The Fourth Green and Sustainable Chemistry Award

Sumitomo Chemical Company Limited

Development and Industrialization of the Hydrogen Chloride Oxidation Process

The world production of isocyanates, which consumes chlorine, is expected to be growing by 4 to 6% annually, but it has the problem of hydrogen chloride generated as a by-product. The by-product hydrogen chloride is usually marketed as hydrochloric acid or used as a raw material of vinyl chloride monomer. However, as the vinyl chloride production growth is slow, excess supply of hydrogen chloride is foreseen. Furthermore, the main chlorine production method, salt electrolysis, needs large amounts of energy, and accompanies the additional disadvantage of producing caustic soda. Thus, a chlorine recycling technology has been most wanted for a long time from the viewpoint of not only the by-product problem, but also the energy and resources problem.

In this background, Sumitomo Chemical has developed its own catalyst and process technology for the production of chlorine from hydrogen chloride, using the oxidation catalyst. It was found that RuO_2 type catalysts have far higher activity than conventional catalysts, and that their activity levels can be improved further by supporting the RuO_2 on TiO_2. Moreover, the use of a rutile TiO_2 carrier has resulted in the successful development of a high activity catalyst. Conventional catalysts do not have sufficient activity levels, and the reaction must therefore be carried out at higher temperature. In contrast, our new catalyst shows a practical reaction rate acceptable for use in industrial applications, even at low temperature.

Sumitomo Chemical has also succeeded in the development of a fixed bed reactor for the first time in the world as a hydrogen chloride oxidation technology. This was accomplished by improving the thermal conductivity of the catalyst, and by dividing the reactor in several zones. Different kinds of catalyst are filled in each zone to obtain the best performance, even though previous technology has adopted a fluidized bed reactor because removing the reaction heat is easier than in a fixed bed reactor.

A commercial 100,000 ton/year plant using this technology is operating smoothly since 2003 at a certain chemical company in Japan. This new technology not only realizes the Green Sustainable Chemistry by chlorine recycling, but also allows reduced consumption of resources and energy. For example, the consumption of energy is 1/15 compared to salt electrolysis, as well as 1/3 against MT-Chlor method established by Mitsui Chemical. It is expected that this new technology will be widely accepted in the world in the future.