

CHROMATOGRAPHIC DETERMINATION OF ISOSTERIC HEATS OF ADSORPTION OF AROMATIC HYDROCARBONS ON SILICA GEL

J. N. O. Fernando and Ananda Mallawatantri
(*Department of Chemistry, University of Colombo, Colombo 3*)

A gas chromatographic method has been used to obtain adsorption isotherms and isosteric heats of substituted benzenes on silica-gel.

Samples were injected using a micro-syringe. Chromatographic data obtained was used to construct adsorption isotherms in the temperature range 250–320°C. The isotherms were found to be essentially linear (in accordance with Henry's law) for the full range of coverage studied.

Isosteric heats determined by applying Clausius–Clapeyron equation gave heats which are essentially independent of coverage. Values recorded for benzene, toluene, m-xylene and mesitylene were 52, 57, 62 and 66 kJ mol⁻¹. This regular increase in heat can be attributed to the increasing number of methyl groups attached to the nucleus: their electron repelling nature causes an increase in the density of the pi-electron cloud of the aromatic hydrocarbon. It has been reported that these hydrocarbons form a pi-bond with the lone pairs on the hydroxyl groups on the surface of the silica-gel. The increasing heat can therefore be reasonably explained as being due to the increased strength of this pi-bond giving rise to an increasingly strong (though weak) chemisorption bond.

Similar studies on cyclohexane gave a heat of only 37 kJ mol⁻¹. Since similar pi-bond type interactions are not possible in this case, adsorption is possible only by physisorption.