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VEGETABLE OILS AS A SOLVENT FOR THE LIQUID LIQUID EXTRACTION OF ISOPROPANOL FROM ISOPROPANOL-WATER SYSTEM

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Abstract:
Isopropanol is a very useful and important solvent and the need of anhydrous Isopropanol is tremendous for specific applications. There are so many methods available for separating isopropanol from Isopropnol–Water system such as Azeotropic distillation, Extractive distillation, Pressure swing distillation, Reactive distillation, Diffusion distillation, Membrane pervaporation, and adsorption. Most of these methods are expensive and energy requirements are high. Liquid-liquid extraction is method used in the separation of the constituents of a liquid solution using an immiscible solvent. In the present study feasibility of vegetable oils are as a solvent in liquid liquid extraction of isopropanol from isopropanol –water system is studied
First of all suitability of vegetable oils such as sunflower, ricebran, groundnut and soybean oil was studied for this, known quantities of these oils were mixed with isopropanol and it was observed that isopropanol has shown good miscibility with these vegetable oils since water is completely immiscible in vegetable oils and isopropanol has shown good miscibility with vegetable oils so vegetable oils can be used as solvents for the liquid liquid extraction of the system of Isopropanol and water. Equilibrium data for Isopropanol water and vegetable oils system were also generated at room temperature and atmospheric pressure.

Keywords: ***Extraction, Equilibrium data, Miscibility, Vegetable oils, Anhydrous, Isoproopanol***

1. Introduction - Isopropanol has been called as the first modern synthetic petrochemical, it is a very important solvent and generally used as rubbing alcohol it is also used for medical applications, it is relatively non toxic as compared to alternative solvents. It is specially used in food industry for preserving food..Isopropanol water system forms an azeotropic mixture. Azeotrope is a defined as a mixture of two or more liquids which boil at constant temperature and possess the same composition of constituents in liquid phase as well as in vapor phase. The constituents of an azeotropic mixture cannot be separated by simple distillation because their compositions are unchanged by distillation. Azeotropes are also called constant boiling mixtures. A well-known example of a positive azeotrope is 87.7% isopropanol and 12.3% water (by weight). Isopropanol boils at 82.5 °C, water boils at 100 °C, but the azeotrope boils at 80.4 °C, which is lower than either of its constituents. Various techniques used for the separation of this mixture are azeotropic distillation, extractive distillation, membrane separation, reactive distillation etc In the present work suitability of vegetable oils like sunflower, rice bran, ground nut,soybean oil as a solvent in Liquid Liquid Extraction is checked for the above mentioned system and equilibrium data are generated at room temperature and atmospheric pressure.

2. Materials and Methods

The materials and glassware, which we are using, are mentioned below.

- Isopropyl alcohol, Distilled water, Vegetable oils
- Graduated cylinder with stopper, beaker, Relative density bottle

First, we make solution of isopropyl alcohol and water (50% by volume) and add the different quantities of vegetable oil one by one into the solution to make samples. After preparing the samples we shake it for 30 minutes in the graduated cylinder which are closed by stopper and left the sample for 24 hours to separate. After 24 hours, two separate layers in the cylinder are formed. One layer is of isopropyl alcohol + water and the second one is of oil + isopropyl alcohol. We measure the volume of both layers. We repeat the same procedure for different vegetable oil .To check whether the equilibrium is achieved or not we mixed and shacked the sample for another 30 minutes and leave it for 24 hours since the readings were reproducible it means the proper equilibrium conditions were attained .

Analysis

To calculate the equilibrium time, make a sample of isopropyl alcohol, water and vegetable oil and shake it for 30 minutes in the graduated cylinder with stopper and left the sample for two hours. After two hours, we measure the volume of both layers. Then again shake the same sample for 30 minutes and left it for two hours. After two hours, again measure the volume of both layers. If the volume of both layers is not same as we checked before, repeat the same procedure for 4 hours, 8 hours, 12 hours, 18 hours and 24 hours. At 24 hour, we get the same volume of both layers as we checked before. So 24 hour is equilibrium time for isopropyl alcohol, water and vegetable oil system. Densities were measured in RD bottle

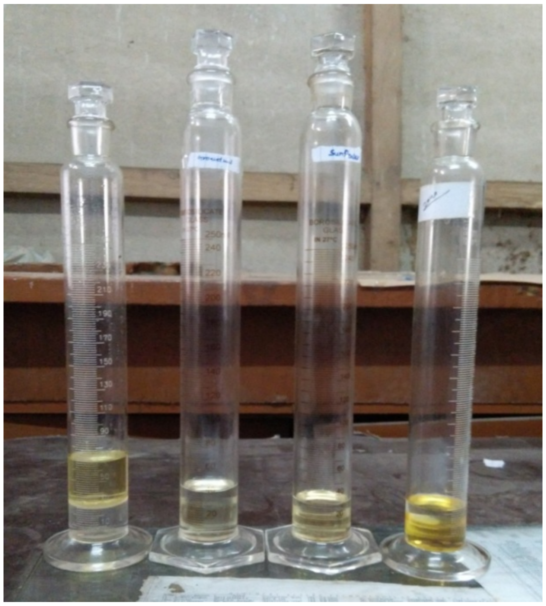

Fig1- Separation of layers – Isopropanol+ vegetable oils and Isopropanol + water

Fig 2- Relative density bottle for measurement of density

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3. Results and Discussion - From the preliminary experimentation it was clear that isopropanol showed good miscibility in sunflower, ricebran, groundnut and soybean oil. To confirm the possibility and to produce detailed data set for studies We made a solution of isopropanol and water (50 % by volume) by adding 16 ml of isopropanol and 16 ml of water. After this we add different quantities of sunflower oil into the solution to make samples. Same procedure is repeated for rice bran, ground nut and soybean oil as well.. When the liquid-liquid equilibrium is achieved, the readings have been taken which are given further and calculation of equilibrium data were done and graphs were also plotted for different vegetable oils.

