



## RECENT TECHNICAL & ENVIRONMENTAL DEVELOPMENTS IN WORLD LEATHER SECTOR AND FUTURE TRENDS IN THE MIDST OF COVID-19

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**Abstract:** World leather tanneries process 16 to 18 million tonnes of hides & skins per year. Nearly 60% of world leather production is carried out in Asian region and tanneries discharge more than 1200 MLD. Leather process in India ranges from 1.0-1.2 million tones per year and in an average wastewater generation is about 120 MLD. There has been major reduction during COVID-19 due to poor demand from hotel industries, tourism, cancellation of mass religious activities and functions, etc. The tannery operations particularly raw to semi-finished processes reduced by 30-60%.

Sustainable cleaner production and treatment technologies have been engineered in many countries in India, China, Turkey & other leather producing countries. Effluent discharged from conventional processes in textile dyeing and tanneries are unable to meet some of the discharge parameters such as Total Dissolved Solids (TDS) to the level of 2100 mg/l in existing physiochemical and biological treatment units. In addition to TDS management, the control of volatile solids in hazardous category sludge is also becoming a necessity. The unutilized fleshing is converted into biological liquefaction and anaerobic digestion with bio-energy generation. Anaerobically digested sludge is converted into bio-fertilizer. The technical paper deals with recent technical and environmental developments and future trends in the midst of COVID-19 in India & other countries.

**Key words:** Leather production, Environmental sustainability, Anaerobic digestion, COVID-19, Trends in Revival.

### 1. INTRODUCTION

The process of hides and skins are mostly in the same level of 16-18 million tonnes per year during the past 10 years. China is the world leader in leather production with a share of 20-24%, followed by Italy 15-17%, Brazil 12-14%, India 4-5%. The other leather producing countries are Turkey, Vietnam, Russian Federation, Bangladesh, Pakistan, Spain, East Europe & African countries. During the process of 16 to 18 million tonnes of hides & skins per year an average of 2000-2200 million liters per day (MLD) of wastewater is generated from the world tanneries. Nearly 60% of the world leather production is carried out in Asian region and the tanneries discharge more than 1200 MLD. The leather process in India ranges from 1.0-1.2 million tons/year with an average wastewater generation of 120 MLD [1].



Slaughtering and meat consumption reduced by 30% in high meat-consuming Latin American countries such as Brazil, Argentina, etc. from 2008 onwards due to economical recession and health awareness. Furthermore, reduction occurred during COVID-19. Brazil & Italy are the most affected countries by COVID-19. Tannery operations, particularly raw to semi-finish operations, reduced by 30-60% in most of the European, Asian countries including China and India due to occupational safety, logistics problems, low market demand for fashion and high-value leather articles. In many countries, the export level reduced and there are no buyers for raw hides & skins generated from slaughter houses.

Tanneries in most of Asian countries are located in clusters. Common Effluent Treatment Plants (CETPs) which had been established in many leather producing countries such as Italy, India, China, Turkey, Spain, Bangladesh, Pakistan, etc. There are 18 operating CETPs in India. The treatment technologies are depending upon the final mode of treated effluent, enforcement of regulations and local conditions such as availability of domestic sewage for dilution/mixing with treated effluent for TDS management such as in Kanpur, Pallavaram in Tamilnadu and discharge into backwater such as in Kolkata, Bangladesh, Italy, etc. The first Zero Liquid Discharge (ZLD) technology with water recovery was implemented in Lurka, Spain for a capacity of 5.0 MLD during 2005-2010 and enforced in CETPs located in Ambur, Vaniambadi, Ranipet, Perundurai (Erode), etc. in South India.

The world leather sector learned a costly lesson from the ZLD system implemented in one of the CETPs in Lurka, Spain which is not sustainable due to combined treatment without proper segregation and cleaner production at source. High capital investment and O&M cost resulted in the closure of ZLD system. This trend is also being reflected in the reduction of leather production in South Indian Tanneries adopting ZLD system. Their market share in India is reduced from the level of 40% to less than 25% during the past 10 years. The O&M cost is also a major variable which ranged from 1.0 to 4.0 Euros/m<sup>3</sup> of effluent. Highest in South Indian tanneries which adopt ZLD system and it is followed by Italy. Lowest in Kolkata, India & Bangladesh due to the provision for discharge of treated effluent into sea without reduction in TDS.

