PHI Phillipsite Si(72), Al(28)

Contributed by David Hayhurst

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Type Material $K_{3.1}Na_{0.9}[Al_{11}Si_{12}O_{32}] : wH_2O$

Method D. T. Hayhurst, L B. Sand [1]

Batch Composition 6.95 Na_2O : 3.50 K_2O : Al_2O_3 : 18.5 SiO_2 : 325 H_2O

Source Materials

distilled water
potassium hydroxide (Mallinckrodt reagent grade, 87% KOH)
sodium silicate solution (PQCorp., N-brand, 8.9% Na_2O, 28.7% SiO_2)
sodium aluminate (Nalco, 30.5% Na_2O, 45.6% Al_2O_3)

Batch Preparation (for 100 g dry product)

(1) [636 g water + 91.6 g potassium hydroxide + 826.9 g sodium silicate solution]. Dissolve in a stirred flask at 100˚C under reflux
(2) [(1) + 45.28 g sodium aluminate], continue mixing at 100°C for crystallization

Crystallization

Vessel: 3 L, 3-neck flask under reflux
Temperature: 100˚C
Time: 6 to 8 hours
Agitation: mechanically stirred

Product Recovery

(1) Filter to recover solids
(2) Wash to pH<10
(3) Dry at 120˚C
(4) Yield: 100% on Al_2O_3

Product Characterization

XRD: PHI (only crystalline product); Competing phases; MOR,[a] ERI,[a] LTL,[b] GIS,[b] ANA[c]
Elemental Analysis: 0.8 K_2O. 0.2 Na_2O . Al_2O_3 : 5.24 SiO_2
Crystal Size and Habit: multi-crystalline aggregates, ~5 μm dia.

Reference

[1] D. T. Hayhurst, L B. Sand, in ACS Symposium Series 40, 1. R Katzer (ed.), Am. Chem. Soc., Washington, D. C., 1977, p. 219

Notes

a. Higher silica batch composition
b. $K^+/(Na^+ + K^+) > 0.4$
c. $K^+/(Na^+ + K^+) < 0.1$