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TEXTILE INDUSTRIAL EFFLUENTS : IMPLICATION AND POSSIBLE USE FOR AFFORESTATION IN WESTERN RAJASTHAN

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ABSTRACT

In this paper, the environmental problems related to industrial effiuents with particular reference to western Rajasthan are discussed. In Jodhpur district alone, textile effiuents constituting major source are discharged untreated at the rate of 7 million litres/day. The effiuents are coloured with high pH (9-11), predominant in sodium (600-3500 ppm) having high RSC values (11-90 me/1), very low in calcium, magnesum, lead and cadmium. Effluent can possibly be used for establishing tree species of economic value and the soil deterioration can be reduced by giving some soil treatments.

INTRODUCTION

With the increasing industrialization,the disposal of industrial effluents is causing concern to the environmentalists the world over. In Rajasthan State nearly 2.93 lac cubic meter of untreated effluents from large and medium scale industries located in Kota, Udaipur, Alwar, Jaipur, Jodhpur and Pali districts are discharged per day which are affecting the soil, surface and groundwaters, and thus the environment (Goel 1987; Saxena et al. 1988; Rao and Rao 1987). Textile effluents constitute a major part of the industrial effiuents in western Rajasthan.

There are nearly 125 large scale and 149 medium scale industries in the state. According to the surveys carried out so far 88 large scale and 47 medium scale industries are water polluting ones in Rajasthan. Besides these there, are large number of small scale industries which also generate polluted water. Generally the problem of water pollution is more in industrialy advanced districts like Kota, Alwar and Udaipur etc. However, there are exceptions like Jodhpur, Barmer and Pali which do not have high industrial base but where the problem of water pollution is far more acute due to presence of texitle processing units. On the basis of polluting industries, 27 districts of Rajasthan can be classified in the following three categories :

	Class-A (High)	Class-B (Medium)	Class-C (Low)
1.	Pali	Jhunjhunu	Banswara
2.	Jodhpur	Swai Madhopur	Jhalawar
3.	Balotra (Barmer)	Bharatpur	Jalore

4. Kota	Bundi	Dholpur
5. Alwar	Chittorgarh	Nagaur
6. Udaipur	Tonk	Dungarpur
7. Jaipur	Bikaner	Jaisalmer
8. Bhilwara	Sriganganagar	Sikar
9. Ajmer	Sirohi	Churu

Rajvanshy and Goel (1984) reported that trade effluents generated in the state are of the order of 2.93 lac cubic meters. Of this, Kota and Udaipur account for 55% and 11% respectively, while Alwar, Jaipur, Jodhpur and Pali contribute approximately 3% each. Among the various industries the textile and metal rolling mills generate the maximum quantity of polluted water. Number of textile processing units in Pali, Jodhpur and Balotra are mainly responsible for generating large quantity of polluted water.

Characteristics of textile and metal processing unit effluents

(a) Textile processing units

Generally weaving and finishing are two integrated processes in textile industry. However, in this region only finishing operations are performed as the "Grey cloth" is obtained from outside. Various processes carried out during textile finishing and nature of effluents are described in the flow sheet below.

process	Effluents
1. Desizing	Starch, fats
2. Mercerising	Starch, caustic surfactants
3. Scouring or keiring	Starch, fats, detergent, pigments, alkalies
4. Bleaching	Chlorine, alkalies
5. Dyeing or printing	Dyes, Salts, Surfactants
6. Afterwash and after treatments	Dyes, Salts, thickners, detergents

As a result of these processes the effluents of these industries are generally coloured rich in chlorides and sulphate with high chemical/biological oxygen demand and pH.

(b) Steel rolling mills

The stainless steel rolling mills mainly generate effluents, in a process known as the pickling, in which scales formed on the sheet is removed. Pickling solution generally consists of 2-3% hydroflouric acid, 10-20% nitric acid and the rest is water. After the contents are completely used up the water is discharged in the form of effluent having low pH and high level of iron which often contain greese and oil also.

The chemical analysis of industrial effluents of Jodhpur (Table 1) shows high titratable alkalinity and pH (9.0-11.1), preponderence of Na, CO_3, Zn, and very high value of residual sodium carbonate (RSC). The effluents are coloured, light green to red and sometimes purple.

Industrial effluents and environmental pollution

Industrial effluents in general and effluents of textile industry in particular in western Rajasthan pose serious environmental problems both for human and animal health in Pali, Jodhpur and Balotra. Intensive use of caustic, acids, dyes (Direct Vat, Azo and sulphur dyes) and their copious discharge adversely effect the open lands and agricultural fields, pollute the rivers and underground water.

