TEXTILE INDUSTRY WASTEWATER EFFECTS ON THE EFFICIENCY OF THE SOUTHERN ISFAHAN WASTEWATER TREATMENT PLANT

S. Babamir, Engineer
Isfahan Water & Sewage Company

translated from WATER & SEWAGE, vol. 11, Winter 1994
by H. Movahedian & D. Tyree-Akhgar

INTRODUCTION

Industrial development and increasing use of modern technology play a major role in environmental pollution. Industrial wastewater is the major problem of industrial expansion, causing river and groundwater pollution. Industry's demand for water necessarily increases with the development of technology. The demand for water, and therefore the quantity and quality of wastewater, should be evaluated; the possibility of recycling some of the materials contained in the wastewater, as well as reuse of the water in a closed cycle should also be considered. Water can be redirected/recycled into its natural cycle with the selection of a suitable treatment system or discharge of wastewater into the sewer system.

AIM

Isfahan, one of the largest industrial cities in Iran and a major textile manufacturing center, has six large textile plants inside the city limits and located a short distance from the Zayandehrud River. It has sewer networks and wastewater facilities with the Southern plant servicing a population of 950,000. This treatment plant consists of three phases:
First the physical, chemical and biological units, operational since 1967, use a trickling filter method with a hydraulic capacity of 1000^3 m/h. This part of the plant serves the older residential zone and is connected by 54 k of sewer pipelines.
The second and third phases, each with a service capacity for 450,00 per capita, was put into operation between 1983 and 1987 with an activated sluge method design. The final pumping capacity is $12,000^3$ m/h. This treatment plant serviced 105,000 connections in 1987 with about 1,450 kilometers of sewer network. Until 1990 the wastewater of five large textile plants was discharged into the Zayandehrud River, causing intense pollution of the river and its ecosystem. Consequently, the wastewater of these textile factories was connected to the sewer system without any pretreatment. Because one of the possible receptive locations for this wastewater is the sewer system, we try to show the effects of this kind of untreated industrial wastewater upon existing treatment plants or simultaneous treatment of industrial with domestic wastewater.

The Effects of Discharging Textile Wastewater

While designing wastewater treatment plants, the characteristics of wastewater should be considered carefully vis a vis the quality and quantity of the incoming wastewater. Simulataneous treament of industrial with municipal wastewater facilitates better treatment with higher efficiency because of its equalization, dilution and increasing surface absorption. When designing the Southern Isfahan Wastewater Treatment Plant, it was anticipated that the industrial wastewater would go through pretreatment before discharging into the sewer network. In prior years, these factories' wastewater entered into the sewer network without any pretreatment. In this article, the effect of this wastewater on the Southern Isfahan Treatment Plant will be discussed. First a figure from the quantity and quality of this type of wastewater is shown:

The type of dying ingredients used include: chromium, active vat, disperse, direct, disperse pigment, basic, and metal complex. Wastewater in the textile industry is the result of the following activities:

*cleansing raw mateirials (this produces the strongest effluent.)
*printing a dying wastewater containing unabsorbed dying materials and minerals used in the dying process.
*rinsing of dyed fabrics.
*bleaching and starching.
*cleaning prepared fabrics.
*Domestic wastewater from these factories is also added to this wastewater and enters the sewer network.

Table 1 : Industrial Wastewater

Materials Used	Vol. of ww Produced by Materials	BOD	TSS	Oil	Chromium	Phenol
Washed wool	544	314	196	191	1.33	0.22
Unwashed wool	537	78	43	—	1.33	1.17
Cotton	317	155	70	—	—	—
Artificial silk	24	30	55	—	—	—
Acetate	75	45	40	—	—	—
Nylon	125	45	30	—	—	—
Acrylic	210	125	87	—	—	—
Polyester	100	185	85	—	—	—

In reference to the above data, textile industrial wastewater has SS, detergents, organic and mineral materials, minute fibers, grease and oil; each of these can be problematic. The major difficulties occuring in the Southern Isfahan Treatment Plant from the connection of wastewater are as follows:

1. Decrease In Plant Efficiency

In the biological process there needs to be enough time for microorganisms to grow. High organic load can cause increase in effluent BOD and decrease in removal efficiency. The parameters affecting the efficiency include: organic materials exceeding standards, poisonous materials, low temperatures, pH, insufficient aeration time, and insufficient biomass caused by lack of pretreatment connections in the sewer network.

