walled hard glass tubing (not Pyrex). Attempts at sealing these tubes (and *B*) into a glass support for the cell and chimney were unsatisfactory, so a rubber stopper and a short glass collar of slightly greater diameter than the chimney

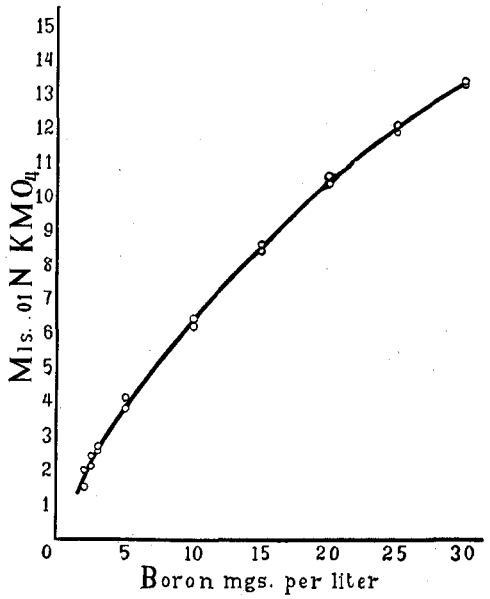

FIGURE 5. POTASSIUM PERMANGANATE SOLUTION REQUIRED TO ELIMINATE FIRST GREEN BAND FROM SPECTRA OF BORON BURNED IN OXYGEN

were substituted. A metallic base supported with a ring-stand clamp is recommended for the introduction of the gas tubes and support of the cell and chimney. The chimney is of heat-resistant glass. An unsteady flame due to currents of oxygen can be avoided by placing glass wool in the bottom of the chamber.

Figure 5 shows the grams per liter of boron in methyl alcohol represented by any quantity of 0.01 *N* potassium permanganate solution within the limits of the method.

The possibility of replacing the buret and cell with a scale and sliding glass wedge similar in color to potassium permanganate solution was considered but was not investigated. The use of the wedge would probably simplify the absorption of the spectrum and shorten the method, but to approach the accuracy of the buret and cell, the lengths of the scale and wedge would probably be too great for convenience. The spectroscopic method by burning in oxygen will detect the presence of less than 0.5 part per million of boron in methyl alcohol. Quantities of boron between 3 and 30+ parts per million can be determined quantitatively with an accuracy of ±0.35 part per million.

Plant materials could not be checked as accurately as could solutions of boric acid, but could be checked within the limits of ±0.95 part per million, or ±0.000095 per cent on a moisture-free basis.

The method of Wilcox (*10*) and the A. O. A. C. (*1*) volumetric method were not applicable to the determination of such minute quantities of boron as occur in normal plant tissues. The low buret readings on extremely large samples of plant material and the necessity of two additions of standard alkali resulted in a wide range of inaccuracy.

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An Esterification Resin as a Ground-Joint Lubricant

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IN A paper by Bruun and Schicktanz (*1*), mention is made of the use of a mixture of diethylene phthalate and triethylene phthalate resins as a stopcock lubricant for use in contact with petroleum distillates. Although this mixture was found to have the desired consistency and stability for a ground-joint lubricant, it was not adapted for use with distillates rich in the aromatic hydrocarbons, since these resins are readily soluble in benzene and toluene. It was found that a resin made with a polyglycol and a tri-reactive acid, in which the esterification was allowed to proceed only to the fusible stage, provided a lubricant having the proper viscosity which was insoluble in both the aromatic and aliphatic hydrocarbons.

One mole of citric acid and 1.5 moles of tetraethylene glycol were heated together at 180° to 185° C. for 90 minutes. The flask was then removed from the oil bath and allowed to cool to room temperature. Prolonged heating of this mixture results in an infusible product. The resin obtained was clear, amber-colored, of balsam consistency, and possessed marked adhesiveness. It was found to be readily soluble in water, alcohol, and acetone, but insoluble in petroleum ether and toluene. Chemical analysis indicated about 65 per cent esterification.

When applied by the customary technic to ground joints, it provided a satisfactory seal in contact with petroleum distillates over considerable periods of time with no tendency to become thin, and of low lubricating value. In contrast with many lubricants suggested for this purpose, the resin offers greater stability, is chemically inert, and may be kept indefinitely without changes occurring in its properties.

Tetraethylene glycol, $CH_2OH(CH_2OCH_2)_3CH_2OH$, may be synthesized from ethylene oxide and triethylene glycol in a pressure reaction. It boils at 190° C. at 3-mm. pressure. The presence of the long chain separating the two reactive groups imparts fluidity when it is used as a resin base. A similar resin made with citric acid and triethylene glycol was more viscous and, when used at room temperature, presented too much resistance to turning of the stopcock.

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