



IIT ROORKEE



NPTEL ONLINE
CERTIFICATION COURSE

SPECIAL MOLDING PROCESSES

Full mold, Plaster molding, Vacuum molding, etc.

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MIED



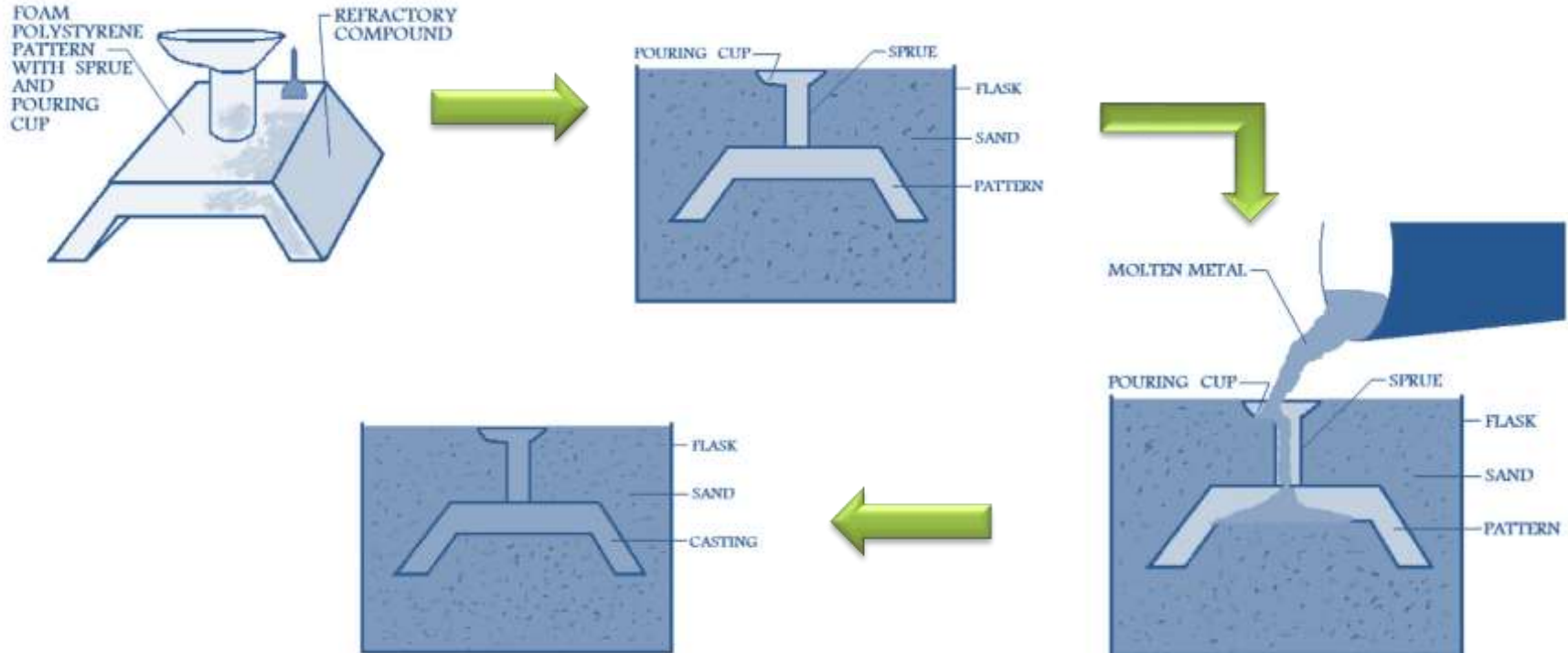
FULL MOLD CASTING

- Pattern (with gates & riser) made of expanded polystyrene.
By machining & fabrication → coated with suitable mold wash
→ finally embedded in a no bake sand.
- Pattern gasifies after it comes in contact with molten metal
(molten metal having temperature 25-30°C higher than that for sand casting)
- Blowholes & pinholes are prevented
(as no air is present in mold)
- Best suited method for one off castings (or at short notice)

FULL MOLD CASTING

- Pattern prepared from pre-expanded polystyrene granules which are injected or gravity filled in the walled aluminum or copper dies & heated under steam or in hot water.
- The granules expands and join together to form a solid shape conforming to die cavity.
- Sophistication to this process is magnetic molding in which pattern is embedded in iron sand in a flask which is surrounded by electro magnet. After pouring and solidification magnetic field is switched off.

