80 YEARS OF IMPACT

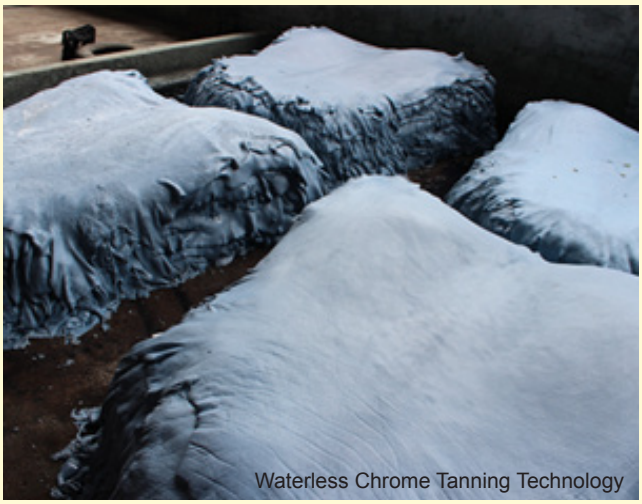
Council of Scientific & Industrial Research

Leather for Employment

THE leather industry occupies prominence in the Indian economy because of its massive potential for employment, growth and exports. The leather and footwear industry directly employs approximately 4.5 million people, with more than 30% being women.

Established in 1948, CSIR-Central Leather Research Institute (CLRI), Tamil Nadu, has interwoven its research efforts to meet the training needs of industry since the time industry was operating in the cottage sector. Realising the significance of this synergy, the University of Madras handed over the Department of Leather Technology to be housed at CSIR-CLRI. CSIR-CLRI employs Science and Technology to develop society through a strong connection of the academy, research and industry, hosting the trinity model. The Institute's education, training and skill development initiatives nurture human resources and enable the percolation of the cutting-edge technologies developed at CSIR-CLRI into the industry.

The latest in the list includes technologies like waterless chrome tanning process, electro-oxidation based zero wastewater discharge, smart leathers, compost for agricultural applications, product for dry tanning, high-value collagenous products and activated carbon from trimming and fleshing wastes, preservation-cum-unhairing process and biogas for energy conservation. The transfer of such technologies to the leather and leather product industries (existing and startups) has contributed directly to an increase in the existing employee base and new job creation.



Waterless Chrome Tanning Technology

CSIR-CLRI has also developed technologies for culling out wealth from waste, including combining banana fibres and leather scrap and exotic leather products from chicken feet skins (poultry waste). These interventions have been disseminated *via* training programmes.

CSIR-CLRI has always led the nation in skill development programmes at the primary level. Around 9390 artisans have been trained pan India since 2006 in association with sponsoring organisations like National Scheduled Castes Finance and Development Corporation and Gujarat Rural Industries Marketing Corporation Limited, and 3703 artisans trained by Central Footwear Training Institute have been assessed for skill training. More than 80% of primary level candidates are placed every year in wage/self-employment, with around 5% of candidates taking up entrepreneurship (individual/Self-help Groups).

Under the Leather Technology Mission, CSIR-CLRI has revived the traditional Kolhapuri chappal industry in the Athani leather cluster of Karnataka through technological intervention and training support, benefitting around 250 artisanal families.

CSIR-CLRI is the programme implementation unit (tannery sector) under the Indian Footwear Leather and Accessories Development Programme, Department for Promotion of Industry and Internal Trade (formerly DIPP), Government of India and has contributed to the creation of jobs for 9272 skilled workforces from 2017 to 2021. During the 11th and 12th five-year plans, CSIR-CLRI functioned as the National Monitoring Unit to monitor the human resource activities sponsored by the DIPP, monitoring around 5.5 lakh candidates pan India.

Probing into high-end skilling requirements, more than 3400 Indians have undergone professional training from CSIR-CLRI in the form of Diploma, PG Diploma and industry-oriented executive courses (standardised and tailor-made) – 30% of these candidates are entrepreneurs generating employment and the rest occupy prominent positions in the industry.

CSIR-CLRI organises various academic programmes — BTech (Leather Technology), MTech (Leather Technology/ Footwear Science and Engineering) and MS by research in collaboration with Anna University. Having stepped into the Platinum Jubilee Year, more than 2000 candidates have completed their BTech/MTech programmes to date through this academic partnership.

Today, the industry's absorption of CSIR-CLRI trained technologists is close to 100% of the supply. CSIR-CLRI has also turned out more than 450 Doctoral candidates in leather and allied sectors in association with Anna University, Madras University and Academy of Scientific and Innovative Research. Today, 50% of the Indian Leather Industry is being managed by CSIR-CLRI alumni. They command a 1 in 3 ratio of the global supply of tertiary level workforce in the leather industry.

