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VIABLE ENVIRONMENTAL TECHNOLOGIES INTEGRATED WITH CLEANER PRODUCTION - SUSTAINABLE OPTIONS FOR GLOBAL LEATHER SECTOR

Dr. S. RAJAMANI[1]

Chairman-Asian International Union of Environment (AIUE) Commission, Old No. 18, New No. 45, First Street, South Beach Avenue, MRC Nagar, Chennai-600028, India, Mobile : +91 9840063210

Corresponding author: Dr. S. Rajamani, E-mail: dr.s.rajamani@gmail.com

Abstract: *World Leather tanneries process 16 to 17million tones of hides & skins per year and generate 600million m^3 of wastewater. Nearly 60% of the World Leather production is carried out in Asian region and the tanneries discharge more than 350 million m^3 of wastewater per annum. Environmental challenges due to the depletion of quality water resources, disposal of chrome containing sludge, increase in salinity, etc. have resulted in the development of sustainable cleaner production in tanneries and upgradation of treatment technologies such as advance oxidation for reduced sludge generation. Viable cleaner production and treatment technologies had been engineered in many individual and Common Effluent Treatment Plants (CETPs) in India, China, Turkey and other leather producing countries.*
Some of the recent developments in environmental protection technologies are (i) Improved chrome recovery system (ii) Advanced process control and cleaner production (iii) Special biological treatment system with mild chemical usage for reduced sludge generation (iv) Advanced tertiary treatment systems, etc. for the application of single or multiple stage Reverse Osmosis (RO) system for recovery of water. Recent applied R&D on the sustainable development in cleaner leather production, environmental protection techniques with focus on saving of energy, chemical usage, occupational health and safety, water-recovery for reuse, development of social forestry using treated effluent, salt recovery, marine disposal of saline reject with proper bio-control system, etc. are dealt in this noval technical paper.

Keywords: *Improved Chrome Recovery system, Effluent Treatment, Sludge generation, Biological treatment, Water Recovery.*

1. INTRODUCTION

Annual leather process in Asian Countries is estimated at 8 to 10 million tons of hides and skins which is more than 50% of the world leather production of about 16 million tons per year. The tanneries in Asian countries including India, China, Vietnam, etc. discharge more than 350 million m^3 of wastewater per annum [1]. In India there are 20 Common Effluent Treatment Plants (CETPs) mainly located in Tamilnadu, Uttarpradesh, Kolkata and Punjab.

Conventional physiochemical and biological treatment systems are designed and implemented only to reduce Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Suspended Solids (SS), Heavy metals etc. and not TDS and salinity which are mainly contributed by chlorides, hardness and sulphates[2]. Due to inherent quality of wastewater from tanning industry, the treatment plants are unable to meet the prescribed standards in terms of TDS, chlorides in salinity in the treated effluent. The TDS limit is being enforced in India and other parts of the World depending upon the final mode of disposal. In addition to the removal of TDS in the treated effluent, it is necessary to recover water for reuse to meet the challenge of water shortage. In some of the states such as Tamilnadu in India, the pollution control authorities insist on water recovery integrated with Zero Liquid Discharge (ZLD) system[3]. However, the achievement of Zero Liquid Discharge concept has got many technical challenges in terms of management of saline streams from membrane system, disposal issues of contaminated salt from multiple stage evaporator, high operation and maintenance cost, etc.

Recent directions from the National Green Tribunal (NGT) and Environmental Protection authorities, paved way for adoption of Sustainable Technologies[4] Integrated with Cleaner Production, Centralized Chrome Recovery System and TDS management without the use of Multiple Stage Evaporator (MEE).

2. CLEANER PRODUCTION AND SEGREGATION OF STREAMS FOR CONTROL OF CHROMIUM AND SALINITY

Due to inherent quality of industrial wastewater such as textile dyeing units, tanneries etc., the conventional treatment plants are unable to meet the prescribed TDS level of 2100 mg/l in the treated effluent. In addition to TDS management the control of volatile solids in hazardous category sludge is also becoming a necessity. For control of salinity, chromium, sludge and viable management of TDS with recovery of quality water from wastewater, the required treatment steps are (i) Cleaner production and other viable process control in tanneries (ii) Segregation of streams such as spent chrome liquor for recovery and reuse (iii) Upgradation of biological treatment systems with better efficiency in BOD and COD removal, (iv) Minimum usage of chemicals in the treatment process and reduction in sludge generation (v) Tertiary treatment and integration of treated tannery effluent with treated domestic sewage wherever feasible for TDS management [5].

