

Editorial corner – a personal view

Using thermogravimetric analysis to determine polymer thermal stability: Relevance of changes in onset temperature of mass loss

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When one reads through publications, especially in the field of polymer composites and nanocomposites, where composite samples were characterised, thermogravimetric analysis (TGA) data are almost always presented as part of a whole range of analysis methods. Most of the time the shifting of the TGA mass loss steps to higher temperatures is interpreted as being indicative of delays in the thermal degradation process and hence improvements in the thermal stability of the polymer(s) brought about by the presence of the filler (nano)particles.

The question one should ask oneself: Is it possible to measure the onset of degradation of a polymer or composite by using TGA, or does one only measure the onset of mass loss? Of course one only measures the onset of mass loss, which means that anything that may delay the transport of volatile degradation products out of the composite will cause a delay in the evaporation of these products, and the onset of mass loss will only be seen after a longer time or at a higher temperature, depending on whether the analysis was performed as function of time or temperature. This means that the (nano) filler probably had no effect on the thermal stability of the polymer matrix, but that it either contributed to the formation of a carbonaceous char layer or strongly interacted with the volatile degradation products, both of which would retard the diffusion of these degradation products out of the polymer. This would give rise to the mass loss step starting at higher temperatures (after longer periods of time)

giving the impression of an apparent increase in thermal stability.

On the other hand, one cannot neglect the possibility that the (nano)filler can retard the actual degradation process through strong interaction with the polymer chains and/or free radical chains, which can restrict the chain mobility and slow down the degradation propagation reactions. Whatever the reason for the delayed onset of mass loss, one has to delve deeper to find the real reason and not just assume that it is the result of the (nano)filler improving the thermal stability of the polymer. It is also important to realise that, although the onset of degradation is not necessarily delayed in the presence of (nano)filler particles, any delay in the volatilization of the degradation products (which is measurable with TGA) is an important factor to keep in mind regarding the flammability of the polymer.



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