



# TURNING POINT



Tata Centre Newsletter, July 2019



R. Raghuttama Rao, CEO, GDC at IIT Madras briefing the I-NCUBATE participants on Day 1

in the I-NCUBATE program, four teams are from Tata Centre, while eight of the fourteen teams in the IDEAS program are again from the Centre. Each team, consisting of a faculty lead, entrepreneur lead, researchers, and a mentor, has been guided by instructors, adjunct faculty members, and program managers.

During the first three days of the program, the teams are taught the basics of customer discovery,

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## I-NCUBATE + IDEAS at Tata Centre

Two programs that guide through customer discovery, product-market fit, and business plan canvas development are currently working with 12 Tata Centre projects.

The Gopalakrishnan Deshpande Centre for Innovation and Entrepreneurship (GDC) of IIT Madras has been conducting Cohort 5 of the I-NCUBATE program, in IIT Bombay. This eight-week long exercise works with the key objective of enabling faculty, researchers, and entrepreneurs to bring their ideas from the lab to the marketplace. Simultaneously, the IDEAS program, an initiative under the Mentoring by Alumni Program (MAP), is launched by the Desai-Sethi Centre of Entrepreneurship to encourage and support innovation and entrepreneurship activities at IIT Bombay. The objective of the program is to help each team develop their idea along with evidence-based validation.

Both programs are similar in structure and the hope is that a maximum number of projects benefit with a developed value proposition canvas and framed hypotheses for each customer segment. Out of the eleven teams participating

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# Silver paste for solar cells— Made in India?

ENERGY

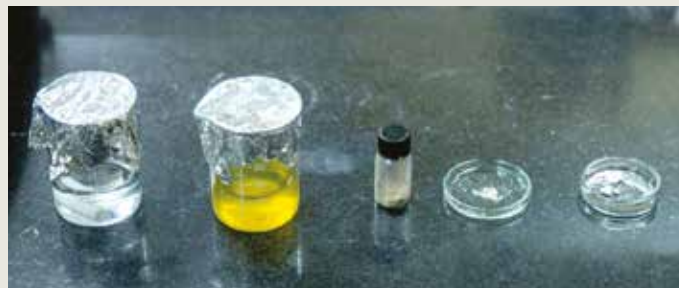
Indigenous preparation of silver paste can solve the affordability problem and match the efficiency of leading market players.



Silver particles synthesis by TCTD process



Synthesised silver powder



Journey of silver paste making



Electrically conducting pen



Continuity check of paper circuit

Silver paste is an integral raw material in solar cell manufacturing. India currently imports several tonnes of silver paste annually. The addition of silver is responsible for the high cost of the silver paste. With the growing emphasis on solar energy, it is important to make affordable solar cells. Indigenous preparation of silver paste can solve the affordability problem to a great extent. Prof. Parag Bhargava and his team, from the Dept. of Metallurgical Engineering and Materials Science, have been currently working on Development of indigenous screen-printable silver paste for solar PV, with Tata Centre.

The team has been successful in preparing good quality silver paste. It has also developed a great hold on the organic additives added to the paste. The indigenously prepared silver paste almost matches the efficiency of the leading silver paste in the market. These technical advancements encourage the team to prepare the most efficient silver paste and also to make the process of quality paste making reproducible. The team has several ideas to accomplish its objective of preparing affordable silver paste while keeping the properties of the paste unchanged. Initially, silver nanoparticles were thought to be key in improving the affordability of the silver paste, but it proved otherwise. The addition of silver nanoparticles lowered the melting point of the paste. The nanoparticles settled down within the

printed layer, affecting the paste's performance. Instead, silver nano-wires and sub-micron particles were found to be better alternatives. The silver nanowires have a high aspect ratio which enables good electrical contact. The team also has plans to try different industrial grade wafers such as high sheet resistance wafers with the help of the NCPRE at IIT Bombay.

