A150   Microwave-Assisted Extraction for Qualitative Analysis of Carpet Fibers

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After attending this presentation, attendees will learn about how polymer additives can be employed to objectively compare carpet fibers.

This presentation will impact the forensic science community by providing a potential method for comparing carpet fibers that could one day be applied in crime labs.

Synthetic polymers are used in the manufacturing of many manmade products, including carpets. Synthetic polymers are long-chained molecules that are compounded with many, varied, and proprietary additives that chemically modify the polymer to improve its performance. In forensic science, carpet fibers can be used as evidence. Microscopy and spectroscopy are current methods used in the identification and comparison of carpet fibers. However, these techniques cannot determine the origin of a carpet fiber, thereby making these methods very subjective.

In this study, polymer additives were extracted from nine different carpets (made of nylon, polypropylene, or olefin) in 1:1 acetone:hexane through microwave-assisted extraction (MAE). Each carpet was tested four different times. The extracts were then analyzed through gas chromatography – mass spectrometry (GC/MS). Because each carpet yielded four chromatograms, the peak lists for these chromatograms were combined to make an averaged chromatogram for each of the carpets. These averaged chromatograms were then used to compare the carpets for base polymer and manufacturer differences. For comparison purposes, peaks were accepted at a 3:1 signal-to-noise (S/N) ratio. Moreover, it is hypothesized that similarities and differences can be seen between the various carpets.

The carpets were first compared in regards to their base polymer: nylon, polypropylene, or olefin. It was found that carpets made of nylon had a significant amount of differences when compared to polypropylene and olefin. Specific peaks and certain peak patterns were identified. Differentiating polypropylene and olefin carpets was more difficult considering olefin carpets are a mixture of polypropylene and polyethylene polymers. This in turn made it very hard to identify specific peaks and peak patterns between carpets made of polypropylene and olefin.

Because manufacturers chemically modify their carpets, it was determined if manufacturer type contributed to a carpet's profile. For example, the nylon carpets were compared among each other to establish whether any similarities or differences exist. With the nylon carpets, it was found that manufacturer type contributed to the observed differences. Moreover, a carpet made with a polymer (e.g., nylon) from the same company exhibited differences when different carpet manufacturers modified that polymer. Carpets made of polypropylene and olefin still exhibited some difficulties when comparing them in regards to manufacturer type. While significantly fewer peaks could be identified for polypropylene (and olefin) with at least a 3:1 S/N, carpets made of polypropylene (or olefin) could still be distinguished from one another.

In conclusion, this research successfully showed that carpet fibers can be analyzed and compared through a more objective method. Differences could be seen between carpets made of different base polymers. It could also be seen that carpets made of the same polymer can still be distinguished from each other due to the various chemical modifications that manufacturers apply to the polymers.

Carpet Fibers, GC/MS, MAE