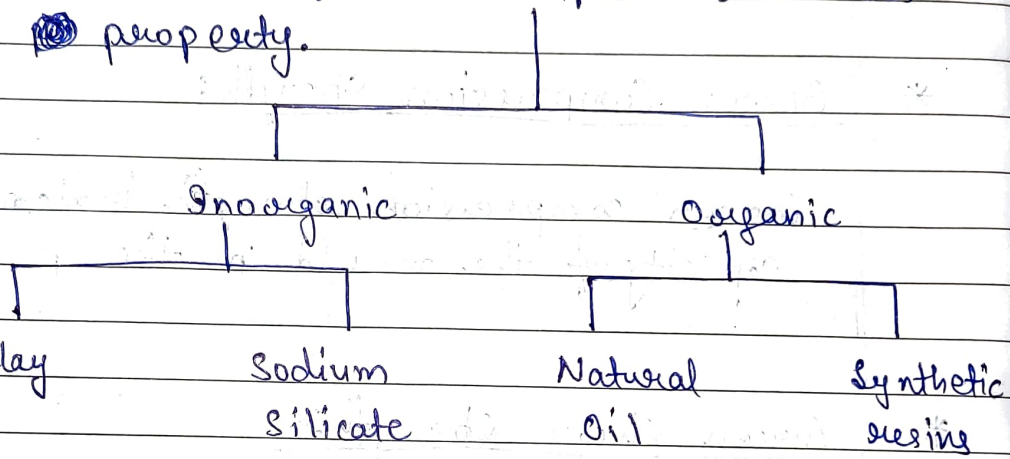
* **Binder:-**

(i) Ingredient which hold the sand each other by making bond.

(ii) It should retain it property till the solidification is complete.

(iii) When the solidification complete its losses it property.



Sodium Silicate: SiO_2, Na_2O, H_2O

Weight Ratio	Typical Analysis (% wt)			Sp. gravity at 20°C	Viscosity at 20°C (centi-Poise)
	Na_2O	SiO_2	H_2O		
SiO_2/Na_2O					
2	17.8	35.7	46.6	1.7	90000
2	16.6	33.2	50.2	1.625	4500
2	15.2	30.4	54.4	1.56	850
2	14.0	28.1	57.9	1.5	200
2.2	13.2	29.2	57.6	1.5	220
2.4	12.7	30.8	56.5	1.5	310
2.9	9.2	26.8	64.0	1.375	100

Date: / /

⇒ For foundry use: Ratio: 2 - 2.4 and water content around 50 %.

* Important facts about Sodium Silicate :-

(a) Higher the SiO_2/Na_2O ratio for a given solids content the greater of the viscosity. The rise being very rapid with higher percent of solid.

(b) Higher the viscosity, lower the coating ability and hence higher ratio silicates content lower solid percent and higher H_2O percent than lower silicate.

(c) Solution below 2.8 ratio are alkaline and above this the solution neutral.

(d) Silicate with ratio less than '2' don't harden quickly enough to be of foundry use.

* Mechanism of Hardening in CO_2 Process

- In CO_2 process, the overall hardening is affected by 3 things :
  (a) Chemical gelation
  (b) Physical dehydration during gassing
  (c) Physical dehydration during storage due to loss of water molecules.

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Chemical Gelation:

$$SiO_2 + H_2O + Na_2O + CO_2 \rightarrow H_2CO_3 + Na_2O + SiO_2$$

$$SiO_2 + H_2O + Na_2O + H_2CO_3 \rightarrow Na_2CO_3 + SiO_2 \cdot 2H_2O$$

↓

Silica hydrogel

(Bonding Material)

Physical Dehydration: SiO_2, Na_2O, H_2O

This bond is stronger than the silica hydrogel. This is because the drying up of silica hydrogel, will result in formation of micro cracks. Aim should be to get minimum of silica gel bond and maximum of dodaglass bond.

Under Grassing:

High flow rate short time.

These condition occur in the early stage of gassing after the first silica hydrogel layer has been formed and before silicate glass has been formed.

