ABSTRACT BOOK

INDIAN CONFERENCE ON LIFECYCLE MANAGEMENT (ILCM), MUMBAI

October 04-05th 2018

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About ILCM

Indian Conference on Life Cycle Management (ILCM) is a flagship event instituted by FICCI to promote Life Cycle Thinking among various stakeholder groups in India - government, industry, academia as well as non-voluntary sector. It is the only forum in India that focuses exclusively on Life Cycle Management and related topics. The conference brings the latest knowledge and understanding about emerging concepts in Sustainable Consumption and Production to Indian industry. The platform is even more significant as technical issues relevant to the host country drive the ILCM agenda.

FICCI augmented its annual conference on Life Cycle Management (ILCM) with an aim to mainstream use of Life Cycle Knowledge in public policy and business decision making. ILCM 2018, the seventh edition of the series, was organized on 04-05th October 2018 in Mumbai, supported by Ministry of Environment, Forest and Climate Change (MoEFCC) and brought together over 110 national and international stakeholders.

Thematic Areas for Abstract submission

The two-day conference focussed on the following key areas:

- Harnessing the power of Life Cycle Knowledge for addressing Sustainability challenges
- Greening the building and construction sector - using LCA and EPD
- LCM based strategy for achieving/advancing Resource Efficiency & Circular Economy
- Life Cycle Inventory data as fundamental necessity for sustainable production and consumption

Conference Agenda

Day 1: 04th October 2018 (Thursday)	
08:30 – 09:30	**Registration**
09:30 – 10:30	**Inaugural Session** **Welcome Remarks** *Mr. Manoj Patodia, VC & MD, Prime Urban Development Limited* **Special Address** *Dr. Ashok Menon, Global Technology Leader, SABIC Technology Centre* **Mainstreaming LCT in South Asia: FICCI Initiatives 2012-18** *Dr. Sanjeevan Bajaj, Advisor – Quality Forum* **Theme Address** *Shri Anil Diggikar, Principal Secretary, Environment Dept. Government of Maharashtra** **Closing Remarks** *Mr. Mritunjay Kumar, Joint Director & Head- FICCI Quality Forum*
10:30 – 11:00	**Networking Break | Poster Presentation**
11:00 – 12:30	**Session 1: Using Life Cycle Information for achieving/advancing Resource Efficiency & Circular Economy**: This session will explore use/application of Life Cycle Approaches as a supporting and validating tool in the context of Circular Economy and resource efficiency **Chair: Dr. Prasad Modak, Executive President, Environmental Management Centre** **How will Life cycle information be used in a digital circular economy?** *Ms. Martina Prox, Ifu Hamburg* **Application of Circular Economy Indicators for Polymer Products and its linkages with Life Cycle Assessment** *Mr. Rajesh Mehta, SABIC Research and Technology Pvt. Ltd.* **Advance assessment of circular economy - coupling material circularity indicators and life cycle based-indicators** *Dr. Pradip P. Kalbar, Centre for Urban Science and Engineering (CUSE), IIT Bombay* **Application of an LCA Integrated GTAP Model to Evaluate Sustainable Returns of Utilizing Biomethane as Transport Fuel for Passenger Cars in India** *Ms. Tavishi Tewari, National Institute of Industrial Engineering, Mumbai*
12:30 – 13:30	**Lunch | Networking Break**

13:30 – 15:00	**Session 2: LCA Case Studies:** This session will showcase LCA studies from industry and researchers supporting the overall sustainable decision making. **Chair: Dr. Pradip P. Kalbar, Centre for Urban Science and Engineering (CUSE), IIT Bombay** **Case study 1: LCA study of wood based regenerated Cellulosic Fibers** *Mr. Gaurav Agarwal, Grasim Industries Ltd., Vadodara* **Case study 2: Life Cycle Assessment of Printing with HP Indigo Digital Press** *Mr. Umesh Kagade, HP Indigo Division* **Case study 3: Life Cycle Assessment of production of Cobalt oxide nanoparticles for supercapacitors** *Mr. Baranidharan Sundaram, Dept of Civil Engineering, NIT Andhra Pradesh* **Case study 4: Life cycle Assessment of Monolithic Concrete Construction Technology (MIVAN)** *Ar. Tanvi Patil, Department of Environmental Architecture, Dr. B.N. College of Architecture, Pune*
15:00 – 15:30	**Networking Break | Poster Presentation**
15:30 – 16:30	**Panel Discussion: Demystifying Life Cycle Thinking for Business Decision making:** LCA is a powerful tool yet traditionally it is considered as complex and time consuming. Information delivered by an LCA is essential part of achieving broader goals such as sustainability rather than the simple comparison of product. The session will demystify the complexity around LCA and explore how effectively can life cycle knowledge be used for business decision making. **Chair: Mr. Anirban Ghosh, Chief Sustainability Officer, Mahindra & Mahindra** *a) Dr. Ashok Menon, Global Technology Leader, SABIC Technology Centre* *b) Mr. Abhay Pathak, Head, Sustainability, TATA Motors* *c) Dr. Rajesh Kumar Singh, Managing Director, Thinkstep Sustainability Solutions Pvt. Ltd.*
16:30 – 17:45	**Session 3: Harnessing the power of Life Cycle Knowledge for addressing Sustainability challenges:** This session will illustrate the use of Life Cycle Knowledge for addressing the sustainability challenges that we (businesses, nations, civil society) face today and help them take more informed decisions. **Chair: Mr. Manohar Samuel, Sr. President Marketing, Birla Cellulose** **Can Life Cycle Knowledge increase potential of used oil?** *Wg. Cdr. Asheesh Shrivastava, Indian Air Force, University of Petroleum & Energy Studies* **Taking Climate Action by Setting a Science Based Target** *Mr. Prasad Sudhakar Giri, Mahindra Sanyo* **Addressing marine litter within Life Cycle Assessment** *Mr. Philip Strothmann, Forum for Sustainability through Life Cycle Innovation* **Hotspots Analysis of the Global textiles value chain** *Dr. Sanjeevan Bajaj, FICCI*
1930 hrs. onwards	**Networking Dinner** *(Self Paid - for details contact Team FICCI)*

Day 2: 05th October 2018 (Friday)	
09:00 – 09:30	**Welcome Tea**
09:30 – 10:30	**Session 4: Greening the building and construction sector - using LCA and EPD:** This session will showcase case studies focusing on use of LCA in the building and construction sector and its use in developing EPDs. **Chair: Ms. Martina Prox, Ifu Hamburg** **Environmental product declaration of average PPC and PSC cement** *Mr. K. N. Rao, ACC Limited* **A market-based approach for interpreting, bench-marking and comparisons of LCA- and EPD-information** *Mr. Sebastian Welling, IVL Swedish Environmental Research Institute* **Life Cycle study on steel-concrete composite construction** *Mr. D Datta, AGM (C & S), Institute for Steel Development & Growth*
10:30 - 11:00	**Networking Break | Poster Presentation**
11:00 – 12:00	**Panel Discussion: Using Life Cycle Knowledge for Circular Plastics Economy:** LCA is a valuable tool for the systematic evaluation of the environmental aspects of a product or service system through all stages of its life cycle so we can balance trade-offs, avoid burden shifting and positively impact the economy, environment, and society. While the circular economy thinking intuitively makes sense to consumers and decisions makers, however form LCA perspective, there are few risks involved with this approach. The session will explore the critical importance of LCA based decision making for truly sustainable designs and material choices. **Chair: Dr. Ashok Menon, Global Technology Leader, SABIC Technology Centre** *Mr. Abhijit Patil, Manager, Reliance Industries Ltd.* *Ms. Rashi Aggarwal, Director, Banyan Nation* *Dr. Shilpi Kapur, Fellow, TERI*
12:00 – 12:15	**Interactive Exercise - LCA Game** *Mr. RaviTeja Pabbisetty, SABIC Research and Technology Pvt. Ltd.*

12:15 – 13:00	**Session 5: Life Cycle Inventory data as fundamental necessity for sustainable production and consumption:** This session will explore the opportunities and Challenges in creating national/ industry specific Life Cycle inventory database/datasets and the interoperability of databases. **Chair: Dr. Rajesh Biniwale, Principal Scientist, NEERI** **Overcoming the challenge of data accessibility and interoperability with the Global LCA Data Access platform** *Mr. Llorenç Milà i Canals*, *UN Environment* **A new LCI database for India** *Dr. Andreas Ciroth, Green Delta, Germany* **Life Cycle Inventory for Textile and Agriculture sector in India** *Ms. Archana Datta, FICCI*
13:00 – 14:00	**Lunch | Networking Break**
POSTER	
1	**Harnessing the power of LCT for addressing Sustainability Challenges** Ms. Sunetra Kulkarni, ISO-QMS, Public Administration
2	**A strategy for Recognition and Branding of Business and achieve sustainability** Mr. Joy Shah, Innov8 ProTech Solutions

Abstracts

1. Augmenting learnings on "life cycle thinking" in an organization through gamification

Authors: Ravi Teja Pabbisetty[1], Ananda Sekar[1], Rajesh Mehta[1], Ashok Menon[1]

[1]SABIC Research and Technology Pvt. Ltd.

