Outdoor exposure tests of 6,6-nylon cable ties
– Use of thermal desorption (TD)-GC/MS –

[Background] When using plastic cable ties in outdoor environments, the deterioration of the mechanical properties of the plastics due primarily to UV irradiation is of concern; therefore, long term weathering testing is needed. The effective use of evolved gas analysis (EGA)-MS to evaluate the degradation of cable ties was reported earlier (Technical note PYA3-023E). In this note, the degradation of 6,6-nylon cable ties using thermal desorption (TD)-GC/MS is described in terms of changes in the additives compositions.

[Experimental] Three different types of cable ties with different responses to weather and heat were analyzed using TD-GC/MS. Prior to analysis, each sample was stored in a sealed container (indoor) or an outdoor environment (outdoor) for two years. Analysis was done using a GC/MS system in which a Multi-Shot Pyrolyzer (EGA/PY-3030D) was directly interfaced to the GC injector. The surface layer of each sample was scraped off using a cutter knife and the powder was placed in a sample cup. The cup was subsequently dropped into the pyrolyzer furnace and the additives were thermally desorbed (100 - 340ºC, 40 ºC/min). Volatiles evolving from the sample were cryo-trapped at the head of a separation column using a MicroJet Cryo-trap. Once the TD process was completed, the cyro-trapping was stopped and the column was heated to elute compounds which were detected using a mass spectrometer.

[Results] TD chromatograms of each sample are shown in Fig. 1. In the outdoor exposure of sample No.1 (standard), peaks for C_{15} and C_{17}, which are derived from the decomposition of fatty acids, are observed. In the outdoor exposure of samples No.2 (weather resistant) and No.3 (weather/heat resistant), peaks for C_{15} and C_{17} are detected; however, their intensities are weaker than those observed in sample No.1 (outdoor), suggesting that fatty acid decomposition is inhibited. The indoor exposure of samples No.2 and No.3, yields 2,6-di-*t*-butylphenol which is derived from an antioxidant, and diphenylamine and aniline which are derived from an anti-aging agent. The peak intensities of these compounds decrease when the exposure was done in outdoors. This example demonstrates the value of TD-GC/MS when characterizing the effects of an environmental stress on a given plastic product.

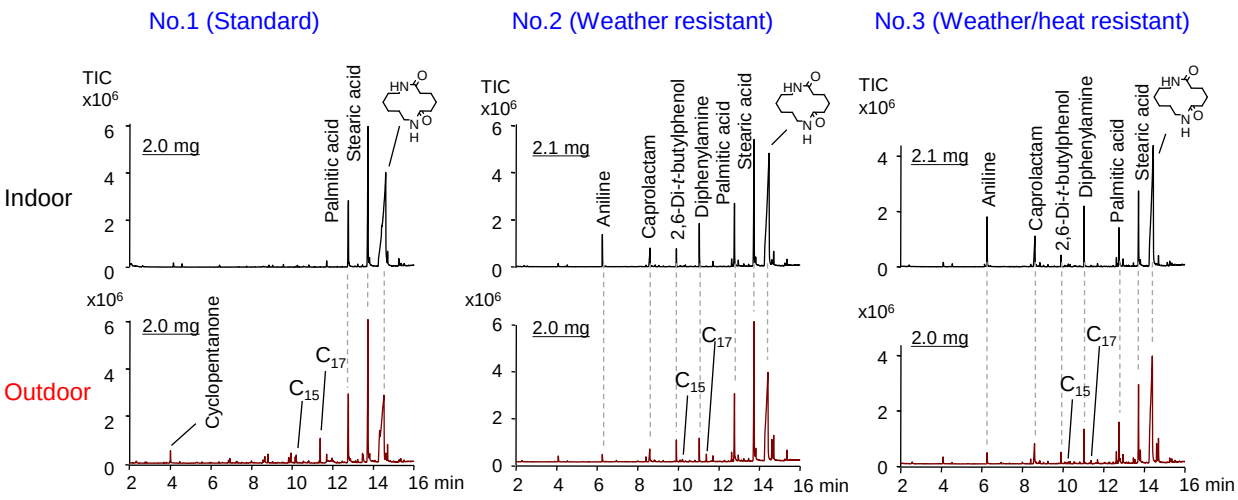

Fig.1 TD chromatograms of samples stored indoor and outdoor environments

PY furnace temp.: 100 - 340ºC (40 ºC/min), Cryo-trapped by MicroJet Cryo-Trap,
Separation column: Ultra ALLOY⁺-5-30M-0.25F (5% diphenyl 95% dimethylpolysiloxane, *L*=30 m, i.d.=0.25 mm, df=0.25 µm),
Column flow rate: 1 mL/min (He), Split ratio: 1/2, GC oven temp.: 40 - 320ºC (20 ºC/min), Sample amount: ca. 2 mg

Keywords : Cable ties, 6,6-nylon, Exposure test, Thermal desorption, Degradation, Weatherability

Products used : Multi-Shot Pyrolyzer, Auto-Shot Sampler, MicroJet Cryo-Trap, Vent-free GC/MS adapter, UA⁺-5, Eco-Cup LF

Applications : General polymer analysis, Degradation test

Related technical notes : PYA3-023E

Please forward your inquiries via our web page or send us a fax message.

R&D and manufactured by :
Frontier Laboratories Ltd.
Phone: (81)24-935-5100 Fax: (81)24-935-5102
http://www.frontier-lab.com/