Abstract for graduation project

In today's world, the energy demand is experiencing a significant surge, underscoring the imperative to explore and sustain alternative sources of renewable energy, such as biogas derived from organic materials like food waste. This research paper is dedicated to the development of a sustainable methodology for repurposing and recycling food waste through an anaerobic digestion process to yield biogas. The efficacy of extracting biogas from food waste is evaluated using a digester or bioreactor equipped with multiple strategically placed airlift pumps, deviating from the conventional and less efficient continuous stirred tank reactors (CSTRs). The examined digester incorporates multiple airlift pumps at equally spaced circumferential locations, reinjecting biogas to circulate and blend the liquid sludge, thereby enhancing its mixing rate within the digester. Additionally, computational fluid dynamics (CFD) simulation is employed to evaluate the mixing process within the digester, particularly with the implementation of four standard riser airlift pumps. The analysis involved evaluating the velocity contours and vectors of air-water with those of biogas-liquid sludge, noting differences in the average velocity of water and liquid sludge. The study also explores the rheological property changes, whether Newtonian or non-Newtonian, in the behavior of liquid sludge at varying mass flow rates of biogas. The study reveals that despite the liquid sludge's high viscosity and density, its average velocity aligns with the trend observed in water, suggesting Newtonian fluid behavior within the digester at low mass flow rates of both liquid and gas phases. However, as the mass flow rates of liquid sludge surpass 216 L/min, it reverts to its original non-Newtonian fluid characteristics due to an increased shear rate, leading to an increase in liquid sludge's viscosity. This shift causes the average velocity trend for liquid sludge to deviate from that of water, resulting in lower values of average velocity for the liquid sludge. Therefore, the identified maximum mass flow rate for liquid sludge exhibiting Newtonian fluid behavior is 216 L/min. When the liquid sludge acts like a Newtonian fluid its active volume will be maintained at a sufficient level for a certain period, thereby enhancing the overall formation of biogas.

Best regards,

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