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THE USE OF THE PENETROMETER IN THE DETERMINATION OF CONSISTENCY OF PETROLEUM JELLY*

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The object of this short talk is to explain to those not familiar with the penetrometer the working method to be employed with this apparatus and precautions which should be undertaken to ensure that repeatable and comparable results may be obtained which are indicative of differences in consistency between petroleum jellies from different sources. As many of you will be aware, the consistency of petroleum jelly can vary sufficiently to cause subtle differences in the finished product in which it is used and, although a Yellow B.P. W/A Grade 45 or a White B.P. W/A Grade 40A or 40B may be specified, you may not always receive supplies derived from

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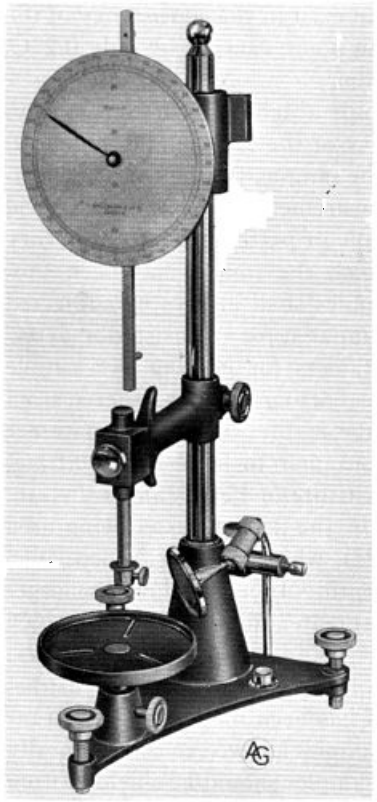
the same source. The B.P. specification for melting point range for both white and yellow jelly lies between 38 and 56°C. and, even though you obtain supplies with a melting point with a much smaller range, say 4°C., considerable differences may be felt between samples when handled. Later in this talk, I shall attempt to show you that, although a number of samples of petroleum jelly can have melting points lying within 3°C. of each other, a very considerable difference can exist in the consistency of the samples. In fact, samples having a melting point varying by only 0.2°C. can have a difference in consistency of 2.8 mm.

At this point, it may be as well to attempt a definition of consistency. Briefly it is the degree of firmness or solidity of the sample and is defined by the penetration of a standard cone into the sample, the depth of penetration being measured in $^1/_{10}$ mm., this measurement being the numerical value reported. The consistency of a sample of petroleum jelly will vary somewhat, depending on conditions to which the sample has been subjected. It is therefore important that samples shall always be subjected to the same set of conditions when being compared for a consistency determination by the penetrometer. The containers for holding the sample to be tested should be cylindrical with a flat bottom and constructed from metal of sufficient gauge to prevent any give at the side of the container when handled. It is preferable for the container to have a well-fitting, slip-on cover. The size specified by the Institute of Petroleum is $2^3/_{16}$ in. internal diameter × $1^3/_8$ or $2^1/_4$ in. in depth (the deeper vessel being used for samples with a consistency of over 225), whereas A.S.T.M. specified $4 \pm {}^1/_4$ in. diameter and $2^1/_2$ in. or greater depth. In my opinion, the larger container is to be preferred because of the greater number of tests which can be carried out on the one sample.

The coded containers should be heated to 180°F., filled to a level just below the top rim with petroleum jelly which has been melted in a constant temperature oven at 180°F., and the filled samples allowed to cool naturally on a level bench free from vibration. The samples should be shielded from direct sunlight or draught and if possible should be in a temperature maintained at 77 ± 5°F. After the samples have solidified, they should be allowed to age for not less than sixteen hours before testing and during at least six hours of this time the sample should be in air maintained at 77 ± 1°F., or the lids sealed and the container completely immersed in a water bath maintained at 77 ± 1°F. It is preferable that the sample be tested without disturbance of the surface but if it is found, as is sometimes the case, that the surface is depressed toward the centre, the surface may be carefully cut level with a sharp blade, care being taken not to work the surface during this operation. If the surface is badly depressed at the centre, the sample is best discarded. If the cone temperature varies by more than 3° from 77°F., its temperature should be adjusted to 77 ± 1°F.,

as also should be the blade if this is used to cut the surface of the sample.

