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Environmental Assessment
of
Ennadhafa JUDY, Tunis, Tunisia

by

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DISCLAIMER

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I. EXECUTIVE SUMMARY

An assessment of environmental controls at the Ste. Ennadhafa - JUDY plant was conducted under the sponsorship of the World Environment Center (WEC) and the United States Agency for International Development (USAID) in June 1992. The project supported USAID's Project in Development and the Environment (PRIDE).

The assessment was performed by Mr. Gerald N. McDermott, a licensed Professional Engineer with over forty years of experience in the detergent industry and working with governmental agencies.

JUDY mixes and bottles or packages several consumer products: chlorine bleach, liquid detergents, toilet deodorizer, household disinfectant, and insecticides.

JUDY's water use averages 70 cubic meters per day. There is little opportunity to save water at JUDY given their existing bottle washing system which already reuses water and collects water which overflows or is spilled. A more sophisticated counter-current multiple vat bottle washing and rinsing system is discussed which has the potential of saving water for JUDY.

A possible method for treating JUDY's wastewater is a land treatment system. This method involves spraying the wastewaters on soil (at low rates) and allowing the bacteria in the soil to degrade the detergent and other organics. There is vacant and agricultural land within a reasonable distance of the plant.

Chlorine is used at JUDY to make bleach. It is a highly dangerous material that must be handled with the most failure-proof equipment available. The most common accident related to chlorine is a small leak in the chlorine system. JUDY is presently taking steps to procure oxygen-supplying equipment for repairmen to use while fixing such a leak. Information on the safe handling and storage of chlorine was requested for JUDY from several U.S. industry organizations.

Sodium hydroxide (caustic) in concentrated form is another hazardous material handled at JUDY. It is recommended that eye wash stations and showers be installed to treat eye and skin injuries due to accidental contact with caustic.

A compound containing chromium is used at JUDY to give the bleach a yellow color which distinguishes the JUDY product and also prevents accidents due to misidentifying the bleach for water. Chromium is a metal whose concentration is limited by drinking water standards. The author suggests investigating alternative coloring agents which do not contain heavy metals, nor are otherwise environmentally objectionable.

JUDY's wastewaters are presently hauled to disposal sites since no public sewer service is available. The author suggests that a more economic and reliable system for addressing JUDY's wastewater would be treatment at a joint community facility which serves residential, commercial and industrial users.

II. INTRODUCTION

The World Environment Center contributes to sustainable development worldwide by strengthening industrial and urban environmental, health and safety policy and practices. In June 1992, WEC furnished the services of Mr. Gerald N. McDermott, an environmental engineer, to investigate the environmental control program of Ste Ennadhafa - JUDY of Tunis, Tunisia, to assess its soundness and areas for improvement.

This document records that assessment and gives an account of manufacturing activities and facilities pertinent to environmental control. The account includes manufacturing process descriptions with emphasis on wastewater, gas emissions, and discarded material sources. Some assessment of the hazards to workers' health and to the environs of the plant is included. The information was gathered by the author during site visits.

In making this assessment, the author made use of 23 years of experience dealing with environmental problems at one of the largest producers of soap and detergents and food oils in the United States and the world. The author is retired and independent of the company currently.

In general, the bleaching and detergent industry throughout the world accomplishes wastewater treatment in combination with community wastewaters in community treatment

facilities. The wastewaters are accepted in community systems without regard to the concentration of compatible constituents. In the United States, only one plant in approximately one hundred provides sufficient treatment for discharge of its wastewaters directly to a stream or lake. A different system of control is being established in Tunisia.

The Tunisian system limits industrial wastewater characteristics to the concentrations found in residential sewage or denies use of the public sewer entirely. Such an approach requires complicated pretreatment processes. Each industrial plant requires a processing plant for the material removed from its wastewaters and a means for ultimate disposal of the residual waste material. The costs of individual treatment is high and the policing of these treatment requirements and disposal practices is difficult and expensive.

A matter which occupies considerable attention in this report is the safety practices for handling chlorine gas, a major constituent of one product. The facilities and practices for safe use of this gas require adjustments, based on risk assessment and management.

This report will be a useful document in the future and should be updated periodically. It will be of assistance in a number of applications including:

- managing reviews and program directions;
- training supervisory and operating personnel;
- promoting understanding of the program by the community and neighbors; and

- reviewing environmental matters with control agencies.

The cooperation of Ennahdafa-JUDY was complete and the assistance of the managers and engineers was enthusiastic and generous. The author is appreciative and grateful for their help.