During the past year they have made significant progress and prepared solar cells with this paste. Compared to the ones supplied by industry leaders, these cells are within 1–2 per cent of the efficiency obtained with pastes supplied by the industry leader. The plan is to carry out some more work to fine tune the pastes following which it will be taken out for pilot studies.

The team is attempting improvements, checking reproducibility and making trials in an industrial set-up through an interested solar cell manufacturer.

However, the two major challenges foreseen are retaining the same properties of the silver paste during large scale production and, commercialisation of the silver paste. Once the paste is ready for the market, there will be a need for a proper strategy to convince the users to switch to their indigenous silver paste.

**Rohan Ohri,**  
Tata Fellow 2017-19



## Ready for the *gur* market

FOOD & AGRICULTURE

The jaggery plant with a continuous process aims to manufacture food items for daily use that are free of harmful chemicals.

Jaggery, a natural sweetener, is produced from sugarcane in a cottage industry. Small scale traditional plants have a capacity of one tonne per day of sugarcane crushing. The traditional plant has a perpetual requirement of space and labour. The bagasse obtained as side product from sugarcane crushing is dried in open space to act as fuel for heating sugarcane juice. Each key process in jaggery making is manually handled and utilises two-three labours. The task of producing quality jaggery is given to the skilled labour. Thus, the jaggery manufacturer faces dependency on both skilled and unskilled labour, process inefficiency, space requirement, hygiene maintenance, quality assurance, and scale-up problems. Prof. Sanjay Mahajani and Prof. Narendra Shah and their teams, from the Dept. of Chemical Engineering and CTARA respectively, started working on improving the pain-points of the jaggery manufacturer.

The team has developed a continuous process to produce jaggery. The plant situated in Tatyasaheb Kore Institute



of Engineering and Technology, Warnanagar, works at a scale of ten tonnes per day of sugarcane crushing. From its inception, the plant has undergone various changes in the process of jaggery making. Development in bagasse drying, juice heating system, multi-effect evaporator for energy efficient evaporation, clarification, crystallization, powder making, and moulding-demoulding have led to the elimination of some of the challenges for the existing jaggery manufacturer. The developed process of jaggery making ensures hygiene and minimum labour requirement. The plant has successfully been able to produce jaggery powder, cubes and solids.

A MoU has been signed between IIT Bombay and Mellows, a food manufacturing and marketing company located at Kolhapur, to market the products manufactured in the plant. Jaggery powder made in the continuous plant is now available under the Mellows brand on online platforms for sale. The team wishes to bring other products as well on similar platforms to give maximum visibility in the coming future.

**Rohan Ohri,**  
Tata Fellow 2017-19



Mellows jaggery powder manufactured in the TCTD plant



TCTD plant situated at TKIET, Warnanagar



# Disseminating technology to reclaim sand

WASTE MANAGEMENT

All small-scale sand foundries particularly those which reclaim green sand can be benefited with this TCTD project filling the evident gap.



TCTD pilot plant for reclamation, commissioned at Govt. Polytechnic, Kolhapur



Reclaimed sand dispatched to Malati Foundry Pvt. Ltd., Kolhapur for mold making



Green sand is prepared using reclaimed sand with the help of sand muller



Molds are prepared using reclaimed sand



Molten metal is poured into the mold



Casting was done using reclaimed sand at Malati Foundry Pvt. Ltd., Kolhapur

Annually, Indian sand foundries dump around 10 million tonne of waste foundry sand (WFS). This disposal remains a big challenge. An urgent need has been felt to develop a technology capable of reclaiming WFS economically and meeting the foundries' requirements.

The existing solutions for sand reclamation in the market are designed with large scale (3-5 tonnes of waste sand per hour) foundries in mind. They are capital intensive with both thermal and mechanical reclamation facilities. From market assessment, there appears to be no product available in the market which can reclaim waste green sand and recycle purely as green sand. Small foundries are in dire need of this. TCTD's two-stage attrition device has been developed by Prof. Gajananrao N. Jadhav and his team from the Dept. Of Earth Sciences.

