The Second Green and Sustainable Chemistry Award Awarded by the Minister of Economy, Trade and Industry

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Novel Non-phosgene Polycarbonate Production Process Using By-product CO_2 as Starting Material

Polycarbonate is an engineering plastic with outstanding transparency, impact resistance, and heat resistance, which is used in a wide range of applications basic to the modern lifestyle including optical discs, automobiles, office equipment, and sheets. About 2.7 million tons of polycarbonate are produced annually worldwide, and until now all production used carbon monoxide (CO) as a starting material. The vast majority of polycarbonate is made in a process where CO and chlorine are combined to form phosgene, a toxic gas, as an intermediate material. The phosgene process entails a number of drawbacks in environmental terms including the toxicity of phosgene, the use of the low-boiling-point solvent methylene chloride to which exposure must be restricted, and the large quantity of waste water containing methylene chloride which must be treated. Many attempts have been made to overcome the environmental and cost disadvantages of the phosgene process, but faced with significant technological barriers, both for a production step for a safe monomer to replace phosgene and for a polymerization step to produce polycarbonate, success has been limited.

Based on a concept of green and sustainable chemistry which contributes to society, research and development for this new process spanned about twenty years, in an endeavor to develop new non-phosgene technology for the production of polycarbonate necessary for the modern lifestyle. In contrast to other existing processes, which use CO as a starting material, this is the world's first non-phosgene polycarbonate production process which uses CO_2 as a starting material.

This technology uses ethylene oxide, its by-product CO_2, and bisphenol-A as starting materials to produce high-quality polycarbonate and high-purity ethylene glycol at high yield. Because CO_2 has low chemical reactivity, it was considered to be difficult to incorporate it into the polycarbonate main chain. However, this technology successfully integrates all of the CO_2 used into the products through deft utilization of chemical reactions. The CO_2 used as starting material is a by-product generated in the production of ethylene oxide (generally used to make ethylene glycol for PET bottles and polyester fiber), and is usually released to the atmosphere.

This technology overcomes the problems of the phosgene process and additionally achieves high yield, resource conservation, and energy conservation while contributing to reduced CO_2 emissions (173 tons per thousand tons of product PC) in an expanse of benefits which embodies the spirit of green and sustainable chemistry.

This technology was commercialized at a plant of Chimei-Asahi Corporation, an Asahi Kasei affiliate, which entered commercial operation in June 2002. With lower plant construction costs and lower feedstock costs, it is anticipated that it will be widely adopted throughout the world as a non-phosgene polycarbonate production process.