Augmenting the capacity of national and international training institutions in leather and leather products has always been on the agenda of CSIR-CLRI. More than 450 citizens from 65 countries (including 14 countries of Africa) have been trained at CSIR-CLRI, carving an internation research-cum-skill ecosystem. The Leather Industry Development Institute (LIDI) in Ethiopia on a twinning mode is a classic example. It has led to the growth transformation of the leather sector in Ethiopia.

CSIR-CLRI has successfully registered 8 of its PG Diploma, Diploma and executive courses under the National Qualifications Register. It is the first Laboratory among CSIR to obtain such accreditation and issue accredited skill certificates for its Skill Development Programmes under the National Skill Development Agency. CSIR-CLRI is also an assessor and endorsing body for the Leather Sector Skill Council (LSSC).

CSIR-CLRI pledges to continue its journey keeping in mind its motto of "doing better today than yesterday, forever", and building lives from the bottom.

Adapted from the CSIR Blog (https://www.csir.res.in/csirblog-success-stories)

Integrated Municipal Solid Waste Disposal System (i-MSWDS)

MSW Management Pilot Plant towards Zero Waste
CSIR-CMERI Colony

WITH ever-increasing population and urbanisation, the country is facing a huge challenge in waste management. The volume of waste is projected to increase from 62 million tonnes at present to about 165 million tonnes by 2030. Dumping of garbage at the current rate without any treatment would require about 1240 hectares of landfill area per year and with projected generation of 165 million tons of waste by 2030. Setting up landfills for 20 years with 10 m height will require 66,000 hectares of land. This necessitates the importance of scientific solid waste management in today's context.

Waste-to-energy is an option for sustainable solid waste management and it is the need of the hour to realise its potential as one of the most significant future renewable energy sources. Studies suggest that the MSW generated in India mostly consists of a large fraction of organic wastes (40-60%). Unscientific waste disposal practices in landfill sites produce Greenhouse Gas (GHG) emissions and other air pollutants. Methane emitted from landfills is one of the most important contributors to GHGs.

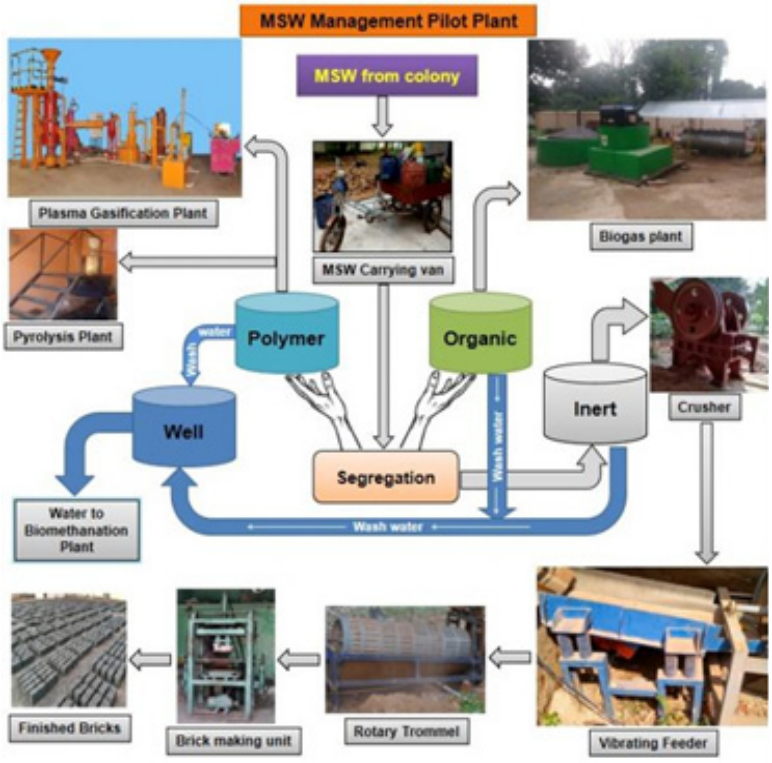
Scientific and most popular techniques for the disposal of wet waste include composting and bio-methanation plants. As per information available for 2013-14, compiled by CPCB, municipal authorities have so far only set up 553 compost & vermicompost plants, 56 bio-methanation plants, 22 RDF plants and 13 Waste-to-Energy (W to E) plants in the country. Many of these plants have experienced failure due to several issues related to the segregation of waste, low calorific values of the waste and challenges in the operation and maintenance of the plants (CPCB 2013-14).

The CSIR-CMERI (CSIR-Central Mechanical Engineering Research Institute), Durgapur, has developed an integrated Municipal Solid Waste disposal system (*i*-MSWDS) for disposal of solid waste in a scientific way in line with Solid Waste Management Rules (SWM) 2016 prescribed by the Union Ministry of Environment, Forests and Climate Change (MoEF&CC), Govt of India.

