Molecular Weight Distribution Of High-Density Polyethylene Using Conventional High Temperature Gel Permeation Chromatography

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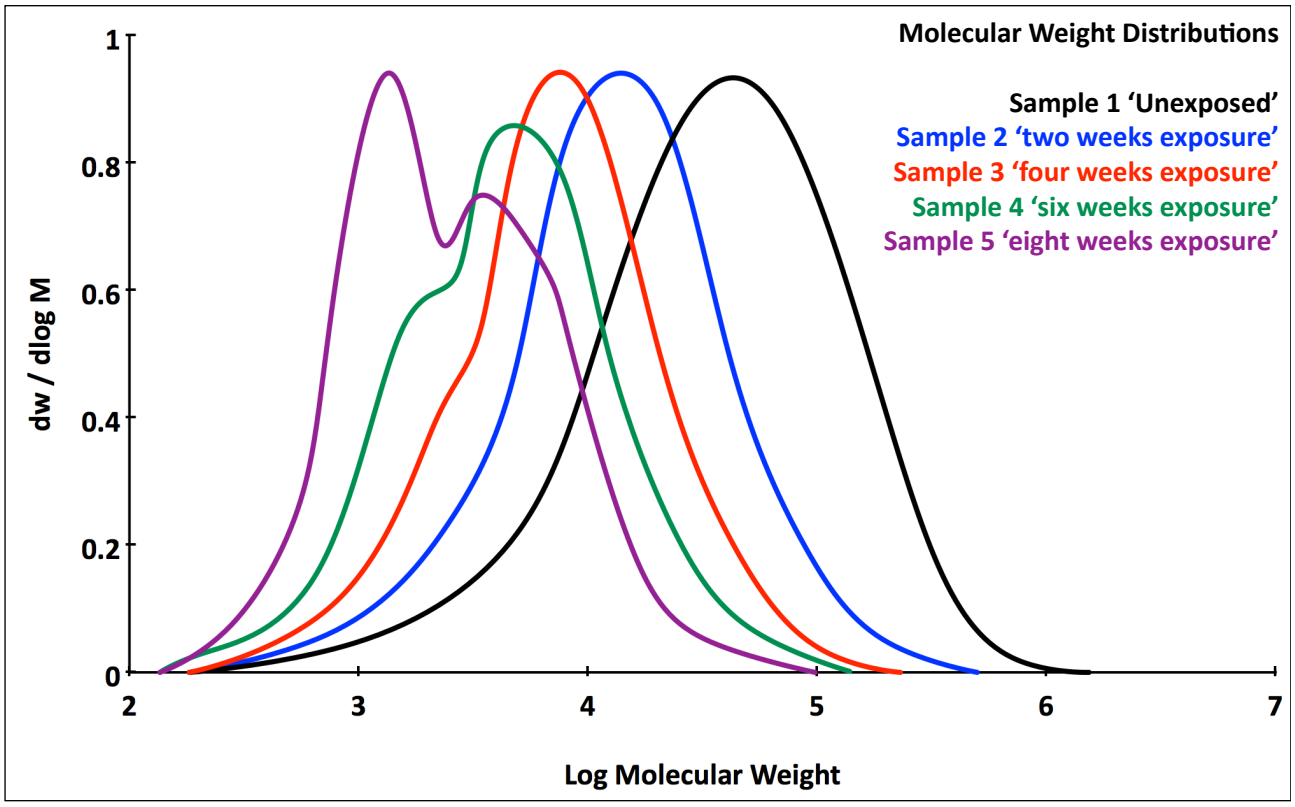
Columns:	Agilent PLgel Olexis guard plus 3 x PLgel Olexis 300 x 7.5 mm, 13µm
Eluent:	1,2,4-trichlorobenzene with anti-oxidant
Flow-rate:	1.0 mL / minute (nominal)
Temperature:	160℃ (nominal)
Detector:	Differential refractive index



Plots for duplicate runs of five samples. The system was calibrated with polystyrene however, the 'Universal Calibration Procedure' has been applied, using literature values of Mark-Houwink parameters to express the results as for linear polyethylene.

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Discussion

Conventional high temperature GPC provides a good comparison of polyethylene molecular weight distribution, providing the samples are of the same structure (long-chain branching). In this case the polymer is high density polyethylene and all samples linear.

Polyethylene undergoes degradation by *chain scission* with higher molecular weight (longer chain length) polymer statistically more susceptible to scission. Polyethylene degradation can occur at any stage in the lifetime of the material, from polymerisation, processing, end use, and recycling. In this example, the broad, high molecular weight polymer becomes narrower in distribution and lower in molecular weight with increased exposure time to heat and ultraviolet radiation. In some instances the distribution of degraded polymer can become complex as increasingly lower molecular weight material is generated.

In most situations polymer degradation is an undesired effect. This may be due to poor temperature control or insufficient stabilisation during processing, or subjecting the product to abnormally high temperature and ultraviolet exposure beyond the material specification. In other instances controlled degradation is desirable, induced by the presence of a pro-degradant additive - the end point resulting in a very low molecular weight product that may then undergo biodegradation.