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WASTEWATER PROBLEMS IN FLAX PROCESSING[1]

HUNGARY

(IS/HUN/74/012)

Terminal report

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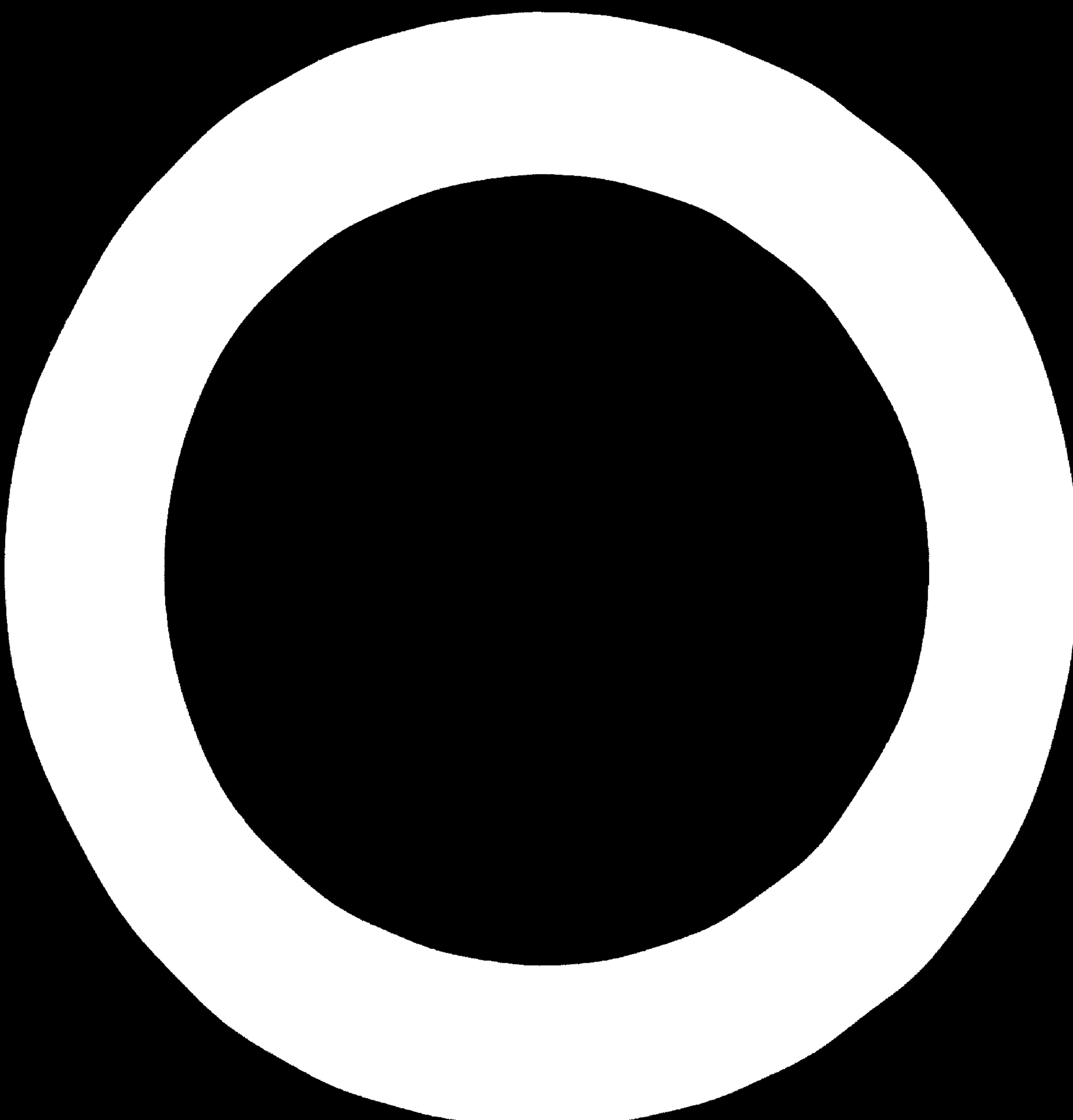

I. TABLE OF CONTENTS

TABLE OF CONTENTS /Continued/ Page No.

-x-x-x-x-x-x-x-

II. SUMMARY

A 60 day preliminary study was made during July and August, 1975 of the Hungarian flax processing industry wastewater disposal problems.

Ten flax plants and three other types of industrial plants were visited and two major conferences and many separate discussions were held during this period. A general knowledge was obtained and described in the Report of the flax industry, water quality in receiving streams, water pollution abatement problems and procedure and State views and procedures for pollution abatement.

Eight specific recommendations were made and ten suggestions for individual plant procedures were given during the study. All are included in this Report.

III. INTRODUCTION

A. DESCRIPTION OF TEXTILE PROBLEM

The textile industry in Hungary is an ancient endeavour and currently produces more than 77,000 m^3 of total wastewater per day. At present there are 10,000 hectares of land used for growing flax. There are 8 relatively small factories processing flax by retting. Both cold and hot water retting are used. There are 2 wet spinning mills with bleaching and 4 weaving mills /3 of which have finishing/. The reader is referred to Appendix No. 5 for the location of these plants in Hungary.

Because of the shortage of workers for this type of industrial production and prevalence of air and water pollution problem flax production is currently in a state of redevelopment. The final product is a necessity for Hungary and, therefore, the industry is in little danger of being eliminated.

In the last five years fines for water pollution have become increasingly severe. In 1973, the textile industry in Hungary paid 22 million Fts for such penalties. Also publicity concerning this pollution has been increasing. Therefore, a desire and some urgency exists for water pollution abatement of the flax processing plants.

Although similar severe problems are found in Hungary in cotton, wool, synthetic, and hemp textile processing plants, they will not be subjects of this Report. The writer visited these plants also as well as a large old tannery.

B. DESCRIPTION OF DANUBE BASIN

The Danube River is the largest river in Hungary /See Appendix No. 13/, discharging a mean flow of 1420 m^3/sec. All of the flax retting plants discharge their wastewaters into this basin. The river enters Hungary from Austria in the northwestern corner of the state carrying a mean flow of 1300 m^3/sec, travels easterly along the northern country border to about halfway across the state and then turns and flows south through Budapest and leaves the state to the east of Pécs and flows into Yugoslavia. The river appeare to be in a remarkably clean state considering all the many sewages and wastes it receives. The river in the vicinity of Budapest is a very turbid grey /not the renowned "blue" once written about/ and often reveals dead fish although fishing is practised. No odors or visual contamination in the Danube at Budapest indicating either sewage or textile waste were apparent to the writer. No specific or detailed analysis of the Danube was made available to this writer. Only the general values as given in Appendix 11 and 14 were presented to the writer.

C. MEETINGS

In order to accomplish the objectives of this Report conferences with the Design and Planning Office, National Office of Water Authority, Ministry of Light Industry, Linen Industry Organization in addition to the flax processing plants and other industrial plant visits were carried out during the period between June 30th and August 17th, 1975. The personnel attending these conferences and the associated dates are shown for the record in Appendix No. 6.

D. PRODUCTS OF FLAX

The seed of the flax plant is used for 3 products

1 - seed for additional plants
2 - linseed oil
3 - varnish from contaminated seed

The tow /or separated outside plant shell/ is used for two additional products

1 - plywood or fibreboard
2 - twine

The bast fibre /thin fibre from within the shell/ is used for the final purpose of

1 - linen fibre to be spun into yarn

About 25% of the flax plant ends up as tow or bast fibre, normally 10% of bast or long fibre and 15% tow, a short fibre.

E. COST OF FLAX PRODUCTION

Farmers are paid a state-controlled price of about 3 Forints per kg for flax plants. The price of retted, dried flax product is 48 to 70 Fts per kg depending on the grade of flax. The yield of flax fibre is only about 10% for bast, and 15-17% for tow fibre.

The increasedproduction cost resulting from the need for new and more modern machinery, increasing land needs, and the pressure for higher wages from a dwindling labour supply, is of some concern to the future of this industry.

IV. FINDINGS

A. GENERAL

/1/ Pollution problem

Flax plant wastewaters are primarily retting wastes which contain excessive organic matter, minerals, and sulfides and generally possess a low pH. The only effective flax wastewater treatment in Hungary has been land disposal and then only with limited success. These wastes are generally discharged into a live stream leading to excessive color, odor, and oxygen demand. The accompanying air pollution, fish kills and appearences of streams have aroused the public and encouraged fines by the state. The flax processing plants now seek relief from these fines and public pressures.

/2/ Flax plant administrative lines

The flax industry is the responsibility of the Ministry of Light Industry /See Appendix No. 4/. Under this system of Government the plant manager must seek advice, support and approval of both the LENFONÓ ÉS SZÖVŐIPARI VÁLLALAT /Hungarian Linen Wks/ and the Ministry of Light Industry in matters related to pollution control. Money for environmental protection including wastewater treatment, originates from 3 main sources: /1/ plant private development fund /2/ OVH fine for pollution excess special fund /3/ credit in the bank awarded by the State. The total amount of these monetary sources is limited and the amount allocated to any one plant depends upon many factors such as need, subjective decision and product orientation.

/3/ Effluent standards

Hungary uses a system of effluent standards for controlling excess contamination in its receiving streams. The standards used appear to be designed to be attainable within reason as a result of typical secondary treatment of a wastewater comparable in organic strength to normal domestic sewage. For example, effluents discharged to live streams have a permissible limit of 75 ppm of dichromate oxygen demand /See Appendices 1 and 2/. Two different sets of effluent standards are used; one for discharge into live streams and one for discharge into municipal sewers. Apparently, the standards apply equally to industrial and municipal effluents. However, the demands for compliance based largely on the penalty system /See Appendix 3/ are focused mainly on industrial effluents. This has resulted in an absence of interest and urgency for municipal sewage treatment systems and an equal absence in modern sewage treatment plants with capacity sufficient to handle industrial effluents. Therefore, industrial effluents are seldom approved for disposal in municipal sewers. Perhaps, this practice is enhanced by the absence of any limit for dichromate oxygen demand in municipal sewers. There are also apparent inconsistencies between the two sets of effluent standards; such as suspended settleable solids of 75 ppm for municipal sewers while total suspended solids of 1000 ppm for live streams whereas the penalty for excess of each standard /0,5 Fts/kg/ is the same.

The rationale for using a COD rather than a BOD effluent standard is difficult to understand for a country which is in its infancy as far as waste treatment is concerned. Presumably, the purpose of this standard is one of convenience of analysis. The standard may be reasonable for normal domestic sewage treated effluents but is extremely difficult to attain with a retting wastewater, tannery, or pulpmill effluent even after effective secondary treatment.

There is also no evidence that attainment of even these effluent standards will protect and preserve the receiving water quality of rivers in Hungary. In fact, there appears to be no differentiation made between the large volume and load producer of wastewater and the very small volume and load contributor. Both are required to attain the same effluent quality.

/4/ The penalty systems and organization of water pollution control

The national laws related to water pollution control are published in VIZÜGYI ÉRTESITŐ XVI and XVII 25 and 29 in December 8 and 30, 1969. The contaminant limits for discharge into live streams and into municipal sewers as well as the penalties imposed for exceeding these limits are published in these references as shown in Appendices 1, 2, 3 of this Report. The rules and regulations are promulgated and supervised by the National Water Authority /OVH/. The responsibilities of this central authority are distributed to 12 regional offices as shown in Appendix 12. The authority acts independently of any ministry and possesses a responsibility similar to a ministry.

