FUNDAMENTAL PERVAPORATION STUDIES WITH MEMBRANE INTRODUCTION MASS SPECTROMETRY

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Membrane introduction mass spectrometry (MIMS) is a convenient way to detect trace organics in aqueous systems. It is well suited to environmental and process monitoring. Pervaporation is the process by which MIMS operates and although there is growing literature on analytical applications of MIMS, little has been reported on how MIMS can be used to study the fundamentals of pervaporation. The understanding of the permeation mechanism of liquid mixtures through dense polymer films is important in the design of membranes for pervaporation. This work utilises MIMS to study the effects of feed flowrate and temperature on the pervaporation process, namely the enrichment, flux and depletion of organic compounds by the membrane.

All the experiments were carried out on a helium purge type of membrane inlet as described by Virkki et.al.[1] and coupled to a magnetic sector mass spectrometer [Figure 1]. A 10cm length of Dow Corning 0.51x0.94mm silicone hollow fibre membrane was used to analyse separate samples of 5ppm solutions of benzene and chloroform. The temperature and feed flowrate ranges investigated were 50^{o}C to 90^{o}C and 0.25mL/min to 4mL/min respectively. Data was collected continuously by measuring the water and organic compounds signals separately.

Results obtained show that the permeation (flux) and enrichment of organic through the membrane increased when either feed flowrate or temperature were increased. These results correlate with those shown by Dongre et al.[2] where increasing the temperature of the membrane interface increased the response of the analyte species. In addition, depletion of the organic component (ie. Amount of organic taken up by membrane) decreased with increasing feed flowrate. These results provide an absolute mass transfer description of the pervaporation process. Plots of the logarithm of flux versus the reciprocal of absolute temperature were linear and hence activation energy data can be obtained for the process.

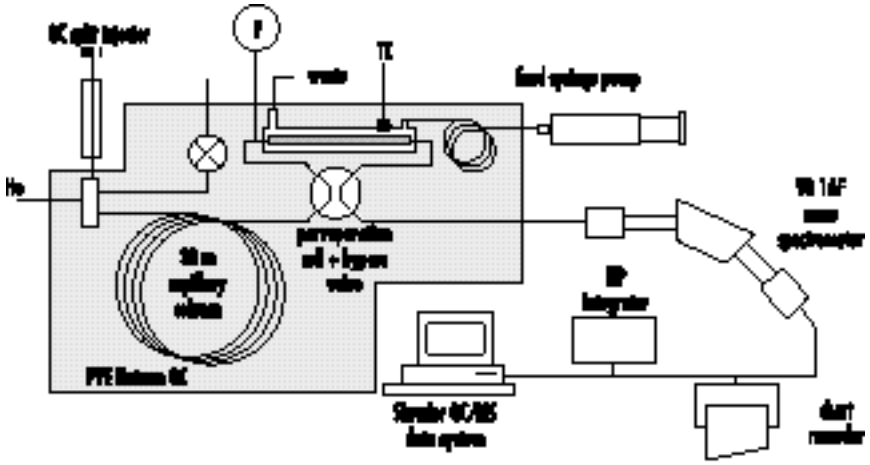

Figure 1

1. Virkki, V.T., Ketola, R.A., Ojala, M., Kotiaho T., Komppa, V., Grove, A., and Facchetti, S. Anal. Chem. 1995, 67, 1421-1425.
2. Dongre, A.R., Hayward, M.J. Anal. Chim. Acta. 1996, 327, 1-16.

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