## **2. CHALLENGES DURING 2010-2020 & EFFECTS OF COVID-19**

The slaughtering and meat consumption started reducing from 2008 onwards in high meat-consuming countries (i.e. Brazil, Argentina, South American countries) due to economical recession and health consideration. The average meat consumption in Argentina which was about 80kg per capita per annum the highest in the world is reduced to less than 50kg per capita per annum during the recent period.

The tannery operations in United States (USA, Germany, Australia & other developed countries) reduced drastically during the past recent decades due to high environmental cost and labour. The tannery activities were shifted to Asian countries and 60% of the World Leather Production is made in Asian region mainly in China with a share of 20-24% [2]. The main leather production and development of tannery activities in Latin America during 2000-2010 is in Brazil with a world share of 12-14%. However due to economical recession, enforcement of environmental regulations, etc. resulted in the declining of leather production during the past decades. Further reductions during COVID-19 due to poor demand from hotel industries, tourism, cancellation of mass religious activities & functions, etc. Brazil is the worst-affected country due to COVID-19 pandemic and unforeseen developments.

The tannery activities particularly raw to semi-finish operations reduced by 30-60% due to occupational safety, logistics problems, low market demand for fashion, high value leather articles



and poor exports. In many countries, there are not many buyers for raw hides & skins during COVID-19.

The tannery operations in USA, Germany, Australia and other countries further reduced and preferred in exporting salted hides & skins and the Research & Development in US and West European countries such as Germany, Spain, etc. had to come to a standstill. Most of the fashion and high-ended leather products shops were closed. The international trade and restriction in logistics and travel resulted in stagnation of raw material & finished products. Sales and prices came down even for industrial and leather products for regular use. Confidence level in using and maintenance of leather articles against protection measures such as sanitizer for COVID-19 need to be established.

Italy, the second major leather producer and leader in high fashion & value products, international trade & promotion activity is the first affected European country due to COVID-19. Their international trade and promotional activities have come to a stand still.

### **3. EFFECTS OF COVID-19 IN TECHNOLOGICAL DEVELOPMENT & DISSEMINATION**

Due to gradual closure of tanneires in United States, United Kingdom, Germany and other Western European countries, the leather production started shifting to Asian countries and partly to East Europe during the past two decades. Most of the US & European institutions carrying out Research & Development (R&D) were closed down and practically there was no acitvty during 2020 due to COVID-19. There is no scope of revival or restarting of technical institutions in most of the countries.

During the past two decades the R&D Institutions, Universities in China & India were active mainly focussing on Cleaner Production, Solid Waste Management and Environmental Protection to meet the requirements of the leather tanneries and upgradation of effluent treatment plants. Due to COVID-19, the R&D activities, mainly physical participation were affected. Only in few countries such as Russian Federation & African Countries, the effect of COVID-19 is not much serious in leather production and they have reported that it is improving mainly for local consumption.

The 8<sup>th</sup> International Conference on Advanced Materials and Systems (ICAMS 2020) in Bucharest, Romania during October 2020 was changed into Zoom/ Virtual conference. Similarly XVI International Scientific-Practical Conference Leather and Fur in the XXI Century: Technology, Quality, Environmental Management, Education in Russian Federation during November 2020 was also organized in Zoom program as a webinar. Though presentations were good, responses & interactions are not very effective when compared to conferences organized with physical participation.

There is no clear picture about the mode of organizing the proposed 2021 IULTCS Congress in Addis Ababa, Ethiopia during November 2021 due to COVID-19 pandemic situation. The situations not clear due to the re-occurrence of COVID-19 pandameic in India and other countries from March 2021 onwards. The publications from physical form have been mostly converted into e-communications.

The industrial activities in leather processes drastically reduced in South India particularly by the tanneries catering the need of high-value fashion items. Uttar Pradesh (Kanpur, Unnao, Agra, etc.) region is not much affected. This is mainly due to the production of leather for common and industrial usage products.

Environmental protection measures and expansion of tannery operation activities are being shifted from South India and other parts such as Kanpur & Kolkata. The upgradation and expansion



of industrial units and CETPs with major funding from Government are taking place by adopting sustainable technologies.