The fines for excess contaminants are expressed in Hungarian forints per kilogram of wastewater as shown in Appendix 3. The penalties imposed on flax processing plants have been for the following 5 contaminants: O_2 demand, pH, total salts, total suspended solids, and sulfide. It is interesting to note that there is no penalty for O_2 demand or total salts when discharged into municipal sewers and that the penalty for sulfides in live streams is twice that of municipal sewers. In addition, despite the same forint charge for excess suspended solids the total charge will be less for live streams because of the description differences in the tests /already discussed in IV A/3/ /. The pH penalty will also be three times as great for wastes in municipal sewers than for live streams. The rationale for these discrepancies in charges is not evident.

The computation of the prices is quite arbitrary at best since it is generally based on random sampling and may not represent the true average contaminant level nor wastewater volume of the plant in question. Moreover, their penalty system has been modified in 1972 /See Ipari Vizgazdálkodás, Vol. 6, by Mándory Károly, p. 179, Budapest, 1972/, to include variations for /1/ discharging into the center of streams ather than at the bank /2/ any unknown contaminants which may affect the self purification ability of the receiving water; that is its capacity to deoxygenate and reaerate in normal manner and /3/ any or all of six other receiving water utilization concerns. Since these modifications to the basic fine rate are rather unique and interesting since they have considerable validity, they are summarized in Appendix No. 15. All these factors tend to provide the OVH with the ability to lessen or raise the fine of a given plant when external effects are considered.

An unpublished but highly practised procedure used by the OVH is the progressive increase or decrease in yearly penalty rate based on the attempt of the plant to resolve its wastewater treatment problem. It represents a "bonus" given to the plant for making progress or an additional fine for lack of progress. The practice in some instances has been to double the basic fine rate the second year, triple it the 3rd year, etc., when no progress has been made. The limit for this increase has been 5 years.

Certainly, the penalty system has played a major role in encouraging plants to install waste treatment. Of all the fines collected by OVH 80 to 90% are from industrial plants while only 10 to 20% are from municipal sources. A total of about 200 million Fts are collected each year by the OVH. This money is available for expenditure for water quality maintenance only for all plants and municipalities. An industrial plant is free to make its own proposal to the Central OVH for water pollution abatement.

Although combined municipal and textile waste treatment is technically and theoretically feasible in many cases it is seldom practised. There is no provision for state monetary support to either industry or municipality for such combined treatment. A central fund for this purpose would certainly enhance combined treatment where feasible.

In general operation a textile plant assigns the task of pollution abatement to the Designers Office. A preliminary plan is then evolved from the Designers Office and presented to the Regional Office of the OVH. This regional office provides preliminary technical approval for detail design by the Designers Office. But the Designers Office must obtain approval of the Central OVH before final design and actual construction can proceed.

Whereas previously little concern was given to pollution abatement in new plant construction, now a joint effort between the OVH and the National Planning Office proposes supervision of new construction technology to include wastewater treatment.

/5/ <u>Hungarian Surface Water Quality</u>

All surface waters are divided into 3 categories /I, II, III/. Specific contaminant quality levels are established for each of the 3 categories as shown in Appendix No. 11. From multicolor maps prepared by the

OVH the following conclusions appear to be significant:

A - The mineral content of the Danube is Class I from the Austrian border inlet to the Yugoslavian border exit

B - The oxygen and BOD parameters of the Danube place it in Class II during most of its length until the Southern end when it returns to Class I

C - The NH_4^+ $NO_3^=$, pH, Fe, Mn, phenol, detergent, Cn and oil contaminants place the Danube in Class II during its entire length of flow in Hungary.

Other streams of interest in the flax processing industry received the following classifications by the OVH in the area of the plants

Stream	Mineral content	Oxygen parameter	NH_4^+ etc.
Rába /Győr/	Class II	Class I	Class I
Zala	Class II	Class II	Class II
Dráva	Class I	Class I	Class II
Repce	Class I	Class I	Class I
Rába /Szombathely/	Class II	Class I	Class I

There are no Class III waters of large stream importance receiving flax retting wastes. However, very small streams remain unclassified by this system. As shown in Appendix No. 14 only 1,0% of streams are below Class II in oxygen parameters; 0,1% in inorganics, and 24% in the other special parameters such as NH_4, NO_3, etc. It also seems quite difficult to classify a surface stream in any given category when only one of many contaminant parameters exceeds the limit. Obviously this classification system is highly subjective despite the specific contaminant values given in Appendix No. 11.

Hungary receives streamflow from many sources but discharges flows to other countries mainly in only the Danube and Tisza /See Appendix No. 13/. While international committees do exist and international standards are published they cannot be maintained in reality because of the difficulties of establishing the original contaminant source.

/6/ <u>Types of flax retting</u>

Two basic types of flax retting are in common usage in Hungary

/1/ the closed or Belgian system and
/2/ the open system.

The closed system takes place in covered tanks usually heated and in two stages; the first which uses up the available oxygen and the second which is entirely anaerobic. The entire process is similar to the anaerobic batch decomposition of domestic sewage sludge and requires about 90 hours depending on temperature /optimum: 35°C/. The open system is at least partially aerobic and in fact, is generally aided by aeration with compressed air. The open tanks allow the retting liquor to cool below the optimum temperature and therefore must be heated by steam or utilize natural thermal waters as occur in many parts in Hungary. Retting takes longer in the open from 5 to 7 days.

The open system, despite the inability to use it during cold weather, produces a more uniform fibre and requires only about 37% of the manpower as the closed system. Workers object to the working environment of the Belgium closed system /hot - 50°C and humid inside/. Since a manpower shortage exists in the Hungarian flax industry

/as in other industries in Hungary/, the trend is toward the use of the open retting system. The advantage of shorter retting time of closed retting is also somewhat defeated by the constraint of slower drying during winter and raining seasons.

B. SPECIFIC PLANTS

1. Plant No.1 /Budakalászi/ /Central Manufacturing Plant/

This plant is located just north of Budapest on the West side of the Danube /See Map, Appendix 5/. The plant employs about 1,500 workers, uses about 700,000 m^3 /186,000,000 gals/ of water per year and discharges about 600,000 m^3 /159,000,000 gals/ of wastewater per year and manufacutres about 10,000,000 m^2 of cloth per year. Based upon a 280 day work year the wastewater volume equals about 2,140 m^3 /570,000 gals/ per day. Plant No.1 weaves and finishes its raw material /50% cotton, 35% flax, and 15% synthetics [polyester-polyacrylonitrile] /. The wastewater is known to contain approximately the following contaminants

pH	8,4 - 10
O_2 dichromate demand	340-880 mg/l
Na^+	67 - 76,4 mg/l
organic solvents /grease and oil/	6 - 35,2 mg/l

It is discharged into the Barát River which empties into the Danube untreated after about 600 yards. The plant has paid in excess of 255,000 Forints pollution penalty each year since 1972. The penalty has been largely based upon Na^+, pH, and dichromate oxygen demand. However, a key factor in this problem is that within five or so years the Budapest Sewer System will be extended to the plant and the wastewater accepted into the sewer system. At that time Na^+ and O_2 demand will not be as restrictive.

It was apparent that a solution to the high pH and accompanying high oxygen demand should be recommended, but that it should involve a minimum of permanent expenses at this time /with a sacrifice in some contaminant removal efficiency/. At this point two in-plant modifications seemed possible to avoid extensive final wastewater treatment: /1/ dialysis of mercerizing wastes and /2/ air flotation or filtration of kier boil-off. A sampling and analysis program at 4 locations was recommended. These results are shown in Appendix 7. Equalization of the wasted kier and other finishing wastes would serve to reduce the peak contaminant concentrations.

The mercerizing wastewater contains considerable suspended matter and therefore must be floated prior to dialysis /See Appendix 7/. As expected the alkalinity and pH values of this wastewater are very high and warrant recovery and reuse as recommended. The kier boil also must be air floated and filtered before recovery and reuse in kiering. It is extremely heavy in suspended matter /more than 10,000 mg/l/. Pilot experiments should be carried out to confirm these recommended solutions. The kier boil as well as the mercerizing waste is extremely high in C.O.D. /more than 20,000 ppm/ and demands recovery in order to lessen the fine charge.

2. Plant No. 2 /Csillaghegyi Szövőgyár/

This plant is located in Budapest /north west part of City/ on the west bank of the Danube /See Map Appendix 5/.

The plant employs about 700 people and produces 3,000,000 m^2 per year of woven fabric /largely canvas/. Its raw material is about 83% double-twisted cotton yarn and 17% single or twisted blended flax. The plant operates 24 hours per day for 5 days and 8 hours per day on the sixth day. Wastewater volume totals about 200,000 m^3 per year or, for 280 days about 600 m^3 per day /159,000 gals per day/. Dyeing and finishing is the first and foremost wet processing source of wastewater. Only 9 m^3 per day are estimated lost in dyeing; the wastewater then is about 591 m^3/day. The woven goods are largely jig dyed and largely with sulfur-type dyes and strong penetrants. The plant sewer is a combined one. The jigs empty into a main collection tank of 1 x 1 meters and about 70 cm deep and containing an inclined hand-cleaned bar screen. After this location other wastewaters such as naphthol dyes from pads, water-repellant finishel /Al $(OH)_3$/, water softening wastes from boilers, and oily water from fuel oil tanks are discharged. Penalties in 1973 and 1974 of 120,000 and 60,000 Forints were assessed for wastewater discharge into the Budapest City Sewer. The wastewater flows along with the Budapest domestic sewage untreated to the Danube River. There does not appear to be a direct correlation between the calculated penalty and the actual penalty paid by the plant. However, as evident from a letter dated July 10, 1974 to the plant, the penalty assessed was based on 5 contaminants; acidity, sulfide, alkalinity, organic solvent extractable matter and settleable solids. The penalty is made by the City Sewer Agency of the City Council. Space for wastewater treatment is limited since the plant is surrounded by a residential area. Since there were two major sources of wastewater for which penalties were assessed, sampling and analysis of the Jig Effluent Screen Chamber and the

Oil Condensate sump from fuel oil storage were recommended. These results are shown in Appendix No. 8. At this point a preliminary appraisal of a logical solution to the wastewater problem was as follows:

1 - Create two separate dye wastewater systems by separating the jig dye waste from the rinsewater

x2 - Reduce pH /by acid or flue gas/ of the jig dye waste to emit H_2S

x3 - Burn H_2S in boiler to SO_2 and absorb the SO_2 in water, or
absorb H_2S directly on iron scrap to form FeS which could then be removed periodically and sold to steel mills

4 - Equalize all the remainder of the dye wastes to avoid acid or alkaline "slug" loads. Use mechanical screens to remove large fibres and rags

5 - Settle to remove settleable suspended solids

6 - Remove oil as a separate wastewater treatment by skimming if necessary in fuel oil - water separator.

