

## RHEOLOGY SOLUTIONS

### EFFECTS OF THERMAL AGING ON MELT PROPERTIES OF LDPE

#### PROBLEM

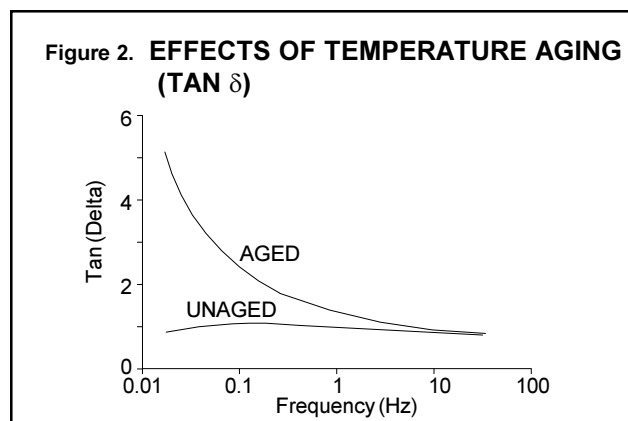
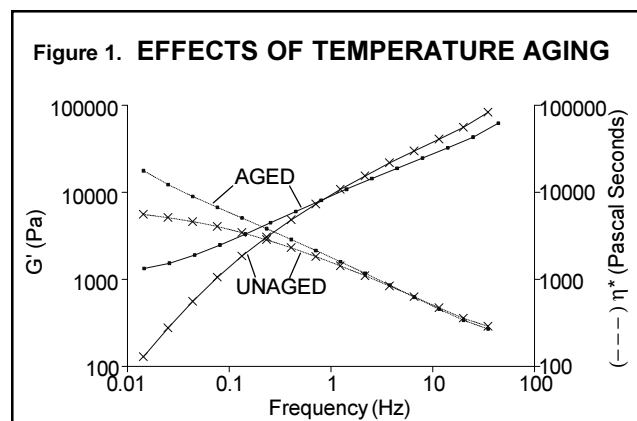
Exposure of polymer systems to high temperatures for extended periods of time can cause changes in their molecular structure. These changes sometimes may not be evident in tests insensitive to molecular structure. However, these changes may be important in processing and end-use performance.

#### SOLUTION

A Controlled Stress Rheometer was used to determine if thermal aging produces changes in the molecular structure of thermoplastic polymers, for example low density polyethylene (LDPE) resin. Samples of material before and after exposure to 195°C for several hours were evaluated using an oscillatory test. Stress was applied in a sinusoidal manner to achieve a strain of two percent over a frequency range of 0.01 to 40Hz. From the stress, strain, and phase angle difference between the stress and strain, dynamic properties of the two

samples were obtained.

Figure 1 illustrates the storage modulus ( $G'$ ) and complex viscosity ( $\eta^*$ ) results for the two materials. The samples appear to be similar at the higher frequencies which are not very sensitive to molecular structure. At the lower frequencies there is a divergence between the materials. The  $\eta^*$  value for the unaged sample appears to be attaining a plateau representative of its molecular weight. The  $\eta^*$  value for the aged sample continues to rise suggesting that the molecular weight has increased. This latter result is probably due to cross-linking which can occur during the thermal aging process. The differences in  $G'$  values are consistent with the  $\eta^*$  results. Figure 2 provides information on tan delta (ratio of  $G''$ , the loss modulus, to  $G'$ ). These results also show that a structural change has occurred in the aged sample. This change could result in a non-homogeneous melt and eventually poorly fabricated products.



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