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

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PROGRAMME ON PURFICATION OF INDUSTRIAL WASTE WATER

COUNTRY PAPER: UNITED REPUBLIC OF TANZANIA*

Prepared by

D.A. Mashauri, S.S. Mkuula, F.M. Mpendazoe and F. Gumbo
UNIDO National Experts

*The views expressed in this document are those of the authors and do not necessarily reflect the views of the Secretariat of UNIDO. This document has not been edited.

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EXECUTIVE SUMMARY

1.0 INTRODUCTION

Tanzania is a country just south of the Equator covering an area of 945,000 sq.km of which 886,000 is land and 59,000 sq.km inland lakes.

The country has a population of 23.2 million. The annual growth rate is 2.8 per cent. These figures were observed in the 1988 census.

The agricultural sector dominates the economy. It contributes more than 50 percent to the GNP, 75 per cent to the total export earnings and is an employer of 80 percent of the national population. The main export products are coffee, cotton and sisal.

The industrial sector contributes about is 5 per cent to the GNP. The last decade has been a period of decreasing Industrial production which is a consequence of the worsening economical conditions during this period.

Tanzania is rich in minerals, such as coal, iron, gold and natural gas. However, the mining sector is yet to be developed. The country has also good exploitable resources for hydroelectric energy production.

2.0 MAJOR POLLUTION PROBLEMS IN TANZANIA

Tanzania suffers a full share of the problem of degradation of the environment. The country has problems of desertification and soil erosion, depletion of aquatic and marine natural resources, of agrochemical pollution, urban and Industrial pollution.

The pollution of the environment that can be observed in Tanzania is not different from that of other tropical developing countries. The most obvious and serious pollution is the urban pollution, i.e. water pollution, air pollution and solid waste emanating from densely populated areas as a result of poor, if any at all existing, waste water and solid waste Management.

Industrial pollution is another distinguishable type of pollution, through not yet as pronounced as in developed ccuntries. The third pollution problem is pollution through the use and handling of chemicals in agriculture, notably pesticides.

This paper is on programme on purification of Industrial wastewater. Explanation of the Characteristics of the wastewaters from tanneries, sugar industries, textile industries, slaughterhouses, breweries, sisal

industries and pesticide formulating plants are given. The present condition of the treatment plants are evaluated.

3.0 INDUSTRIAL POLLUTION IN TANZANIA

In the earlier days in Tanzania, the industrial development focused an investments in new industries. Now priority is given to rehabilitation of the existing industries.

The majority of Tanzanian industries are located in the large towns. Inevitable industrial waste discharges form the main part of the urban pollution.

Few existing industries in the country have taken any environmental measures; a situation which significantly contribute to the urban water pollution. In addition there are rural based industries which have serious impacts on the local environment.

The large industries in the leading towns are connected to municipal sewerage systems, where existing. The majority of these produce wastewaters with a quality similar to sanitary wastewater. This industrial wastewaters input contributes to a serious overloading in terms of quality and quantity.

There are industries with acceptable effluent treatment, even if they are very few. One example is Southern Paper Mill in Arrange region.

4.0 CHARACTERISTICS OF WASTEWATERS AND CONDITION OF EFFLUENT TREATMENT PLANTS OF THE SELECTED INDUSTRIES

4.1 TEXTILES INDUSTRIES

The wastewaters from the textile Mills contains a variety of Chemicals such as inorganic salts, organic acids, starch, hydrogen peroxide, detergents alkalis, Urea as well as waste products from a big number of different dye stuffs. The dyestuffs could contain some toxic compounds. Detailed explanation on the production, water consumption and wastewater disposal at the textile Mills visited is given in chapter one of the main report. The textile Mills visited include Tanganyika Dyeing and Weaving Company at Gongo la Mboto Dar es Salaam, Friendship Textile Mill in Dar es Salaam, Morogoro Polyester Limited in Morogoro, Canvas Ltd in Morogoro and Kilimanjaro Textile Cooperation Ltd in Dar es Salaam.

The wastewater from the Polyester Textile Mill and the Canvas Mills is treated in a wastewater treatment plant which mainly consists of stabilization ponds and chlorination. The treatment is not adequate. There is also a need to recycle water used in these Mills in order to improve wastewater handling and disposal as well as reduce the amount of wastewater produced and water consumption.

Of the three Industries which are located in Dar es Salaam; Friendship -Textile Mill, Tanganyika Dyeing and Weaving Mill, Kilimanjaro Textile Corporation Factory discharge their wastewater to the environment untreated. The Tanganyika Dyeing and Weaving Mill discharges untreated 600,000 litres of wastewater daily into the Msimbazi River. The Kilimanjaro Textile Corporation Factory discharges 45,000 litres of untreated wastewater into Msimbazi valley and ultimately into Msimbazi River.

In order to improve Wastewater Management from the three factories, for the Friendship Textile Mill, the oxidation ponds will have to be properly maintained and water recirculation system be provided. For the remaining two industries, proper waste water treatment plants should be constructed.

4.2 Sugar Industries

The sugar industries in Tanzania is quite active in the production of sugar and inevitably polluting the environment. There are five sugar production areas e.g. Kilombero I and II, Mtibwa, TPC and Kagera Sugar companies.

In this mission only Ruembe (Kilombero II) and Msolwa (Kilombero I) were visited. The others were visited sometimes last year and the year before. The data contained herein is therefore quite update.

The main problems are (i) excess filter mud (ii) boiler ash (iii) spent oil and lubricants (iv) sulphur dioxide and or (vi) excess bagasse. In some cases herbicides and pesticides are applied in fields and thereby residuals are bound to end up in the receiving waters. In all cases there are no wastewater treatment plants incorporated in the design of the sugar factories. It is obvious that the proponents did not (either knowingly or due to other constraints!) design for the protection of the environment.

It may be safely said that these Industries are set up in rural vast lands and such pollution is localized and in any case dilution factors will take care of the wastes produced. This is a misconception as the localized pollution tends to "overkill" at the area of effluent production and thereby constrict the use of the waters by the other recipients in the area. Chapter 2 of the main report gives more details on this.

