Editorial corner – a personal view

Loss factor from dynamic mechanical analysis (DMA) – the right prediction tool?

*J. Karger-Kocsis**

Department of Polymer Engineering, Faculty of Mechanical Engineering, Budapest University of Technology and Economics, H-1111 Budapest, Hungary

Polymers are viscoelastic materials. DMA is an excellent tool to get information on their viscoelasticity because it measures the stiffness (modulus) and damping (energy loss, loss factor) of polymers as a function of temperature and frequency. Researchers, fascinated by this technique, have always tried to deduce correlations between DMA parameters and different test results, such as impact, erosion, friction, fatigue. The target was to offer an easy-to-perform alternative to the related time-consuming measurements. Many papers reported on correlations between the mechanical loss factor and impact tests results ([https://doi.org/10.1016/0032-3861\(82\)90054-4](https://doi.org/10.1016/0032-3861(82)90054-4)). This is, however, rather surprising considering the fact that usually there is a big difference in the frequencies of the DMA measurement (below 10 Hz) and impact tests (in kHz range). In addition, failure under impact may be generated by inherent flaws of different origins which are highly localized whereas DMA is linked to bulk performance. To substantiate the correlations received attempts were made to consider the time (frequency)-temperature superposition principle – selecting relaxation transition well below that of the corresponding test or computing the shift in the DMA parameters by master curve methods (<https://doi.org/10.3144/expresspolymlett.2015.18>). The wet skid/traction and rolling resistance of tyre rubber formulations are often estimated by the height of the loss factor at 0 °C (the higher the better) and 60 ° (the lower the better), respectively (<https://doi.org/10.5254/rct.14.86947>). Again, in this case there is a wide gap between the frequencies of the DMA

test and tyre in service. The frequencies may be similar, however, in fatigue crack propagation (FCP) for which inverse correlation between the loss factor and FCP resistance was reported (<https://doi.org/10.1023/A:1006695723138>). Nonetheless, loss peak effect-related correlations are experimentally found. In order to give a physical explanation for such findings we have to accept that the molecular relaxation processes are far more complex than anticipated. No doubt that the basic assignments of the primary and secondary relaxations, as described in the pioneering book of McCrum-Williams-Read in 1967, are still correct. In the meantime, however, we had to learn for example that single glass transition peak does not necessarily reflects a homogenous system. Rigid and mobile constituents have also been revealed in the amorphous phase. To clarify the reason of the observed loss factor-related correlations extensive studies are needed. They should cover both theoretical and experimental works on polymers with precisely known molecular and morphological structures. These works may contribute to settle the ‘battle of faith’ whether or not such correlations exist.

Prof. Dr. Dr. h.c. József Karger-Kocsis
Editor-in-Chief

*Corresponding author, e-mail: karger@pt.bme.hu
© BME-PT