III. FINDINGS

A. Manufacturing processes; wastewater and emission sources

1. Liquid bleach for home laundering

a. Materials

Chlorine
Sodium hydroxide
Potassium dichromate
Hydrochloric acid
Dish washing detergent
Water
Glass bottles
Labels
Glue

b. Equipment

Chlorine gas piping system
Basins for caustic and chlorine reaction
Tanks for adjustment of strength of solution
Mechanical bottling machine
Hand bottling racks
Bottle washing basins

c. Products

Liquid bleach for home laundry use

d. Employees

250 - total plant

e. Process description; wastewater and emission sources

Bleach is made from chlorine and sodium hydroxide. The gaseous form of chlorine is slowly discharged into a solution of sodium hydroxide and water. The chlorine reacts with the sodium hydroxide to produce sodium hypochlorite. Sodium hypochlorite remains in solution in a stable state in the presence of unreacted sodium hydroxide. This condition is maintained by the liquid while in-process at the plant and in the product. If the concentration of sodium hydroxide becomes too low, and the concentration of sodium hypochlorite is high, the reaction will reverse and chlorine gas will be released into the vapor space above the liquid. At low levels, chlorine gas is hazardous to life.

Sodium hydroxide is purchased as a solution of 50 percent sodium hydroxide and 50 percent water. Chlorine is received in steel cylinders each holding a metric ton. The pressure in the cylinders is such that the chlorine is in liquid form. When released to atmospheric pressure at the cylinder valve, the chlorine vaporizes and flows to the reaction as a gas. The chlorine cylinders are transported to the plant by truck and rolled from the truck bed to a raised platform on which there are steel tracks for positioning the cylinders. Details of this installation are discussed in the subsequent section on safety.

The chlorine cylinder area is equipped with a number of plastic tubes which are each connected to a cylinder of liquified chlorine. Each hose extends to one of a number of ceramic-lined concrete basins or cells each of about 6 cubic meters in volume. The open hose end lies on the bottom of each basin. The basin is first filled with sodium hydroxide and water. Water is added to the basin in addition to the caustic so that the final

concentration of caustic, after chlorine is added (to produce the proper concentration of sodium hypochlorite) is low. Chlorine is added slowly to create a solution of sodium hypochlorite of less than 3.6 percent concentration which is the maximum concentration allowed for household use in Tunisia. Some excess sodium hydroxide must remain unreacted in order for the solution to be stable, that is, it will not release chlorine gas (as previously explained).

The temperature of the solution in the vats is monitored. If the exothermic reaction increases the temperature to a value greater than a selected safe level, the chlorine is shut off at the cylinder. The vat is then cooled by aeration. With the caustic at a high level, there is no release of chlorine in this cooling process.

The basins for this reaction are served by a pipe manifold so that caustic solution and water can be delivered to any basin. The natural agitation which occurs as the chlorine reacts with the caustic is used to stir the contents of the vats. The tank contents mix well as the chorine is added. The strength of the hypochlorite is monitored (as the addition of chlorine proceeds) by periodically analyzing samples in the control laboratory. The addition of chlorine to each batch takes a matter of hours, ordinarily, so it is slow enough to allow this monitoring control. The measurement of the rate or quantity of chlorine addition is not necessary.

The addition of chlorine is stopped after the solution in the basin is at the desired strength. The sodium hypochlorite solution is then pumped to a series of plastic tanks positioned at an elevated level above the bottling plant. These tanks are referred to as dilution tanks. A batch transferred there is analyzed and sufficient water is added to achieve a concentration at or very near a selected concentration equal to or less than the 3.6 percent sodium hypochlorite limit. The sodium hypochlorite and the unreacted sodium hydroxide concentrations are equal to or less than those required for marketing hypochlorite bleach in Tunisia, as regulated by the government. The strength is such that the release of chlorine from the bleach even at hot water temperatures will not create a hazard in the home. The United States government has a strength limit which is similar.

A small amount of potassium dichromate is added to the solution in the dilution tanks. This agent has an intense color and, when diluted, imparts a bright but low intensity yellow color to the bleach. The company adds this coloring agent to make the product attractive to customers. The dichromate does not perform a laundering function. The color makes it less likely that the contents of the bottle will be mistaken for water. Since the product is bottled in sizes and shapes identical to those used for drinking water, adding a color to the bleach solution appears to be a good idea. The choice of this particular agent may not be the best because it contains chromium. This matter is discussed in a subsequent section.

The bleach flows by gravity through pipes to a mechanical bottling machine. The bottles are filled as they are conveyed through the machine. The machine is equipped with spill or

overfill collecting channels which route the spilled liquid to a sump from which it is pumped to the filling tank and thus recovered.

At times when the bottling machine is not functioning, the bleach flows to hand-filling stations. Small diameter rubber hoses discharging the bleach are moved from bottle to bottle by hand. The operators wear rubber gloves. The hand filling operation is also subject to small portions of the bleach being discharged to the drain system through overfilling of bottles and the breakage of bottles in handling. This drainage flows through trench drains in the floor to a sump from which it returns to the bleach making process.

