Pilot Scale R&D Biogas plant for Anaerobic Co-Digestion of Vegetable Market waste with Slaughter House waste at CSIR-CLRI, Chennai
Dear Doyens and Stakeholders of the Indian Leather Fraternity; Indian R&D Community, the OneCSIR-family, my Colleagues from CSIR-CLRI, Friends! It gives us great pleasure in sending you our August 2020 edition of The LEATHER POST.

“Central Leather Research Institute is on the verge of a major growth path. With leather and footwear likely to surge ahead and be part of the economic growth of the nation, CLRI has a major role to play. The institute would now shed some of its existing business models and work on a direct partnership model with the industry and their stakeholder bodies. CLRI requisitions the support of the industry in partnering the institution in its charter forward. Industry - Institute partnership needs to be defined at still higher levels. The new normal requires a new partnership model. As CSIR celebrates its foundation day on 26 September 2020, may I request the industry leaders to lead us in a partnership of growth.”

राष्ट्रीय चर्म अनुसंधान संस्थान, पररत्ति के एक मुख्य पथ पर आगरता है। चर्म एवं पॉटेंशियर पहलूओं के आगे बढ़ने की परवशया की जाती है और वे राष्ट्र की आयुर्विक एरात्ति का एक भाग बनते हैं। इस संदर्भ में सीएलआरआई द्वारा अद्या की जनेवारी भूमिका आवश्यक आवश्यक है। अब संस्थान, अपने कुछ पुराने सूचकात्मक मॉडल को पीछे छोड़ते हुए उद्योग एवं उनके पदार्थवादी निकायों के साथ कार्य करेगा। सीएलआरआई, अपने उद्योगियों को आगे ले जाने के लिए संस्थान के साथ साझेदारी करने के लिए उद्योग के प्रति समर्पण का अनुभव करता है। उद्योग-संस्थान की साझेदारी को उद्योग सहर पर परिभाषित करने की आवश्यकता है। इस नए संसारिक नवीन नवीन साझेदारी मॉडल तैयार करने की आवश्यकता है। सीएलआरआई, अपना साधनपन दिसंबर 26 सितंबर 2020 को मना रहा है और इसी संततितित में, कब तक उद्योग के भुतकूल को इस पररत्ति ने हमारी साथ चलने का अनुरोध कर सकता है?

जय हिन्दु
Flip-flop is a very common type of footwear, and it has been considered as open footwear. In this type of footwear, only two major components, such as a Y-shaped strap and the bottom sole, are used. The strap is an upper component which has design as per the fit foot, and the bottom component sole can be PU, PVC, EVA or rubber. The main advantage of this flip-flop kind of footwear is not having fasteners like Velcro or buckle, and the foot can be directly slipped into the footwear easily, and it is also called as a slipper.

The method of manufacturing part and cost is convenient in this modern days, but we have to focus on the most required term ‘fit’ on the flip-flops and also on the testing parameters that are relevant to the quality of the footwear. In this way, up-to-date technology combined with traditional knowledge can contribute to a high quality accurate and personalized production of flip flop design process. An analysis consisting of the pure emotional and psychological evaluation of the user need not only for the design and production process of the flip-flop but for the whole marketing and promotion strategy of the product is essential.

In today’s world flip-flops are the most important parts of human apparel. High biomechanical pressures and human body weights are loaded on the footwear and especially on the foot bed. In essential need of the footwear has to be ergonomically comfortable with high-quality hygiene materials to produce happiness and feelings of comfort for the user.

