SYMPOSIUM ON FUNDAMENTAL VISCOSITY OF BITUMINOUS MATERIALS

INTRODUCTION

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This symposium reviews existing knowledge and presents new information on the relation of absolute viscosity of bituminous materials to the problems associated with the construction and performance of bituminous highways.

The papers deal with the definitions of fundamental viscosities, the instrumentation available for their measurement, the relation between current empirical measurements of consistency and absolute units, the relation of absolute viscosity to laboratory stability measurements, the application of viscosity to practical problems in the specification and use of bituminous materials, the significance of viscosity with respect to the more complex rheology of bituminous materials, and the advantages of substituting viscosity units for the present empirical units.

The idea of using absolute viscosity units to measure the consistency of bituminous materials is, of course, not new. At the ASTM Annual Meeting in 1937, a similar symposium was sponsored by Committee E-1 on Methods of Testing. There had been earlier presentations in 1923.

The 1937 symposium highlighted the advantages of using fundamental rheological properties of materials. It was emphasized at that time that it would be desirable to use fundamental units to measure viscosities of new materials and new processes where the industry was not already accustomed to the use of empirical methods. The potential advantages of the use of such units in well established fields were also discussed.

Three papers given at the 1937 symposium are of particular interest to the bituminous technologist. A paper by R. N. Traxler entitled "The Flow Properties of Asphalts Measured in Absolute Units" described a rotating cylinder device and a vacuum-operated capillary tube viscometer that had been reported to the industry in 1935. This was the viscometer designed by Rhodes, Volkmann, and Barker that is now known as the Koppers viscometer. Traxler also pointed out the limitations of the penetration test—its failure to correlate with true viscosity and its varying shear rate.

A paper by Rhodes, Volkmann, and Barker presented at the 1937 symposium pointed out the large number of empirical consistency tests then being used and stressed the need for the replacement of such empirical instruments with instruments capable of measuring viscosity in absolute units. Although practical instruments for absolute viscosity measurements were then available, it was recognized that an interim period would be needed to permit a general depreciation of the empirical equipment. This paper, therefore, discussed the relation

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of each of the empirical measurements used in the tar industry with the absolute viscosity.

The third paper, by J. C. Geniesse, discussed viscosity measurements of petroleum products and lubricants. His conclusions stressed the need for, and the advantages of, adoption of fundamental units of viscosity as a replacement for the empirical values.

As is evident from the summaries of these papers, many of the principles being discussed in research papers at the present time were clearly set forth at least 25 years ago, but little practical use has been made of the information.

Why has progress been apparently so limited?

One possible explanation is that during World War II, and the years immediately preceding it, fundamental research on asphalt was almost completely eliminated. Even though considerable progress was made in the areas of paving equipment because of the immediate need for roads and airfields, there was no time to experiment with fundamental measurements of consistency. The empirical tests were adequate to get the job done.

This latter thought perhaps is the most important reason that progress has been limited insofar as specification limits based on fundamental viscosity units are concerned. The empirical units in the hands of experienced highway engineers and bituminous technologists have been, and still are, generally adequate for practical purposes. Within the relatively limited geographical area of a single highway department, the penetration test, despite its recognized limitations, does serve to differentiate between grades of asphalts. Furol viscosities run at the proper temperature adequately control liquid grades of asphaltic products; the Engler-viscosity for tars is equally adequate in its limited field.

The situation with respect to highway construction, however, is changing. Highways must now be built to accommodate faster and more frequent traffic; there is a demand to permit heavier loads; and the economic situation requires that the highways last longer.

To accomplish these aims, more research is needed. The fundamental principles of pavement design and the properties of the materials used must be determined more precisely. Engineers and bituminous technologists are realizing that the empirical methods are inadequate, and measurements must be made in fundamental units to establish the desired relationships.

The mutual concern of the ad hoc committee of the Highway Research Board, The Asphalt Inst., the Bureau of Public Roads, and the subcommittees of ASTM Committee D-4 on Road and Paving Materials has resulted in a determined effort to promote the use of fundamental units for bituminous materials. In the past few years, considerable research has been concerned with such units, proposals have been made for using fundamental units in specifications, the shear susceptibility of asphalts has been examined critically, and the importance of viscosity and viscosity changes in bituminous materials has been discussed. The present symposium summarizes the old and new information and charts the course of future action.