From Appendix 8 - 1 data it can be seen that the hourly variation in oil and grease escaping to sewer from the fuel oil storage tank is great /24 to 13,746 mg/l/. Oil of some quantity is always present and, even after dilution with the other plant wastes, will often exceed the 60 mg/l limit in municipal sewers. Skimming oil in a one to four hour retention tank is definitely

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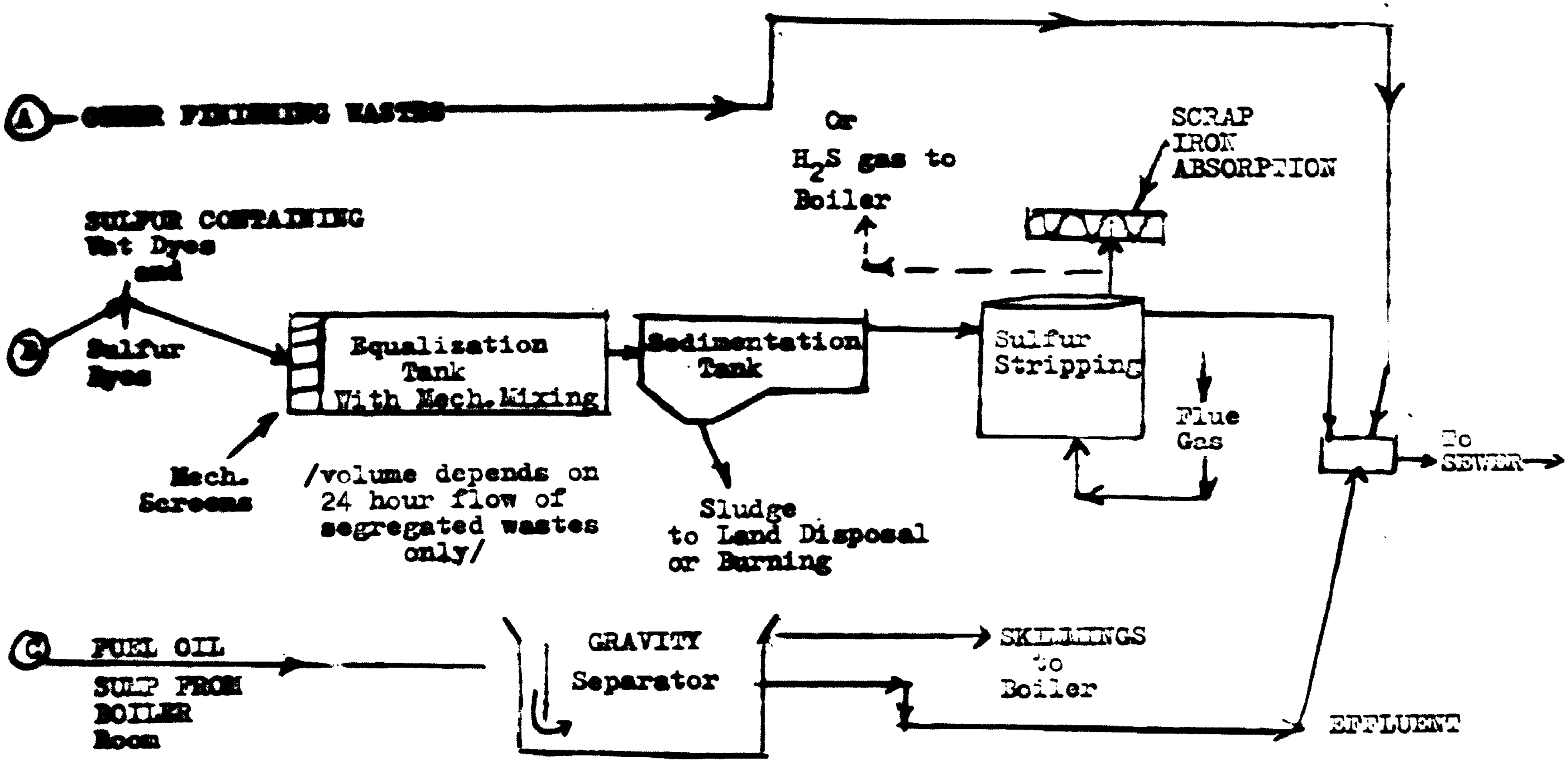
x An alternative to removing S by stripping with acid or CO_2 may be biological oxidation to $SO_4^{=}$.

required to prevent this escape of contaminant. Since this type of fuel oil should be immiscible with water, it can be separated merely by gravity separation. Flotation with air and chemicals should not be required. The exact size of the skimming tank must depend upon the temperature and turbulence of the contents. Actual prototype experimental data is advisable prior to detailed design of the oil removal tank. The skimmed oil can be burned with other fuel oil in the boilers.

From Appendix 8-2 data it is shown that the hourly variations in pH /5,0 - 11,4/, alkalinity /0 - 22,49 mg/l/, COD /118 - 2,940 mg/l/, settleable solids /0 - 600 ml/l/ and sulfide /0 - 988 mg/l/ are extreme. Equalization of these wastes over the entire 24 hours is an absolute necessity to reduce charges and, to enhance removal of suspended solids. Even after segregation of the jig dye and finishing wastes there were periods when the sulfide ion content was zero. Therefore, equalization will always be necessary to level off the sulfide concentration for stripping. After equalization the concentration still will be high enough /about 400 ppm/ for effective stripping by reduced pH. The sequence of treatment after segregation of all sulfur and sulfur-containing vat dyeing from other dyeing and finishing should be as illustrated below:



Now, that the treatment required and order of units are established, the specific treatment unit designs should be made after laboratory prototype experimentation.

Plant No. 3 /Budapesti Fonógyár/ is located in the center of Buda west of the Danube /See Map, Appendix 5/. The plant is a spinning mill only. It receives 1400 tons of flax, 500 tons of flax waste /tow/, 350 tons polyacrylonitrile-polyester, 350 tons of wool-polyamide-polyacrylonitrile /for carpet industry by commission/. The plant uses three main processes /1/ water spinning, /2/ kier boiling and /3/ bleaching. The wastewater of 150,000 m^3/year goes to the City sewer with no treatment and no penalties for excessive contaminants. This mill apparently has no pollution problem since Na^+ is the only major contaminant - but no limit has been set for this value in "live sewers". Also, oxygen demand may be high, but because of high degree of dilution with bleaching and rinse waters and lack of a limit established for sewers no fines have been imposed. Until and unless future analyses show excess contamination no expenditure for wastewater treatment is recommended at this plant. However, it would be appropriate if the final effluent was sampled and analysed sometime when convenient for actual volume, Na^+, oxygen demand, and pH of a 24 hour composite.

4. Plant No. 4 /Komárom/ is located 60 miles northwest of Budapest on the Danube /See Map, Appendix 5/. Actually 2 separate plant operations are carried out here /1/ flax retting and /2/ flax spinning, weaving and doubling.

4-1 The flax is picked, deseeded, bundled loaded on racks and onto railroad car tracks and into 8 retting tunnels totaling 2,566 m^2 of which 1,554 m^2 is useful capacity. The retting tanks are covered and, therefore useful for 230 days per year and 24 hrs per day. The useful capacity of the retting tanks is 4500 raw tons of deseeded flax per year, 300 tons of flax solid waste result from retting. Retting is carried out at 23-30°C by mixing hot and cold waters from wells and takes 90 hrs/about 4 days/ for one complete cycle. No chemicals are added. The closed system conserves the heat and is said to provide a better distribution of biological activity than the open system. It is essentially a 2 - stage digestion or anaerobic fermentation process which swells the flax fibre tube and loosens the bast flax fibre within the tube. 70-80,000 m³ of retting liquid are discharged from the retting tanks per year by pumping into 4 lagoons for evaporation and draining. These lagoons are located about 1 mile from the plant in an isolated area. There is no discharge from the lagoons except in unusual wet weather in the fall or spring. The lagoons are overgrown completely with a tall /6-10 feet/ cane type of vegetation. There were no amounts of residual retting liquor nor odors in the lagoons during our site visit on July 10, 1975. In fact, usually the last 3 lagoons connected serially to the first one are seldom used. If draining is necessary the lagoons can be drained to a collection tank from which it can be released to the municipal sewer. After the 90 hrs period of retting the flax bundles are removed and placed in adjoining fields in teepee form for drying /normally for 5 days in good weather/. No air pollution seems to develop from either the retting nor the drying process. No analyses of the retting liquor were made since authorities have not sampled because no continuous discharge occurs. Although no treatment of wastewater is recommended at this time sampling and analyses of retting liquor pumped to lagoons and to Komárom sewer is recommended for future information.

4-2 The spinning mill obtains most of its water /800 m³ per day/ from drilled wells and discharges its wastewaters directly to the Komárom public sewer. The City is now building a sewage treatment plant to serve the present population of 13,000 people which will grow to 30,000 people. This plant will have a capacity of 3000 m³ per day and will begin operation in 1978. The treatment will be a primary one involving filtration /probably screening/ and sedimentation only. The total volume of spinning mill waste is 580 m³/day. A penalty of about 112,000 Fts will be assessed based upon sampling of wastewaters on May 13, 1975 /See letter to Plant dated June 4, 1975/.

The spinning mill wastewater contained on that day

	ppm	limit	excess	kg/day
$SO_4^{=}$	58	400	NONE	
volume	580 m³/day	-		
organic solvent extract	92	60	32	18,56

Oil or grease or wax is apparently the only problem at the spinning mill. After a preliminary investigation of the water spinning operation and the receiving manhole it was evident that grease was obviously present in the wastewater. A 24 hrs sampling program of the water spinning effluent /each hour/ was recommended with analysis only for volume and oil and grease. It was recommended that the samples be allowed to stand for 1 hour, surface skimmed and the subnatant wastewater also analysed for grease and oil. These analyses are shown in Appendix No. 9. Tentative preliminary solution to the problem was thought to be grease skimming basin either with or without air flotation or cracking depending upon the percentage of miscible grease. Analysis of Appendix 9 reveals that the grease is miscible and therefore cannot be removed by simple floation. The grease must be "cracked" by chemicals /probably $CaCl_2$ and H_2SO_4/ prior to floatation. The writer recommends laboratory and pilot experiments to determine actual design data for the cracking and floatation units.

5. Plant No. 5. /Győri Lenszövőgyár/ is located in Győr about 130 miles Northwest of Budapest on the Danube River /See Map, Appendix 5/. This plant produces light colored awnings, camping bed and chair fabrics and working apparel. They manufacture by weaving and finishing yarn and piecegoods, 11,000,000 m² per year. About 60% of the production is jig-dyed of which 50% is sulfur dye types. Other dyes are mainly vat and developed. Anionic surfactants are used for emulsifiers and dichromate used for oxidizing sulfur dyes for improving color fastness. The high pH and $\bar{S}$ concentration apparently constitute the major contaminants for which fines are imposed. The wastewater is discharged from the plant without treatment and, after 500 meters it enters into a city sewer used exclusively for industry. All Győr industrial waste - including another textile mill and steel mill - discharge into this sewer. They are equalized or mixed in a tank near the Danube and then settled in another tank before being discharged to the Danube River. Previous sampling and analyses in 1973, 1974 and 1975 have shown various excess of pH and $\bar{S}$. Penalties were imposed but not representative of the true character of the wastewater. The Győr City Council fines the individual industries but in accordance with the level of fine imposed upon it by the National Water Office for discharging into a live stream /Danube/. Therefore, since some neutralization and chemical reaction undoubtedly occurs in the industrial sewer system, the actual fine imposed upon the individual plant is not

representative of the original individual plant discharge. Actual water consumption at this plant is 1200 m³ per day. No realistic analysis of the plant effluent exists - nor of the penalties imposed for excessive contaminants. Therefore, at least four, 24-hour, hourly sampling periods and analyses were recommended of the final combined plant effluent. These 24 hour periods should include various production capacity levels from 0 to 100%. Two of these results are shown in Appendix No. 10. Since certain pretreatment advantages already exist in the combined industrial wastewater treatment rather than a separate treatment of this single plants waste. A conference was also recommended to include the Győr City Council representative, the plant, the National Water Office, the Planning and Design Office and this consultant representing the Ministry of Light Industry and Lenfonó industry of Hungary. A tentative solution may be adequate equalization of the individual plant's waste followed by either /a/ chlorination /b/ chemical coagulation with $FeCl_3$ and $Ca/OH/_2$ or /c/ aeration before entering the City industrial sewer. A more appealing /but perhaps impractical/ method involves chemical coagulation of the equalized total industrial effluent only.

