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Material conversion from paper-sludge ash in NaOH, KOH, and LiOH solutions

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Abstract

Zeolites were synthesized from paper-sludge ash in different alkali solutions. The ash used in this study has a high-Ca content and a low abundance of Si, in part due to the presence of calcite that is used as a paper filler. The major minerals present in the ash are gehlenite ($Ca_2Al_2SiO_7$) and anorthite ($CaAl_2Si_2O_8$). Three kinds of alkali solutions (NaOH, KOH, and LiOH) at four different concentrations (1, 2, 3, and 4 *M*) were reacted with paper-sludge ash at 90 °C for 24 h. Powder X-ray diffraction showed that hydroxysodalite ($Na_6Al_6Si_6O_{24}\cdot 8H_2O$) and zeolite Linde F ($KAlSiO_4\cdot 1.5H_2O$) had formed in NaOH and KOH solutions, respectively, and that anorthite had dissolved in these alkaline solutions, whereas gehlenite had remained unaffected. In the LiOH solution, both anorthite and gehlenite dissolved, and various minerals, including Li-ABW zeolite ($Li_4Al_6Si_6O_{16}\cdot 4H_2O$), hydrocalumite [$Ca_2Al(OH)_6(Cl, OH)\cdot 3H_2O$], tobermorite [$Ca_5Si_6O_{16}(OH)_2\cdot 4H_2O$], katoite [$Ca_3Al_2(SiO_4)(OH)_8$], and portlandite [$Ca(OH)_2$] formed. The products of mineral synthesis from paper-sludge ash by reaction in alkaline solutions strongly depend on the specific alkali present.

Keywords: Paper-sludge ash, hydroxysodalite, zeolite Linde F, Li-ABW, hydrocalumite, tobermorite, katoite, portlandite