Table 1. Chemical composiion of industrial effluents of Jodhpur

Constitutents	Range
pH	9.0-11.1
EC (dSm^{-1})	4.4-10.8
RSC (meq L^{-1})	11.5-90.1
SAR	60-176
Total Alkalinity (ppm)	710-1760
Chemical Oxygen Demand	155-800
Ionic composition (ppm)	
Sodium	630-3421
Potassium	14.2-80.9
Calcium	Traces
Magnesium	Traces to 16.8
Copper	0.071-0.748
Zinc	0.011-0.537
Iron	Trace-0.67
Manganese	Traces
Lead	Traces-0.134
Cadmium	Traces
Cobalt	Traces
Carbonates	30-1050
Bicarbonates	640-3446
Chloride	270-480
Pho sphate	0.5-5.1
Sulphate	100-320

Pollution of rivers and under ground water

Industrial effluents of the western part of Rajasthan ultimately go to the three rivers viz., Luni, Bandi, and Jojri. These rivers are non-perenial and flow in their full capacity only during rainy season and gradually dry up with advance of the lean season. During the lean season these rivers carry only the industrial effluents. At

Rajasthan where water is in scarcity. Therefore in such regions, the use of industrial effluents as such has been explored for afforestation with some soil amendments.

Studies were initiated on the feasibility of use of textile industry effluents for establishment and growth of tree species suited to this region. Eight tree species viz., *Eucalyptus camaldulensis*, *Acacia nilotica*, *Acacis tortilis*, *Azadirachta indica*, *Hardwickia binnata*, *Colophosparmum mopane*, *Prosopis cineraria* and *Prosopis juliflora* were identified as tolerant to this water based on the germination and survival percentage in green house conditions. These species were planted under field conditions in July 1988 having two soil treatments viz., no amendment and gypsum @ 3 kg per pit. The species were irrigated with these effluents from November 1988 at the fortnight and weekly intervals during winter and summer months respectively. The periodical growth of tree species were recorded and changes in soil chemical properties were studied. The data in Table 3 reprsent the growth of some trees recorded upto December 1989. The results showed 100% survival and establishment of these tree species. The increase in growth was normal. From these results the species can be grouped into two sub-groups (i) species tolerant to textile effluent water and not requiring gypsum treatment, (ii) species less tolerant to textile effluents and require gypsum treatment in soil for higher growth. The species *E. camaldulensis*, *A. indica*, *P. cineraria*, *A. nilotica* belong to first sub-group and the species *H. binnata*, *C. mopane*, *P. juliflora* and *A. tortilis* belong to second sub-group. The maximum response to gypsum application was observed in *H. binnata*.

Table 3. Effect of industrial effluent with and without gypsum on the growth of some four tree species

Tree species	Increase in height (cm) No amendment	(July 1988 to Dec. 1989) With gypsum application	C.D. 5%
E. camaldulensis	112.0	112.8	NS
Azadirachta indica	156.2	147.2	NS
Acacia tortilis	103.2	131.3	25.2
Hardwickia binnata	30.2	89.7	12.3

Mitigating the adverse effect of effluents on soil

The use of effluent water without amendment increased the pH (8.1 to 8.6) and SAR (from 6.19 to 74.13) of the soil studied. In gypsum treatment the pH and SAR of soil were quite low compared to without gypsum treatment. With the adoption of light and frequent irrigations in pit, the effect of effluent was restricted to the upper layer only. Thus, once the trees are established during first two years, the roots in lower layers will not be affected during the later stages of growth.

Conclusion and Suggestions

The foregoing presentation of status of industrial effluents particularly in Rajasthan indicate the discharge of effluents in huge quantities without treatment thus affecting the soil, human/animal health and the overall environment. Due to lack of best technology economically viable for treatment, at present these effluents are not put to any profitable use particularly for agricultare. The major problem chemically with these effluents is presence of coloured dyes, high pH, high content of sodium and high COD values but low level of toxic heavy metals. Flyash another waste material from thermal plants has been found to be cheap and effective source for removing coloured dyes from effluents. Subsequent treatment of leachate from flyash with gypsum reduce the pH and alkali hazard. It is suggested that effluents can be effectively put to use as irrigation source for establishing trees by treating tree pit with gypsum. The multipurpose tree species have been identified and raised successfully by irrigation with the effluents discharged from textile industries.

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