

Pyrolysis-GC-MS of Pharmaceutical Packaging Results in Reaction Products

Application Note

Pharmaceutical Packaging

Abstract

Pyrolysis of PVC and PET together generates a reaction product.

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Multi-step heating analysis was performed on 100 mcg of medication blister packaging. At 150°C, very little evolved, but at 300°C, the packaging starts to degrade. Pyrolysis products of PVC, paper, and polyurethane, acrylic and polyester are revealed. In addition, another product of unexplained origin is present: Di(2-chloroethyl ester) terephthalic acid, seen in Figure 1.

The question arose if Di(2-chloroethyl ester) terephthalic acid could be a reaction product between polyvinyl chloride (PVC) and polyethylene terephthalate (PET). To determine if this is the case, PVC and PET were pyrolyzed separately, and then together. When PVC and PET are run individually, Di(2-chloroethyl ester) terephthalic acid was absent, but if PVC and PET were pyrolyzed together, all the typical pyrolysis products of PVC and PET were present, as well as an additional peak for Di(2-chloroethyl ester) terephthalic acid (Figure 2).

Hydrochloric acid produced from PVC is thought to attack the double bond in divinyl terephthalate, adding a chloride ion and creating Di(2-chloroethyl ester) terephthalic acid (Figure 3).

In general terms, pyrolysis products of polymers do not react with each other. a reactive pyrolysis product is created however, it may react with other constituents. Co-pyrolysis of PVC and PET is a prime example of this behavior. All samples were analyzed using a CDS 6000 Series Pyroprobe interfaced to a GC-MS.

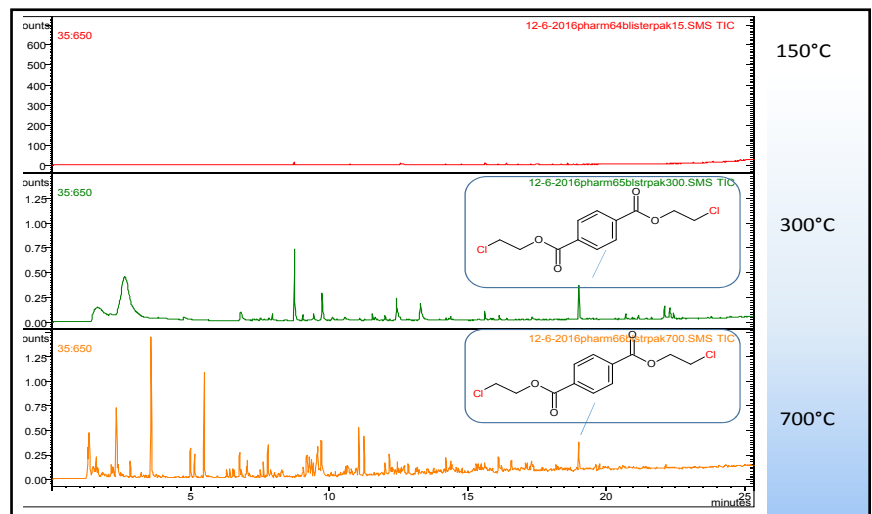


Figure 1. Blister Packaging Heated to 3 different temperatures reveals an unexpected compound for Di(2-chloroethyl ester) terephthalic acid, circled in blue.

Instrument Conditions

Pyroprobe

Pyrolysis: 150°C, 300°, and 700°C
Valve Oven: 300°C
Transfer Line: 325°C

GC/MS

Column: 5% phenyl (30m x 0.25mm)
Carrier: Helium, 100:1 split
Injector: 350°C
Oven: 40°C for 2 minutes
10°C/min to 325°C
10 minutes
Mass Range: 35-550

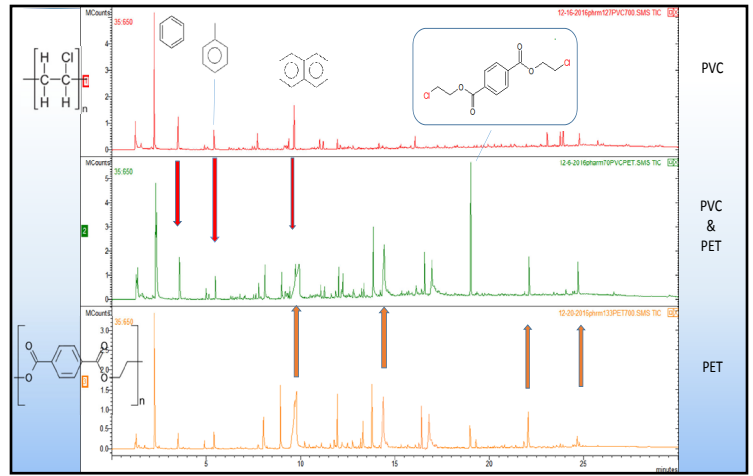


Figure 2. Pyrolysis (700°C) of Polyvinyl Chloride (PVC) and Polyester Terphthalate (PET) separately (top and bottom), and PVC and PET pyrolyzed together (middle) reveals a new reaction product, Di(2-chloroethyl ester) terephthalic acid.

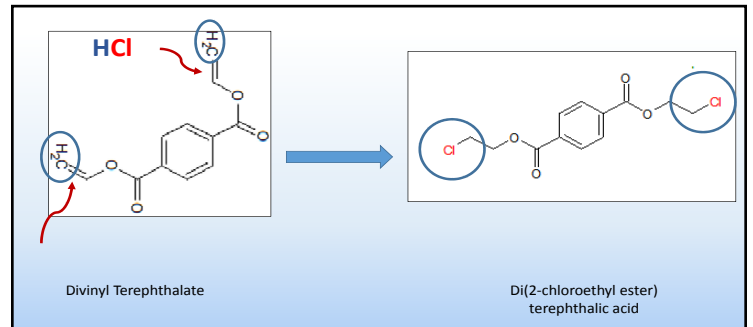


Figure 3. Hydrochloric acid from PVC attacking the double bond in divinyl terephthalate, adding a chloride ion to form Di(2-chloroethyl ester) terephthalic acid.