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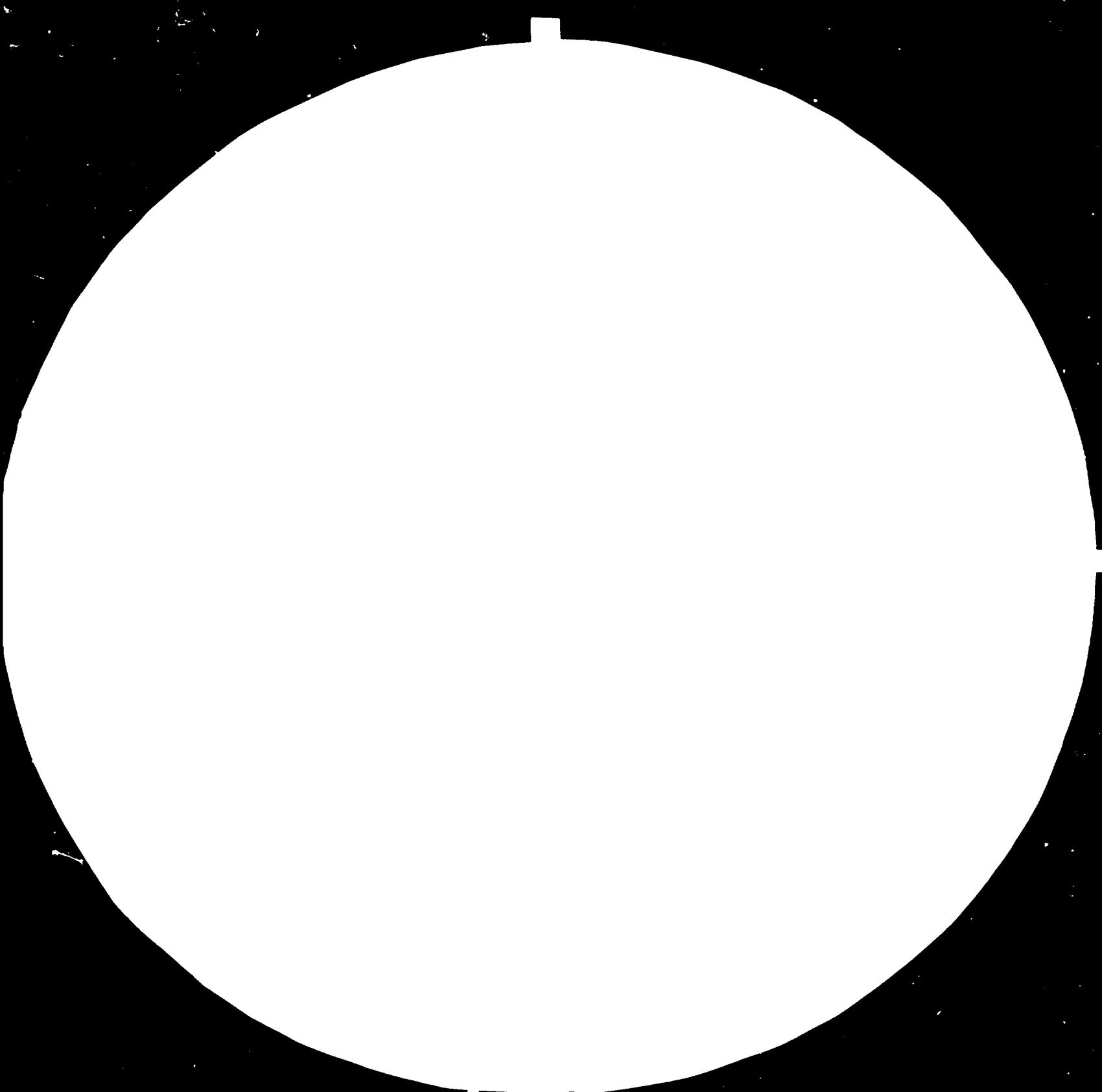

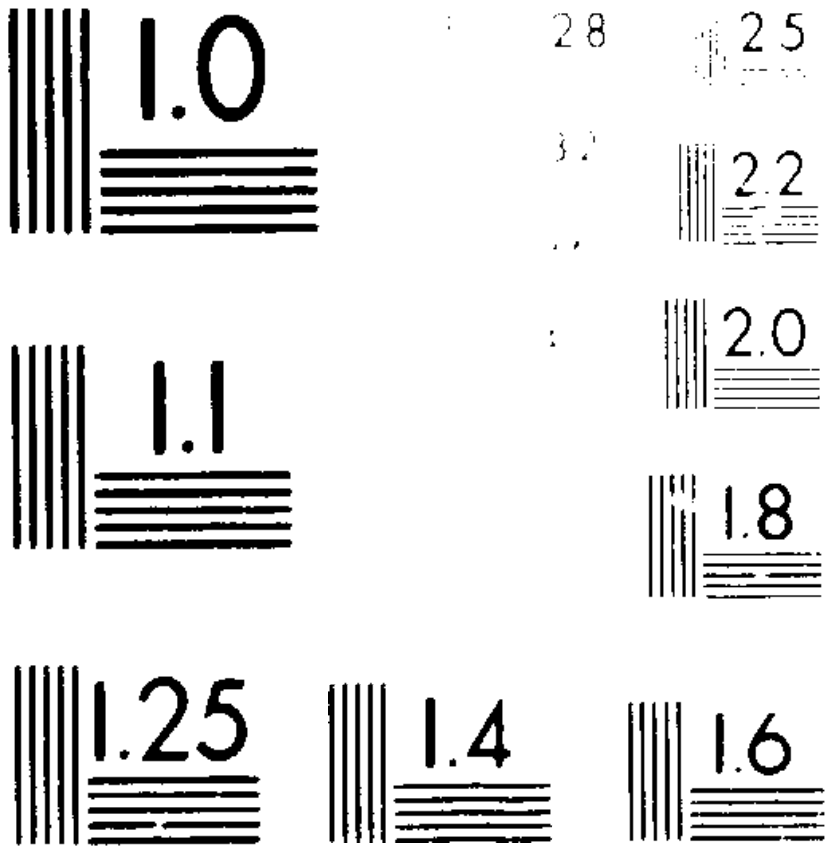

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FINAL REPORT

14003

Turkey.

TECHNICAL PROGRAMME FOR FIBER RECOVERY AND WATER REDUCTION

SEKA - TURKEY

DP/TUR/81/018/11-02/32.I.E.

by

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Expert in Recovery of Fibers

The United Nations Industrial Development Organisation
Acting as Executing Agency for the United Nations
Development Programme

FINAL REPORT
FIBER RECOVERY and
WATER REDUCTION
PROGRAMME

S E K A
IZMIT - TURKEY

26 March, 1984

C O N T E N T S

S U M M A R Y

This report describes the mission carried out by W.P.Svitelsky within SEKA IZMIT MILL, Turkey, during the period 05.02.1984 - 05.04.1984. The aim of the mission was to give technical support to SEKA technical staff in solving problems of fiber recovery and water reduction in various paper departments of the Izmit Mills.

During his mission the expert made certain observations on the water recycling systems in various departments of the Izmit Mills and gave recommendations to the Mill manager and engineering staff on how to improve the efficiency of fiber recovery units, how to reduce the fresh water consumption and fiber losses to the drainage system.

The observations and the recommendations will be presented in detail in the following sections of the report.

INTRODUCTION

SEKA (TÜRKIYE SELÜLOZ VE KAGIT FABRIKALARI IŞLETMELERI) is a state enterprise and owns seven mills within the country. There are also about 35 firms from the private sector active in this production sector. The total annual output of paper and board is 810,000 tons. SEKA produces 650,000 tons of which 99,500 tons are printing and writing papers, 182,000 tons newsprint and 350,000 tons wrapping paper and board.

The head office for SEKA organisation is in Izmit. The mills owned by this state enterprise are located in various parts of TURKEY: Izmit, Çaycuma, Dalaman, Aksu and Afyon. During the last two years new mills started operating in Balikesir, Akdeniz and Kastamonu.

With respect to size, it can be said that SEKA mills have attained dimensions which are comparable with other mills all over the world. Particularly at new pulp, paper and board mills planned and under construction, the most recent technologies and production methods are being preferred.

The rapid development of SEKA made it necessary to improve the existing technology and to use a new technology for environmental protection. With the assistance given by UNIDO the state company has a possibility to improve the coating processes, the chemical recovery technology, pulp processing, etc. and to reduce the environmental pollution.

But with the existing technology it is only possible to eliminate discharges, such as fiber and filler, and special internal and external measures are needed for the reduction of impurities in the waste water. The rapid increase in the cost of energy, chemicals and wood has encouraged mill management to collect spills and minimize fiber losses. These measures involve changes in separate processes, change in process system layout and construction of external effluent treatment plants. The external treatment plant is expensive and non-productive. In this instance it is important to define an optimal combination of the internal and external measures.

This report comprises the expert's observations and his recommendations to the Manager of the Izmit Mills on how to reduce

fibre losses and fresh water consumption in the various departments of the mill and how to close further the water systems at the mill. All recommendations were discussed with the engineers of the mill.

Expert's time programme

The assignment of the expert covered the period between 05.02.1984 and 05.04.1984. These two months could be broadly classified into five parts:

- Briefing and travelling	- 5 days
- Mill observations and discussions with mill staff	- 8 days
- Study on water recycling systems at Izmit paper mills Nos. 1-5 and on the efficiency of fiber recovery units	- 27 days
- Preparation and discussion with the mill staff of the recommendations on the improvement of fiber recovery units operation and on reduction of fiber losses	- 10 days
- Debriefing and travelling	- 7 days

Briefing

The briefing of the expert took place in UNIDO/Vienna.

Dr. Manfred Judt, Senior Development Officer for UNIDO, explained to the expert the nature of the assignment and the special problems to which the expert has to pay attention during his mission.

IZMIT PAPER MILLS

The Izmit Group of Paper Mills dates back to 1934. They were expanded and modernized through the years 1966 to 1980 to increase the production capacity from 100,000t/y to about 150,000 t/y. They produce sulphite and groundwood pulps from

spruce, fir and poplar, chemical and semichemical straw pulp, chemical pulp from hemp and flax, in addition to the use of waste paper.

There are five paper mills in Izmit with a total of ten paper and board machines operated.

The polydisc filters, Waco filters are used as fiber recovery installations at mills Nos. 3-5, and decantation units (Antuan type) are used at mills Nos. 1,2 (Annex B-5).

General observations

The expert's mission to the Izmit Mills could be classified into two main parts. The first part included a preliminary acquaintance with different departments of the mill, a study of daily reports on data concerning fiber losses and waste water operation control as well as discussions with mill engineering staff on the main problems connected with the white water recycling and fiber recovery units operation at the mills.

The second part covered detailed studies of the water recycling system at each mill and the preparation of the technical recommendations.

Fiber losses and water quality control

The fiber loss control is provided by the Quality Control Laboratory. The technical personnel of the laboratory take samples twice a day from the drainage system of each mill and provide information to the mill staff about fiber losses and waste water discharge. A special report on fiber losses is prepared for the manager and engineering staff of each mill. The laboratory controls once or twice a day the efficiency of fiber recovery units for each mill. The following analyses are included into the daily report data:

1. The total suspended solids in the sewer,
2. The ash content of the total suspended solids ,
3. The waste water flow discharge to the drainage system.

The statistical calculation of the daily report data is shown in Table 1 "Present data on waste water discharge and fiber losses" (Annex G-1).

Preliminary conclusions

The general observation of the Izmit Mills has shown that all water systems have common problems which could be investigated during the expert's mission. The detailed study of the white water systems at paper mills Nos. 1-5 should include:

- The general inspection of the white water system operation,
- Study on the water system of the drying section,
- Inspection of the sealing water system of the vacuum pumps,
- Study of the shower system at the wire and the press sections,
- Control of the operation of the fiber recovery units,
- Inspection of rejects from the final screening stage,
- Control of the consistency of the broke pulp at the drying section pulpers, coach pit and thickeners.

A special engineering group acting as counterparts was formed to study the real conditions of the white water recycling system.