Life Cycle Assessment (LCA) as a concept is perceived to be "too technical" or "too complex" to comprehend by most in an organization. To explain newer concepts, techniques such as presentations, posters, and audio-visuals are widely used. We tried to take a different route to help penetrate the concept of life cycle thinking and its value through an interactive decision-making game. Relying on "learning by doing" pedagogy, it is proposed to be used for internal and external engagement workshops on sustainability.

With annual global sales exceeding 1.5 billion units[4] ICT industry has a strong dependency on material resources and growing at significant pace. In view of its ubiquity and familiarity, coupled with its relevance for circularity, the game is themed on Life cycle of a Smart Phone.

The interactive game relies on attributional as well as consequential LCA approaches, wherein, the player gets to make life cycle choices of a smart phone from choice of materials, battery capacity and display size, choice of packaging to various aspects of its use such as source of electricity, mobile data versus broadband network, GBs of data use, etc. The player also gets to make decisions on circularity such as frequency of changing the phones, choices on end-of-life such as resale, repurposing, recycling to even preserving them as collectibles. The game-play objective is to design a phone with lowest carbon footprint while staying within a certain allocated cost budget.

The oral presentation will cover various features of the game as well as highlight key insights gained during development of the game. Further development of the game will be to incorporate circularity concepts, as with policy developments across the globe strongly driving circularity of materials, it is imperative for us as sustainability experts of a global company to instill LCA insights on circularity into various sections of the organization from marketing teams to technologists and the like.

References:

1. http://ec.europa.eu/environment/circular-economy/index_en.htm
2. https://thewire.in/environment/insufficient-planning-may-be-the-undoing-of-maharashtras-plastic-ban
3. https://www.ellenmacarthurfoundation.org/assets/downloads/insight/Circularity-Indicators_Project-Overview_May2015.pdf
4. https://www.statista.com/topics/840/smartphones/

2. Application of Circular Economy Indicators for Polymer Products and its linkages with Life Cycle Assessment

Authors: Rajesh Mehta[1], Salil Arora[2], and Ashok Menon[1]

[1]SABIC Research and Technology Pvt. Ltd., Bengaluru, INDIA [2]SABIC, Houston, USA

The Circular Economy (CE) methodology applies system thinking, 4R framework, and waste hierarchy to eliminate product "end of life".[1-3] The CE methodology looks beyond the current take-make, dispose, and extractive industrial model. The CE framework proposes that companies incorporate business models and product systems with Circular Economy principles. Multiple performance indicators and tools exist, both quantitative and semi-quantitative, to measure CE performance.[4-7] Indicator scope varies from a macro level assessment of the economy, EU commission,[5] to a micro level assessment of a company or a product system, Material Circularity Indicators (MCIs)[4]. The existence of multiple indicators increases complexity for designers, sustainability experts, value chain partners, and decision makers as there are differences and limitations in existing approaches to measuring product's circularity performance.

Few studies have been conducted that link CE indicators with lifecycle assessment (LCA). In this work, we studied usefulness and applicability of existing CE indicators for measuring product circularity for polyolefin products going into different end-use applications: rigid and flexible packaging. Further, the study applied CE indicators together with LCA to 1) measure sustainability performance of the product; and 2) study relationship between CE indicator score and LCA impact assessment results.

The presentation will demonstrate our integrated approach to use MCI and CEIPT CE indicators with LCA models and LCA workflow. The study concluded that LCA complements the Circular Economy frameworks and CE indicators. Results from our work demonstrated the ease of use of CE indicators for communication to non-LCA experts. However, CE indicator scores cannot answer all questions from decision makers on sustainability impacts of a product system. Therefore, the suggested integrated approach is better suited for organizations with large non-expert LCA audience.

References:

1. https://www.ellenmacarthurfoundation.org/circular-economy
2. Julian Kirchherr, Denise Reike, Marko Hekkert, Conceptualizing the circular economy: An analysis of 114 definitions, Resources, Conservation & Recycling 127 (2017) 221–232.
3. http://ec.europa.eu/eurostat/documents/2995521/8587408/8-16012018-AP-EN.pdf/aaaaf8f4-75f4-4879-8fea-6b2c27ffa1a2
4. https://www.ellenmacarthurfoundation.org/assets/downloads/insight/Circularity-Indicators_Project-Overview_May2015.pdf
5. http://ec.europa.eu/eurostat/web/circular-economy/indicators
6. Steve Cayzer, Percy Griffiths & Valentina Beghetto (2017) Design of indicators for measuring product performance in the circular economy, International Journal of Sustainable Engineering, 10:4-5, 289-298, DOI: 10.1080/19397038.2017.1333543

7. Michael Saidani, Bernard Yannou, Yann Leroy and François Cluzel, “How to Assess Product Performance in the Circular Economy? Proposed Requirements for the Design of a Circularity Measurement Framework”, Recycling 2017, 2(1), 6.

3. Addressing Marine Litter within Life Cycle Assessment

Authors: Philip Strothmann[1]

[1] Forum for Sustainability through Life Cycle Innovation

The Medellin Declaration (Sonnemann and Valdivia, 2017), published by the Forum for Sustainability through Life Cycle Innovation e.V. (FSLCI) in collaboration with the Red Iberoamericana de Ciclo de Vida (RICV) last year highlighted that currently life cycle assessment (LCA), as one of the most widely used sustainability assessment tools for greening the economy (UNEP, 2012), is not adequately addressing the impacts on the environment generated due to marine debris, such as plastics and microplastics. It also noted that there does not seem to be any life cycle assessments on products that include plastics and adequately addresses the challenge of marine litter. Indeed, there is still an overall need to assess marine ecological impacts in life cycle assessment in a meaningful way (Woods et al, 2006).

Given the magnitude of the impacts caused by marine debris, plastics and microplastics in the oceans and as response to the public concern on these impacts echoed at the recent UN Ocean Conference (United Nations, 2017), the FSLCI organized an initial workshop in collaboration with the RICV in May 2018 with the objective to link different expert communities together to start a process towards addressing the issue of marine litter within life cycle assessment and management.

The workshop convened 30 experts with a background in Life Cycle Assessment and Management (LCA/M) as well as marine debris generation and impact assessment to open a dialogue between life cycle and marine litter experts which would ultimately result in a process that builds the basis for the inclusion of marine litter in LCA. The presentation presents key conclusions and recommendations that derived out of the workshop and outlines next steps that are planned to address the topic of marine litter within LCA.

References:

1. Sonnemann G and Valdivia S (2017) Medellin Declaration on Marine Litter in Life Cycle Assessment and Management, Int J Life Cycle Assess (2017) 22:1637–1639
2. UNEP (2012) Greening the Economy Through Life Cycle Thinking, Paris, http://www.unep.fr/shared/publications/pdf/DTIx1536xPA-GreeningEconomythroughLifeCycleThinking.pdf
3. United Nations (2017), Our Ocean, Our Future: Call for Action, New York,https://oceanconference.un.org/callforaction
4. Woods JS, Veltman K, Huijbregts MA, Verones F, Hertwich EG (201&) Towards a meaningful assessment of marine ecological impacts in life cycle assessment (LCA), Environ Int. 89-90, 48-56

4. Cradle-to-gate life cycle assessment of biogas production from palm oil mill effluent

Authors: Nur Izzah Hamna A. Aziz[1], Marlia M. Hanafiah[1]*

[1]*School of Environmental and Natural Resource Sciences, Faculty of Science and Technology, Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor, Malaysia*

ABSTRACT

Exploring renewable energy sources is becoming increasingly important due to its low environmental impacts as compared to the consumption of non-renewable fossil fuel sources. Waste-derived biogas is one of the promising technologies that yields a renewable, sustainable, and green source of energy. In Malaysia, palm oil mill effluent (POME) can be a suitable feedstock for biogas production due to its abundant and high potential in energy generation. However, a comprehensive assessment need to be conducted to ensure the sustainability of POME-based biogas production. This study was conducted to evaluate cradle-to-gate life cycle environmental performance associated with the production of biogas by the anaerobic digestion of POME. The functional unit was defined as 1 tonne of POME used for biogas production and the system boundaries covered the plantation-processing mill-biogas plant stages. The life cycle assessment (LCA) was performed using ReCiPe 2016 environmental impact method and SimaPro 8.4 software. It was found that the total characterization factor for human health damage by water consumption (WC) and carbon dioxide (CO_2) ranges from 2.49×10^{-8} to 3.36×10^{-3} DALY per m^3 of consumption and 1.45×10^{-5} to 1.42×10^{-3} DALY per kg of emission, respectively. The total characterization factor for ecosystem damage by WC, land use change (LUC) and CO_2 ranges from 6.76×10^{-15} to 2.04×10^{-5} disappeared fraction of species (PDF) over time and space ((m^2·year)/m^3), 4.92×10^{-8} to 4.78×10^{-6} PDF over time and space ((m^2·year)/m^2) and 1.19×10^{-12} to 4.28×10^{-6} PDF over time and space ((m^2·year)/kg), respectively. The present study demonstrates that the generation of electricity from biogas is advantageous comparing electricity production in conventional power plants. The results also able to identify hotspots in the life cycle of the biogas production where environmental performance of the system can be improved and environmental benefits can be achieved from the anaerobic digestion of POME with regard to the reduction of greenhouse gases emissions.