4.3 BREWERIES

The important breweries in Tanzania include two plants owned by Tanzania Breweries Ltd (TBL), one plant owned by Dar-Brew Limited and one plant owned by Tanzania Distilleries Limited. With the exception

of the TBL all of them are located in Dar es Salaam. Supply of beer from these plants is far below the demand. Tanzania Breweries limited plants have a total installed capacity of 437 m^3/day, but are currently producing about 250 m^3/day.

Tanzania Distilleries plant is undergoing expansion and the TBL Dar es Salaam plant is being rehabilitated to enable utilization of its installed capacity (20,000 cases/day).

In all these breweries there is neither any treatment of wastewaters nor monitoring of the effluents. The plants have extensive impacts to the environment, for example dissolved oxygen depletion. In addition TBL has plans to set up a third brewery in Mwanza and there are also a number of plans for building small and medium size private plants in different parts of the country. The total capacity for the planned breweries will be about 330 m 3/day. The design for the planned Mwanza plant includes an effluent treatment plant. With the expanded production of beer it is invariable that increase in wastewater production and thereby more environmental degradation is to be expected.

4.4 MEAT PROCESSING INDUSTRY

In this sector only two factories are discussed. Both of these factories are situated in Dar es Salaam.

Tanganyika Packers Limited which was established in 1947 with an installed capacity of 65,000 heads of cattle per annum is now capable of processing meat from 26,000 heads of cattle per year. The plant machinery are old and dilapidated. The plant is going on an intensive rehabilitation. The plant discharges 10,000 litres of untreated wastewater per day. The oxidation ponds for treating the wastes are blocked and therefore not working.

Vingunguti abattoir,the other meat processing point, has a capacity of 50 cattle and 100 goats per day. Untreated Wastewater from this factory is discharged directly into Msimbazi river. There were settling tank and small pond which were used for treating wastewater but were blocked and not in use since 1984.

Environmental impacts caused by meat processing industry include high dissolved oxygen depletion in the receiving water (Msimbazi river), foul smell, breeding of flies and other insects.

4.5 PESTICIDES FORMULATING PLANT

Though has a number of pesticides formulating plants, Tanzania has only three operating medium or large scale plants. These include Twiga Chemicals (T) Ltd for pesticides and SAPA Chemicals Industries which

specialises in insecticides for cotton, coffee maize and tobacco. Both these industries are located in Dar es Salaam. SAPA plant has plans to formulate herbicides too but at another plot. The third plant is Tanzania Pesticides Limited which is situated in Morogoro Town which formulates insecticides, herbicides and nematocide.

Generally none or very little water is used in these formulations and dry absorbing is relied upon. However, with the rising awareness of environmental protection, pressures are building up for more professional approach to the industrial pollution problem, striving to achieve zero contamination of the environment which these practices can not guarantee. Realizing this trend one of the leading Companies, Twiga Chemical (T) Limited, an associate company of ICI (UK) Ltd has on its own designed and planned to construct an effluent treatment plant in its factory.

Also under construction is much bigger (about 10,000 tons/year of pesticide) plant which will formulate and also produce some of the pesticides. This plant which is in Moshi town 850 km from Dar es Salaam has included designs for treating wastewaters from its chlo-alkali and copper oxychloride plants as well as an incinerator for solid wastes. Negotiations are going on to include an effluent treatment plants for the formulating plant also.

4.6 TANNERIES

Tanneries are renowned for the particularly polluting nature of the effluents from the production process. For the tanneries discussed in this report; i.e. Morogoro Tannery, Mwanza and Moshi Tannery, their effluent treatment plants are not operating at all. These tanneries discharge their wastewaters into either sewerage works or to the environment [e.g. water bodies] untreated. These treatment plants need to be rehabilitated to the original condition. And in addition, some adjustments to the production process be made in order to reduce water usage and chrome content in the final effluents. Introduction of sequential washings method instead of concurrent washing method which is practiced in all the plant will be able to reduce the water used by 50%. Use of high - exhaustion chrome method will reduce chrome oxide content in the residual float to 0.3g/l instead of the present method which leave chrome oxide content in the residual float at 6.99 g/l.

Another important fact noted is that the prevention of environmental pollution has not been a priority for the tanneries Environmental awareness is still low. There is an urgent need to promote awareness of environmental management and protection. Moreover, finance and expertise are still a constraint.

Chapter 6 of the main report gives a detailed explanation of the quality of wastewaters discharged from tanneries industries and its management.

4.7 SISAL INDUSTRIES

Most of the sisal industries in Tanzania do not have any wastewater treatment facilities. Those which have the facilities are not working most due to the fact that they had broken down for a long time and no efforts are being made to put them operational.

In this report wastewater characteristics and status or working condition of the treatment plants of Pangawe Kingolwira Sisal Estate in Morogoro region, Msejani Sisal Estate, Ngombezi Sisal Estate and Hale Mwakinyumbi Sisal Estate in Tanga region are discussed. Pangawe Kingolwira Sisal Estate was visited very recently i.e. in March 1990 while sisal estate in Tanga region were visited in February,1989.

Pangawe Sisal Estate discharges its untreated wastewater into river Ngerengere. There is no treatment plant however there are oxidation ponds which at present are blocked with sludges.

Pangani and Sigi rivers are Victims of the sisal wastewater pollution from Mjesemi Sisal Estate, Ngombezi Sisal Estate and Hale Mwakinyumbi Sisal Estate. The high values of BOD and permanganate values in the rivers indicate the introduction of large quantities of organic matter into the rivers. This is clearly confirmed by the decreasing dissolved oxygen level in the rivers. The introduction of the wastewater also has resulted in big changes in pH in the rivers.

There is an urgent need for the sisal processing industries to rehabilitate the effluent treatment plants and give priority to environmental management and protection. Chapter seven gives detailed information of this sector regarding wastewater management.

