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EVOLUTION OF MASS TRANSFER COEFFICIENT USING BEREL SADDLE AND STAR RING PACKING WITH DIFFERENT SOLVENTS FOR LIQUID-LIQUID EXTRACTION

V. S. Patil*, Prajakta C. Kulkarni and Mamata A. Neve****

University Department of Chemical Technology, North Maharashtra University,
Jalgaon-425001 (India)

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ABSTRACT

The experimental investigation is conducted to generate comparative equilibrium data for different solvents (Benzene, xylene, kerosene) for acetic acid -water system. Thus required data for tie line & binomial curve were gathered for system.

Acetic acid- water - xylene
Acetic acid- water- kerosene

Two types of packing are used for liquid-liquid extraction. Application of these two packing with same solvents has been discussed. Triangular diagrams for each system & various compositions have been presented. The results are used to find percentage of acetic acid in extract & raffinate phase, number of transfer units, height of transfer units, and mass transfer coefficient for extract & raffinate phase. Comparing all these parameters for different solvents & each packing indicates the overall result.

Key words:- mass transfer coefficient, number of transfer units, height of transfer units, berl saddle & star ring.

INTRODUCTION

Extraction is an operation by means of which one or more components of a liquid or a solid are transferred to another liquid. In case of Liquid-liquid extraction one of the component mus.t be sufficiently insoluble so that two liquid phases are formed The phases are then separated to recover the desired product[13]. The liquid added to bring about the extraction is known as a solvent. The solvent layer is called the extract and the other layer, composed of the reminder of the Original Solution plus some of the solvent is termed as raffinate.[4] The three component system is usually represented on a tri-angular diagram system with composition within a bionodial solubility curve usually separate into two liquid phases Equilibrium composition of the two phases lie on this curve and the line joining this equilibrium composition is called the tie line[5] (different Composition of solvent). The selection of the phases to be dispersed depends on various consideration[6-8]:

The direction of mass transfer should be such that it can promote interfacial tur-bulence in the phase of a higher resistance. Coalescence occurs when mass transfer takes place from dispersed to the continuous phase. It is generally better to disperse the phase of higher viscosity from settling point of view[9-11]

MATERIALS AND METHOD

A.R grade chemicals from S.D. fine chemical laboratories were used for experimental work. We had carried out the simple extraction of binary system of acetic acid & water. The extraction is carried out for different solvents. Solvents used are xylene & kerosene. We had calculated density & concentration of resulting extract & raffinate phase. These above calculated data is used for plotting curve & tie line for each Solvent.

Afterwards for the same binary system, extraction is carried out using extraction column & two types of packing. Packing used were berel saddles & star rings. Experimental set up is as shown in figure below. Two-funnels were used, one containing solvent & other containing binary mixture. Packing were filled in the extraction column & extraction is carried out. We got two phases extract & raffinate. Height & diameter of column was measured. From this data we had calculated no. of column & mass transfer coefficient for extract & raffinate phase.

OBSERVATION

Table-1 1) Acetic acid + Water + Xylene

		Set-1		Set-2	
Sr. No.	Acetic acid	Xylene	(B.R.) water	Water	(B.R.) Xylene
1	8	2	0.8	2	1.2
2	7	3	0.6	3	1.0
3	6	4	0.4	4	0.8
4	5	5	0.2	5	0.6
5	4	6	_	6	0.6

Table-2. 2) Acetic acid + water + Kerosene

		Set-1		Set-2	
Sr.No	Acetic acid	Water	(B.R) Kerosene	Kerosene	(B.R.) water
1	8	2	1.6	2	1.2
2	7	3	1.4	3	1.0
3	6	4	1.0	4	0.9
4	5	5	0.6	5	0.8
5	4	6	0.3	6	0.7

Table-3. Acetic Acid Percentage in Extract & Raffinate

1) Solvent: Xylene

Composition			Extract	Raffinate
A.A.	H_20	Xylene	%E	%R'
30	30	40	23.26	51.30
50	20	30	18.00	70.24
40	30	30	5.5	64.17

