NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE | Nanyang Environment and Water Research Institute

CLOSED-LOOP ADVANCED MANUFACTURING PROCESS (C-LAMP)

Abstract

Aligned with Singapore's national priorities in PE ITM and SG Green Plan, the Closed-Loop Advanced Manufacturing Processes (c-LAMP) programme is poised to contribute to this collective effort in positioning our manufacturers for a sustainable future. The rise in green procurement coupled with increasing demand for non-ferrous metals drive manufacturers to close their production loops to stay relevant, capture emerging opportunities, and be more resource resilient.

Focusing on the production of high value, customisable feedstock via small-batch production from non-ferrous industrial scraps, c-LAMP programme proposes three strategic thrusts to holistically help manufacturers close their production loops:

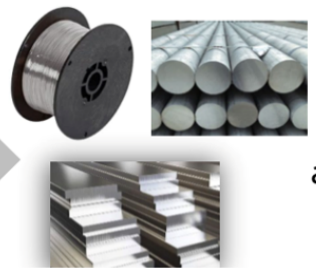
1. Innovate processes for manufacturing resource pre-treatment
2. Re-engineer manufacturing processes for cleaner production of manufacturing feedstock
3. Optimize manufacturing processes efficiency with water-energy-waste analytics.

Outcomes from c-LAMP will strengthen enterprise sustainability, deepen the capabilities and competitiveness of our manufacturing sector with the growth of preferred green suppliers to remain attractive to global manufacturers. In the process, Secondary waste must also be treated in order not to problem shift. However, wastewater treatment is an energy-intensive process and will be very complex if various liquid waste streams are mixed. Hence, it is desirable to perform wastewater treatment at the source of generation for effective water reuse for the same purpose and these treatment processes should be modularised so that they could be configurable and tailored to the targeted pollutant. The project aims to develop a modularised and energy-efficient treatment process that could be used to treat secondary wastewater at its source and just sufficiently for reuse. The approach is via electrochemical-biological process, which have been shown to be more energy-efficient but have some limitations such as the conductivity of the wastewater stream.

In particular, SIMTech will be working on electrochemical wastewater treatment, which may include electrocoagulation and electrochemical advanced oxidation processes, and NTU will focus on the biological treatment process. SIMTech and NTU will work together to explore synergies in wastewater treatment by combining the electrochemical and biological approaches and evaluating the effectiveness and efficiencies.

Metal scraps and swarfs

Closed-Loop Advanced Manufacturing Process (c-LAMP)



High quality, customisable alloy feedstock on-demand

Wastewater generated from pre-treatment of metal scraps and swarfs needs to be treated for water reuse.

Innovate Processes for Manufacturing Resource Pre-Treatment

Developing a modularized and energy-efficient treatment process, ie. electrochemical-biological hybrid process to treat secondary waste, ie. wastewater from swarf cleaning, with the purpose of effective water reuse, forming a circular pre-treatment loop for the manufacturing process. Key approaches including profiling and understanding the type of incoming wastewater, tailor the treatment system to water reuse requirements, modularize treatment units for applications of different wastewater from different industries.

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