Until a Conference can yield more positive cooperation between industrial plants and Győr, the Győri Szövőgyár plant should equalize its wastewater. Appendix 10 shows that the sulfides are sometimes 0 and as high as 1,610 ppm at other times. Phenolphthalein alkalinity, acidity, and pH are equally as variable, thus pointing out the necessity of equalization. Since there appears to be no predictable pattern of contaminant discharge, the writer recommends a 24 hour detention equalization period. Chemical coagulation with lime and ferric chloride at a pH of 9,5 to 10 is recommended as a second stage of treatment. After sedimentation the sulfide content of the effluent, COD, and pH should be reduced sufficiently so that after mixing and diluting with other plant wastes fines for excess of the contaminants will be reduced. Exact design of the coagulation basin and dosage of chemicals must be determined by pilot experiments with composite samples of equalized effluent.

6. Plant No. 6 /Kapuvári Lengyár/ is located 25-30 miles west of Győr and inland from the Danube /See Map, Appendix 5/. The plant deseeds 5,000,000 kgs of imported /from 25 km away/ flax per year; retts 2,700,000 kgs; and produces 1,000,000 kgs of bast fibre. Part of the flax seed is sent to another plant to manufacture vegetable oil while the other part is returned to the soil for cultivation. 300 m³/67,800 gals/ per day of water from the Kisrába River /polluted by Kapuvár and its meat processing plant/ are used per day for retting. The water is cold and soft and the retting carried out in open basins is only possible from about April 1st to October 31st depending upon the air temperature. Compressed air aeration is used in retting in the spring until the water temperature reaches 22 C°. Aeration is then discontinued in order to slow down retting production. At 22 C° and normal flax quality retting takes 7-8 days. At 12-15 C° it takes 10-12 days. The retting waste is discharged to an open ditch which travels 4 km to the River Repce and then 6 km further to another live stream /Hanság Főcsatorna/. This river flows 10 km to the River Rába which then flows to the Danube and finally ends up after flowing through Hungary and Yugoslavia in the Black Sea. The plant has paid fines now for years and is expected to pay about 1,000,000 Ft for a 1974 penalty which will be imposed in 1975. Although the pH of the discharge is about 5,5, the penalty is based

primarily /80%/ on an excess oxygen demand above 75 ppm /present O_2 dichromate demand is greater than 3,300 ppm/ and 20% is based on pH. The fine is progressively increased each year to encourage the plant to build a treatment facility. Nothing has been done primarily because it has been found that the treatment plant cost would far exceed the yearly penalties. This situation however is rapidly changing with the level of the fine and the pressure from the National Water Office and the Ministry of the Light Industry to correct the pollution problem. Although the plant is located in a rural agricultural area, it owns little unused land. It would have to purchase additional land for any land disposal treatment solution. Public health regulations require the retting waste discharge to be 10 km from vegetable growing and 4 km from habitation. Grazing on lands receiving this waste is prohibited.

Opposition to any plan involving land utilization and disposal seems to be centered in the National Hydro Office. This Office has more or less insisted that the plant solve its pollution problem on its own present property by constructing a wastewater treatment facility. After a personal inspection of the entire retting operation it was observed that there are 16 steps involved in converting the raw flax fibre and seed to bast fibre for spinning. Only 11% of the original flax actually becomes linen and 14% becomes tow /scrap flax/.

Initially it is believed that if compressed air aeration open retting could be utilized continuously, not only would retting be enhanced, but also the wastewater may remain at a higher pH. This could serve 2 objectives /1/ lower fines /2/ easier biological treatment as a subsequent purification step. After retting in this manner the pH could be raised still further, if found necessary. Biological aeration for about 7 days could then be employed to reduce the oxygen demand to near the 75 mg/l limit. However, instead of discharge to the open ditch even with this improved effluent, this writer recommends spray irrigation on an additional piece of land adjacent to the plant. Wild cane growth only should be cultivated initially on this irrigated land. In order to gain approval of this treatment plan a conference with the National Water Office personnel and the Planning and Designing Office is recommended. If approval of the system is obtained the design could then be produced for the treatment facility.

7. Plant No. 7 /Drávaszabolcs/ is located 31 kilometers south of Pécs on the Yugoslavian border /See Appendix 5/. The plant processes flax only which is shipped from different parts of Hungary from farm cooperatives. 8,000 tons are processed yearly. 2000 tons are deseeded here and 6000 tons are deseeded at two different plants before coming here. 5000 tons remain for actual retting /3000 tons are lost as seed and combed waste/.
Retting is carried in 4 tanks having a capacity for 13 tons per day and takes from 100 to 140 hours depending on the thickness of the fiber, the water temperature and the quality of the flax. No aeration is used during retting. The retting water comes from both live stream and from a drilled well. After heating with live stream the mixed retting water attains a temperature of 28°C. 42,000 m³ of retting water are used per year or about 300 m³ per day for about 150 days.

About 30% of the retting liquor is lost by evaporation. The effluent from retting discharges in a 150 meter long pipeline leading to a live stream /Fekete Viz/ combined with the treated domestic waste from 100-150 people. After [illegible]00 meters the Fekete Viz reaches the River Dráva a tributary of the Danube in Yugoslavia. The drainage of retting liquor must be fast in order to prevent overretting of bundles of flax which would destroy the fragile fibres.

Penalties have been imposed by the OVH /74,000 Fts in 1974 and 178,000 Fts in 1973/ mainly for organic matter /the dichromate oxygen demand in the 1974 sampling was 540 mg/l/. There is very little space available for waste treatment except in a flood zone area. It was determined that 33% of the retting liquor can be reused for retting after sedimentation. The pH of the retting liquor appears to be close to neutral. Because of all the constraints already mentioned and because the receiving stream flows directly and immediately into Yugoslavia, biological waste treatment is recommended. The location of the biological treatment unit should be south of the retting tanks.

<u>Research pilot experiments</u> are required to determine the exact size of the biological plant and parameters /such as ppm of mixed liquor suspended solids and m³ of air per kilogram of BOD /for plant operation. Sludge from the biological treatment unit should be settled and part returned to the aeration tank to maintain the optimum MLSS while the remainder can be wasted to agricultural land. About 67% of the sedimentation tank effluent can be discharged to the same receiving stream while the other 33% should be recirculated to the retting tanks.

<u>A cost comparison analysis</u> must also be made relating the cost of treatment to the penalty payments for various degrees and types of biological treatment ranging from 0 to 100% organic matter removal. This analysis will point

to the optimum combination of treatment to yield the minimum plant cost.

8. Plant No. 8/Fenékpuszta/ is located about 8 kilometers southwest of Lake Balaton on the Zala River, the only feeder stream of the lake. /See Appendix No. 5/. This plant processes flax brought in from [illegible]0-80 kilometers away. Retting is done generally from March to October only /about 1[illegible]0-190 days/. 3,[illegible]00 tons of flax are retted after seeding each year. Retting water /about 200 m^3/day/ comes from 2 streams as well as from a moorland. Six basins each having a 230 m^3 capacity and 1,3 m deep are used for retting. Retting water is not heated artificially but one source is from a thermal stream /25°C/. Aeration is used continuously, thereby reducing retting time to 4-6 days. The retting wastewater is collected below ground level at the edge of a dam along the River Zala and pumped across the river and discharged by one 25 cm pipe onto the moorland. Although 20 acres of moorland exist here, only about 3 acres are actually required. For 27 years the retting liquor has been disposed of here successfully in this manner. The moorland contains a silty soil on which cane grows abundantly. The wastewater is evaporated readily here because of the good soil permeability. There are no nearby groundwater uses nor odors in the area of the moorland which is owned by the plant. Although mosquitoes are prevalent they are considered part of the natural environment since they occur in the moorland naturally without retting wastewaters. No chemical analysis of the effluent is available since no fines have ever been imposed.

Since no disposal problem exists here, the municipality also plans to utilize the moorland as a soil absorption system for its 6,000 m^3 of domestic wastewater per day.

He [illegible] expressed the opinion that this [illegible] could also be used at KAPUVÁR /Plant No. [illegible]/ if it [illegible] its own land for soil evaporation.

Since no problem of wastewater disposal exists here, or, is anticipated in the immediate future, no treatment suggestions or improvements are recommended.

Plant No. 9 /Szombathely/ is located about 170 kilometers west of Budapest and about 88 kilometers southwest from Győr /See Map, Appendix No. 5/. Its wastewater is discharged into a small river which empties into the Rába River flowing through Győr northeast into the Danube River. 4,500 tons of flax with seeds are brought in yearly from 120 kilometers south. The raw water for retting comes from a small stream - Gyöngyös Folyó - a fairly clean stream /however, at Kőszeg, several woollen mills discharge into it, 20 kilometers upstream/. About 160 m^3 of raw water are used per day for retting in 10 closed tanks. The Belgian retting process provides a flax retting capacity of 5,5 tons in each tank. The retting is an anaerobic process requiring a detention time of 90 hrs with hot water /35°C/ produced by steam injection. The wastewater from the retting basins is discharged into 2 earthen pits connected in series and then by gravity into the same stream only a short distance downstream from its intake. The retting season extends from March 1st to October 31st. Each year at the beginning of the retting season the sludge is cleaned out from the sedimentation basins and used by workers for fertilizing their own croplands. The sludge is given away free with no complaints received from the workers. The receiving stream is fast /0,5 m/sec/ and is about 5 meters wide and possesses and average daily flow of about 300 m^3/sec at the point of discharge.

The sedimentation basins are about 30 years old and have capacities of [illegible]80 and 520 m³, respectively. Total detention times, therefore, are about 5 and 3 days, respectively. Odors and low pH-values /pH 3-4/ exist in these basins. COD-values of about 1000 and an excess of the allowable 2,000 mg/l of minerals also exist in the effluents of these basins. The following penalties for pollution have been assessed

1970 - 113,120 Fts
1971 - 207,223 Fts
1972 - 207,669 Fts
1973 - 324,255 Fts
1974 - 446,220 Fts

However, it is admitted by the plant administration that these penalties do not represent the true penalty charge.

The entire area receives a high rainfall of about 700 mm per year. Here, only 3-4 acres of land is owned by the plant and available for potential irrigation to the south of the plant. However, the whole area is underlain by gravel deposits and groundwater uses exist 1 kilometer to the northeast and some to the south. Therefore, a potential for groundwater contamination exists plus odors for the nearby community.

The plant has just announced a decision to cease flax retting at this plant in two years /at the end of the 1977 season/ and convert it to twine production. Twine is produced <u>dry</u> from spinning the tow waste of flax. This decision was made primarily because of /1/ pressures of the city council to close down the plant if the environmental pollution, air and water pollutions continued and /2/ worker availability - more workers desire the "clean" spinning mills as compared to the "dirty" [illegible].