5.0 LEGISLATION IMPORTANT FROM INDUSTRIAL WASTEWATER MANAGEMENT VIEWPOINT

There are three (3) Acts of legislation worth mention in this report which are relevant to the Industrial wastewater Management:

1. The Industries licensing and Registration Act 1967 and 1982, which set up the licensing board to decide on the siting of industries in relation to the availability of land and water.

2. The water utilization Act 1975 and its 1981 amendment. This act established a system of rights, licences and control of water use as well as the Temporary water Quality Standards for water

resources, effluents and domestic water.

3. The National Environment Management Act 1981 set up the National Environment Management Council (NEMC). NEMC sees its role as integral to the planning process, especially of industrial development, and as such its input towards safeguarding the environment should be included at an early stage. It has meanwhile assessed the state of the environment and sources of pollution from different industries in the country. These three Parliamentary Acts are important but only if they can be implemented and enforced. At present these laws are hardly applied leave alone enforced due to weak legal systems in the institutions vested with these responsibilities and due to lack of trained personnel of the same. Lack of appropriate equipment to monitor and analysis wastes is yet another hurdle in this task of environmental protection process.

6.0 CONCLUSION

The prevention of environmental pollution is an aspect that should be given proper attention to industrial activities. Most of the industries discussed discharges their wastewater untreated to the environment. Some of the industries have had at some stage, a treatment plant for reducing the level of pollution of the receiving environment; but almost all of these are non-operational at present. Prevention of environmental pollution has obvious not been a priority to the management of these industries.

Also awareness of the need for environmental management and protection is low though it is now gradually growing.

Another fact is that most of the industries are in financial and expertise constrains through it can not be used as an excuse to do nothing about protection of the environment from wastewater discharges.

7.0 RECOMMENDATIONS

1. There is a need to promote environmental management and protection awareness among the industrialists and implementers of any institutions which do pollute the environment.

2. There is a need to rehabilitate the available treatment plants which are in bad working condition and to construct pre-treatment plants to those industries which do not have them.

3. Training of implementors [short courses] in environmental issues is very important and should be enhanced.

4. There is a need to introduce programmes to monitor and handling of hazardous industrial wastes.

MAIN REPORT

1.0 TEXTILE INDUSTRIES

1.1 TANGANYIKA DYEING AND WEAVING MILLS LIMITED

1.1.1 GENERAL

The factory is situated at Gongo la Mboto, Ilala District in Dar es Salaam. The factory was established in 1962 with an installed annual capacity of producing 18,000,000 meters of cloth. Actual capacity, however, stands at 12,000,000 meters of cloth per year.

1.1.2 WASTE WATER

The factory uses about 900,000 litres of water per day drawn from Msimbazi river when it is not provided with enough water from the normal City water supply system. Of the 900,000 litres, 600,000 litres are daily discharged into the Msimbazi River downstream of the factory.

The wastewater mainly contains several kinds of chemical and dyestuffs:

Table 1.1 shows the characteristics of the waste waters produced, treatment available and recommended treatment if needed.

Table 1.1 TYPICAL WASTEWATER CHARACTERISTICS OF TANGANYIKA DYEING AND WEAVING MILLS (DAR ES SALAAM)

Raw material and chemicals used	Main processes	Characteristics of wastewaters produced	Wastewater treatment available	Environmental impacts	Wastewater treatment needed
1.Raw cotton 2.Water 3.Dyestuffs	1.Spinning 2.Weaving 3.Processing 4.Finishing.	600,000 lts of water containing:- 1.Caustic soda 2.Common salt 3.Sodium hypochlorite 4.Urea 5.Acetic acid 6.Soda ash 7.Hydrogen peroxide 8.Starch 9.Enzymes 10.Citric acid 11.Stannous chloride 12.Napthols	1.Sedimentation	1.Dissolved Oxygen depletion 2.pH charges 3.Introduction of toxic chamicals	1.To rehabilitation on the oxidation ponds 2.Chemical recovery

1.2 Friendship Textile (Urafiki) Dar es Salaam

1.2.1 General

The factory was established in 1967 with an installed capacity of 33 million metres of cotton-cloth per annum. The actual capacity has been falling constantly due to lack of spares parts and chemicals old age of the mills and shortage of water. The 1989 production was only 14.5 million metres of cotton cloth. The highest recorded capacity was that of 1978 at 32 million m of cotton cloth. The factory is scheduled for rehabilitation to its installed capacity.

1.2.2 Waste water

The mills use upto 4500 m3/d of water of which more than half comes out as waste water. The waste water contains cotton wastes, dyestuffs and other chemicals as used in the bleaching, dyeing and printing processes. Table 1.2 depicts in summary the characteristics of the wastes produced and the treatment needed.

Table 1.2 FRIENDSHIP TEXTILE MILLS WASTEWATER CHARACTERISTICS AND TREATMENT NEEDED.

Raw material and chemicals used	Main processes	Characteristics of wastewaters produced	Wastewater treatment available	Environmental impacts	Wastewater tretment needed
Raw cotton Water Dyestuff, Acids, Enzynes etc.	Cotton clearing Carding Spinning Weaving Dyeing and Printing	High ss High dissolved solids high pH (10.5)	Oxydation Ponds System	Occupational hazard to the high work noise levels airborne particles	Maintain the now Operating ponds. Recycle some of the water for cooling, rinsing etc.

1.3 Morogoro Polyester Textiles Limited

1.3.1 General

The factory was established in 1978 at Kihonda Industrial Area in Morogoro township. The actual capacity in 1989 was 1470x103m of yarn blended against a planned production 3279x103m. The production of woven fabrics stood at 6070x03m versus the installed capacity of 13870 x103 in for the same year. The work force is planned at 2010 but the actual is 1808.

1.3.2. Waste water

The factory uses 1650m^3/ water/ week of which 1200m^3/week is produced as wastewater. The factory consumes 1160 tonnes/year as cotton fibres, 450 tonnes Rayon/year and 3100 tonnes polyester/year. The dyestuffs totals over 70 tonnes/year while other chemicals are about 780 tonnes/year.