Table 1: Extraction data for system composed of Isopropnol, water and Sunflower Oil

Initial			After Shaking	
Isopropanol (ml)	Water (ml)	Oil (ml)	Isopropanol + Water (ml)	Isopropanol + Oil (ml)
16	16	16	26	22
16	16	24	24	32
16	16	32	20	44
16	16	40	16	56

Table 2: Extraction data for system composed of Isopropnol, water and Ricebran Oil

Initial			After Shaking	
Isopropanol (ml)	Water (ml)	Oil (ml)	Isopropanol + Water (ml)	Isopropanol + Oil (ml)
16	16	16	24	24
16	16	24	21	35
16	16	32	18	46
16	16	40	16	56

Table 3: Extraction data for system composed of Isopropnol, water and Groundnut Oil

Initial			After Shaking	
Isopropanol (ml)	Water (ml)	Oil (ml)	Isopropanol + Water (ml)	Isopropanol + Oil (ml)
16	16	16	24	24
16	16	24	22	34
16	16	32	18	46
16	16	40	16	56

Table 4: Extraction data for system composed of Isopropnol, water and Soybean Oil

Initial			After Shaking	
Isopropanol (ml)	Water (ml)	Oil (ml)	Isopropanol + Water (ml)	Isopropanol + Oil (ml)
16	16	16	22	26
16	16	24	20	36
16	16	32	18	46
16	16	40	16	56

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X axis $X' = \frac{kg\ of\ isopropanol}{kg\ of\ water}$ and Y axis $Y' = \frac{kg\ of\ isopropanol}{kg\ of\ oil}$

Table 5 : Equilibrium Data for Sunflower oil

X`	Y`
0.41	0.44
0.25	0.41
0.10	0.39
0	0.36

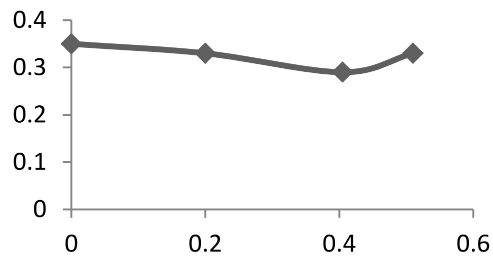

Fig 3 : Graph for Sunflower Oil

Table 6 : Equilibrium Data for Ricebran oil

X`	Y`
0.41	0.44
0.25	0.41
0.10	0.39
0	0.36

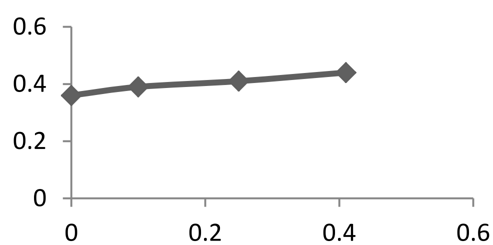

Fig 4 : Graph for Ricebran Oil

Table7: Equilibrium Data for Groundnut oil

X`	Y`
0.41	0.44
0.33	0.37
0.10	0.39
0	0.36

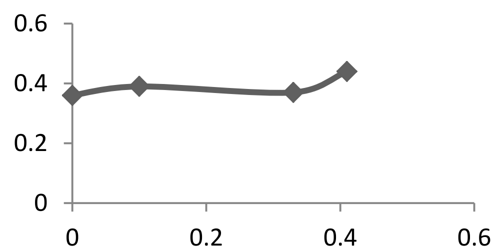

Fig 5 : Graph for Groundnut Oil

Table 8: Equilibrium Data for Soybean oil

X`	Y`
0.30	0.56
0.20	0.45
0.10	0.39
0	0.36

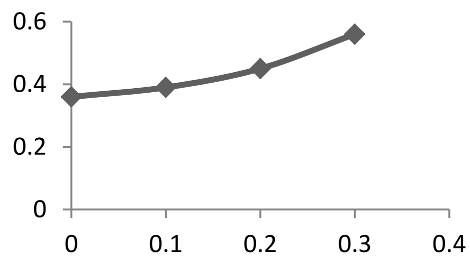

Fig 6 : Graph for Soybean Oil

Conclusions From the tables it is evident that sunflower oil, ricebran oil, groundnut oil and soybean oil can be used as a solvent for the extraction of isopropanol from isopropanol water mixture. Equilibrium data has been generated for isopropanol, water and vegetable oil ternary systems at room temperature and atmospheric pressure. Isopropanol is completely miscible with water as well as partially miscible with vegetable oil. But vegetable oil is completely immiscible in water. So, isopropanol can be extracted from isopropanol water mixture by using vegetable oil. To extract isopropanol, four different type of vegetable oil have been used. Since most of the vegetable oils have similar properties so they can be used as a solvent for extraction of isopropanol from water. The experiment has been done at room temperature and atmospheric pressure. The work can be extended for different higher temperature also. Thermodynamic modeling can also be done for the above mentioned system.

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