Flip-flops are not only meant for the beaches or the pool, they are now available in different designs and styles to suit various occasions. The CSIR-CLRI Design & Fashion Studio offers services to customers looking to design and develop new flip-flop designs. Their services include:

1. Design ideas (including engineering) and colour trends for a new range of flip-flops
2. Test and evaluate flip-flops being manufactured by you and do a comparative study with other brands
3. Set-up a mini ‘physical testing laboratory’ and train your personnel in the area of design development and physical testing
## Quality standards for flip-flops

The following test required for flip flops slippers:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Property</th>
<th>Minimum standard required</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Upper materials(Upper, &amp; Socking materials)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Breaking strength, N/mm</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Flexing endurance</td>
<td>No crack at 100000 flexes</td>
</tr>
<tr>
<td></td>
<td>Martindale abrasion (Sock)</td>
<td>Not worse than moderate wear</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dry 25600 cycles</td>
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<tr>
<td></td>
<td></td>
<td>Wet 6400 cycles</td>
</tr>
<tr>
<td></td>
<td>Rub fastness test (Upper&amp; Socking)</td>
<td>Not worse than Grey scale3</td>
</tr>
<tr>
<td>2.</td>
<td>Components</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Toe strap attachment, N</td>
<td>250</td>
</tr>
<tr>
<td></td>
<td>Attachment strength of decorative items, N</td>
<td>200</td>
</tr>
<tr>
<td>3.</td>
<td>Soling materials and units</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Abrasion resistance, mm3</td>
<td>MCR: Low density 700</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PU: Polyester type 300</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PVC: All gender 300</td>
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<tr>
<td></td>
<td></td>
<td>High density 160</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Polyether type 500 (Skin on)</td>
</tr>
<tr>
<td></td>
<td>Flexing endurance, Max cut growth, mm/Kc</td>
<td>0.04</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.005</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.02</td>
</tr>
<tr>
<td></td>
<td>Slip resistance, Co-efficient of friction</td>
<td>0.4 (Dry &amp; Wet clay tile)</td>
</tr>
<tr>
<td></td>
<td>Hardness, IRHD</td>
<td>35-55</td>
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<tr>
<td></td>
<td></td>
<td>50-80 (Skin on)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>50-70</td>
</tr>
</tbody>
</table>

## Future of flip-flops

In these modern days, the flip-flops must satisfy the essential parameters and the reasons are mentioned below:

- Shock absorption on flip-flops
- Foot injuries due to improper design or material
- Strength of the thong part due to more force is used there.
- Comfortability on the foot bed

In conclusion, the quality and comfort of anatomic flip-flops are to combined with the style, attractiveness and trend of the fanciest and colorful flip-flops even for the most demanding customer for both anatomy, comfort as well as attractiveness, aesthetics and style.

For further details, please contact: clriinfo@clri.res.in; sathiyaraj@clri.res.in
CSIR-CLRI has implemented a pilot scale R&D biogas plant for Anaerobic Co-Digestion of Vegetable Market waste with Slaughter House waste for recovery of energy from organic fractions of municipal solid waste generated in Chennai at CSIR-CLRI. This work is part of Resource and Energy Reliability By Co-Digestion Of Veg-Market and Slaughterhouse waste (RESERVES) project funded by Indo-German Science and Technology Centre, New Delhi. The plant is equipped with specially designed shredder and pumps so as to feed the digester without addition of water externally. The German industrial partner has supplied Bio-Extruder an innovative technology as pre-treatment to improve the treatment efficiency and biogas production. The pre-treated waste from bio-extruder is pumped into the digester. The digester is insulated and provided with online monitoring, agitators for mixing and heating arrangements, so as to maintain different temperature in the digester for study. Scrubbing system and auto flaring unit are also provided. The electrical control panel with Programmable Logic Controller (PLC) and Human Machine Interface (HMI) have been provided for automation of the system and for safety aspects. The plant is operated for 500 kg per day of vegetable market waste with slaughter house waste.

For details, please contact: clriinfo@clri.res.in; svsrinivasan@clri.res.in
The project focuses on evaluation of an organic product formulation that ensures both preservation and unhairing of hides and skins. Since the product has dual functionality, it can be used in slaughterhouse and the hair gets loosened during transportation and storage. By the time the raw material reaches the tannery, the loosened hair can be removed either mechanically or manually without using any toxic unhairing agents. In addition to this, the new system of preservation helps to reduce the wastewater discharge with less pollution load, time and cost of end-of-pipe treatment system. The product formulation would be evaluated for different kind of raw materials at pilot scale level and would be optimized for application at industrial scale level followed by demonstration and dissemination of the technology.