The wastewater naturally contains cotton wastes, cotton/rayon/polyester fabrics and various chemicals as used in the individual processes. Table 1.3 shows the typical waste water characteristics and the treatment required.

Table 1.3 MOROGORO POLYESTER TEXTILES WASTE WATER CHARACTERISTICS AND TREATMENT NEEDED.

Raw material and chemicals used	Main processes	Characteristics of wastewaters produced	Waste water treatment available	Environmental impacts	Waste water treatment needed
1. Cotton fibres 2.Rayon 3.Polyester 4.Dyestuffs 5.Chemicals 6.Water	1.Cleaning 2.Winding 3.Worping 4.Dyeing 5.Printing	1.High ss 2.Sludge from oxidation ponds.	1.ph regulation by conc.HCI 2.Trash-rack 3.Two-stage aeration in the oxidation ponds	1.DO depletion 2.Dye stuff wastes in the effluent water 3.Scenic nuisance	1.Proper handling of the sludge from the oxidation ponds 2.Recirculation of water 3.Better way of disposal of waste water from the oxidation ponds.

1.4 Morogoro Canvas Ltd., Morogoro

1.4.1 General

The mill was commissioned in 1984 as a subsidiary of Tanzania Leather Associated Industries (TLAI). The workforce is 1100 working in 3 shifts for six days per week. The factory has an installed capacity of 6.2 million meters of canvas cloth per year while the actual capacity is 4.2 million meters canvas or 70% capacity utilization.

The new material is cotton which is locally available and conventional textile dyes which are necessary for the dyeing and printing process. Up to 340 m3 of water is used in a day as process water out of which 60 m3 for domestic purposes.

1.4.2 Waste water.

Other than the wastewater produced the mill has cotton dust which is released into the atmosphere. The main problem is the dyestuff

residuals in the wastewater produced. The second is solid waste and management.

Table 1.4 TYPICAL WASTEWATER CHARACTERISTICS FOR MOROGORO CANVAS MILLS.

Raw material and chemicals used	Main processes	Characteristics of wastewaters produced	Wastewater treatment available	Enviromental impacts	Wastewater treatment needed
1.Cotton 2.Dyestuff	Cleaning Carding Spinning Weaving	1.Dyestuff residuals 2.Heavy metals	A.Pretreatment 1.Cleaning 2.Settling 3.Aeration B.Effluent Treatment Plant 1.Oxidation ponds system 2.Chlorivation 3.Resorpion by vegetation	1.depletion of dissolved oxygen 2.High suspended solids 3.Oil film	Available treatment works should be sustained.

1.5 KILIMANJARO TEXTILE CORPORATION LTD DAR ES SALAAM

1.5.1 GENERAL

The factory is situated at Gongo la Mboto about 20 km from the City Centre on the Dar es Salaam Kisarawe road.

The factory was established in 1964 - 1965 with an installed capacity to process 7 million meters of cotton cloth. At time of the visit in Mid April, 1990 the factory was closed awaiting major rehabilitation.

The factory production processes include carding, spinning, weaving, bleaching, dyeing, printing and finishing.

1.5.2 WASTE WATER

The water consumption at full production is 60,000 gallons per day.

Due to old age, it had been estimated that before the factory was closed down the water consumption was estimated at 10,000 gallons per day.

When the factory is working the effluent is discharged to the Msimbazi valley without any kind of treatment. It is therefore no doubt that the untreated waste water from the factory pollutes the Msimbazi Valley as well as Msimbazi River.

The waste water contains a number of chemicals used in the process. Table 1.5 below gives the Characteristics of the factory waste water and treatment needed.

Table 1.5 TYPICAL WASTEWATER CHARACTERISTICS OF KILIMANJARO TEXTILE CORPORATION IN DAR ES SALAAM.

Raw material and chemicals used	Main processes	Characteristics of wastewaters produced	Wastewater treatment available	Environmental impacts	Wastewater treatment needed
1. Raw cotton 2.Waste 3.Dystuff	1.Carding 2.Spinning 3.Weaving 4.Bleaching 5.Dyeing 6.Printing 7.Finishing	45,000 litres of water containing sodium carbonate caustic soda 1.Sodium carbonate 2.Caustic soda 3.Tri-sod Phosphate 4.Hydrogen poxodide 5. Acetic acid 6.Urea 7.Soda ash 8. Starch 9. Enzymes 10.Citric acid 11.Napthols 12.Dyestuffs etc.	No proper waste water treatment technique is available	1.plt charges 2.Introduction or toxic chemicals 3.Dissolved Oxygen Depletion	1.To costruct oxidation ponds 2.Chemical recovery

2. SUGAR INDUSTRY

2.1 RUEMBE SUGAR FACTORY (K2)

2.1.1 GENERAL

The factory is situated in the Kilombero Basin some 150 km from Morogoro Town. The factory was established in 1976 with an installed capacity of 2400 tons cane crush per day. The corresponding installed production is 45000 tons sugar per year while the actual production is 32000 tons sugar per annum.

Sugarcane harvesting is mainly done manually but in some instances mechanical harvesting is used as a supplement. In any case when mechanical harvesting is applied the problem of excess mud is prominent at the Dor-clarifier. This problem could be averted by cane washing which entails additional costs due to extra power and water necessary for the exercise.

The resulting molasses is usually transported to Kilombero I for onward transmission to buyers in and out of the country. In some cases due to lack of transportation or and insufficient storage capacity the molasses are drained into the Ruaha river together with the industrial sullage. Filtermud is used as a soil conditioner in fields where cane and maize is grown. Any excess filtermud is flushed into the receiving water body in this case the Ruaha river. The main energy source for the boilers is bagasse which is available during crushing campaign. To start up the boilers however, firewood is used meanwhile there are plans to use coal instead for cost reasons.

