the successful implementation of SI/CPR/85/803, and in possible follow-up investment on the aluminium scrap processing and in further pursuing and specifying potential technical assistance through UNIDO on the copper scrap processing in the form of preparation of a next investment decision.

on behalf of UNIDO	on behalf of TESCO/UVATERV	on behalf of SRRUC

14 January 1987
Shanghai

Enclosure 1

PROGRAMME

(Draft)

Jan. 10, 1987, Saturday

Evening: Guiding foreign guests to hotel

Jan. 11, Sunday: Open

Evening: Open

Jan. 12, Monday

Forenoon

9:00 -12:00: Visiting the Zhoupu Non-ferrous Metals Refinery

12:00-13:30: Working lunch

Afternoon

13:30-16:00: Recommendation on the follow-up project

Evening: Open

Jan. 13, Tuesday

Forenoon

8:30-12:00: Visiting the Shanghai Precious Metals Refinery

12:00-13:30: Working lunch

Afternoon

13:30-16:00: Evaluation of the UNIDO project SI/CPR/85/803

Jan. 14, Wednesday Visit to the Shanghai Iron and Steel Research Institute

Evening: Farewell banquet

Jan. 15, Thursday: Departure from Shanghai

Prepared by SRRUC

EVALUATION AND CONCLUSIONS
ON THE PROJECT SI/CPR/85/803
(BASED ON THE STUDY TOUR IN HUNGARY IN 1986)

SHANGHAI RESOURCE RECOVERY & UTILIZATION CO.

December 1986

EVALUATION AND CONCLUSIONS
ON THE PROJECT SI/CPR/85/803
(based on the study tour in Hungary in 1986)

I. Background

Following the visit in May, 1983 of a 6-member Chinese delegation to Hungary under the sponsorship of World Bank/UNDP on resource recovery and utilization and the follow-up visit to Shanghai of Mr. Imre Szekacs, Director General of TESCO, Hungary, the Shanghai Resource Recovery and Utilization Company (hereinafter SRRUC) as well as the Hungarian party both deemed it necessary to further explore the possibility of co-operation in the field of waste recycling.

At the invitation of Mr. Imre Szekacs a 4-member Chinese investigation group headed by Mr. Zheng Jing, Manager of SRRUC, visited Hungary in June, 1984. The Chinese party showed keen interest in the technology of industrial waste recycling in Hungary. So it was expected that expanding exchange of recycling technology and experience would benefit both parties.

On Nov. 3-10, 1984 the International Resource Recovery and Utilization Seminar was held in Shanghai under the joint sponsorship of World Bank/UNDP and CDG of West Germany. Mr. Pal Narancsik of UVATERV, Hungary, as a nominated member of the World Bank expert consultants missioned to Shanghai, participated in a general inspection of the waste recycling system of SRRUC and attended the meeting with a specialized presentation on "Metallurgical Treatment of Metal Scraps".

By the end of the international seminar Mr. L. Pados, Commercial Director of TESCO, accompanied by Mr. Janos Mayer of METALLOGLOBUS, Hungary, visited Shanghai to join Mr. Pal Narancsik to hold a talk with the leadership of SRRUC and reached an agreement in principle that the Governments of both parties would submit an official request to UNIDO to set up a project on resource recovery and utilization of waste in metallurgical and other industries with an aim at enhancing technical co-operation between TESCO of Hungary and SRRUC of China.

To explore the possibility of establishing a UNIDO project comprising chiefly study tours of Hungarian experts to Shanghai and the possible technical transfer of Hungarian recycling technology to China and the study/training tour of Chinese technical staff to Hungary in preparation of further development of co-operation, Dr. E., T. Balazs, Head, Metallurgical Industries Section of UNIDO, visited Shanghai in May, 1985, and concluded the project proposal to UNIDO for clearance.

On the basis of the approved UNIDO project on resource recovery and utilization of wastes in metallurgical and other industries No. SI/CPR/85/803 the Hungarian expert delegation (consisting of 8 members), headed by Mr. Pal Narancsik and Dr. B. Pataky, made a 21-day inspection tour (from April 16 to May 7, 1986) on the existing technology and facilities for industrial and domestic waste recycling in Shanghai with special emphasis on the following subjects:

1/ Utilizing waste ferritic oxide to produce magnetic material
2/ Processing of aluminium scrap
3/ Refining of copper scrap
4/ Production of carpeting material from textile cuts and waste synthetic fibers

The Hungarian experts worked out their mission report in due time and proposed a study/training programme for the forthcoming visit of Chinese technical staff to Hungary.

II. Study/training tour in Hungary

In accordance with the UNIDO project SRRUC sent a 10-member study/training team, headed by Mr. Zhu Kexi, Deputy Manager, to visit Hungary. The study/training tour started on July 4 and ended on 31, 1986.

