STUDIES OF ASTRINGENCY.*

PART I.—A METHOD OF MEASURING ASTRINGENCY.

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In various industrial processes, it is often necessary to measure at least relatively the astringent action of certain chemicals such as alum, zinc chloride, alcohol, tannic acid and certain mixtures of these substances. In reviewing the literature relative to this property, the writer was unable to find a method of rating astringency. The property is defined by Wilson[2] in terms of combination of tannin materials with animal skin. He says that when skin is placed in contact with tannin solution, the combination of tannin with the outer surface of the skin results in a tension or an area differing from that of the skin as a whole. While such a definition allows us to picture to some extent the nature of astringency, it does not give us a quantitative measurement of this property.

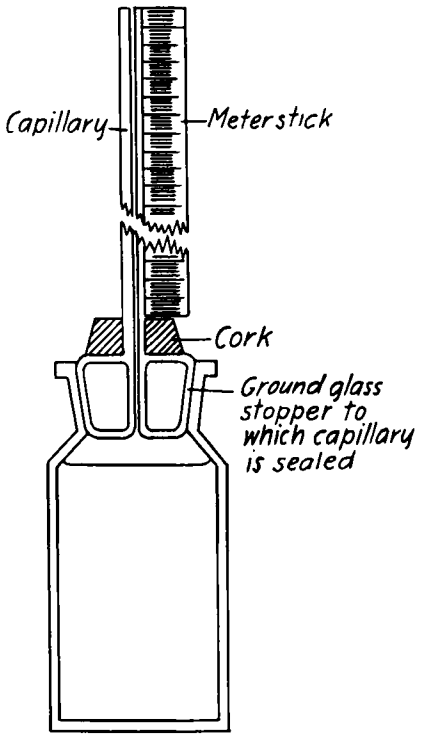

Fig. 1.—Bottle dilatometer.

If well-swollen tissue (skin) is placed in contact with such solutions as zinc chloride, alum, alcohol and water, then after an hour the skin surface examined microscopically, the surface of the pieces of skin immersed in zinc chloride or alum is seen to be drawn or tight while that immersed in water is unchanged. This experiment gives us a more quantitative picture of astringency but is entirely too cumbersome for ordinary laboratory measurement.

Theis and Neville[3] have shown that if tissue be brought in contact with water and placed in an improved "dilatometer," a contraction of the net volume takes place. This contraction is measured in the capillary tube attached. The apparatus used is shown in Fig. 1. The volume contraction is a direct measure of the hydration of the tissue. The theory involved is the following: When a tissue hydrates, the water taken up by the tissue during hydration is placed under compression within the tissue, the compressed water naturally occupying less space—resulting therefore in a decrease in net volume of the system.

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[2] J. A. Wilson, "The Chemistry of Leather Manufacture," *A. C. S. Monograph*, Chem. Catalog Co., 1928.

[3] *Ind. Eng. Chem.*, 21 (1929), 377.

This same theory should if true, work in the opposite manner—that is if we start with a fully hydrated tissue, placing it in the dilatometer together with a dehydrating solution, a net expansion of the system should occur, being measured in the capillary tube.

In microscopical studies of the action of so-called astringent solutions upon hydrated skin we find a "shrunken" effect-indicating dehydration. We can thus hypothecate that the action of astringents is to cause an instantaneous surface dehydration. If such is the case, then placing such solutions as those made from alum, zinc chloride, etc., in contact with hydrated skin, should cause a net increase of the system. This we find to be the case as is graphically shown in Figs. 2 and 3.

DISCUSSION.

Figures 2 and 3 show the dehydration of animal skin due to the astringent action of various substances. Figure 2 shows the relative astringency of a commercial mouth wash in comparison to such chemicals as alum and zinc chloride. It is also to be noted that for any given strength, zinc chloride exerts a greater dehydrating or "astringency" effect than does alum. The action of zinc chloride and alum may

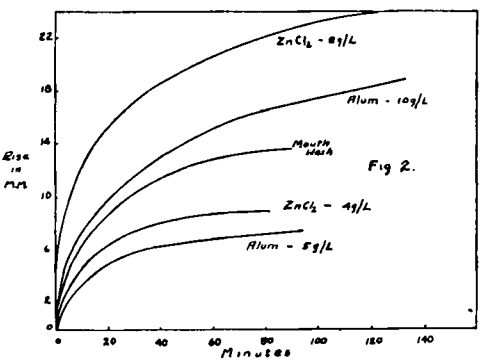

Fig 2.

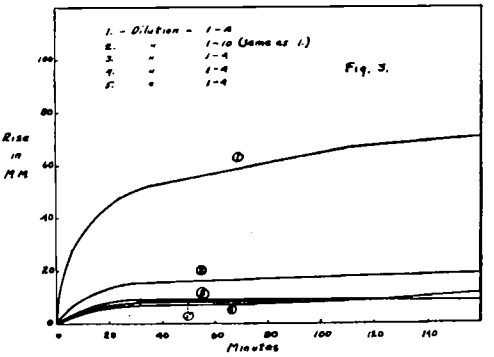

Fig. 3.

possibly be due to two distinct effects—hydrolysis of the reagent into hydrated oxide and free acid as shown in following equation:

$$ZnCl_2 + 2H_2O \rightleftharpoons ZnO.H_2O + 2HCl$$

Experimentally, the small amount of hydrochloric acid formed, was found to account for but a very small portion of the hydration while the formation of hydrated oxides appears to cause the greater portion of the dehydrating action.

Figure 3 shows the relative effect of various commercial astringent preparations and indicates that the various preparations differ widely as measured by this method. These preparations (as according to formula on label) all contained alcohol and zinc chloride.

CONCLUSION.

A distinctly new method for measuring the relative "astringency" of liquids has been devised. This method is based upon the principle that if well-hydrated tissue is treated with an astringent liquid, a net increase of the system occurs, which can be accurately measured. The astringent action of various chemicals and commercial preparations has been demonstrated and is shown graphically.