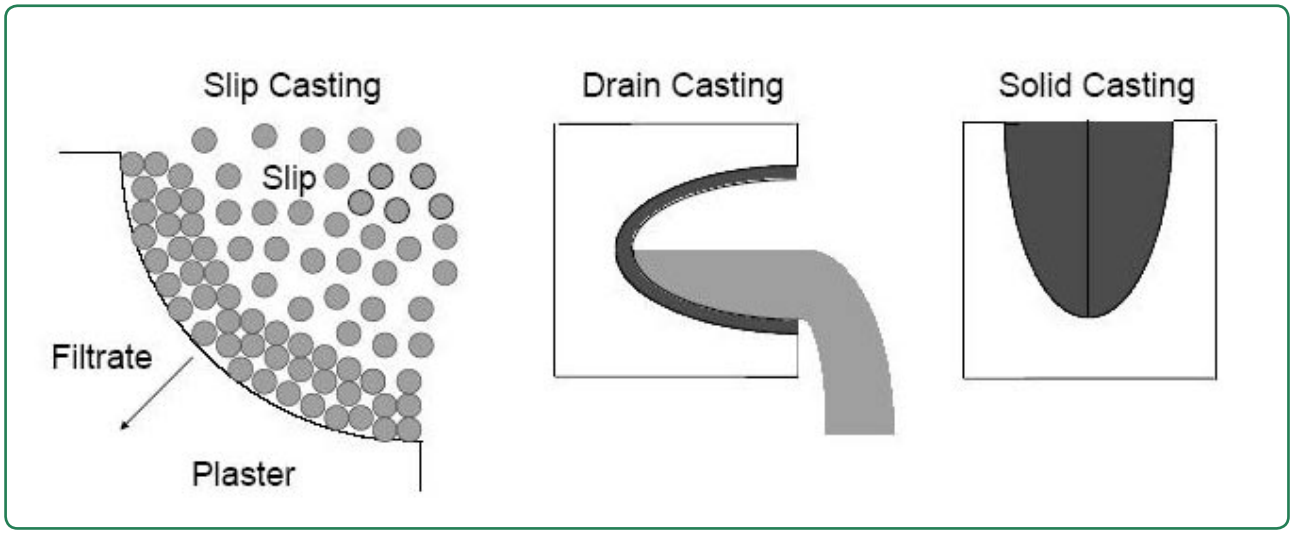
Slip Casting and Pressure Slip Casting – Forming of Complex Shapes



In slip casting, water is removed from the powder suspension by the water suction of the plaster mould and a consolidated layer consisting of packed particles builds up. When a desirable thickness has been reached the excess slip is removed (drain casting), or the casting proceeds until the casting fronts approach each other and a solid body has been obtained (solid casting).

Slip casting is a method for powder-based shaping of ceramic components that has been used for a long time in the traditional ceramic industry for the manufacture of tableware and sanitaryware. Slip casting is occasionally also used in the manufacture of advanced (technical) ceramics.

Slip casting is a filtration process, in which a powder suspension – usually a water-based suspension – is poured into a plaster mould, which by its porosity creates capillary forces and removes liquid from the suspension (slip). When the liquid (filtrate) is sucked into the plaster mould, the powder particles are forced towards the mould walls and a consolidated layer (filter cake) is gradually built up. When a desirable layer thickness has been obtained, the casting process is stopped either by having the excess slip removed, or by letting the casting fronts approach each other in the centre of the piece to form a solid body. After a certain period of drying the shaped piece can be released from the mould for further drying and firing (sintering).

The advantages of slip casting as a forming method are mainly that complex geometries can be shaped, and good material homogeneity is generally achieved. Furthermore, the mould material is cheap. The disadvantages are that a large-scale production requires many moulds and large areas, coupled with the fact that the plaster moulds have a limited durability, as plaster of Paris erodes/corrodes in water processing. To get around these problems a method called **pressure slip casting** or **pressure casting** has been developed. Instead of plaster moulds, moulds of polymeric materials are used, and these have a porosity consisting of larger pores that do not give the same capillary forces but require an externally applied pressure to drive the filtration process. However, as much higher pressure (<40 bar or 4.0 MPa) is applied, this gives much faster casting cycles than in slip casting where the capillary forces correspond to a pressure of 1–2 bar (0.1–0.2 MPa). Furthermore, the high pressure gives such dry, cast pieces that demoulding can be done immediately and a new casting cycle can be started. The polymeric materials used have much better durability than plaster and, therefore, it is possible to achieve shaped products with better dimensional tolerances. In pre-studies for large-scale pressure casting, filter pressing can be used and SCI has designed a filter press adapted for use in

a universal testing machine, where the plunger movement and load (pressure) can be accurately controlled.

For some time now, SCI has worked with slip casting and pressure casting of both traditional ceramics (porcelain) and advanced ceramics. We have acquired considerable knowledge of the entire process from the preparation of powder suspensions, which includes knowledge of surface chemistry and rheology, to the manufacture of moulds, shaping and sintering. Based on this knowledge we can support you in selecting materials, dispersing concept, mould designs etc. Prototypes of ceramic components can be produced and support can be given in establishing contacts with potential manufacturers.

Filter pressing offers an opportunity of simulating pressure casting on a small scale, evaluating mould materials and characterising the casting behaviour of slips.

References

The Swedish Ceramic Institute has, among other things, published the following papers within the area:

Stabilization and Slip Casting of Silicon and Silicon Nitride in a Non-Aqueous Medium, Lyckfeldt O, Bostedt E, Persson M, Carlsson R & Bergström L, Proceedings 7th CIMTEC, pp. 1073–82, 1991

Fabrication of Nitrided Pressureless Sintered (NPS) Silicon Nitride by Slip Casting, Lyckfeldt O, Pompe R, Lidén E & Carlsson R, Euro-Ceramics II, Vol. 2, pp. 735–9, 1993

Progress in the Fabrication of Si3N4 Turbine Rotors by Pressure Slip Casting, Lyckfeldt O, Lidén E, Persson M, Carlsson R & Apell P, J. Eur. Ceram. Soc., 14, 383–95, 1994

Colloidal Processing of Alumina with MgO Additions, Lyckfeldt O & Ferreira J M F, in Euro Ceramics V, Part 1, pp. 313–6, 1997

Influence of Magnesia on Colloidal Processing of Alumina, Tari G, Ferreira J M F & Lyckfeldt O, J. Eur. Ceram. Soc., 17, pp. 1341–50, 1997

Contact us for more information

Do not hesitate to contact us if you want to have more information or have specific questions that you want to discuss. Based on your requests and needs we can provide a quotation.

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