Table-4. 2) Solvent: Kerosene

Composition			Extract	Raffinate
A.A.	H_20	Kerosene	%E	%R
30	30	40	2.04	49.17
50	20	30	3.817	72.37
40	30	30 .	6.666	53.51

Table-5. Packing used :- Berl saddle

Sr. No.	Solvent	XE	XR
1	Xylene	0.193	1.58
2	Kerosene	0.04	1.57

Sr. No.	Solvent	NOE	NOR
1	Xylene	0.422	0.826
2	Kerosene	0.48	1.022

Sr. No.	Solvent	HOE	HOR
1	Xylene	0.841	0.042
2	Kerosene	0.739	0.347

Sr. No	Solvent	KOE	KOR
1	Xylene	2.008	5.537
2	Kerosene	1.359	2.878

Table-6. Packing used :-Star ring

Sr. No.	Solvent	XE	XR
1	Benzene	0.0675	0.0086
2	Kerosene	0.021	0.013

Sr. No.	Solvent	NOE	NOR
1	Benzene	2.622	3.36
2	Kerosene	2.8	2.622

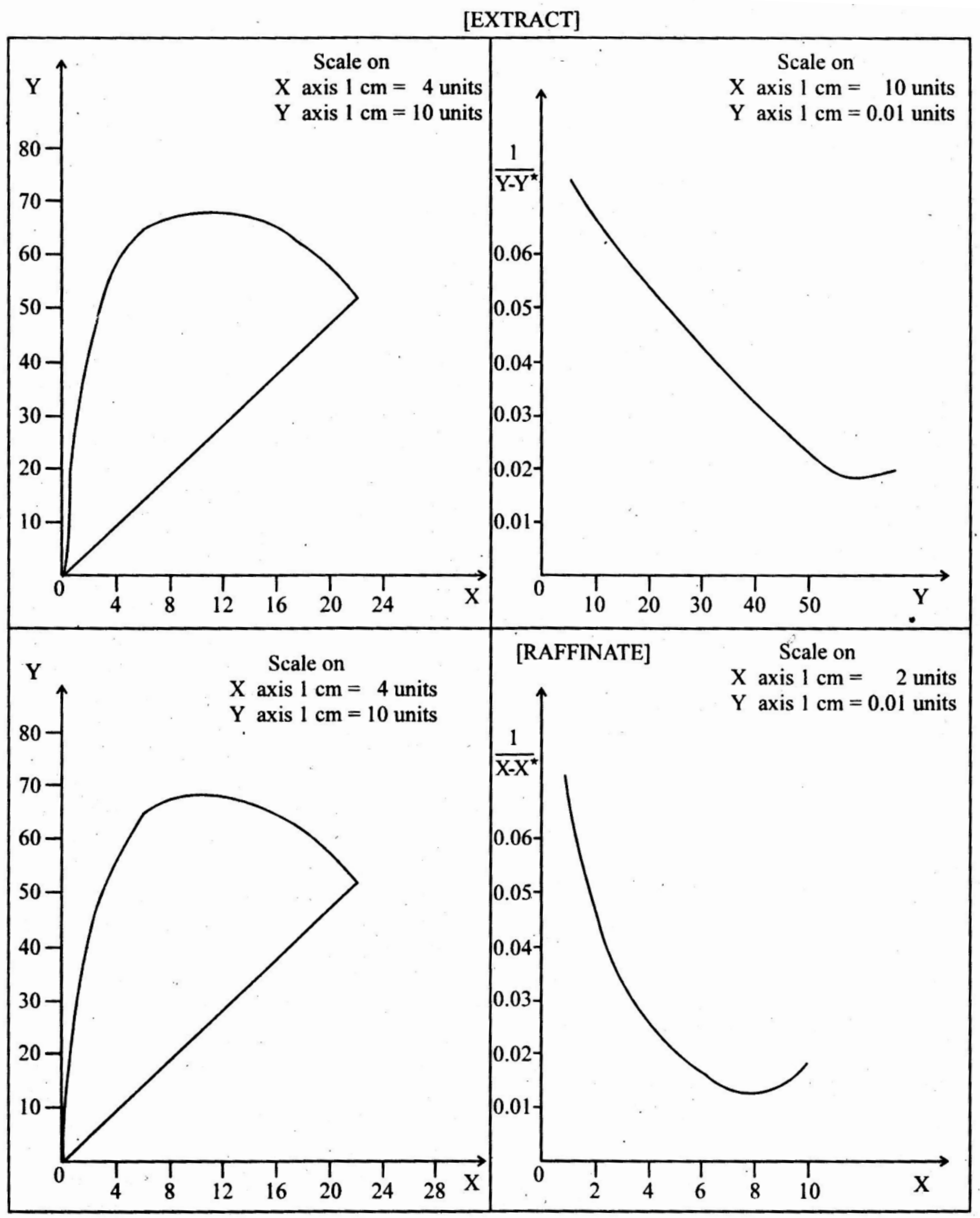
Sr. No.	Solvent	HOE	HOR
1	Benzene	0.135	0.095
2	Kerosene	0.114	0.122