The bottles are recycled. The purchasers of the bleach are accustomed to returning the bottles to the place of purchase. The returned bottles are then taken to the bottling plant. The bottles are washed and rinsed by hand before placed in the filling system. This operation creates the major volume of wastewaters in this plant. The bottles usually contain only residuals of the bleach but the company must guard against bottles with other material which would contaminate the product. The labels are also washed from the bottles, thus the wastewater contains glue, paper label, any agent used in washing the bottles (such as detergents or phosphates), and any residual material that the user may have placed in the bottle.

The wash water draining from the washing area and from the washed bottles flows across the floor and in trench drains to a sump. A pump recirculates the washwater from the sump to

the washing vats. A stream of this washwater is conveyed to the sewer system continuously as a means of limiting the quality of the washwater. This water amounts to about 21 cubic meters per day. During the visit the quality of this water was inspected. It is virtually clear. The pH was 8.3, a near neutral value. The wastewater generated a small amount of foam when shaken in a bottle.

This water also contains the labels washed from the bottles. A small screen is placed in the drain to capture labels which are then collected and disposed of in drums. The screen removes some of the labels which remain whole as they separate from the bottles, but many labels are removed as fragments which are carried away with the wastewater. The washwater also contains a number of plastic caps which are discarded from the bottles at the beginning of the washing process.

The bottles are closed with a plastic cap either by the machine or by hand. The final operation is the placing of the bottles in boxes or crates in which they are shipped to the stores.

After the repeated use and washing of glass bottles, the bottles will develop a film of mineral deposits on the surface. This is a common occurrence particularly if the calcium and magnesium content of the water used in washing or in the product is high. The film is not removed in common washing processes but can be removed by an acidic solution since the acid reacts with the material in the film to make a soluble product.

This plant uses a dilute solution of hydrochloric acid to remove film on bottles. The acid strength is about 0.1 normal, which is a quite dilute acid. Bottles for film removal are selected by workers as the bottles are washed. The designated bottles are then washed with the acid solution by workers wearing rubber gloves. The spent acid solution is occasionally dumped to the drain.

There are no emissions of vapors or gases to the air from the bleach plant.

2. Detergent for Dish Washing

a. Materials

Dodecylbenzene sulfate
Nonylphenol ethoxylate
Laurylalcxoholether sulfate
Bottles, plastic and glass
Labels
Glue
Perfume
Formaldehyde
Hydrochloric acid
Isopropylene

b. Equipment

Tanks for mixing ingredients
Bottling machine
Bottle rinsing station

c. Product

Liquid detergent for dish washing

d. Process Description: Wastewater and Emission Sources

The detergent process consists of mixing the proper proportions of the three ingredients of the product. There is no synthesis or reaction involved. The three principal ingredients, dodecylbenzene, ethoxylate and lauryether sulfate, are pumped to tanks and a batch of the desired composition is prepared. The pH is adjusted with hydrochloric acid. Perfume is then added (when used) and the mix is pumped to bottling operations. A preserving agent, formaldehyde, may also be added. There is a bottling machine for each size and type of bottle. The machines have a system for collecting overfill or spillage due to breakage which is then returned to the filling tank.

The glass bottles are hand labeled which can be difficult if there is any product on the surface. Any product overflowing on the surfaces must be rinsed off before labeling. This is done by rinsing the filled bottles in the same basin arrangement used for washing the returned bottles for the bleach product.

Plastic bottles are procured with labels embossed as a part of the bottle so reused plastic bottles need not be rinsed for labeling.

The detergent is subject to bacterial degradation in the bottle. In order to have reasonable shelf-life before objectionable amounts of bacterial growth occur, formaldehyde is added to each batch of mix to inhibit growth of bacteria. The concentration used results in less than 0.1 percent of formaldehyde in the product.

The rinse water is the only liquid or gaseous waste from this operation.

3. Deodorant

a. Materials

Paradichlorobenzene
Perfume

b. Equipment

Tablet forming press

c. Product

Sanitizing product for use in the water tank of a commode or urinal.

d. Process description: wastewater and emission sources

The material for forming the product is received as powder in bulk form. The manufacturing process consists of charging amounts to a form or die. The powder is pressed into the form at considerable pressure. The pressure causes the material to harden in the form of the die, which, in this case, creates a round shallow pad of the material.

There are no wastewaters or even use of water in this operation.

There are no gaseous emissions.

4. Insecticides

a. Materials

DDT
Permethynoel class of compounds.
Type 1
Type 2
Trichlorotrifluoroethane (Freon)
Kerosene

b. Equipment

Propellant charging machine

c. Products

Insecticides for household use

d. Process Description; Wastewater and Emission Sources

The insecticides are received in bulk from manufacturers in the Netherlands and England. The operation performed in this plant is to transfer the bulk materials to cans or other packaging.

