

Ceramic Materials Manufacturing

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Powder Compaction

B- Pressure less compaction

1- Slip casting

Used for compacting ceramic powders to make large & complex shapes for limited production runs

- A slip is a suspension of ceramic powder (finer than 5 μm) in water or other soluble liquid which is pored into a mould, dried and further sintered.

- Slip is usually made of,

1) A dispersion agent to stabilize the powder against colloidal forces,

2) A solvent to control the slip viscosity and help casting,

3) Binder for giving green strength to the cast shape,

4) plasticizer to modify the properties of the binder

- For successful slip casting, formation of suitable and a consistent slip is important.

This is achieved by proper control of particle size, size distribution, order of component addition, their mixing time, suitable ageing of slips

- To prevent the settling and aggregation of powders and keeping the desirable viscosity of the slip.
- Mostly **water** is used as suspending medium, but absolute alcohol or other organic liquids may also be used.

Additives like alginates – ammonium and sodium salts of alginic acids, serve three functions of control pH, suspension agent & binding agent to improve green strength of the compact.

- The slip to be cast is obtained in a form of suspension of powder in a suspending medium:

1-The slip should have low viscosity & low rate of setting so that it can be readily poured.

2-The slip cast should be readily removable from the mould. Low shrinkage and high strength after drying is expected.

-To obtain these properties, 5 μm powder particles should be used.

- In the case of fine molybdenum powders, a slip can be prepared by suspending the powder in 5% aqueous polyvinyl alcohol with a minimum viscosity, at a pH value of 7.
- For coarser, spherical stainless steel powder, a mixer of 80.7% metal powder, 19% water, 0.3% of sodium alginate having a pH value of 10 can be used.

- **Steps in Slip Casting:**

Preparing plaster mould.

Preparing the slip.

Filling the mould.

Absorption of water from the slip into the porous mould.

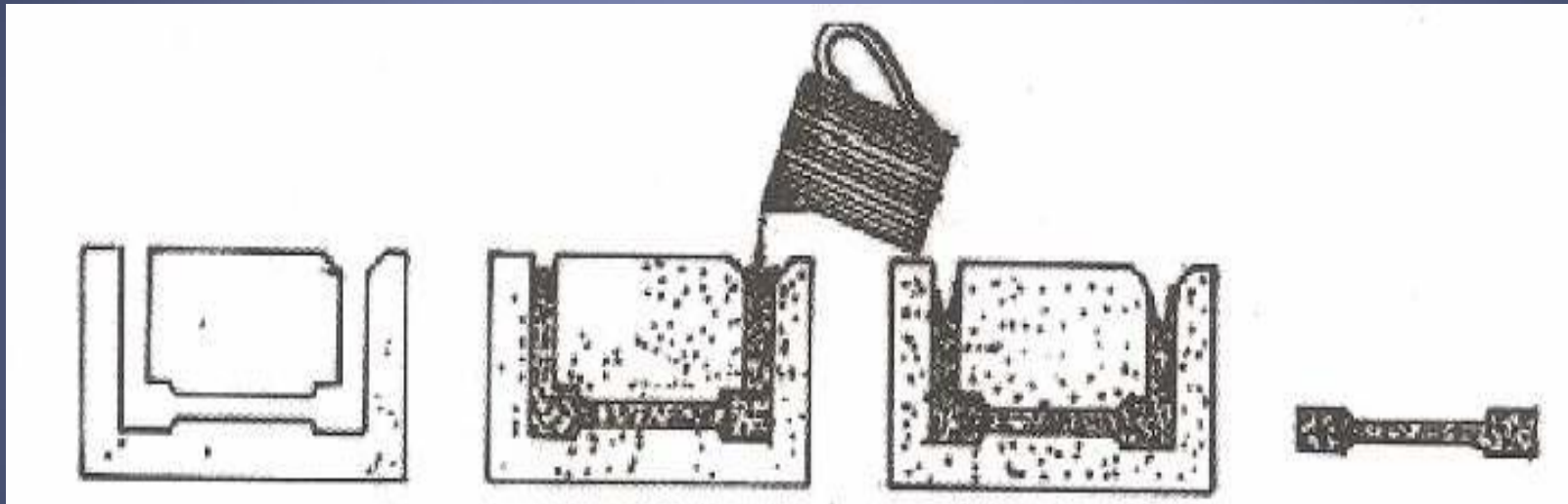
Remove excess slip.

Ageing and drying the slip.

Removal of part from the mould.

Finishing the part.





mould

Filling mould

**Absorption of
water from slip**

Part removal

- Not :

- Sometimes mould release agents like oil, graphite can be used.

