VAPOUR-LIQUID EQUILIBRIUM FOR THE SYSTEM WATER + ETHANOL + ISO-OCTANE AT 101.3 kPa.

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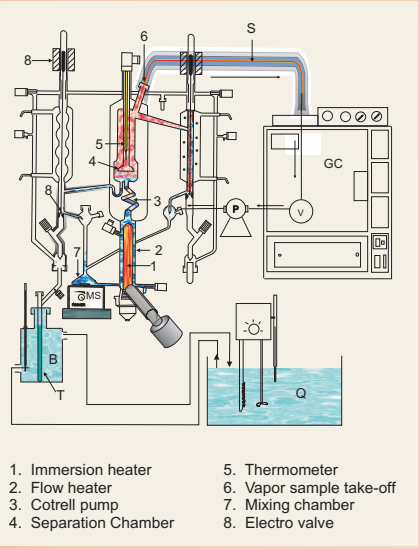
Many studies have been carried out in the heterogeneous azeotropic distillation field either by experiment or by simulation. The development of all these studies requires the use of sets of isobaric vapour–liquid–liquid equilibrium (VLLE) data. However, the number of ternary systems with experimental VLLE data is very limited, since it is difficult to find a useful equipment to determine them.

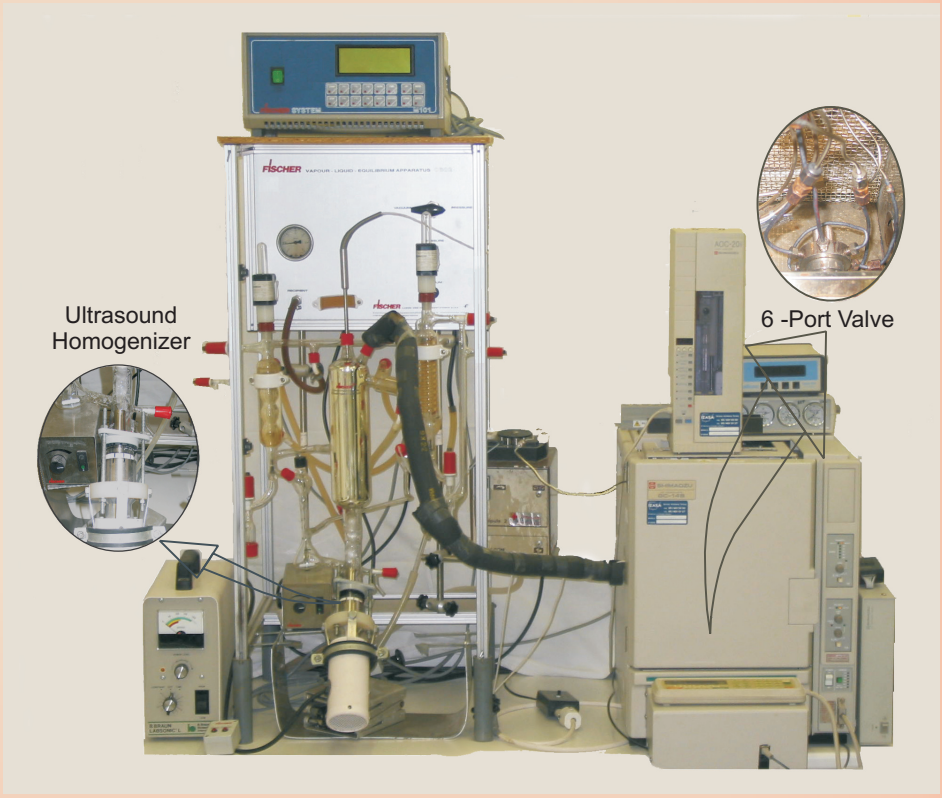
One of the most successful applications of the heterogeneous azeotropic distillation is the dehydration of ethanol to obtain absolute alcohol (Pham and Doherty, 1990) using an entrainer. Many different entrainers have been tried in order to improve this process. For example, the use of a hydrocarbon, such as 2,2,4-trimethylpentane (iso-octane), could be of considerable interest to the ethanol dehydration for use in gasohol production (Furzer, 1985).

