CHAPTER VII

DISCUSSION

Liquid liquid extraction processes have been used industrially to great advantage as a means of chemical separation and purification where operation such as distillation evaporation, or adsorption are impractical.

Equipment design for continuous counter current extraction is largely based upon various methods for obtaining a high interfacial area between the two liquids contacted. Greater efficiency or improved mass transfer is usually achieved by increasing the degree of mixing of the two phases and mass transfer area. The most important parameters of industrial importance were the capacity and efficiency of the column.

The parameters that govern the capacity and efficiency of a controlled cycling extraction are numerous. The parameters are combined volumetric flow rate, flow ratios, cycle time, duration of flow periods, duration of delay periods, plate spacing, type of plate, size of nozzles, direction of flow, and physical properties of the system.

For this thesis we had just studies the effects of mass transfer for controlled cycling operation on the following variable parameters:-

1. The effect of combined volumetric flow rate
2. The effect of volumetric flow ratios
3. The effect of controlled cyclic period
4. The effect of total cycle time
5. The effect of fraction open of H_2O to MIBK

The results of the experiment concerned of these variables were discussed as follow:-

7.1 Effect of Combined Volumetric Flow Rate

Experimental results showed in Figure 6.1 to 6.4 indicate that the column efficiency which show by Number of Transfer Unit (N.T.U.) and $\frac{Yin-Yout}{Yin} \times 100$ is almost unchange with combined volumetric flow rate increased. This causes when the volumetric flow rate increased the smaller droplets increased with leads to increasing mass transfer area, but the same time reducing contacted time between two liquid phases, and increasing the volume of extraction. Then it increased the capacity of extraction. Number of transfer unit NTU is between 3-5; and $\frac{Yin-Yout}{Yin} \times 100$ is about between 80-90 percents.

The volumetric flow rate does not appear to affect the column efficiency. This result is the same as the result which had been done by Szabo, Lloy, Cannon and Speaker (1964). They used perfarated plate extractor containing eight plates spacing 8.3 in apart.

7.2 Effect of Controlled Cyclic Period

Two sets of controlled cyclic period were studied. Set 1 MIBK flow period 1 second, H_2O flow period 1 second, MIBK coalescence 7.5 seconds, H_2O coalescence 8.5 seconds. Set 2 MIBK flow period 1 second, H_2O flow period 1.3 seconds, MIBK coalescence 8.4 seconds H_2O coalescence 7.3 second. The results of experiment were shown in Figure 6.7 and 6.8, indicate that efficiency of extraction of set 2 is better than set 1. This cause by increasing period of H_2O flow it increased the time of forming eddy diffusivity. More-over as H_2O flow from the top of column, the better fragmentation of the drop form than MIBK flow from bottom of column, The optimum of mass transfer for set 1 is at flow rate 48 litresper hour, and 37 litresper hour for set 2. Then the capacity of set 1 is greater than set 2.

7.3 Effect of Volumetric Flow Ratio (H_2O/MIBK)

The experimental results were shown in Figure 6.9 to 6.12. Figure 6.9 and 6.10 showed effect of volumetric flow ratio on total cycle time 3.2 seconds, but Figure 6.11 on total cycle time 11.8 seconds As the flow ratio increased or the flow rate of extract solvent increased then increased mass transfer area and overall mass transfer coefficient. The efficiency of extraction was increased until the optimum point. After the optimum flow ratio, the efficiency of extraction was reduced. This cause by the size of droplets smaller than the limit, the movement of solute in the droplets decreased, and reduced the contacted time between two liquid phases. So these phenomenon lead to decrease efficiency of extraction. And it taker a long time to separate into two phases. Therefore it decreased the capacity of column.

7.4 Effect of Total Cycle Time

Three sets of total cycle time were used, they were 18 seconds, 13.2 seconds and 11.8 seconds respectively. The results of experiment for total cycle time 18 seconds showed in table 1 to 4, for total cycle time 13.2 showed in table 6, and for total cycle time 11.8 showed in table 7. The efficiency of mass transfer represented by N.T.U and $\frac{Yin-Yout}{Yin} \times 100$ decreased as the total cycle time decreased. As the total cycle time decreased, the contact time between two phases decreased. When contact time was short, there was not enough time to develop the turbulent diffusivity in order to reduce boundary layer thickness. Therefore the efficiency of mass transfer reduced as total cycle time decreased. At the same time the capacity of column increased as reducing total cycle time.

7.5 Effect of Fraction Open of H_2O to MIBK Flow

Total cycle time 18 seconds was used. The ratio was varied from 0.7 to 1.6. The coalescing periods of both phases were constant and equal to 7.8 seconds. The results of experiment were shown in Figure 6.13 and 6.14. The optimum fraction open was at 1.4.

Fraction open was variable which related to the time of fluid flowing in the system. The higher value of fraction open of H_2O take a longer time for H_2O flow. As a lower ratio of H_2O flow, it had a short time to form eddy diffusivity hence the boundary lager thickness could not be reduced. At fraction open of 1.4 it had sufficient time to yield significant effect of forming eddy diffusivity. When fraction open was greater than 1.4, the column efficiency was reduced. When fraction open of H_2O large the velocity of H_2O flow was reduced, the turbulence diffusivity could reduce; overall mass transfer coefficient was less than higher velocity.

7.6 Errors of Experimental Results

There were many experimental errors which could affect all of the experimental results obtained in this investigation. These were as follows:

1. Error in determination of concentration of acid; NaOH was used to titrate with acetic acid in water and in MIBK phases. It was easy to titrate NaOH with acetic acid in water phase, but it took time for titration with acetic acid in MIBK phase. And it was difficult to read the end point of titration exactly. These caused the main error of the experiment.

2. Error for measuring flow rate; Because the cyclic operation caused fluctuation in fluid flow rate. The approximated average values of flow rate were used. Moreover volumetric flow was measured by measuring cylinders, which it is not accurated to measure.

3. Error of controlled cyclic periods; Controlled cyclic periods was very short and difficult to control and record exactly.

4. Error of equilibrium curve; The equilibrium curve is not exactly straight, but slightly curve. In this thesis the equilibrium curve was assumed to be straight for simple calculation of ideal stage and number of transfer unit.