The integrated municipal solid waste disposal system starts with the mechanized segregation of solid waste. The mechanized segregation system segregates solid waste into metallic waste (metal body, metal container, etc.), biodegradable waste (foods, vegetables, fruits, grass, etc.), non-biodegradable (plastics, packaging material, pouches, bottles, etc.) and inert wastes (glass, stones, etc.).

The bio-degradable component of the waste can be decomposed in an anaerobic environment popularly known as bio-gasification. In this process, biogas is liberated through the conversion of organic matter. The biogas has a typical volumetric composition of 55-60% methane and 35-40% CO_2 with traces of moisture and other impurities such as hydrogen sulphide and it can be used as fuel for cooking purposes. The gas can also be utilised in gas engine for the generation of electricity.

The residual slurry is good organic manure and utilised as fertilizer. The organic waste is also converted to compost in



a natural process known as vermi-composting by introducing earthworms. The vermi-compost is utilised in organic farming.

Biomass waste such as dry leaves, dead branches, dry grass, etc. is disposed of by first shredding it to a suitable size followed by mixing with the slurry of the biogas digester. This mixture is feedstock for briquette, which is utilised as fuel for cooking. These briquettes are also being utilised in gasifier for the production of syngas which is a mixture of mainly carbon monoxide and hydrogen. The syngas has a calorific value equivalent to that of biogas and hence can be utilised in gas engine for generation of electricity. The ash produced from burning of briquette is mixed with cement and water in an appropriate proportion for the production of bricks which are used for construction work.

The polymer waste consisting of plastics, sanitary waste, etc. is being disposed through two main processes i.e. pyrolysis and plasma gasification. In the pyrolysis process, the polymer waste is heated to a temperature of 400-600°C in an anaerobic environment in presence of a suitable catalyst. The volatile matter from the polymer waste comes out as a result of heating which on condensation gives pyrolysis oil. Different heating mechanisms such as solid fuel-based, liquid fuel-based and gaseous fuel-based in standalone mode or combined mode have been developed for carrying out the process.

The pyrolysis oil is termed as Petro Alternate Fuel (PAF). The crude pyrolysis oil after purification can be used in industrial boilers, generators, etc. for heating/power generation purposes. The non-condensed syngas from the pyrolysis process is fed to the gas engine for the generation of electricity. The solid residue known as char is mixed with the biogas slurry for the production of briquette. These briquettes are being utilised for heating the reactor of the pyrolysis process thereby making the process self-sustainable in terms of fuel.

The polymer waste or sanitary items are also disposed of utilising high-temperature plasma. The plasma gasification process converts the waste into syngas which can be utilised for the generation of electricity. The residual ash is mixed with cement for the preparation of bricks.

The Construction and Demolition (C&D) waste is crushed in a jaw crusher and then segregated in different sizes in the trommel. The fines are mixed with cement and water in appropriate proportion. The prepared mixture is then filled in the mould cavity of brick press. Then it is being pressed using hydraulic press to give it a proper shape and compaction. The bricks are cured to achieve the desired strength. Finally, the prepared bricks are tested for engineering properties. The ready bricks are being used as construction materials. The oversized crushed materials are used as aggregate in PCC road making.

CSIR-CMERI has already installed an MSW Management Pilot Plant in CMERI Colony where day-to-day waste generated at CMERI Colony is being processed aiming towards a "Zero Waste CSIR-CMERI Colony". No waste has been discarded from the Colony in the last two years. The CSIR-CMERI MSW Management Technology is completely energy sustainable. The Cyclic Model of Waste Processing facilitates this energy sufficiency of the MSW Technology.

CSIR-CMERI steadily envisions a 'Zero-Landfill' and a 'Zero-Waste City,' by possibly espousing a business model for the MSMEs whereby individuals can deliver their household wastes to the garbage collectors who are incentivized for delivering the wastes to the MSW facilities. This will give the necessary enthusiasm for the citizens of a city to participate in waste management efforts.

CSIR-CMERI organises three-day workshops on handling of municipal solid waste and legacy waste. Programmes such as these are intended to raise the awareness levels of young minds on waste management and skill them with appropriate know-how on advanced and indigenously developed MSW Technologies.

The MSW management technology involves the participation of the local community in the operations and maintenance of the technology, thereby empowering the community with the necessary skills for employment opportunities. A decentralised model of waste processing also helps reduce expenditure on transportation thereby saving valuable resources on fossil fuels, which are both import-dependent and pollution-causing. Indirectly it will also have consequences on reducing medical expenses and protect mankind against toxic gases and wastes.

CSIR-CMERI has already installed and commissioned biogas plants of different capacities at different locations in West Bengal. In addition, CSIR-CMERI, Durgapur, is engaged in providing waste management solutions to CRPF Group Centre, Amrawati and PHE Department, Govt of Manipur.

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