

ABSTRACT

The introduction and review in this Thesis encompass a brief review over the past six decades on Process Intensification using pulsation and vibration. Pulsations have been categorized as imparted to the system through mechanical vibration, ultrasound, and thermally induced. The grey areas identified are expected to assist in enriching the research on process intensification. The second chapter discusses, augmentation in liquid-liquid two-phase extraction process due to flow pulsation on a continuous flow, studied both experimentally and theoretically. Based on the observations a modified Linton and Sherwood-like correlation for determining extracted concentration at the exit of the test section in semi pulsatile flow conditions has been proposed. Acetic acid is the diffusing species, whose transfer is maximized from the organic phase (toluene) to the aqueous phase (water) when they merge together at the T-junction. The optimum pulsation parameters are found for economic extraction operations. In the third chapter, the application of air damper on pulsatile flow is explored to further enhance the liquid-liquid two-phase extraction operations. It is established that introduction of a captive air column in combination with pulsating flows at the modified T-junction leads to benefits in terms of liquid extraction per unit power input. It is found that smaller lengths of extraction column with a nominal length of air damper deliver a comparatively higher rate of species extraction compared to longer columns for the same power input. The fourth chapter of this Thesis, discusses fully pulsatile flow, in-phase and out of phase flow conditions, the results, and comparisons of the plug flow range and overall volumetric mass transfer coefficient for T junction with no air at the top and the same junction with the variable volume of air at the top have experimented. Flow pattern maps, plug characteristics, and mass transfer experimentation on equal and unequal amplitudes and frequencies of toluene and water in downflow situations were performed and it was found that

extraction was highest for the highest pulsation frequency, and for equal amplitudes, and frequencies of toluene and water.

Keywords: *Liquid-liquid extraction, Process Intensification, Two-phase flow, Mass-transfer, Flow pulsation, Air-damper, Enhanced extraction efficiency, Modified Linton, and Sherwood correlation.*