Keywords: Palm oil mill effluent, biogas production, anaerobic digestion, renewable energy

5. Emission savings from substituting quarried virgin aggregates with recycled aggregates from construction and demolition waste: results from India

Authors: Vaibhav Rathi[1], Abhijit Banerjee[2]*, Rachna Arora[3] and Reva Prakash[3]

[1] Development Alternatives [2] CSTEP [3] GIZ-India * Corresponding author

ABSTRACT

Introduction/Aim

India is going through a construction boom that is likely to continue in the foreseeable future. Aggregates such as sand, stones, etc. are major inputs for construction, but their extraction is associated with significant ecological impacts. Construction and demolition (C&D) waste, though poorly managed in India, can be an attractive alternative source of recycled aggregates, as already seen in many countries. In addition to reducing pressure on virgin resources and ecology, using recycled aggregates has the potential to reduce overall CO_2 emissions. This study attempts to answer the question whether, and under what circumstances, CO_2 emission savings are possible when substituting virgin aggregates with recycled aggregates from C&D waste.

Methods

A life-cycle approach was followed to determine energy use in transportation and processing of virgin rock and C&D waste into aggregates. Standard industry values for India were used to prepare the energy inventory; this was converted to CO_2 emissions using standard international conversion factors and considering Indian energy mix. A comparative Life Cycle Impact Assessment (LCIA) of processing virgin aggregates v/s C&D waste was conducted using scenarios for varying processing capacity and transportation distances.

Results

The analysis indicates that it is possible to achieve up to 21% CO_2 emission reduction by processing C&D waste, compared to virgin aggregates, under Indian conditions. However, CO_2 savings critically depend on transportation distance of raw materials from the processing site.

Discussion/Conclusion

As population pressures displace quarrying, transportation distances keep increasing for virgin aggregates, while C&D waste is readily available inside urban areas. However, C&D waste management systems need to be intelligently designed to minimize transportation distances in order to realize economic and CO_2 emission savings. As the Government of India attempts to improve C&D waste recycling in Indian cities, this study can help inform development of appropriate management systems.

Key words: aggregates, C&D waste, CO_2 savings, recycling, India

6. How will Life Cycle information be used in a digital Circular Economy?

Authors: Martina Prox[1]

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One of the fundamental sustainability challenges is, how we can transform the throughput economy to a circular economy with the aim to improve resource efficiency by magnitudes and reduce up to eliminate negative environmental impacts. To identify the paths and roadmaps to a circular economy is one of the great challenges of today's decision makers in industry and politics. Digitalization, Industry 4.0 and Internet of Things (IoT) are generating more and more data, within companies, along supply chains, and during the use phase. Whenever a new machine is purchased in a company it comes fully equipped with sensors and metering abilities and generates data while operating. This data can be turned into useful information, that can be used for identifying improvement potentials. Products and components are linked to related compliance information, which is transferred throughout the supply chain. Further supply chain challenges like conflict minerals, modern human slavery are subject to mandatory and voluntary reporting schemes, which require also the transfer of specific and trusted information from the original source to the industrial user of the respective material or component up to the marketed product. Consumers are not only in the role of demanding information about the products on social and environmental aspects, but also share more and more use phase information over fully connected devices with each other and eventually the producer. This contribution will provide insights how this great variety of paths for information flows along a life cycle that is being established can be used to realize the vision of the digital twin for products and components which provides access to compliance, environmental and social information. This is one precondition for a digital circular economy which enables to close the loops and eliminate wastage from production systems.

Key words: Digitalization, Circular Economy, Life Cycle Information, Innovation

7. Life Cycle Management Approach - A strategy for Recognition and Branding of Business and achieve sustainability.

Authors: Joy M Shah'

'Founder and Chief Consultant at Innov8 ProTech Solutions

ABSTRACT

LCM is a business management approach that can be used by all types of business in order to improve their sustainability performance. A method that can be used equally by both large and small firms, its purpose is to ensure more sustainable value chain management. LCM can be used to target, organize, analyze and manage product-related information and activities towards continuous improvement along the product life cycle.

LCM is about making life cycle thinking and product sustainability operational for businesses that are aiming for continuous improvement. These are businesses that are striving towards reducing their footprints and minimizing their environmental and socio-economic burdens while maximizing economic and social values. There are three principles underlie strategic positioning of any business for sustainable competitiveness. viz.

1. It is creation of unique and valuable position, involving different set of activities.
2. It requires you to mark trade off in competing - to choose what not to do.
3. It involves creating fit among a company's activities.

In today's world recognition and branding are most important aspects. Every business has to create their own brand for penetration to customers as well as delight of customers. LCM approach can support to build strategy for recognition and branding and there by Sustainable operation. A life cycle approach enables product designers, service providers, government agents and individuals to make choices for the longer term and with consideration of all environmental media (i.e., air, water, land). There are six pillars which will get benefited by LCM approach for sustainability of the business.

1. Industries
2. Government
3. Consumers
4. Employee
5. Shareholders and
6. Society

In this paper, how these six pillars will get benefited by Life Cycle Management approach is discussed which will bring sustainability of business.

8. Life cycle assessment of production of cobalt oxide nanoparticles for supercapacitors

Authors: Baranidharan Sundaram[1], Sudipta Biswas[2], Vikas Sharma[2], Amressh Chandra[2], Brajesh Kumar Dubey[1]

[1]Department of Civil Engineering, Indian Institute of Technology Kharagpur, West Bengal

[2]Department of Physics, Indian Institute of Technology Kharagpur, West Bengal

ABSTRACT

Nanotechnology is one of the fastest growing technology which has raised widespread production, application of nanoparticles (NPs) in various fields such as automobile coatings (metal oxide NPs), semiconductors, super capacitors (Co_3O_4 NPs), sunscreens (ZnO), paints (TiO_2), clothes (Ag), food additives

(SiO_2 as E551)). As per a latest report (2016), global consumption of nanomaterials was estimated to be 3,33,043 metric tons and said to grow by 19.2%.

Objective: The goal of this work is to evaluate the environmental impact due to synthesis of 1 gm of Co_3O_4 NPs of hollow and disc morphologies using life cycle techniques and is based on cradle-to-gate approach. To achieve this objective, this study compiled a Life-Cycle Inventory (LCI) for quantifying the material, energy required during the synthesis. The evaluation is as per the international standards ISO 14040 and 14044.

Material and Methods: SimaPro 8.0.3.14 software and Ecoinvent v 3.1 database was used to calculate the overall life cycle impact using the ReCIPe Midpoint method.

Results and Discussion: For Hollow morphology, apart from power consumed in NP synthesis, isopropanol has greater impact in terms of climate change, terrestrial acidification and water depletion than glycol. Apart from electricity consumption, interestingly, glycol impact on ozone depletion, freshwater ecotoxicity was found to be more than isopropanol. For disc morphology, based on the contribution analysis, power consumed for the NP synthesis has higher role on all the indicators than the chemicals used. Further, it was observed that power consumed for hollow morphology has 1.7 times greater impact than disc on global warming potential (GWP).

In order to lower the environmental footprint, other alternative scenarios such as power from roof top solar panel was considered. Interestingly for Hollow morphology, the impact on most of the categories was mainly from isopropanol followed by glycol and power from solar panel. Between the two morphologies considered, disc was found to have least effect on the CO_2 emission followed Hollow (7 times more).

Conclusion: From the study, it can be inferred that power consumed for synthesis of NPs has greater impact on the indicators than the raw materials, which can be substantially reduced by opting for the renewable source of energy.

9. Inclusion of Fly ash and geo-synthetics in civil engineering projects: A paradigm shift

Author: Mr. Nakul Kumar Sardana[1]
[1]Green Pencil Engineering Solutions Pvt. Ltd.

