DIFFERENCES BETWEEN DMA MODES AND TESTING EQUIPMENTS

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Abstract: As the fields of applications of polymer matrix composites (PMC) have been continuously growing, the knowledge of their physical and also their mechanical properties become indispensable in order to predict their thermo-mechanical behavior and consequently, optimize designs and minimize project risks. Among the experimental techniques used to characterize these materials in various studies, Dynamic mechanical analysis (DMA) is one of the most common approaches employed. However, the absolute values of the modulus and temperatures related to phase transitions are well-known to show divergences between samples and loading clamps even when the test conditions are essentially the same. Despite this, few researches can be found in literature on the mathematical formulation and comparative data of complex modulus in different operational modes provided by different DMA machines. Aiming at contributing to fill this gap, the purpose of this work is to investigate how the complex modulus is mathematically formulated and measured by two different DMA machines in basically three different operational modes. Experimental tests were carried out using single cantilever, dual cantilever and three-point bending modes with similar test conditions. Two temperature scanning techniques were performed, namely temperature scan and temperature-frequency scan. The measurement results were compared to study the influence of testing equipment and also the influence of operational modes in each DMA machine. Afterwards, both Cole-Cole diagram and Black space were built in order to observe how the thermorheologically simple behavior was identified by each operational mode in each DMA machine and then, the time-temperature superposition principle (TTSP) was applied to build the master curves. Although there were some discrepancies, a good agreement was found for certain tests.

Keywords: DMA, experimental method, operational modes, temperature dependence, frequency dependence