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Environmental issues and its impacts associated with the textile processing units in Tiruppur, Tamilnadu.

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***Abstract*— There are about 9000 knitting, dyeing / bleaching, processing, manufacturing units in Tiruppur that provide employment for more than 2 lakh people. The dyeing / bleaching units were extremely polluting until the Govt. of Tamil Nadu issued an order for commissioning effluent treatment plants. This case study has captured all available data and understood that while a lot has been done to reduce pollution load in water bodies, more work needs to be done both in terms of policy and implementation.**

I. Introduction

Tiruppur, 50kms from Coimbatore district of Tamil Nadu has emerged as a leading cotton knitwear industrial cluster in South India both for overseas market and the domestic market, primarily because the climatic conditions (high temperature and low rainfall) facilitate easy processing of yarn. In addition, availability of raw material and cheap labour has ensured that the textile industry activities here experienced rapid growth in the last two decades. Today, almost 80 per cent of India's cotton knitwear exports happen from Tirupur. There are 6,250 units involved in various operations of the textile industry here. It has 4900 knitting and stitching units, around 736 dyeing and bleaching units, 300 printing units, 100 embroidery units and 200 units catering to compacting, raising and calendering. Buyers from around 35 countries visit Tirupur frequently. This small town annually contributes about INR.11000 crores (Rs. 110 billion) in foreign exchange earnings to our country, besides an earning matching or surpassing the above figure to cater the domestic market. In brief, the economic prosperity of Tiruppur depends highly on this industry and most of the local people are in one way or another involved in the knitwear business.

II. Issues

The environmental problems of textile manufacturing are related to the bleaching and dyeing (textile processing) segment of the industry

In textile processing, bleaching and dyeing are the two major activities that require a large amount of water. However, these activities are `non- consumptive' and most of the water used by these units is discharged as effluent after processing.

For the last two decades the dyeing units located in and around Tirupur have polluted the “Noyyal”, a non-perennial river that ends in the Cauvery, near Karur by discharging the toxic effluents into the river.

According to the TNPCB (Tamil Nadu Pollution Control Board)[1], 8.8-crore litres of effluents, after primary treatment in effluent treatment plants, are being let out into the Noyyal every day. TNPCB Board stipulates that the total dissolved solids (TDS) in the water discharged into the river should not be more than 2,100 parts per million (ppm). But the TDS level in the water in the Orathupalayam dam area is above 9,000 ppm; in summer, when water evaporation is higher, the level of TDS is even higher.

Figure 1. Effluents is being fed into the river from the dyeing factory.

III. Description of dyeing process[2]

Dyeing is the application of colour to the cloth. There are many classes of dyes, for example, vat dyes, developing dyes, naphthol dyes, natural dyes, (which includes vegetable dyes) etc.

The water requirement for dyeing (for different types of dyes and shades) varies between 36 – 176 liters/kg with an average of 106. The effluent generation during dyeing process is slightly lower than the water intake and is between 35 to 175 liter/kg with an average of 105.

[1] Frontline issue Volume 22 - Issue 17, Aug 13 - 26, 2005
[2] Private communication with plant manager, Topline knit finishers, Tiruppur.

The dyeing process is as follows: The bleached material and water is loaded into the winch along with the required quantity of dyestuff (varying from 0.001% to 10% as per the colour and quality required). Common salt (about 40 to 120% of the weight of material is added to dye bath) depending on the shade required. Sodium carbonate (4-22% of the material weight) and caustic soda (1-3%) are also added and the winch is operated at 80^0 C for 1-3 hours. The material is then washed with fresh water for half an hour and the whole process is repeated. Next the detergent is added to the winch and followed by 5-10% Hydrochloric acid treatment for neutralization. The material is washed twice before adding dye-fixing agent (about 1% of the weight of material). The material is washed after each operation. All the waste water is either transferred to the treatment unit and then to the "Noyyal" or directly into the "Noyyal".

IV. Source of water for the textile industry

The water need of the textile industry in Tirupur is met by both surface water and ground water. The units in Tirupur alone annually consume around 28.8 billion litres of ground water[3]. Water is brought from the surrounding villages like Avanashi, Palladam, Annur, Kangeyam, and from several parts of the neighboring Erode district in tankers. Needless to add, Tirupur is facing severe water scarcity. Around 80% of the total water requirement is supplied by tankers. The textile units buy water at the rate of Rs.250-450 [4] per tanker (12,000 liters capacity). The same is sold by the farmers at Rs 40 – 80 per tanker. Even at this rate the farmers find it more lucrative to sell water rather than carry out agricultural activities.