ABSTRACT
The growing environmental concerns have continuously prompted humans to devise a more constructive and innovative approach to provide solutions to the impending threat which can be a result of consistent human negligence towards the environment. In sync to the alignment with environment-friendly services, over the years different constructive inputs were put in together by various stakeholders in different segments. One of the initiatives which helped the human to ameliorate the growing problem of residual from coal plants was the generation of fly ash which is widely used these days by constructors and builders

to form fly ash bricks and pavers. Apart from paying heed to the environmental concerns, fly ash also provides a strong foundation to different structures where it was used. At Green Pencil Engineering Solutions Pvt. Ltd., we are involved in manufacturing pavers and fly ash bricks which present a viable solution for completely eliminating the carbon emissions from India's large brick-making industry which burns huge amounts of coal and emit a million tonnes of CO2 each year. It also saves valuable topsoil from getting exploited as earlier it was rifely used as raw material for building clay bricks2.
In addition to the aforementioned approach, we also use Geo-synthetic material in our various projects promotes the practice of sustainability and aims at reducing the pressure on natural resources thus relying on geo-synthetics offers a lucrative sector for intervention as they are made up of polymeric materials used with soil, rock or other materials and have wide applicability for various civil-engineering work1.
The approaches discussed above are in sync with the sustainable practices which are inclusive of overall assessment of the technology which is being deployed and carried forward in the construction works. Such initiatives work towards making civil engineering projects more aligned to the concept of environmental conservation.

References:

1. Holtz, Robert. (2009). Geosynthetics for soil reinforcement. 10.1201/9780203875599.ch6.
2. Kayali Obada.(2005).High Performance bricks from fly ash. http://www.flyash.info/2005/5kay.pdf

10. Advance assessment of circular economy - coupling material circularity indicators and life cycle based-indicators

Authors: PRADIP P. KALBAR[1] , MONIA NIERO[2],

[1]Centre for Urban Science and Engineering (CUSE), Indian Institute of Technology Bombay, Powai, Mumbai 400 076, India.
[2]Aalborg University, Department of Planning, Sustainable Design and Transition, A.C. Meyers Vænge 15, 2450 Copenhagen - Denmark

ABSTRACT

In this study we propose an advance assessment of circular economy (CE) via coupling material circularity indicators and life cycle based-indicators. We base our demonstration of the method using a case study on packaging, i.e. a sector with high priority for circular economy (CE) implementation, by exploring a situation where a company intends to compare the circularity performances of different products in order to identify which is the best option from a CE perspective. We considered four different packaging alternatives for beer in different contexts in UK and India and calculated the following indicators to assess product-level circularity: i) the Material Reutilization Score (MRS), included in the Cradle to Cradle® certification program; ii) the Material Circularity Indicator (MCI) developed by the Ellen Mac Arthur Foundation and Granta and iii) the most relevant impact categories for beer product category, i.e. climate

change, abiotic resource depletion, acidification, particulate matter, water consumption. We applied the Multi-Criteria Decision Analysis (MCDA) methodology for an integration of these varies set of indicators and obtained an aggregate score representing performance of the product-system with respect to various aspects such as material intensity, recycling content and eco-efficiency. We argue that the alternatives ranked based on such approach will help in identifying the best packaging alternative from a CE perspective.

11. Life cycle assessment of Mahindra XUV 500 - A case study

Authors: Dr N Saravanan, Mr Rahul Lalwani, Dr Venugopal Shankar[1], Mr Ritesh Agrawal, Ms Hiranmayee Kanekar[2]

[1]Mahindra research Valley
[2]Thinkstep Sustainability Solutions Pvt Ltd., Mumbai

ABSTRACT

Introduction Life cycle assessment is widely used as a holistic environment assessment tool for sustainability assessment and deployment of product strategy in automotive sector. Mahindra and Mahindra aimed to quantify the life cycle environmental performance from cradle to grave perspective of its vehicle XUV 5OO model for identification of hot-spots in the value chain and also for setting product level environmental targets.

Materials and Methods A product bill of materials (BOM) was used as source of data for materials, primary data collection was carried out on inhouse manufacturing processes along with utilities and supply chain data. The use phase data was modeled based on test data provided by the companies' R&D unit while the ELV was modeled according to the standard recycling norms based on material composition of the vehicle. A maintenance phase based on the guidelines provided in user manual was also included. The LCA model was created using the GaBi DfX and GaBi professional Software for life cycle engineering, developed by Thinkstep AG.

Results: In the cradle to grave system boundary for the service life use of 300000 km of vehicle, use phase dominated the Acidification Potential (AP), Eutrophication Potential (EP), Global Warming Potential (GWP 100 years), Photochemical Ozone Creation Potential (POCP) and Primary energy demand (net cal. value) with values in the range of 67%-88% of the Vehicle's total impact. The cradle to gate impact was higher in the Abiotic depletion potential and Ozone Depletion potential. In rest impact categories the contribution were in the range of 12%-30%. End of life phase credit in various impact categories in the range of 3%-21%. The maintenance phase was dominated by tyres and Battery replacements.

Discussion: Tail pipe emissions and production emissions of fuel used in vehicle dominated the use phase. Raw materials such as metals, used in the vehicle body, contributed to the cradle to gate impact followed by power consumption in the production unit.

Conclusion: There is a potential to improve the environmental performance of this vehicle by exploring the various scenarios of light weighting for BIW, Chassis and selected components replacing mild steel by HSS and advanced HSS. Further gate to gate impact can be improved by reducing the energy consumption or changing to renewable options. Decreasing maintenance cycles by improving tyres and battery used in the vehicle will further help in reducing the impacts. Part which can be remanufactured should be identified and further design improvements are recommended to achieve easier remanufacturing.

12. Taking Climate Action by Setting a Science Based Target (SBT)

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ABSTRACT

Aim: Setting greenhouse gas emission reduction targets (SBT) in line with climate science is a great way to future-proof growth.

Abstract: Over the years, there has been increasing commitment from the Indian steel industries to address environmental issues. The prime objective of steel industry is to show and prove the environmental friendliness of the steel production processes and also demonstrate that the Indian Steel Industry is not only going beyond to statutory requirements but also position itself at par with the world class steel plants. So the aim is to document by facts and figures the actual status of the future environmental performance particularly focusing on energy consumption and GHG emissions.

In 2016-17, In order to understand and study the environmental impact assessment of company operations, Mahindra Sanyo Special Steel Pvt Ltd (MSSSPL) conducted Simulation ELCA computing for forecasting Environmental Impacts of 2021 with respect to wherein there are production targets and other reduction targets across the various environmental impacts like GHG, Energy, recyclability, waste, renewable materials, other environmental toxins etc. over the complete lifecycle of the products. Whereas in 2017-18 we made an attempt to understand and align company's greenhouse gas emission target in line with climate science, Mahindra Sanyo Special Steel Pvt Ltd (MSSSPL) has evaluated GHG emission reduction target for 2030 with the help Science Based Target evaluation methodology. Setting Science Based Target for entire value chain, wherein there are production targets and other reduction targets across the various environmental impacts like GHG, Energy, recyclability, waste, renewable materials, other environmental toxins etc. over the complete lifecycle of the products.

Mahindra Sanyo Special Steel Pvt Ltd, is the 1st Steel Company in world and 1st Indian company to have approved Science Based Target for its operation. In this study we studied overall reduction in GHG per ton over the period of through reduction targets for oil and electricity along with our renewable energy ambition. We adopted ISO 14046 guidelines for GHG foot-print analysis and Sectorial Decarburization Approach for entire target evaluation.

Conclusion: Based on the study did, “Indian steel manufacturer Mahindra Sanyo Special Steel commits to reducing Scope 1&2 emissions per tonne of steel produced 35% by 2030, against a 2016 base-year. Mahindra Sanyo also commits to reducing Scope 3 emissions per tonne of steel produced by 35% by 2030 against a 2016 base-year.

13. Environmental product declaration of average PPC and PSC cement

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ABSTRACT

Introduction: Cement industry plays a crucial role in the infrastructural development. It is highly energy and resource intensive process. Environmental Product Declaration (EPD) is a third party verified, internationally recognized and comprehensive disclosure of a product’s environmental impacts over its life cycle.

Aim and Objective: Publish EPD for 1 ton of average PPC and PSC cement across various grades from all 17 cement plants of ACC Limited. This will support to communicate transparent and comparable information of product’s environmental impacts, particularly to various Green Building Certification schemes.

Methods: For preparing an EPD, a set of specific rules and guidelines called as Product Category Rules (PCR) were identified, as EN 16908:2017 (sub-PCR Cement and Building Lime) and PCR 2012:01, Construction Products and Construction Services. Primary data was collected from all manufacturing plants over gate to gate boundary and GaBi 8 LCA software system, developed by Thinkstep AG was used to develop LCA model and use background databases to quantify the identified LCIAs as per PCR.