Translation of the technology on Manufacturing Organic Supplement and Compost from Hair waste (FTT – MLP 2002):
The project centers on the demonstration and dissemination of the technology of manufacture of organic supplement and compost from animal hair waste to the stakeholders. The production of organic supplement and compost from hair waste has been standardized and optimized at pilot scale level. The products have been evaluated at field level and found to have increased the crop yield significantly with improved crop properties. In addition to this, it aids in import substitution for the country as about 15 million metric tons of fertilizer gets imported every year. The potential stakeholders are the start-ups and the existing organic manure and compost manufacturers, tannery associations and farmer producer organizations.

Dr K J Sreeram, Director, CSIR-CLRI takes the pleasure in congratulating the team CATERS for successful completion of its Desktop Review of NABL. He has acknowledged the tireless efforts of TEAM CATERS in ensuring that the adequacy survey by NABL at the end of the first year of accreditation is completed successfully.
CSIR – CLRI in association with the Department of Chemistry, Sathyabama Institute of Science and Technology conducted six days online Faculty Development Programme (FDP) on “Energy and Environment – Towards Sustainability” through the zoom meeting platform for the larger benefit of the teaching and research staff to upgrade their knowledge in the areas of Energy and Environment. The conveners of the programme were Dr. S. Swarnalatha, Senior Scientist, Environmental Science Lab, CSIR-CLRI and Dr. S. Supriya, Associate Professor, Department of Chemistry, Sathyabama Institute of Science and Technology. The duration of the programme was six days from 3rd August to 8th August 2020. About 155 faculties, scientists and regular staff of various universities, colleges and research institutions participated in the programme.

The experts who shared their knowledge in the FDP were Prof. S. Kanmani, Professor & Director, Centre for Environmental Studies, Anna University; Prof. Kothandaraman Ramanujam FRSC, Associate Professor, Department of Chemistry, Indian Institute of Technology, Madras; Dr. P. Shanmugam, Senior Principal Scientist and Head, Environmental Science Lab, CSIR-CLRI; Dr. G. Sekaran, Formerly Chief Scientist & Cluster Chairman, Environmental Technology Division, CSIR-CLRI; Dr. N. R. Sasirekha, Assistant Professor, Department of Crystallography and Biophysics, University of Madras and Dr. B. Muthuraaman, Assistant Professor and Head i/c, Department of Energy, University of Madras.
The Government of India has allowed corporate India to use their mandatory Corporate Social Responsibility (CSR) spending for investments in publicly-funded incubators and contribute to research efforts in science, technology, medicine and engineering at major institutions and bodies. This 2% CSR fund of average net profit of companies over the last three years can be spent on incubators funded by Central or State Government or any agency or Public Sector Undertaking of Central or State Government, and, making contributions to public-funded Universities, IITs, National Laboratories and Autonomous Bodies (established under the auspices of ICAR, ICMR, CSIR, DAE, DRDO, DST, MEITY) engaged in conducting research in science, technology, engineering and medicine aimed at promoting Sustainable Development Goals (SDGs).

It is a matter of pride for the business entities to participate in the national development by investing in an ethical and transparent way to contribute positively towards the growth as well as the welfare of the society. This investment in national development plays a critical role in enabling society to operate effectively. Considering that we are presently in a knowledge-based society, an investment towards R & D as well as S & T interventions is expected to lead to a very high degree of social empowerment, economic development and environment compliance.

CSIR-CLRI is in the process of attracting the Corporate Social Responsibility funds of its stakeholders / Indian Industries for investment in the following S & T interventions of CSIR-CLRI towards addressing the R & D and technological demands of the leather and products industry and augment the socio-economic benefit to the society.

- Creation of infrastructure and specialized facilities within the campus for
  - conducting skill development programs and
  - conducting research and development in science and technology relevant to leather and allied industries
- Support for technology-driven projects for the benefit of the Industry
- Support for projects in futuristic technology areas for the benefit of the S & T development of the Industry
- Research fellowships for the specified project objectives.