V. Environmental issues of textile processing

From the data presented it is apparent that the textile industry, although a very important foreign exchange earner for the country is creating an environmental havoc around Tirupur – one which is expected to have a lasting depilating impact on the region. There are 600,000 people in Tiruppur and around 800,000 people along the downstream of river are affected by this pollution. The industry also cannot be wished away and shut down on environmental grounds. A qualitative impact of the environmental impact because of the industry is presented below

A. Orathupalayam dam

In 1991, the Orathupalayam dam was constructed on the Noyyal River at the cost of Rs.16.46 crores to irrigate an area of 500 acres in Erode district and 9875 acres in Karur district. But instead of serving its purpose it became a storage tank for wastewater as the textile units started releasing their effluent into the dam's reservoir. This effluent could neither be discharged into the river nor be stored due to percolation and contamination of groundwater aquifers. The effect of pollution was noticed when there was great economic loss for farmers in the downstream areas of Erode and Karur districts, in addition to contaminating the river Cauvery.

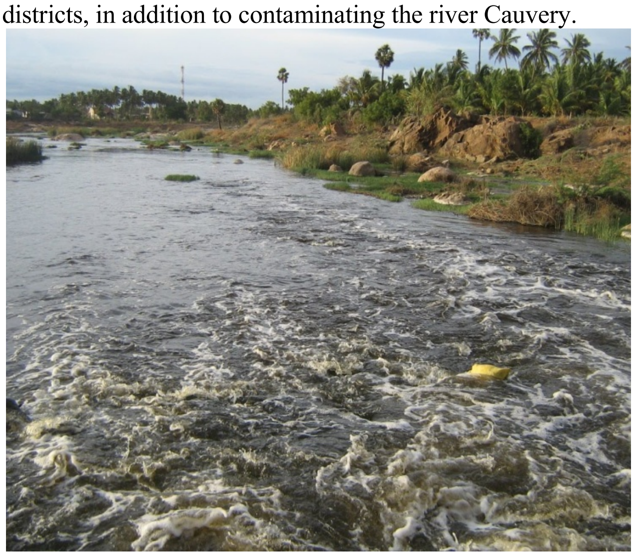

Figure 2. Toxic effluents mixed with the river water in "Noyyal"

B. Physical Impact

a) Impact on ground water

Water levels in the borewells are lowering due to the large scale exploitation of groundwater for industrial application. Also, the quality of water is poor from the deeper aquifers especially the TDS & TSS parameters. Generally, the water is not suitable for the textile industry and for drinking. The depth of borewell in Tiruppur area varies from 1000 to 1200 feet.

b) Impact on surface water

The river Noyyal which was non perennial earlier now flows throughout the year because of the effluent discharge from the industries. The water quality is very poor and few parameters like dissolved solids, chlorides, sulphate, oil and grease are higher than the permissible limit.

c) Impact on land

The continuing disposal of partially treated or untreated textile effluent either into the river or on to the land has resulted in the soil being concentrated with salts and unfit for agriculture. Farmers have resorted to the very short sighted and interim livelihood solution of sale of water (instead of tilling the land).

C. Economic Impact

a) Impact on agriculture

The effluent discharged into the stream and on land has severe impact on agriculture, fisheries and on drinking water. With the filling up of Orthupalyam dam with effluent, the farmers were unable to irrigate their land. The effluent also percolated down to join the groundwater making the water unfit for both irrigation and for drinking. The yield of the crop has declined and the quality of the soil has also

[3] "Zero Discharge – Treatment Options For Textile Dye Effluent: A Case Study At Manickapurampudur Common Effluent Treatment Plant, Tiruppur, Tamilnadu", Eswaramoorthi, K. Dhanapal and J.Karpagam

[4] Personal communication with few Industrialists at Tiruppur, 2010

deteriorated. As a result of this, the water is not stored in dam presently. The damage caused due to effluent discharge on agriculture is estimated to be Rs. 234.54 crores[5].

b) Impact on Fisheries

The fish mortality at Orathupalayam reservoir has compelled the Fisheries Department to stop fish culture here. Both the ground water and the surface water are unfit for consumption. They have to walk long distances to fetch potable water.

VI. EFFLUENT DISCHARGE

A. Total quantity effluent discharged

It has been reported that the total effluent discharged by the textile units in Tirupur is 87 MLD (Million liters per day). As a result of a court ruling all effluent is required to treat either in Individual Effluent Treatment Plants (IETPs) or in Common Effluent Treatment Plants (CETPs). The number of industries has increased from 703 to 736 from 2000 to till date, increasing the quantity of effluents generated from 83 MLD to 87 MLD. The total quantity of effluents treated in CETPs is 40.3 MLD and the balance is treated in IETPs.