The expert worked in cooperation with Mr.Ali Aykaç from SEKA Operations Department, Mrs. Sacide Alpaslan from the Quality Control Laboratory, acting also as an interpreter, and with Mr. Resul Ari from the Research and Development Department. The possibility to improve the efficiency of the fiber recovery units at each mill was discussed with Mr. Atilla Çiftçi, the Chief Engineer of the Izmit Mills and with the technical staff of various mills. The General Manager of the whole group of Izmit Mills, Mr.Fahri Altun and his technical assistant, Mr.Hüsamettin Izmitlioglu also took part in the discussions. Once a week the main recommendations and conclusions were discussed with the members of the Research and Development Department.

During the expert's mission the technical personnel of the Quality Control Laboratory assisted him by collecting additional data and making analyses according to the instructions of the expert to determine the quality of white and waste waters and the efficiency of fiber recovery units.

PAPER MILL No. 1

This mill has a capacity of about 27,000 t/y and comprises the paper machine M1 (Fourdrinier) and the board machine M2 (4 cylinder vats and one Fourdrinier).

The paper grades produced are writing and printing papers of 60 to 120 g/m^2 whereas the board grades are bristol and file covers of 150 to 860 g/m^2.

For paper and board production it is consumed:

Paper machine

Bleached sulphite pulp (1.0-1.5% consistency)	20 t/d
A.D. straw pulp or bleached pulp from other mills	20 t/d

Board machine

Groundwood pulp (3% consistency)	23 t/d
Unbleached pulp (1.0-1.5 % consistency)	20 t/d
Waste paper, periodically used up to	25 t/d

Observations

The paper production process and mill equipment are maintained in good condition. Both machines have closed cycle water system with vacuum pumps, white water system for regulating pulp consistency, cleared white water for wire showers. The groundwood plant also operates with the closed white water system. The conical funnels (Antuan type) are operated at this mill: two units (volume: 150 m^3 and 250 m^3) for the paper machine and two other units for the board machine.

Based on the observations at the mill and on the study of daily report data the following findings were established:

- waste water discharge is about 380-390 m^3/h ,
- high white water flow to decantation units, especially to the funnels of the machine M2,
- large foam at the conical funnels,
- high fiber losses at the board machine.

The microbiological slime problem took place in summertime.

Fresh water consumption

Fresh water is used at the mill for:

- cooling the reels, the cooling cylinders, the centralized lubrication system and cooling motors and refiner units;
- for felt showers at the press section, wire showers after coach and before breast rolls, feeding showers in the coach and press rolls.

The fresh water after drying section is passed to the drainage, the water from the refiner units is pumped to the power department. According to the capacity of the pump the maximum fresh water consumption at this mill is 250 m^3/h, this corresponds to the specific fresh water consumption of 80-90 m^3/t.

Waste water

The main amount of waste water is discharged with excess filtrates from pulp thickeners and excess cleared water from decantation units of machine M2. The average amount of waste water discharged to drainage is about 130-135 m^3 per ton of paper. The suspended solids content is 0.85-1.05 g/l. The basic water balance of the mill and fiber losses data are shown in Annexes B-1 and G-1.

Decantation units

The efficiency of the decantation units was designed for the maximum water flow through the large unit as 125 m^3/h (hold-up time is 2 hours) and through the small unit as 75 m^3/h. Operation control data and observations have shown that the efficiency of the Antuan funnels is at present between 73 and 86 % (Annex B-2). The content of suspended solids in cleared water varies between 80-100 mg/l and 200 mg/l. The sludge fed to the process has a consistency of 1.05-5.0 g/l. Usually the efficiency of such recovery units depends on the flow rate and hold-up time of the white water in the funnel. For a good efficiency, hold-up time must be about 2.2-2.7 hours (130-165 min).

Recommendations

1) To collect the cooling water of the drying sections of both machines and reuse it together with fresh water.

2) For reusing excess clarified white water from the funnels, collecting tanks should be constructed for each machine separately. The volume of those tanks should correspond to the pulper capacity (approx. 20-30 m^3).

3) Thickener filtrate should be reused in the sulphite plant.

The realisation of these recommendations should reduce the consumption of fresh water by about 90-100 m^3/h and specific water consumption from 85 m^3/t to 55 m^3/t.

For improving the operating conditions and the efficiency of the decantation units it is recommended:

4) For paper machine M1:

4.1) To separate filler-containing water from felt shower water; only filler-containing water should be directed to conical towers. The felt shower water should be recycled through the side hill screen as shown in Annex B-3 and reused instead of fresh water for the same purpose. This measure should reduce the flow rate of white water to the decantation units by about 18-20 m^3/h and increase the hold-up time from 2.0 hours to 2.3-2.35 hours.

4.2) For increasing the efficiency of the conical units and the consistency of the sludge, the sludge removal pump should be operated periodically with regular intervals. A special experiment has shown that only 15 minutes are needed for increasing the concentration of the sludge from 5.0 g/l to 15.0-18.0 g/l (Annex B-4).

4.3) For foam reduction a special shower system as a temporary measure has given good results, however a better result will be reached if the deaerating tank is installed before the conical towers.

5) For board machine M2:

5.1) An additional side hill screen, DSM or Bauer system, should

be installed before the Antuan funnels, as shown in Annex B-5. This should give good results by reducing both the white water flow to the conical towers and the content of suspended solids in the water put through the funnels. The experiments show that this type of screens has good operating data. Good fiber after the screen should be directed to the broke thickener (consistency 1.5-2.0 %) and the fine-containing water can be used for the wire shower system. The DSM screen with a standard capacity of 400 m^3/h should be a flexible design of a closed water recycling system for the paper machine M2. The excess water after decantation funnels with a low solids content can be used as additional water for the shower system or discharged to the sewer.

5.2) When intensive slime growth at the surface of the funnels is observed, sodium hypochlorite (10% concentration) should be used periodically 1-2 times per month for 1-2 hours for washing the conical towers.

The results of calculation of fiber losses and waste water reduction are given in Annex B-6.

PAPER MILL No. 2

This mill makes special grades of paper such as cigarette paper, carbonizing tissue and light weight grades such as manifold paper, etc. The two paper machines (M4 and M9) produce approximately 14 tons of paper per day.

The paper machine room is integrated with the pulping (cooking, washing and bleaching) department. The fibrous materials used are mostly hemp and flax pulp. Calcium carbonate is used as a filler for cigarette paper.

Observations

Both paper machines have typical water recycling systems. The fresh water is used for wire and felt showers, as cooling water in drying sections and for vacuum pumps as well as in stock preparation department. The calculations were based on the

information given by the mill staff that the specific fresh water consumption is for:

- Cigarette paper 314 m^3/t (92 m^3/h)
- Light weight grades mach. M4 252 m^3/t (73.6 m^3/h)
- Stock preparation 280 m^3/t (75.0 m^3/h)

The excess white water of the machine M9 is cleared at the conical funnel. There is no fiber recovery unit for excess water of the machine M4. Some amount of this water is used for stock preparation and another part is passed to mill No. 3 and to the sulphite plant, as claimed by the production chief of mill No.2. The content of suspended solids in white water of the paper machine M9 is about 0.8-0.9 g/l and about 0.5-0.7 g/l at the paper machine M4.

Pulping department

The pulp washing and bleaching department is operated in two shifts (16 h/d). Excess cleared water from the decantation unit and excess water from the bleaching department are fed to the Hollander as pulp washing water. The fresh water is used only in the Hollander shower system. The main quantity of fresh water is used as washing water for bleached pulp.

Conical decantator

There is a high flow rate to this unit. Excess white water (92 m^3/h) is directed to the decantation unit (V= 150 m^3). The cleared water (1200 m^3) is used in the pulp washing department and excess cleared water (1000 m^3) is discharged during night time and time between shifts to the drainage system. The sludge after the decantation unit is recycled to the process.

Technical recommendations

For fiber loss reduction it is recommended:

1) The flotation unit should be installed as a fiber recovery unit for the paper machine M4. This method is the best for

fine fiber. The Turkish paper industry has an experience in using this equipment at a private paper mill, the Ipek Kagit of the Eczacibaşi Group. The Krofta Supercell SPS unit is operated there. The flotation unit should be installed before the white water collecting tank. The cleared water can be used for the wire shower at the paper machine M4.

2) The excess water from seal pit of the machine M9 should be used for vacuum pumps (Annex C-1). This measure leads to reduced flow rate to the decantation unit as well as to reduced fresh water consumption. Only a 30 m^3/h water reduction to tne conical unit would be sufficient to improve its efficiency.

The calculations of fiber loss reduction are given in Annex C-2.

PAPER MILL No. 3

This mill makes packaging grades such as box board, kraft linerboard and corrugating medium. The two machines are operated at the mill: machine M6 for board production and machine M7 for corrugating paper. The original capacity of the mill was 27,000 tons/year. After modernization this mill has a capacity about 43,000 tons/year.

The paper mill is integrated with the groundwood plant, straw pulp plant and waste paper recycling department.

The furnish of paper and board during the mill observation is shown below:

Machine 6	Waste paper pulp	Groundwood pulp	Kraft pulp	NSSC rejects from pulp mill
	78 %	12 %	10%	
Typical furnish	90 %	-	-	10 %

Machine 7	Waste paper pulp	Straw pulp
	60 %	40 %
Typical furnish	50 %	50%

The specific fresh water consumption of this mill is about 96-98 m^3/t. for paper production including pulping department.

The waste water discharged to the drainage system is about 93-96 m^3/t or 560-580 m^3/h. Groundwood and waste paper pulp of this mill is directed to paper mill No.5. There are two polydisc filters used as fiber recovery units at mill No.3.

Observations

After the expansion and modernization of the mill the water recycling system remained the same and this is one of the main reasons of a high overflow from white water collecting tanks to the drainage system.

The white water recycling system of the mill consists of the water recycling system around the paper machines, excess water flow through the fiber recovery units, clear and cloudy filtrate recycling systems and fresh water distributing system.

The rejects from the last stage of centricleaners are collected in a special tank and used for waste paper dilution in hydropulpers.

Fresh water

Fresh water is used as cooling and sealing water for pumps and process equipment, in the felt showers, in the coach and press roll showers, for wire showers after the coach roll and as additional water for level control in the tanks under the polydisc filters. Cooling water after the drying section of the paper machines is recycled through the seal pit.

The expert supports the opinion of the mill engineer that it is not possible to collect the cooling and sealing pump water, as this water is distributed over a large surface of floors in different departments. But it is not feasible to direct the cooling water from the reel and calender to the seal pit. This water should be directed to the fresh water line.

Fiber recovery units

The polydisc filters at this mill have a good operating efficiency but a lot of the excess cleared filtrate cannot be reused at present; this filtrate is directed to the drainage. The clear and cloudy filtrates are pumped to the process directly from the disc filter chest. The volume of this chest is small

and at present a lot of fresh water is added to the filtrate tank for level regulation. The expert proposed to construct a new collecting tank for excess cleared and cloudy filtrate. The filtrate from this tank should be distributed in the process and for level control in the tank under the polydisc filters instead of fresh water.

Waste water

The fiber-containing waste water is continuously directed to the drainage system with the excess filtrate from the polydisc filters and the filtrate from the pulp washing thickeners at the straw pulp mill. Another cause for fiber losses is the overflow from the reject collecting tank and the overflow from the white water collecting chest.

Technical recommendations

For reducing the fresh water consumption and fiber losses to the drainage it is recommended:

1) A new collecting tank (200-250 m^3) should be constructed at the mill with two chests for excess cleared and cloudy filtrate separately. The filtrate from this tank should be distributed in process (for example, to straw digester, to pulpers) and used for level control in the chest under the polydisc filter. This measure will reduce the fresh water consumption approximately by about 20-25 %.

2) The cooling water of the drying section of the paper machines M6 and M7 should be directed to the fresh water line. At present this water is directed through the seal pit to the polydisc filter .

3) The filtrate from the straw pulp thickeners should be passed through the fiber recovery unit before drainage. This volume is about 40-50 m^3/h with a fiber consistency of 0.8-0.9 g/l. A DSM type side hill screen would be good for reduction.

4) The expert also supported the opinion of the mill engineers that for the limitation of the reject losses from the reject collecting chest an additional pump is needed. This pump

should direct the rejects to a broke thickener at the time when it is not necessary to feed water to the hydropulper.

PAPER MILL No. 4

Paper mill No.4 comprises the groundwood pulp plant and the two paper machines M3 and M8 (both Fourdriniers) for making newsprint and exercise book paper of 52 to 100 g/m^2. The total capacity of both machines is 52,000 tons/year or 145 t/d. Usually the daily production is about 130 t/d. For newsprint grade the fibrous furnish is composed ot 75% groundwood pulp and 25% sulphite pulp. The pulp is passed to the mill from the sulphite plant.