The receiving waterbody (Ruaha river) is used, downstream of the factory, as a source of drinking water, irrigation as well as fishing. It is for these reasons that the waste water introduced should meet the effluents standards in order not to harm the recipients. There are also emissions to the atmosphere SO_2 and CO_2 during sugar production process. These could be quantified and possible treatment instituted.

The factory is due for rehabilitation to bring its capacity back to the installed one.

2.1.2 SUMMARY

Table 2.1 shows in summary the characteristics of w/waters produced, treatment available and the recommended treatment if needed.

Table 2.1 TYPICAL WASTEWATER CHARACTERISTICS OF RUEMBE SUGAR FACTORY.

Raw material and chemicals used	Main processes	Characteristics of wastewaters produced	Wastewater treatment available	Environmental impacts	Wastewater treatment needed
1.Sugarcane 2400 tons/day 2.Water 3000m^3/hr 3. Caustics Soda 4. Sulphur Lumps(for SO^2 production) 5.Lime	1.Cane Crushing 2.Clarification 3.Evaporation 4.Crystalization 5.Centrifugation 6.Drying.	1.Lime Leakage from clarifiers 2.Caustic soda Inhibited 3.Hydrochlo-Acid 5001/year 4.Oil spills During Machinery servicing 100001 year. 5.Domestic sewage	No treatment available Oxidation ponds	1.Dissolved Oxygen depletion 2.Oil film cover of receiving water 3.Boiler ash loading of the receiving waters 4. Smell nuisance 5.Slime scenic issue)	1. Oxidation ponds system 2. Oil Trap to recover the oil 3. Recirculation of cooling water.

2.2. MSOLWA SUGAR FACTORY (KI)

2.2.1 General

Like the Ruembe factory Msolwa factory is also in the Kilombero basin. The factory was established in 1962 with installed capacity of 2175 tons/day cone crush. The sugar production capacities per annum is 36000 tons and 15000 tons installed and actual respectively.

The factory too uses bagasse as a source of energy for the boilers and electricity production. Some excess bagasse is inherent of the process

and is disposed off through the cane fields. The factory is at a railway sideline which serves at an outlet for both sugar and molasses produced. The problem of excess molasses therefore does not arise. The waste water is drained into a small stream leading into the nearby Ruaha river. The receiving water is need extensively by the locals for domestic purposes, irrigation and fishing. It is therefore proper to treat the effluent before discharging to the river.

2.2.2 SUMMARY

Table 2.2 shows the typical waste water characteristics available and needed treatment.

The problems are as in Ruembe factory and likewise the treatment required is similar.

Table 2.2 TYPICAL CHARACTERISTICS OF WASTE WATER OF MSOLWA SUGAR FACTORY.

Raw material and chemicals used	Main processes	Characteristics of wastewaters produced	Wastewater treatment available	Environmental impacts	Wastewater treatment needed
1. Sugarcane 200 tons/day 2.Water 0.6m^3/S 3.Caustic Soda 4.Sulphur lumps 5.Pesticides	1.Cane crushing 2.Clarification 3.Evaporation 4.Crystallization 5.Centrifugation	1.Lime leakage 2.Caustic soda 3.Inhibited Hydrochloric Acid 4.Oil spills 10001/year 5.Pesticides 6.Filtermud dumped into river system 7.Domestic sewage	None Oxidation ponds system	1.Oxygen Depletion 2.Oil film cover on receiving water 3.Smell nuisance 4.Slime (Scenic issue)	1.Oxidation ponds 2.Oil recovery (oil trap) 3.Recirculation of cooling process waters

2.3 MTIBWA SUGAR FACTORY

2.3.1 GENERAL

The factory was established in 1970 and started production in 1972 as a private company which was nationalised by the government in 1974. The factory nationalised by the government in 1974. The factory is 100 km from Morogoro town.

The plant capacity is 2000 tonnes of cane crushed per day. Normally crushing campaign is 7 months i.e. from June to December, and off season is 5 months during which maintenance is done. During crushing campaign production is done for 24 hours.

The targeted factory downtime is 20%. However, is reality due to ageing of machines and problems of canes supply, it is higher than 20%. It is about 40%. There are future plans to rehabilitate the factory so as to minimize its downtime and to reach its installed production capacity.

Wastewater from the factory is discharged into the drain untreated; this drain pass through the sugar cane fields and end up into a small stream leaving the estate after about 6km from the factory. The stream flows through unhabited land, flooded during wet season and reaches Wami river after some kilometres. Condenser cooling water is recycled. Recycling of this water is necessary because the factory is far away from the water source Water used by the factory is about 60-70 cubic metres per hour; and 100 cubic metres per hour for domestic purposes.

2.3.2 SUMMARY

Table 2.3 shows in summary the characteristics of wastewaters produced, treatment available and the recommended treatment is needed.

Table 2.3 TYPICAL CHARACTERISTICS OF WASTEWATERS FOR MTIBWA SUGAR FACTORY.

Raw material and chemicals used	Main processes	Characteristics of wastewaters produced	Wastewater treatment available	Environmental impacts	Wastewater treatment needed
1.Sugarcane 2000 tonnes per day 2.Water 60 - 70 m^3/ day 3.Caustic soda 4.Lime 5.Sulphur	1.Cane crushing 2.Clarification 3.Evaporation 4.Crystalization 5.Centrifugation 6.Drying	1.Lime leakage from clarifiers 2.Caustic soda 3.Oil Spills 4.Domestic sewage	No Treatment available	1.Dissolved oxygen depletion 2.Oil film cover of receiving water 3.Smell nuisance	1.Oxidation ponds system 2.Oil Trap to recover oil

3. BREWERIES

3.1 TANZANIA BREWERIES LIMITED

3.1 GENERAL

The head office of the Tanzania Breweries Limited and the Dar es Salaam plant are located along Uhuru road in the centre of Dar es Salaam. The Dar es Salaam plant which has an installed capacity of 250m^3/day

(20,000 cases/day) is currently producing at around 106 m^3/day mainly due to worn-out bottling machines. Another plant in operation belonging to the company is located in Arusha about 850 km from Dar es Salaam and produces at about 150 m^3/day. Design capacity is 187 m^3/day. Both breweries get their malt from the Company's malt plant in Moshi, a town 100 km from Arusha plants.