B. Quality parameters

The water is required by the textile units for non-consumptive purposes. Water is a medium in which the bleach or the dye is mixed and applied to the fabric or the yarn. There is no further use for the wastewater or effluent. The effluent from the various bleaching and dyeing units has undesirable parameters, higher than the permissible limit specified by the Pollution Control Board. This is because of the usage of various bleaching and dyeing chemicals.

TABLE 1. CHEMICALS USED IN TEXTILE PROCESSING AND HAZARDS ASSOCIATED WITH THEIR UNSAFE DISPOSAL[6]

Chemicals used in Indian textile industry	**Hazards**
a. **Detergents:** Non-ionic detergent based on nonyl- Phenol Ethoylates	Non bio-degradable, generates toxic metabolites highly poisonous to fish
b. **Stain remover:** Carry solvents like CC14	ozone depletion, ten times more than CFC
c. **Oxalic acid** used for rust stain removal	toxic to aquatic organisms boosts COD
d. **Sequestering agents:** Polyphosphates like Trisodium, Polyphosphate, Sodium hexameta phosphate	banned in Europe still used in India and house hold detergents
e. **Printing gums:** Preservative Pentachlorophenol is used in Europe & India	dermatitis, liver & kidney damage, carcinogenic banned
f. **Fixing agent:** Formaldehyde and Benzindie	Harmful, internationally banned
g. **Bleaching:** Chlorine bleaching	itching, harmful
h. **Dyeing:** Amino acid liberating groups	carcinogenic, internationally banned

VII. TEXTILE EFFLUENT TREATMENT

Under the Water (Prevention and Control of Pollution) Act 1974, every industry has to provide adequate treatment for its effluent before disposal. These effluents can be treated jointly by industries themselves or under some higher organization. The large scale industries are expected to have their own treatment plants, where as the small scale or medium scale industries that have limitations on availability of land, manpower and finance can economically treat its effluent in Common Effluent Treatment Plant.

VIII. STATUS OF EFFLUENT TREATMENT

Realizing the seriousness of the textile effluent pollution, the Court gave an order against the functioning of polluting units without effluent treatment plants in 1997. After that the state pollution control agency put more pressure on all the units towards effluent treatment, 164 units were closed. Presently out of the 736 units, 278 are treating 38 MLD of effluents through 20 Common Effluent Treatment Plants (CEPTs) and more than 400 are treating 45 MLD of effluents through Individual Effluent Treatment Plants (IETPs). For effluent treatment, USD 10 million was spent for fixed costs, which are highly subsidized by the Government. In the recent budget the Government proposed to provide a one-time grant of Rs.200 crore to the Government of Tamil Nadu towards the cost of installation of a zero liquid discharge system and the money was issued to the Tirupur Corporation on Oct 17-2010. Besides that, USD 6.7 million had been incurred as annual variable/running costs. The cost analysis showed that the variable cost per unit of effluent treatment is much higher than the capital cost both in the IETPs (86% of total cost) and CETPs (73%). Unfortunately the present treatment system is insufficient for reducing the TDS, particularly the Chloride and Sulphates. The average TDS (Total Dissolved Solids) concentration in the treated effluents is as high as 6394 mg/l in IETPs and 6537 mg/l in CETPs, which is far higher than the TNPCB standard of 2100 mg/l. The same

[5] Case Study On Wastewater Disposal Practices And Likely Treatment Options In Textile Processing Units In Tamilnadu, 2007

[6] Case Study On Wastewater Disposal Practices And Likely Treatment Options In Textile Processing Units In Tamilnadu, 2007

is true of Chloride, which averages 3290 mg/l in IETPs and 3127 mg/l in CETPs whereas the standard is 1000 mg/l.

IX. Towards Cleaner Production

The above analysis clearly reveals the economic base of the knitwear industry in Tiruppur region along with the magnitude of environmental damage and the inefficiency in existing pollution management efforts. At one stage it was assumed that installation of effluent treatment plants would solve the problem. But this did not happen because plants are not designed to remove TDS. Now pollution is not only the concern of non- industrial sectors but industries too. Water is an unavoidable input factor for textile processing. Since water resources are extremely scarce in Tiruppur region, extraction and transporting a large quantity of fresh water from distance sources and then discharging the entire waste water which leads to pollution, is not a sustainable resource management practice. Since the industrial activities are the major source of employment and income in Tiruppur, the possibilities of public agitation against pollution is also small. Recently, the pollution problem caused by the industry has been of concern to overseas buyers and consumers and their future reaction may be a big challenge too. Anyhow it is a hard time to come up with some solution for the pollution problems in Tiruppur.