Observations

The water system of the paper mill consists of the water recycling system at the groundwood plant and the white water recycling system at the paper mill.

The points of the effluent formation at the groundwood plant are as follows:

- Overflow of fresh water from the fresh water collecting tank;
- Rejects of the last stage of centricleaners;
- Overflow of white water from the collecting tank.

At the paper mill the main quantity of waste water going to the drainage consists of excess white water from the wet end of the paper machines including the vacuum pump system, overflow from the vacuum box collecting chest, rejects from the last stage of centricleaners, filtrates from the pulp and broke thickeners as well as clarified water overflow from the polydisc filter.

According to the central laboratory daily control reports, the total quantity of waste water discharged is about 400-450 m^3/h. The total specific fresh water consumption is about 66-70 m^3/t in paper production. The suspended solids content in the waste water is controlled in two points of the drainage system. The first one is immediately after the paper mill, the second one is common for both the paper mill and the groundwood plant. An average content of suspended solids is 1.2-1.3 g/l which corresponds to 6.0-8.0% of fiber losses per ton of paper production (Annex E-17).
The polydisc filter of the Beloit Jones type is used as fiber

recovery unit at the paper mill.

Groundwood plant

The groundwood plant produces 90-100 B.D. pulp per day. There are three water recirculation systems at the groundwood plant: fresh water distribution system, the schleifer (grinder) white water recycling system, and the white water recycling at the polydisc filter. The fresh water consumption is about 50-55 m^3/h. As additional water, excess white water from the paper mill is used. The excess white water (90-120 m^3/h), mainly from the schleifer white water collecting tank, is directed to the waste water channel.

Fresh water system

The fresh water at the groundwood plant is used as cooling and sealing water for pumps and process equipment as well as dilution water for showers at the polydisc filter and at the last stage centricleaners.

White water system

The white water recycling system at the groundwood plant includes the cycle of water recirculation to the schleifers and screening equipment and white water cycle at the disc filter (Annex E-2). The clarified water from the disc filter is pumped to its own shower system as well as used for diluting the groundwood pulp. To prevent the clogging of the nozzles, the fresh water is used for diluting the clear filtrate.

The excess of cleared filtrate through the white water collecting tank is passed to the schleifer white water system (Annex E-2). The white water overflow from the collecting tank is directed to the waste water channel.

Water system of the paper machines

The basic white water recycling system of the paper machine room is shown in Annex E-3. The excess white and sealing water after wet end and press section and vacuum pumps are

collected in the seal pit and then this water is pumped to the disc filter. Broke pulp from the coach pit as well as the sulphite pulp are fed to the vat of the disc filter. The cleared filtrate from the disc filter is fed to the shower system of the wet end and used as sealing water for vacuum pumps. General characteristics of the white water is shown in Annex E-1.

Final screening

With the rejects after the last stage centricleaners, about 3.6% of fiber after the paper machine M8 line and about 1.0 % of fiber after the paper machine M3 line are lost to the drainage. Those losses are high enough because a typical amount of rejects in the form of fibrous material should be in the range of 0.1-0.5% based on the production capacity.

Pulp and broke thickeners

The sulphite pulp at a flow rate of about 1.3-1.4 t/h to the thickeners has a consistency of 1.0-1.5 %. According to the flow sheet diagram the filtrate after these units (130-140 m^3/h) must be used at the barking plant. Practically the filtrate is passed to the drainage system.

The filtrate from the broke thickeners is pumped to the seal pit and to the groundwood plant. It should be noted that the consistency of the broke pulp is varying in the range of 3.0-25.0g/l.

Polydisc filters

There are two polydisc filters operated at paper mill No.4: the first one in the paper machine room is used as a fiber recovery unit and the second one as a thickener for the groundwood pulp. The data on the efficiency of both units are shown in Annex E-4.

The white water from the seal pit, excess vacuum pump water, the rejects from the deaeration unit of the centricleaners and the sulphite and broke pulp as sweetener stock are directed to the inlet of the disc filter. They are added ahead of the feed box. Thus, the water volume fed to the filter is 500-730 m^3/h which is much higher than its rated throughput. The inlet consistency to the filter varies from 2.6 to 3.5 g/l.

Technical recommendations

During the observation of the water recycling system at paper mill No.4 and the discussion with the mill engineering staff the following recommendations were made concerning the fiber losses:

1) The vacuum pumps should be connected to the white water system as is proposed in Annex E-3: namely, the sealing water of the vacuum pumps should be passed to the outlet of the cleared filtrate in the disc filter tank. Further, this water should be directed together with the cleared filtrate to the showers and the vacuum pump system. This measure makes it possible to reduce the flow rate to the polydisc filter as well as to direct the overflow from the vacuum box chest to the seal pit. The content of suspended solids in vacuum pump water is the same as in the cleared filtrate after the disc filter (Annex E-1). There are no risks of clogging for the nozzles of the showers.

2) The filtrate of the pulp thickeners should be collected and passed back to the washing department of the pulp plant. Only a collecting tank and pump are necessary to realize these measures. The use of the pulp thickener filtrate will reduce the waste water discharge by 90-110 m^3/h at paper mill No.4 and the fresh water consumption at the sulphite plant.

3) An additional centricleaner unit should be installed for the reduction of fiber losses with rejects from the last stage centricleaners. To improve the existing installation, one can add a new cleaning stage according to the principle shown in Annex E-5. The additional stage should be supplied with a periodically operating chamber. The white water is injected tangentially into the upper part of the chamber. This water is used simultaneously for diluting and washing the rejects. In general 70-75% of the fibrous material can be recycled using an additional centricleaner unit.

4) To improve the efficiency of the polydisc filter of the paper machines, it is necessary that the input consistency to the filter should be about 5.0 to 8.0 g/l. The consistency and quality of the sweetener stock is of importance for both the capacity of the filter and the quality of the clarified water.

Sulphite pulp is the best sweetener stock; the additional quantity of sweetener may be obtained by recirculation of the stock from the disc filter to the feed box of this unit. If the broke pulp from the coach pit will be used as the sweetener, the consistency of this pulp must be higher.

5) To achieve an acceptable low content of suspended solids in the clarified filtrate, the highest possible amount of cloudy filtrate from the disc filter must be racirculated. This measure reduces also the volume of the excess filtrate directed to the groundwood plant.

6) To reduce fiber losses and excess white water at the groundwood plant, a new side hill screen should be constructed for separating fiber from cleared filtrate, before it is directed to the shower system. And also the amount of cloudy filtrate from the machine disc filter to the schleifer white water collecting tank should be regulated (Annexes E-2, G-7). It is possible using these measures to reduce the waste water discharge at the groundwood plant by about 40-50% and the fiber consistency in the overflow water of the schleifer collecting tank by 30%.

PAPER MILL No. 5

The production of different wrapping papers is about 23,000 t/y at the two paper machines, M5 and M10 (both are Fourdriniers).

The typical furnish:

1) At the paper machine M10:

Bleached pulp from sulphite plant	60-65 %
Bleached straw or reed pulp	40-35 %

2) At the paper machine M5:

Kraft pulp or unbleached sulphite pulp	30 %
Ground wood	20%
Waste paper and paper broke	20 %
Waste newsprint	30 %

There are two fiber recovery installations, the disc filter (M10) and Waco filter (M5).

Observations

The effluent of this mill is formed from excess filtrates of the waste paper pulp and the sulphite pulp coming from other mills and its own excess white water. The content of suspended solids and fiber losses at the mill are rather low, but the fresh water consumption is rather high, about 66 m^3/t. The disc filter (Jones type) has a good efficiency (Annex F-1). At present the Waco filter is reducing solids content only by 30-40 % and fresh water is used for diluting cleared water before it is passed to the water recycling system. The wire mesh of the Waco filter is less than the wire mesh of the paper machine. The excess filtrates, the polydisc cleared and cloudy filtrate and excess filtrate from the Waco filter are discharged to the drainage system.

Recommendations

1) For improving the efficiency of the Waco filter, the wire mesh of this unit should be increased to be higher than the wire mesh of the paper machine. The efficiency of the Waco filter operating without sweetener stock usually increased, if the movement of the drum is reversed. According to the expert's experience this measure should increase the filter efficiency up to 70-75%. At this time the drum speed should be a little higher than usual.

2) Instead of fresh water cleared filtrate should be directed from the polydisc filter to the collecting tank under the Waco filter. According to the data for controlling solids the dilution coefficient in this point is 0.75-0.80. (The fresh water addition is about 20-25%).

3) The cleared filtrate from polydisc filter should be used at the vacuum pump No.4 (machine M10) instead of the cloudy filtrate. The cloudy filtrate should be recycled to the inlet of the polydisc filter.

The calculations made permit to assume that these measures will reduce:

- the suspended solids losses from 28.2 kg/t to 15.8 kg/t
- the fresh water consumption from 66 m^3/t to 45.5 m^3/t
- the waste water discharge from 128 m^3/t to 95 m^3/t (Annex F-2).

GENERAL DESIGN OF THE WATER SYSTEM CLOSURE

The general data on the fresh and waste water reduction in different departments of the Izmit Paper Mills are shown in Annex G(1-4). It would be possible as a result of the implementation of the technical recommendations given by the expert for each mill to reduce:

- Fresh water consumption from 1580 m^3/h to 1150 m^3/h or on the average for all mills by 28 % (Annex G-2, G-3);
- Waste water discharge from 1930 m^3/h to 1230 m^3/h or on the average for all mills by 37 % (Annex G-1, G-3);
- The average rate of reduction of fiber losses will be between 24 - 49 % (Annex G-4).

For the reduction of fiber losses and the improvement of the efficiency it is recommended to purchase and install additional equipment for the water recycling system (Annex G-5). Internal measures should also be taken according to the recommendations given on the former pages.

Conclusions and Recommendations

For the system closure at the paper mill, i.e. for the reduction of water consumption and suspended solids losses both technical and organisational measures are essential.

1. Fresh water reduction

To reduce the total fresh water consumption at Izmit pulp and paper mills, these are required:

1.1. Flowmeters should be installed on the waterpipes at each sub-mill. Present control of the waste water flows does not reflect the fresh water consumption. The data of this report may be recommended as an initial calculation for fresh water consumption at mills Nos. 1-5.

1.2. The number of positions where fresh water is added for the level control of white water tanks should be minimized. The observation has shown that a large amount of fresh water is added for level regulation, e.g. at mills No.3 and No.5. 20-25% of fresh water is used in the collecting tanks under the fiber recovery units.

1.3. The felt shower systems at the machines M1 and M10 should be controlled and more efficient shower nozzles should be selected.

1.4. The cooling water from the drying sections should be directed to the fresh water system where it is possible, e.g. at mills No.1 and No.3. This type of water is not in contact with pulp and is therefore not contaminated.

2. Waste water and fiber losses reduction

To reduce fiber losses and effluent discharge, it is required:

2.1. The control of recycling the filtrates from the pulp thickeners at the paper mills to the washing department of the sulphite plant should be organised.

2.2. The efficiency of the centricleaner installations must be improved. An additional cleaning installation is usually required for the reduction of fiber losses. Modern centricleaner units include four steps plus a final reject step to ensure minimum fiber losses.

2.3. For the improvement of the polydisc filter efficiency the consistency of the sweetener stock is important.

Other recommendations for each mill were given above. Here it must be pointed out that it is essential to have a training programme for the operators. The effect of a well-designed closing programme can be totally ruined by operators lacking necessary information, training and motivation to adjust themselves to the considerable changes in their previous routine. That is why a special management training programme is needed.

3. Management organisation programme

3.1. The recognition of the problem and the need to solve it. Everyone involved should understand that water reduction is a problem and that it must be solved. The expert's experience has shown that in other case very little success will be gained by the programme.

3.2. A special committee should be formed from the mill managers. This group will be responsible for guiding the water reduction efforts. Its function is to maximize available talents and coordinate the project.

3.3. Incentives are needed. Everyone should know the economics of water use, including an understanding of the existing status of water use - how much is used and where it goes.

3.4. A plan should be developed. This plan will involve making:

- a water balance around each machine,
- understanding the qualities and characteristics of white water,
- understanding the requirements of a white water system.