CSIR-CLRI Projects and Programs for deployment under CSR funds to Achieve Sustainable Development Goals (SDGs)

- Demonstration of technologies and conducting workshops to augment the awareness of the significance of these technologies to the leather cluster and common people
- Demonstration of liquid and solid waste management technologies to the tannery clusters on the manufacture of value-added products.
- Demonstration and validation of the use of the value-added products of the solid wastes of the leather industry to the user industries
- Skill Development and Training Programmes predominantly for women / under-privileged people for training the beneficiaries in leather, leather products and allied sectors to augment their quality of life

For Project Guidelines and further details about CSR projects/programs, please refer

https://clri.org/Events/CSR/index.html
On the occasion of 74th Independence Day Celebration, Dr K J Sreeram, Director, CSIR-CLRI hoisted the National Flag and addressed the gathering. The address of the Director is available in the link https://www.youtube.com/watch?v=HOI9h3huMrY. In this address, he saluted the warriors of COVID-19 for their tireless efforts towards containment of the virus.

For breaking the COVID transmission chain, CLRI COVID Response Team in association with Greater Chennai Corporation undertook sanitization of CLRI staff quarters and CSIR-CLRI campus.
Several rural leather artisans in and around Durg district in Chhattisgadh State are engaged in making bag tanned leathers and footwear for local market. The footwear made by them are primarily used by the Tendu leaves collectors in that region. SUTRA, an NGO from Raipur (Chhattisgadh) working for these artisans approached CSIR-CLRI seeking technological support in establishing a leather processing facility in that region with financial support from Khadi and Village Industries Commission (KVIC) and Micro, Small and Medium Enterprises (MSME) for the rural tanners and imparting training in leather processing so that the quality of manufacturing bag tanned leathers may be improved and the market base of the footwear made by them may be extended.

In this regard, the representatives from SUTRA Ms Namrata Bais and Mr Sourabh Choubey visited CLRI RCED Ahmedabad to get first-hand information about leather processing in general and about various tannery machines in particular. They were provided required information with display of various types of leathers. Demonstration of various tannery machines and leather goods machines were also arranged for them.

CSIR-CLRI and Greater Chennai Corporation, Adyar Zone conducted a Covid Testing camp for staff quarters residents, staff, research scholars, contract workers of CSIR-CLRI for 3 days. Body temperature and pulse oximetry, throat and nasal swab tests were done in the camp. The participation of the above was very encouraging. The Director CSIR-CLRI thanks everyone who got tested.
Engineered Mussel Adhesive Protein for Tissue Engineering Applications

Mussel adhesive proteins (MAPs) forms the sticky foots of mussels that helps them to attach on various surfaces in wet and saline conditions. The adhesive nature is mainly due to the presence of post-translationally modified amino acids namely L-DOPA, hydroxyproline (Hyp) and phosphoserine in the protein. This water resistant gluing ability opens up diverse application of MAPs. Next generation of protein engineering paves a way to produce novel MAPs containing modified amino acids for better function and yield since the natural protein extraction is difficult so far due to inefficient extraction methods. In this study we have developed a novel MAP containing both DOPA and Hyp (HD-MAP) through global incorporation of non canonical amino acids (NCAA). The HD-MAP was compared with MAP, single amino acid modified MAPs; DOPA containing D-MAP and Hyp containing H-MAP for its coacervation properties which helps the protein to be in a dense and undiluted form in water. It is observed that the novel protein showing similar properties as that of natural MAPs like forming condensed coacervates at acidic pH (pH 4.5) and are stable upto 200 min. Hence this coacervate forming HD-MAP can be used as a bioglue for various tissue engineering applications and drug delivery.

