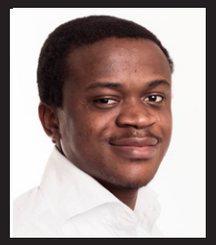
This thesis presents work that was done within the Swedish Centre for Resource Recovery (SCRR). Research and education performed within SCRR identifies new and improved methods to convert residuals into value-added products. SCRR covers technical, environmental and social aspects of sustainable resource recovery.



In this thesis, a novel textile-based bioreactor was presented as a way of addressing some of the technical and economic challenges associated with fermentation based production using ethanol and biogas production as case studies. Fermentation has been long known to man. However, the application of biotechnology and chemical engineering principles for the fermentative production of different products such as antibiotics, biofuels, amino acids, biopharmaceutical drugs, enzymes, proteins, biopolymers, microbial biomass and food flavours kick-started after the commercial production of penicillin and has improved afterwards. Fermentative production occurs in reactors called bioreactors. For the fermentation process to go as intended, the bioreactor must be designed to provide the enabling conditions needed by the microorganisms, cells or enzymes that carry out the transformation. There are currently different bioreactor designs, but the conventional designs are expensive, are not flexible, require a long installation time and require considerable expertise to operate. Hence, the textile-based bioreactor was designed and developed to address these challenges.

The bioreactor design aspects that were considered while developing the textile based bioreactor during this doctoral study were centred on mixing, mass transfer, temperature control, rheology, hydrodynamics and stress containment in the bioreactor for aerobic and anaerobic applications of the bioreactor with different microorganisms such as yeast, fungi and bacteria.

The textile based bioreactor was found effective in reducing the fermentation investment cost by 21 % or more. It could be used at dilution rate above 1/h for ethanol production using flocculating yeast without the cells washing out of the bioreactor, thereby improving productivity. The textile bioreactor hydrodynamics minimised foaming even at a high aeration rate of 1.4 VVM. For medium- or large-scale applications of the bioreactor with volumes ranging from 100 to 1000 m3, the tension per unit length that would be exerted on the bioreactor would be between 300–20000 N/m.

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