TA Instruments

Thermal Analysis & Rheology

THERMAL SOLUTIONS

ANALYSIS OF POLYMER DECOMPOSITIONS BY TGA-MASS SPECTROMETRY

PROBLEM

The decomposition process for polymers is more complex than for inorganic materials which exhibit predictable stoichiometric weight losses with temperature. In addition, the atmosphere around the polymer often affects the decomposition process. Hence, traditional techniques, such as thermogravimetric analysis (TGA) which provides an indication of the amount of weight lost during the decomposition process, do not provide sufficient information to fully understand the process.

SOLUTION

A more complete analysis of polymer decomposition processes is obtained by coupling TGA to a mass spectrometer so that the evolved decomposition gases can be identified. Figures 1 and 2, for example, show the results for polyvinylchloride (PVC) in inert (helium) and reactive (air) atmospheres respectively. The TGA weight loss profiles indicate that multistage decomposition processes are occurring. In both cases, HCL, benzene, and vinyl chloride are the primary decomposition products in the first weight loss, while higher molecular weight unsaturated hydrocarbon fragments are the main decomposition products in the second weight loss. However, the relative amount of the different decomposition products varies with atmosphere. Furthermore, a third decomposition step occurs in air which is not present in helium. This step corresponds to decomposition of residual carbon residue to form carbon dioxide.

Figure 1. PVC DECOMPOSITION - HELIUM PURGE

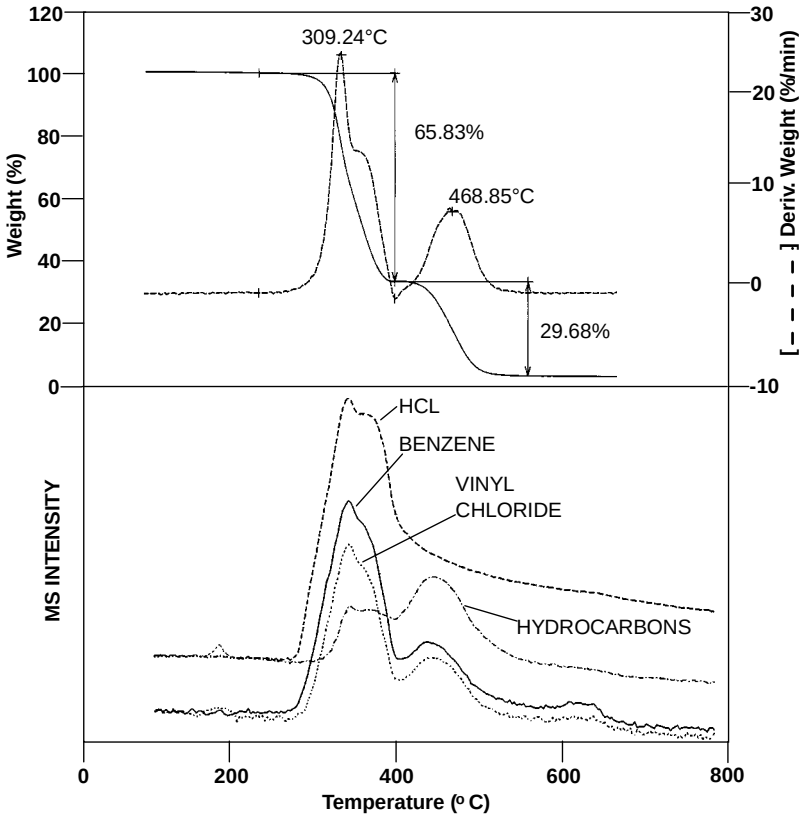
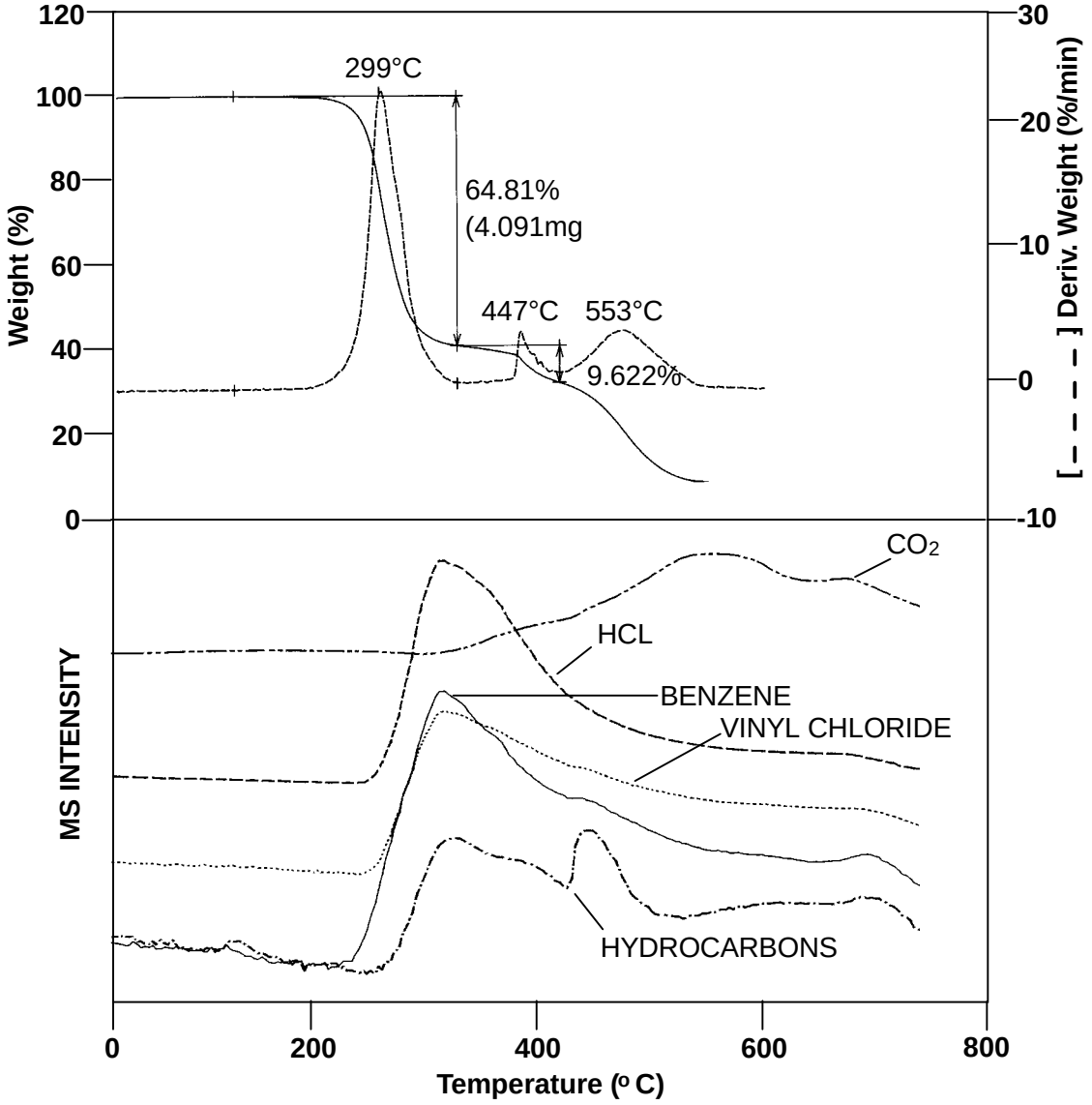


Figure 2. PVC DECOMPOSITION - AIR PURGE



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TS-14A