Any mould or core strip in this condition would develop very high strength on standing since only little amount of silica hydrogel has been formed and there is much more sodium silicate left for conversion to strong silicate glass bond.

Date: / /

Choice for Foundryman :

(a) For immediate use, gassing should take place at high flow rate for long time to produce maximum of strong silicate glass.

(b) For use in period upto one week after making gassing should be at low flow rates for short time to give low as gas strength with very little or no silicate glass bond, which on storing will develop high strength, due to physical dehydration on drying producing silicate glass bond.

Silica hydrogel is formed which is sufficient to strip the pattern from the mould.

★ ## CO_2 Process :-

⇒ Ingredient of CO_2 Process :

Sand – Clay free dry silica sand
SiO_2 / Na_2O ratio → 2:1
Sodium Silicate – 3 to 5%
Mixing – 3 minute
Normal 1 kg of Sodium Silicate will required about 0.5 – 0.75 kg of CO_2 gas will be passed.

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⇒ Advantage of CO_2 Process :-

(a) Much more rigid and stronger moulds and core can be made.

(b) High flowability so give better compaction of moulds and cores.

(c) Casting produce have better dimensional accuracy.

(d) Less friable hence lesser sand inclusion.

(e) Lesser gas defect.

(f) Faster Production.

(g) Suitable for jobbing and mass production.

(h) Lesser in skill required.

(i) Process can be automatic.

⇒ Disadvantage of CO_2 Process :-

(a) Poor breakdown (collapsibility)
(b) Shorter bench life.
(c) Higher cost of sand reclamation.
(d) Special Patterns required.

★ Cold Box Process :-

→ **Ingredients –**

(i) **Resin :-**
Phenolic Resin (dissolved in organic solvent) to give low viscosity resin solution to facilitate coating of sand and building with the 2nd Component.

(ii) **Hardner :-**
Polymeric Isocynate
Blended with organic solvent to form a Low viscosity solution.

(iii) **Catalyst :-**
Dimethyl Ethyl Amine, or,
Trimethyl Ethyl Amine.

(50 % Resin + 50 % Hardner) → 1.5 to 2 % of total Sand
⇓
Total Binder

→ Its addition depends on Casting.
for Steel → 2 % and,
for Cast iron → 1.5 %.

→ 0.2 to 0.5 % Amine in a mixture is used at 30 pounds per square inch pressure.

→ CO_2 or NO_2 or Ar are used as Carrier gases.

⇒ Mechanism of Hardening:-

Phenolic Resin + Poly isocynate $\xrightarrow[\text{Amine}]{\text{Vapours of}}$ Urethane (Polymeric Bond)

So, water or any other by-products is not formed in this reaction and 3 to 4 % Nitrogen comes from the 2nd component.

- Zr sand, Cr sand or Olivin sand can be used.

This system contains high Carbon which contribute the formation of lustrous Carbon and reducing mould atmosphere during pouring.

- Benchlife of Mixture (Component 1 and 2)
  - ↳ 2 to 3 hours.
- Compressive strength - 2000 kg/m²
- Strip time - 10 to 30 seconds.
- Mixture should be free of water since the Isocynate reacts with H_2O in preference resin.
- Additives - 1 to 2 % Clay Sugar, or,
  1 to 3 % Iron Oxide
- High temperature defect is Venning.
  To reduce this defect, additives are used.
  (In steel Casting, Iron oxide 1 to 3 % used for Venning defect improvement)

Date: / /

⇒ Advantages :-

(i) High dimensional accuracy and Surface finish
(ii) Low gas evolution
(iii) High density and good abrasion resistance.
(iv) Excellent Shockout and Collapsibility.
(v) Cold blower and cold shooter can be used for good curing even in thick section of mould or course.
(vi) Sand metal ratio can be reduced to 1:1 due to high sand strength.

⇒ Limitations :-

(i) Amine vapours is highly inflamable and poisonous.
(ii) Prone to venning.
(iii) Low pouring temperature metals and alloy, moulds and core, may not show good breakdown properties.
(iv) Thickness greater than 10 mm may show surface roughness.