

CHARACTERISATION OF HINDERED AMINE LIGHT STABILISERS USING DESI AND TANDEM MASS SPECTROMETRY

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Abstract

Polymers degrade via oxygen based free radical type reactions resulting in undesirable physical changes such as colouring, hardening, cracking and embrittlement. Hindered amine light stabilisers (HALS) are additives designed to inhibit the oxidation and degradation of polymers via formation of nitroxyl radicals.¹ Nitroxyl radicals are stable enough so that proton abstraction from the polymer is slow, but react readily with free radicals that are involved in polymer degradation. The prophylactic effect of HALS is thought to be catalytic (Figure 1) making HALS one of the most effective antioxidant additives available, extending the useable life of many polymers such as car paints and tyres by many years.²

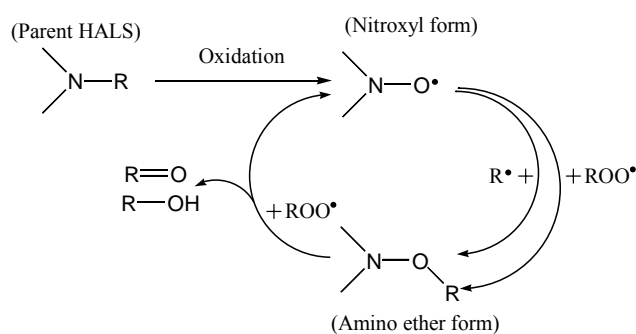


Figure 1. Simplified mechanism for HALS anti-oxidant

We have applied electrospray ionisation mass spectrometry (ESI-MS) and tandem mass spectrometry (MS/MS) to the identification and characterisation of HALS in polyester coatings. Fragmentation pathways specific to HALS molecules have been recognised that allow structural identification of analogous HALS species formed during polymer cure and degradation. Using these techniques we have observed transformation of an *N*-acyl HALS to its *N*-H equivalent as well as the formation of an *N*-CH₃ HALS from the *N*-H derivative during polymer cure.

To circumvent the solvent extraction and filtration steps, a DESI ionisation source has also been used to ionise HALS directly from a polyester coating. This approach required addition of a swelling solvent such as chloroform to the polyester surface to aid migration of the HALS to the surface prior to ionisation. While DESI is a technique that allows rapid sample throughput and minimal sample preparation, surface effects such as uneven distribution of HALS after swelling and electrostatic charging during ionisation were observed to strongly affect the ionisation efficiency.

References

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