Presented by
V. Sisila, Research Scholar,
Bio-chemistry & Bio-Technology Department

Marine Originated Recombinant Tissue Engineering Tunable Materials

Developing a protein-based underwater adhesive biomaterial had high demand in orthopedic medicine because bonding of living tissues in the wet environment is highly challenging. Current biomedical and recombinant engineering efforts, despite the numerous notable successes, are fundamentally hampered for production of protein-based adhesives by challenging low production yield (repetitive sequences), low post translational modification, and extensive hydroxylation of tyrosine as well as practical heterologous expression limit wet adhesive strength of the protein. Hence, it is paramount important to develop novel water resistant biocompatible adhesive which should be non-immunogenic, non-toxic and effective adhesive nature. Our approach will make it possible to produce large scale quantity of underwater adhesive cement proteins with high DOPA contents will lead to long-sought technology to replace the stitches, staples, and screws used in orthopedic medicine or dentistry. We aimed to use pioneered recombinant DNA and genetic code engineering technologies for practical production of cement proteins in E. coli. The blood-resistant, complex coacervation, crosslinking and adhesive mechanism of congener protein will be discovered through advanced spectroscopic and material characterization. These latter efforts will pave the way for novel or significantly improved therapeutics for major unmet medical needs of in vivo bone regeneration.

Presented by
Ansuma Janeema, Research Scholar,
Bio-chemistry & Bio-Technology Department
Fungal Biomass: Biosorption and Non-enzymatic reduction of Cr (VI)

The effectiveness of heat-inactivated fungal biomass a fermentation waste was studied for Cr (VI) removal in water and applied for Cr (VI) removal from tannery effluent. The pH, biomass concentration and contact time were optimized using Box-Behnken design of response surface methodology. The adsorption process fits the Langmuir isotherm and followed the second-order kinetics model indicating both chemisorption and physisorption. Thermodynamic studies showed that the process is spontaneous at ambient temperature. Adsorption of Cr (VI) onto the biomass was confirmed using SEM-EDAX, FTIR analysis showed that the hydroxyl and NHCO groups are involved in biosorption of Cr (VI). XPS analysis confirmed the reduction of Cr (VI) to Cr (III). XRD analysis showed increased crystallinity of biomass after chromium adsorption. The amount of chromium adsorbed was 72.38% and 68.33% for water and effluent, respectively. Chromium adsorbed onto biomass was desorbed at pH 9 with 1 molar NaOH. Total chromium desorbed was 61.40 and 59.38 percent from water and effluent, respectively. The amount of Cr (III) in the desorbed sample was 71 and 68 percent, respectively. The heat-inactivated biomass is a suitable material for efficient Cr (VI) removal and detoxification.

Presented by
Georgi Sebastian, Research Scholar,
Bio-chemistry & Bio-Technology Department

Praseodymium-cobaltite re-inforced collagen biomimetic scaffolds for angiogenesis, wound healing and stem cell differentiation

The study involving the fabrication of collagen biomaterial re-inforced with praseodymium-cobaltite nanoparticles (PCNP) for wound healing applications was performed. PCNP were synthesized by sol-gel method with citric acid as reducing agent. The nanoparticles were successful in terms of biocompatibility as observed from cytocompatibility and hemocompatibility studies. The synthesized nanoparticles were actively used for the reinforcement of collagen molecules. The resulted re-inforced biomaterial increased thermal stability and decreased proteolytic susceptibility to collagen. Circular dichroism spectroscopy and FT-IR-ATR analyses confirms the suitability of incorporation of PCNP into collagen without affecting its characteristic triple helical structural integrity. Re-inforced collagen has shown to possess biocompatibility and hemocompatibility which are the desirable properties of a wound dressing material. The re-inforced collagen sheets provided proper matrix elasticity that promotes angiogenesis was confirmed with tube formation and aortic arch assay. This biomaterial increased ductility for pro-angiogenic potential and differentiation of mesenchymal stem cells into endothelial cells owing to the therapeutic potential of nanoparticle formulation. This study paves the way for exploring the therapeutic potential of rare-earth based nanoparticles for tissue engineering applications as an alternative for traditional wound healing materials.