#### 4. CHALLENGES AND INDUSTRIAL OPERATIONS IN INDIA & ASIAN COUNTRIES DURING 2010-2020

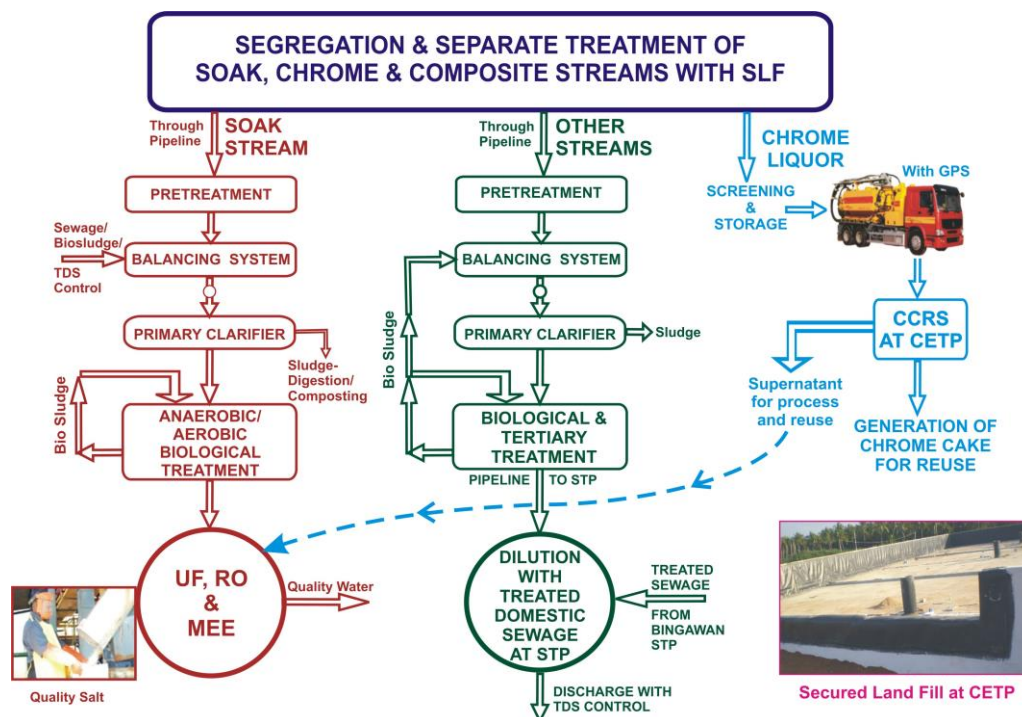
- Leather process from raw to semi-finish is reduced by 50% due to stringent environmental action in South Indian States such as Tamil Nadu during the past 10 years.
- Share of Tamil Nadu in leather processes reduced from 40% to less than 25% mainly due to the high environmental costs and stringent regulations such as adoption of ZLD system, etc.
- The leather production share in Kolkata in India has increased from 15% to more than 20% due to the expansion of industrial units and low operation & maintenance cost of the CETP system. In Kanpur region, which is the Northern part of India, the leather production has increased from 15% to more than 25% during the recent period mainly due to the integration of industrial effluent treatment with domestic sewage treatment system [3].
- In all regions, during COVID-19, the capacity utilization was in the range of only 30-60%. The revival after COVID-19 is positive in Kanpur region, moderate in Kolkata and poor in South India.
- There was no new license or expansion for the tanneries during the past 10 years. Recently, Environmental Clearances have been accorded for a Mega Leather Complex with the production capacity of about 600 tonnes/ day of raw hides and skins near Kanpur and expansion of units and CETP.
- New regulations and directions have been given for cleaner production, segregated centralized treatment, mode of effluent disposals, etc. by Ministry of Environment and Forests & Climate Change (MoEF-CC), National Green Tribunal (NGT), National Mission for Clean Ganga (NMCG), Central Pollution Control Board (CPCB) & State Governments.
- In China, for sustainability, small scale tanneries (about 400) with less than 10-15 tons/ day capacities closed as per new regulations. Water recovery and reuse is also adopted with advance oxidation to increase the production capacity.
- About 13 major Effluent Treatment Plants (ETPs) had been built in China's Leather Sector during the growth period of 2000-2010. The utilization capacity is reduced gradually from 2010 onwards and further reduced during 2019 & 2020 due to COVID-19.
- In recent times, China outsourced the Raw to Semi-finish process of hides & skins in countries such as Vietnam, Bangladesh, etc. due to stringent environmental requirement and sustainability. Incentives are provided for exports in China after COVID-19.
- Japan developed special breed for signature meat such as "KOBE" meat and getting high quality hides in limited capacity.
- R & D activities on Cleaner Leather production and Environment are being carried out by mainly in Asian Universities (China & India). Industry associations such as China Leather Industry Association (CLIA) & Indian Leather Technologists Association (ILTA) are playing active roles in promotion and dissemination of technologies through publications.