The plan should be based on a practical analysis of the situation and on what degree a white water close-up is possible.
In closing up a system, it is extremely important to select the equipment which have the best potential for success.

3.5. Implementation of this plan and training of the mill staff. The staff should be aware of the alterations and how the system was designed to operate. It is also important that they be aware of the fiber losses associated with the water use.

The expert wishes and hopes that the calculations and recommendations of this report will be useful for developing the future measures to realize a close water system.

CONCLUSION

The recommendations set forth in the present report were approved by the engineering staff of the mill and were submitted for consideration to the Manager of the Izmit Mills Mr. Fahri Altun as well as to the Technical Director of SEKA Miss Ferhan Taptik. Their development in such short time became possible due to business-like support rendered to the Expert by all specialists of the Mills and Research & Development Center of the Company directed by Mr. Ziya Yelen as well as due to close cooperation of the Expert with Turkish partners Mr. Ali Aykaç and Miss Sacide Alpaslan.

The Expert expresses his gratitude to the Administration, engineering and technical staff of the Mills and Research & Development Center for technical assistance in the inspection of water systems at the Mills and in typing a preliminary report, and to Mr. Ahmet Dogukan, Administrative Assistant UMDP-UNIDO who lent his support to the Expert in correcting and typing the main part of the report.

In conclusion, the Expert emphasises that a further development of recommendations on the reduction of fiber losses, fresh water consumption and effluent discharge will depend on the efficient organization of recommended measures and require a precise program of engineering ensurance of technical recommendations and a training program for the mill staff.

A N N E X E S

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ANNEX A

SOURCES OF INFORMATION AND ACKNOWLEDGEMENTS

Mr. ZIYA YELEN - Head of Research, Development and Training (National Project Coordinator)

Mr. AYHAN MENGI - Manager of Research and Development
Mr. CEMAL DEĞER - Research Expert
Mr. RESUL ARI - Chief of Documentation and Information
Miss BESIME ERYENER - Chief of Fundamental Research
Mr. AHMET DOĞUKAN - Administrative Assistant UNDP-UNIDO
Mr. ALI AYKAÇ - Chief of SEKA Pulp and Paper Department
Mr. ATILA ÇIFTÇI - Chief of IZMIT Pulp and Paper Mills
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Mr. ULGU KOYUNLU - Chief of Mill No 2

Mr. ÖMER ZEKI YILMAZ - Chief of Mill No 3
Chemical Engineer

Mr. HAMZA BAKAN - Chief of Mill No. 4
Chemical Engineer

Mr. EMIR UZMAN - Engineer
Mr. HALUK TURGAY - Engineer

Mr. ORHAN OZALP - Chief of Mill No 5
Chemical Engineer

Mr. MUZAFFER ÖZON - Engineer

Expert is indebted to all the staff for providing the information and active assistance.

ANNEXES B - F

DATA ON FIBER RECOVERY AND WATER REDUCTION

Mills Nos 1-5

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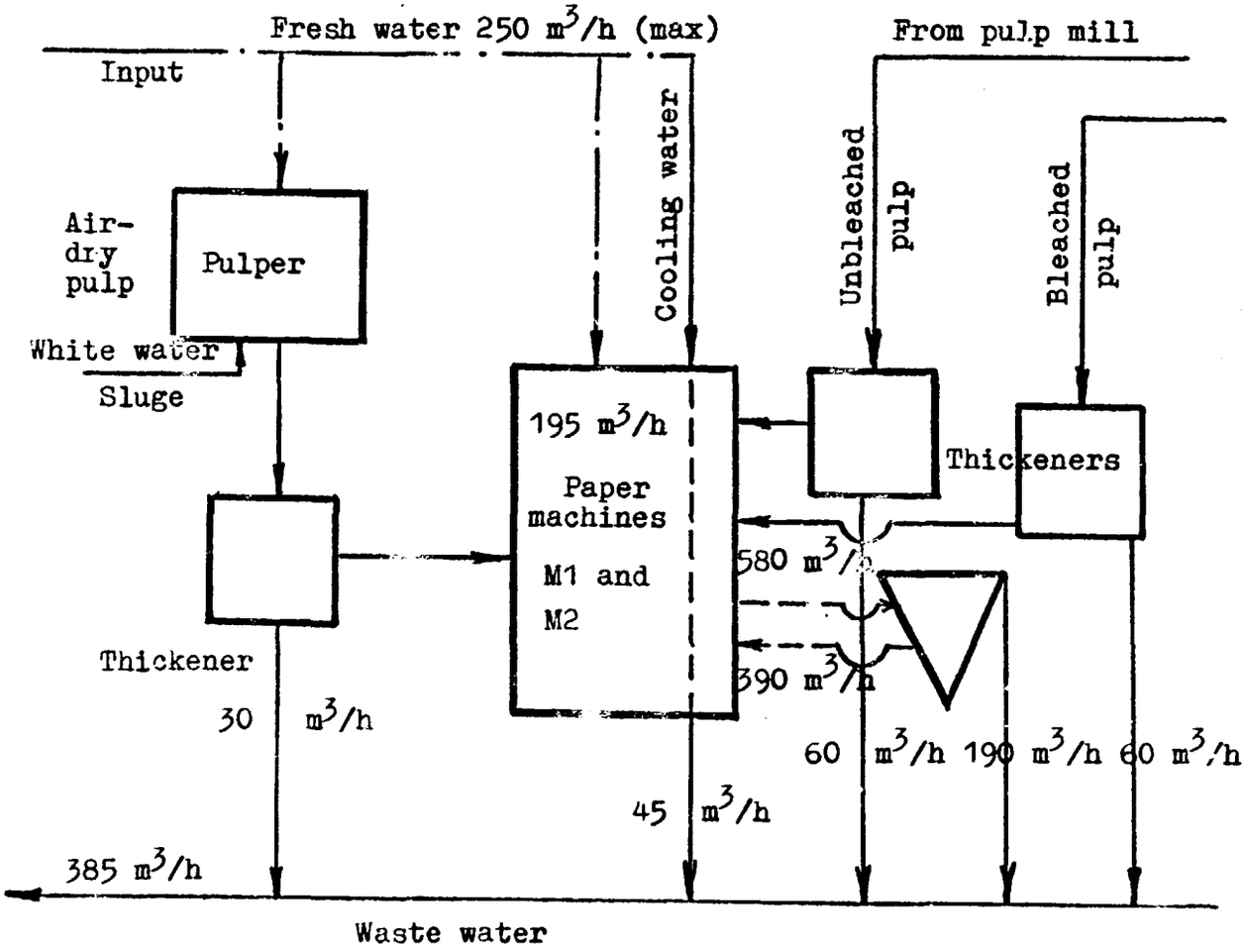
ANNEX B-1

Mill No 1



Schematic block diagram
of excess water discharge

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ANNEX B-2

Mill No 1

Writeting and printing papers

Decantation unit efficiency

Decantation unit	White water, g/l		Efficiency, %	Sludge concentration, g/l
	Inlet	Outlet		
Paper machine M1				
1. 250 m^3	1.204	0.049		6.085
	0.084	0.080		-
	0.934	0.179		3.240
	0.773	0.103	86%	4.52
2. 150 m^3	0.140	0.100		9.73
	0.874	0.084		4.144
	0.200	0.100		1.14
	0.356	0.95	73.3%	4.94
Paper machine M2				
1. 250 m^3	0.639	0.517		0.934
	0.924	0.023		-
	1.044	0.189		-
	1.008	0.073		1.552
	0.904	0.200	77.9%	1.043
2. 150 m^3	0.560	0.070		4.200
	0.920	0.040		5.460
	0.680	0.160		1.873
	0.935	0.026		-
	0.882	0.259		5.050
	0.795	0.111	84.7%	4.145

Ash content:
White water to conical units - 27.01 - 37.21%
Clear water from conical units - 34.67 - 54.91%
Sludge - 27 - 33%

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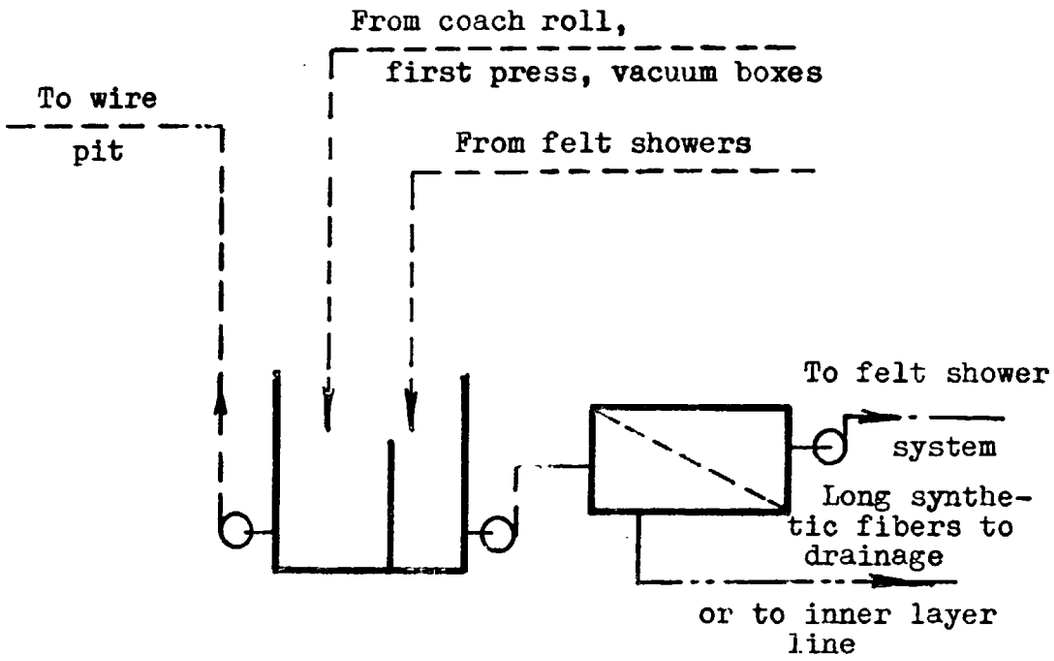
ANNEX B-3

Mill No 1



Basic system for recirculation vacuum pump water to felt showers

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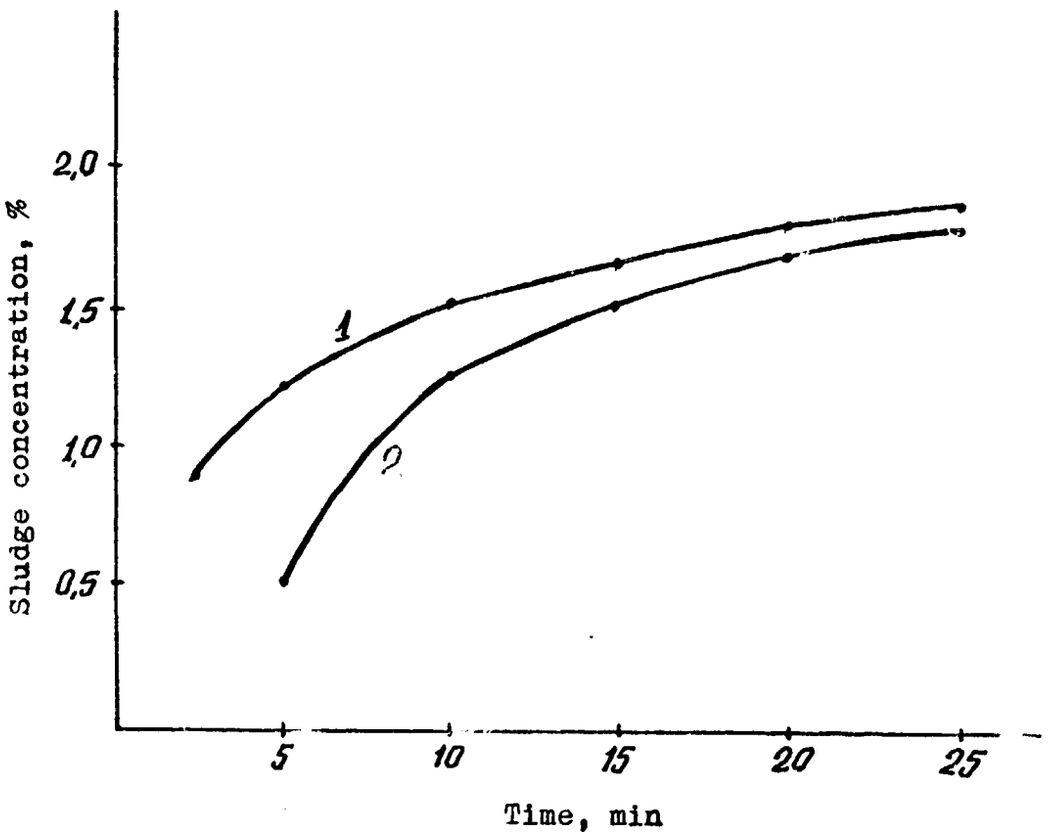
ANNEX B-4