Results and Discussion: Global Warming Potential was 688.35 kg CO_2-Eq (87.5% from clinker); Ozone Depletion Potential was 6.02×10^{-10} kg CFC11-Eq (43.2% from cement grinding); Acidification Potential was 2.15 kg SO_2-Eq (76.8% from clinker); Eutrophication Potential was 0.29 kg Phosphate-Eq, (88.1% from clinker); Photochemical Oxidant Creation Potential was 0.13 kg Ethene-Eq (89.4% from clinker); Abiotic Resource Depletion Potential was 7.38×10^{-04} kg Sb-Eq (99.5% from cement grinding); Primary energy demand was 3986.44 MJ (70.6% from clinker). The net use of fresh water was 0.665 m^3. Other life cycle inventories were also quantified as per the PCR. The emissions from clinker production were largely process emissions and captive power plant emissions using coal and petcoke as fuel.

Conclusion: The published EPD will be used for communicating to the Green Building schemes and working on the hotspots for improvement opportunities.

14. LCA study of wood based regenerated cellulosic fibres

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ABSTRACT

Introduction Clothing is one of the basic necessities of mankind and fibre is the backbone of clothing. Cellulosic fibres such as cotton, viscose and synthetic fibres like polyester, viscose, acrylic, nylon are major fibres that are used for manufacturing textiles globally.

With increasing population, the demand for textile fibres will also magnify. Naturally the food demand will be on the rise, thereby the need for increased productivity and optimisation of arable land use will be inevitable. In this scenario, wood based regenerated cellulosic fibres like viscose, modal and lyocell will play a significant role in sustainable production and consumption over the complete life cycle.

Purpose To build a well-documented Life Cycle Inventory (LCI) and provide cradle-to-gate Life Cycle Impact Assessment (LCIA) of 1 ton of viscose fibre as per ISO Standards 14040/44. The reason was to identify environmental hotspots over the complete value chain of the fibre across various product grades and plants.

Methods Primary LCI data were collected from all the 7 manufacturing plants across India, Indonesia, China & Thailand. GaBi software and thinkstep databases were used to quantify the significant LCIAs.

Results and discussion LCIAs were quantified as per the purpose of the study. The processes significantly contributing were electricity and steam generation, caustic production and auxiliary chemicals production. Various scenarios were identified, internal benchmarking across the manufacturing plants was carried out and analysed for improvements.

Conclusions The study established the baseline across all product grades and plant locations of '1 ton of viscose fibre'. Awareness and capability building was held across various levels and functions. Improvement opportunities were identified and short/medium term roadmap was developed to implement on the recommendations. The study was a starting point for setting up the life cycle management framework the organisation.

15. A new LCI database for India

Authors: ANDREAS CIROTH[1], SALWA SYED BURHAN[1], JONAS BUNSEN[1]

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ABSTRACT

India is among the fastest growing large economies in the world. Over the past decades, the country has been facing environmental challenges of colossal proportions. Life Cycle Assessment (LCA) is one of the recognised tools designed to help understand the impact of these environmental challenges and consequently, alleviate them. However, for any sound LCA case study, reliable, fit-for purpose data is imperative. While available data for LCA has generally increased a lot in recent years worldwide, for specific regions, like India, data is still scarce.

This recognised need led to the development of a new LCI database for India. This new database is specifically designed to be fit-for-purpose, as defined by the UN Environment GLAD initiative. It combines specifically collected data and data obtained from GreenDelta's LCA Data Machine. For the collection, direct collection on sites, web crawling and web data access, and indirect information retrieval techniques are used. This allows rapid massive data collection which is combined with traditional data collection. Overall, therefore, the database is rather an extension and expansion than a disruption of the traditional way of creating databases in LCA. Result is a fully unit process based, flexible and transparent database, which is capable of reflecting different application settings and user requirements, and at the same time can be updated quickly.

In the presentation, we will explain the approach for creating the database, show several examples for datasets from the database, discuss differences of this database compared to other existing databases, and show a full case study application, also compared to other case studies.

16. An LCA-Based Case for Integrated Formal and Informal Recycling Systems

Authors: Banyan Nation

ABSTRACT

Introduction The recycling trade in India is dominated by the informal sector which lacks scientific rigor, traceability, and environmental accountability. While the informal sector is highly energy and resource efficient in collecting and recovering plastic waste, a lifecycle assessment can help establish that informal sector processing and recycling of waste plastic is significantly less resource efficient and significantly more polluting than formal recycling system, effectively negating the benefits of non-mechanized, energy efficient and inexpensive recovery.

Discussion The negative impact of such informal recycling systems stems from a) improper disposal of waste water, and release of emissions into the atmosphere; b) sub-optimal and energy inefficient cleaning and processing technologies; and c) down-cycling of the recovered and processed waste plastic which significantly reduces its usable life

Conclusion It is our hypothesis that in a country like India where informal recovery systems are strong, an integrated, formal recycling value chain that harnesses the collection and recovery efficiencies of the informal sector, and combines it with hi-tech processing capabilities of a formal recycling infrastructure, is the most resource efficient system for large scale recycling in the country. Such integration can be achieved by highlighting the strength of both formal and informal systems in the following ways: • Sourcing and Collection: Harness the collection efficiencies of the informal system through a datadriven approach and hub-and-spoke type models that allow it to recover large volumes of materials, ensuring minimal environmental impact of waste collection. • Segregation: Train and empower the informal sector which manually segregates waste, achieving approximately 80% percent efficiency – only the last 20% of segregation is done using mechanized sorting. • Processing: Invest in energy and water efficient washing lines, and extrusion technologies that are not only 6 times more energy efficient than the ones used by informal sector, but also are emissions free. • Virgin resource substitution: Formal recyclers produce high-quality material at consistent volumes and prices as required by mainstream brands and manufacturers and are more likely to substitute virgin polymer use at a large scale.

17. Life Cycle Assessment of Mobile Phones

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ABSTRACT

The mobile phone plays a very significant role in our daily life. New and upgraded versions of mobile phones fascinate the young generation and encourage them to replace their old sets with the more advanced versions. Exponential growth in the production of mobile phones has resulted in the generation of huge amount of e-wastes in the world which contribute to an increase in pollution and adverse health effects. Mobile phones contain plastics, glass, metals and resins. All these can be recycled and a zero waste policy can be implemented. The present study is concerned with the life cycle assessment of mobile phones in which all parts of mobile phones can be separated and recycled and metals present in its various parts can be recovered. This will prevent pollution of the environment and reduce the costs of obtaining metals by conventional mining processes. Our results show that an average mobile phone contains 40% plastic, 20% glass, 32% non-ferrous metals, 3% ferrous metals and 5% other. Precious metals like gold, silver are also present in small amounts as 0.034 g and 0.35 g, respectively. Mobile phones also contain toxic elements like

mercury, lead, cadmium, and bromine. Collection of mobile phones from across the country and proper handling, recycling and extraction can produce large amount of metals which can minimize use of conventional mining processes thereby safeguarding the natural resources. Life cycle assessment can help to evaluate the pros and cons of the recycling processes and to attain the goal of zero waste.

Keywords: Mobile Phones; Recycling; Extraction; Life Cycle Assessment

18. Comparative Life Cycle Assessment of Textile Products made of Cotton, Cellulose and Organic Cotton Fibre – Case study from India

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ABSTRACT

With growth in national income and rise in a consumption driven culture, lifestyle products have seen an increased demand. In context of climate change and pressure on resources, it becomes paramount to adopt sustainable practices in all walks of life including textiles. A Comparative Life Cycle Assessment (LCA) of textile products made of various fibres-cotton, organic cotton, tencel and modal was performed in order to compare the environmental effects through parameters such as water usage and global warming potential. This will help in making clothing more sustainable.

Water usage for various products were calculated in terms of litre per kg of product lifecycle. LCA considers both direct and indirect water use. Direct water use refers to water used directly in the production of a crop such as irrigation water, cooling and processing water, water to dye and finish textile products, and water used in the washing machine. Indirect water use can come from several sources, but a major source is the water associated with power generation and production of various chemicals and solvents. Similarly, the carbon footprint is due to various reasons. At fibre production stage, there are emissions from field, production of fertilizers and electricity and fuel required in irrigation. Using fibres and energy sources having lesser environmental footprint can be extremely helpful.

It is found that if we replace the fibre of 10,000 units of each of the above textile products in the country annually, we may be able to save 52,500 cubic metres of water which will meet the annual drinking water requirements of 70,000 people. Similarly, it also saves 33,100 kg of carbon emissions which is equivalent to 1100 round trips between IIT Kharagpur campus to Kolkata airport. Thus, change in fibres and use of renewable energy can significantly products contribute towards making the lifestyle products sustainable and our choices more eco-friendly.

