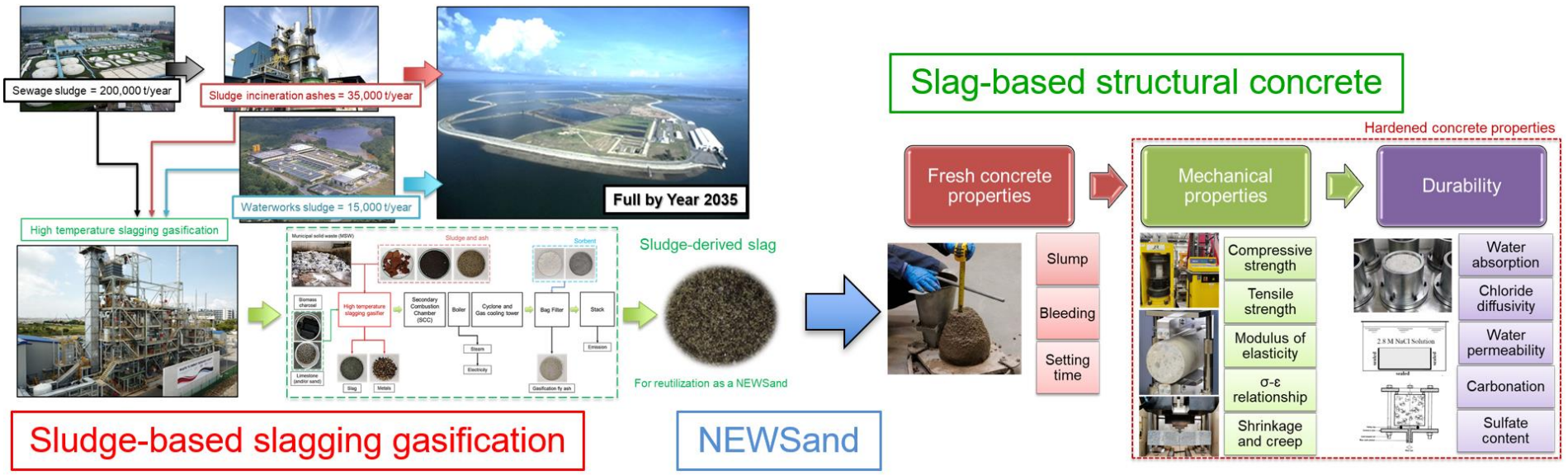
NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE | Nanyang Environment and Water Research Institute

FROM SLUDGE TO SLAG: SLAGGING GASIFICATION AND STRUCTURAL CONCRETE

Abstract:

Feasibility study on the co-gasification of sludge with municipal solid waste (MSW) at Waste-to-Energy Research Facility (WTERF), a demonstration-scale facility employing high temperature slagging gasification, demonstrated stable operation up to 50% (wet basis) of sludge co-feeding and generated sludge-derived slag with very low leaching of heavy metals, meeting or close to the limits as listed in the draft Reference Values (RVs) from National Environment Agency (NEA) for the re-utilization of waste materials as alternative construction aggregate. The sludge-derived slag is also meeting the Singapore's standards for fine aggregates (SS EN 12620) and concrete mix (SS EN 206) while showing highly comparable performance in compressive strength when replacing natural sand as the fine aggregate for concrete production, which is potentially applicable for non-structural and structural applications. However, the feasibility study was performed in relatively short durations (about three days of testing for seven different input sludge mixes at two different loading ratios, respectively), a long-term trial is therefore crucial to further assess the technical feasibility and robustness of the production of sludge-derived slag and address the challenges observed.

In this project, a long-term feasibility study and technical evaluation of sludge gasification through a demonstration scale trial is proposed with the modification and adaptation of WTERF to increase the co-gasification ratio of sludge and aiming to reach 100% sludge gasification in the slagging gasification. The trial is essential to ensure robust conversion of sludge to slag can be achieved and producing up to 100 tonnes in total (estimated at around 2.5 tonnes per day during the stable operation period, after the optimized conditions are achieved through the trial) of sludge-derived slag with consistent physical and chemical properties. This will be achieved through the changes in operating conditions, the modification of the facilities at WTERF and based on the complementary inputs from the laboratory testing on slag. The slag produced will be applied for the proposed research works in this project, specifically the high value-added structural application of slag concrete, and supplied to the industry players and potential off-takers from the construction industry in Singapore for non-commercial use in non-structural applications. This project will also further explore and enhance the resource recovery (such as phosphorus and valuable metals) from the by-products generated during sludge gasification to improve the economics and sustainability of this treatment process while contributing towards the circularity of economy and closing the waste loop for Singapore.



PI: Assoc Prof Grzegorz Lisak (NEWRI)