The insecticides are placed in pressurized cans along with a propellant. The propellant used is trichlorotrifluoroethane. This raw material is obtained from a manufacturer in Italy. The pressurized tanks are connected to the can-charging machine which charges the gas into a can with a valved outlet so that the can seals automatically. It is stated that the machine accomplishes the charging without significant loss of freon.

Kerosene is added to some of the products to increase their solubility and reduce their viscosity so that the contents are more suitable for spraying.

The pesticides are also packaged in containers with screw cap closures. The material is used by the consumer by placing it in a hand held sprayer which creates a spray of the liquid in air.

No actual synthesis of a product is carried out in the insecticide part of this plant. There are no by-products or discarded material.

The insecticide packaging is done in an area of the plant which has no sewers or trough drains. There are no wastewaters. Air emissions are limited to the losses of freon, if any, from the charging machine.

5. Disinfectant

a. Materials

Cresyllic acid (phenol)
Detergent

b. Equipment

Bottling station

c. Product

Disinfectant for home or commercial use

d. Process Description; Wastewater and Emission Sources

The cresylic acid is received in bulk. The operation here consists of diluting it with water and placing it in bottles. The bottles are labeled and packaged for shipment. Bottling is done

by hand. A surface active agent is added to add a cleansing ability to the solution.

This operation has the usual potential of losses in the filling line through over-filling and bottle breakage. The same bottling place is used as for the bleach. The production is currently small and the wastewaters minimal.

6. Rainfall Runoff and Spill Protection

Nearly all of the site is roofed area. Only roadways and the chlorine vessel storage areas are uncovered. Raw materials are received in drums and there are no unloading or pump transfer areas with the exception of the loading area for the wastewaters.

The quality of the rainfall runoff should be much like the general urban runoff. The runoff flows to a natural drainage channel adjacent to the property that flows to the east toward the sea.

7. Sanitary Wastewaters

Wastewaters from the toilets and showers flow in a separate sewer to a cesspool located on the property. The cess pool has walls which allow the water to permeate the surrounding soil and move into the groundwater. A sanitary wastewater contract hauler occasionally is called to pump out and dispose of the solids accumulating in the cesspool.

A public sewer has not been placed in this area. The nearest connection is approximately one kilometer from the plant.

8. Auto Servicing Wastewaters

JUDY operates a fleet of trucks for delivery of its product and other business. A service shop for the fleet is located at the manufacturing site.

Waste materials from this operation consist of used crankcase oil and discarded repair parts. The crankcase oil is collected in drums and is picked up by a firm which reprocesses oil.

A number of cars and trucks are washed at this location as part of the servicing. Washing is done by hand using detergent solution and rinse water. The car washing wastewater flows to a trench and on to an accumulating tank. The overflow from this tank flows on to the accumulating basin of the plant where the bottle washing wastewater and miscellaneous drainage accumulates.

B. Wastewater System, Wastewater Treatment Practice and Disposal.

The areas of the plant in which bottle washing and bottling of liquid products takes place are equipped with trough floor drains or sewer pipes which convey the wastewaters from those areas to concrete accumulating basins. The accumulating basins are located beneath the ground surface so that flow to them is by gravity. The plant has one major accumulating

basin and a second which overflows some wastewaters to the main tank. Most of the solid material carried by the wastewaters are bottle caps which get flushed away and bits of paper or whole labels which are washed from the bottles.

The plant has a tank mounted on a trailer for hauling wastewaters. It is pulled by a tractor. A pump is available at the tank for pumping the wastewater from the accumulating tank to the tank on the trailer. The wastewaters are hauled to remote locations and discharged.

Water is obtained from the public supply. The use of water averages about 70 cubic meters per day. JUDY management estimates that about 8 cubic meters per day is used in the toilets and showers. The bottle washing and rinsing operation uses about 21 cubic meters per day. Car washing uses as much as a cubic meter per day. The amount of water used in producing the bleach product is about 40 cubic meters per day.

The capacity of the three industrial process wastewater accumulating tanks is about 50 cubic meters. The tank trailer for wastewater hauling carries at a maximum 3 cubic meters. Thus, if the haul time was about an hour, the trailer would have to be operated continuously during the day.

C. Air Emission Control Practice

The information obtained during this plant visit indicates there are no routine emissions of importance from this plant, hence no control equipment or program is needed. There is a potential of a major air quality problem if there were to be a leak or rupture of the tanks and pipes holding and conveying chlorine gas. This subject is discussed in the section on hazards.