FULL MOLD CASTING



PLASTER MOLDING PROCESS

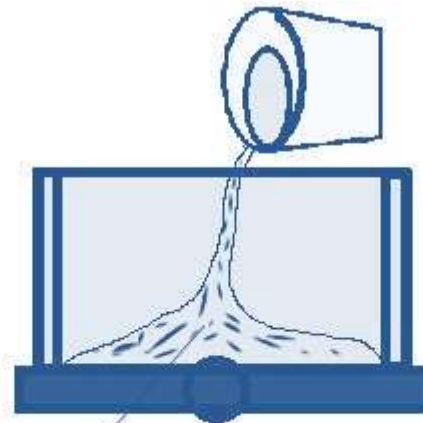
- Mold is prepared in Gypsum plaster (mixed with water and additives)
- Slurry poured over pattern placed in flask and mold is vibrated so that slurry sets.
- After setting is complete (~30 minutes,) pattern is withdrawn and mold is heated (~200°C) for dehydration before pouring.
- Disadvantage is low permeability. To overcome that, mold preparation and pouring may be done under vacuum or metal may be fed under pressure using compressed air.
- Because of low refractoriness of mold, only non ferrous metal is cast.
- Due to very low conductivity, there is no chilling tendency and hence thin sections can be cast (high accuracy and finish)



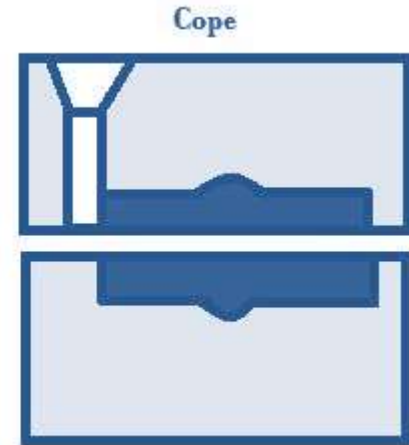
PLASTER MOLDING PROCESS



Making of Plater Slurry



Ceramic Mould Making



Final Part Production

VACUUM MOLDING PROCESS

- No use of binders and moisture.
- Mold preparation by dry sand and compaction and cavity shape by use of vacuum.
- No fettling problem, clean environment.
- 90-100 molds/hour may be made.
- Pattern set on hollow carrier plate.
- Thin plastic sheet softened by heating.
- Softened sheet dropped over pattern & vacuum created in carrier plate.
- Doubled walled flask set on pattern, flask filled with dry sand and vibrated, sprue formed, mold levelled sprue opening & mold top covered with plastic sheet, vacuum applied to flask, sand gets compacted.



VACUUM MOLDING PROCESS

- Vacuum in carrier plate released & mold stripped.
- Cope and drag molds assembled, having plastic lined cavity. Vacuum in flasks maintained during pouring, and later till casting solidified. On releasing vacuum, sand drops having clean casting.
- Process requires special pattern plated and double walls flasks for creating effectively vacuum, efficient venting system in inner face of flask to prevent sand particles being sucked by vacuum pump, a device of stretching and heating plastic sheet and a powerful vacuum pump.
- Sand grains (two screen sand) 70% 70 mesh size & 30% 270 mesh size for better compaction
- A vibratory frequency of 3000 cycles per minute used for few seconds to cause compaction.