The mechanical attrition device developed and patented successfully by the team has reduced the clay content from a whopping 12 per cent to 2.2 per cent. The cost of the reclaimed sand has turned out to be Re 1 per kg,

much less compared to the cost of fresh sand between Rs. 2.5-3.5 per kg. The Kolhapur foundry cluster has been identified as a test bed for this proposed solution. A pilot plant has been commissioned at the partner institute, Government Polytechnic, Kolhapur, and it is running continuously for more than a month now.



Furthermore, the sand reclaimed is being tested in the nearby foundries. This has helped generate valuable data where more than 10 tonnes of sand have been reclaimed till date and tested in the foundries. The quality of casting has met the requirement of the foundry. Moving forward, a local foundry, Malati Foundry Pvt. Ltd., in Kolhapur, will test the reclaimed sand on a larger scale in a month-long trial, which will help disseminate this technology widely in Kolhapur and across the other clusters as well.

**Moiz Khan,**  
Tata Fellow 2018-19



**I-NCUBATE + Ideas at Tata Centre** *Continued from page 1*

value proposition, and hypotheses framing. Upfront is the task of completing at least 100 customer interviews with regular documentation on the online portal. The teams are expected to present their learnings and the updated business model canvas on a webinar, each week. A scheduled office hour is allowed for each team to clarify doubts with any instructor. The customer discovery process makes all the technical researchers go out in the field and meet the potential customers for evidence to validate the hypotheses without mentioning the solution.

The teams are to assume the various customer segments and value proposition. All the assumptions are considered as hypotheses to be tested just like a scientific experiment. The task of conducting a hundred interviews helps in keeping the team always on the go. Analysing the interviews and then presenting to the instructors gives significant insights to plan the next set of interviews.

Despite the challenges faced during the initial period of the program, the insights and the “Aha” moments obtained from talking to the customers have motivated each team to cover as many customers as possible. After the completion of the seven weeks, the teams expect to be meeting for the final time in the closing workshop of the program to present a story of their journey during each week of this whole program. The experience of talking to hundred customers and the business model canvas are meant to be the prized possessions from these programs.

**Rohan Ohri,**  
Tata Fellow 2017-19

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Out of the eleven teams participating in the I-NCUBATE program, four teams are from Tata Centre, while eight of the fourteen teams in the IDEAS program are again from the Centre.

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Instructor helping understand value proposition



In-class customer interview activity



Active participation in class



# Testing the greywater treatment model in field

WASTE MANAGEMENT

Greywater, which consists of all domestic wastewater apart from toilet water, accounts for 70-80 per cent of the total domestic wastewater, the treatment and reuse of which offer a huge opportunity for water conservation.

Water shortage has been a burning issue in the country over the past few years. According to a recent study conducted by NITI Aayog, India is facing its worst water crisis till date and the demand would exceed supply by 2030. Nearly 600 million Indians face high to extreme water stress and about 2,00,000 people die every year due to inadequate access to safe water. Approximately, 70 per cent of urban India’s sewage is untreated as a result of which an estimated 75-80 per cent of water pollution is from domestic sewage.

Unlike sewage, grey water is easier to treat and handle. Most existing set-ups for water recycling tend to treat the entire sewage which turns out to be uneconomical. Prof. Suparna Mukherji, Prof. Sanjeev Chaudhari and Prof. Anurag Garg and their research team from the Dept. of Environmental Science and Engineering came up with an idea to address these issues. The main objective of this project was to come up with an economically feasible technology to

treat greywater and reuse it for flushing and gardening purposes, thus reducing freshwater usage significantly.



A modified Rotating Biological Contactor (RBC) equipped with non-woven fabric for improving the quality of treated water was designed and tested at lab scale, with greywater sourced from one of the hostels at IIT Bombay. The lab-scale model was found to successfully treat the water and generate water of adequate quality for recycling and reuse for flushing and gardening purposes. The main advantage of the technology has been its ability to produce good quality water while ensuring ease of operation and low operational costs.