IV. CONCLUSIONS AND RECOMMENDATIONS

The following recommendations are made to JUDY and discussed more fully in the subsequent pages:

1. Consider a counter-current multiple vat bottle washing and rinsing system that could potentially save water.

2. Consider land treatment of JUDY's wastewater as an alternative to the present practice of hauling wastewater to disposal sites.

3. Consider the use of alternative coloring agents (rather than the presently used chromium-based compound) for the bleach which would maintain the product's yellow hue but not contain heavy metals nor be otherwise environmentally objectionable.

4. Procure gear which would provide a supply of oxygen to a repairman fixing a leak in the chlorine system.

5. Install eye wash stations and showers to prevent injuries due to accidental worker contact with caustic.

6. Institute a formal safety program to include:

   - labels on tanks containing hazardous materials;

   - exhibition of safety data sheets on tanks or in the immediate area;

   - records of employee training to include dates and type of training;

   - elimination of any overhead piping of hazardous materials, where possible; and

   - provision of secondary spill containment for storage tanks and unloading areas for hazardous materials.

7. Promote the use of a more economic joint treatment system where industry wastewaters would be treated at a community facility serving residential and commercial customers, as well.

A. In-process Measures to Reduce Wastewater Flow or Pollutant Quantities

JUDY's bottle washing system has a built-in reuse system. The wash water is kept in a basin and used for many bottles. In addition, the overflow and rinse waters are collected in a sump and returned to the washing vats.

The bottle-filling machines and the hand-fill stations have a collection system for the material which overflows the bottles or is spilled.

Thus, there are no remaining prime opportunities for water conservation. A more sophisticated counter-current multiple vat washing and rinsing system might save water. This would consist of a number of vats through which the water flowed in series. The first vat would receive the unwashed bottles and the water containing detergents would be in the vat. The opposite end of the line of vats would be the one which received the fresh rinse water. For maximum effectiveness, the rinse water would be sprayed directly into the bottle.

There is a special valve made which would be connected to a small diameter pipe extending about the mid depth of the bottle. The valve is made with a pressure pad for valve actuation. The bottle is lowered by hand over the pipe until the top hits the pad. The pressure of the weight of the bottle or hand pressure actuates the valve and the spray of pressurized water

strikes the inside of the bottle. After spraying water for a moment, the bottle is removed and set in a rack upside down to drain.

The rinse water flows to the vat located between the washing and rinsing vats. In this vat, the bottle would be scrubbed and checked, as necessary, and then delivered to the rinsing step. The water from this vat would flow to the vat receiving the unwashed bottles. Here, they would get their first soaking. The overflow from the first vat would be to the wastewater system.

These bottles could possibly be washed in a mechanical bottle washer. At one time in the United States, the return and washing of soft drink bottles was a common practice. Some of these bottle washing machines may be surplus and therefore could be obtained inexpensively. On the other hand, the cost of labor in Tunisia may not justify automation.

The wastewaters are of low organic concentration. A low concentration of detergent and some glue would essentially be all the dissolved organic. The labels would contribute some suspended matter. Altogether, these wastewaters are not a large environmental concern since they are susceptible to simple treatment in a community wastewater system. The chlorine may be a problem in the immediate discharges, but this would soon dissipate in the presence of organic.

B. Control of Emissions

There are no significant emissions from the operations described in this report. However, there is a certain potential of a loss of chlorine gas to the atmosphere by a leaky cylinder or a plastic tube disconnect or failure. This subject is discussed section on Safety Consideration.

C. Ground Water Quality Protection

Protection of ground water quality is of great importance in a country of low rainfall and limited water supplies. Areas of the land which contribute to ground water of usable quality should be protected from pollution. There likely are lenses of salt or brackish water extending inland a short distance from the shoreline. This brackish or salt water would render the groundwater in this strip unusable. Discharge of the JUDY wastewater in this area is not likely to have a significant impact on the environment.

Groundwater quality would be affected if these wastewaters were deposited on highly permeable soil. Once detergent reaches lower layers of soil, it persists since it does not degrade readily in the absence of oxygen.

D. Land Treatment

Land treatment refers to spraying the wastewaters on soil at low rates of application, (for example: 1 centimeter depth per day on average over the total land used) and allowing bacteria in the soil to degrade the detergent and other organics which will degrade in the

presence of oxygen. The application rate would have to take into account the loading of organic matter onto the soil as well as the water quantity. These wastewaters do not have high concentrations, so the organic loading probably will not control the application rate. There is vacant land and agricultural land within a reasonable distance of the plant. The wastewaters could either be pumped or hauled to the land.

The plan of operating would be to wet certain areas and then let these areas rest for a day or so. Other areas could be wetted during this rest period. A high population of micro-organisms will develop in the upper layer of soil. These are supplied by oxygen from the air. Biodegradable material will be essentially removed as the water percolates through a few inches of soil. The soil must be such that it will allow percolation. Sprays can be continued during rainfall or snowfall as the bacteria will continue to function in the soil.