It seems possible to convert one sedimentation basin to an aeration basin followed by sedimentation for 2-4 hrs with some sludge recirculation. The other sedimentation basin can be used, as before, for primary sedimentation or, for a 2nd stage aeration and sedimentation basin. Aeration periods of only 1 to 2 days are anticipated and sedimentation times of only 2-4 hrs are needed. Therefore, the conversion of both basins to the new treatment facility is feasible for the 2 year period while the current production is being continued. This treatment should reduce the dichromate oxygen demand value to near the allowable limit. Air compressor equipment purchased for this treatment can be shifted to another plant after the 2 year period.

<u>Plant No. 10. /[illegible]spuszta/</u>

This plant is located about 45 kilometers north of the Southern end of Lake Balaton. The plant brings in from 70-80 kilometers and processes 7,000 tons of unseeded flax per year /about 4,000 tons of retted flax/. The raw water supply for retting comes from the live stream Széplak. The retting wastewater is discharged to a moorland after a French drain ditch system, but the excess of undesiccated wastewater released from the ditch system overflows the moorland and enters the Széplak River which empties into the Zala River and travels to the Lake Balaton 45 kilometers away. The plant utilises 6 Belgium system /closed/ and 6 open system retting tanks; each retting about 2,000 tons per year. The closed system is the same as is used at Szombathely /Plant No.9/ and requires only 90 hrs with tightly packed /70 kgs flax/m^3/ bundles of flax. The open system requires 5-6 days for retting when using aeration equipment but produces finer fibre. It is planned to increase the production system here to absorb half of the flax [illegible] production /1,200 tons/. The other half will be done at Kapuvár. /Plant No. [illegible]/. The closed system will be discontinued entirely here and replaced with more preferable open tanks. While the present plant production produces 105 m³ of wastewater the increased production in 1977 will deliver about 210 m³ of wastewater /comparable to about 6,5 m³ per ton of flax/. Yearly fines are paid for excess contamination.

For example, in 1972, 8,000 Fts were paid: in 1973 - 13,000 Fts; in 1974 no fine was assessed because the OVH failed to sample during an overflow period; and, in 1975 the plant will be assessed a Forint penalty for the following wastewater analysis:

PO_4 = 14,7 ppm
pH = 5,5
O_2 demand = 5,000 mg/l

In 1970, three studies were prepared by the OVH after reconstruction of the French drain ditch system failed to solve the wastewater overflow problem. Only 1 study was prepared in detail and this involved expropriating hilly land for orchard irrigation. Essentially, it involved 3,000 m³ of storage tank, reconstruction of desiccation field into 3 ditches and 1,100 m² of land area. At that time, the land requirements were considered excessive so the plan was not adopted.

The present plant management has been installed since 1971 at which time there was no capital for wastewater treatment. The present management professes a desire to invest in treatment but have experienced three recent unpredictable years /1972 - too much rain, 1974 - no rain, 1975 - floods and rain/.

Since there is abundant land available here and little or no habitation nearby, land disposal appears the ideal solution to this plant's problem. Production of flax will continue and will even increase here as verified by plant management.

The quality and amount of land needed is very important. Therefore, a soil analysis of selected locations on the slopes of the nearby hills was recommended. The soil analysis should include both a classification of type /sand, silt, gravel, clay, etc./ and, a permeability analysis to measure the capacity for drainage. A percolation test of saturated soil samples was also recommended.

An analysis of the aerobic flax retting effluent is necessary in order to determine the degree of pretreatment required before irrigation. A composite sample from all the aerobic tanks was recommended to include N, Na^+, salts, O_2 demand, and pH.

In summary, although land disposal is called for, positive recommendation can not be given for this solution until both the soil and wastewater are analyzed. Once the analyses are available, the location of the land and the amount of land required as well as the types of pretreatment needed can be established. Then a final design of the overall treatment system can be made.

11. Other plants

Three other, non flax industrial plants were visited during this study. They all exhibited severe wastewater disposal problems, but since they represented plants of a type outside of the scope of the writers mission, they were not studied in detail and no specific recommendations are presented in this Report. They are mentioned here solely as a reference of the writer's activities. The plants visited were

1 - Pécs Leather Tannery /Pécs/
2 - PANYOVA /United Hungarian Textile Printing Works/ /Budapest/
3 - Nagylak Hemp Processing Plant /Nagylak/

Conferences were held at all three plants and visits to the production facilities made at 1 and 3. Informal, general procedural, recommendations were given to each plant during the site visits.

V. RECOMMENDATIONS

The following recommendations are made as a result of this brief study:

1 - A model /pilot/ plant study be instigated at one of the flax retting plants. The model should include equalization, biological aeration, spray irrigation, and reuse of retting liquors.

2 - Laboratory biological aeration treatment experimentation should begin at the Textile Research Institute to determine reasonable effluent quality where land disposal as a final treatment is not feasible.

3 - Solutions or procedures leading to eventual solutions to each of the ten flax plants /including some mixed fibre finishing /should be followed as presented in Part IV of this Report/.

4 - Administrative procedures should be altered either through enforcement or penalty changes to increase municipal pressure for wastewater treatment and penalties in line with those imposed on industry.

5 - Establish a Central Fund through the OVH for support of joint municipal and industrial wastewater treatment facilities.

6 - Change the COD criterion for industrial effluents into live streams - either to a more realistic higher value or by replacement with the more meaningful BOD-value. Also add this criterion for effluents discharged to municipal sewers.

7 - Develop effluent standards which are more realistic for each industry. Standards related to units of production are suggested.

8 - Begin a formal educational and training program for true water pollution control engineers for permanent positions in Lenfonó, the Ministry, and in the larger industrial plant complexes.

9 - Give some consideration to retting only at processing plants where flax plants are also grown so as to provide a potential cultivatable crop for spray irrigation as a means of wastewater treatment.

VI. ACKNOWLEDGEMENT

The writer would like to express his appreciation to the Ministry of Light Industry and, especially to Dr. Imre Szabó, Dr. Endre Hajnal and Miss Katalin Rábai for their administrative and personal support during this 60 day period. The technical services of Mr. Tamás Peck and Mr. Endre Énekes of Lenfonó és Szövőipari Vállalat were very helpful to the writer. However, whithout the translating and interpreting services of Mr. István Lengyel the writer's mission could not have been accomplished in this period. The time, effort and patience expended by Mr. Lengyel were immesurable. Mr. Lengyel also typed the first draft of this Report from the english longhand. The great efforts made by the Textile Research Institute, the National Hydro Office and the Dept. of Design and Planning were sincerely appreciated.

VII. APPENDICES

Appendix 1.

Permissible concentrations of polluting materials in living waters:

No.	Sort of pollution	Industrial or municipal /Effluent from Sewer Plant/ Limiting value R_{max} /mg/l/
1	Consumption of oxygen	75,0
2	Oils, fats /extraction of organic solvent/	10,0
3	pH	6,5-8,5
4	Total salt	2000,0
5	Natrium	45% equivalent
6	Phenols	3,0
7	Content of total suspended solids	1000,0
8	Bitumen	2,5
9	Ammonia /NH_3/	30,0
10	Iron /Fe II./	5,0
11	Manganese /Mn/	2,5
12	Detergent /ANA/	5,0
13	Phosphate /PO_4/	4,0
14	Nitrate /NO_3/	20,0
15	Sulphide /S^{2-}/	5,0
16	Free chlorine /Cl_2/	2,0
17	Fluoride /F^{--}/	10,0
18	Free cyanuro /CN^-/	0,2
19	Total cyanuro /CN/	10,0
20	Copper /Cu/	25,0
21	Lead /Pb/	10,0
22	Chromium /Cr III/	50,0

Appendix 1. /continued/

23	Chromium /Cr VI/	10,0
24	Arsenic /As/	5,0
25	Cadmium /Cd/	10,0
26	Mercury /Hg/	2,0
27	Nickel /Ni/	2,0
28	Silver /Ag/	0,1
29	Zinc /Zn/	5,0
30	Tin /Sn/	1,0
31	Benzene	----
32	Radioactive materials	individually assessed

Appendix 2.

Effluent limits for Discharge into Municipal Sewers

/Contaminant/		limit /mg/1/
1.	Oils	60
2.	pH	6,5 - 10,0
3.	$SO_4^{=}$	400
4.	Phenol	80
5.	Settleable suspended solids /after 10 mins./	75
6.	Tar	20
7.	Detergent /Anionic/	100
8.	Sulphide	1
9.	Chlorine	50
10.	Fluoride	100
	Poisoning agents	
11.	Cn	0,2
12.	Bound cyanides	1
13.	Cu	25
14.	Pb	10
15.	Cr^{VI}	10
16.	Cr^{III}	50
17.	As	5
18.	Cd	10
19.	Hg	2
20.	Ni	2
21.	Ag	0,1
22.	Zn	5
23.	Sn	1,0
24.	Benzene	1
25.	CS_2	2
26.	Organic solvents /non miscible/	2
27.	Radioactive	individually assessed

Appendix 3.

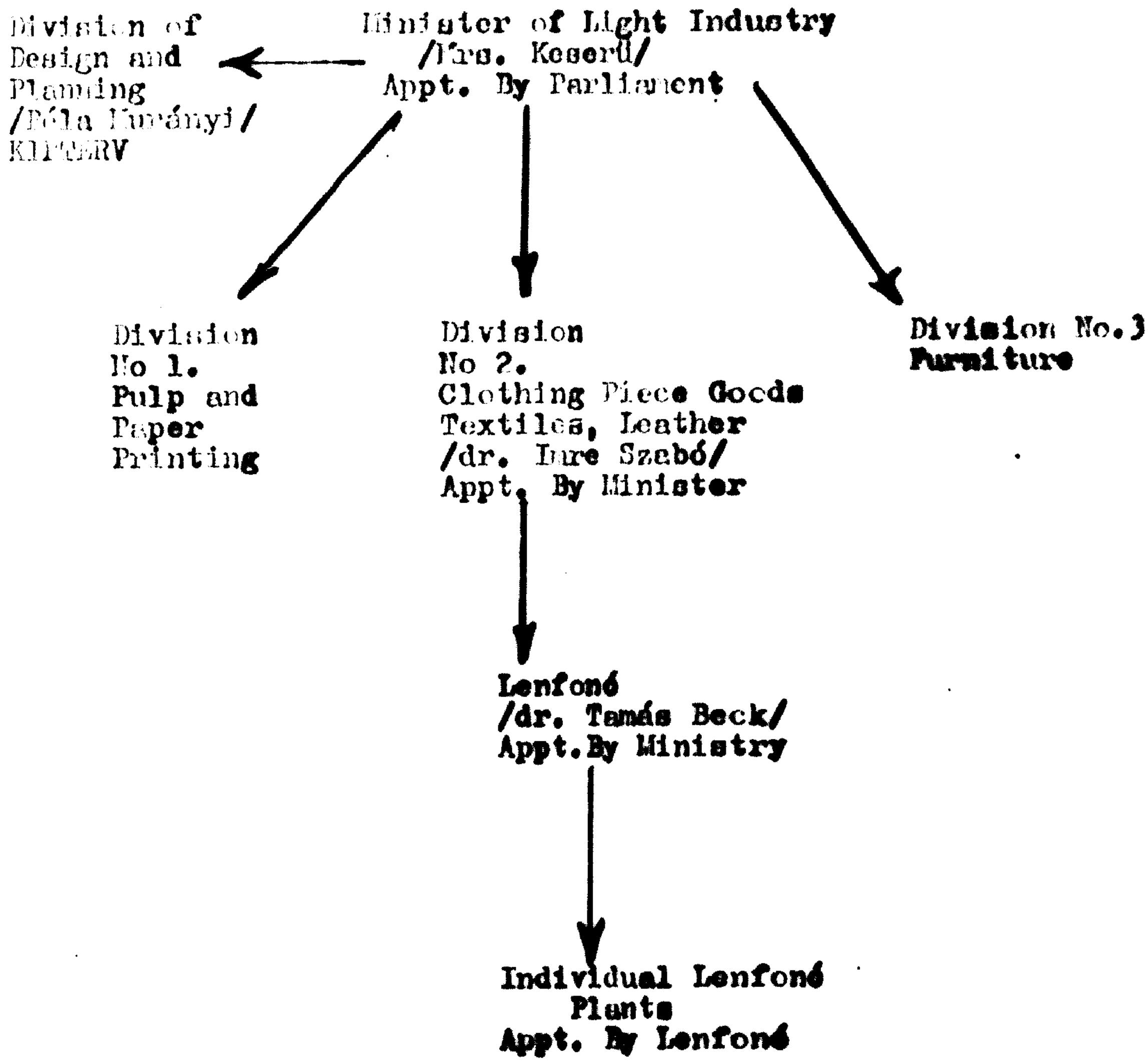
Penalties for Exceeding Effluent Contaminant Levels