During the 28-day tour, TESCO/UVATERV of Hungary, as host for programming our study/training activities, had very well executed its contractual obligations.

For the first ten days we were accommodated in SZEKSFEHERVAR and started our comprehensive stud[illegible]it to

VIDEOTON Electronics Factory with special observation of its subsidiary magnetic material production plant, KOFEM Light Metal Works and NEHEZFEMONTODE Heavy Metals Foundry (all situated in SZEKESFEHERVAR), and then VASKUT Research Institute for Ferrous Metallurgy, METALLOGLOBUS Metal Waste Recycling Company and UVATERV Consulting and Engineering for Communication and Trensportation (all in Budapest).

Slides, vioeo recording or verbal narrative usuallypreluded as an introduction to the field of activities, technical operations and profiles of the plants or companies we were visiting. Following a well-guided tour of observation, techno-economic consultations were held between our team and directors or department chiefs of different enterprises. Relevant Hungarian experts, with whom we had collaborated during their April visit to Shanghai, accompanied us throughout the tour and consultations.

The programme for our study/training proceedings was worked out with our agreement in two days after our arrival and officially introduced on July 8 at a welcome meeting held in the Headquarters of TESCO with the participation of all our team members, TESCO/UVATERV leadership, representative from China embassy in Hungary and almost all the experts who had visited Shanghai.

On July 14 started a week-long on-the-job training. Our team members were divided into 4 professional groups in line with the above-mentioned 4 specific subjects.

During the training week on-site visits were closely arranged to definite factories and plants and increasing technical and professional exchanges were organized, but major attention of the trainees was drawn to on-site operational demonstrations in order of processes.

The aluminium and copper groups worked together chiefly in SALGOTARJAN, QUALITAL Light Metal Foundry/APC, MEH SZEGED, MEH GYONGYOS and sometime later in MOFEM/MOSONMAGYAROVAR; the textile group carried out their training activities chiefly in KUNSZENTMIKLOS and MOHACS of TAMAFORG Co.; and the ferrite magnet group, after a revisit to VIDEOTON, moved to Budapest and devoted their study in VASKUT, KOVAC and HAGY.

On July 18 different professional groups assembled and were accommodated in Budapest. On the same day afternoon the study/training team visited the Headquarters of TESCO to meet Dr. E. T. Balazs, Head, Metallurgical Industries Section of UNIDO, who came directly from Vienna, to hold a talk with both parties concerning the implementation of the UNIDO project and to show concern for our study activities in Hungary. When asked about the general impression we had got during the past two-week study/training tour, Mr. Zhu Kexi briefed on our activities well organized by TESCO/UVATERV and expressed satisfaction. He emphasized that the Chinese party was looking forward to closer technical co-operation with the Hungarian party and especially the forceful support from UNIDO to develop such co-operation.

From July 19 to 30 our study activities were carried on in accordance with the programme.

In the afternoon of July 30 Mr. Imre Szekacs, General Director of TESCO, received all our team members just after his return to office from vacation, and held a farewell cocktail party in our honor. Representatives from all the parties in concern, including the First Secretary of China embassy in Hungary also attended the party. To conclude our study/training mission in Hungary with the good assistance of TESCO/UVATERV directorate a protocol was signed by both parties.

III. Our observations

Being not very rich in natural resource, Hungary has a good tradition to recover waste materials that still retain a potential value after processing. And so processing industry has played an important role in the development of all other industries in this country, where people of all walks of life speak highly of waste recycling as a specialized profession. In Hungary, besides the biggest scrap collection and recycling company, MEH Trust of Raw Materials, several big complexes develop their own waste processing plants or worshops. The long history and the important economic position of resource recovery in this country has doubtlessly enriched its experience and technology in developing this specialized field of industry, which can be summed up as follows:

1. To exploit the high value utilization of scraps

Take QUALITAL Light Metal Foundry as an example. It utilizes more than 80% of aluminium scrap to produce qualified die casting blocks and compression castings of small, medium and large series according to different demands of the clients. After preliminary sorting and classifying, chips go to the roaster for pretreatment. The scrap alloyed castings are first to be rid off iron content in a double-chamber dripping furnace. Foils and shavings are subject to faggoting before melting. They are separately smelted in the revolving drum furnace under salt cover. The liquid metal is delivered in portable ladles assembled on trucks to be carried to the TCAL type heat-keeping furnaces in the casting place. Sampling is timely made by the ARL 3460 quantometer to make sure of the composition and adjust the component ratio. After removing the runner systems and burring, well-polished castings of different specifications are produced. For still higher value utilization precision castings are made for different industrial purposes.