Sr. No.	Solvent	KOE	KOR
1	Benzene	1.074	1.77
2	Kerosene	3.325	3.113

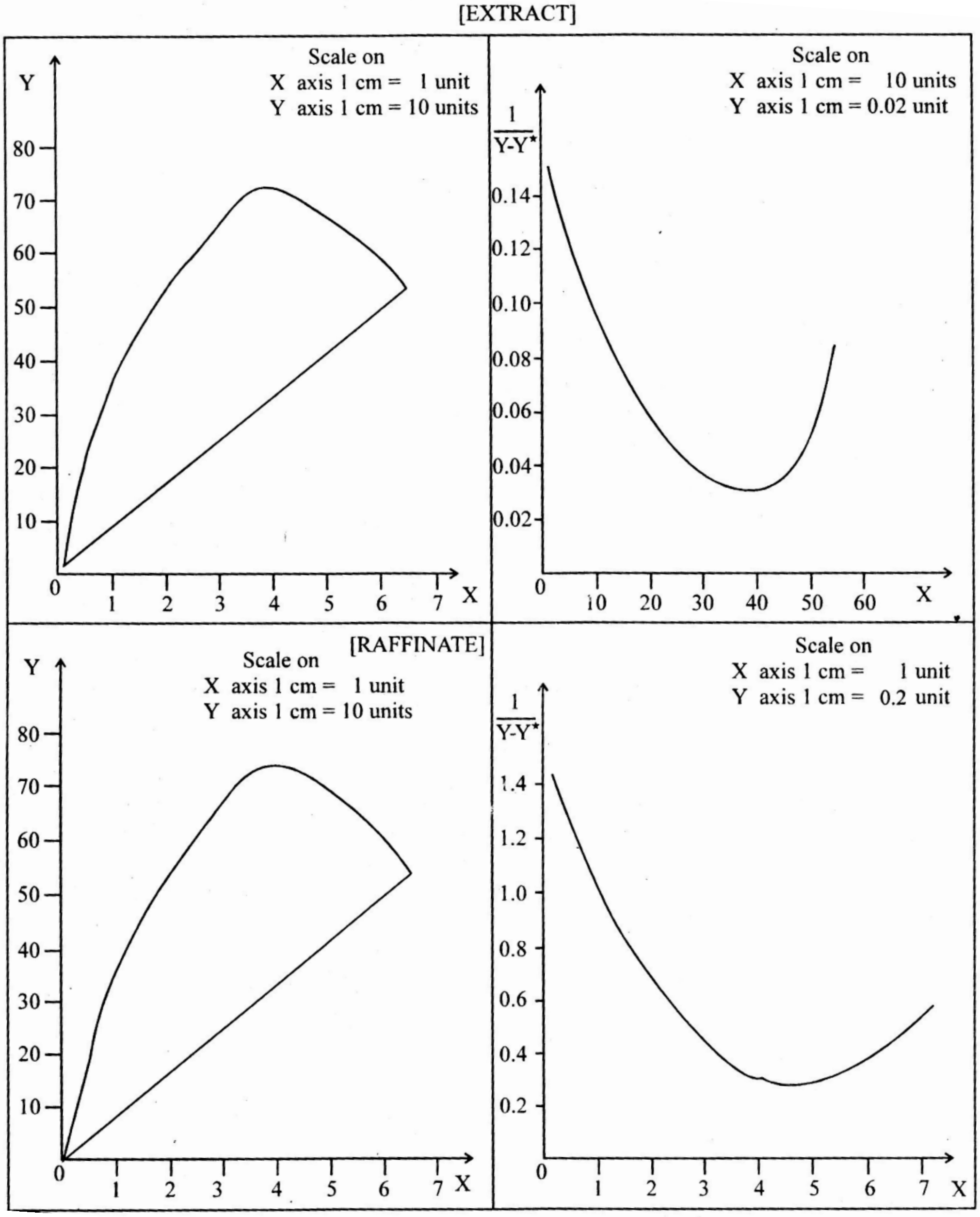
RESULTS AND DISCUSSIUNS

Extraction of acetic acid from binary mixture is done by using various organic solvents. The characterization of xylene & kerosene is given in observation table. From these tables we have compared percentage of acetic acid in extract & raffinate phase. We found that, percentage of acetic acid in extract & raffinate phase when xylene is used as solvent is higher than kerosene. From* table 5 we found that, no. of transfer unit for extract & raffinate phase is higher for kerosene. From table 5 we conclude that height of transfer unit for extract phase is higher for xylene & height of transfer unit for raffinate phase is higher for kerosene. From table 5 mass transfer coefficient for extractc & raffinate phase is higher for xylene. From table 6 we found