Mill No 1



Concentration of sludge from the decantation unit as a function of sedimentation time:

1 - laboratory data

2 - increase of concentration at the decantation unit

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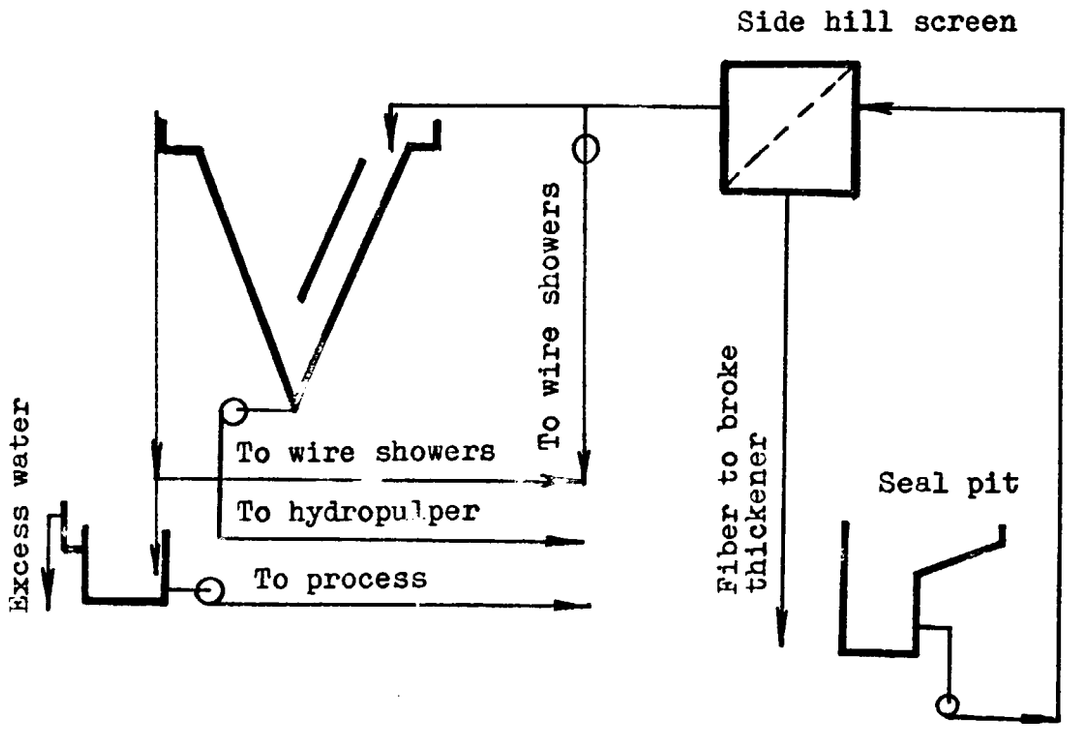
ANNEX B-5

Mill No 1



Basic white water system of the paper machine M2.

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ANNEX B-6

Mill No 1

Fiber losses and waste water reduction

At Mill No 1, when writing and printing papers are produced, the continuous processes resulting in a high content of suspended solids are absent. Waste water is discharged to the sewer:

- excess white water from the decantation units (0.1-0.2 g/l, max. 0.5 g/l);
- thickener filtrate (0.2-0.4 g/l).

Rejects from the paper machines M1 and M2 are directed to the inner layer line. Excess white water from the groundwood plant is usually recycled to the groundwood production. This water contains 1.2-1.6 g/l of suspended solids. According to the information of the mill engineering staff the overflow water is discharged to the drainage only from time to time.

Some amount of fiber is lost with foam from the decantation units. The suspended solids content in foam can reach 1.0-2.0%. The expert has proposed a shower system for foam reduction. The operation of this system has given good results.

The main amount of fiber losses is associated with too high flow rate to the decantation units of the paper machine M2 when board is produced. This flow rate is 370-390 m^3/h. It is a reason of fiber losses to the sewer (about 60-70%). High fiber losses are also observed during grade changes as well as during floor and equipment washing.

Annex B-6 cont'd

The data on waste water and suspended solids reduction are given below.

Process	Present		Future		*Reduction	
	m^3/h	g/l	m^3/h	g/l	kg/h	kg/d
1. Decantation unit overflow to drainage:						
Machine M1	40-50	0.12	15-20	0.05-0.08	4.0	96.0
Machine M2	130-140	0.8	60-70	0.03-0.08	108.2	2590.0
2. Pulp thickener filtrate	150	0.28	30-60 (120 m^3/h should be recycled to the pulp mill)	0.28	32.8	624.0
3. Cooling water	45					
4. Suspended solids with foam from decantation units		8.0-20.0				
Total	385		120-160			3312.0

The fiber losses reduction: (ash content 40%)

$$\frac{3312 \times 0.60}{5030} \cdot 100 = 39.5\%$$

The waste water reduction

$$\frac{385-160}{385} = 51\%$$

*The data are the difference between the calculated and existing values.

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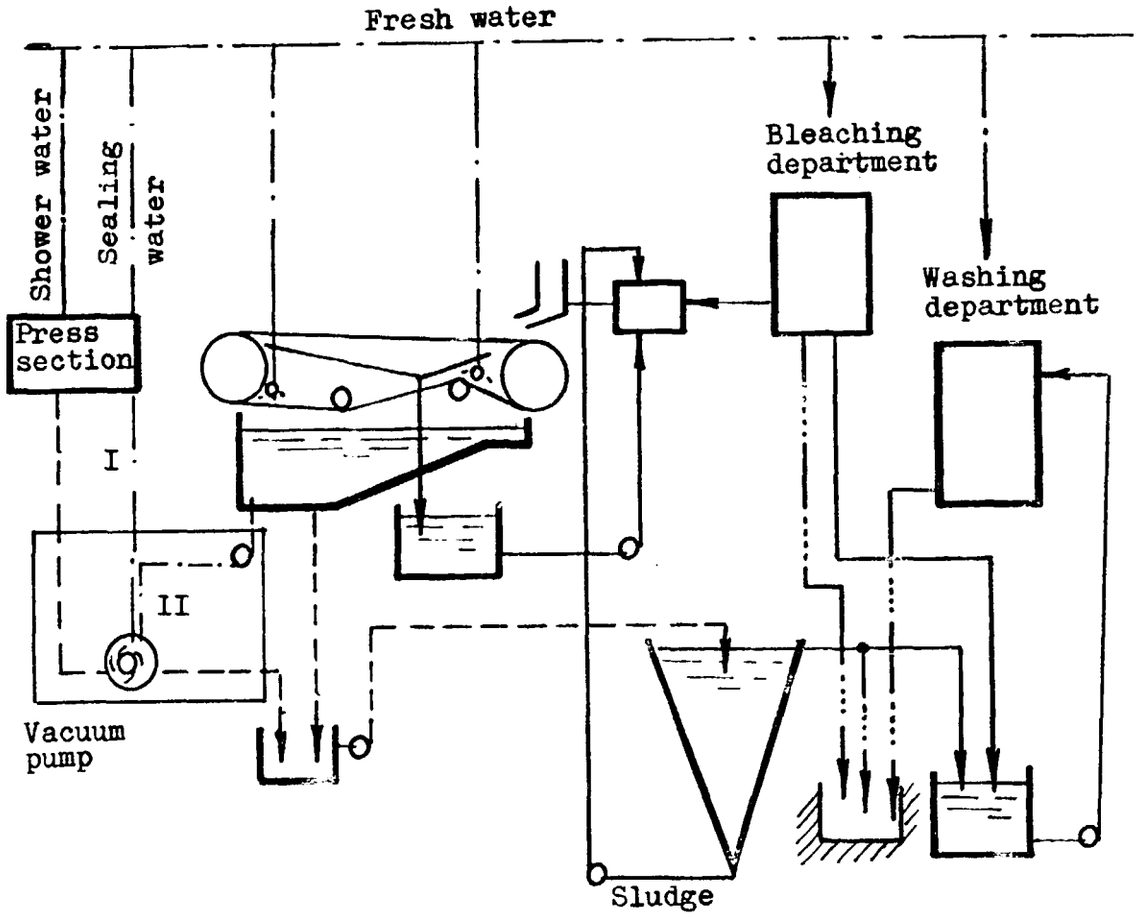
ANNEX C-1

Mill No 2



Basic water recycling system
of the paper machine M9

I. Existing system
II. Modified system (fresh + seal pit water)

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ANNEX C-2

Mill No 2

Fiber losses reduction

Daily paper production: paper machine M4 - 7 tons
paper machine M9 - 7 tons

Fresh water

Papermaking department

Machine M4: 53,000 m^3 per month
252.0 m^3/t
73.6 m^3/h

Machine M9: 66,000 m^3 per month
314.0 m^3/t
92.0 m^3/h

Pulping department 54,000 m^3 per month
280 m^3/t
75 m^3/h

The waste water to the drainage system from pulping department is 3070 m^3/16 h

including chemical-containing washing water (3010 m^3/16 h) and black liquor (60 m^3/16 h).

Waste water and fiber losses

	Present	Future	Reduction
Waste water, m^3/h			
Machine M9	42.0	12.0	30.0
Machine M4	56.0	25.0	31.0
Pulping department	129.0	129.0	-
Black liquor	2.5	2.5	-
Total	229.5	168.5	61.0

Annex C-2 cont'd

	Present	Future	Reduction
Fiber losses, kg/d			
Machine M9	60.0	50.0	10.0
Machine M4	806.0	67.2	738.8
Total	866.0	117.2	748.8

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ANNEX D-1

Mill No. 3

Polydisc filter efficiency

Paper or board grades	Suspended solids, g/l		
	Inlet	Cloudy filtrate	Cleared filtrate
Box board,	2.28	0.093	0.078
grey board	2.37	0.144	0.076
	3.64	0.210	0.067
Corrugating	2.78	0.325	0.131
paper	12.79	0.310	0.026
	11.13	0.24	0.020

ANNEX D-2

Mill No 3

Suspended solids and fiber losses reduction

Suspended solids losses with excess filtrate from polydisc filters:

150 m^3/h x 0.20 = 30.0 kg/h (720 kg/d)

Fiber losses from a straw pulp thickener:

45 m^3/h x 0.85 = 38.2 kg/h (920 kg/d)

After modification of the water recycling system, fiber losses would be reduced:

$$\frac{(720 + 920) \times 0.85}{5520} \times 100 = 25.2\ \%$$

Waste water reduction:

$$\frac{150}{571} \times 100 = 26.2\ \%$$

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ANNEX E-1

Mill No 4

Waste water characteristics

Position	Suspended solids content, g/l					Average SS, g/l	Ash, %
1	2	3	4	5	6	7	8	9
1. Pulp thickener								
a) Bleached pulp:								
inlet	21.62	18.44	17.10	19.84	17.58	17.02	0.57
outlet						35.0	
b) Unbleached pulp:								
inlet	8.34	10.64	10.48	12.10	14.80	11.26	1.46
outlet						35.0	
c) Filtrate	0.222	0.149	0.200	0.255	0.314	0.228	30.5
2. Broke thickener							
a) M3:							
inlet	8.26	9.05	10.69	11.97	25.29	12.51	23.84
outlet	82.94	40.63	32.13	53.84	52.59	52.42	9.60
b) M8:							
inlet	22.43	11.62	3.83	2.09	5.11	9.02	7.75
outlet	49.56	66.12	52.68	20.92	66.04	51.06	6.47
3. Rejects from centri-cleaner							
3rd stage M3	16.80	15.82	33.35	19.53	53.08	27.72	64.00
3rd stage M8	16.45	10.04	11.59	6.74	13.21	11.60	45.50
4. Vacuum pump collector:							
M3	0.523	0.423	0.381	0.377	0.532	0.447	46.82
M8	-	-	0.278	0.255	0.426	0.319	40.70
5. Coach pit:							
M3	-	-	-	-	16.48	-	-
M8	-	-	-	-	8.01	-	-

