

Asphalt Institute

Guidance Document on the Use of Solubility in Standard Specifications for Asphalt Binders

According to Halstead and Welborn (1974), the first specification for asphalt in the United States was based on the use of Trinidad Lake asphalt and analytical tests to determine the amount of bitumen (portion soluble in carbon disulfide, CS₂), insoluble organic matter, and inorganic matter in a given sample. The intent of these specifications was strictly to identify the source of the asphalt. As asphalts began to be used from more than one source, specifications were written to attempt to control the quality of the asphalt. Petroleum asphalts, which came into use around 1900, were considered by some asphalt suppliers and contractors to be inferior to the Trinidad and Bermudez Lake asphalts. Thus, specifications were written to minimize the possibility of using an inferior asphalt.

In 1903, A.W. Dow presented a paper describing the use of various tests, including solubility, in a specification for ensuring the quality of asphalts. The solubility test was one of the first tests used to identify asphalt and provide assurance of uniformity. The original test procedure, ASTM D165, was adopted by ASTM in 1927 and used in the first ASTM specification for asphalt cements, D946, published in 1947. The solubility test procedure remains substantially the same today (now identified as ASTM D2042 – adopted in 1966), although the use of solvents has changed.

The solubility test for petroleum asphalt binders, as it exists today in asphalt binder specifications, is used to ensure that an asphalt binder does not contain insoluble organic and inorganic matter that doesn't contribute to the "active cementing constituents" of the asphalt binder. In recent years, coinciding with an increased use of polymer-modified asphalt binders, a different solubility test (ASTM D5546) was developed. ASTM D5546 was developed principally because some polymer modifiers did not dissolve adequately during the ASTM D2042 procedure, thus resulting in some polymer-modified asphalt binders failing the solubility criterion (usually 99.0% soluble or greater).

Although the original purpose of the solubility test was to identify the source and quality of native asphalts, it remains an important specification test for petroleum asphalt binders. The inclusion of a solubility requirement prevents the use of inorganic (or insoluble organic) matter that serves only to stiffen the asphalt binder, but provides no other performance benefits.

While the solubility test and criterion is in the specifications of all liquid asphalt materials, a recent user-producer survey conducted by the Asphalt Institute seems to indicate that the majority of respondents (64%) did not require the solubility test for performance-graded (PG) asphalt binders. This may be an oversight by some users since the criterion is not included in Table 1 of AASHTO M320, but rather is written in Section 5.4.

Given the recent results of the user-producer survey, the Technical Advisory Committee of the Asphalt Institute believes it is important to re-emphasize that the solubility requirement should continue to be used in the specifications for all liquid asphalt paving materials including modified and unmodified asphalt cements (viscosity graded, penetration graded, and performance graded) and asphalt emulsions to prevent the intentional or unintentional use of inorganic (or insoluble organic) matter into these materials. Since AASHTO M320 includes asphalt binders that are polymer-modified, it is recommended that ASTM D5546 is the preferred procedure for determining solubility of PG asphalt binders.

While ASTM D5546 is the recommended procedure, it should be noted that ASTM D2042 is also an acceptable procedure for determining the solubility of PG asphalt binders. If an asphalt binder meets the solubility requirement following ASTM D2042, then it is not necessary to perform testing following

ASTM D5546. However, if the minimum solubility requirement is not met using ASTM D2042, then the user should consider conducting the solubility test using ASTM D5546 before reporting the test result as failing.

User agencies and producers can decide the required frequency of solubility testing. However, it is recommended that the solubility test is not needed on every sample, but can be performed on some scheduled basis in accordance with the producer's Approved Supplier Certification (ASC) as described in AASHTO R26.

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