GENERAL DISCUSSION OF VISCOSITY GRADING OF ASPHALTS

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•ABOUT 10 years ago a program was launched to determine the consistency of asphaltic materials in fundamental units. I am a strong supporter of this program. Part of this program was a search for new, simpler methods for determining the viscosity of asphalts. I also heartily support this effort. Somewhere along the way, the program seems to have become bogged down insofar as asphalt cements are concerned, because no simple, precise method for determining viscosity of asphalt cements at lower temperatures has been widely accepted.

This problem appears to me to be largely due to the sensitivity of consistency measurements of many asphalt cements at lower temperatures to even moderate changes in shear rate. The penetration method that has been used most widely in the past to measure asphalt cement consistencies at lower temperatures usually shears the asphalt sample at higher shear rates than most of the newer viscosity methods. This leads to differences that are supposed to show that the penetration method is inferior. It appears obvious to me that, no matter what method of test is used, different consistency values will be obtained at different shear rates at the lower temperatures where most asphalt cements are shear susceptible.

The efficacy of the penetration method is not of prime importance. The important matter is the determination and control of those rheological properties of the asphalt cement that have an important effect on the finished pavement. I think these important properties are the viscosity of the binder at the mixing temperature, at the compaction temperature, at the highest temperature that the pavement reaches in service, and at the lowest temperature that the pavement reaches in service. These 4 rheological properties can be divided into those that we can control and those that we cannot. We have little control over the highest and lowest temperatures that the pavement will reach. We can control the temperature of mixing and compacting the pavement and, through this control, the viscosity of the binder during these operations. Because we cannot control the highest and lowest temperatures in the pavement, it is an important function of the specifications to control the rheological properties of the binder at these temperatures.

I think that viscosity at 140 F as determined by ASTM Method D 2171-66 is satisfactory for the control of viscosity at the highest temperature. I do not think that we have a satisfactory method of controlling the viscosity of the binder at the lowest temperature in the pavement. The proposal for controlling the viscosity at low temperatures through the combination of viscosity controls at 275 and 140 F plus a minimum penetration causes me some concern especially when I realize that many people want to eliminate the penetration requirement. The precision of the viscosity methods at 275 and 140 F are not as good as we would like but they are certainly usable.

The real precision problem is apparent when we try to use viscosity specifications at 140 and 275 F to control the low temperature properties of the binder. The imprecision of the viscosity methods at 140 and 275 F is greatly increased by using them in combination, and this imprecision is multiplied by extrapolating the result down to the lowest temperature in the pavement. This is the great disadvantage of this type of specification.

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I do not think that anyone would have suggested controlling the low temperature properties in this manner if a reasonable test method for determining these low temperature properties directly had been available. It appears to me that we must again make an effort to develop a test method capable of measuring the low temperature properties of the binder. I do not think that the penetration test is satisfactory for this purpose even though it may be used as an interim method while a better method is being developed. The required method should be capable of measuring the properties in fundamental units of the binder at the lowest temperatures expected in the roadway and at stresses and strains similar to those encountered in the pavement.

The type of specification for the rheological properties of asphalts that I envision is one that would set viscosity limits at 140 F or some other high temperature and then set a maximum low temperature at which the binder must perform satisfactorily in a pavement based on the new test method results. There would be no specification requirements for the viscosity over 140 F, but the supplier might be required to give the temperatures at which the binder reached certain viscosities for mixing and compaction.

H. J. FROMM AND W. A. PHANG, Closure—We do not have much to add in the way of comments to this discussion. Our position has already been stated in our paper. We believe a minimum viscosity specification is necessary at 275 F in order to control the viscosity of the mix at road construction temperatures. A maximum viscosity specification at low temperatures (around the freezing point) would also be of great use in ensuring good low-temperature performance from pavements in the colder regions of our countries. Concerning the temperature, however, at which the asphalts are graded, we believe 140 F is too close to the temperature region in which the waxes are melting (or solidifying) to be safely used as a temperature for control purposes. It is quite possible that an asphalt cement could be obtained where its waxes were melting in this temperature region and then the test results would not be reproducible. We believe some other temperature should be selected. Because a great deal of experience has been obtained over the years with asphalts graded at 77 F, we see little reason to change from this temperature. We urge that every effort be made to develop a test method by which viscosities may be easily and reproducibly determined at 77 F.