that, for star ring packing, no. of transfer unit for extract phase is higher for kerosene than benzene & for raffinate phase the opposite is observed. Height of transfer unit for extract phase is higher for benzene than kerosene & for raffinate phase the opposite is observed. Mass transfer coeffcient for extract phase is higher for kerosene than benzene while for raffinate phase the opposite is observed. When kerosene is used with Berel saddle mass transfer coefficient for extract & raffinate phase is lower than for star ring packing. Binodial curve for all solvents are dumped shape &tie line curves are raffinate to extract.

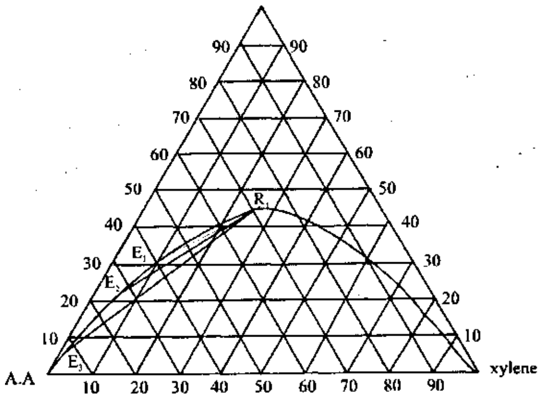
ACETIC ACID + WATER + XYLENE



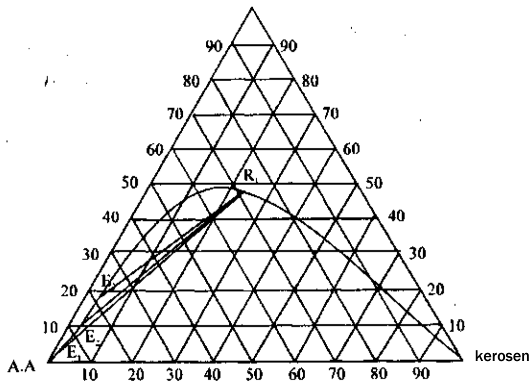
ACETIC ACID + WATER + KEROSENE



TIELINE & BINODIAL CURVE FOR XYLENE



FOR KEROSENE



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