CMET Seminar

UNIVERSITY OF DELAWARE

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366 CLB

"Irreversible Impact of Thermal Treatment of Rheological Behaviour of Anaerobic Digested Sludge"

The management of sludge produced during wastewater treatment processes, which represents up to 50% of the operational cost of a treatment plant, is one of the most difficult unsolved environmental problems all over the world. Globally, the need to achieve a sustainable sludge management strategy has become of greater concern due to the legal banning of conventional sludge disposal methods such as landfill. In future liveable cities, sustainable urban design compels a better integration of wastewater treatment in the whole urban water cycle in which treated water has to be reused while excess sludge has to be seen as a 'valuable resource' and become a second-life raw martial for energy production. Biogas from the anaerobic digestion of sludge can provide a clean, easily controlled source of renewable energy, replacing firewood and/or fossil fuels. In order to maintain the requisite constant homogeneous conditions within digesters, operating conditions must be regulated according to the rheological characteristics of the sludge. An accurate estimate of sludge rheological properties is required for the design and efficient operation of sludge pumping and digester mixing, especially, when more concentrated sludge will flow through treatment plant due to rapid population growth and urbanization.

In this presentation, the rheological behaviour of digested sludge at different concentrations and different temperatures are presented, and their common features highlighted. We showed that the rheological behaviour of digested sludge is qualitatively the same at different solids concentrations and temperatures, and depends only on the yield stress and Bingham viscosity and modelled it with modified Herschel-Buckley model. A master curve was obtained independent of both temperature and concentration. These two parameters (yield stress and Bingham viscosity) increase when the solid concentration increases but decrease when the temperature increases.

Although the results showed that by changing the temperature, the sludge becomes less viscous; however, the rheological characteristics of sludge including yield stress and apparent viscosity do not come back to their original values after cooling the heated sludge. The solubilised COD showed a composition change after cooling the heated sludge which confirmed the irreversible change in the rheological characteristics of digested sludge after heating. After being heated and cooled, digested sludge showed a lower yield stress but higher infinite and liquor viscosity than the initial material, at the same temperature. It was observed that thermal treatment of digested sludge induced a transfer of the organic matter from the solid compounds to the dissolved constituents and this transfer is proportional to the evolutions of the yield stress and liquor viscosity. Such behaviour has to be taken into account for the practical design and operation of anaerobic digesters, especially heat exchangers and the head loss calculation of pumps.