Annex E-1 cont'd

1:	2	3	4	5	6	7	8	9
6.	Vacuum box chest:							
	M3	-	2.47	-	-	-	1.43	-
	M8	-	1.06	-	-	-	-	-
7.	White water collecting tank of the paper machine room	0.152	0.354	0.305	0.301	0.413	0.305	47.06
8.	Rejects from the last stage of groundwood plant centricleaner	7.48	-	1.87	1.55	2.83	3.43	1.15
9.	White water collecting tank of the groundwood plant	0.346	-	0.335	0.263	0.216	0.302	2.64

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ANNEX E-2-1

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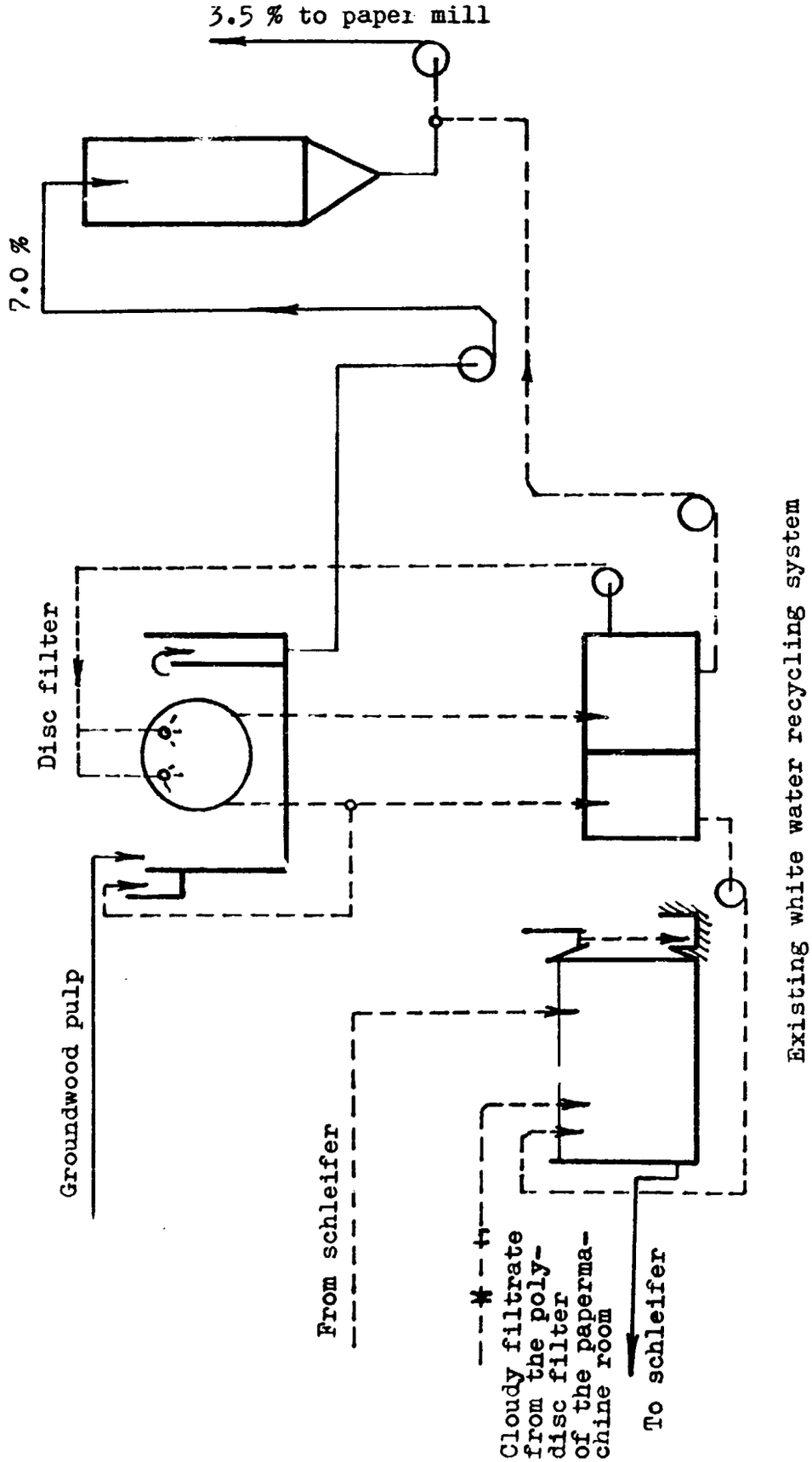

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ANNEX E-2-2

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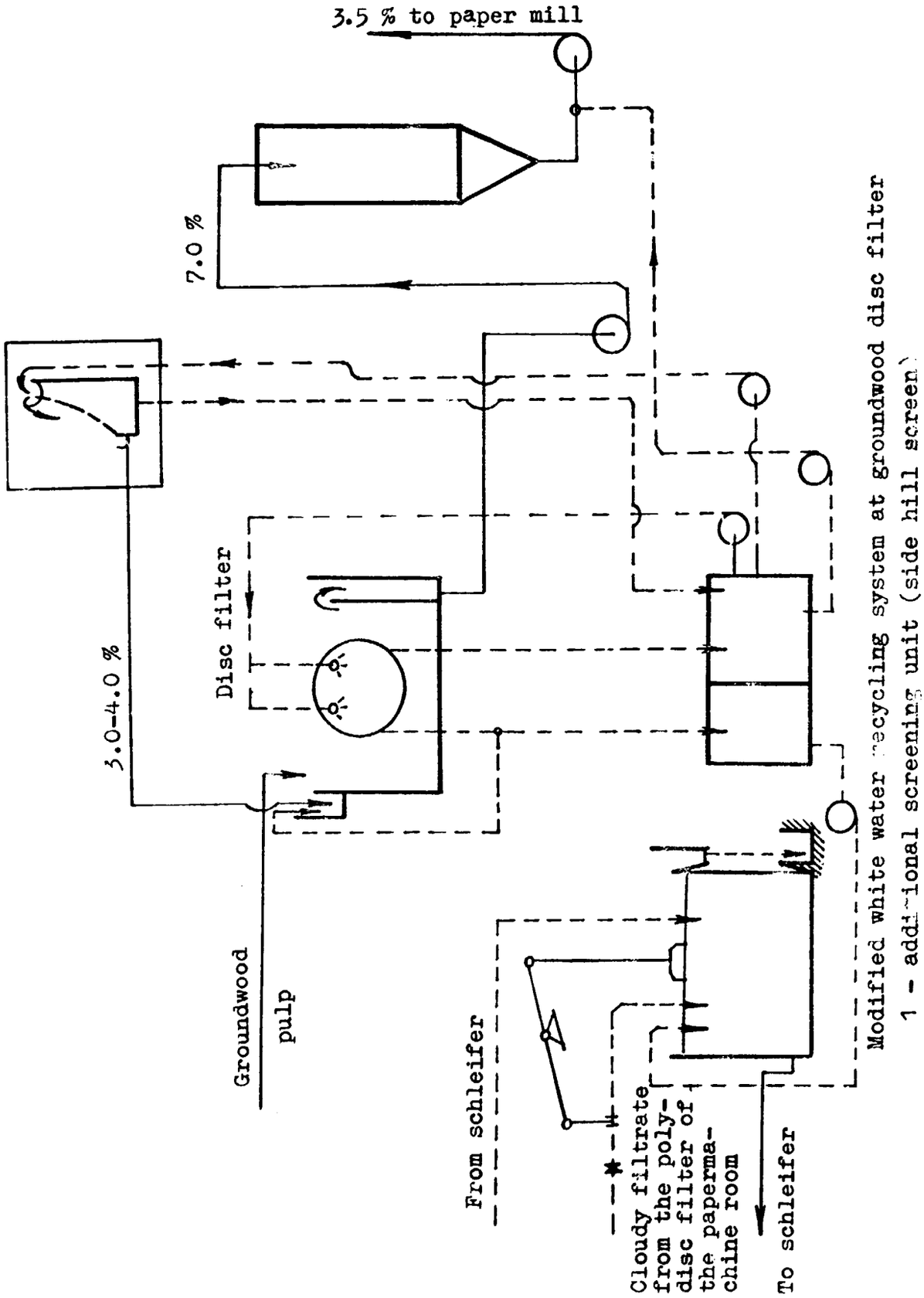

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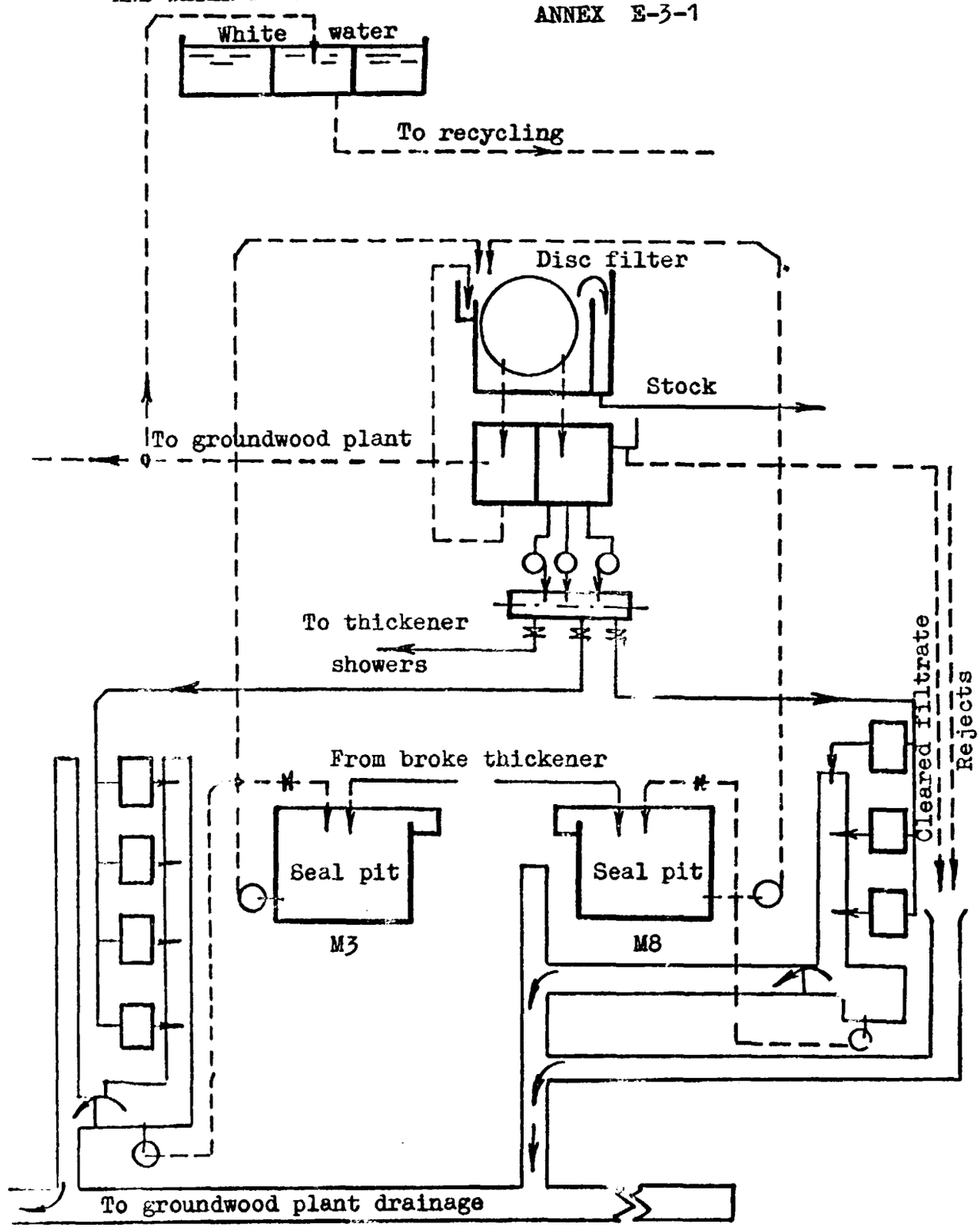
ANNEX E-3-1



Existing vacuum pump water recycling system at the paper machines M3 and M8.