The Dar es Salaam plant employs 1200 people and operates in two shifts. The main processes are brewing, fermentation, largering, filtering and bottling. The major wastes discharged include spent grains (30 tonnes/day), yeast from the fermentation and largering, kieselgnar from the filtration and beer (about 7% loss)and broken bottles from the bottling plant.

Table 3.1 WASTEWATER CHARACTERISTICS AT TANZANIA BREWERIES LIMITED

Raw material and chemicals used	Main processes	Characteristics of wastewaters produced	Wastewater treatment available	Environmental impacts	Wastewater Treatment needed
1.Malt 2.Enzyme 3.Yeast 4.Water		1.High BOD 2. Spent grains at 15 tons/day 3.Beer spillages	None	1.Dissolved oxygen depletion in the receiving body(Msimbazi Stream)	1.Water reuse and recycling of waste products should be promoted 2.Water consumption should be monitored 3.Recycle all the spent grains 4.Oxidation ponds systems and neutralization of effluents

3.2 DAR-BREW LTD

3.2.1 General

This factory which is situated along Morogoro road in Dar es Salaam city was established in 1966. The main products are Bulk and Tikisa brands of Kibuku a local alcohol-good beverage. The installed capacity is 7000 litres of Bulk and 3000 litres of Tikisa Kibuku per day.

The raw materials used are maize, Sorghum, alpha-amylase (enzyme) and yeast. In one brew 2400 kg of maize and sorghum, 1 litre of enzyme and 2kg of yeast are used. Up to 5 brews are made in a day.

3.2.2 WASTE WATER

The factory uses up to 30,000 litres of water per day. About 1000 litres of this is lost; mixed with spent grains which are disposed off as wastewater. The sludges/solids produced are sold as animal feed which solves the problem of solid waste management/disposal.

Smoke from the boilers omitting some CO_2 and SO_2 into the atmosphere are a significant nuisance and cause for complaints by nearby residents and motorists. This also should be looked into when thinking of the solutions to the environmental impacts.

Table 3.2 TYPICAL CHARACTERISTICS OF WASTE WATERS FROM DAR-BREW FACTORY IN DAR ES SALAAM.

Raw material and chemicals used	Main processes	Characteristics of wastewaters produced	Wastewater treatment available	Environmental impacts	Wastewater Treatment needed
1. Maize & sorghum 2 tons	1.pressure working	1.spent grains at 5000.1	No treatment	1.Dissolved Oxygen depletion	1.Oxidation ponds system
2. 2 tons & Amylase Enzyme 5 litres	2.Straining	2.Boiler ask	Waste water is led into nearby Luhanga	2. High suspended solids(ss in receiving wate	2.Oil trap to recover oils

4. MEAT PROCESSING INDUSTRY

4.1 TANGANYIKA PACKERS LIMITED

4.1.1 GENERAL

The factory is situated at Kawe about 10 kilometers North of Dar es Salaam City centre within the coastline of the Indian Ocean.

The factory was established in 1947 with an installed capacity to process meat from 65,000 heads of cattle per annum. Due to old age however the factory is now only capable of processing meat from 26,000 heads of cattle per year. An intensive programme-to rehabilitate the factory is currently going on to expand and reinstall the factory's full capacity.

4.1.2 WASTE WATER

At the present factory capacity between 100 and 250 heads of cattle are slaughtered and processed per day. The main contents of the waste water are blood and fats. A lot of water is used in meat processing about 400,000 litres per day of which 100,000 litres are released as waste water which is mixed with blood and fats. The waste water with a BOD ranging from 1,000 to 1,800 is discharged into soak away pits and lagoons.

The waste water is not properly treated in oxidation ponds since the ponds need major rehabilitation.

Table 4.1 shows the characteristics of the waste waters produced, treatment available and recommended treatment if needed.

TABLE 4.1 TYPICAL WASTEWATER CHARACTERISTICS OF TANGANYIKA PACKERS LTD.

Raw material and chemicals - used	Main processes	Characteristics of wastewaters produced	Wastewater treatment available	Environmental impacts	Wastewater treatment needed
1.Cattle Meat 2.Salt 3.Water 400,000 lts /day	1.Slaughtering and Dressing 2.Dehairing 3.Sterilization 4.Packing	1.Blood 2.Fats 3.Hides,hair etc) 4.Oil spills	None	1.Oxygen depletion 2.Bad smell	1.Oxidation ponds system 2.Trash rack to collect and remove solids hair skins etc.

4.2 VINGUNGUTI ABATTOIR

4.2.1 Vingunguti abattoir is situated at Vingunguti area in Dar es Salaam. About 70 people are employed.

An average of 50 cattle and 100 goats are slaughtered everyday for meat and skins and hides. The main processes involved are; slaughtering, dressing packing and dispatch.

4.2.2 Waste waters

Waste water containing blood, fats, hair is discharged directly into a drain which falls into Msimbazi river. The discharge has caused a lot of organic waste products to accumulate in the river bed. A settling tank (2x5m) and a small pond (about 5 x 10m) have earlier been used for treatment of the wastewater. The tank and the pond are now blocked and have not been used since 1984.
Water Consumption is unknown.

Table 4.2. TYPICAL WASTEWATER CHARACTERISTICS AT VINGUNGUTI ABATTOIR

Raw material and chemicals used	Main processes	Characteristics of wastewaters produced	Wastewater treatment available	Environmental impacts	Wastewater treatment needed
about 50 cattle and 100 goats per day	1.Slaughtering 2.Dehairing	Wastewater contains blood fats and fleshings giving rise to high BOD, foul smell and colour to the receiving water.	None	1.High dissolved oxygen depletion in waste water 2.Suspended solids in effluent water 3.Faul smell and lack of anaesthetic condition 4.Breeding of flies and insects	1.Oxidation ponds 2.Rack for collecting suspended solids 3.Aeration of oxidation ponds

5. PESTICIDE FORMULATING PLANTS

5.1 TWIGA CHEMICAL INDUSTRIES COMPANY

5.1.1 General

Twiga Chemical Industries Company was established in 1966 and it is owned by ICI in Great Britain. It has 75 workers.