## 5. NEW DEVELOPMENTS IN CLEANER PRODUCTION & TREATMENT SYSTEM

As per the new regulations of MoEF-CC, NMCG, NGT, CPCB and State Governments, the tanneries have to adopt specific cleaner production processes, segregate and treat the saline and chrome stream separately for recovery of quality water, salt and chemical[4].

The safe disposal of solid wastes from tanneries and sludge from effluent treatment plants are major challenges and also cost of sludge disposal in the Secure Land Fill (SLF) system is becoming very expensive. This is similar to the challenges faced by tanneries and CETPs in Italy, Spain, etc.

A typical model which is being implemented in the CETPs of UP is given below:



*Fig 1. Segregation and Separate treatment of Effluent Streams from Tanneries*

It is becoming necessary to convert the chemical treatment to anaerobic / aerobic biological treatment to reduce the sludge generation and to achieve the required treatment standards. These are all the following developments which are being applied in the upgradation and expansion of effluent treatment plants in India.

- Upgradation of equalization system into first-stage aerobic biological treatment with sulphide oxidation.

- Adoption of improved aeration system such as Jet Aspirator linked with integrated compressors for providing improved mixing, oxygen transfer upto 2.2 kg/kWh and odour control. An improved equalization cum sulphide oxidation system adopted in one of the CETPs is shown in the following figure.

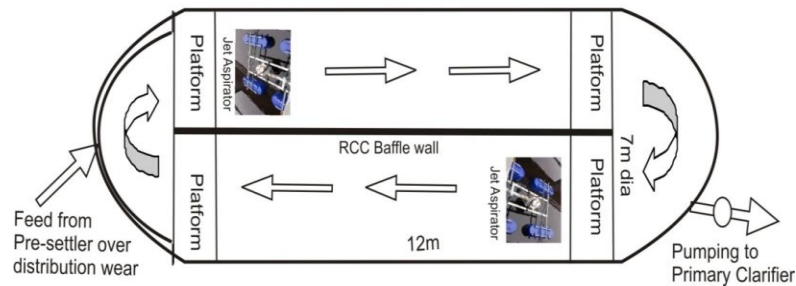


Fig 2. Improved Equalization-cum-Sulphide Oxidation System

The conventional effluent treatment system, though, could remove suspended solids, chromium, BOD, etc., but it is difficult to achieve COD norms and clarity in the treated effluent. With a view to overcome this problem, advanced oxidation using liquid oxygen and ozone are adopted to reduce residual COD, colour and microbes in treated effluent and make it fit for safe reuse. It is also reported from health care field that ozone treatment improves the immunity of human body against Cancer & COVID-19 viruses.

The disposal of large amount of sludge and un-used solid wastes such as fleshing are becoming challenges in India and many countries. In view of this, technological developments such as biological liquefaction of fleshing, anaerobic digestion with bio-energy generation and composting of digested sludge are being introduced in pilot and commercial scale [5]. The process flow diagram of biological liquefaction and anaerobic digestion are shown in the following figures.