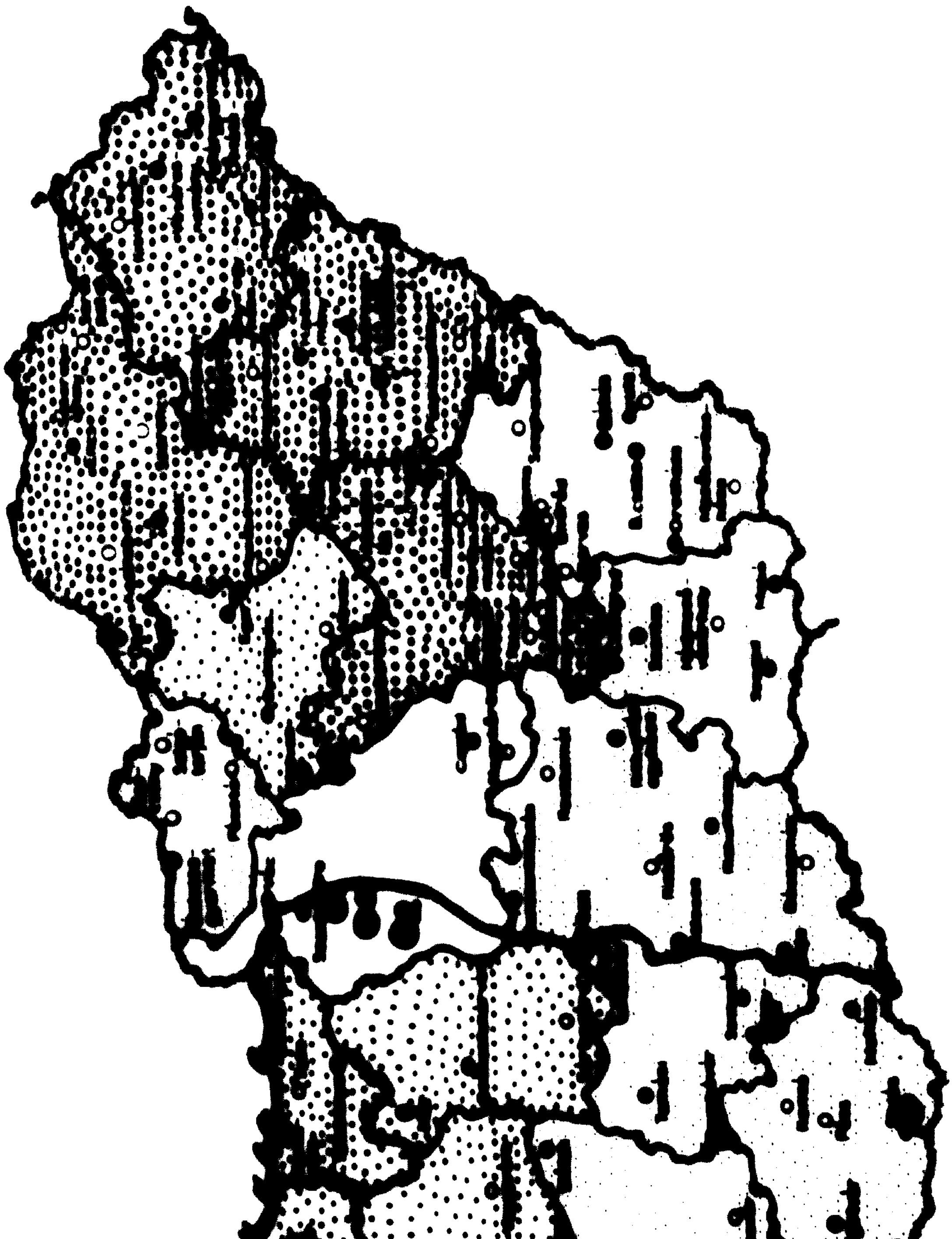
Ft = Appr. 17 Hungarian Forints = $ U.S 1.-

Contaminant	In Live Stream Ft /Forints/kg/	In Municipal Sewers Ft /Forints/kg/
O_2 demand /dichromate/	1	-
Organic solvent extract	20	20
pH	5	15
Total Salts	0,10	-
Na	2,0	-
Phenol	50	50
Total suspended solids	0,5	0,5
Bitumen	120	120
Ammonia	1	-
Iron	5	-
Manganese	20	-
Detergend /anionic/	60	100
Phosphate	5	-
Nitrate	1	-
Sulfide	100	1
Chlorine /free/	50	50
Fluoride	50	100
Free cyanide	5000	5000
Total cyanide /bound/	50	500
Copper	50	50
Lead	100	100
$Chromium^{+++}$	5	5
$Chromium^{VI}$	100	100
Arsenic	200	200
Cadmium	100	100
Mercury	100	500
Nickel	500	500
Silver	1000	1000
Zinc	100	100
Tin	1000	1000
Benzene	--	500
Carbon disulfide	--	50
Organic /non miscible/ solvents	--	50
Radioactivity	individually assessed	

Appendix 4.

Table of Organization as Related to Flex Industry





Appendix 6.

[illegible] visited at plants and conferences and dates

[illegible]	[illegible]	Name of person	Capacity of person	Education
1.	2.	3.	4.	5.
[illegible]e 30.	Budakalász	Miss Rábai	Ministry of Light Industry	Economist
		dr. Beck	director, Lenfonó	Mech. Eng.
		dr. Hajnal	Min. of Light Industry	Economist
		dr. Fülöp	Chief Eng.	Mech. Eng.
		Mr. Honti	Vice Dir.	Mech. Eng.
		Mr. Énekes	Chief Energy Expert	Electrical Eng.
[illegible]ly 2.	Textile Research Institute	dr. Tilajka	Managing Dir.	Mech. Eng.
		dr. Hajmásy	Dir. Res. Dev.	Mech. Eng.
		dr. Králik	Chemist in pollution control	Chemist
[illegible]ly 4.	Ministry	dr. Szabó	Div. Head of Min.	Mech. Eng.
		Miss Rábai		
		dr. Hajnal		
[illegible]ly 7.	Budakalász	dr. Beck		
		dr. Hajnal		
		Mr. Énekes		
July 8.	Budakalász Plant No.1	Mr. Hauptmann	Chief Eng.	Mech. Eng.
		Mr. Véber	Chemist	Chemist
		Mr. Toronyi	Plant eng.	Mech. Eng.
		Mr. Deák	KIPTERV	Architect.
		Mrs. Gyarmathy	KIPTERV	"
		Mr. Énekes		
July 9.	Csillaghegy Plant No.2.	Mr. Hahner	Dir.	Mech. Eng.
		Mr. Jevicsky	Plant Eng.	Electrical Eng.
		Mr. Tóth	Chemist	Chemist
		Mr. Szőllősi	Power Eng.	Mech. Eng.

Appendix 6. /continued/

July 9.	[illegible]nógyár Plant No.3.	Mr. Koltai	Dir.	Mech. Eng.
		Mr. Teilhanasky	Plant Eng.	Mech. Eng.
		Mr. Jámbor	Techn. Devel.	Electrical Eng.
		Mr. Énekes		
July 10.	Komárom Plant No.4.	Mr. Obricht	Chief Eng.	Mech. Eng.
		Mr. Sátori	Dep. Dir.	Mech. Eng.
		Mr. Szabó	Plent Eng.	Mech. Eng.
		Mr. Énekes		
		Mr. Vajda	Power Eng.	Electeical Eng.
July 10.	Győr Plant No.5.	Mr. Wolstremner	Plant Eng.	Mech. Eng.
		Mr. Mert	Plant Chem.	Chemist
		Mr. Nógrády	Chief Eng.	Chem. Eng.
		Mr. Énekes		

x = Mr. István Lengyel - Interpreter, was present at all meetings

July 11.	Kapuvár Plant No.6.	Mr. Sey	Plant Mgr.	Economist
		Mr. Jámbor		
		Mr. Rothanesky		
		Mr. Énekes		
July 22.	KIPTERV Conference	Mr. Murányi	Dir. KIPTERV	Architect.
		Mr. Hossang	Sen.Sci.	Chemist
		Mr. Énekes A.	Budaflax	Electrical Eng.
		Mr. Énekes B.	"	Mech. Eng.
		Miss Adacsy	Text. Res. I.	Chemist
		Mr. Nagy	" " "	"
		Mr. Antal	KIPTERV	Architect.
		dr. Morvay	Paper Ind.	Chemist
		Mr. John	Ministry	Economist

Appendix 6. /continued/

July 24.	[illegible]	Mr. C[illegible]des	Dir.	Economist
		Mr. [illegible]den	Expert UNIDO	Leather chemist
		Dr. Tóth	Development	Chemist
		Mr. Barna	Env. Protect.	Pub. Health Exp.
		Mr. [illegible]	Journalist	
		Mr. Énekes		
July 24.	[illegible] Plant No.7.	Mr. Varga	Plant Mgr.	Economist
		Mr. Topor	Production	Mech. Eng.
		Mr. Vajda	Power Supply	Electrical Eng.
		Mr. Énekes		
July 25.	[illegible]puszta Plant No.8.	Mr. Tur	Plant Mgr.	Economist
		Mr. K[illegible]nar	OVH	Chemist
		Mr. Énekes		
July 28.	Ministry Conf. for OVH and KIPTERV	dr. Kelemen	Dep. OVH. Div. Head	Chemist
		Mr. Kiss	Dept. Head Reg. OVH	"
		Mr. Kubo	Dept. Head, Tata Coal Mines	"
		Mr. Mako	Tata Coal Mines	Mech. Eng.
		Mr. Hossang	Org. Chem. Res. I.	Chemist
		Mr. Hamar	Coal Mining Investm.	Environm. Protection
		Mr. Nagy	Min. Light. Ind. Shoe and Leather Dept.	Mech. Eng.
		Mr. Barna	Pécs Tannery Env. Prot.	Chemist
		Mr. Énekes		
		Miss Rábai		

