Tata Centre
Technology and Design, IIT Bombay

TURNING POINT

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Waste Management

From policy to practice

A workshop supported by Tata Centre brought policy makers, practitioners, CSR agencies and academicians under one roof to talk about menstrual hygiene management.

Discussing the challenges in menstrual hygiene management

The first workshop, 'Menstrual Waste: Disposal and Management' under the Policy to Practice Series was organized by TCTD, CPS (Centre for Policy Studies), CTARA (Centre for Technology and Rural Alternatives) and DPE-IITB CSR Study Unit in April, at IIT Bombay. The highlight of the session was the screening of the Oscar winning documentary film 'Period. End of Sentence'. Panel discussions were very interactive bringing on alternatives for sanitary napkins along with disposal and treatment of the current sanitary waste, such as the use of eco-friendly incinerators. The discussion on the policy scenario highlighted the gap between the BAT (Best Available Technology) and MAT (Most Available Technology), the need for scalable solutions and fund raising through private sector partnerships.

Interacting with speakers and panellists

Through the day-long workshop, Smt. Gouri Chaudhury and Ms. Ajeya Deep from Action India talked about their project on menstrual hygiene, in the Hapur village of Uttar Pradesh. An important point which came up at the end of every discussion was to take on the challenge of building awareness about menstrual hygiene management.

The next workshop in the Policy in Practice series is on the theme of Municipal Solid Waste Management: Scalable best practices and policy gaps, and is expected to take place on 7th May, at IIT Bombay.

Vrushali Gardare,
Tata Fellow

Water

Addressing water crisis through desalination

The humidification-dehumidification desalination system aims for a decentralised, low-cost solution with maintenance-free operation for remote areas.

Water scarcity has been on the rise for the past few years due to depleting water resources. Desalinating sea water seems to be a feasible option as more than 95 per cent of the total available water is salty. Prof. Shankar Krishnan, Dept of Mechanical Engineering, got his interest in water-based problems to work on the humidification dehumidification (HDH) desalination system. His project team is currently working on developing a small-scale decentralised HDH system which can cater to remote locations where no frequent maintenance is required like in membrane-based process such as Reverse Osmosis (RO).

The technology works like the natural water cycle where sun rays cause the water to evaporate and condense to form clouds in another zone. In HDH, all these processes are carried out in separate units; humidifier, dehumidifier and heater. The team is currently working on combining the humidifier and heater into one unit so as to reduce the cost and area of the system. The capital investment in HDH is similar to that of a water heater and unlike RO where frequent cleaning of membrane is required, HDH requires maintenance only once in four years, making it more robust. The technology works on low-grade energy but due to this low temperature differences are encountered and heat recovery becomes difficult which leads to lower efficiencies. Desalination system efficiency is measured in terms of GOR (Gained Output Ratio) which is given as

$$GOR = \frac{\text{Distilled water produced} \times \text{Latent Heat}}{\text{Imported Thermal Energy}}$$

GOR for conventional thermal desalination processes multi-effect distillation (MED) and multi-stage flash ranges from 7 to 12. Currently with heat recovery, the GOR obtained is 2 while the theoretical value based on water heated HDH cycle without extraction/injection is 2.5. Thus, by developing multi-effect processes, it is possible to obtain GORs close to MED. For the HDH systems to have equivalent thermal performance as that of MSF or MED, a GOR of at least 7 should be achieved.

Despite the relevant literature on HDH available in the field, most of it is covered from a theoretical point of view where thermodynamically favourable conditions are talked about. However, there is not much literature in terms of the actual design of the process. Hence, the team is working on the design and development of general guidelines for designing along with optimizing it for a fixed size. Today, almost all the desalination technologies have a major challenge of dealing with the brine generated during the process. To tackle this, the team has been working on the concept of 'zero liquid discharge' where water is kept recycling back to the system till only solid waste remains in the process. An important point to be accounted for HDH system is that the output is distilled water which is non-drinkable as it is devoid of minerals. Therefore, a remineralization unit is expected to be placed after the HDH unit, in order to make the water fit for drinking.

