


Experiment Report Form

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|  | Experiment title: Pozzolanic reaction mechanisms in lime-zeolite mixtures using in situ X-ray diffraction and Raman spectroscopy | Experiment number: 26-02-450 |
| Beamline: BM01B | Date of experiment: from: 03/12/2008 to: 08/12/2008 | Date of report: <i>Received at ESRF:</i> |
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Report:

Abstract

The early pozzolanic reaction in pastes of lime and natural zeolites was studied with time-resolved *in situ* synchrotron X-ray powder diffraction. For chabazite and Na-, K-, and Ca-exchanged clinoptilolite tuffs, which were mixed with lime and water, the evolution of the quantitative contents of crystalline phases was followed during the early pozzolanic reaction in the first hours and days. The dependence of the rate coefficient on temperature was examined by isothermal curing at 313, 323, and 333 K of lime-chabazite tuff pastes.

Kinetic analysis indicates that the reaction rapidly displays a deceleratory character. This is explained by the modified Jander equation as a result of the reaction rate control by diffusion processes through a condensing reaction product boundary layer. The exchangeable cation content of clinoptilolite influences the duration of

the initial induction period, the diffusion characteristics of the boundary layer of reaction products, and the structural evolution of the C-S-H reaction product. Alkali-exchanged clinoptilolites show a higher pozzolanic reactivity, a more permeable reaction product layer, and longer silicate chains in the C-S-H phase compared to their Ca-exchanged counterpart. The temperature dependence of the reaction rate coefficients in the lime-chabazite tuff pastes obeys the Arrhenius equation.

Published in: Snellings R, Mertens G, Hertsens S, Elsen J (2009) The zeolite-lime pozzolanic reaction: Reaction kinetics and products by in situ synchrotron X-ray powder diffraction. *Microporous Mesoporous Mater* 126:40-49.