Appendix 6. /continued/

		dr. Dobolyi	VITUKI /Water resources res. and planning, Sen. Sci.	chemist
		dr. Szabó	/VIKÖZ/ Municipal water supply, Techn. Advisor	Mech. Eng.
		dr. Hajnal	Moderator, Ministry	Economist
July 29.	Szombathely Plant No.9.	Mr. Nagy	Plant Mgr.	Elect. Eng.
		Mr. Kardos	Reg. OVH	Chemist
		Mr. Márta	Development	Mech. Eng.
		Mr. Jámbor		
		Mr. Énekes		
July 30.	Mikospuszta Plant No.10	Mr. Joo	Plant Mgr.	Economist
		Mr. Gere	Accountant	Economist
		Mr. Kardos	Reg. OVH	Chemist
		Mr. Márta		
		Mr. Jámbor		
		Mr. Énekes		
Aug.1.	Ministry	dr. Szabó		
		dr. Hajnal		
		Miss Rábai		
Aug.1.	PANYOVA /Cotton Finishing Wks./	Mr. Orbán	Div. Head	Mech. Eng.
		Mr. Rakics	Env. Prot.	Chemist
		Mrs. Frey	In charge of finishing	Chemist
		Mr. Borbás	Coal Mines of Tata	Chemist
		Mr. Gerő	Coal Mines of Tata	Chemist
		dr. Hajnal		
Aug.4.	Kenderfonó, Szeged	Mr. Bille	Chief eng.	Mech. Eng.
		dr. Hajnal		
Aug.4.	Nagylak /Hemp retting/	Mr. Béres	Dir.	Mech. Eng.
		Mr. Bille		
		Mr. Herceg	Plant Eng.	Mech. Eng.
		Mrs. Herceg	Accountant	Economist
		dr. Hajnal		

[illegible] No.1.

Appendix 7.

Place of sampling	Time of sampling	p_{alk} mval/1	m_{alk} mval/1	Content of floating substances mg/1	C.O.D. mg/1	pH
1.	2.	3.	4.	5.	6.	7.
River [illegible]	1975.VIII.8.					
	6^{10}	2,05	7,16	184	366	8,9
	7[illegible]	7,16	7,16	113	455	10,1
	8^{30}	3,58	7,16	93	465	9,6
	9^{40}	4,09	7,16	46	476	9,3
	10^{40}	4,09	9,20	10	832	9,2
	11^{50}	3,07	7,16	31	396	9,2
	12^{00}	8,18	5,11	44	366	10,4
	13^{30}	7,16	8,18	307	257	10,5
Open width [illegible]er Boil	1975.VIII.8.					
	1^{30}	235,18	337,43	12,666	25,740	10,5
	1^{30}	214,73	306,75	17,800	27,720	10,5
	1^{30}	245,40	316,98	4,600	20,790	10,6
Mercerizing wastewater /Small Tank/	1975.VIII.8.					
	6^{30}	75,67	34,77	551	584	12,1
	7^{40}	79,76	32,72	454	634	12,1
	8^{30}	83,85	26,59	454	495	12,2
	9^{30}	86,91	26,59	560	693	12,3
	10^{35}	104,30	26,59	485	79,2	12,4
	11^{30}	72,60	19,43	686	178	12,2
	12^{30}	86,91	21,47	598	119	12,3
	13^{30}	114,5	27,60	499	970	12,4
Mercerizing wastewater /Saturation Tank/	1975.VIII.8.					
	13^{30}	3006,20	153,38	7777	1317	13,7

Appendix No. 8 - 1

Wastewater analyses Csillaghegyi

Fuel Oil Sump Tank Effluent

Date and time July 24, 1975	pH	Oil and grease /Mg/l/
9	7,5	7,831
10	8,2	8,699
11	7,8	13,746
12	7,9	4,465
13	8,5	6,766
14	8,2	8,698
15	9,0	3,53
16	8,7	24
17	8,6	147
18	8,9	145
19	8,2	2,825
20	9,6	249
21	8,8	1,866
22	9,2	869
23	8,4	8,165
24	8,0	1,188
July 25, 1975		
1	8,1	5,194
2	7,9	5,147
4	7,7	922
5	7,7	761
6	8,0	773
7	7,9	8,290
8	8,2	4,673

Appendix No. 8 - 2.

Wastewater analyses Csillaghegyi Finishing Tank Effluent

Date and time July 23, 1975	pH	Alkalinity /Phenol/ mval/l	S /mg/l/	Settleable Solids /cm^3/l/	COD /mg/l/
15	7,1	0	219	60	862
16	8,5	22,49	292	4	647
17	8,3	Ø	786	120	447
18	8,8	Ø	0	40	1176
19	8,2	0	0	120	1960
20	10,65	Ø	592	260	941
21	9,1	Ø	876	260	1568
22	9,4	Ø	187	360	2587
23	10,1	3,06	227	13	294
24	9,3	2,04	221	40	355
July 24, 1975					
1	10,0	10,22	808	4	235
2	5,0	0	0	20	431
3	1,4	0	0	4	221
4	10,1	8,18	962	600	2940
5	9,6	2,05	0	400	1764
6	7,3	0	0	200	893
7	8,8	1,02	0	0	124
8	9,2	5,11	146	0	678
9	11,4	Ø	988	380	1372
10	9,4	4,09	176	4	196
11	9,6	6,14	0	40	255
12	8,5	3,06	65	304	784
13	8,3	2,04	333	8	157
14	8,9	Ø	267	4	118

Ø = undeterminable because of color

ANALYSES WASTEWATER PLANT No. 4-2.

Appendix No. 9.

Place of sampling	Time of sampling	Content of floating substances I. from the upper part after 1^h sedimentation	Content of floating substances II. from the lower part after 1^h sedimentation and removing the upper part	Oil and fatty content from the organic solvent extract I. from the upper part after 1^h sedimentation	Oil and fatty content from the organic solvent extract II. from the lower part after 1^h sedimentation and removing the upper part
1	2	3	4	5	6
	1975.Aug.4.				
	8^h	718	40	9864	1367
	9^h	202	135	4014	9667
	10^h	699	294	579	400
	11^h	106	73	4780	5359
	12^h	143	56	239	7682
	13^h	100	292	7762	5366
	14^h	140	724	3681	4935
	15^h	2503	2054	5530	2389
	16^h	5773	1091	1710	3332
Effluent collection tank	17^h	10335	12177	10615	9169
	18^h	10448	11072	8483	4956
	19^h	14221	6554	12175	11572
	20^h	6468	4382	1272	991
	21^h	3383	3217	8127	7345
	22^h	2751	3344	3877	9202
	23^h	2790	2495	6026	1788
	24^h	25762	20312	5392	6014
	1975.aug.5.				
	1^h	19354	16945	3692	4583
	2^h	5623	4948	2465	3008
	3^h	6684	5216	6191	4654
	4^h	2345	1832	3542	2965
	5^h	1016	843	1848	2082
	6^h	1565	1393	5695	6458
	7^h	1348	1251	3783	5624

Appendix No. 10.

Wastewater analyses Győr /Plant No. 5./

Date and time	pH	Phenol. alkalinity /mval/l/	Sulfide /ppm/
1	2	3	4
July 29, 1975.			
[illegible]^{0}	7,4	indetermi-	indetermi-
[illegible]^{5}	7,2	nable	nable
9[illegible]^{5}	10,2	7,15	"
9[illegible]^{5}	8,9	2,04	"
1[illegible]^{15}	11,0	6,14	20
1[illegible]^{30}	10,4	7,15	indeterminable
[illegible]^{45}	10,3	2,04	818
[illegible]^{0}	9,3	3,06	0
[illegible]^{15}	9,5	3,06	0
1[illegible]^{30}	9,4	5,11	0
1[illegible]^{0}	11,4	8,18	33
1[illegible]^{5}	10,3	6,14	0
1[illegible]^{0}	9,4	5,11	0
1[illegible]^{15}	10,4	6,14	0
1[illegible]^{30}	9,4	6,14	0
15^{00}	8,9	0	0
15^{15}	8,6	4,09	0
15^{30}	8,4	2,04	0
15^{45}	7,0	0	0
16^{00}	7,9	0	0
16^{15}	9,6	5,11	7
16^{30}	9,1	3,06	0
16^{45}	9,4	9,2	6
17^{00}	8,2	0	0
17^{15}	7,1	0	0
17^{30}	11,5	24,54	41
17^{45}	10,4	14,34	90
18^{00}	9,7	4,09	0

Date and time	pH	Phenol. acidity /mval/l/	Sulfide /mg/l/
5		6	7
July 29, 1975.			
9^{00}	6,9	1,73	0
9^{30}	6,0	2,17	0
10^{00}	6,7	1,73	0
10^{15}	5,7	3,03	0
10^{30}	5,9	2,17	0
10^{45}	5,9	2,17	0
11^{00}	5,6	1,73	0
13^{00}	6,4	1,73	0
14^{15}	4,1	2,6	0
July 31,1975		phenol alkalinity /mval/l/	
18^{15}	7,5	0	103
18^{30}	8,7	5,11	207
18^{45}	8,6	2,05	0
19^{00}	8,1	1,02	0
19^{15}	8,1	1,02	0
19^{30}	8,9	2,05	55
19^{45}	9,0	2,05	61
20^{00}	8,9	3,07	0
20^{15}	9,0	3,07	0
20^{30}	9,1	2,05	0
20^{45}	7,9	0	0
21^{00}	8,2	0	0
21^{15}	8,7	1,02	0
21^{30}	11,3	23,51	1610
21^{45}	11,6	14,32	98
22^{00}	9,4	1,02	53
22^{15}	9,1	1,02	0
22^{30}	10,3	4,09	0
22^{45}	9,4	0	0
23^{15}	9,0	1,02	0
23^{45}	11,0	18,41	219
24^{00}	9,5	1,54	0

Appendix No. 10. /Continued/

Date and time	pH	Phenol. alkalinity /mval/1/	Sulfide /ppm/
Aug.1.1975.			
0^{15}	8,1	0	0
0^{30}	9,7	5,11	204
0^{45}	10,0	5,11	461
1^{00}	10,0	4,6	356
1^{15}	10,4	6,14	851
1^{30}	8,7	3,07	35
1^{45}	9,4	4,09	0
2^{00}	8,8	2,05	0
2^{15}	8,0	1,02	0
2^{30}	9,3	3,07	0
2^{45}	8,9	3,07	373
3^{00}	7,8	4,02	470
3^{15}	9,8	5,11	0
3^{30}	7,4	0	0
3^{45}	9,2	3,07	0
4^{00}	8,8	1,02	0
4^{15}	10,0	4,09	0
4^{30}	9,3	3,07	0
4^{45}	7,5	0	0
5^{00}	8,9	4,09	0
6^{30}	9,1	3,07	0
6^{45}	8,6	1,02	192
7^{00}	9,4	4,09	123
7^{15}	8,4	2,05	0
8^{00}	9,0	4,09	0
8^{15}	9,0	3,06	0

Date and time	pH	Phenol. acidity /mval/1/	Sulfide /mg/1/
July.31.1975.			
23^{00}	6,6	0,87	0
23^{30}	5,0	5,2	0
5^{15}	5,9	0,87	0
5^{30}	6,6	0,43	0
5^{45}	6,7	0,6	0
6^{00}	6,8	0,6	0
6^{15}	6,5	0,43	0
7^{30}	6,8	0,60	0
7^{45}	6,8	0,43	0