Tables 2,3,4, show the mean amount between the years 1989 to 1991 in the Southern Isfahan Treatment Plant. The results are seen before and after connection and show the decrease in plant efficiency. Considering the mean amounts of BOD5, COD, TSS in 1991 after the connection of the wastewater to the network, there were the following efficiency decreases: 7% of BOD5, 5% of COD, and 11% of TSS. These decreases show the difficulties resulting from the discharge.

2. Chronic Toxification

Wastewater from the textile industry contains chromium, and if it directly enters the treatment plant, it will rapidly destroy the biomass in the aeration tanks. But in th Southern Isfahan Treatment Plant, the immediate shock is not significant because the amount of industrial influent is less than the amount of domestic wastewater. The test results carried out on activatd sluge in these tanks show that the sludge can store chomium gradually. The entering 6-valanced chromium is about 740 micrograms; while the chromium in circulated activated sludge is 16 mg/l and in the mixture of wastewater and sludge is 12 mg/l. Regarding the permissable range of chromium in activated sludge (1-10 mg/l), the toxicity of sludge is apparant. Elements such as chromium are gradually stirred in bacterial cells during the time that these bacteria are constantly recycled into the aeration tank. By gradually increasing these elements' concentrations inside the bacteria, the bacterial activity decreases and may cease. This process causes chronic toxification which necessitates continuous control of activated sludge, as well as expenditures of great amounts of money and energy.

Table II : Results From 1989

Mean	Influent	Effluent	Secondary Effluent of 2nd phase	Secondary Effluent of 3rd Phase	Total of Treatment Plant	Removal Efficiency in 2nd Phase	Removal Efficiency in 3rd Phase
BOD_5	225.08	24.4	20.57	25.5	79.1	90.4	88.6
COD	579.08	79.16	70.58	90.16	86.3	78.8	84.4
SS	260.41	30.16	23.9	36.91	88.4	79.5	85.8

Table III : Results From 1990

Mean	Influent	Effluent	Secondary Effluent of 2nd phase	Secondary Effluent of 3rd Phase	Total of Treatment Plant	Removal Efficiency in 2nd Phase	Removal Efficiency in 3rd Phase
BOD_5	214.2	28.3	27.8	28.2	86.7	87.02	86.8
COD	475.4	77.9	84.5	77.5	73.6	84.3	83.6
SS	231.9	36	84.4	40.4	44.4	84.13	82.5

Table IV : Results From 1991

Mean	Influent	Effluent	Secondary Effluent of 2nd phase	Secondary Effluent of 3rd Phase	Total of Treatment Plant	Removal Efficiency in 2nd Phase	Removal Efficiency in 3rd Phase
BOD_5	208.08	34.3	33.7	36.7	83.5	83.8	82.3
COD	450	83.7	85.3	91	81.3	81.04	79.7
SS	215.9	48.08	51.08	51.1	77.7	76.3	76.3

3. Detergent Problem

Detergent is used in nearly all textile factories at the finishing stage to clean the fabric, increasing the problems associated with detergent entering the treatment plant, including:

1. The creation of foam at the surface of the aeration tank, preventing a complete aeration in the mixture of sludge and wastewater.
2. Colloidal coagulation problems.
3. Delay in suspended solids removal causing a sedimentation phase.
4. Negative effects associated with the removal of grease and oil in wastewater.
5. Creation of toxic conditions in the primary and secondary settling tanks.
6. Increase in the amount of air necessary for treatment.
7. BOD_5 removal efficiency decrease.
8. Possible harm to beneficial aquatic bacteria and plants in wastewater is discharged into rivers.

4. Organic Load and Hyraulic Shock Resulting from Production Changes

Generally, wastewater from textile factories varies in its quality because of the types of dying processes, dyes and fibers. These variations create difficulties in the treatment process and precipitate a sudden shock; in this case activated sludge should be discharged from the reactor and biomass should be regenerated. These problems repeatedly occur during the spring and summer.

