Mooney Measurement of NORDEL™ MG

The presence of carbon black in NORDEL™ MG hydrocarbon rubbers makes analytical measurements on the base polymer more complicated and challenging. Mooney viscosity of the polymers is one of the key properties used universally by end users to characterize a product. Typically, Mooney viscosity for EPDM is measured at 125°C using a large rotor and reported as ML1 + 4 at 125°C. The measurement is made according to standard ASTM/ISO procedures. The measurement is made directly on the bulk sample or a massed sample.

In the case of NORDEL MG, the direct measurement of Mooney viscosity of the base polymer is not possible due to the presence of carbon black. Even measurement of Mooney on the composite sample (polymer + carbon black + additives package) using standard conditions is more difficult and practically impossible for higher viscosity grades (>90 Mooney) due to the high torque generated.

For these reasons, Mooney viscosity of NORDEL MG grades is reported as a calculated value. This is based on two separate models. For lower viscosity grades such as NDR 37060 and NDR 47085, the model uses Mooney measurement of the massed product. A riffled sample of the material is melt massed in a Brabender mixer and the Mooney is measured using standard conditions—ML 1 + 4 at 125°C. The carbon black and the additives have a significant effect on the measured Mooney. Hence, adjustments have to be made to account for these variations. A model has been developed to calculate the Mooney based on the measured Mooney of the composite (total) material. The calculated Mooney has been validated against molecular weight measurements and found to have good correlation.

The Mooney model for higher viscosity (>90 Mooney) NORDEL MG grades uses a standard formulated compound to calculate polymer Mooney. In this model, a NORDEL MG compound containing 60 phr of a paraffinic oil (SUNPAR® 120), stabilizer, and 40 phr (total) of N650 black are massed together in a Brabender mixer. The compound viscosity is measured under standard test temperatures and conditions—ML 1 + 4 at 125°C. The model calculates the polymer Mooney from the measured compound viscosity.

Ideally, it would be desirable to have a simple test method that customers can perform directly on incoming material. The Dow Chemical Company has investigated a mill massed Mooney measurement method, similar to the ASTM test procedure. While it is possible to measure Mooney directly on NORDEL MG product under different conditions – Ms 4 + 8 at 150°C, the reproducibility of measurement for the high Mooney products is not good.

Summary
- Due to the presence of carbon black, the Mooney viscosity of NORDEL MG hydrocarbon rubbers is a calculated value based on internally developed models.
- Up to 90 Mooney, the model makes use of Mooney measurement of the massed sample.
- Above 90 Mooney, the model utilizes Mooney measurement on a standard formulated compound.
- A test method for direct measurement of Mooney viscosity on incoming material has been ruled out based on initial results.

1Riffled samples—Riffling is a process that divides up a quantity of non-homogenous material in such a way that every size component is equally distributed in the smaller samples.
2SUNPAR is a trademark of Sun Oil Company.
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