19. Life Cycle Sustainability Assessment of Decentralized Wastewater Treatment Plants in India

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ABSTRACT

Introduction This study employed life cycle assessment (LCA) to evaluate the environmental impacts associated with the six most commonly used wastewater treatment technologies in India, namely; Sequencing batch reactor, Membrane bioreactor, Moving bed biofilm reactor, Soil biotechnology, Aerated lagoons and Activated sludge process. Additionally, two scenarios were compared: scenario 1 (direct discharge of treated effluent, i.e., no reuse) and scenario 2 (effluent reuse and tap water replacement).

Materials and methods The goal of this study was to evaluate the environmental impacts of the operation phase of wastewater treatment plants (WWTPs). The functional unit was defined as 1 m3 of treated wastewater. The scope of the study considered operation and maintenance phase, sludge treatment and landfilling, and the transportation of sludge to landfill. The inputs considered were influent, electricity, chemicals, and the fuel utilized. The outputs were effluent, gaseous emission, and disposed sludge. CML Baseline 2000 method was used for assessing life cycle impacts considering eleven potential impact categories.

Results and discussion Emissions associated with electricity production for operating the WWTPs, emissions into water bodies from the treated effluent and hazardous heavy metals emissions into effluent and waste sludge have been identified as the main contributors to the overall environmental impact. Soil biotechnology system obtained the lowest environmental impact in all the evaluated impact categories, except for eutrophication potential. While, the Aerated lagoon presented the worst results due to the high electricity and chemicals consumption. The results also showed that, significant economic and environmental benefits can be obtained in scenario 2 by replacing the freshwater demand for non-potable uses. CONCLUSION: A comprehensive LCA have been documented in the present study which can help decision makers to take well informed decisions simultaneously addressing sustainability.

20. Insights in the application of food waste as feedstock for anaerobic digestion - combating climate change using life cycle thinking and circular economy

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ABSTRACT

Globally the disposal of food waste is a soaring challenge due to environmental and economic constraints. Recovery of energy, fuel, and nutrients from food waste using a set of technologies like anaerobic digestion (AD) are being explored to divert the waste reaching landfill. The objective of this study is to comprehend the policy developments on climate change, energy recovery, and application of life cycle analysis (LCA) in development of recommendations for utilizing food waste as a feedstock for the AD in the Indian scenario. As a part of this study, we reviewed three case studies on the application of LCA in the AD of food waste. Sharma and Chandal performed LCA for waste management strategies for Mumbai and reported that combination of recycling, AD and landfill has the least global warming (930.01 kg CO2 eq t-1). In the UK context, substitution of AD feedstocks with food waste resulted in avoided GHGeq emissions of 163.33 CO2-eq. The landfill diversion of food waste based on the circular economy policies demonstrated a substantial reduction in GHG emissions (-2151.04 kg CO2 eq per MWh relative to UK Grid). Based on a study by Pace and co-authors (2018), the composition of the food waste plays a pivotal role in the performance of the AD and global warming potential. Based on the review, the AD is a promising technology to divert food waste from reaching the landfill. However, implementation of AD technologies needs critical thinking on the characteristics of food waste, pretreatment process (biogas yield) and post-treatment process (quality of the biogas). The learning's from this study will provide insights for policymakers, researchers, and entrepreneurs to design systems for utilizing food waste as a feed source for the AD and develop strategies for energy recovery with a focus on reducing the greenhouse gases.

Keywords: Anaerobic digestion; Food waste; Life cycle assessment; Circular Economy; Global warming potential

References:

1. Pace, Sara A., Ramin Yazdani, Alissa Kendall, Christopher W. Simmons, and Jean S. VanderGheynst. 2018. "Impact of Organic Waste Composition on Life Cycle Energy Production, Global Warming and Water Use for

Treatment by Anaerobic Digestion Followed by Composting." Resources, Conservation and Recycling, 137:126–135.

2. Sharma, Bhupendra K. and Munish K. Chandel. 2017. "Life Cycle Assessment of Potential Municipal Solid Waste Management Strategies for Mumbai, India." Waste Management & Research. 35:79–91 3. Pérez-Camacho, María Natividad, Robin Curry, and Thomas Cromie. 2017. "Life Cycle Environmental Impacts of Substituting Food Wastes for Traditional Anaerobic Digestion Feedstocks." Waste Management, 73:140–155

21. LIFE CYCLE STUDY ON STEEL-CONCRETE COMPOSITE CONSTRUCTION

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ABSTRACT

Since India is transforming from a developing country to a developed one there has been an upsurge in the construction activities in India from last few years and is expected to continue for some more years to come. Hence, at this point of development the submitted proposals for a project need scientific evaluation considering all the pros and cons related to strength, durability, longevity, disaster resistance etc. so that selection of technology justifies its specific purpose. Recent statistical studies show that Indian subcontinent and the Far East are becoming more vulnerable to the natural hazards of late. Hence, proper selection of technology will help building our nation with more sustainable and durable construction and the structures could withstand the natural calamities in future. The popular method of such selection followed abroad is Life Cycle Cost Analysis (LCCA), which indicates the present worth of a construction considering the actual initial cost added with the possible future costs discounted to the base year of the study period of LCCA. From the value of the LCC the function of the construction with respect to its durability against all possible natural calamities over the period of its performance i.e. the Life Expectancy of such structure, could be well assessed. If the bidders submit the Life Cycle Cost Analysis of the structure they are going to construct, along with their quotations indicating direct construction costs, the comparison of different proposals would be easier considering present budget constraints and arrangement of funds for future possible expenses. LCCA may indicate lesser LCC even when the direct construction cost is more. This may occur due to use of advanced fast track technology or better material, which may reduce the costs for repairs and maintenance and also may enhance the residual value of the structure at the end of the study period. If fast track technology like Steel-Concrete composite methodology is adopted, due to the lesser construction period, the saving in interest burden on borrowed capital and early generation of revenue also reduces the Net Construction Cost, which reduces the LCC also.

With its mission to popularize the unique material properties of steel in India, INSDAG has carried out a study of LCC on a (B+G+20) storeyed residential building with both RCC and steel-concrete composite options. The

study extends further to compare seven (7) options – one with conventional RCC with brick walls and the six (6) others with steel-concrete Composite options having variations in storey height and type of cladding material including conventional bricks and lighter cladding materials. Though Steel construction is costlier than RCC structure, the outcome of the study shows that SteelConcrete composite construction could give encouraging results even in direct construction cost and definitely in LCC.

Some examples on buildings have been worked out considering Direct Construction Costs of different proposals. For item rates of repair and maintenance and weightage thereof IS 13174 – Part 1 & 2 (Annex C & D) and DSR 2007 with Cost Index as applicable have been referred. For assessment of LCC Table 10 of IS 13174 (Part 2): 1994 has been followed. Reference has also been made to various aspects as stipulated in the US Code ASTM E 917.

Keywords

Direct Construction Cost, Discount Rate, Future Cost, Initial cost, Life Cycle Cost (LCC), Life Cycle Cost Analysis (LCCA), Rental charges, Repair of Maintenance costs, Replacement Value, Residual Value, Super built-up Area, Study period

22. Life Cycle Assessment of Monolithic Concrete Construction Technology (MIVAN)

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ABSTRACT

The conventional mode of construction for residential houses in India comprises of reinforced concrete (RC) framed structure construction with infill masonry walls. Now a day, on the background of increase in mass housing construction and in the view of rapid rate of construction most of the residential projects are using MIVAN technology. As the technology is relatively new in construction field, it needs to be explored w.r.t its advantages and disadvantages. Few advantages like fabrication accuracy speed of construction, light weight formwork etc. is known but we cannot ignore the fact that MIVAN technology uses a huge amount of concrete. Main aim of this study is to assess whether Mivan Technology is environmentally sustainable or not when compared with RC framed structure with fly ash brick infill masonry. The technology that proves to be better can be encouraged by the Architects and builders for sustainable construction. To achieve this Life Cycle Assessment methodology is used. An ongoing residential project in Pune city is considered for the study purpose. Both the technologies: RC framed structure with fly ash brick infill masonry and MIVAN are considered for this same project. Life Cycle Assessment (LCA) of these technologies is carried out from procuring the material from dealer to end of life of the building. The study covers various factors for comparison like material usage, air emissions during construction, U-values of walls, embodied energy etc. The scope of the study is limited to walling material. The results showed that throughout construction to

demolition phase the emissions caused in concrete wall construction is far more than constructing fly ash brick wall. In conclusion, the study recognizes that though MIVAN technology has several advantages but it also has higher long term environmental impacts compared to conventional RC framed structure with fly ash brick infill masonry technology.

