Hydrothermal Solidification of Al-rich Inorganic Waste Materials

Hiroki Maenami, Norifumi Isu, Emile H. Ishida*

General Research Institute of Technology, INAX Corporation

** Graduate School of Environmental Studies, Tohoku University*

E-mail: maenami@i2.inax.co.jp

URL: http://www.inax.co.jp/

Key Words: hydrothermal solidification, inorganic waste material, hydrogarnet, zeolite, flexural strength, nano-size, self-humidity controlling property

Increasing environmental concerns highlight the need to build up a sustainable society based on recirculation of our limited natural resources. The authors have been studying the application of hydrothermal solidification for the recirculation of inorganic waste materials with lesser energy at the waste heat level. The wastes generally contain higher amount of Al_2O_3, yielding the formation of large hydrogarnet crystals as the prevention factor of the strength development of hydrothermal solidification. In this paper, it is clarified that hydrogarnet can work as a new binding material when the size of hydrogarnet is controlled to nano-size by the introducing of the dry press forming process into the hydrothermal solidification technology (Fig.1, 2). Similarly, the formation of nano-size zeolite crystals gives high strength of the hydrothermally solidified wastes. In addition, the authors have been investigating the possibility of the hydrothermal solidification by controlling of the size and morphology of compound of SiO_2–Al_2O_3 formed by the hydrothermal reaction. Since some new binding materials are added in the hydrothermal solidification technology generally having calcium silicate hydrate as the main binding material, it is expected that the range of usable raw materials drastically expands, resulting in drastic improvement of the waste recirculation. In addition, because of nano-size phases formed by the hydrothermal solidification, it is expected that the hydrotharmally solidified wastes can be applied to the self-humidity controllable material (Table 1), the adsorbent and the catalyst carrier.

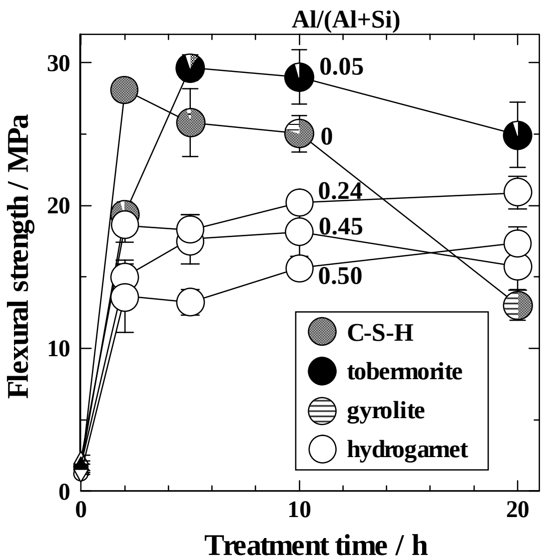

Fig. 1. Variation of flexural strength and phases formed with hydrothermal treatment time in the quartz-kaolinite-lime mixtures formed by dry pressing.

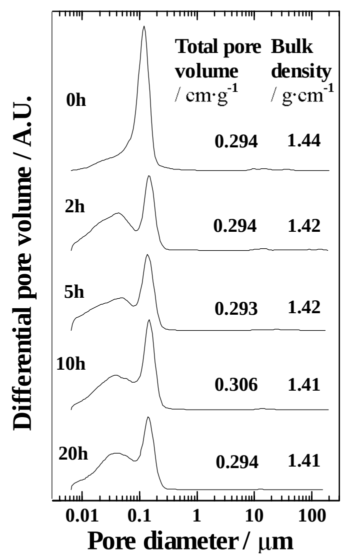

Fig. 2. Pore size distribution of the kaolinite-lime mixtures with Al/(Al+Si) = 0.50 formed by dry pressing.

Table 1. Self-humidity controlling property of hydrothermally solidified sludge from water purification plant and waste soil, and wood

	Self-humidity controlling property† / g·m^{-2}
Hydrothermally solidified sludge from water purification plant	460
Hydrothermally solidified waste soil	76
Wood (Cedar)	65

† The self-humidity controlling property was evaluated by the released moisture amount from specimens (55mm in width, 5mm in height, 55mm in depth) between 90%RH and 50%RH at 25°C in the chamber (PR-3KP, Espec Co., Japan).

Biographical Sketch

Name : Hiroki Maenami

Born : August 02, 1967

Nationality : Japanese

Affiliation : General Research Institute of Technology, INAX Corporation.
3-77 Minatocho, Tokoname, Aichi, 479-8588, Japan
Tel: +81-569-43-8020, Fax: +81-569-43-4879
E-mail: maenami@i2.inax.co.jp
Web: http://www.inax.co.jp/

Title : Researcher

Degree : B. Sc., Material Science and Engineering, Nagoya Institute of Technology, Japan, 1990.
M. Sc., Material Science and Engineering, Nagoya Institute of Technology, Japan, 1992.
Ph D., Science and Engineering, University of East Asia, Japan, 2001.

Award : The award for advancements in industrial ceramic technology from the Ceramic Society of Japan, 2003.

Study : Development of solidification technology for various inorganic wastes by hydrothermal treatment and various soils with slaked lime at room temperature, named “TATAKI.”

Hobby : Music, Home video games, Swimming