TREATMENT OF TEXTILE INDUSTRY EFFLUENTS: LIMITATIONS AND SCOPE

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ABSTRACT
Textile industry generates substantial quantity of effluent, which is mostly treated by chemical and biological treatment processes. These conventional treatment processes may not be very effective for the removal of specific pollutants such as colour and the dissolved solids. Application of the advance treatment technologies and processes, besides reducing these pollutants, facilitates recovery of water and salt from the effluents. The paper covers effluent treatment practices, limitations and the scope for further improvements.

Key Words: Textile industry, Effluent treatment, Recovery of water, Biological treatment processes, Pollutants

INTRODUCTION
Textile Industry answers one of the basic needs of human being and is of great significance. Besides meeting the needs of consumers, it supports number of other industries such as dyes, chemicals and packaging industries. Textile industry in India range from small family owned operations to the large integrated mills employing modern machinery and equipments. The census enumerates 2,324 textile industries in India, of which 83 are composite mills, 165 semi-composite and the rest 2,076 are process houses1. Basically, textile manufacturing consists of three main activities. The fibres are first converted into yarns and threads. The yarns and threads are then converted by weaving and knitting to fabrics. Finally, the fabrics are processed including dyeing and finished as per the market demand. The processing of textiles mainly constitutes large volume of fresh water and the effluents discharged are heavily contaminated with pollutants such as colour and dissolved solids. Textile industries use a number of dyes and chemicals to impart the desired quality in the fabrics. During processing, considerable portion of these raw materials find their way into waste effluent streams. It is estimated that about 10 to 15% of dye is disposed of in the effluent, which can cause environmental problems unless the effluent is properly treated2. There have been cases of soil and ground water quality deterioration due to indiscriminate discharge of textile effluents. Pollution control in this sector requires more concerted efforts. The pollution control in the textile industries is assuming greater importance in recent times. This is because of the necessity of various textile industries for complying with increasingly stringent regulatory requirement and general awareness of entrepreneurs about the environmental problems. In addition, scarcity of potable water and resource crunch has highlighted the need to go for the more environmentally sound industrial practices.

DISCUSSION
Treatment of textile industry effluents
In majority of textile industries convention treatment system like chemical treatment and chemical treatment followed by biological treatment system are installed. For waste water treatment, the first step is to equalize the effluent batches with the different pollution concentrations, temperature and pH that are discharged at different time and different intervals from various processes. The industries also prefer screening, oil and grease
trap prior to equalization for the removal of bigger size solids and oil and grease. The equalization ensures that the effluent becomes uniform in terms of pollution concentration, pH and temperature etc. The effluent is then taken to flash mixing for the addition of coagulants such as lime, alum, ferrous sulphate, ferric chloride, polyelectrolyte and processed through flocculation and setting. Selection of appropriate coagulants and dose of chemicals are determined based on the treatability study of effluent samples. The chemical treatment helps in reduction of colour and suspended solids. A significant reduction in the Chemical Oxygen Demand (COD) and the Biochemical Oxygen Demand (BOD) is also achieved. The chemical treatment is followed by biological treatment process with setting, which further reduces COD and BOD contents. For the textile process houses, which mostly undertake chemical processing of textile materials, there is not much organic load in the effluent. In such cases, the recent trend is to set up an ozonation unit and activated adsorption system instead of biological treatment process. The treated effluent may require tertiary or advance treatment processes to remove specific contaminants or to prepare the waste water for reuse. Some tertiary and advance treatment processes and technologies implemented in textile industries include adsorption, ozonation, membrane filtration (reverse osmosis/ nano filtration), multiple effect evaporation, crystallization etc.

Limitations

The textile effluents mainly comprise of carbonates, hydroxide, chloride, peroxide, sulphite, nitrate, silicate, acid, starch, gum etc. which are used in the processing stages. The main constraints experienced in effluent treatment are colour, dissolved solids, trace metals and low BOD/COD ratio. In the textile effluents colour is one of the main pollutant. The human eye can readily detect very low concentration of most of the dyes due to colour. Hence, colour from textile wastes causes significant aesthetic importance. Although dyes constitute a small portion of the effluent, these compounds are important for several reasons. The environmental concern with dyes is due to the adsorption and reflection of the sunlight entering the water. This reduces the growth of bacteria to a level insufficient to biologically degrade impurities in the water. Discharge of coloured effluent into inland surface water or on land can degrade water bodies, ground water and soil. Due to discharge of textile industry effluents in Bandi river (Rajasthan) about 10,000 ha of land became less productive. The ground water quality in Noyyal River basin near Tirupur (Tamil Nadu) was observed to be degraded due to the discharge of effluents by several textile industries located at Tirupur. It is reported that 487 textile processing industries in Karur (Tamilnadu, India) discharge about 14600 m³/day of dye laden effluent into the river Amarawati, which affected ground water quality in the river basin. Presence of the dyes in the effluent is of concern because they are not easily removed by conventional treatment processes and their possible long term health effects. The dyes are mostly of synthetic origin having very complex aromatic molecular structure. They are stable to light and oxidizing agents and hence resist their degradation in treatment processes. The removal of the dyes from the effluent is a major problem for most of the textile industries.