The penetrometer itself should be of robust construction and operated in a manner that will not transmit vibration or shock to the samples at the time of impact and contact between the cone and sample. The instrument shown here is the type usually met with but may vary slightly. The cone should be preferably of stainless steel or hardened steel, as this is less liable to damage than one made from brass or stainless with stainless or hardened steel tip. It is essential that the cone be fabricated to the external dimensions specified and that the total moving weight, that is the weight of the cone plus the plunger, shall be 150 gm. If a light cone is used, a weight must be attached to bring the total weight to 150 gm. The specified dimensions of the cone may be obtained from the "Standard Methods for Testing Petroleum and Its Products," I.P. 50/48. The release mechanism should be perfectly smooth in action and the cone and attached shaft should be free to drop on release without appreciable friction.



With samples and penetrometer prepared, the tests should be carried out without loss of time and if possible in a room in which the temperature is maintained within reasonable limits. The penetrometer should be set on a level bench free from vibration and the instrument adjusted until the sample platform is level, using the level gauge mounted on the base of the instrument.

Place the sample on the penetrometer table, adjust the upper assembly so that the tip of the cone is $1^1/_2$ in. from the side of the rim of the container, the tip being sited just above the surface of the sample. If the sample should have a consistency greater than 200, only one test should be carried out with the cone tip sited centrally over the container. Adjust the bottom platform until the tip of the cone is just touching the surface of the sample (adjustment is simple if a light is placed behind the cone to throw the shadow of the tip on to the surface of the jelly when the correct adjustment is arrived at by making the tip of the cone coincident with the tip of

the shadow). A mirror is mounted on the penetrometer to facilitate positioning of the cone tip on the surface of the sample. Adjust the measurement bar so that it rests on top of the plunger bar, set the scale to zero, and quickly but gently release the plunger, keeping the release catch depressed for five seconds by stop watch while the cone penetrates the jelly surface. At the end of five seconds, take your thumb from the release catch so that the cone is held, carefully adjust the measurement bar to rest on the top of the plunger bar, and record the penetration which is shown on the scale in units of $^1/_{10}$ mm. Report to the nearest 0.1 mm. Withdraw the cone from the jelly by depressing the release catch and moving the plunger and cone upward, wiping the cone free from jelly with a clean cloth and ascertaining that no jelly or cloth fibres are on the cone before making the next test.

The total surface area of jelly disturbed has a diameter approximately equal to the depth of penetration and it is essential that, for every subsequent test on the same sample, the tip of the cone shall not be placed nearer the edge of the previous depression than a distance equal to the penetration of the previous determination. The number of tests which can be carried out on a sample will depend upon the diameter of the container and the consistency of the sample. If conditions permit, it is advisable to carry out ten tests on each sample recording the mean penetration of the ten tests. Any three test results should not differ from the mean by more than the following amounts:

(a)	with consistencies less than 200	1.5
(b)	with consistencies greater than 200	3.0

and the reproducibility with different operators should not be greater than

(c)	with consistencies less than 200	7
(d)	with consistencies greater than 200	11

To illustrate variations in consistency, there is given in the table below results from samples of straight petroleum jelly, together with their melting points, and also results in consistency with melting points of petroleum jelly which has been doctored with additions of 1, 5, and 10% of paraffin wax. From this table you will observe that, although the melting points may be quite close, the consistency can vary considerably.

Sample	Composition	Consistency (Mean of 10)	Melting Point, °C.
2907A	Straight white Petroleum Jelly	170	40.9
2908A	2907A + 1% paraffin wax	163	41.8
2909A	2907A + 5% paraffin wax	158	42.7
2910A	2907A + 10% paraffin wax	136	43.6
2911A	Straight Yellow Petroleum Jelly	172	40.5
2912A	Straight Yellow Petroleum Jelly, different source	158	41.6
2913A	Straight White Petroleum Jelly, different source from 2907A	162	42.3
2914A	Straight White Petroleum Jelly, different source from 2907A and different grade from 2913A	164	43.4

It will be apparent to you from reading these results that the firmer the jelly, the lower its consistency; conversely, a soft jelly will show a high consistency and, although the melting point between samples may be only small, the difference in consistency can be large. Whether you require a petroleum jelly with a low or high consistency depends upon your particular problem but to those of you in the audience who have not before used the penetrometer I would say that this instrument is of use in the classification of petroleum jellies, providing it is appreciated that consistency is not necessarily related to quality.

ASSESSING THE QUALITY OF AN ESSENTIAL OIL*

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"Quality" is a somewhat vague term, especially when applied to essential oils, on account of its wide scope. Its general meaning may be taken as suitability for all purposes for which the product in question may be used.

In so far as essential oils are concerned, assessment of quality involves several factors which differ in importance according to the principal use to which the oil is to be put.

These factors are in the nature of specific requirements and are quite independent of the intrinsic "genuineness" of the oil, which for the moment may be assumed to conform with recognised trade standards in its

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