The plant is located at Saza road Chang'ombe in Dar es Salaam.

The products handled are a combination of pesticides in liquid and powder form for the Control of crop pests and for use in public health e.g. Malaria control. This relates to formulated products only.

(a) Powder: The present powder formulation requirements are approximately 400 tons/year but the plant has a capacity of 2000 tonnes/year.

(b) Liquid: The present solvent based liquids formulation requirements are 1000 litres/year but the plant has a capacity of 2 x 106 litres/year. The water based liquids formulation plant is currently out of use but has a capacity of 500,000 litres/year.

Water Consumption: Currently none but when the effluent treatment plant start working water consumption will be 500,000 litres/year.

5.1.2 Waste water:

Waste wager from plant washings of equipment and spillages are collected in a pit (approximately 50 litres/week) and allowed to evaporate. Minor spillages are dry absorbed and removed to tip.

EFFLUENT TREATMENT PLANT.

The company has plans to construct effluent treatment plant. The effluent from the liquid formulation plants will be treated to remove toxic contaminant.

Table 5.1 TYPICAL WASTE WATER CHARACTERISTICS OF TWIGA CHEMICAL INDUSTRIES.

Raw material and chemicals used	Main processes	Characteristics of wastewaters produced	Wastewater treatment available	Environmental impacts	Wastewater treatment needed
A.<u>POWDERS</u> 1.China clay 2.Coconut shell flour 3. Other finished. B.<u>LIQUIDS</u> 1.Industrial solvents 2. Active ingredients 3. Other finished.	No synthetic chemistry, only formulations. Active ingredients mixed with inert or compatible carriers.	Wastewaters from washings of equipments and containers and spillages contain the toxic pesticide ingredient.	1. Collection of toxins wastewater in a pit 2.Minor spillages are dry absorbed 3.Toilet, Laundry, and kitchen water is to 3 settlement tanks and allowed to settle.	1. At the plant sight a. evaporated toxins b.possible contamination of g/water 2.At the garbage dump a.uncotrolled dumping b. contamination of ground and surface water c.Health risks to scavengers and nearby residents	The company has plans to construct an effluent treatment plant for collecting,neutralizing and precipitating toxic process and container washing waters. Future plans include an incinerator for burning the concentrated toxic solid cake.

6.0 TANNERIES AND LEATHER INDUSTRIES

6.1 MOROGORO TANNERIES

6.1.1 GENERAL

The Morogoro Tanneries Ltd was established in 1974. Construction commenced in 1976 and was completed in 1978.

The tannery was designed for a day input of 1,200 hides and 3,000 skins, giving a potential annual output of 107 million square feet of finished leather per year. The actual production capacity for 1989/90 is between 400,000 and 650,000 square feet per year. This company has 600 employees.

The main processes carried out are:

(a) beamhouse i.e. dehairing process (b) Tanhouse
(c) Retaining d) Colouring process (e) Finishing process.

Water Consumption now is 180,000 litres/day but when in full capacity consumption is 1,440,000 litres/day.

6.1.2 Waste waters

Waste water produced is 90,000 litres, when in full capacity wastewater discharged is 720,000 litres per day. Wastewater originally were discharged from the site through a series of oxidation lagoons near the Ngerengere river. Before been discharged through these lagoons, waste water from the tannery were treated in a pre-treatment plant which was designed to take a maximum of 1320m^3/day but this pre-treatment plant is completely broken down and badly blocked.

At present wastewater (untreated) is discharged into the Morogoro effluent treatment plant located on the Morogoro Industrial Estate.

The Quality of effluent discharged from the tannery is as follows:-

BOD	SS	TS	S^{2-}	Cr 3+	kg/day
1,857	2,561	12,183	184	4.35	

In general the treatment plant is in a poor state of maintenance. The concrete works is crumbling in parts, especially where it has been attacked by acids, etc. The metal works is also corroded, especially

the mechanical screens, the pipes and walkways on the homogenizer, the central inlet tubes of the vertical separators and sludge concentrators; the V-notch weirs surrounding the vertical separators to ensure an even discharge. Most of the main pumps are non-operational.

TREATMENT OF WASTEWATER NEEDED

In order to improve the effluent from Morogoro tannery treatment plant which is discharged into Morogoro effluent treatment plant, the following steps be taken.

(a) Reuse of the lime float should be incorporated into the process which will reduces both the organic pollution load and the sulphide content.

(b) There is a need to reduce the chrome content by the use of high-exhaustion chrome method. This is considered to be more appropriate to the Management and operation of the Tanzania tanneries for chrome recovery.

(c) Sequential washing should be used rather than concurrent washing, (a method which was practiced when the plant was working) because the extra water used will further dilute the waste.

All the above mentioned steps aim at economizing on water consumption and reduce the load on the effluent treatment.

The table 6.1 below summarise all the information concerning the Morogoro Tannery.

Table 6.1 TYPICAL WASTEWATER CHARACTERISTICS OF MOROGORO TANNERIES.

Raw material and chemicals used	Main processes	Characteristics of wastewaters produced	Wastewater treatment available	Environmental impacts	Wastewater treatment needed
1 Hides 2.Skins 3.Chrome salts 4.Sulphides 5.Fungicides 6. Syntans 7.Fat liquor 8.Olinor 9.Dyestuffs 10.Resins 11.Enzymes 12.Waxes	Preparing, Dehairing, Tanning and Finishing	1.High BOD value 1857kg/day 2.SS-2561 kg/day 3.TS-12,183 4. S^{2-}184 5. Cr^{3+}-4.34	None	1.Smell 2.Depletion of DO 3.High BOD 4. Chrome contamination	1.Recycling lime 2.Use of high exhaustion chrome method i.o.t. reduce chrome in effluent. 3. Use of sequential washing.

