Investigation on phase equilibrium data for seed oil-ethanol- water ternary system.

Edward Victor Masalla

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University of Dar es Salaam, College of Engineering and Technology, 1993

An investigation on phase equilibrium data for seed oil-ethanol-water ternary system was studied. Different oil samples for experiments were collected from local oil industries in different areas of Tanzania, MOPROCO at Morogoro, SHIRECU at Shinyanga, VOIL at Mwanza and from individual palm oil millers at Kigoma. Physical and chemical properties analysed for oil samples showed that crude oils have high amount of FFA, acid value and with exceptional high Ph value for palm oil. Higher values of viscosity were noted for crude oils, difference in refractive index and density is not significant for all oil samples. Oil: ethanol –water mixture rations (wt%) between 50 : 50 and 20 : 80 were applied for UCST data determination. Oil samples with oil : ethanol ratio of 80 : 20 consisting of different values of FFA and pH at ethanol concentrations ranging from 80 : 0% to 99.8% was used for the investigation of water concentration, FFA and pH effects on UCST. Oil: ethanol –water mixture ratio (wt%) between 5: 95 and 80 : 20 were applied for solubility temperature and vapour pressure determinations. For conjugate phase equilibria, bulk solution composition having a constant oil sample of 50% by weight was introduced in the separating funnel containing a mixture of absolute ethanol with water at a ratio of 2: 48 and 10: 40 weight percent respectively. Following phase separation, extract and raffinate phases were obtained. Ethanol concentrations in extract phases were determined by Gas chromatography where peaks for the corresponding ethanol concentration were obtained by subtraction. Working temperature and pressure was 30˚c and 1 atm. respectively. It has been found that, crude oil samples have higher values of acid values, FFA and viscosity compared to refined oil samples. Higher values of FFA and acid values were noted for palm oil sample. Remarkable influence on the variation of oil and waterconcentrations to UCST of seed oil –ethamol-water termary system was observed. UCST for refined oils are approximately 35% higher compared to crude ones, this difference is however, not significant when higher ethanol concentrations are used. FFA and pH were found to have an influence on UCST and solubility data. This dependency was not significant at low and high oil concentrations. Pressure increase was experienced as ethanol concentration decreased. This

depicts the optimum range of 95.6 to 100% ethanol concentration for less pressurized solvent extraction equipments. Conjugate phase data reveals low values of equilibrium constant whose equilibrium curves downwards. The results are in agreement with literature, that for the equilibrium constant being less than unit, its equilibrium curves downwards (Phillip Wankat, 1979). Tie-line data results indicate that, data points representing concentration of the phase composition lie on the lie-lines authenticating accuracy of experimental results. Experimental and correlated data analysis by UNIQUAC equation indicate a deviation of about 8.0% for cotton seed oil with low values of FFA and about 2.0% for palm oil with high FFA value. This show that, using ASSAY DATA in Hyprotech process simulator (HYSIM), seed oils with higher values of FFA give less deviation from experimental to analysed correlated data. With respect to experimental results it is concluded that, solvent recycling process should be considered in designing a solvent extraction plant when ethanol is considered as solvent. The consideration being in regard to lower values of phase equilibrium constants which influence excessive use of solvent. However, solvent recycling process will optimize solvent requirements in seed oil extraction. Ethanol concentration ranging between 95.6 to 100% for seed oil extraction process is recommended. The concentration range offers lower vapour pressures, thus limiting the use of pressurized equipments which is ideal for safety reasons. Pilot plant design for seed oil extraction is suggested for further work so as to utilize the already established data in connection with seed oil –ethanol –water ternary system.