E. Pretreatment preparation to discharge to a public sewer system.

If access to a wastewater system serving the entire community is made available, these wastewaters would likely be compatible to discharge to the system as produced. The bottle caps and the large pieces of labels would need to be screened from the wastewaters since they present the potential of obstructing the sewers or causing a nuisance.

F. Chromium in the Product

Concern about the health or environmental impact of the chromium content of the bleach product is appropriate but not an acute problem to be solved immediately. Chromium is a

metal whose concentration is limited in drinking water standards.

As discussed previously, chromium is added in the form of a water soluble compound, potassium dichromate, to the bleach as a coloring agent. The concentration is quite low. The route of its entering the environment would be through end use of the product. In the accumulation of household wastewaters from a home, the concentration of chromium would likely be well below the drinking water standard. In addition, percolation to groundwater would likely be accompanied by further dilution of tenfold or higher. For this reason, the matter is not considered one that requires immediate attention or correction.

Nevertheless, the philosophy of an environmentalist typically embraces the principal that any potentially harmful material should be isolated from potential impact on the environment wherever that can be done without significant economic impact or cost. An environmentalist would advocate stopping the use of chromium for coloring the bleach unless marking the bleach with a yellow color was justified on the basis that it might stop a child from drinking it accidently. On the other hand, JUDY risks losing customers if the bleach is not its usual yellow color. JUDY bleach has always been colored, and this is a distinguishing mark to the user. If the bleach were to be colorless, the customer might think he had not received the product he wanted or he might think he was being sold plain water. JUDY has given considerable attention to finding a coloring agent of the same yellow hue, which does not contain a heavy metal or compound that is environmentally objectionable. The search has not been successful because bleach will destroy the color of many organic agents. In

addition, if an organic material is used, the reaction with the chlorine could produce a chlorinated organic which is itself environmentally objectionable or even volatile. The search continues and some suggestions were made to JUDY for coloring agents to test.

If a coloring compound can be found of less environmental concern, it is recommended that the new compound be used. An approach JUDY might consider is to advertise its replacement of chromium in order to generate public goodwill. Interest in the environment is quite broad at this time.

G. Safety Considerations

Occupational safety is not the author's expertise.

Safety considerations for worker and environmental protection are particularly acute for chlorine because it is highly dangerous. Chlorine gas is heavier than air and will tend to accumulate at ground level and in low elevation areas, if released. The equipment used to contain and transport chlorine is the most failure-proof available.

The water supply and sewage treatment industries are major users of chlorine gas. Both of these industries have organizations that provide their members with manuals outlining the safe handling and storage of chlorine. The author requested these organizations to supply manuals to the management of JUDY. In addition, the Chlorine Institute, a chlorine gas

manufacturers' organization, provides literature and advice on the safe use of chlorine. Appendix F is a copy of a letter requesting them to provide advice to JUDY.

The most common accident is a small leak in the chlorine system. In order to repair a leak, a repairman must be equipped with oxygen-supplying gear. Such emergency equipment is a minimum for good practice and JUDY has taken steps to procure such equipment.

Sodium hydroxide (caustic) in its more concentrated form is another hazardous material that is used at JUDY. This material is a particular hazard to the eyes where a small amount splashed in the eye can cause vision impairment or loss. An eye wash station which turns a fountain of water onto the eyes rapidly and automatically, with a minimum of actuation, should be available nearby. Overhead showers are also a typical safety feature so that an operator, once contacted with a spill or spray of caustic, can wash it off immediately.

A typical safety provision is to place warning signs and placards on tanks of hazardous materials or in the immediate vicinity of unloading and transfer stations. Many safety programs require that all employees be thoroughly trained in all safety procedures and that records be kept on such training. The Chemical Manufacturers Association furnishes safety information to its members and may be able to provide materials to JUDY.

In some cases, perfume is supplied as a solution of the basic perfume ingredients in a solvent. Some of the solvents used are flammable and they must be handled and stored to

minimize risks. One risk is that the perfume will leak or be spilled to the sewer and thus cause explosions in the vapor space in the sewers. The perfumes currently used by JUDY are of low flash point and volatility so that extreme precautions are not required.

A more formal safety program is recommended to include:

- labels on tanks containing the hazardous materials;
- exhibition of safety data sheets on tanks or in the immediate area;
- records of employee training including, dates and type of training;
- elimination of any overhead piping of hazardous materials where possible; and
- provision of secondary spill containment for storage tanks and unloading areas for hazardous materials.

H. Treatment with the Combined Wastewaters of the Community

An approach which has predominantly been found to be of maximum societal benefit is for the appropriate public agency to provide wastewater services for all members of the community: residential, commercial, and industrial. Of course, the community systems would accept only industrial wastewater with constituents and characteristics compatible with transport and treatment in their systems.