Almost the same technological processing is applied to high-value utilization of copper scrap.

Take another example for better illustration. Large quantities of iron oxide/scale arising in metallurgical plants and obtained during reclaiming from hydrochloric acidic pickling solutions have very little use in Shanghai; a part of scale is now used in steel production, and other part for pigment production or powder metallurgical purposes. But in Hungary at VIDEOTON's magnetic material production plant and VASKUT Research Institute for Ferrous Metallurgy we notice how they turn iron oxide/scale into magnetic material with appropriate processing stages, such as preparation of raw material (iron oxide/scale as base material mixed with $BaCo_3$ and betonite) with proportional addition of water, dehydration, ball-milling, pre-burning and sintering, heat-preserving, pressing with or without magnetic chamber, fast analyzing to ensure quality, and so on. Different kinds of magnetic material, anisotropic, isotropic, plastic-bonded etc. are produced to meet high demand in the production of TV sets, tape recorders, loud-speakers, fridges, motors etc.

2. Maximizing recovery and ytilization of scraps

Most of waste material collected or purchased is usually mixed and often contaminated. Without careful presorting reclamation of resource is impossible. In the case of plastics, textiles and chemical fibers, wires and cables, effective sorting and separating is of critical importance.

In Hungary pretreatment of waste yields very good result. For instance, MOHACS textile processing plant of TEMAFORG Co. puts a lot of labor and mechanical forces into sorting and classifying processes. First, sorting and classifying the textile waste according to different varieties, such as cotton, silk, wool, nylon, polypropylene, acrylic fiber etc., and then segregating them according to colors into different categories. After cutting, tearing, opening and baling, they become qualified raw material; some can be used to spin threads for making knitwear, and others are to be forwarded to another subsidiary plant of TEMAFORG Co., KUNSZENTMIKLOS, where great amount of non-woven geotextiles are produced as protective layers for drainage, highway and railroad construction.

For cables and wires, SZEGED MEH Waste Recycling Plant gives us a deep impression about the high efficiency of mechanical separation. After preliminary sorting (to remove impurities) with manual labor, cables and wires are subject to mechanical shearing. The lines with an average length of 20 cm are conveyed to shredders, and further forwarded to a set of grinding machines, from which grains of different sizes are moved to further grinding, and a rotating belt-conveyor with hoppers carries the fine grains to a multi-stage vibrating screening machine. In order of weight different kinds of grains, including copper, aluminium, plastics, rubber and other remaining impurities drop from the screening system and glide down in a diversified way to different conveying belts, over which magnetic separators always move around to rid off iron. Defferent containers are placed below the belts to receive different kinds of materials for most viable utilization.

As for copper scrap, strict classification is also required. Almost all the copper scrap processing plants we visited employ every means possible to classify the material, such as brass, bronze, bush alloy, cartridge cases, wormwheels, automobile water tanks etc. which are separately stored with identification marks attached.

3. Computerized system widely applied to business data processing, sample analyzing and quality control etc.

In Hungary computerized system is widely employed to facilitate business management, sample analyzing and quality control. Take just a few examples to justify our observation. SALGOTARJAN Metal Smelter of VASKUT is a designated plant for training our aluminium and copper groups. After site-visit we, as usual, held a techno-economic consultation with the manager of the plant, Dr. Dianovszky Gyula. A lot of questions were raised to him in concern with business volume, varieties of raw material, productive facility and labor, profit earning efficiency, the basic mechanical design features of some imported machines etc. Dr. Gyula answered all the questions distinctly with the help of the computerized system to give rise to digital-to-video display.

When we visited the VASKUT Research Institute for Ferrous Metallurgy, we noticed an instrument for rapid analysis based on the thermometric difference method, named "Dithermanal", which can be used to measure the concentration of all components in nearly all types of substances which occur in the normal analytical practice, such as glass, ores, cement, bauxite, red mud mud, fertilizers, galvanic baths, metals, alloys etc. It is expecially suitable for measuring components in high concentrations (10 to 100%). The analyzer is equipped for digital data output and digital print-out if required.

In QUALITAL Light Metal Foundry we observed the effective operation of computerized system on sample analyzing and quality control. Whether compression die casting or pouring mould casting production that take place directly from waste all require increased expectations from quality control. The components must be defined exactly and quickly. First the composition of the metal bath must be defined after melting the waste. In the knowledge of this, the quality of the alloys to be added must be correctly defined. We observed the demonstrative operation in the laboratory of QUALITAL on the rapid metal analyzer ARL-3460 and other quality control devices to facilitate the casting production and assure the quality of the products.

