FAU Linde Type Y Si(71), Al(29)

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Verified by G. Price and C. Kuntz

Type Material $Na_{56}[Al_{56}Si_{136}O_{384}]$: 250 H_2O

Method D. M. Ginter, A. T. Bell and C. J. Radke [1]

Batch Composition[a]

Seed Gel (5% of Al): 10.67 Na_2O : Al_2O_3 :10 SiO_2 : 180 H_2O
Feed Stock Gel (95% of Al): 4.30 Na_2O : Al_2O_3 : 10 SiO_2 :180 H_2O
Overall Gel: 4.62 Na_2O : Al_2O_3 : 10 SiO_2 : 180 H_2O

Source Materials

deionized water
sodium aluminate solid (Strem Chemical[b] 1.27 Na/Al, 6.1% H_2O)
sodium hydroxide pellets (J. T. Baker, 99% NaOH)
sodium silicate solution (PQ Corp, N Brand, 28.7 wt% SiO_2, 8.9 wt% Na_2O)[c]

Batch Preparation (for 32 g anhydrous product)

Seed Gel

(1) [19.95 g water + 4.07 g sodium hydroxide + 2.09 g sodium aluminate], stir in 50 mL plastic bottle until dissolved
(2) (1) + 22.72 g sodium silicate solution], stir moderately for at least 10 minutes; after stirring, cap the bottle and let the solution age at room temperature for 1 day[d]

Feedstock Gel

(3) [130.97 g water + 0.14 g sodium hydroxide + 13.09 g sodium aluminate], stir in a 500 mL plastic beaker until dissolved
(4) [(3) 142.43 g sodium silicate solution], stir vigorously with a high-shear turbine mixer[f] until the gel appears somewhat smooth; cover the beaker until the addition of the seed gel

Overall Gel

(5) [(4) + 16.50 g of (2)], slowly add seed gel (2) to feedstock gel (4) under high shear;[f] move the beaker during mixing to ensure the entire gel volume encounters the high shear from the turbine (up to 20 minutes)[g]

Crystallization

Vessel: 300 mL polypropylene bottle (sealed)
Incubation: One day at room temperature g Temperature: 100˚C [g]
Time: After about 5 h, the gel will separate into a solid (containing the NaY Zeolite) that will settle to the bottom, and a hazy supernatant liquid. Continue heating until the supernatant is clear indicating complete crystallization (no more than 2 additional hours)[g]

Product Recovery

(1) Centrifuge; decant supernatant
(2) Filter the wet solid product; wash with distilled water until pH of filtrate is below 9
(3) Dry at 110°C
(4) Yield: approximately 32 g of anhydrous NaY (about 98% on Al_2O_3)

Product Characterization

XRD FAU; characteristic strong reflections at d = 14.28, 8.75 and 7.46 Å, a_0 = 24.72 Å
Competing phases (if present): GIS, GME, CHA
Elemental Analysis; $NaAlO_2$. 2.43 SiO_2
Crystal Size and Habit: octahedral crystals, <1 μm

References

[1] D. M. Ginter, A. T. Bell, C. J. Radke, in Synthesis of Microporous Materials, Vol. 1, Molecular Sieves, M. L Occelli, H. E Robson (eds.), Van Nostrand Reinhold, New York, 1992, p 6
[2] T. Linder, C. Kurtz, personal communications

Notes

a. This procedure is reliable only for the production of submicron NaY crystals and is limited in the range of sizes and compositions that can be produced using slight procedural modifications.
b. Also available as solutions with this Na/Al ratio from Alcoa and U. S. Aluminate.
c. It should be clear of precipitated material.
d. Solution is clear when prepared; during aging, a loose gel forms which contains the NaY seeds.
e. May be prepared concurrently with the seed gel or just prior to mixing the overall gel.
f. 1600 rpm with 2.5 inch diameter, 4 paddle radial mixer (minimum) recommended.
g. If a GIS (NaP) impurity is produced, it can be eliminated by reducing the Na aluminate in (1) to 1.40 g and aging the seed gel for 1 to 5 days prior to blending it into the feedstock. Further aging of the composite is optional with this seed, and pure product has been obtained after crystallization at 90°C for 22 hours. [2]