[CONTRIBUTION FROM THE PHYSICAL CHEMISTRY LABORATORY OF THE STATE UNIVERSITY OF IOWA]

# Rhythmic Cracking of Silica Gels in Contact with Hypertonic Solutions

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Rhythmic cracking of rigid gels on drying in tubes of circular cross section has been reported by Davies,[1] and other regular cracking effects when the gel dries on a flat surface have been observed by Ghosh and Prakash.[2] The purpose of this paper is to describe similar cracking effects which were observed when silica gels were placed in contact with concentrated solutions in cylindrical and rectangular cells.

The cylindrical cells (Fig. 1) were from 0.2 to 0.8 cm. inside diameter and about 10 cm. long. The rectangular cells, about $1 \times 3 \times 24$ cm., were made by clamping rectangular pieces of plate glass on either side of a glass rod bent into a U-shape and covered with rubber tubing.

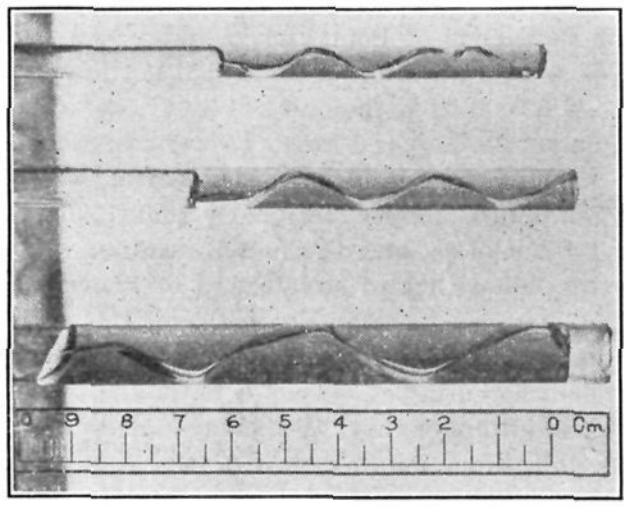


Fig. 1.—The cracking of silica gels in contact with hypertonic solutions in cylindrical cells.

The gels were prepared by adding a 1.59 *N* solution of sodium silicate (sp. g. 1.160) to an equal volume of 4.75 *M* hydrochloric acid. The diffusing solution placed on top of the solidified gel contained 0.787 *M* sodium chloride, 1.589 *M* hydrochloric acid and 1.00 *M* cupric chloride.

Two types of cracks develop in the rectangular cells (Fig. 2) when the water diffuses from the gel into the hypertonic solution. One (Type A) consists of a main cleavage plane extending parallel to and approximately midway between the two faces of the cell, and small lateral cracks perpendicular to the main cleavage plane. It

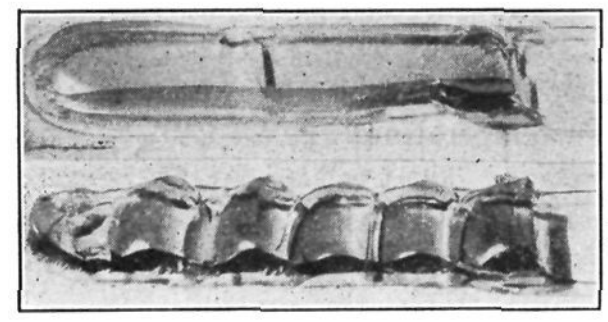


Fig. 2.—The cracking of silica gels in contact with hypertonic solutions in cells of rectangular cross section.

occurs most often when the initial crack at the top of the gel starts midway between the two faces of the cell. In Type B, the main cleavage has a wave form with relatively few, if any, lateral cracks. In both types the initial cleavage is always in a straight line perpendicular to the smallest dimension of the cell. Occasionally Type A changes to Type B as the crack proceeds downward into the gel, but the reverse change was not observed.

In cylindrical cells only Type B cracks were formed. In some cases the gel would shrink away from the glass without cracking. The effects are in general less regular if the diameter of the tube is greater than 1 cm.

In both flat and cylindrical cells the wave length of Type B cracking is approximately 4.5 times the amplitude, as observed by Davies[1] in drying gels.

The same effects were obtained with concentrated solutions of sucrose but not with more dilute solutions.

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(1) Earl C. H. Davies, *J. Phys. Chem.*, **35**, 3618 (1931).
(2) S. Ghosh and Satya Prakash, *Koll. Z.*, **63**, 315 (1933).