

Core Making And The Use Of Sodium Silicate.

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This happens to be my personal specialty. I actually have patents on using Sodium Silicate to make sand cores and moulds!

Let's talk about Sodium Silicate first. Sodium Silicate is made by melting Silica Sand and Soda Ash together in a furnace. The resulting glass can be dissolved in water, steam and much pressure, to make liquid Sodium Silicate. This is one of the oldest and cheapest industrial chemicals in the world.

When you ask for "Sodium Silicate" (a.k.a. Water Glass) you may get just about anything. It's a bit like asking for "Motor Oil." The two things that describe any Sodium Silicate are the Weight Ratio and the Solids Content. The Weight Ratio is the ratio of the Silica to the Sodium Oxide. The most common Sodium Silicates are all made with a Weight Ratio of 3.22 parts of Silica to 1 part of Sodium Oxide. If you just ask for Liquid Sodium Silicate, this is most likely what you will get, a "3.22 Ratio Silicate." In bulk tankers, I buy it for about \$.06/lb. It weighs in at about 11.6 lb. per gallon and has the viscosity of Olive Oil.

This 3.22 Ratio Sodium Silicate usually has a solids content of about 36 to 38%. The balance is water. Treat this liquid like VERY strong industrial detergent. It has a pH of about 13.0 and stings like a bitch if you get it in your eyes or into a cut on your skin. Otherwise, it is completely water-soluble.

The largest manufacturer in the world is PQ Corporation. They sell this basic product as "N" Grade Liquid Sodium Silicate. You may be able to buy a 5-gallon pail of this stuff for about \$50.00. Check the website www.pqcorp.com

This is not the best choice for making sand cores and moulds, since it does not provide very good strength. The preferred product would be a liquid sodium silicate with a weight ratio of about 2.4 to 2.6. It will cost slightly more, but will make much better cores. PQ sells a 2.4 Ratio liquid sodium silicate as "RU" Grade. It comes as a very thick liquid. You can add about 15% by weight water to get the solids content down to about 38 to 40%.

Sodium Silicate can go from liquid to solid by simple de-hydration (baking), by passing Carbon Dioxide THROUGH it, or by reacting it with a liquid ester, like Propylene Carbonate or Glycerol Triacetate or Ethylene Glycol Diacetate. If you use the straight Sodium Silicate, the collapsibility of the sand core won't be very good. Sodium Silicate does not burn out, so you will need to add something organic. The simplest thing to use is Sugar. Start by adding about 10-12% by weight of the liquid Sodium Silicate. It will mix in nicely, and stay as a stable liquid.

You could also add something as simple as 0.25 to 0.5% by weight of the sand of wheat flour, starch, molasses, ground charcoal, or even kaolin clay to get better breakdown. The kaolin clay will provide some green strength, which might make it possible to strip the core without gassing it, and then let it dry in an oven. You don't need to get it much hotter than 225°F.

How much to use? If you use a clean, dry sand that has a grain fineness of between 60 and 90, I would start with a Sodium Silicate addition of 4.0% by weight of the sand. You can mix this with a simple kitchen mixer in a plastic mixing bowl. Mix for about a minute or two at high speed. Once the sand is mixed, put a lid on the bowl, or put the sand into a plastic bag to keep it from de-hydrating. The covered sand should stay good for MONTHS, so long as it does not dry out.

If you want to use Carbon Dioxide Gas for hardening the core, you must allow the gas to pass through the entire sand mass. Simple exposure to the surface of the sand won't give you any appreciable hardening. You can get small bottles of CO₂ from the guys who service soda pop machines. **YOU MUST USE A REGULATOR TO CONTROL THE PRESSURE OF THE CARBON DIOXIDE!** The soda machine guys will sell you a used one for a few bucks. Generally, you don't need much more than 10 - 15 psi. for the gas.

You can use a nail or a wire to make a vent in the sand to pass the gas through it. If you were using Carbon Dioxide at 10 psi. and you want to cure 1 lb. of sand; it will only take about 5-10 seconds of gassing. This is enough strength to get the core out of the core box. After you get the core removed from the form, just let it dehydrate overnight in a dry place. Or, you can bake it out in a warm oven or even a Microwave. (Microwave works REALLY well, just be careful, since the Sodium Silicate attracts MW and the sand is likely to get extremely hot in just a minute or two.)

If you opt to use the ester hardener, you need to add it to the sand mix at about 10% by weight of the liquid Sodium Silicate. Just keep in mind that once it is mixed together, you will have only a certain amount of time before the sand mix begins to harden. We call this "Work Time." You need to have all the sand in place before the end of Work Time. Then you need to wait until the sand is so hard that you cannot put a nail or knife into it. We call this point "Strip Time."

If you use PQ "RU" Grade Silicate watered down to 40% solids, and then add Propylene Carbonate as the ester hardener, you will have about 10 minutes of Work Time and a 20 minute Strip Time at room temperature. If the sand is hotter, it goes faster.

If you are casting Aluminium, you can get by without adding any organic additives to the sand mix, just dunk the finished casting in water and the cores will flush out in a few minutes. If you are pouring Brass, Bronze or Iron, you will fuse the Sodium Silicate core into something that behaves like concrete, unless you have added some additional organic material.

You can also make incredible cores with a two-part epoxy binder. I would not use more than a total of 1.5 to 2.0% total epoxy binder and hardener on a 60 to 90 Grain Fineness sand. Let it harden completely before you take it out of the box. Dust the box with baby powder before you ram the sand into it. This will help it to release from the core box.

If you can get Corn, Potato, Rice or Tapioca Starch, you can make very nice cores by mixing the starch at about 2% and water at about 1% into the sand. You can harden the core by baking or microwave oven. This work really well for Aluminium castings, and they fall out of the hole!

You can also use Linseed Oil or Tung Oil at about 1.0 to 2.0%, with a little Kaolin Clay and water as the binder. Strip the core green and then bake it at 350-400°F for 10 minutes per inch of thickness. We call this "Baked Oilsand."

You can also make great cores by boosting up the strength of greensand with more clay, cornstarch and water. Let them dry out before you use them.

I have been making sand moulds and cores for over 35 years. there is no mystery to how this is done. There are several binders that can be used. Sodium Silicate is cheap and safe. Starch is a little more difficult to use, but shakes out better. Epoxy and other organic adhesives are expensive, but work extremely well. I can remember making water jacket cores for this guy who was building a 12 cylinder Jaguar engine. That was a tough one. The epoxy worked really well.

On many occasions, I started with a block of cured coresand, and then ground away the extra sand to get the shape that I needed. Recently, I have done this with a 3-axis milling machine. If you want to go this route, make a really strong core mix first. I use a grinding stone (like from a Dremel) instead of a milling cutter and the results are very nice.

If you want to know more, just ask.

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"In Pyro Veritas"