Presented by
Vinu Vijayan, Research Scholar,
Biological Materials Laboratory
Invited talk at INAYS Inaugural Mid-Year E-Meeting

Dr N Nishad Fathima, Senior Principal Scientist was invited to deliver a talk during the Indian Young Academy of Sciences (INYAS) inaugural mid-year E-meeting held on August 1, 2020. The title of the talk was “Woman scholars of Pre-independent India in Education, Chemistry and Medicine”. The session was live streamed on INYAS YouTube channel (https://www.youtube.com/watch?v=LYPcrMynPJI&t=3s).

The talk covered three woman scholars who were change makers in each field viz., Savitribai Phule (First female teacher of India) in Education, Kamala Sohonie (First Indian woman PhD in science) in Chemistry and Anandibai Joshi (First Female Indian Physician) in Medicine. The talk chronicled their lives, the trials and tribulations faced by them and the impact they made in their respective fields. “Be the change” and “In a gentle way one can shake the world” were the take home messages of the talk. The talk was well received and appreciated by one and all.

Bioengineered hybrid collagen scaffold tethered with silver-catechin nanocomposite modulates angiogenesis and TGF-towards scar-less healing in chronic deep second degree infected burns

K. Cheirmadurai & P. Thanikaivelan
Advanced Materials Laboratory, CSIR-CLRI

Management of burn wounds with diabetes and microbial infection is challenging in tissue engineering. The delayed wound healing further leads to scar formation in severe burn injury. Herein, a silver-catechin nanocomposite tethered collagen scaffold with angiogenic and antibacterial properties is developed to enable scarless healing in chronic wounds infected with Pseudomonas aeruginosa under diabetic conditions. Histological observations of the granulation tissues collected from an experimental rat model show characteristic structural organizations similar to normal skin, whereas the open wound and pristine collagen scaffold treated animals display elevated dermis with thick epidermal layer and lack of appendages. Epidermal thickness of the hybrid scaffold treated diabetic animals is lowered to $33 \pm 2 \mu m$ compared to $90 \pm 2 \mu m$ for pristine collagen scaffold treated groups. Further, the scar elevation index of $1.3 \pm 0.1$ estimated for the bioengineered scaffold treated diabetic animals is closer to the normal skin. Immunohistochemical analyses provide compelling evidence for the enhanced angiogenesis as well as downregulated transforming growth factor- $\beta$ 1 (TGF-$\beta$ 1) and upregulated TGF-$\beta$ 3 expressions in the hybrid scaffold treated animal groups. The insights from this study endorse the bioengineered collagen scaffolds for applications in tissue regeneration without scar in chronic burn wounds. (https://doi.org/10.1002/adhm.202000247)
Utilization of Waste Leather – Full of Wealth

The process of Leather manufacturing produces vast amount of solid waste annually (8.5 million tons worldwide), and most of the solid waste (80%) is produced in pre-tanning operations. The fleshing operation to remove flesh, subcutaneous tissue and natural fat from the flesh side of the hide/skin (fleshings) accounts for 50-60% of total solid waste. Attempts to extract oil from the fleshings have been made, however the application of the oils from fleshing in tanning has not been explored to that extent. One of the prominent oil tanned Leather is Chamois. The oil tanning process takes about 9-12 days (which is very long when compared to chrome tanning which takes approximately less than 6 hours), and this explains why the technology is not commonly used.

Conventionally, Polymerized (sulphited) Fish oil or Cod Liver oil is used in chamoising. The oil extracted from the fleshing waste can be characterized and polymerized (sulphitation) in such a way that it can be used for tanning. The results of previous study (on the extraction fat-oil from fleshings) gives us a hope to explore more on tanning, as well as the hope for producing special Fat Liquors for a particular article.

Leather is Full of Wealth; Even the waste produced during the manufacturing of leather is of wealth. Recycling of Waste not only helps us to make the leather manufacturing Eco-Benign, but also to mint money. Clever man gets more profit.

Presented by
Anjudha M, B Tech Leather Technology, 3rd Year
Anna University, Chennai

The readers of The Leather Post can submit their Feedback by clicking on the link below.

https://forms.gle/PRXYuEa4dooL2Tyk7
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