Keywords: MIVAN technology, Life Cycle Assessment, Fly ash bricks, Sustainable technology.

23. A market-based approach for interpreting, bench-marking and comparisons of LCA- and EPD -information

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ABSTRACT

Introduction The lack of trustworthy approaches to interpret, bench-mark and compare information from Life Cycle Assessments (LCA) and Environmental Product Declarations (EPD) has resulted in less use of LCA-data for different market applications than expected. The EU Commission has therefore taken an initiative with an overall goal to find ways for bench-marking LCA- and EPD-information, called Product Environmental Footprints (PEF).1

Availability of EPD-information is increasing and databases within programme operators such as the International EPD System2 allow robust statistical analyses for giving a reliable market-based bench-mark.

Materials and Methods The statistical analyses in this study are making use of data for two different product categories - from 54 EPDs on insulation materials and 49 EPDs on bakery products to show the market-distribution of the environmental performance.

Results The results show that distributions, mid- and end-points of environmental performances differ significantly for the product categories and studied indicators. The distribution curves of insulation materials are not normal distributed and the results for bakery products are closer to a normal distribution curve, but differ for the studied indicators.

Discussion The market-distribution of the environmental performance is important for the development of a trust-worthy benchmark. Market-based data is required for each product category, since distributions seem to differ within product categories and indicators. The findings of this study indicate the need for further development for defining a reliable bench-mark.

Conclusion A common approach, i.e. using mid-point or average values for the development of benchmarks, might not be accurate for the definition of an indicator to interpret and bench-mark separate LCA- or EPD-information with regard to its position in relation to the real market distribution.

References

1European Commission (2013) Commission Recommendation of 9 April 2013 on the use of common methods to measure and communicate the life cycle environmental performance of products and organisations (2013/179/ EU). Official Journal of the European Union, Volume 56, 4 May 2013

2 EPD (2018) The International EPD System website. http://www.environdec.com/ [Accessed 2018-06-26]

24. Can life cycle knowledge increase potential of used oil? Case study of aviation oil

Authors: Wg Cdr Asheesh Shrivastava[1], Dr Prasoom Dwivedi, Dr Saurabh Tiwari[2]

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ABSTRACT

Background As Indian economy grows in size and strength it's dependency on imported crude increases proportionally. Amongst the crude distillate, lubricating oil is the priciest. Indian refineries processed about 243.5 MMT of crude to produce 1.03 MMT of lubes against a domestic demand of 3.5 MMT during 2016-17 (PP&AC, MoPNG, 2018). The shortfalls were made good by importing finished lubricants.

Unlike fuel, lubricants are not consumed, only their properties degrade. Waste oil (WO) can be recycled as base-stock to produce new product or used as fuel in cement/ brick kilns. Whereas, unsolicited disposal of WO degrades environment, contaminates ground water, pollutes soil, destroys vegetation, threatens ornithology and marine. LCA studies to evaluate the environmental impact of WO and provide justification for its reuse/ recycling have been conducted by many countries (Department of Resource recycling and Recovery, 2013). Today, reclamation of used oil is a globally accepted practice for conserving dwindling stocks of crude and reducing environmental impact. Germany leads in WO collection and recycling.

Study As India consumes large amount of lubricant, it obviously generates an equally large amount of WO, indicating vast potentials for reclamation industry. Inputs from LCA studies also indicates large ecotoxic footprint of WO due to unsolicited disposal. A pioneering study to map the type and quantity of WO generated by the defence aviation sector, assess its environmental impact and identify its reclamation potential was conducted. The study also developed a Reverse Supply Chain (RSC) network for maximising collection and minimising disposal. The network was optimised using Analytic Hierarchy Process (AHP). The study sums up by recommending certain changes in policies at organisation/ government level, methods for

increasing awareness amongst technician/ logistician, improving transportation and developments in technologies for reducing environmental impact. The suggested model can be adapted by other oil consuming industries/ sector for reducing their carbon footprint and increasing revenue.

References

Department of Resource recycling and Recovery. (2013). Critical Review of Used Oil Life Cycle Assessment Study. California, USA: Life Cycle Associates. PP&AC, MoPNG. (2018). Ready Reckoner, Snapshot of India's Oil & Gas Data, April 2018. N Delhi: MoPNG

25. Harnessing the power of LCT for addressing Sustainability Challenges

Authors: Sunetra Kulkarni-Kavimandan[1]

[1] ISO-QMS, Public Administration

ABSTRACT

In ancient India an intellectual level of the great people whom we call Rishi's had a tremendous capability. Even, persons who were kings, rulers, emperor's - had huge capacity but as generations progressed the capacity has drastically decreased intellectually, physically, strength wise also. Considering this reduction in capability on all fronts to have best of the kingdom lord Krishna selected a group of persons and he appointed them as kings so it is the first time in the world, universe the experiment of collective leadership took place. This is the only example of collective leadership wherein Dharma raj, Bhima, Arjun, Sahadev, Nakul - experts in their respective skills, had qualities. For running a good kingdom or a good empire which will set a benchmark for all best things such expertise was required. Lord Krishna made them to rule the country, the kingdom. This remarkable example of collective leadership continued for 3,044 years, it has sustained. Persons- Dharma raja Yudhishthira and all were not there but the system was there and today everyone talks about systems like ISO or any system. A person-oriented thing will not last long but a system-oriented system will have sustainability. In today's scenario there is a gap; one side there are MNC'S on other MSME's. In fact, MSME'S are resources of prime sector of economy which build the nation. If they are strong g the economy will be strong, if economy is strong nation will be strong. MSME's are not strong on all fronts, facing limitations of various resources, manpower, intellect, finance, whereas MNC's have everything in abundance. So how this gap can be bridged? If various MSME's will come together and they form a group/ cluster in short, they make a synergy then they can beat MNC's also and become stronger. In modern management we say this is an age of synergy. Collective leadership and synergy both are same but contexts are different. Even today, in our democracy we are following collective leadership not autocratic, wherein government is run by number of MP's, Secretary's, bureaucrats- a large group of intellectuals but in modern language known as a synergy of resources, of expertise When this is done it can lead towards sustainability. Life Cycle Knowledge is a complex in nature. If we attributed to an individual, living human life cycle it will lead us in wrong direction. Where we have to consider the life cycle of principles, system, policy, life cycle of mechanism of

implementation and from that perspective a synergy of expertise, brain put in mechanism which has got almost endless lifecycle. Because in that synergy one thing fails something else takes place system doesn't stop. Second thing when system is running the expertise behind takes care of the upgradation, keeping pace with the technology, market, demand and trend. So, life cycle is explored in real sense in this method. There has to be an innovative mind and risk-taking mindset and this method will be a master-key for success of the smart cities.

26. Emission reduction in the food and beverage industry - an indicative lifecycle science based approach

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ABSTRACT

Introduction Most food and beverage (F&B) companies seem to have articulated their visions around climate mitigation and transitioned to low carbon practices in the last two decades. However, science based targets intended to limit global temperatures to below 2ºC, requires them to re-look into their product life cycle to discover levers for emission reduction. This paper explores growing emissions and suggests accounting and mitigation strategies for a science based target.

Methods The Science Based target methodology requires projections of emission that impinge upon Scope 1 and 2, as well as Scope 3 emissions. Life cycle emissions in agricultural ingredient sourcing, manufacturing, packaging and recycling, energy intensive cooling equipment operation, distribution etc., needs evaluation in the light of emission growth and reduction scenarios. Literature review of life cycle approaches and projected emissions growth trajectories show trends of emission growth and reduction opportunities in the value chain. This harbingers innovations in technology and business models that necessitate stakeholders to come together to usher in a low carbon transformation.

Results and Discussion Industries need to redefine their goals towards achievable emissions reductions. From upscaling renewables to packaging innovations for enhanced recycle and reuse to sustainable agriculture practices– there could be a myriad ways to bring about a realistic decrease in emissions. The nexus of water and energy, waste and energy, decarbonization and growth seem to impinge upon life cycle stages and provides the trigger for setting targets. Intensity reduction strategy should also keep in consideration financial, economic and locational/regulatory constraints.

Conclusion With ever ubiquitous use of digital technologies, larger and more definitive emission reductions can be delivered through careful planning and organization within the supply chain. Examples of interventions in various life cycle stages would provide fillip to the sector for setting science based targets, which is the need of the hour.

27. Application of an LCA Integrated GTAP Model to Evaluate Sustainable Returns of Utilizing Biomethane as Transport Fuel for Passenger Cars in India.