The present regulations for industrial use in Tunisia do not permit this approach to be applied, since they limit pollutants which can be adequately treated by the same processes that are used for residential wastewaters. For toxic pollutants, on the other hand, the limitations in present Tunisian regulations are commensurate with the treatment of combined

wastewaters of the community and much like those imposed by facilities accepting all compatible constituents. This effort to serve all customers is called joint treatment indicating all users join in the effort. Industrial users properly consider the joint facilities as an extension of the manufacturing facilities and can be involved in the effective and economic operation to a degree, not dissimilar, to their concern in making a quality product.

Joint treatment is practiced by almost all local agencies in the United States. Each wastewater agency has appropriate sewer use regulations. The local regulations incorporate requirements imposed by the United States Environmental Protection Agency. Such regulations do not require the reduction in concentrations of compatible pollutants by pretreatment. In the case of the JUDY plant, the wastewaters likely have no toxic material. The expected quantities of un-reacted chlorine in the wastewaters could possibly be of concern, but chlorine will react rapidly with ammonia and organics from other wastewaters and will dissipate harmlessly.

The appropriate pretreatment requirements for JUDY would be the removal of corks and large pieces of labels. These could potentially obstruct sewers or other equipment. Since glue and detergent are in a low concentration, the wastewaters are attractive candidates for treatment with domestic sewage. With normal treatment and discharge to the sea at a reasonable distance from the shore and depth of water, the wastewaters would not have a measurable impact on the sea water quality.

In the case of the bleaching agent and the detergent used for dish washing, the products are obviously contained in the residential wastewaters of users. That is their route of use and disposal. The materials are necessarily compatible with treatment of the residential wastewater in the community facilities. The same materials present in the manufacturing process wastewaters are therefore compatible.

The quantity of these materials in the industrial wastewaters of the JUDY plant is a small percent of that normally in the total community wastewaters. The concentration of these materials discharged from any one source, is not significant, in itself, but only as it contributes to the concentration at the treatment plant in conjunction with the other wastewaters. The total mass of materials from all users determines the concentration at the treatment plant. Thus, the contribution of a small volume of concentrated wastewaters will make an incremental addition of little consequence.

In the normal practice of joint treatment, permits would be issued to each industrial user where the quantity of each important material would be registered. Thus, the treatment capacity provisions which must be included for each industry are known. The important practice of conserving water will increase the concentration of constituents in a company's wastewaters. This will not affect a company's use of the joint facility since it is the total quantity of polluting materials which is monitored.

Prohibiting the use of a public sewer for a compatible wastewater does not offer the best program for environmental protection nor the most economic. For JUDY to haul the wastewaters, and police the disposal, is costly and unreliable. There is risk to groundwater quality and to the environment, generally. Hauling also adds to traffic congestion and auto exhaust pollution.

The costs of pretreatment will be much higher than costs of treatment in the community system. The costs of a community wastewater system can be shared equitably among the users. The industry must only provide its system with a means for measuring its wastewater volume and enough monitoring must be done to confirm wastewater concentrations so a fair charge for use of the community system can be determined. The agency would be expected to confirm these concentrations by periodic checks. All costs of serving and policing industry would be born by the plants via service charges. The residential users would bear none of the industry generated costs. In fact, because the treatment plant for all community members will be larger than one for the residential class alone, the scale factor will result in lower costs for all users, including residential.

In summary, the best approach allows a local agency to provide the treatment facilities and the experts to run them. Such a system is less costly to everyone, more effective, much easier to manage and police, and the environmental impacts of misoperations are minimized.

V. APPENDICES

APPENDIX A

Itinerary for Gerald N. McDermott

June 28	Arrive Nabuel, Tunisia
June 29 - July 1	Conferred and observed, Ennadhafa JUDY
July 1	Departed for Monastir

APPENDIX B

Persons and Organizations Visited

Mohamed El Fehry Mehrez
President Directeur General

BEL HADJ KACEM Fethi, Doctor Engineering
Directeur

Abdelkader BOUDEN
Conseller Technique

Company address:
JUDY
Ste Ennadhafa
Z.I.D.C. El Fehry
8011 Dar Chaabane
Tunisia

Mr. Saleh Mahjoub
USAID/Tunis,Tunisia

Mr. Barry Hill
Agriculture Development Officer
US Consulate, Tunis, Tunisia

APPENDIX C

Business Cards of Persons Contacted

ENNADHAFA

JUDY

Mohamed El Fehry Mehrez

Président Directeur Général

Sté Ennadhafa
Z. I. D. C. El Fehry
8011 Dar Chaâbane El Fehry
TUNISIE

Tél : (02)85.727
Tlx : 24.661
Fax : (02)87.960

BEL HADJ KACEM Fethi

Docteur Ingénieur
en Sciences des Matériaux

DIRECTEUR

~~CIBO Fabrique de Bougies~~ "JUDY"
~~Z.I. Béni Khiar 8060 Béni Khiar~~ · TUNISIE
Z.I. DARCHAABANE. 8011