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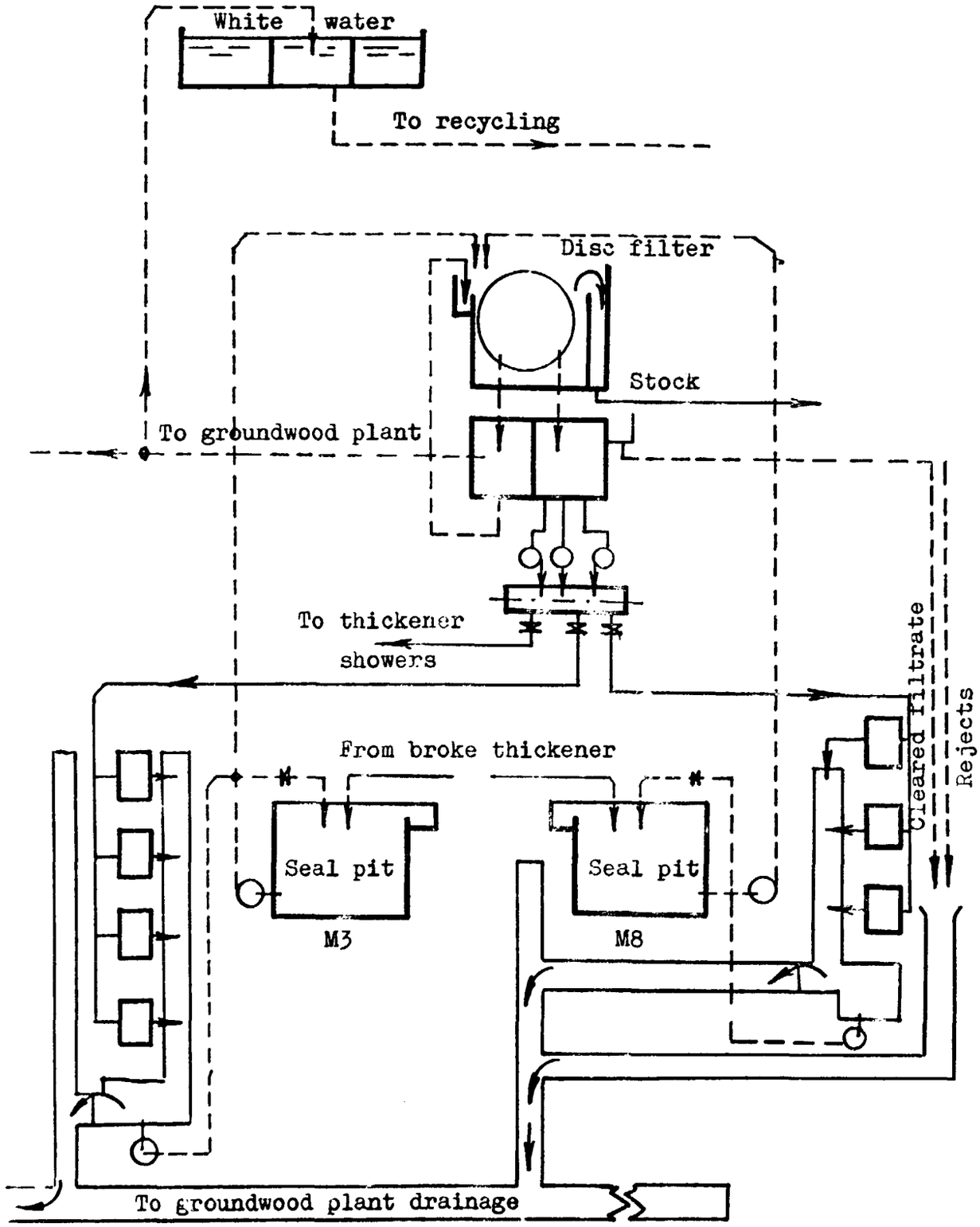
ANNEX E-3-2



Modified vacuum pump water recycling system
at the paper machines M3 and M8

Polydisc filter efficiency

	Process	Suspended solids content, g/l					Average SS, g/l	Ash, g/l
1	Paper machines M3, M8							
	Inlet (pulp+white water)	3.32	2.62	3.56	3.11	3.50	3.22	23.15
	Sweetener stock	42.19	37.78	43.17	39.30	43.41	41.17	20.02
	Cloudy filtrate	0.53	0.42	0.64	0.73	0.89	0.64	48.15
	Cleared filtrate	0.53	0.39	0.41	0.40	0.49	0.44	49.32
	Shower water	-	-	-	-	0.49		
2	Groundwood plant disc filter							
	Groundwood pulp, inlet	5.36	-	4.12	7.06	6.33	6.75	1.73
	- " - outlet	88.07	-	88.13	84.16	99.05	8.98	0.95
	Cloudy filtrate	0.46	-	0.46	-	0.31	0.41	1.75
	Cleared filtrate	0.37	-	0.43	-	0.28	0.36	2.35
	Shower water	-	-	-	-	0.20		-

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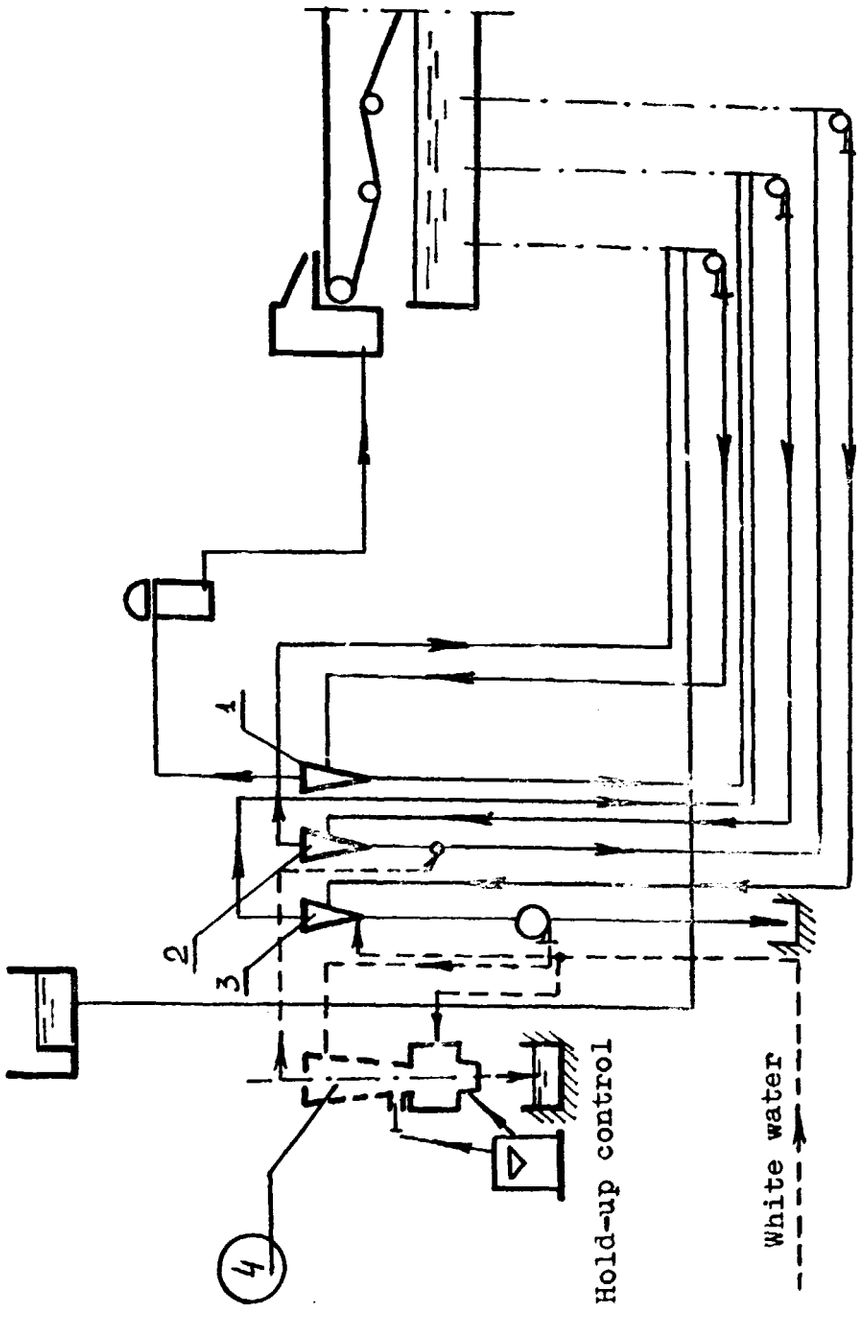
ANNEX E-5



Basic design with an additional unit for reject reduction:
1-3 - existing process
4 - additional centricleaner with a periodically functioning chamber

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ANNEX E-6

Mill No 4

Fiber losses reduction

1. The calculation of filtrate volume from pulp thickeners

Pulp from sulphite plant	Flow, t/h	Concentration, %	Filtrate, m^3/t	Filtrate, m^3/h	Filtrate to drainage, m^3/h	Shower water, m^3/h
Bleached pulp thickener						
Inlet	1.35	1.7	53.0	72.0	44.0	15.0
Outlet		3.5	20.0	28.0		
Unbleached pulp thickener						
Inlet	1.35	1.46	60.0	81.0	59.0	15.0
Outlet		3.5	20.0	28.0		

The filtrate volume from both thickeners to the drainage system is 133 m^3/h.

Fiber losses:

133 x 0.23 = 31.7 kg/h or 736 kg/d

where 0.23 g/l is suspended solids.

2. Suspended solids and fiber losses with rejects from the last stage centricleaners

a) Machine M3

Suspended solids losses: 27.72 x 2.5 = 69.3 kg/h or 1663 kg/d
Fiber losses: 1663 x 0.36 = 598,7 kg/d
where rejects from last stage centricleaners are 27.72 g/l, ash content is 64.0%, flow rate is 2.5 m^3/h (Annex E-1).

b) Machine M8

Suspended solids losses: 11.6 x 15.3 = 177.5 kg/h or 4529 kg/d

Annex E-6 cont'd

Fiber losses: 4529 x 0.55 = 2343 kg/d
where rejects from last stage centricleaners are 11.6 g/l, ash content is 45.5%, flow rate is 15.3 m^3/h.

3. Losses with overflow from the schleifer white water collecting tank.

Fiber losses: 96 x 0.34 = 32.0 kg/h or 768 kg/d
where 90-120 m^3/h is excess white water to the drainage.

Data on suspended solids and fiber reduction

	Present kg/d	After modernization kg/d	Reduction kg/
1. Rejects from centricleaners: M3 + M8	1663 + 4529	1859	4334
2. Filtrate from pulp thickeners	736	220	516
3. Excess water from the wet end of M3 and M8	1042	416	626
4. Overflow from the schleifer collecting tank	768	307	461
			5935

Percentage of total suspended solids reduction:

$$\frac{5935}{11920} \cdot 100 = 51.2\ \%$$

where fiber losses reduction : $\frac{5935 \times 0.76}{9180} \times 100 = 49.0\ \%$

The values 11,920 kg/d and 9,180 kg/d are taken from the daily report data (Annex G-1).

