OIT measurements should only reflect this reduced amount, termed here the effective VE concentration (EVC)

During processing, VE is expected to be partially consumed, reducing the amount of VE available for further protection

Discussion

Results

Materials

Three sets
- un-processed powder
- direct compression molded (DCM) pucks
- DCM pucks irradiated to crosslink (10 MeV e-beam)
- GUR 1050 powder (Ticona) solvent blended with VE (DSM)
- 0.01, 0.02, 0.05, 0.10, 0.25, 0.28, 0.38 (wt/wt) +/- 0.0012 wt%
- determined using Accelerated Solvent Extractor (ASE, Dionix, Inc.)

Calculations appear to hold for OIT > 5 minutes (near technique resolution), regardless of processing conditions

OIT compared to nominal VE concentration in Figure 2

An OIT of 5 minutes is equivalent to 0.0004% concentration.

Conclusions

OIT provides a novel, sensitive method for determining VE concentration in UHMWPE components

Suitable for QC and R&D to evaluate effective VE levels after processing

Provides a provisional detection limit of < 0.001 wt%

The technique could be used to investigate the influence of processing on effective VE concentration

We are currently extending this research with a round-robin study to validate intra- and inter-lab repeatability

Suggested future work includes determining the applicability of this method to other antioxidants

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References


Figure 1: OIT and VEI v Nominal VE Conc. Error bars 1 σ. Solid symbols are OIT, hollow symbols are VEI.

Figure 2: OIT value in minutes v Nominal Vitamin E concentration after three different processing steps. Error bars are 1 σ.

Figure 3: Relative EVC (the ratio of the Nominal VE concentration to the EVC) versus nominal VE concentration.