Now the industrial units have two options. The first one is to enhance the existing effluent treatment plants through Reverse Osmosis (RO) and the second is to switch over to Cleaner Production Technologies (CPT). Installation of RO might be possible in 20 CETPs, which cover 278 Units, but it is not at all possible in 424 IETPs. The Capital cost needed to RO would be between USD 89 to USD 112 for one million liter of effluents, which means the CETPs and IETPs together would have to incur additional capital investment of about USD 8.9 million. Further USD 178 to USD 222 is required as operating and maintenance cost per million liters of effluents (mle), which means an additional cost of USD 6.7 million per year. However, the major benefits of RO is that the treated effluent is almost as good as raw water and in this way industry can save 80% of fresh water cost, that is USD 18.8 million per year (presently industries are spending USD 889 for purchasing 1 million liter fresh water).

Savings: (on an average)

Capital and maintenance cost of RO plant/mle = \$ 100 + \$200

Cost of 1000 liters of water = \$0.9

The effluent generation during dyeing process is slightly lower than the water intake.

Savings of RO plant/mle = (\$0.9)*1000*80% - \$ 100 + \$200 = \$420

The current processing technology employed by most of the units in Tiruppur is traditional which require large volume of fresh water and chemicals. But the modern sophisticated processing technologies like “soft flow” machines etc can reduce the water and chemical requirements and ultimately the volume of effluents and pollution load. The application of CPT in textile industry might include some combination of soft flow machines, low salt dyes and membranes filtration. Studies proved that the material to liquor ratio in the soft flow (1:5 to 1:10) is less than the conventional winch is (1:15 to 1:25). In the soft flow dyeing the salt and water requirement per kg of fabric processed can be reduced up to 50%. But the soft flow is ten times costlier than the current machines. With the combined use of low material liquor ratio machine and low salt reactive dyes the TDS level of the effluents can be reduced by about 40%. Dye bath segregation is another successful method for reducing TDS and requires only minor plant modifications. The cost analysis shows that the textile processing cost in soft flow dyeing is 22-29% lower than the conventional winch. Moreover, soft flow offers excellent process/product quality, which is an additional benefit to the export business. Currently most of the tiny and small units in Tiruppur are not at all aware of these technologies. But around 10 big integrated units, who are also direct exporters, are in the implementation stage of CPT. Besides a few medium scale units are also thinking about it.

X. Conclusions

The current practice of

- water usage,
- effluent treatment and discharge and
- sludge storage and disposal

is not sustainable and would cause irreparable damage to the ecosystem while threatening the livelihoods of the farmers in the vicinity of the textile units. There is need for intervention.

- Reverse Osmosis is the technology option recommended by the TNPCB for zero effluent discharge and recycling of wastewater. However there are financial issues involved in its adoption, there is a positive net return on investment. So initial funding is the concern and the Government has to support the industrialists by securing funds. Though the government granted Rs. 200 crores to the industry to set effluent plants, it is not sufficient for the industry.
- Government along with providing subsidies should ensure faster implementation of these effluent plants to reduce the further effects.
- Government has started to clean the river which is a good sign to the city but it has to be done faster.
- Even if mechanisms can be found to overcome the financial issues relating to installation of RO units and ensuring that all effluent is treated in RO units the problem of safe storage and disposal of sludge remains. It appears that sufficient thought has not been given to managing sludge. If effective management of sludge is

not practiced then the investment in effluent treatment and ensuring adherence to TNPCB would be nullified.

- There is need to introduce cleaner technology to reduce the pollution load. For example by introducing soft flow machines the liquor ratio can be reduced to (1:5 to 1:10) from the higher liquor ratio in the conventional winch (1:15 to 1:25). Soft flow machines also reduce salt and water consumption by half. But the soft flow is ten times costlier than the current machines. If wash water and dye bath is separated and treated, the water pollution can be reduced. With the combined use of low material liquor ratio machine and low salt reactive dyes the TDS level of the effluents can be reduced by about 40%.
- There are serious climate change issues arising due to water pumping from deep bore wells, power consumption for water softening and diesel usage for transportation of water. These issues have not been the subjects of concern so far. There is a need to carefully estimate the same.
- Reverse Osmosis has been identified as a technologically suitable option for treating textile industry effluent from large and medium sized units. Large units have invested in individual ETPs and medium scale units have invested in Common ETPs. However no technology option seems to be forthcoming for effluent treatment from small units. This problem would become acute and there has to be technology development effort now for techno-economically viable options to emerge in the near future.

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