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ABSTRACT

The automotive industry is considered as an important pillar of Indian economy. Market trends strongly indicate that annual sales of passenger cars in India will be close to 10 million units by 2030. While revenues derived from the sale of passenger cars continue to grow and strengthen. India's economic muscle, efforts should be made to minimize its environmental implications. India is currently dealing with three key sustainability challenges. Importing crude oil at monumental rates is deeply widening India's trade deficit. The Green House Gas (GHG) emissions attributed to transportation sector is surging and air quality is deteriorating day by day in cities. To address these concerns, India is ambitiously planning to launch Battery Electric Vehicles (BEVs) on a large scale.

But the electricity generation is the highly coal-dependent and environmental cleanliness of BEVs in India is highly skeptical. At this juncture, cheaper and more renewable fuel sources such as biomethane derived from anaerobic digestion of food waste can be considered as an alternative.

A Life Cycle Assessment (LCA) study is conducted to assess the environmental benefits of using biomethane as a transport fuel in passenger cars. The results of the study are integrated with Global Trade Analysis Project (GTAP), a global computable general equilibrium model to quantify the economic benefits of utilizing biomethane as a fuel for passenger cars and to capture the macro inter-sectoral linkages and interactions in the economy. The fact that around 67 million tons of food go waste in India every year makes the production of biomethane from food waste a potentially cheaper and renewable fuel option. This study reports sustainable returns of utilizing biomethane as a transport fuel for passenger cars in India. It provides valuable insights to policymakers and automotive Original Equipment Manufacturers

(OEMs) on: (a) economic gains derived by curtailing crude oil imports when biomethane is used as transport fuel; and (b) reduction of environmental externality costs resulting from proper management of organic food waste which otherwise is a major problem in many Indian cities. The model also presents strategies to overcome financial barriers associated with the development of biomethane based transportation infrastructure in the country. This study is unique as it broadly captures utilization of waste to an economically valued output which is an important attribute of the circular economy.

Keywords: Automotive, Sustainability, Life Cycle Assessment, GTAP, Circular economy

28. Business value: harnessing the power of life cycle knowledge in a circular economy

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ABSTRACT

Purpose & Scope The aim of this paper is to raise awareness on the critical role of life cycle knowledge in achieving business value within a circular economy. It points out the comparisons between the linear economy and a circular economy, it identifies tools for successful product life cycle innovation and demonstrates the holistic importance of life cycle knowledge and application in addressing sustainability challenges for business, society and the environment.

Introduction A linear economy of take, make, use and dispose is simply not sustainable. The world is in trouble with this linear thinking. It's a problem because natural systems are both the source of raw materials and the sink for our wastes. Life cycle management supports sustainable production during the entire product life cycle in a circular economy and at its core, entails innovation and creativity.

Materials and Methods Global business and societal case studies were used.

Results The fastest growing organisations are those who are working closely with the principles of the circular economy through product life cycle management. They are the ones who share, regenerate, conserve, innovate and the ones who are putting a stop to wastage, energy loss and environmental degradation – Phillips Healthcare Case Study.

Discussion The circular economy is inspired by natural living systems. How can we amalgamate this idea into our man-made systems? This is the crucial role that life cycle knowledge and management plays in the circular economy – if products could be designed in such a way that they could be reused and disassembled at the end of life, we could retain the high value of the products and its materials.

Conclusion Product life cycle management is more than just about one organisation changing one product. It's about the coming together of different stakeholders to design effective flows of material and

information increasingly powered by renewable energy. Creating economic, societal and environmental benefits

29. Management of Crop residue , in conservation agriculture for enhancing soil health and microbial diversity

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ABSTRACT

Agriculture is an important sector of national economy. A large amount of agricultural / crop residue generated is not properly managed leading to economic losses and environmental damage. In order to overcome these short comings many approaches are being adopted. A recent approach is to use this crop residue for the surface retention in an alternative agricultural system which is known as Conservation Agriculture (CA). This system involves minimum soil disturbance thereby conserving the energy and retention of the previous crop residues on the soil surface. Crop residues retained on the surface exerts multiple direct and indirect benefits. The most obvious being conservation of the soil moisture, homeostasis of soil temperature, improving the soil organic carbon content and input of the nutrients back into the ecosystem. In an eight year study, undertaken in the western Indogangetic plains. It was found that microbial population and diversity, and productivity of soil could be maintained or improved with CA involving zero tillage and crop residue recycling

30. Enhancing the performance of the human resource through effective training methods: the Srilankan scenario

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ABSTRACT

Being a developing country Sri Lanka is in serious need of a performance culture of excellence in every organization as her socio-economic development heavily depends on success and performance of organizations. Today every organization's top priority is to manage the human resources. Sri Lanka's public expenditure on education has remained at between 2-3 percent of GDP during the past decade and a half, compared to a 3.5 percent average in the rest of South Asia. Two objectives could be drawn as to discuss about the effective training to improve employee knowledge and the skills for their better

performance and to analyze the effect of the Training on the employees Performance in Sri Lanka. This study was done using the secondary data of relevant review of different studies, reports, periodicals, books and web sources.

Referred secondary data were reviled that training ultimately upgrade not only the efficiency of employees but also of the organization. It has rightly been said, employee development is the key to organizational sustainable development and effective training is help to Improve high quality, high productivity and safety environment of the Human resources. As well as this study revealed that effective training has a positive impact on human resource performance and it is help to improve employee's knowledge and the skills for their better performance.

References

1. (n.d.). Retrieved December 01, 2016, from siteresources.worldbank.org/SOUTHASIAEXT/Resources/.../slknowledgechapter5.
2. ADB. (2006). Retrieved December 2016, from worldbank.org/SOUTHASIAEXT/Resources/.../.
3. D, H. (2014). Retrieved December 06, 2016, from https://openknowledge.worldbank.org/.../882690PUB0978100Box385205B00PUBLI.
4. Gamage & Imbulana. (2013). Retrieved December 03, 2016, from www.ischolar.in/index.php/ijmfsmr.
5. Hail D et al. (2014). Retrieved December 06, 2016, from https://openknowledge.worldbank.org/.../882690PUB0978100Box385205B00PUBLI.
6. Halil. (2014). Retrieved December 05, 2016, from https://openknowledge.worldbank.org/.../882690PUB0978100Box385205B00PUBLI.
7. Henarathgoda & Dhammika. (2016). Retrieved December 06, 2016, from https://www.researchgate.net/.../303723117.
8. Muhammad, M. (2013). Retrieved December 06, 2016, from https://www.researchgate.net/.../260219097_THE_IMPACT_OF_EMPLOYEE_TRAI.
9. Ongori et al. (2011). Retrieved December 06, 2016, from scienceandnature.org/IJEMS-Vol2(4)Oct2011/IJEMS_V2(4)3.
10. Ongori, H. (2011). Retrieved December 03, 2016, from scienceandnature.org/IJEMS-Vol2(4)Oct2011/IJEMS_V2(4)3.
11. Ongori, H. (2011). scienceandnature.org/IJEMS-Vol2(4)-Oct2011/IJEMS_V2(4)3. Retrieved December 03, 2016
12. Ongori, H. (n.d.). scienceandnature.org/IJEMS-Vol2(4)-Oct2011/IJEMS_V2(4)3.pdf. Retrieved December 03, 2016
13. Ongori, H. (n.d.). Training and Development. Retrieved December 2016, from scienceandnature.org/IJEMS-Vol2(4)-Oct2011/IJEMS_V2(4)3.pdf.
14. Organization, T. a. (2011). scienceandnature.org/IJEMS-Vol2(4)-Oct2011/IJEMS_V2(4)3. Retrieved December 03, 2016
15. Rao, D. N. (2016). Training methods. Hyderabad: nimsme.
16. Sharma, U. (2016). Training and Development. New Delhi: jnanada Prakashan (P & D).

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About the Organizer-FICCI

FICCI, a not- for profit body is the country's apex chambers of commerce and industry and works very closely with the Indian Government, public and private sector on policy and capacity building initiatives. It plays a leading role in policy debates that are at the forefront of social, economic and political change. FICCI was established in 1927 and incorporated in its present form in 1956. FICCI regularly takes up research work to identify and analyze national/international best practice trends, draw implications relevant to our national context, and disseminate them widely.

FICCI Quality Forum (FQF) is a specialized division of FICCI working in the areas of Quality and Environment Management, Climate Change and Sustainable Production/Consumption and providing training, consultancy and research services for adoption of quality management systems to enhance quality quotient of clients and partners. To facilitate Indian industry, keep abreast of latest developments in its domain, FQF constantly strives to organize Scientific Symposiums and Business Seminars on topics of contemporary relevance. FQF has taken the initiative to create a platform for national and international experts, practitioners, researchers, and academicians working on Life Cycle Management topics and build a focal point for LCA/M knowledge and expertise in the country. As part of FQF's strategic partnership with UNEP-SETAC Life Cycle initiative, FQF works on projects to mainstream Life Cycle Thinking and Sustainable Consumption Production (SCP) in Indian subcontinent.

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