- Advantages of slip casting:

- 1-Products that can not be produced by pressing operation can be made,

- 2- no expensive equipment is required, works best with finest powder particles

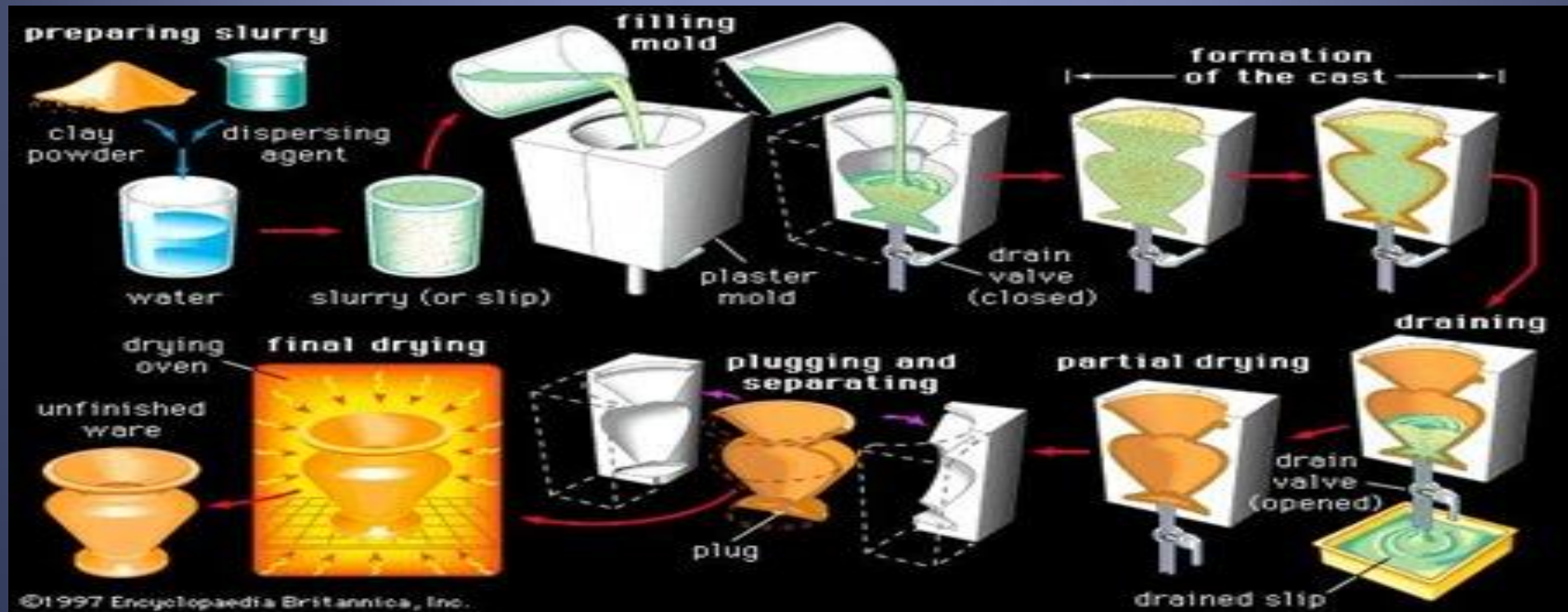
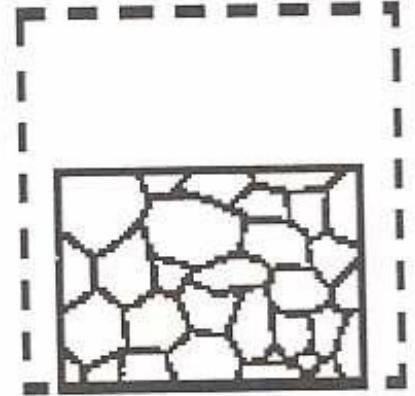
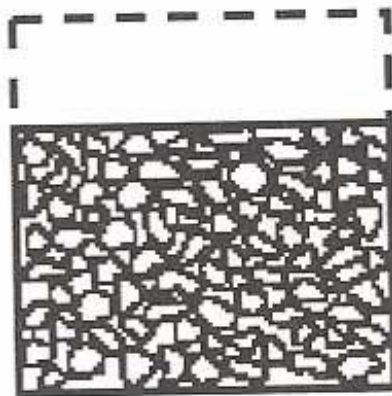
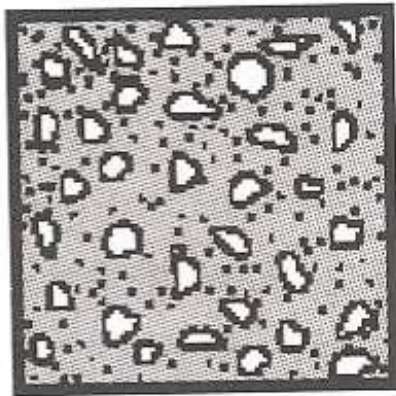
- 3- Hollow and multiple parts can be produced

- Disadvantage:

- 1-slow process,

- 2- limited commercial applications

- Applications: tubes, boats, crucibles, cones, turbine blades, rocket guidance fins; Also products with excellent surface finish like basins, water closets.