Some of the land locked locations such as in Uttar Pradesh and Tamilnadu in South India where the availability of domestic sewage is limited for dilution with treated domestic sewage the noval idea of segregation of soak liquor, separate treatment and recovery of quality salt for reuse have been developed and are being adopted in many tannery clusters. The segregated soak liquor is taken to the CETPs through separate pipe line and after primary and secondary treatment units, membrane system is adopted for recovery of water and quality of saline stream for reuse in pickling. The balance treated saline stream is evaporated and quality salt (98% purity) is recovered for reuse without any difficulty. In addition to recovery and reuse of quality water by the industry, the additional benefits are savings in chemical usage in the tanning process and reduction in pollution load in the effluent.

The segregated chrome stream is taken for Centralized Chrome Recovery System (CCRS) for recovery of chromium in the form of chromium cake. The process flow diagram of the improved chrome recovery system is given below:

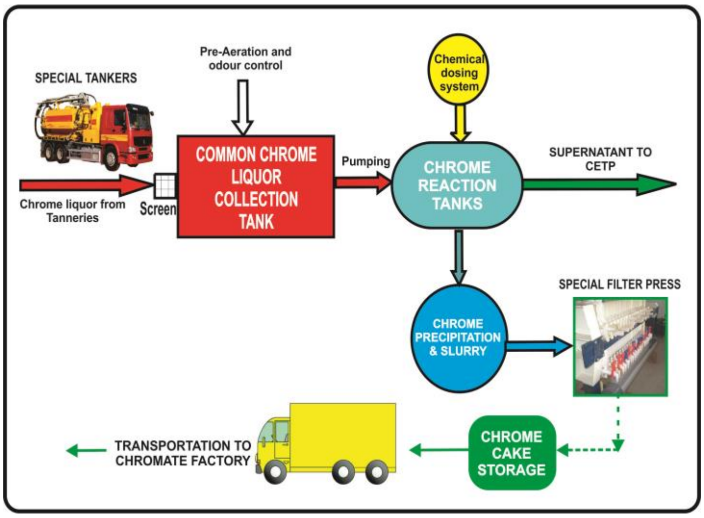

Fig.1: *Improved Chrome Recovery System and Recovery in the form of Chrome Cake*

3. SUSTAINABLE INTEGRATED TREATMENT FOR TDS MANAGEMENT AND FINAL DISPOSAL

Due to the segregation of soak liquor and chrome stream for separate treatment and reuse, the TDS level in the main combined stream taken to the CETP is reduced by 50% and it has become viable to adopt fully biological treatment system and scope for mixing the treated effluent with treated domestic sewage for overall TDS management and disposal by meeting all the discharge parameters without the necessity of multiple stage evaporator[6].

The technological system developed in accordance with the National Green Tribunal (NGT) and Pollution Control authorities is shown in the following process flow diagram.

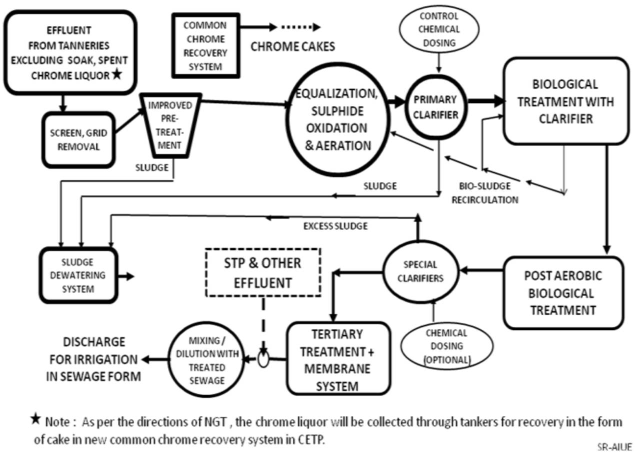

Fig.2 : *Upgradation of CETP – Integrated with Cleaner Production and Mixing with treated domestic sewage for TDS management*

4. CONVERSION OF PHYSIOCHEMICAL TREATMENT IN TO TOTAL BIOLOGICAL TREATMENT

In conventional physiochemical treatment the effluent is collected in equalization cum mixing system, pumped to the primary clarifier, mixed with high dosing of chemicals such as lime alum, etc. The conventional system adopted in most of the CETPs in India could not reduce the sulphide level in the physiochemical treatment and the sludge accumulation in the equalization tank is one of the major problems. The COD reduction to the prescribed level (i.e. 250mg/l) in the final treated effluent could not be met by some of the CETPs adopting conventional physiochemical and biological treatment. The performances of the aerobic biological treatment system with limited detention time are not satisfactory and unable to produce required quality effluent.