5. Dyes in Textile Wastewater

The negative problems associated with discharge of textile wastewater into sewer networks is the presence of dyes in the wastewater. These materials usually are unbiodegradable, and only a small amount will be absorbed by activated sludge and cause major difficulties in biological teatment systems (aerobic and anaerobic), including increase in the ratio of COD to BOD. In the Southern Isfahan Textile Plant's case, the ratio is 2:2.2. This

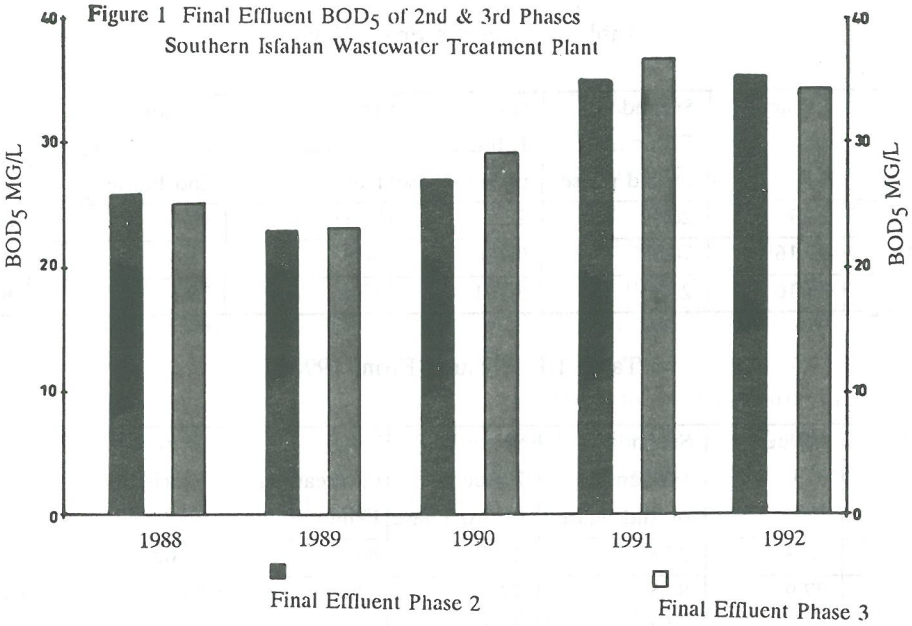

Figure 1 Final Effluent BOD_5 of 2nd & 3rd Phases Southern Isfahan Wastewater Treatment Plant

category of wastewater, because of the dying materials, usually enters into wastewater treatment plants separately. However at the Southern Isfahan Treatment Plant, this is not the case since the volume of domestic wastewater is higher than the textile industrial wastewater. Conversely, at Shahinshahr Treatment Plant, which has recently started recieving textile industry wastewter from northern Isfahan, a continuous and separate network is used.

6. Fibers

According to the different stages in textile factories, almost every stage is accompanied by a cleaning process. In each stage there are tiny fibers including synthetic, plant and animal fibers which enter into the waste water causing an increase in organic load and creating problems in screening, sound removal, primary clarification, sedimentation, sludge thinning, and digester stages. In the last two steps, it prevents proper settlement and increases sludge volume. Usually production of large volumes of sludge effect the quality of the sludge itself, especially in textile industries where some chemicals retard or completely stop the anaerobic digestion process for wastewater.

CONCLUSION

Regarding the above discussion, in simultaneous treatment of domestic and industrial wastewater, this industrial wastewater should have special characteristics so as to no prevent the biological treatment processes in the plant. Therefore, it is necessary to take measures to decrease the volume and pollutants of wastewater and remove inhibitors inside the factory in order to bring standards up to environmental agency regulations. In this case, it can be said mixing domistic and industrial wastewater and simultaneous treatment thereof, the following advangtages are obtained:

a. Industrial wastewater envionments lacks nutrients necessary for growing microorganisms present in domestic wastewater, so a mixture of the two can counterbalance any negative effects.
b. Because the volume of domestic wastewater is high, its mixture with industrial wastewater dilutes the industrial wastewater and its toxic concentrations should be decreased to meet environmental protection agency standards.
c. Because of buffering characteritics of domestic wastewater, the acidity of the industrial wastewater is quickly neutralized.
d. Because of toxic contents, there is no possibility of growing microorganisms in industrial wastewater. Mixing it with domestic wastewater would compensate for this deficiency.

Therefore, if the mixture of industrial and domestic wastewater is done based on a detailed survey and sufficient information, sucessful tratment is possible, otherwise hydraulic and organic shock with their related problems will disturb any sound treatment processes.