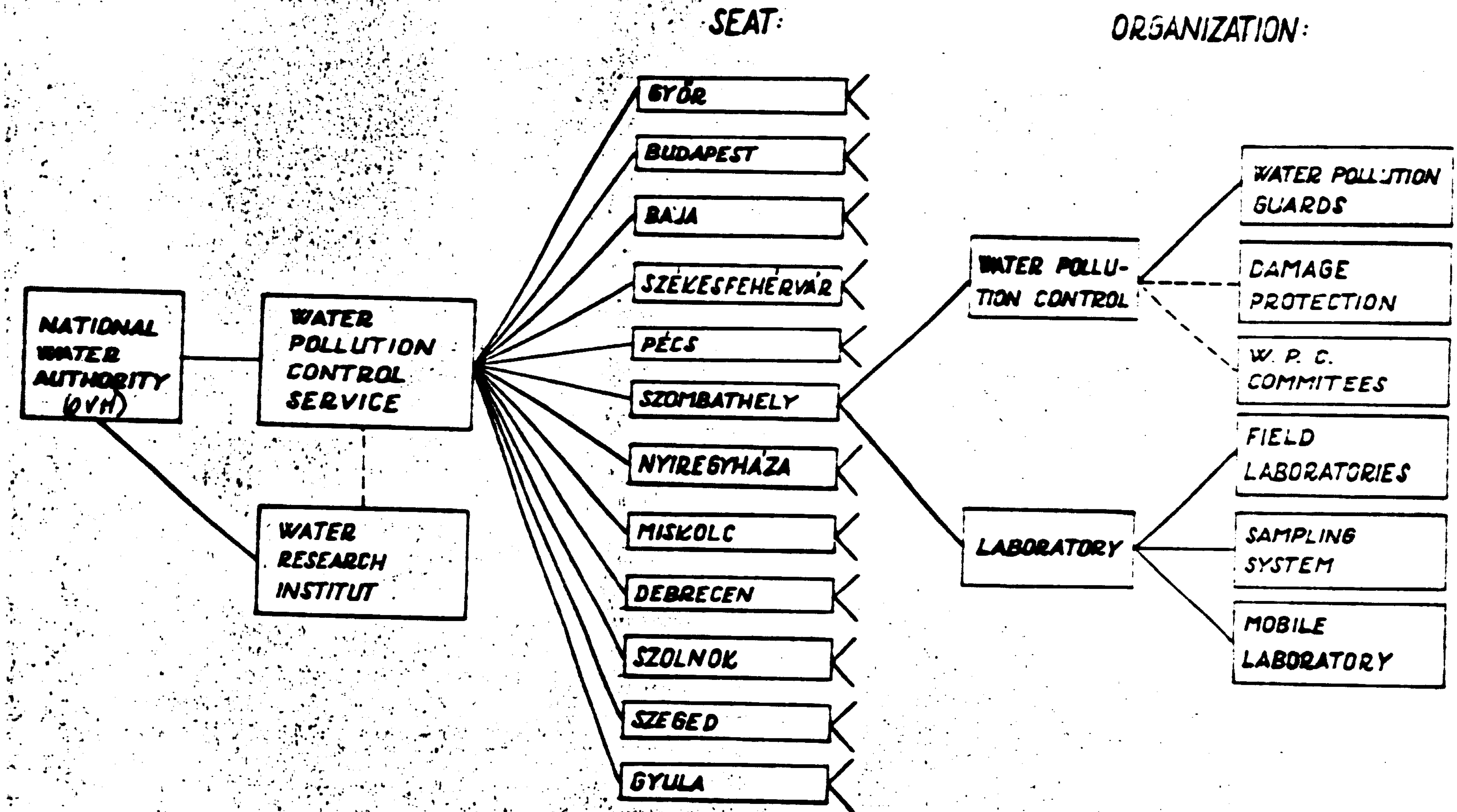
Appendix No. 11. - Quality directives for Categories I-II

Component	Unit	Category I	Category II	Category III
a 1. Dissolved oxygen, O_2	mg/l	6	6	3
a 2. Oxygen saturation O_2	%	75	50	30
a 3. BOD_5O_2	mg/l	5	10	15
a 4. Oxygen Consumption	"	10	15	25
		Excl. waters containing humus substances		
a 5. Hydrogen sulphide /H_2S/	"	no detectable		0,1
a 6. Biological condition, Saprobity		oligo to beta mezo	beta to alpha-mezo	alpha-mezo
b 1. Chloride ion, Cl_2^-	"	200	300	400
b 2. Sulphate ion, $SO_4^=$	"	150	250	300
b 3. Total hardness	G.*deg.	20	30	40
b 4. Calcium ion, Ca^{2+}	mg/l	150	200	300
b 5. Magnesium ion, Mg^{2+}	"	50	100	200
b 6. Total dissolved solids	"	500	800	1200
c 1. Ammonium ion, NH_4^+	"	1	3	10
c 2. Nitrate ion, NO_3^-	"	13	30	-
c 3. pH		6,5 - 8,5	6,0 - 8,5	5,5 - 9,0
c 4. Total iron, Fe^{3+}	"	Excl. waters containing humus substances		
c 5. Manganese, Mn	"	0,1	0,3	0,8
c 6. Vapour volatile phenols	"	0,002	0,02	-
c 7. Hungarian practice Detergents, ANA	"	0,01 [1]	0,05 [2]	0,1 [3]
		For anionic detergents only. For others special limits must be determined in accord with the analytical methods		
c 8. Cyanide ion, CN^-		0,01	0,02	0,1

* = 1 Unit German = 0,80 English unit

ORGANIZATION OF WATER POLLUTION CONTROL

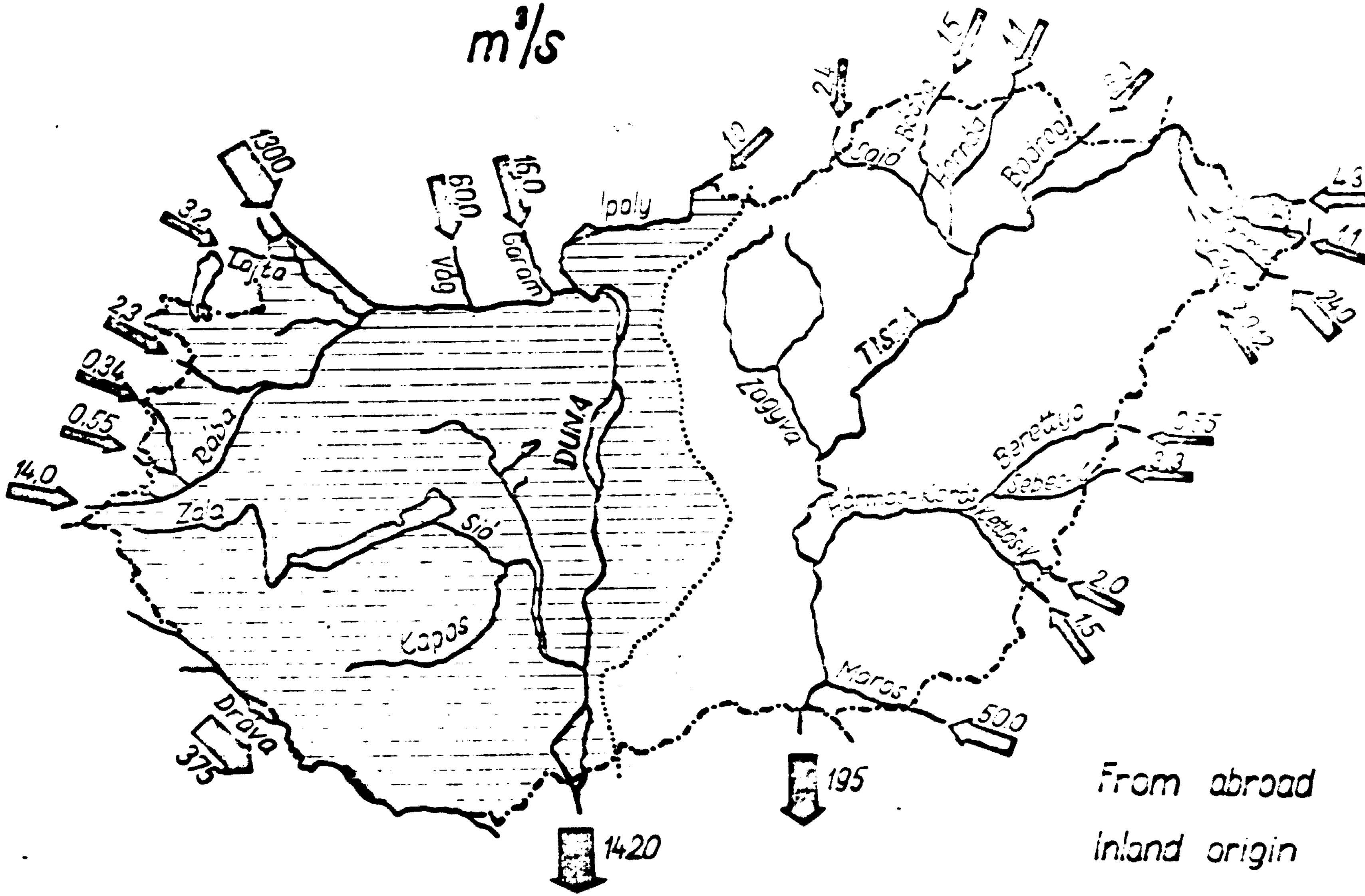
WATER POLLUTION CONTROL SERVICES OF THE DISTRICT WATER AUTHORITIES



APPENDIX NO.

THE MINIMUM FLOW OF THE HUNGARIAN SURFACE WATERS

m^3/s



From abroad 1920 m^3/s

Inland origin 14 m^3/s

To abroad 1930 m^3/s

APPENDIX NO. 13

APPENDIX No 14.

CLASSIFICATION OF SURFACE WATERS

	CLASS			
	I.	II.	III.	IV.
Oxygen household	56,3%	42,7%	0,9%	0,1%
Anorganic contents	98,6%	1,3%	0,1%	
Special indices	12,9%	63,1%	23,9%	0,1%

Appendix No. 15.

Modifications to penalty /fines/ levied for excess contamination

MODIFICATION FACTOR No. 1.

Method of waste Introduction Into Stream	Stream class					
	I	II	II	IV	V	VI
	Factors /Modifications/					
On the bank	0,3	0,5	0,7	0,8	0,9	0,10
In the middle	0,1	0,3	0,6	0,8	0,9	1,0
Streamflow /m³/sec/	above 210	30-210	5-30	1-5	0,25-1	below* 0,25

* - including natural lakes, artificial ponds, irrigation systems and groundwater.

MODIFICATION FACTOR No. 2.

Dilution required to reach 50% tolerance Limit by biological tests on Daphnia Magna	Modification Multiplier Factor
Below 3	1,0
3-15	1,2
15-30	1,5
30-60	2,0
60-100	2,5
100-400	3,0
400-800	3,5
above 800	4,0

MULTIPLICATION FACTOR No. 3.

a - Treatability of waste
b - Detrimental effect on public health
c - Operation condition and efficiency of
    water purification system
d - Utilization of receiving stream
e - Characteristics of receiving stream
f - Other water economy aspects.

The multiplication factor will vary between
0,5 - 1,5 times the penhalty.

76.01.20