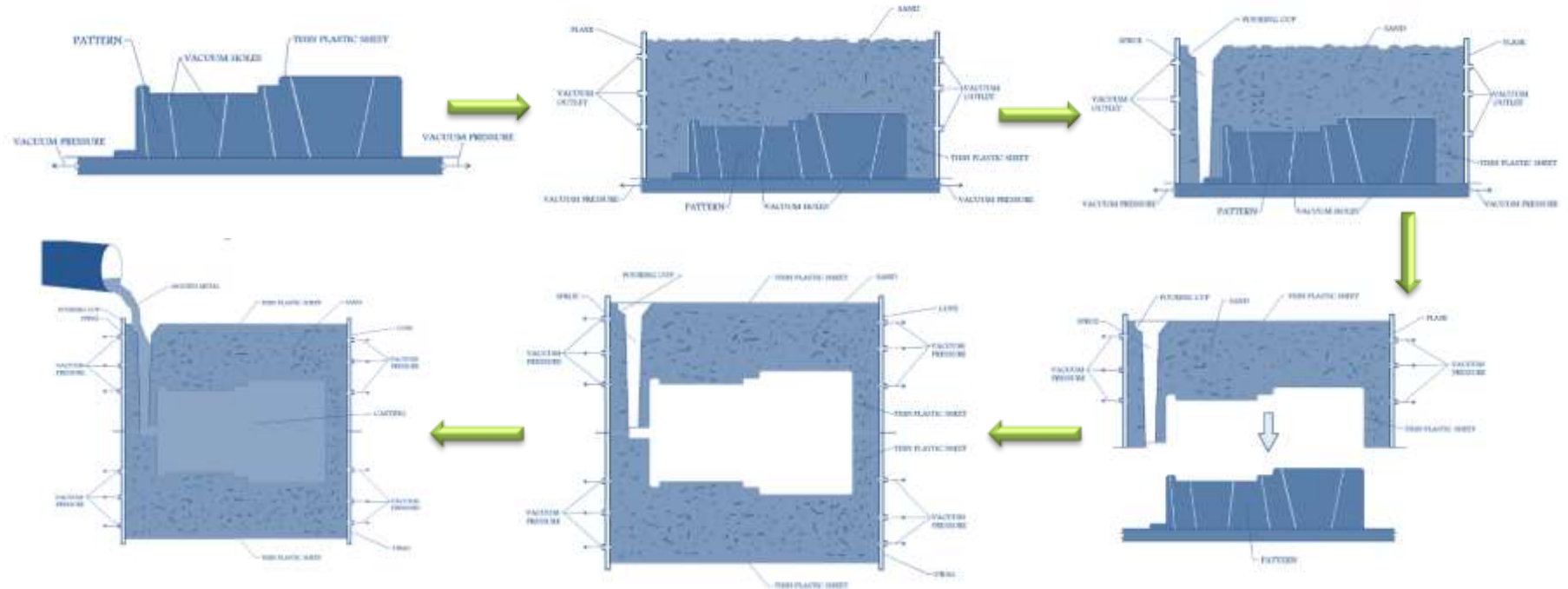


VACUUM MOLDING PROCESS

- **Modified vacuum process** → use of EPS pattern, duly applied with refractory coating. Loose sand grains (dry) poured around pattern & compacted by vibration followed by application of vacuum for full consolidation of sand.
- Vacuum needs to be applied only during pouring & for a short time thereafter.
- While vacuum process well suited for simple shaped casting (need minimum coring), modified process can be applied for complex shaped castings as well.



VACUUM MOLDING PROCESS



VRH PROCESS

- Principle uses dehydration of CO_2 molds and their hardening under reduced pressure.
- Flask containing sand compacted over the pattern is placed inside a VRH vacuum hardening box.
- After closing, suction is applied and resulting reduced pressure promotes evaporation of water present in sodium silicate.
- Due to chemical reaction (removal of water), silica gel is formed. Vacuum replacement is done by injection of CO_2 gas. The mold hardness further increased.
- Strengthening achieved by only $\frac{1}{2}$ weight of sodium silicate & bond is uniform. Collapsibility improved because of reduced consumption of sodium silicate & further reduced amount of residual Na_2O has economical, technical & environmental benefits.

VRH PROCESS

- Desirable requirements:
 - Sodium silicate (mol. ratio 2.0-2.2, viscosity 50° Bc)
 - Sand (% silica $\geq 96\%$, water content $\leq 0.5\%$, fines of size -200 mesh $\leq 1.5\%$)
 - Reclaimed sand to have $H_2O \leq 0.3\%$, residual $Na_2O \leq 0.5\%$, fines of size -200 mesh $\leq 0.55\%$)
 - Mold strength and Mold collapsibility are having satisfactory values.

CEREMIC MOLDING PROCESS

- Process uses chemical & ceramic slurries for mold preparation (gives high precision & fine finish)
- Suitable for all types of cast metal & even for highly reactive metals like Ti and Uranium.
- Casting don't require risers, venting or chilling due to extremely slow cooling rate.
- Process suitable for producing forging dies, tyre molds, dies for plastic molding, dies for drawing/extrusion, die casting & glass making, pattern for shell molding.
- Pattern material: Metal, wood or epoxy.



CEREMIC MOLDING PROCESS

- Refectory slurry is prepared by mixing ceramic aggregates (critical blends of ceramic refractories as per properties required) and liquid binder (modified alkyl silicate, an alcohol based silicon ester).
- When binder begins to set, refractory particles start locking with each other.
- Slurry powder over pattern kept in flask & sets in 3-5 minutes. Slurry fills all cavities, no ramming or even vibration of mold required.
- Pattern withdraw & ceramic mass removed from flask is treated with a catalyst or hand over to promote full chemical stabilization.
- Mold then heated to 90°C in furnace to expel all liquid binder completely.
- Metal poured & allowed to cool slowly.

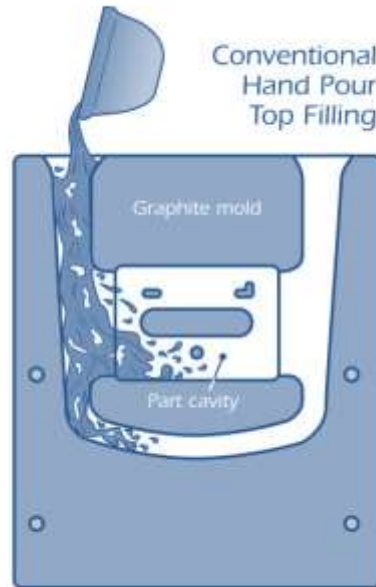


GRAPHITE MOLDING PROCESS

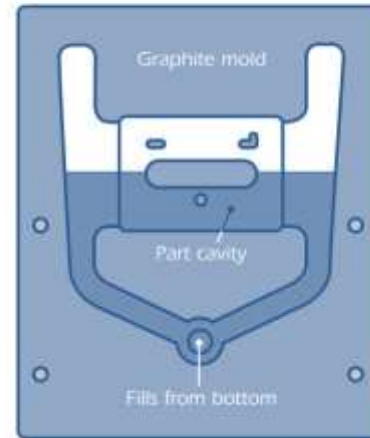
- Graphite used as mold material for producing steel castings, particularly wheels for railway wagon & coaches.
- Graphite does not fuse with steel at high temperature.
- Graphite has high resist to thermal shock, low coefficient of expansion & ability to resist distortion.
- Mold can be used many times.



GRAPHITE MOLDING PROCESS



Graphicast LTA™
(Low Turbulence Automatic
Casting Process)



THANKS

