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F. P. VEITCH & M. G. DONK

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H. W. WILEY, Chief of Bureau.

COMMERCIAL TURPENTINES:

THEIR QUALITY AND METHODS FOR THEIR EXAMINATION.

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WASHINGTON:

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF CHEMISTRY,
Washington, D. C., October 15, 1910.

SIR: I beg to submit for your inspection and approval the results obtained in an investigation made in this Bureau by F. P. Veitch and M. G. Donk on the adulteration and grading of turpentines. The results show the extent to which turpentine is adulterated, and indicate the loss of values to the turpentine farmers, and the extent to which turpentine users are defrauded by adulteration. Methods for the analysis and testing of turpentine have been simplified and improved. Based largely on this investigation and the field work connected therewith, specifications for grades are suggested which it is believed will prove equitable to the producer and enable the purchaser to secure turpentine of the character desired. The data obtained are thus of special interest to the buyers and sellers of this product. I recommend that this report be published as Bulletin No. 135 of the Bureau of Chemistry

Respectfully,

H. W. WILEY,
Chief of Bureau.

Hon. JAMES WILSON,
Secretary of Agriculture.

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COMMERCIAL TURPENTINES.

INTRODUCTION.

NATURE AND GENERAL PROPERTIES.

Commercial spirits of turpentine is a mixture of similar and closely related terpenes having the general composition expressed by the formula $C_{10}H_{16}$, with varying quantities of oxidized and hydrated derivatives of terpenes, usually present only in small amounts when first distilled from the gum.

These terpenes differ both in their physical and chemical properties, and consequently commercial turpentine may distill at from 154° to 215° C. (309° to 419° F.). The fractions obtained on distillation have specific gravities ranging from 0.8580 to 0.9500 or more, with refractive indices of from 1.462 to 1.520, respectively.

The pinenes, several of which, differing slightly from one another in boiling point, specific gravity, and refractive index, have been recognized, are among the chief constituents of spirits of turpentine freshly distilled from the gum. Dipentene[1] has also been reported as occurring in American turpentine, but as dipentene distills alone at about 178° C., it is probably present in but small quantities in those turpentines which distill completely below this temperature. The above-mentioned terpenes boil between 155° C. (311° F.) and 178° C. (352° F.); their specific gravities lie between 0.845 and 0.866, and their refractive indices between 1.46 and 1.472. Other constituents which may be present, regarding the identity of which but little is known, have specific gravities of from 0.865 to 0.950 and refractive indices as high as 1.5200 at 20° C., and boil at from 160° C. to 215° C. (320° to 419° F.). Turpentines which have been kept long, particularly those held in partly filled vessels, frequently have higher specific gravities, refractive indices, and boiling points than freshly distilled turpentine. In changing they become more oily and usually somewhat darker in color.

The quantity of each constituent present in commercial American turpentine is influenced not only by the physiological processes of the individual trees, but also, and probably more largely, by the

[1] Gildemeister, Die Aetherische Oele, 2d ed., 1910, p. 328; Allen, Commercial Organic Analysis, 3d ed., vol. 2, pt. 3, p. 263.

conditions under which the crude gum is gathered and the time which elapses before it is distilled, by the method of conducting the distillation, and finally by subsequent storage conditions. When the face of the tree over which the crude gum flows before it reaches the box is long, the weather hot, and the gum is kept long before it is distilled, there is more evaporation of the lighter constituents and at the same time the oxidation and polymerization of the gum are increased. It is customary to carry the distillation further on gum from old than from new boxes. The temperature in the final stages of the distillation rises higher, as a rule, and the product obtained near the close of the distillation is more frequently colored or burned. For these reasons turpentine from old boxes, as a rule, is heavier, distills less completely below 170° C., and has a higher refractive index than turpentine made from first-year gum or "virgin dip."

One of the chief causes of the observed variations in the constants of turpentine freshly distilled from the gum lies in the practice followed in the barreling of the product at the still. From time to time during the distillation the turpentine is transferred to barrels for shipment, and as a rule the turpentine first distilled is placed in one barrel, the middle portion in another, and the last off in a third barrel. In the earlier stages of the distillation the turpentine having the lowest specific gravity, refractive index, and distilling temperature passes over. As distillation proceeds the distillation temperature, gravity, and refractive index of the distilling turpentine steadily increase, though with occasional lapses and not necessarily proportionally. As a result the constants of the turpentine in the first barrel may agree with the lower limits, while that in the last barrel may approach the upper limits recognized for turpentine.

Because of these conditions, exposure in the woods, variations in distilling, differences in the product at successive stages of the distillation, and changes in composition after distillation, it is customary to recognize variations in the specific gravity of turpentine from 0.862 to 0.875, in refractive index from 1.4670 to 1.4750, both at 15.5° C., and in the initial boiling point of from 154° C. to 159° C. (309° to 318° F.), while the percentage which distills below 170° C. (338° F.) varies from about 85 to 99 per cent.

Old turpentine, even though it is kept in closed vessels, may undergo changes and have a specific gravity as high as 0.9460 and a refractive index of 1.480 or more, while the initial boiling point is raised and the percentage distilling below 170° C. (338° F.) is lowered.

It is desired in this bulletin to distinguish between old turpentine and turpentine to which mineral, coal tar, or other dissimilar oils have been added. While old, highly oxidized turpentines can not properly be classed as normal turpentines, they are, nevertheless,