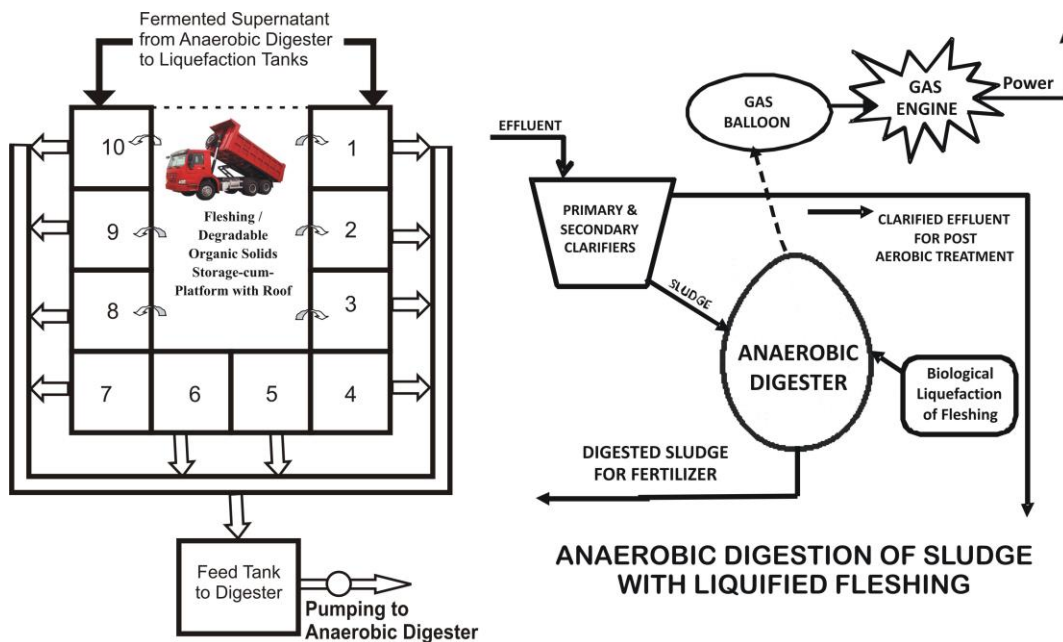


Fig 3. Biological Liquefaction of Fleshings and Anaerobic Digestion



## 6. LESSONS LEARNT ON SUSTAINABILITY IN CLEANER PRODUCTION AND EFFLUENT TREATMENT

- The sustainability of any cleaner technology would depend upon how it is made simple and acceptable by field technicians in commercial-scale operation.
- Many countries in US, Germany & European Union due to high labour cost and unsustainable environmental regulations resulted in closure of tanneries and export of salted raw hides & skins. Correspondingly R&D institutions are also closed down[6].
- Operation & Maintenance cost of effluent treatment is a major variable (1.0 to 4.0 Euros/m<sup>3</sup>) depending upon mode of disposal and regulations. First ZLD project with capacity of 5.0 MLD connected with 25 tanneries in Lurca, Spain closed down.
- Highest cost is in Tamil Nadu, South India due to the adoption of ZLD system, then in Italy, due to the total conversion into biological system to manage the sludge disposal issues.
- Lowest O&M costs are in Kolkata, Bangladesh, Vietnam, etc. mainly due to the provision for discharge of treated effluent into backwaters and to the sea.
- Cost of effluent treatment from land-locked tanneries such as Kanpur, Tamil Nadu, Jalandhar, etc. in India would be sustainable if the treated effluent from tanneries is able to be mixed with treated effluent domestic sewage, if available for TDS management.
- The 12<sup>th</sup> Asian (AICLST) Conference is scheduled during Oct. 2022 in Queenstown, New Zealand and XXXVI IULTCS Congress is scheduled during 2023 in Chengdu, China. However, there is uncertainty in organizing the conferences with physical participation due to the re-occurrence of COVID-19.

## 7. CONCLUSIONS AND RECOMMENDATIONS

- Separate treatment of saline soak stream & conversion of physiochemical treatment to biological treatment, recovery of quality salt, generation of bio-sludge & bio-fertilizer and reduction in sludge by more than 50% in effluent treatment plants would be achievable.
- Discontinued R&D in leather sector would resume in US and Europe, only if salted hides & skins are banned for export under health & safety reasons and restarting of tannery operations.
- Continued applied R & D in cleaner production, reduction/ recovery of chromium and other salts in all levels, utilization of solid wastes / sludge etc. to reach sustainable carbon footprint is necessary.
- Due to COVID-19 major challenge is faced by World Leather Sector mainly for fashion oriented high-value products.
- Revival would depend upon the occupational health & safety measures, control of COVID-19, flexibility in mobility and economical condition.
- High environmental cost such as adoption of total ZLD for composite stream in the absence of safe salt usage/ disposal is one of the major threats. The occupational health and safety in the context of COVID-19 pandemic situation would become a major threat for sustainability of world leather sector.
- Similar to the improved image of cotton textiles & organic farming, image of genuine leather usage shall be improved and disseminated for sustainability.



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