

Carbothermic Reduction of Phosphoric Acid Extracted from Dephosphorization Slags to Produce Yellow Phosphorus

Authors : Ryoko Yoshida, Jyunpei Yoshida, Hua Fang Yu, Yasushi Sasaki, Tetsuya Nagasaka

Abstract : Phosphorous is an important element for agriculture and industry and is a non-renewable resource. Especially, yellow phosphorus is an essential material in advanced industrial technology, but phosphorus resources were not produced in Japan at all, and all depend on imports. It has been suggested, however, that the remaining accessible reserves of phosphate ore will be depleted within 50 years. Therefore, alternative resources for phosphate ore must be found. In this research, we have developed a process that enables the production of high-purity yellow phosphorus from domestic unused phosphorus resources such as steelmaking slags. The process consists of two parts: (1) the production of crude phosphoric acid from wastes such as steelmaking slag; (2) producing high-purity yellow phosphorus by low-temperature carbothermic reduction of phosphoric acid (H_3PO_4). The details of the carbothermic reduction of phosphoric acid are presented in this paper. Yellow phosphorus is commercially produced by carbothermic reduction of phosphate ore in an electric arc furnace at more than 1673K. In the newly developed system, gaseous P_4O_{10} evaporated from H_3PO_4 is successfully reduced to yellow phosphorus by using carbon packed bed at less than 1273K. To meet the depletion of phosphate ore, the proposed process in this study to produce yellow phosphorus by carbothermic reduction of H_3PO_4 that are extracted from dephosphorization slags will be one of the effective and economical solutions.

Keywords : carbothermic reduction, phosphoric acid, dephosphorization slags, yellow phosphorus

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