6.2 MWANZA AND MOSHI TANNERIES

6.2.1 General

Mwanza and Moshi tanneries are among the tanneries which cause environmental pollution due to their untreated effluents the two factories discharge into the environment. Due to time constraints, the two factories were not visited, but some important information/data were available from previous visits made by the National Environment Management Council. Below the two tanneries are briefly discussed with regard to wastewater related problems.

6.2.1 MOSHI TANNERY

The Moshi Tannery was established in 1968. Production started in 1969. The installed capacity of the Moshi Tannery is to process a daily input of 1000 hids and 4000 skins which would yield an output of approximately 10 millions square feet of leather per year.

The present production capacity is 3 million square feet of leather per year. This is due to several of the machines are no longer in operation and the present condition of the machinery would not allow for an output of more than 3 million square feet per year.

Water consumption of the plant is about 37 litres per kg of fleshed hide or about 20.9 litres per square feet of crust leather produced. Wastewater produced is about 793m^3/day. The quality of wastewater produced is as follows:

BOD	SS	TS	S^{-2}	Cr^{3+}	kg/day
2,341	3,230	15,363	232	149	

6.2.2 MOSHI EFFLUENT TREATMENT PLANT

The treatment plant of Moshi Tannery was designed in 1978 in order to provide a complete treatment for the effluent. Construction of the plant was started but ran into difficulties so that by the end of 1983 the work came into standstill. All the civil works are virtually complete most of the mechanical equipments are on site but not installed and none of the electric works has been started.

The plant was designed to operate with a daily flow of 480 m^3/day and maximum flowrate of 90 m^3/hr.The underlying reasons for the delay and problems of the uncompleted work has been the lack of money for the tannery to pay for the work.

Currently the effluent from the tannery, which is mixed together in a small pumping well and discharged at intervals, flows with any surface water along a ditch to a series of informal lagoons where settlement and gradual purification may take place. When one lagoon become full of sludge, the flows can be diverted to another lagoon. Except in circumstances of heavy rain, the effluents are contained within these lagoons from which the water both evaporates and filters into the ground. Since the environment surrounding the tannery is a sensitive area, it is essential that any effluents are treated to a high degree of purity.

Since the treatment plant is still in a reasonable condition, there is a need to complete it so that it can start operating.

6.3 MWANZA TANNERY

6.3.1 General

Mwanza Tannery Ltd was established in 1974. Production started in 1978. The installed capacity was based upon an assumed daily inputs of 1500 hides resulting in an annual output of 7.5 million square feet of chrome leather and 340,000 kg of vegetable tanned sole leather.

The capacity utilization gradually went down from approximately 33% in 1979 to 8% in 1988. The tannery has never performed satisfactorily. The main reasons given to this poor performance are inadequate supply of hides, non availability of essential chemicals due to foreign exchange constraints and persistent interruptions to the electricity supply.

The water supply to Mwanza Tannery is pumped directly from Lake Victoria. For the maximum production, water required is approximately 615,000 litres per day.

6.3.2 EFFLUENT TREATMENT PLANT

The treatment plant at Mwanza Tannery was built in 1974. The plant was designed to receive flows of 600-800 m^3/day.

The plant ran until 1983 when it became completely choked with sludges which blocked up the effluent pipe to the first settling tanks. The effluent channel from the factory was then diverted away from the concrete tanks straight to the earth-lined settlement tanks and hence to the large settlement lagoon from where it evaporates and infiltrates into the groundwater and at times of high flow runs off into the lake.

Under the present conditions of low production and a blocked drainage system within the factory, all the wastewater from the tannery comes together in a single ditch leading towards a series of lagoons. These lagoons form the final stage of the original treatment system. It is likely that some purification takes place as the waste passes

through these lagoons and nearby reed beds, and that, due to low production, little if any effluent is discharged directly into the lake, except when there is extremely high rainfall. However, the final effluent lagoon is almost connected to the lake via the groundwater through cracks in the clay bottom of the lagoon. The level in this lagoon is probably regulated by the level of the lake. This means that some infiltration and contamination of lake water occur, albeit after percolation through the soil.

In summary, there is a need to rehabilitate the treatment plant to its original state using the same civil works and modify the processes in order to reduce water usage and chrome content in the effluent. This will be achieved by use of high-exhaustion chrome tanning and sequential washing.

7. SISAL INDUSTRIES

7.1 PANGAWE KINGOLWIRA SISAL ESTATE

7.1.1 General

Pangawe Kingolwira sisal estate was established in 1928. It now belongs to Sisal Authority. It is 15km off Morogoro municipal.

The installed capacity is to produce 15 tons/day of sisal fibres. The actual production now is 5 tons/day. Water consumption is 60,000 litres/day and wastewater discharged is 61,200 litres/day and wastewater discharged is 61,200 litres/day. Wastewater is discharged into Ngerengere river untreated. There is no treatment plant. There are oxidation ponds which are not in use now. The have to be rehabilitated before put in operation.

7.2 NGOMBEZI SISAL ESTATE

Ngombezi Sisal Estate dumps its untreated effluents into Pangani river. The effluents has changed the quality of water drastically. The amount of DO is well below the allowable value also there is a rise of the permanganate value. The rise is PV indicates the introduction of organic matter in the river.

Pangani river is a source of water for industrial and domestic use.

7.3 MJESANI SISAL ESTATE

The untreated wastewater from Mjesani Sisal estate is discharged into Sigi river. Sigi river enters Mabayani Dam thus the wastewater from the estate finds its way into the Dam which is the source of water for Tanga town. As a result of wastewater pollution, dissolved oxygen (DO) is depleted and a lot of organic material is dumped into the Dam rising Permanganate value of the water.

7.4 HALE MWAKINYUMBI

The pollution of Pangani river as a result of the introduction of wastewater into the river by this estate is similar to that caused by similar sisal estate processing factories.