
Effect of Ambient Atmosphere on Solid State Reaction of Kaolin-salt Mixtures

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Abstract: The reaction of kaolin with NaCl was followed by dynamic thermal analysis and mass spectrometry under N₂, CO₂, and air atmospheres and in a 10⁻⁵-torr vacuum. The weight loss was a function of the atmosphere used and, according to mass spectrometry, was due to the evolution of H₂O, HCl, and very small amounts of H₂. HCl was formed only after the release of 85% of the hydroxyl content of the kaolin. When the clay was pretreated with saturated salt solution, H₂O and HCl evolved in more or less the same temperature range, indicating that only some of the OH groups reacted with the chloride ion. High-temperature X-ray powder diffraction patterns showed that the sodium ion reacted with the non-crystalline metakaolin to give NaAlSiO₄. Chemical analysis showed that the reaction of kaolinite and sodium chloride started below 400° C. The rate of the reaction increased at higher water vapor concentration. From mass spectrometric data, the NaCl-treated kaolin appeared to adsorb CO₂. Desorption at several distinct temperatures suggests that CO₂ was adsorbed by different parts of the structure, i.e., holes and channels. X-ray powder diffraction and infrared absorption data indicate that the kaolinite structure persisted even after it had been heated with NaCl in a CO₂ atmosphere to as high as 800° C.

Key Words: Infrared spectroscopy • Gaseous atmosphere • Kaolin • Metakaolin • Salt • Thermal analysis

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