02.85.727
Tél. ~~(02) 29 772~~
Télex 24 661

ICO

International Trade Company

Abdelkader BOUDEN
Conseiller Technique

ZI Dar Chaâbane El Fehry BP 54 Tunisie
Tél. 0[illegible]452 Fax. 02 87 960 Tx. 24661

APPENDIX D

List of documents received - none

APPENDIX E

October 1, 1992

Chlorine Institute
2001 L Street NW, Suite 506
Washington, D.C. 20036

Dear Institute,

I would like your help in advising a firm in Tunisia on safe chlorine handling and use. I am an environmental engineer with some knowledge of safety practices at water treating plants and at wastewater treatment plants. The industrial use I am writing of is for the production of sodium hypochlorite bleach.

I would like to give you in an attachment a brief description of their facilities with the hope that with that information you will be able to judge the educational or advisory material which you have that they could use. I request that you send any information or advice to them directly. I would like to know whether anything was sent but do not need a copy of the material.

I doubt that the company or the chlorine people who supply them are members of your organization. I visited the plant as a volunteer for the USAID office to advise them on environmental control. I found them highly appreciative of help and are an impressive technically and as a society. All the help we can give these developing nations in the Arabic world I think will be returned manyfold in a happier better world. I hope you feel the same.

The technical director to whom I request you send the material is a competent technical person. He has a doctorate from the Sorbonne in France. His name is:

Fethi BEL HADJ KACEM
Director Technology
JUDY Company
8011 Dar Chaabane El Fehry
Tunisia

Please call me at 602 284 1743 if you think I could help you in any way in this matter.

Sincerely yours,

Gerald N. McDermott

Professional Resume

GERALD N. McDERMOTT, P.E.

Principal
Environmental Engineer

Years Experience: 40+

Education:

Massachusetts Institute of Technology, Sanitary Engineer
Harvard University, S.M., Sanitary Engineering
University of Wyoming, B.S., Civil Engineering

Experience:

Mr. McDermott was a member of the Commissioned Corps of the United States Public Health Service and has assigned his entire public career to the Water Pollution Control Research division in Cincinnati, Ohio. He was instrumental in industrial waste studies that developed guides to water pollution control for several major industrial categories. He participated in several field studies of water quality including the Ohio, the Pearl, the South Platte, the Yellowstone, and other rivers.

During this work, he was the first to measure and report the quantity and characteristics of municipal landfill drainage; the first to employ bioassays in industrial waste source surveys for identification of toxic streams; and the first to investigate the use of clays for the removal of trace levels of oil and other organics. He supervised an exhaustive investigation of the tolerance level of heavy metals in biological treatment.

He served as Chief of Process Development, Advanced Waste Treatment Program for the Public Health Service. He supervised field application of activated carbon adsorption, integrated biological chemical treatment, foam separation, reverse osmosis, algae harvesting, powdered activated carbon treatment of wastewaters, and supervised research on use of the Total Organic Carbon measurement and the dissolved oxygen monitoring for control of an activated sludge plant.

- During his employment with Procter & Gamble Company, he first served as group leader and then as Wastewater Technology Leader. He provided design and engineering service in the treatment of wastewaters for direct discharge. These facilities included activated sludge treatment, aerated lagoon treatment in the largest such facility in the world, the largest land application system in the citrus industry, reverse osmosis treatment of food oil refining wastewaters, and granular activated carbon treatment of sulfation wastewaters of a chemical plant.

As a technology leader, his assignment included keeping abreast of all developments in wastewater treatment technology. He did this by studying the current literature, by site visits to new process installations, and attending technical sessions of various organizations.

He also supervised research conducted by consultants and university researchers for P&G and was acquainted with most of the leaders in such work. He was particularly active in maintaining relationships with the municipalities which received P&G wastewaters and was called upon to help solve technical and financial problems of the plants and agencies.

GERALD N. McDERMOTT, P.E.

Professional Affiliations:

American Academy of Environmental Engineers
Water Pollution Control Federation
American Society of Civil Engineers
American Chemical Society

Registrations:

Registered Engineer in California

Additional Accreditations:

Former Task Group Chairman for BOD and Oil Analytical Methods, Standard Methods

Represented P&G in Industrial Associations:

Edible Oil, Soap, and Detergent
Chemical Manufacturers Association
National Food Processors Association
Associated Municipal Sewerage Agencies
Oil Chemists Society