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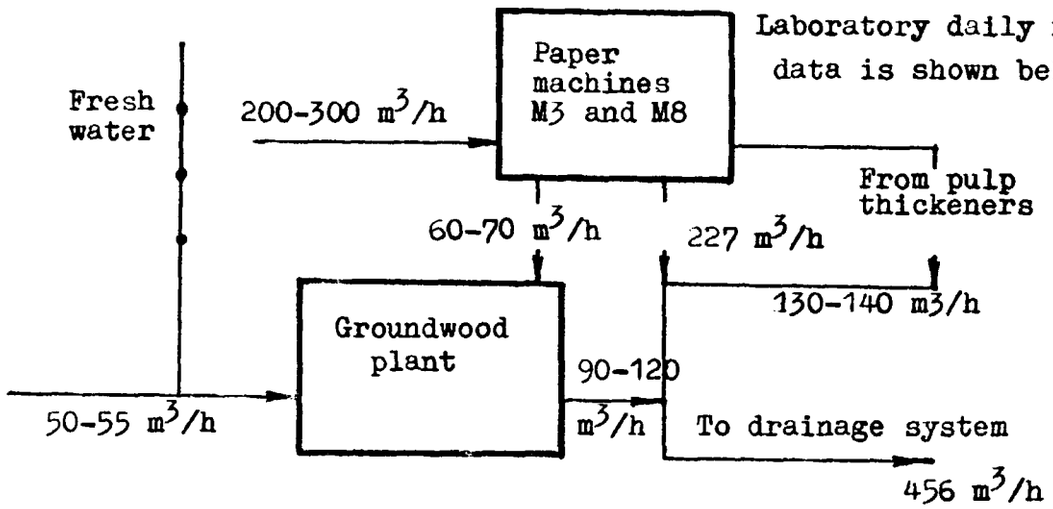
ANNEX E-7

Mill No 4
Waste water reduction

The basic waste water balance according to the Central Laboratory daily report data is shown below



Waste water reduction

Measures	Waste water, m³/h		
	Present	After modernization	Reduction
1. Reuse of pulp thickener filtrate	130-140	30	100
2. Closure of the vacuum pump water system	227	160-180	40
3. Improvement of polydisc filter operation at the groundwood plant	110	50-70	40
Total (approx)	456	240-280	180

Waste water reduction to the drainage system

$$\frac{180}{456} \cdot 100 = 39.4\ \%$$

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ANNEX F-1

Mill No 5

Wrapping paper

Efficiency of fiber recovery units and filtrate quality

White water	Suspended solids, g/l				Average SS, g/l
	1	2	3	4	
Paper machine M5					
a) Waco filter:					
Input	0.89	0.80	0.78	1.04	0.88
Clear filtrate	0.47	0.58	0.61	0.78	0.58
Collecting tank	0.21	0.53	0.61	0.44	0.45
Sweetener stock	30.20	30.80	22.45	3.30	29.40
b) Vacuum pump sealing water	0.64		0.50	0.64	0.59
Paper machine M10					
a) Polydisc filter:					
Input	3.88	1.70	6.63	3.30	3.10
Cloudy filtrate		0.40	0.23	0.18	0.27
Clear filtrate	0.29	0.17	0.11	0.13	0.17
Sweetener stock	22.84	14.20	18.3		18.43
b) Vacuum pump sealing water					
Cleared filtrate	0.30	0.52	0.39		0.42
Cloudy filtrate				0.80	0.80

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ANNEX F-2

Mill No 5

Waste water and fiber losses
reduction

Paper Machine M5

Excess water with pulp from other mill
(Unbleached pulp and waste newsprint) ..... 44-52 m^3/h

Paper Machine M10

Excess water with bleached pulp ..... 67 m^3/h
with straw/reed pulp ..... 44-52 m^3/h

Waste water (daily report data) ..... 288 m^3/h

Fresh water ..... 288-96 = 192 m^3/h
Specific fresh water consumption:
192 : 2.9 = ... 66.2 m^3/h

The use of cleared water (filtrate) from the disc filter instead of fresh water in the collecting tank under the Waco filter would reduce the waste water discharge approximately by 60-65 m^3/h.

The modernization of the Waco filter will increase its efficiency from 32% to 70%.

The suspended solids losses to the drainage would be reduced:

60 (0.58-0.24) = 20.4 kg/h

where 0.58 g/l is the present content of suspended solids after the Waco filter,

0.24 g/l is suspended solids after modification of the Waco filter.

For the additional reduction of suspended solids, cleared filtrate should be used instead of cloudy filtrate at pump No 4:

40 m^3/h (0.8-0.17) = 25.2 kg/h

Annex F-2 cont'd

The total reduction of suspended solids:

45.6 kg/h x 24 = 1094 kg/d.

Fiber losses reduction is approximately 660 kg/d

or

$$\frac{660}{1510} \times 100 = 44.0\ \%$$

Fiber losses to the drainage: 1.85%

Waste water reduction: (60/288) x 100 = 24.3%

Specific fresh water consumption: (192 - 60)/2.9 = 45.5 m^3/t

A N N E X G

GENERAL DATA ON FIBER LOSSES AND WATER REDUCTION

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ANNEX G-1

Present data on waste water discharge
and fiber losses

Significants	Units	Mills				
		1	2	3	4	5
1. Production capacity	t/d	62.5	14.0	140.5	129.6	53.4
2. Waste water discharge	m^3/t	133.3	394.8	95.8	84.9	128.0
average	m^3/h	386.7	229	571.0	456.0	288.0
max.	"	430.0	-	665.0	588.0	332.0
min.	"	310.0	-	420.0	359.0	238.0
3. Suspended solids						
average	g/l	0.95	0.65	0.607	1.29	0.34
max.	"	1.46	-	0.98	1.44	0.61
min.	"	0.10	-	0.44	0.77	0.29
4. Ash content	%	42.0	30	25.2	22.4	31.6
5. Suspended solids losses	t/d	8.64	0.87	7.04	11.92	2.32
6. Fiber losses	t/d	5.03	0.61	5.52	9.18	1.51
	kg/t	81.0	43.5	39.4	69.6	28.2

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ANNEX G-2

Water recycling operation data after modernization

Significants	Units	Mills				
		1	2	3	4	5
1. Production capacity	t/d	70.0	14.0	140.5	145.0	70.0
2. Fresh water	m^3/t	57.6	310.3	76.2	44.4	45.5
	m^3/h	150.0	180.0	450.0	240.0	132.0
3. Waste water	m^3/t	66.5	272.0	72.4	50.5	75.8
	m^3h	166.0	160.0	420.0	273.0	220.0
4. Suspended solids	g/l	0.90	-	0.51	0.97	0.25
5. Fiber losses	t/d	3.06	-	4.13	5.15	1.32
	kg/t	49.5	6.9*	29.5	35.5	18.6

* Without pulping department

Average suspended solids content in waste water discharged to the sewer is 0.54-0.60 g/l.

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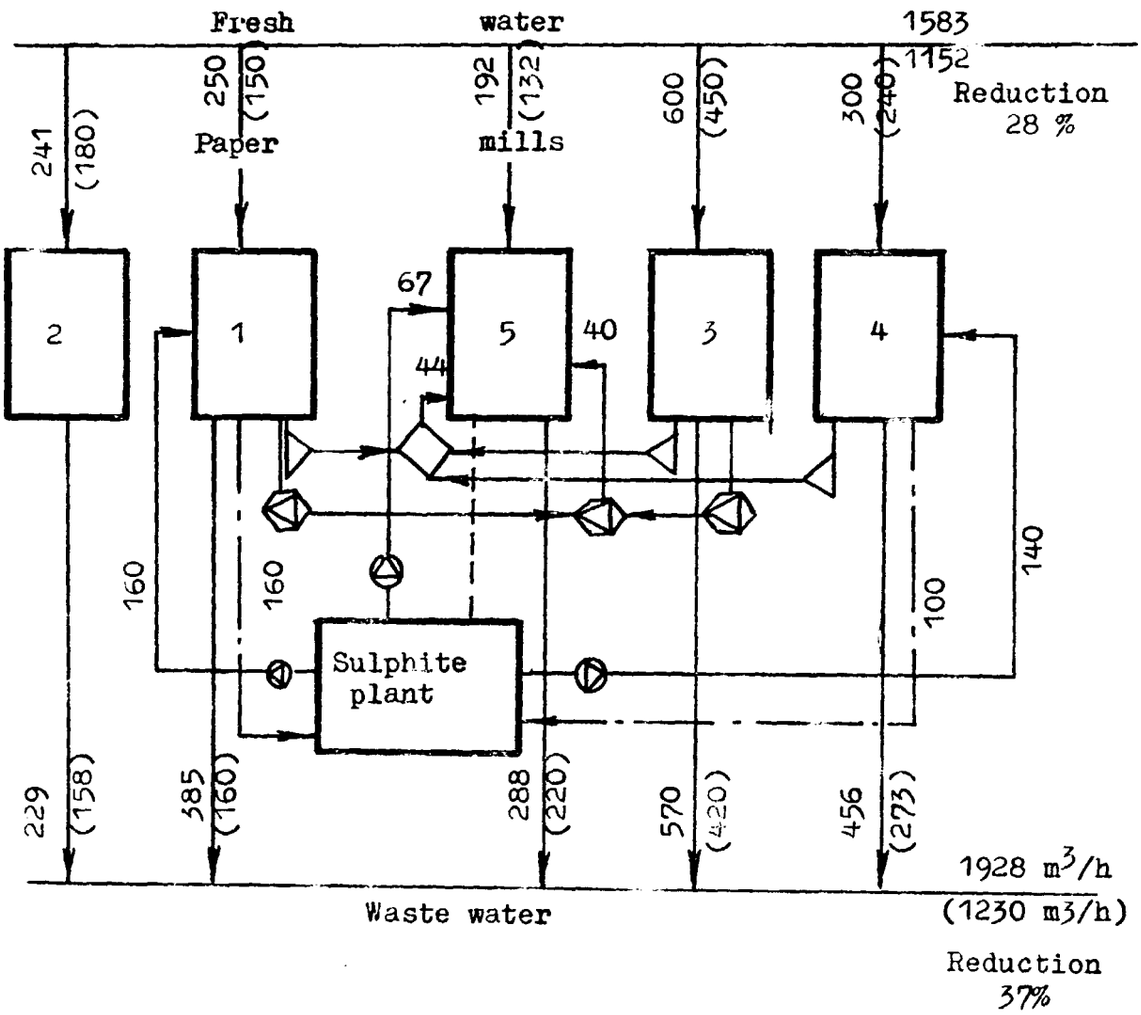
ANNEX G-3

Basic water balance for the Izmit Paper Mills
m^3/h



Groundwood pulp

Waste paper pulp

Sulphite pulp

250 ——— Present System

(150)___ .___ Future System

The existing data on fresh water consumption are based on the material balance calculated by the expert.

The existing data on waste water discharge are taken according to the daily report.

ANNEX G-4

Fiber losses and water reduction

	Units	Present	Future	Reduction, %
Mill No 1				
Fiber losses	kg/t	81.0	49.5	39.5
Fresh water	m^3/t	85.0	57.5	32.0
Waste water	"	133.0	60.0	51.0
Mill No 2				
Fiber losses *	kg/t	43.5	6.9	84.0
Fresh water	m^3/t	283.0	253.0	10.6
Waste water	"	280.0	250.0	10.4
Mill No 3				
Fiber losses	kg/t	39.4	29.5	25.2
Fresh water	m^3/t	97.0	73.0	25.0
Waste water	"	95.8	10.8	26.2
Mill No 4				
Fiber losses	kg/t	69.6	35.5	49.0
Fresh water	m^3/t	66.5	48.0	28.0
Waste water	"	84.9	50.9	40.5
Mill No 5				
Fiber losses	kg/t	28.2	18.6	44.0
Fresh water	m^3/t	66.0	45.5	31.2
Waste water	"	128.0	95.7	24.3

* Note : Without pulping department.

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ANNEX G-5

List of additional fiber recovery equipment

1.	Side hill screen Enso-Bauer Type	Mill No 1 Machine M1 Machine M2	Capacity 100 m^3/h-1 400 m^3/h-1	Enso-Gutzeit PL 34 SF-57101 Savonlinna 10, Finland Tel. 57-21936, Telex 5613 enso sf
2.	"	Mill No 3 Straw pulp washing thickeners	Capacity 100 m^3/h-1	"
3.	"	Mill No 4 Shower system of polydisc filter at groundwood plant	Capacity 200-250 m^3/h-1	"
4.	Flotation unit	Mill No 2 Machine M4	Capacity 80-100 m^3/h	Krofta Apparatebau GmbH, Postfach 1365, 6370 Oberursel 1, Germany
5.	DMS DORR-Oliver screen (additional cleaning information)			AB.Hedemura Verkstäden 77600 Hedemura · Sweden Tel. 0225/12000 Telex 7549 Cables Hedverk
6.	Enso-Twincleaner type (additional unit)			Enso-Gutzeit PL 34 SF-57101 Savonlinna 10, Finland Tel. 57-21936, Telex 5613 enso sf

Annex G-5, cont'd

Questionnaire for equipment order

In Expert's opinion, when ordering additional equipment for fiber recovery, it is necessary to consider the following aspects:

1. Product grade
2. Unit position (equipment function)
3. Water volume to be treated (m^3/h) (l/min)
4. Suspended solids content, mg/l
5. Ash content, %
6. Freeness, °SR

ANNEX G-6

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