HYSTERESIS IN SORPTION VII

Scanning of the Hysteresis Loop. Alumina Gel-Water System

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Introduction

The permanence and reproducibility of the hysteresis effect in sorption has been established in various systems such as, titania gel-water, silica-gel-water, alumina gel-water, silica gel-carbon tetrachloride, ferric oxide gel-carbon tetrachloride. A permanent and reproducible hysteresis loop can be traversed from various points on the sorption and desorption curves. Such a study called the scanning of the hysteresis loop has been made in several systems (loc. cit.). The study of the scanning of the permanent and reproducible hysteresis loop in alumina gel-water system has been presented in this paper.

Experimental

Alumina gel employed in this work was prepared according to the method described in an earlier paper and is a sample of the activated gel used in the previous study on the permanence of the hysteresis loop in sorption. The gel was activated by heating it to 950°C for 2 hours. The activated gel was degassed in vacuum (10⁻² mm.) for 6 hours.

The quartz fibre spring technique, described in Part I was employed in the present work. A series of sorptions and desorptions of water vapour on alumina gel at 30°C was effected. Sorption was effected by introducing air-free water vapour into the sorption tube and desorption by removing water vapour by means of a Cenco-Hyvac pump. In sorption and desorption sufficient time was always allowed for the attainment of equilibrium.

Scanning of the Hysteresis Loop

The permanent hysteresis loop in alumina gel-water system, which is reproduced ten times, has been indicated in a former communication. For scanning of the loop, a reproducible loop had again to be obtained as a separate sample of the same activated gel was employed in the present study. Four cycles of sorptions and desorptions were conducted. The third and fourth hysteresis loops are identical (Fig. 1). The fourth loop was scanned.
The sorptive capacity of the gel at saturation pressure is 28.52 gm. of water per 100 gm. of activated gel. Time required for completing four cycles of sorption and desorption is over 2 months and time for completing scanning is 10 days. Water irreversibly held by the activated gel at the end of first desorption is 2.25 gm. per 100 gm.

The hysteresis loop has been scanned by traversing it from various intermediate points on the sorption and desorption curves. If desorption is effected from any intermediate point on the sorption curve, the hysteresis loop is crossed and the desorption curve is reached (Fig. 2 A). If, on the
other hand, sorption is effected from any intermediate point on the desorption curve, the sorption curve is not reached but a separate curve is traced till the peak of the loop is reached (Fig. 2 B). These characteristics are in conformity with those obtained in other systems, silica gel-water, titania gel-water, silica gel-carbon tetrachloride and ferric oxide gel-carbon tetrachloride (loc. cit.). An explanation of these general characteristics on scanning, in the light of the cavity concept has been offered.\textsuperscript{1,3}

**Summary**

The permanent and reproducible hysteresis loop obtained in the sorption of water vapour at 30° C. on alumina gel has been scanned by traversing the loop from various points on the sorption and desorption curves.

The general characteristics obtained on scanning are in conformity with those of other systems, silica gel-water, titania gel-water, silica gel-carbon tetrachloride and ferric oxide gel-carbon tetrachloride.

These characteristics form a convincing evidence in support of the cavity concept.

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**REFERENCES**

2. \textit{Ibid.}, 1940, 9, 68.
5. \textit{Ibid.}, 1941, 45, 517.