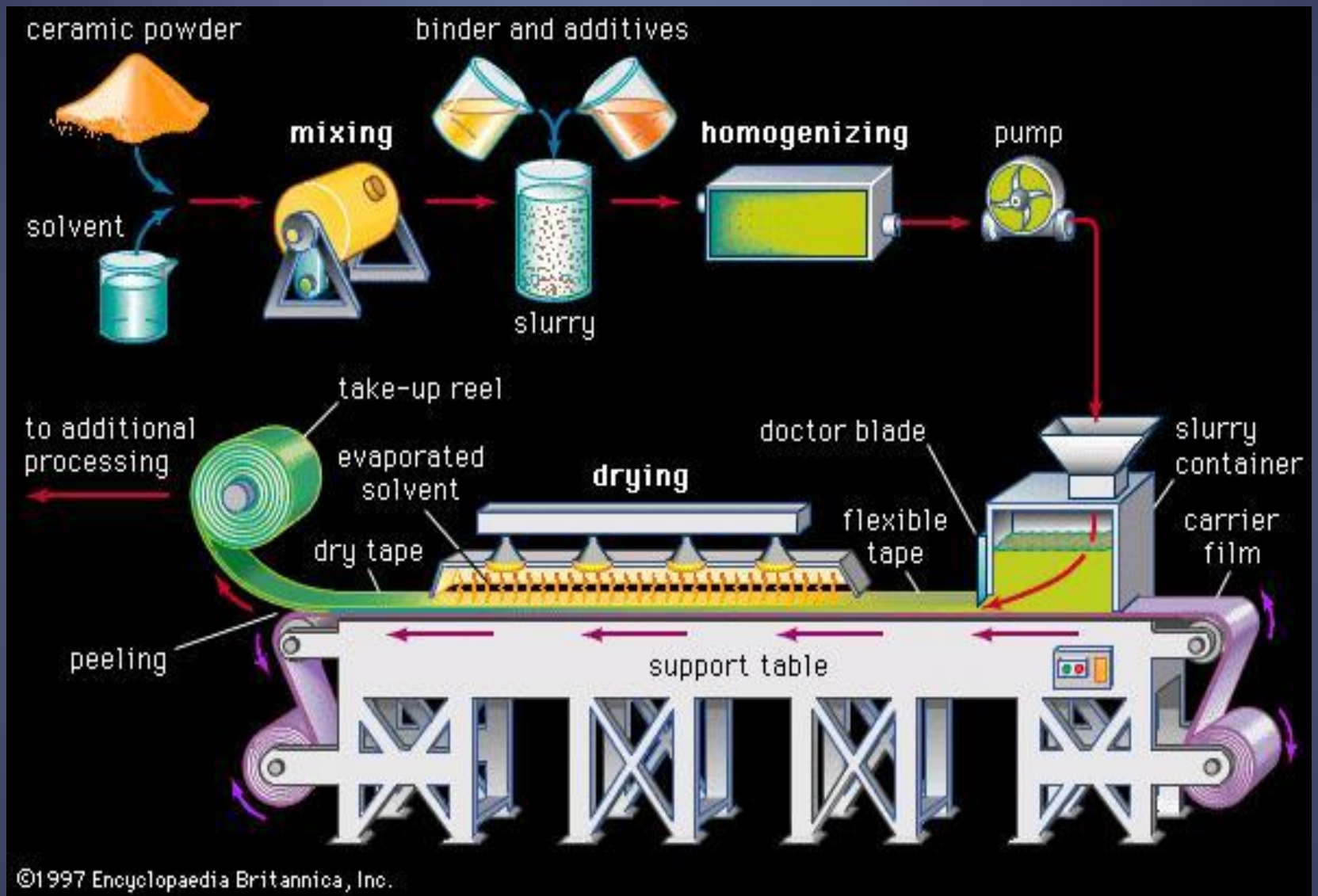


- **2- Slurry casting:**

This process is similar to slip casting except that a slurry of **metal powders** with suitable liquids, various additives, and binders is **poured** into a mould and **dried**.

The solvent is removed either by **absorption** or by **evaporation**.

Very high porous sheet for use as electrodes in fuel cells and nickel cadmium rechargeable batteries are produced by this method.



- **3- Gravity Casting:**

It is used for making sheets having controlled porosity, the powder is poured on a ceramic tray to form a uniform layer and then sintered up to 48 hrs in Ammonia Gas at high temperature.

The sheets are then rolled to desired thickness and to obtain a better surface finish.

Porous sheets of stainless steel, made by this process are used for filters.