A prototype of the small-scale humidification dehumidification system

Vrushali Gardare,
Tata Fellow

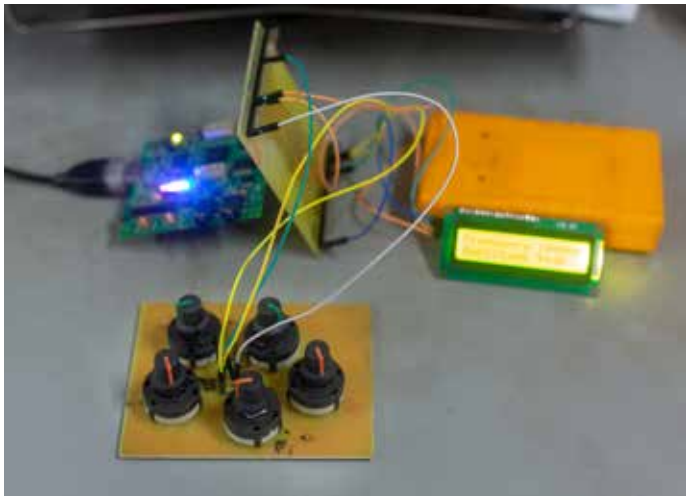
Healthcare

The ring in the ears

The project develops an affordable detection device and a multimodal treatment approach for tinnitus patients

Etymologically speaking Tinnitus (to ring), is a ringing sound that is usually perceived by the patient without any source emitting the sound. Unfortunately, about 98 per cent cases are idiopathic in nature, and that can be nerve-wracking for the patient who is not able to describe the ailment and the doctor diagnosing it. Most patients showing symptoms of tinnitus have been exposed to prolonged noise like those working in music industry or heavy machinery factory. Mr. Neelesh Pandit from the research team observed tinnitus patients and treating doctors as a background study and realizing the potential for e-medicine, the idea was converted into a research project Affordable tinnitus detection device and affordable tinnitus treatment - E medicine, headed by Prof. Maryam Shojaei Baghini, Dept of Electrical Engineering. The research team is currently working on tinnitus diagnosis and treatment which includes the matching device and masking device. The matching device is customized for tinnitus, removing all non-essential features of the conventionally available audiometer and keeping the medical standards intact, to bring down the cost. Conventional audiometers available in the market match only discrete frequencies, whereas the tinnitus matching device claims to have high precision tinnitus matching in the multiples of 20Hz. The treatment involves masking, cognitive behavior therapy, attention diversion and masking therapy. The entire patient report card is generated comprising the user's pattern and patient improvement record.

Working on the experimental setup



Basic prototype ready for field testing

The project has reached the prototype stage where experiments involving calibration with standards like the audiometer is in process. Experiments are performed with the help of sound generators which create simulated environment like that of tinnitus noise. The doctors compare technical characteristics of the tinnitus device and audiometer that is the electrical as well as acoustic outputs to validate the functionality of the device.

The major outcome of this exercise is to cocreate a product that is compatible for the medical market and be accepted by otologists and useful for the patients.
Dr. M. V. Kirtane, an ENT surgeon at Hinduja Hospital Mumbai, has shown interest in the device and the testing of it.

This project shows potential in the e-medicine market, which will be the harbinger of affordable tinnitus diagnosis and treatment.

Sneha Iyer,
Tata Fellow

Education

Learning Math through AR

This project focuses on AR to enhance the learning experience of mathematical concepts for students from rural schools

The project team working on Accessible and affordable digital learning aids for children in rural communities brings alive concepts of Science and Mathematics, which is usually left to the imagination of students. Headed by Prof. Jayesh Pillai, IDC School of Design, the team is designing augmented reality (AR) based learning tools for primary school children. The AR technology is applied as a tool to bring in a combination of surrounding reality and elements of virtual design.

The team focuses on promoting the use of the 3D application to transform the pictorial representation in the textbooks of rural schools, where technological resources are a major constraint in the path of learning. Use of tablets as a platform for the learning application caters to the resource constraint, encouraging a group of children to learn different concepts together.

Understanding existing technologies in primary schools

The application is designed keeping the content specific to what a student sees in his/her daily curriculum, for a state or central board syllabus. To begin with, mathematical concepts have been incorporated in the app to include the geometrical concepts that are spatial in nature. The team has visited three primary schools in Aina Gaon and Shahpur for a background study of the existing technologies being used in the schools and to understand how acquainted the students and teachers are with internet and phone-based applications.

