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Assessment of Analytical Equations for the Derivation of Young's Modulus of Bonded Rubber Materials

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Abstract : The prediction of the vibration response of rubber products by analytical or numerical method depends mainly on the predefined intrinsic material properties such as Young’s modulus, damping factor and Poisson’s ratio. Such intrinsic properties are determined experimentally by subjecting a bonded rubber sample to compression tests. The compression tests on such a sample yield an apparent Young’s modulus which is greater in magnitude than the intrinsic Young’s modulus of the rubber. As a result, many analytical equations have been developed to determine Young’s modulus from an apparent Young’s modulus of bonded rubber materials. In this work, the applicability of some of these analytical equations is assessed via experimental testing. The assessment is based on testing of vulcanized nitrile butadiene rubber (NBR70) samples using tensile test and compression test methods. The analytical equations are used to determine the intrinsic Young’s modulus from the apparent modulus that is derived from the compression test data of the bonded rubber samples. Then, these Young’s moduli are compared with the actual Young’s modulus that is derived from the tensile test data. The results show significant discrepancy between the Young’s modulus derived using the analytical equations and the actual Young’s modulus.

Keywords : bonded rubber, quasi-static test, shape factor, apparent Young's modulus
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