CHA Chabazite Si(68), Al(32)

Contributed by Thomas R Gaffney

Verified by J. Warzywoda, J. Cejka and Liu Xinjin

Type Material $K_{11}[Al_{11}Si_{25}O_{72}]$:40 H_2O

Method M. Bourgogne, J.-L Guth, R Wey [1]

Batch Composition 0.17 Na_2O : 2.0 K_2O : Al_2O_3 : 5.18 SiO_2 : 224 H_2O

Source Materials

demineralized water
potassium hydroxide (J. T. Baker reagent grade, 45% KOH solution)
(Na,H) Zeolite Y (UOP LZY-64)[a]

Batch Preparation (for 25 g dry product)

(1) [198.2 mL water + 26.8 mL KOH (45% solution), mix
(2) [(1) + 25.0 g Zeolite Y], seal in a polypropylene bottle and shake for 30 s

Crystallization

Vessel: polypropylene bottle with a screw-top lid
Temperature: 95°C (steam chamber)
Tune: 96 hours
Agitation: none

Product Recovery

(1) Remove bottle from the steam chamber and filter to recover solids while still hot [b]
(2) Wash two times with 500 mL water per wash
(3) Dry at ambient temperature [c]
(4) Yield: 99% based on alumina, 83% based on silica

Product Characterization

XRD: CHA with no reflections from FAU. Competing phases; FAU when insufficient crystallization times are used [d]
Elemental Analysis: 0.02 Na_2O : 0.98 K_2O : Al_2O_3 : 4.32 SiO_2 (dry basis)[e,f]
Crystal Size and Habit: Sub-micron crystallites, 0.1 um on average, multifaceted (some can be seen to be hexagonal platelets)

Reference

[1] M. Bourgogne, J.-L Guth, R. Wey, US Patent 4 503 024 (1985)

Notes

a. The Na/Al ratio of the NaHY starting materials should be less than 0.17. LZY-64 was prepared by heating NH_4^+ exchanged type Y to 550°C (at 2°C/minute) and calcining at 550°C for 2 hours. Caution: ammonia is liberated during the calcination. Use adequate ventilation and safety precautions.

b. pH = 13.5 after crystallization treatment.
c. The product is stable to drying in an oven at 110˚C.
d. Converting samples of Zeolite Y which contain large crystals or are formed (pelleted, beaded) to chabazite requires longer reaction times.
e. The framework SiO_2/Al_2O_3 is 4.32 by ^{29}Si NMR.
f. For preparing more siliceous product, Nalco 2326 silica (14.5% SiO_2) was used as the silica source. Synthetic chabazite with SiO_2/Al_2O_3 = 5.3 forms from a reaction mixture of composition: 0.17 Na_2O: 4.31 K_2O : Al_2O_3 : 8 SiO_2 : 500 H_2O. Addition of more silica to the reaction mixture (batch SiO_2: Al_2O_3> 8) leads to incomplete conversion of Zeolite Y, and the product is a mixture of CHA and FAU.