Pratiti Sarkar, a PhD student associated with the project, has carried out pilot test experiments with primary school students to find out the angle between the walls using this application. At proof of concept stage, the skeletal frame of the project with the user interface is ready. The app will also interact with the user as well as other real-life objects. For example, in one of the experiments a solid cube in real life becomes a protractor as well as a ladder. The idea that visual memory is stronger in comparison to the text being read is demonstrated in this context.

Further development will take place based on how the primary school teacher will use the app to give tasks to the students. The app will further collate the concepts of Physics, Chemistry and Biology relevant to the school syllabus.

Transforming pictorial representations in textbooks

Sneha Iyer,
Tata Fellow

Ingredients for cotton stalk animal feed

Pre-treating cotton stalks for animal feed

The research team has been successful in improving the digestibility of treated cotton stalks through its tests.

Cotton is one of the main cash crops cultivated in the Vidarbha region of Maharashtra, which receives scanty rainfall and hence experiences fodder shortage in summer. After harvesting cotton, the stalks are removed from the field and are either burnt off or converted to briquettes and sold as fuel. With the aim of tackling the issue of fodder scarcity and value addition of cotton stalks, Prof. Madhu Vinjamur, Dept of Chemical Engineering, and his research team are conducting research on pre-treatment of cotton stalks for animal feed. Cotton stalks are unfit for chewing for the cattle due to the presence of strong lingo-cellulosic bonds. The project team has been testing various chemical processes to break these lingo-cellulosic bonds. In-vitro testing with ozonation has been completed and the research team has been successful in improving the digestibility of treated cotton stalks. The project team has now proceeded for in-vivo testing on small ruminants like goats. Collaborating with Nagpur Veterinary College (NVC) for procurement of cotton stalks as raw material, the PI along with Prof. Narendra Shah, CTARA, and Dr. Suhas Zambre look forward to setup a bigger treatment plant to test this animal-feed for larger ruminants.

Hand picking cotton from fields

Pelletization of feed material

Cotton being a seasonal crop, cotton stalks are available only for a few months in the entire year. The treatment plant can have a good return on investment only if it is in operation all round the year. Entrepreneurs have expressed interest in pelletization of different agri-residue available at other times of the year. Procurement of cotton stalks at one place for treatment is a major challenge that comes up when setting up a large-scale treatment plant. The proposed business model to overcome this challenge is that entrepreneurs will be involved in managing the supply chain dynamics of the raw material and the processed feed pellets. NVC also conducts workshops for farmers and this mechanism can be used for information dissemination, over time.

Shraddha Vekhande,
Tata Fellow

Healthcare | Waste Management

Evaluating cookstoves' emissions

One of the key difficulties in cookstoves' performance evaluation has been the ability to represent field performance through laboratory testing

In India, solid fuel burning accounts for a majority of air pollution in rural kitchens. With the intent of making solid fuel usage clean, team members from the Centre for Environmental Science and Engineering (CESE), Dept of Energy Science and Engineering, Dept of Mechanical Engineering and Centre for Policy Studies have been currently working on a project titled Evaluation of Emissions from Cookstoves using Solid Fuels with a Focus on Reduction of Exposure headed by Prof Virendra Sethi (CESE), at Tata Centre.

One of the key difficulties in cookstoves performance evaluation has been the ability to represent field performance through laboratory testing. Invariably, the emissions in the field are underestimated in the lab studies for reasons such as cooking practices, different types of foods cooked and variations in the fuel. The use of a Portable Emission Monitoring System (PEMS) has been demonstrated successfully in this project, which allows real-time measurements of carbon monoxide, carbon dioxide and particulate matter smaller than 2.5 micrometres. The set-up has been stationed at the National Environmental Engineering Research Institute (CSIR-NEERI), Nagpur, as a cookstove testing hub. The outreach for field work will be carried out by NEERI in collaboration with Clean Energy Access Network (CLEAN), Delhi.

