## The Absence of Fatty Acids Associated with Potato Starch

BY LEO LEHRMAN AND ELVIN KABAT

In the course of some work on potato starch[1] it was necessary to know the amount of fatty acid, if any, associated with the starch. Though 0.04% "fat by hydrolysis," has been reported in this starch,[2] Taylor and other workers in this field now believe that it is fat free.

To establish this point definitely we extracted a 50-g. sample of potato starch with petroleum ether for several hours and found 0.02% extraneous extractable material. Then we hydrolyzed[3] 2000 g. of the starch and found approximately 0.02% "fat by hydrolysis."

Thus potato starch does not contain fatty acids associated with it and is the best whole starch to use as carbohydrate.

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[1] The authors wish to thank Stein Hall & Co., Inc., N. Y. C., for their kindness in supplying this material.

[2] Taylor and Nelson, THIS JOURNAL, **42**, 1726 (1920).

[3] Lehrman, *ibid.*, **51**, 2185 (1929).

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# COMMUNICATIONS TO THE EDITOR

### AN EQUATION RELATING DENSITY AND CONCENTRATION

*Sir:*

Redlich and Rosenfeld [*Z. physik. Chem.*, **A155**, 65 (1931)] have shown on the basis of the Debye–Hückel theory that the partial molal volume of an electrolyte in dilute aqueous solution is proportional to the square root of the normality. This gives a theoretical basis for Masson's empirical rule [*Phil. Mag.*, (7) **8**, 218 (1929)] connecting the apparent solution volume of a salt with its concentration in the solution.

$$\phi = \phi_0 + K\sqrt{N}$$

The relation between the concentration and density of a salt solution and the apparent solution volume of the salt can be shown to be

$$\phi = \frac{\text{Eq. Wt}}{D_{\text{H}_2\text{O}}}\text{ salt} - \frac{1000}{D_{\text{H}_2\text{O}}}\left[\frac{D_{\text{soln.}} - D_{\text{H}_2\text{O}}}{N}\right]$$

By combining these two equations one obtains for the equation relating the density and normality of a solution of a strong electrolyte in water

$$D = D_0 + c_1N + c_2N^{3/2}$$

where $c_1$ and $c_2$ are constants, and $D_0$ is the density of pure water.

This equation was found to hold within the limits of experimental error for solutions of the alkali (without lithium) and alkaline earth halides to a concentration at least as high as 10 *N;* and for sulfuric acid to a concentration of about 25 *N* (75 wt. %) where there was a point of inflection. The constants $c_1$ and $c_2$ were found to be additive.

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# THE SPECIFIC SURFACE AND THE ADSORBENT PROPERTIES OF LEAD SULFATE

*Sir:*

1. In agreement with the results of F. Paneth and W. Vorwerk [*Z. physik. Chem.*, **101**, 445, 480 (1922)], it was found that the specific surface of lead sulfate was the same in suspensions in water as in the presence of an excess of lead nitrate. P. and V. derived an equation from which may be inferred that in the suspension of lead sulfate in water about 40% of the surface of the solid was covered with adsorbed lead ions, whereas the surface was covered with a monatomic layer of lead ions in a solution of 0.005 molar lead nitrate. We determined also the specific surface of lead sulfate in dilute solutions of sodium sulfate and found the same value as before. This constancy of the specific surface indicates that lead sulfate adsorbs neither lead ions from dilute lead nitrate solutions nor sulfate from dilute sodium sulfate solutions. This conclusion was supported by the determination of the adsorption of the two salts according to chemical methods. Considering that we worked with coarsely crystalline precipitates of lead sulfate (of the same size as those of P. and V.) it is quite possible that an adsorption takes place at the corners and the edges. If the latter would have been completely covered with adsorbed lead or sulfate ions, the adsorption would amount to less than 0.1% of the total surface of the coarse crystals, which is beyond detection by the experimental methods used.

2. The adsorption of the sodium salt of Ponceau 4R by lead sulfate was determined under various conditions. It was found that only dye ions were adsorbed, no sodium ions being removed from the solution. This means that we are dealing here with an exchange adsorption, sulfate ions being replaced by ponceau ions in the surface. Experiments are being carried out in this Laboratory with various ionic precipitates showing that the exchange adsorption occurs quite generally.

A detailed account of all the work will soon be presented for publication.

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