Margarine Oil Formulation and Control

Abstract

The spreadability of margarine and butter can be measured in a simple and fast way by the cone-penetration method. A comparison of this method with the Prentice extrusion technique showed that the cone-penetration method is more accurate; the correlation coefficient between the results of the two methods is ≥ 0.95; and both methods give an equally fair prediction of consumer assessment.

In a recent article (1), Wiedermann discussed the methods of determining the spreadability of margarine. It is stated that textural properties manifest themselves under dynamic conditions and that texture measurements should therefore not be performed under static conditions as is, for instance, the case with cone-penetration measurements. A dynamic method (e.g., the extrusion technique of Prentice) is preferable. Some years ago we compared both methods. Wiedermann's paper encourages us to publish the results.

In extruder measurements the margarine is pressed through a small hole (⅛ in.) under influence of an extrusion thrust (ET). Part of the structural hardness, however, is destroyed during the measurement, by the amount of worksoftening depending on the velocity of extrusion, and by the diameter of the orifice.

The yield value calculated from cone penetrations (2) presents a substitute characterization (not depending on an instrument) of one of the flow properties in the absence of worksoftening. The idea of using the yield value as a measure of the spreadability was based on the finding that yield value and apparent viscosity (slope of the flow lines) are closely related. So the situation sketched in Figure 3 of Wiedermann's article will hardly occur in practice. On this ground one can expect some close correlation between the results of both methods. When, moreover, the worksoftening levels of the samples do not differ too much, and this is normally the case with margarines (3), the correlation is expected to be even better. For a number of margarines both methods were used and a straight-line correlation was found:

$$ET_u = 0.66\ C_u - 70$$

where ET = extrusion thrust (varying from 100–1400 g) according to Prentice, C = yield value (g/cm^2), and u indicates that unworked margarines were used.

The correlation coefficient was 0.95, and the standard deviation 125 g.

The same margarine samples were also worked isothermally (3) and used immediately for the measurements. A different relation was found with a closer fit and a lower standard deviation:

$$ET_w = 1.17\ C_w - 62$$

The subscript w indicates that worked samples were involved; the extrusion thrusts now varied between 50 and 900 g. The correlation coefficient was 0.98, and the standard deviation 45 g.

The still high standard deviation (scattering of points about the line) is mainly due to the inhomogeneity of margarine. Hardness differences between samples of the same batch are unavoidable. In general cone-penetration measurements were far more accurate than extrusion measurements (standard deviations calculated from sets of triplicates).

The comparison of the two methods is perhaps important for research and development work, but the question may arise how they can be used for the prediction of a spreadability assessment by panels or in large consumer tests. Our experience in this respect is that both instruments are equally good. The dynamic conditions under which margarine is spread on bread with a knife are neither imitated by the flow through an orifice nor by the falling cone.

It is interesting to note that in consumer tests many housewives were able to detect small differences in the spreadability of margarines. Tests were performed with hard and soft margarines, the result of one, which is representative of all the others, being as follows:

In a triangle test 123 housewives were given three samples cut from two margarines with C-values of 217 and 320 g/cm^2 respectively. They were asked to spread the samples on bread and to indicate the odd one. Sixty-nine gave a correct answer. As some might have obtained this result by mere guessing, a second check question was added, viz., whether the odd sample was softer or harder than the two remaining margarines. Sixty-eight correct answers were now obtained. This test shows that at least half of the untrained housewives could detect the difference between C = 217 and C = 320 in a triangle test.

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