APPARATUS



1. Immersion heater
2. Flow heater
3. Cotrell pump
4. Separation Chamber
5. Thermometer
6. Vapor sample take-off
7. Mixing chamber
8. Electro valve

The equipment used for the experimental work was the Labodest model 602 built in Germany by Fischer Labor und Verfahrenstechnik modified by Gomis et al. (2000) coupling an ultrasonic homogenizer. The use of ultrasonic sound on the boiling flask causes emulsification of the two liquid phases in all the circulating lines of liquid and avoids the oscillations in temperature and flow rate of systems with two liquid phases.



SAMPLE TAKE-OFF AND ANALYSIS

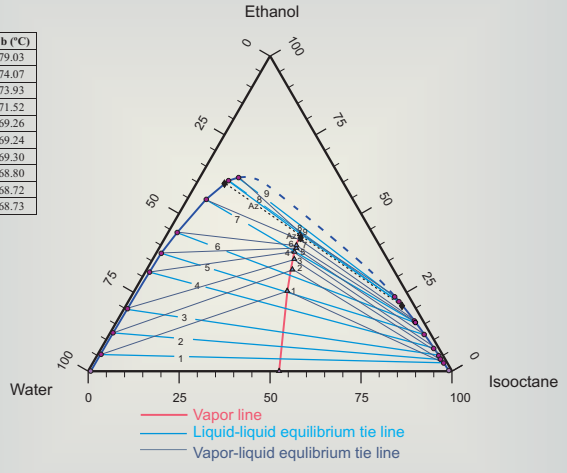
a). GASEOUS SAMPLES were injected into the GC through an 6-port valve. The tube walls S were superheated with a resistance tape so that the vapour becomes unsaturated and condensation is avoided. The analytical work was carried out by chromatography using the external standard method.

b). LIQUID SAMPLES in the heterogeneous region: a small amount of the liquid coming from the separation chamber of the instrument was diverted to a tube (T) using a solenoid valve. The sample analysis was carried out by chromatography using the internal

RESULTS

EXPERIMENTAL DATA

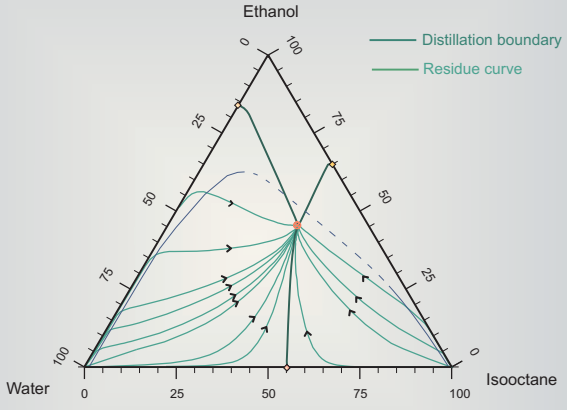
	Tb (ºC)
BIN	79.03
1	74.07
2	73.93
3	71.52
4	69.26
5	69.24
6	69.30
7	68.80
8	68.72
9	68.73



Binodal Curve and Vapour Line

The composition of the ternary azeotrope determined by numerical interpolation is 0.20, 0.43, 0.37 mole fraction of water, ethanol and iso-octane respectively and the temperature is 68.7 ºC.

RESIDUE CURVE MAP



The experimental VLLE and VLE data, together with binary data from the bibliography have been correlated using the UNIQUAC model. The parameters obtained have been used to drawn the Residue Curve Map of the system.

The main features on the map are two minimum boiling binary homogeneous azeotropes (◇), one minimum boiling heterogeneous azeotrope (◇) and a minimum boiling ternary heterogeneous azeotrope (○).