With a view to oxidize the sulphide present in the effluent, control the sludge settling in the equalization tank and to minimize the chemical usage the equalization system has been upgraded with increased detention time, increased depth and usage of new type of aspirators integrated with compressor. The residual excess biosludge from secondary clarifier is pumped to the equalization tank which is helpful in biological oxidation process and to reduce the chemical dosage in the first stage clarifier [7]. The upgradation of equalization cum mixing system in to aerobic biological oxidation using residual / excess biosludge and adopted in one of the CETPs in India is shown below:

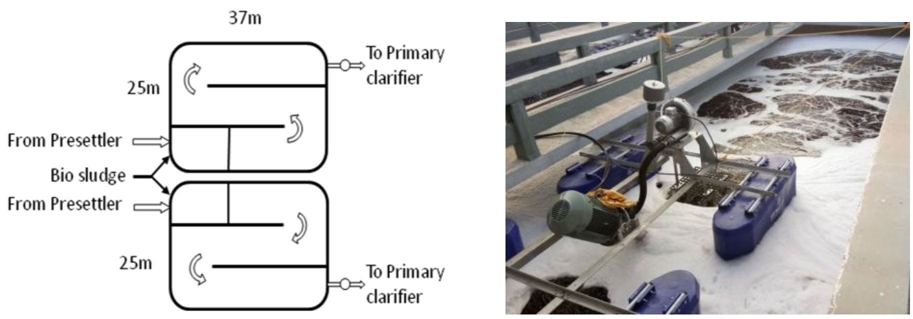

Fig. 3: *Upgraded biological treatment system using Jet Aspirator*

The primary clarifier units are also upgraded by providing elevated clarifiers with minimum required chemical dosing. This improved system is performing better in terms of sludge settling, withdrawal and dewatering. The elevated primary clarifier implemented in one of the CETPs is shown below:

Fig.4 : *Elevated Primary Clarifier*

The improved aeration system with jet aspirator has been successfully adopted in one of the CETPs in Tamilnadu and planned to be adopted in more CETPs in Uttarpradesh and other locations. The viable alternatives to ZLD are being developed and implemented in many CETPs. It is also estimated that nearly 80% capacity of the wastewater from Indian Leather Sector will be treated by adopting cleaner technologies, segregation of streams and separate treatment, integration with treated domestic sewage, etc[8]. In this circumstance, the long term sustainability of the CETPs which are forced to adopt ZLD by incorporating systems such as Multiple Stage Evaporator (MEE) need be reviewed for adoption of sustainable treatment options.

5. CONCLUSION

The conventional physiochemical treatment systems are being upgraded and converted in to total biological treatment system to reduce sludge generation and to achieve the pollution control discharge parameters such as COD and clarity in the treated effluent. Many organizations in countries such as India, China, etc. extend technical and financial support for upgradation of CETPs with Improved Cleaner Production Process, Centralized Chrome Recovery and Reuse systems, Integrated treatment with treated domestic sewage for sustainable TDS management, etc. These technological developments and upgradation of CETPs are being carried out by many CETPs in Tamilnadu and Uttarpradesh with financial outlay of more than 150 million US dollars.

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REFERENCES

[1] S.Rajamani (2017), *Sustainable Environmental Technologies Including Water Recovery for Reuse from Tannery and Industrial Wastewater – Indian and Asian Scenario***,** Paper presented in Annals of the University of Oradea Fascicle of Textiles-Leatherwork, Oradea, Romania.

[2] Lfram Scholz, Nicki Taylor and Keith Hill (2009*), Submerged membrane bio reactor and reverse osmosis technology for industrial effluent treatment and water recycling*, Paper presented XXX IULTCS Congress, Beijing, China

[3] S. Rajamani (2014), *Growth of Leather Sector and Recent Environmental Development in Asian Countries,* Paper presented in 10th Asian International Conference on Leather Science & Technology, Okayama, Japan.

[4] Shweta Singh & Rajamani S, *Issues of Environmental compliance in Developing countries (International Journal) IWA Journal, Water Science and Technology* (issue 12 of Col 47).

[5] IUE Commission Documents, IULTCS, December 2012, *Recent Developments in Cleaner Production and Environment Protection in World Leather Sector*

[6] S. Rajamani (2012), *Recent Developments in Environment Protection in Leather & Agro- based Industries*, Paper presented in 9th Asian International Confernece on Science and Technology, Taipei, Taiwan.

[7] R. Suthanthararajan, K. Chitra, E. Ravindranath, B. Umamaheswari, S. Rajamani, T. Ramesh, *Anaerobic Treatment of Tannery Wastewater with Sulfide Removal and Recovery of Sulfur from Wastewater and Biogas, International Journal* - Journal of the American Leather Chemists Association 99, 2004, 67- 72.

[8] S. Rajamani (2015), *Noval Industrial Waste Water Treatment Integrated with Recovery of Water and Salt Under Zero Liquid Discharge Concept,* Paper presented in The Pacific Basin Consortium for Environment and Health, University of Indonesia, City of Depok, West Java.