A second objective of the project was to study the potential use of processed fuel for reduction of emissions. Several efforts in the past have focussed on the modification of cookstove design for improvement in the performance, which necessitated changes in cooking practices and behaviour, often resulting in low success rate of deployment and acceptability. The intent was to reduce emissions by improving solid fuel without changing the cooking practices. The present work thus focused on the use of briquettes, and successfully showed a reduction in emissions for particulate matter in stoves. Different cookstoves from Varanasi, Chandrapur, and an improved cookstove developed by CSIR-NEERI have been tested for briquettes. Further work is in progress to get recipes for the best combination of coal, types of biomass, and binders to optimise the efficiency of fuel and reduce the emissions for region-specific briquette preparation.

Talking about the portable emission monitoring system (PEMS)

The effort has been successful largely through fruitful collaborations between NGOs such as CLEAN and TIDE (Svati Bhogle), students, CSIR-NEERI, and faculty colleagues at IITB. The PEMS is expected to be replicated for wider deployment through CLEAN, and a region-specific domestic fuel supply chain is proposed based on a co-operative business model.

Rohan Ohri,
Tata Fellow

Training the Tata Fellows

The Centre's two seminar-based courses help the students understand the challenges of designing and implementing technology solutions for resource-constrained communities.

Prof. Murali Sastry

The MNG 630 course, which is taught by Prof. Arti Kalro, Shailesh J Mehta School of Management, in the spring semester, builds upon the learnings from MNG 629, taught by Prof. Shishir Jha, Shailesh J Mehta School of Management, in the fall semester. This course aims to equip the students with requisite skills and methodologies, which they would actively apply to their respective Tata Centre Projects.

This year's MNG 630 course had an interesting mix of lectures delivered by academicians as well as experts from the industry. The session on affordable water purifiers by Prof. Murali Sastry, CEO, IITB-Monash Research Academy, brought to light the applications of nanotechnology in making available affordable clean drinking water to the base-of-the-pyramid (BOP) markets. The students also had the opportunity to interact with Ms. Huda Jaffer, from SELCO foundation, and learn about the principles of design thinking and their application in designing solutions for BOP specific challenges.

Ami Parekh helping students analyze different business entities

A Conjoint Analysis, taken up by Prof. Arti and Prof. Sarthak Gaurav, Shailesh J Mehta School of Management, was a perfect blend of theory and practice. While Prof. Arti explained the conceptual underpinnings of the technique, Prof. Sarthak demonstrated the application of this technique in the context of understanding the customer's preference for products based on set of attributes. Ms. Vartika Srivastava, a PhD scholar at SOM, also ran a hands-on example to help students appreciate the technique of using Conjoint Analysis and help marketers decide which product attributes are of importance to the consumer.

The session on Basic Economics and the fundamentals of writing a Business Plan by Prof. Sarthak gave the students the much-needed exposure on the importance of understanding business finances. By the end of the session, the students were not only able to appreciate the crucial components of a good business plan, but also relate to the various types of financial statements which are key to obtaining a complete picture of a project's business finances.

Finally, the session by Ms. Ami Parekh from Khaitan Legal Associates garnered immense participation from students and staff from across Tata Centre's projects as it focussed on different forms of business enterprises and their legalities. She also discussed the comparative analysis between various forms of business entities and considerations for choosing one business form over another.

Dr Disha Bhanot,
Senior Research Scientist

News & Updates at Tata Centre

Engaging with guests

Tata Centre had a flurry of visitors since March, with a majority of them preferring a day-long engagement over a cursory visit. There were faculty members and undergraduate students from local and foreign universities who were enthusiastic about knowing more about the projects and lab-based activities.

Farewell to the outgoing Tata Fellows batch

A warm gathering was organized by the Centre staff as a farewell to the Tata Fellows from the 2017-19 batch. The party started with the Tata Fellows sharing their priceless moments at Tata Centre and a few faculty members giving their notes of appreciation and advice. Some adrenaline-packed games followed involving action from both batches of Tata Fellows, and it was a fun-filled evening that ended on a high note over pizzas.

New faces

With former staff like Mrunal Phansalkar, Asmita Mishra, Kunal Haria and Dr Disha Bhanot leaving the Centre for better prospects, Prashant Rakshe, Jyoti Kale and Anchal Srivastava have joined the force and are hoping to make a difference.

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