Other critical parameter is the dissolved solids. Use of common salt and glauber salt etc. directly increase Total Dissolved Solids (TDS) level in the effluents. TDS are difficult to be treated with conventional treatment systems. Disposal of high TDS bearing effluents can lead to increase in TDS of ground water and surface water. The dissolved solids in effluent if not controlled, may be harmful to vegetation and soil.

The effluent of textile is not free from metal contents. There are mainly two sources of metals. Firstly, the metals may come as impurity with the chemicals used during processing such as caustic soda, sodium carbonate and salts. For instance caustic soda may contain mercury if it is produced using mercury based catalyst. Secondly, the source of metal could be dye stuffs like mordent dyes. The metal complex dyes are mostly based on chromium. Even a small
concentration of chromium in the water is not acceptable.
In many textile units, particularly engaged in synthetic processing, low BOD/COD ratio in the effluent is observed, which makes biological treatment not a ready proposition. As regards the pH, the waste water generated in cotton based textile is alkaline waste, whereas synthetic fabric processing generally discharge an acidic effluent.

**Scope for improvements**
The conventional treatment processes are not very effective in removal of TDS and colour. Application of the advance treatment technologies and processes while reducing these pollutants, can also facilitate recovery of water and salt from effluents.9 The textile industry effluent can be treated with or without segregation of effluent streams.10 Treatment of effluent streams collectively can give recovery of water but rectory of salt may not be feasible. Segregation of effluent streams on other hand makes it feasible to recover both water and salts.11-13 The highly polluting effluent streams such as spent dye bath has low volume, which is normally 10 % of the total effluent discharge. The remaining 90 % of effluent is contributed by low polluting streams like wash water.14 The segregation of the low TDS streams could be so managed that the segregated stream meets quality requirement for its reuse or disposal after treatment.15,16 The advance treatment methods can be appropriately applied to manage high TDS stream as well as low TDS effluent streams.17,18 For effective management of the effluent of textile industries, some options are discussed below :
The high TDS bearing stream i.e. spent dye bath can be segregated and treated separately. This stream has low volume and as such it can be disposed off through solar evaporation pond where adequate land is available for the purpose. In case of the land constraints, this waste stream can be concentrated to further reduce its volume using appropriate processes such as multiple effect evaporation. The low polluting streams such as wash water etc. can be given primary/secondary/tertiary treatment to meet the disposal standards or for use in industry in appropriate operations. With application of the reverse osmosis (RO) the low polluting effluent stream can be made colourless with zero hardness for reuse in the production process.
Spent dye bath can be segregated and treated with recovery of salt. This effluent stream can be treated using a chemical treatment followed by multiple effect evaporation and crystallization. Glauber salt (sodium decahydro sulphate) based dyeing enables recovery of the salt. The other effluent stream i.e. wash water can be treated separately in primary/secondary/tertiary treatment to meet the disposal standards or it can be treated with RO system to recover and recycle water.
Segregate spent dye bath effluent from wash water stream. Dye bath effluent is to be treated using a nanofiltration system and wash water effluent with RO system. Nanofiltration allows maximum passage of the salt with no colour in the permeate. As such, the permeate (brine) can be directly recycled back to dye bath so that fresh addition of salt can be reduced. For this option common salt is advised to be used in dyeing process. The reject of nanofiltration can be disposed of through solar evaporation ponds or multiple effect evaporation.
The effluent stream arising out of textile processing can be collectively treated using primary/secondary/tertiary treatment to meet the disposal standards. In case water is intended to be reused, the treated water can be further purified with use of reverse osmosis or other methods. The reject stream of reverse osmosis can be disposed of through solar evaporation ponds or other evaporation system.
The above options reduce problems relating to the disposal of high TDS effluent streams of textile industry with recovery of the water and salts. The returns on account of reuse of water and salt can offset the recurring cost on effluent treatment facilities. The recycling and reuse of the treated effluent and salt directly conserve natural resources and a step towards sustainable development.

**CONCLUSION**
Textile industry effluent is mostly treated by use of chemical and biological treatment
processes. These conventional treatment processes may not be very effective in removal of specific pollutants such as colour and TDS. Application of the advance treatment technologies and processes while reducing these pollutants, also give scope for recovery of water and salt from effluents.

REFERENCES