EngineeringX

Founded by the Royal Academy of Engineering
and Lloyd's Register Foundation

Transforming Systems through Partnership

Royal Academy of Engineering

technopolis group

AN INTEGRATED SYSTEM FOR TREATMENT OF TEXTILE INDUSTRY WASTEWATER

Lead partner: Dr Hema Jagadeesan, PSG College of Technology, India

THE CHALLENGE

As global populations grow and urban areas become more densely populated, water scarcity is becoming an increasingly important issue. It is important to develop effective methods to treat industrial wastewater so it can be safely re-used, to minimise its impact on the environment and human health.

The textiles industry is one for which wastewater presents a major problem. The industry consumes close to 140 litres of water per kilogram of finished product. Processes such as dying generate a large amount of polluted wastewater. At the same time, current treatments for textile wastewater produce high volumes of sludge and hazardous materials. To remain viable, the textiles industry needs an efficient and eco-friendly technology to treat its wastewater. This is a significant problem in many low- and middle-income countries, including India – a major producer and exporter for the global textiles industry. In India, pollution of water bodies by the textiles industry has affected agriculture and human health. For example, textiles wastewater can add carcinogens water, and has been known to result in allergic reactions and birth defects in humans. Pollutants in the water can also impact the quality of the soil and prevent plants' roots from developing properly, therefore reducing crop yields.

THE PEOPLE

Dr Hema Jagadeesan, PSG College of Technology

Dr Ramamurthy V, PSG College of Technology

Dr Satheesh Krishnamurthy, Open University

Mr Chandrasekar J, WATSAN

THE PROJECT

This project aimed to **develop a cost-effective, efficient and eco-friendly technology to treat textile wastewater by integrating existing and new technologies**. This included developing low-cost photocatalysts, which use light exposure to change chemical reaction rates, to remove colour from the water; and a phyto-microbe-chemo[1] water treatment system to make wastewater environmentally benign.

The project team **enhanced sectoral understanding** of the microorganisms used in these processes through sharing their research in academic journals and at conferences and workshops. The team produced new educational material on the subject. The educational material will be used in university courses and to educate industry. Over 1000 students have attended workshops delivered by the team.

Wastewater from the textiles industry is a prevalent issue in Tamil Nadu, Southern India, where the project lead is based and Dr Jagadeesan and her team at PSG have worked on this issue for close to a decade. Through this project, the team hopes the resulting biological water treatment method would benefit wider society.

1 This refers to a water treatment process which uses a plant and its root-associated microorganisms to remove pollutants from the water.

IMPACTS

A key achievement of the project was developing a deeper understanding of how low cost photocatalysts and plant-microbe interactions can remediate textile wastewater. Thanks to this understanding, the project team **developed and demonstrated a method for treating textiles wastewater**. The technology is currently at Technology Readiness Level 5 (technology validated in relevant environment). The new method was **demonstrated to be effective with real wastewater**. The team are hopeful that the method can be used in other industries in the future.

AN INTEGRATED SYSTEM FOR TREATMENT OF TEXTILE INDUSTRY WASTEWATER

Lead partner: Dr Hema Jagadeesan, PSG College of Technology, India

During his research, Professor Krishnamurthy also **found the new wastewater treatment approach produced hydrogen energy**, resulting in a patent application for the new method. In total, the project team have published **six journal articles, have submitted one further paper, along with one patent**. They have also **presented their results at several conferences and workshops in India and the UK**, enabling dissemination of the knowledge to wide audiences **including policymakers**.

The project also gave **the universities an opportunity to work collaboratively with industry**. This not only helped the research team, who could better **identify industry needs and test their research in real situations**, but also benefited those at WATSAN, the industry partner. WATSAN now has **access to a method which can significantly reduce pollutants in its wastewater**. This will reduce environmental impact, improve cost efficiencies, and improve their reputation as a business.

The project's impact extended beyond academic research and industry, by **benefiting the education of students at PSG and the Open University**. Students were directly involved in the project and **visited their academic counterparts in the UK and India** to support research and inform their degree theses. Students also **visited industry partners** for further research. **Other master's level and PhD-level theses were carried out using project results and knowledge**. The project also benefited students beyond those directly involved in the research, through **conducting workshops for students to disseminate and exchange knowledge about the new technology and methods developed**. Professor Krishnamurthy, from the Open University, delivered workshops to over 1000 students through India's Department of Science and Technology.

THE FUTURE

The project has **generated a large amount of data**, which the team intend to continue to analyse. This will create **further insights into treating textile wastewater**. The research team also plans to **implement a similar water cleaning system at another industrial wastewater treatment centre**. The team believe the method can be extrapolated to other industries' wastewater.

The three textiles organisations which took part in the research and testing of the new process are planning to **invest in the technology**. These are KG Fabrik, Milky Mist and SPS Mills.

PSG remains in collaboration with Professor Krishnamurthy at Open University. They have continued to publish articles together since the completion of the project.

The project team **greatly appreciated the support from the Royal Academy of Engineering**, without which the project may not have gone ahead. The team would also like to remain engaged with the Academy in the future.

> *"The Academy's support was extremely important in completion of the project... The project addressed a very important environmental problem. The funding not only supported the development of a treatment method but also in furthering industry interactions. I would like to thank the Academy for supporting us."*
>
> Dr Jagadeesan, Lead Partner

SOURCES:

This impact case study was prepared using information from interviews with the project team, documents supplied by the Academy including reports, and additional online resources.

- Interview with Dr Hema Jagadeesan
- IAPPI_66 Initial application
- IAPPI_66 Final report June 2022 (draft)
- IAPPI_66 Report for balance fund May 2023
- Jayapal, M, Jagadeesan, H. et al. (2002) Demonstration of a plant-microbe integrated system for treatment of real-time textile industry wastewater. Environmental Pollution, 302.
- Khan, S., & Malik, A. (2014) Environmental and Health Effects of Textile Industry Wastewater. In: Malik, A, Grohmann, E., & Akhtar, R. (eds) Environmental Deterioration and Human Health. Springer, Dordecht.

This project was made possible by DSIT (formally BEIS) ODA funding under the Engineering X TSP programme, in partnership with the Federation of Indian Chambers of Commerce and Industry (FICCI) in India.

Royal Academy of Engineering
Prince Philip House, 3 Carlton House Terrace, London SW1Y 5DG
For more information: https://engineeringx.raeng.org.uk/tsp