Material's Volumetric-Flow Rate (MVR) as a Unification Parameter in Asphalt Rheology and Quality Control / Quality Assurance Tool for High Temperature Performance Grading

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Abstract
Rheological data of unmodified and polymer-modified asphalts are conventionally obtained from dynamic mechanical characterization and expressed in terms of sets of curves showing the variation of viscoelastic properties with frequency. Using the conventional melt flow indexer, the material's volumetric-flow rate *MVR* (in cm^3 / 10 minutes) through a predefined die under conditions of constant temperature and stress when obtained for the same asphalts, shows a direct relationship with the dynamic data. The *MVR* value helps in unifying the sets of dynamic data curves of $|G^*|$, G'' and $|G^*|/\sin\delta$ versus frequency in the case of unmodified asphalts, polymer-modified asphalts and asphalt mastics. The unification technique has a sound theoretical basis and the unified curves have far-reaching implications. Since *MVR* is so simple to determine quite accurately on a relatively inexpensive, easy-to-use flow measurement device (*FMD*), this parameter can be generated on paving sites or at refineries, if needed, rather than in research laboratories as is the case with the fundamental rheological parameters. The *MVR* can then be used as an excellent indicator of the fundamental rheological parameters through the use of the unified curves. The *MVR* can be utilized to accurately determine the currently used high temperature performance grade specification of paving asphalt. On account of the simplicity in obtaining this specification value from the *MVR*, it may be routinely used for quality control / quality assurance purposes. It can also be used as a rapid product development / formulation tool.

Zusammenfassung
Die rheologische Daten von unmodifizierten und durch Polymere modifizierte Asphalte werden üblicherweise mittels dynamisch-mechanischer Charakterisierung erhalten und dann als Kurvenschar, welche die Änderung der viskoelastischen Eigenschaften bei verschiedenen Frequenzen zeigen, dargestellt. Für die gleichen Asphalte kann aber auch die volumetrische Fliessrate (MVR), welche in einem konventionellen Melt Flow Indexer mit definierter Düse bei konstanter Temperatur und Schubspannung gemessen wird, mit den dynamischen Daten korreliert werden. Der MVR-Wert wird hierbei benutzt, um die frequenzabhängigen dynamischen Daten für $|G^*|$, G'' und $|G^*|/\sin\delta$ für modifizierte und unmodifizierte Asphalte und Asphaltharze zu normieren. Diese Normierungstechnik basiert auf einen theoretischen Hintergrund und die normierten Kurven haben weitreichende praktische Konsequenzen. Der MVR-Wert kann sehr einfach und genau mit preiswerten und einfach zu bedienenden Flow Measurement Devices (FMD) vor Ort oder in Raffinerien bestimmt werden, anstatt in Forschungslabors durch aufwendige rheologische Versuche. Der MVR-Wert kann sodann mittels der normierten Kurven als ein hervorragender Indikator für fundamentale rheologische Parameter herangezogen werden. Zudem kann er benutzt werden um die gegenwärtig verwendete "High Temperature Performance Grade" Anforderungen von Strassenasphalt präzise zu bestimmen. In Anbetracht der Einfachheit, mit welcher diese Spezifikation anhand des MVR-Wertes bestimmt werden kann, könnte dieses Verfahren routinemässig zur Qualitätskontrolle und Qualitätsbürgschaft ebenso zur schnellen Produktentwicklung verwendet werden.

Résumé
Les données rhéologiques d'asphaltes non modifiés et modifiés par ajoût de polymère sont obtenues de manière conventionnelle à partir de la caractérisation mécanique en régime dynamique, et exprimées en terme d'ensembles de courbes, qui montrent la variation fréquentielle des propriétés viscoélastiques. En utilisant l'"indexer" conventionnel d'écoulement de fondu, le taux d'écoulement volumétrique (MVR) du matériau (en cm3/10 minutes) à travers une ouverture prédéfinie et sous des conditions de température et pression constantes, montre une relation directe avec les données dynamiques. La valeur du MVR aide à unifier l'ensemble des courbes dynamiques pour |G*|, G'' et |G*|/sind en fonction de la fréquence, obtenues pour les asphaltes non modifiés, modifiés par ajonction de polymère et pour les asphaltes mastics. La technique d'unification découle d'une approche théorique et les courbes unifiées possèdent des implications profondes. Comme le MVR est simple à déterminer assez précisement avec un appareil de mesure d'écoulement relativement bon marché et facile à utiliser, ce paramètre peut être obtenu dans les raffineries ou directement sur les sites de pavage, si besoin est, plutôt que dans les laboratoires de recherche, comme cela est le cas lorsqu'on veut obtenir les paramètres

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