4. Secondary pollution control

Most of our processing works face the problem of treating effectively the secondary waste generated in the course of meterial recycling. But the problem seems not at all so serious in Hungary, where enterprises or plants dealing with material recovery generally have had more adaptable infrastructures which ensure more serviceable construction for scrap processing operations. Good drainage systems plus rationally economical use of industrial water with proper recycling greatly decrease pollutants sedimentation and the discharge volume of waste water. In most Hungary waste processing works manual sorting and classifying are largely displaced by mechanical separating with effective dust hoods; flue gas is ususlly cleaned by built-in filtering device in the chimney; and dust laden processing, like grinding and milling, are often automatically conducted in vacuum tight chambers. Besides, pollution monitoring and control means are always available in most waste recycling works. No less importance is attached to noise abatement, with an average limit below 90 db in the working place.

Disintegrated scraps are deposited in separate containers or storages to avoid natural deterioration and oxidation in the case of metallic substance. If disintegrated scraps were not properly deposited, serious water pollution might occur when heavy fall of rain sweeps the open space and rushes the effluence with high content of heavy metals and other toxic disjecta into the sewer.

To illustrate the effective control of secondary pollution in most of the scrap processing works in Hungary an example might serve as a convincing proof. In SZEKESFE-HERVAR there is a dairy products factory, which is rather strict with environmental sanitation. But near by it stands the NEHEZFEMONTODE Heavy Metals Foundry, which is engaged in mechanical processing of copper alloy scrap and fabrication of cast copper products. Due to effective control of contamination on the part of the foundry, the dairy products factory has never complained of the near-by existence of the foundry.

IV. Conclusion

After our return to Shanghai from Hungary we made a lot of study and discussion about the follow-up works. In consideration of our existing condition and the most urgent need we worked out the following programme with regard to the reform of technology and equipment for our recycling practice.

1. Implementation actions:

Aluminium scrap recycling in China as a whole still remains laggard with regard to technology, equipment and the art of utilization. Eventually the potential value of scrap aluminium has not yet been fully tapped. On the other hand, a strong market demand of primary aluminium product calls for urgent recovery of scrap aluminium.

Shanghai is, however, leading the country in the applied technology for recuperating aluminium waste, thus creating a favorable condition for in-depth technical reform and renovation of equipment.

We hope, with the introduction of Hungarian technology and equipment for smelting aluminium scrap, to enlarge and improve the original plant to upgrade metal recovery rate and develop new primary aluminium products, while stablizing the production capacity.

We want to adopt the technology, some most needed parts of the equipment and quality control means of QUALITAL Light Metal Foundry/APC of Hungary to cast Si-Al alloy and other series of alloys for different industrial purposes.

With the realization of this project we are able to tap the rich secondary aluminium resource, while attaining a high-value utilization of the scrap, which will eventually contribute greatly to the good yield of economic benefit for the society.

2. Preparatory activities:

A. We are going to improve the layout of the entire production line in the copper refinery and reform the technology and equipment for smelting copper residue and scrap with high copper content, and update the quality control measures as soon as the plant gets enough raw material and stabilizes its production capacity.

B. Multi-staged specific weight separating devices are to be introduced to replace the outdated method of stripping off the insulation casings from the scrap cable and wire so as to assure the optimum utilization of all useful materials.

Refering to the activities required as per paras A and B, SRRUC will request through the responsible Municipal and Governmental organizations to approach UNDP/UNIDO for technical assistance similar in scope and structure to SI/CPR/85/803, to facilitate the preparation of a detailed technological project design and report on reconstruction of copper scrap processing in the Yang Pu Copper Smelter, relying on the known Hungarian experience and on Hungarian technical and financial support through UNIDO.

C. We have attached great importance to the high-value utilization of waste textile and synthetic fibres. After study/training in Hungary, related technical staff will help develop a number of skilled workers with the advanced processing technology involving the skill of spinning threads for making knitwear and producing non-woven geotextiles. When the supply of raw material become adequate and enough funds are available, the original workshop for non-woven textile production will undergo large-scale renovation.

D. Utilizing the ferritic oxide/scale to produce magnetic material has hitherto been our great interest. But owing to fluctuation of market demand for the end product, shortage of suitable raw material within our own system, and unstable supply of scale from Baoshang Steel Complex and other local steel plants or foundries, we have to take the good technology of VIDEOTON's magnetic material production plant as technical reserve. In the meantime, we are collaborating with the Shanghai Steel and Iron Research Institute to train enough technical stafffor preparation of future development.

E. Environmental problems must be tackled with necessary modification of technology and renovation of equipment. Pollution control devices and testing measures must be provided in new and expanding constructions.

VI. Acknowledgement

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ANNEX:-

A name list of SRRUC study/training team in Hungary:

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