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Endocrine Disruptors Contained in Synthetic Polymer (5)
A Novel Method for Polycarbonate Reaction at Low Temperature

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[Introduction] Plastics contain compounds that have endocrine disrupting potential, such as bisphenol A (BPA), nonylphenol and styrene trimer. These compounds, though present in only small amounts many pose significant health problems for children. Bisphenol A in particular, present in baby use milk bottles and plastic coating on cans as well as the styrene trimer from which instant-food containers are made appear to warrant special attention. These compounds are considered to be produce through the thermal decomposition of plastics that occurs during processing at high temperature (300℃). The authors devised a method for affecting decomposition that uses a polyethylene glycol (PEG) heating medium system. It was found that the thermal decomposition of polycarbonate (PC) could be evenly carried out at low temperature. Through liquid-liquid distribution alone, endocrine-disrupting substances at less than 10^{-6} (ppm) could be readily detected and accurately measured.

[Material and Method] PC (Panlite/Teijinkasei) obtained from a commercial source contained 80 mg/g BPA, which was removed to a lower level less than 3 mg/g by treatment with dilute NaOH solution. This material, (Mn, 2.86×10^4; Mw, 6.01×10^4 ; Mw/Mn=2.10) was used after 10 days drying in vacuum (3 mmHg) at 25℃. Thermal decomposition was conducted in 4.9 g heating medium as a 2 wt% dispersed solution. Subsequent to decomposition at fixed temperature and time, the reaction mixture dissolved in dichloromethane was washed with water. The organic layer was treated with diethyl ether and a portion of the polymer was precipitated. The products derived from PC were then analyzed.

[Results and Discussion] PC is subjected to injection molding above 300℃ at which temperature thermal decomposition is considered to likely occur. For clarification of the mechanism for PC thermal decomposition, this process has been conducted in most cases at 300℃ or higher. Davis and Golden found PC to have considerable thermal stability and in the absence of oxygen, decomposition to occur only slightly below 250℃. This thermal decomposition has also been conducted at 500 - 800℃ by flash pyrolysis GC/MS, with detection of H_2O, CO_2, BPA to derive from PC. No data presently appear in literature on PC thermal decomposition below 250℃. Significant results were obtained in this study for PC thermal decomposition conducted at low temperature.

The major product was BPA and a minor peak was noted for t-butyl phenol came from terminal group. Except for reaction temperature, all conditions were maintained constant. Product composition was essentially the same at any temperature and thus the same mechanism should always be operative in the decomposition process. BPA was found to increase with temperature. PC decomposition to occur at temperatures much less than generally considered required. Thus, even at low temperatures in domestic settings plastics may pose significant health problems.