Following the success at lab scale, a pilot plant is currently being tested in Atul Institute for Vocational Excellence (AIVE), a CSR program for training tribal youngsters for various skilled jobs, in collaboration with Atul Industries. The pilot plant is of a capacity of 200 litres per day which has been successfully tested for 12 hours residence time. Further testing would be performed on this system under various operating conditions.

**Akhil Subramanian,**  
Tata Fellow 2017-19



Greywater analysis in the laboratory



Clear water obtained after treatment



Laboratory scale prototype at IIT Bombay



TCTD pilot plant set up at the AIVE



## In the shoes of a Tata Fellow

The two years of being a Tata Fellow have been full of experiences and learnings, and memories of a lifetime. Here's bidding adieu to the Fellows' batch of 2017-19.



TCTD Symposium: Journey of the Tata Fellows - a skit by Tata Fellows 2017-19

After hectic coursework and research work over the past two years, the about-to-graduate batch of Tata Fellows 2017-19 has much to reflect on. When their journey started with a written test and an interview, little did they know that it would change their entire perspective. The courses on Technology and Design and End to End Innovation came with a breath of freshness in contrast to the technical lectures. The guest lectures gave them exposure to the need for innovation in their respective fields and real-life applications to their research. Some of them were eyeopeners and kindled a few minds to think out of the box. The best bonding took place during the TCTD Yatra and MIT trip, even if the sleepless nights and the long journey was worth it all. For some, the social was a new space altogether, but mutual learning helped understanding what the actual need was.

A few Tata Fellows recollect the nights spent in the machine lab while building the prototype, the ups and downs on whether the prototype would work or not, or how relevant it was to the problem they were addressing. It was a great experience to experiment with all the possible instruments in the machine lab by themselves with the help of staff, get their prototypes ready and the cheers that arose when the prototypes actually worked. Endless presentations



Written test for shortlisting Tata Fellows

and reports polished their work and umpteen rehearsals for the TCTD symposium got them prepared to face a larger audience confidently. The story doesn't end here. Now in the last chapter of their journey, the Tata Fellows are caught up in the whirlwind of activity around the big day- their graduation.

They will be missed. We wish them all happy days and much success in their future endeavors.

**Sneha Iyer,**  
Tata Fellow 2018-21



# News & Updates at Tata Centre

**New patent applications:** There are four new patent applications from the TCTD projects' fold this quarter and the list includes two applications from Feasibility study of jaggery making and related products, one from Value addition of cashew apple through processing and preservation, and a trademark application for A digital aid for language (Hindi) teaching and learning.

**Change in intake process of Tata Fellows:** TCTD will be taking in a mixed batch of Tata Fellows this year on. While some of them will be selected from the new M.Tech admissions in July, the other half will be taken in based on recommendations from the faculty members in September, observing their involvement with the ongoing TCTD projects. This change should help smoothen the selection process for the Tata Fellows, encouraging more involvement and contribution from the students.

**Restructuring of Pro-seminar syllabus:** Bringing in a change from the July start to the Pro-seminar curriculum, the core faculty is revising the syllabus to start afresh with its sessions for the new Tata Fellows, in January 2020. The hope is that the observations by the faculty members and the learnings by the Tata Fellows will help redefine the course content.



Learning science concepts through fabrication in Akola



**End-to-End Innovation program:** TCTD conducted its first workshop for the year 2019 in mid-June, for the TEQIP III-KITE participants on End-to-End Innovation who were faculty members from engineering colleges across the country. This course is working out to be a successful combination of the theory and fabrication elements and thus it sets the tone for an innovation ecosystem across disciplines.

**Students' workshop in science fabrication:** A four-day workshop on fabrication to learn science concepts was conducted by the TCTD team at JRD Tata School, Akola. Well-attended by 35 students from classes 7<sup>th</sup> to 9<sup>th</sup> and three teachers, this pilot test has seen interest coming in from the state educational board.

**New team members:** TCTD extends a warm welcome to Sanjana Nanodkar, Parvathi Venkitaraman, Aditya Seth and Vasundhara Vedula who have recently joined the team.



Building an ecosystem through End-to-End Innovation

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