



Sodium Metasilicate Preparation, by KAZAA81

Introduction

Sodium metasilicate is the most stable of silicic acid sodium salts (ortho form isn't much) and can be prepared from molten or hot aqueous NaOH and SiO₂ (preferably in powder, so that it has more reaction area).

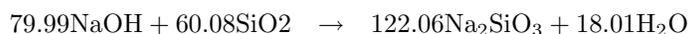
Here I prefer use molten NaOH for not having the trouble of a bubbling aqueous solution. This will lower the bubbling, but will not completely prevent it; if you heat your NaOH too much, it will bubble too.

A good container for this reaction is a steel crucible (even mild-iron suffices), because everything made of glass, ceramic or even quartz, isn't suitable for this reaction. A few types of ceramics could withstand molten NaOH, but I wouldn't recommend this. So, here we are using an improvised crucible made of steel.

The reaction is as follows:



The mass proportions between the reactants and products are:



From these proportions, you can calculate the amount of NaOH and SiO₂ needed, and also the yield based on amount of reagents.

For example:

- for every 1 g of NaOH, you will require 0.751 g of SiO₂
- for every 1 g of SiO₂, you will require 1.331 g of NaOH
- every 1 g of NaOH will produce¹ 1.525 g of Na₂SiO₃
- 1 g of Na₂SiO₃ will be produced by 0.655 g of NaOH²

¹if properly balanced by the amount needed of SiO₂

²if properly balanced by the amount needed of SiO₂

Materials

Here is some information[1] about the substances we will handle:

Sodium Hydroxide NaOH CAS #: 1310-73-2. Mol.: 39.997 g/mol. Form: white orthorhombic crystals; hygroscopic. M.P.: 323°C. B.P.: 1388°C. Density: 2.13 g/cm³. Soluble 42 g in 100 mL H₂O at 0°C; soluble in EtOH, MeOH.

Sodium Metasilicate Na₂SiO₃ CAS #: 6834-92-0. Mol.: 122.064 g/mol. Form: white amorphous solid; hygroscopic. M.P.: 1089°C. Density: 2.61 g/cm³. Soluble in cold H₂O; reacts in hot H₂O.

Silicon Dioxide SiO₂ CAS #: 14808-60-7. Mol.: 60.08 g/mol. Form: colorless hexagonal crystals. M.P.: trans to beta-quartz at 573°C, to tridymite at 867°C and to cristobalite at 1470°C. B.P.: 2950°C. Density: 2.648 g/cm³. Insoluble in H₂O, acids; soluble in HF.

Practical

Reagents:

Sodium hydroxide, NaOH, 10 g
Silicon dioxide, SiO₂, 7.6 g

Apparatus:

Steel crucible, small
Heating source, gas (propane, butane) torch
Tongs that fit to the crucible

The crucible is loaded with NaOH flakes and quartz powder, not necessarily intimately mixed.

The heat source is turned on, and the loaded crucible is put on it. If you have a fitting-plate for the crucible it's better, otherwise you can use a pair of long tongs. Be sure to make NaOH molten but not boil, since NaOH is quite caustic and drops of NaOH aren't needed or wanted.

Maintain the heating for about 20 minutes, and the reaction must be completed.

The water produced by the reaction is quite probably boiled away, so it isn't really a problem; atmospheric vapor is much worse for hygroscopic substances like NaOH and Na₂SiO₃.

We have used slightly more SiO₂ than what needed, because it is easier to separate, since it's insoluble and won't remain in the products as NaOH would be likely to do.

Now you can separate your product by dissolving your sodium metasilicate in water, making a water glass solution of variable strength, or melt it and pour somewhere. Be aware that Na₂SiO₃ is quite caustic also as NaOH, and hygroscopic as well.

Now that you've made sodium metasilicate, you can do many things with it. Some examples are: make other metal silicates, make water glass and/or silica gel (widely used for moisture absorbing) or use it, very dilute in water, as an aid for growing diatoms, radiolarians or other micro-organisms that need silica to build their shells.

References

- [1] The CRC Handbook of Chemistry and Physics, 85th edition, CRC Press.