Alternative Forming Methods – New Options

Both starch consollidation and protein forming offer good opportunies to shape components with various sizes and shapes.

There are many established techniques – pressing, slip casting, injection-moulding etc – to shape powders into components. (This applies to both ceramic and metal powders.) Each method has its advantages and disadvantages when it comes to the size and geometry of a component, series size, cost and material properties. SCI has, for a long period of time, been involved both in improving existing forming methods and in developing new ones. The development of new and alternative methods for powder-based shaping of ceramic and metallic components are very important as a means of broadening the fields of application, increasing the quality and finding more environmentally friendly manufacturing techniques.

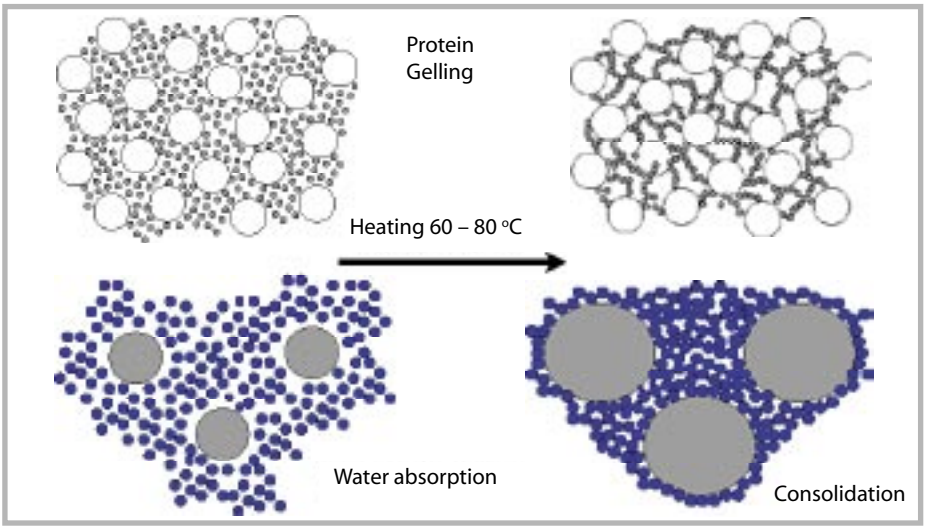
During the last few years two new forming methods have been developed at SCI, **Protein Forming** (in cooperation with SKF Nova AB) and **Starch Consolidation**. Both these methods are based on the principle that an organic material, i.e. a protein (globular) or a starch, is added to a water-based powder suspension that is forced to consolidate (solidify) in a suitable mould through a thermal treatment (60–80 °C). The powder suspension transforms from a fluid substance to a rigid body without any powder compacting or removal of water. This takes place as the protein gels or the starch granules absorb the water. These processes have the potential of giving good material homogeneity in shaped bodies which, in turn, offers good opportunities for a proper dimensional control and optimum material properties.

Globular proteins consist of polymer configurations in the shape of spherical "particles" with a size in the range of several nanometres, whereas starch granules have a size of 5–180 µm (depending on type). This means that protein forming offers better conditions for shaping and sintering materials to full density. The "protein particles" will not, as starch granules, leave pores that will remain after sintering to form critical defects resulting in lower mechanical strength. Powerful sintering methods, however, such as hot isostatic pressing (HIP), remove also the pores left by starch granules and full densification can be obtained.

Alternative Forming

Both protein forming and starch consolidation give large freedom when it comes to the size and the geometry of the components as well as in the choice of mould material. Both these methods are therefore suitable for the manufacture of ceramic or metallic prototypes and for small series production of components at a reasonable cost. SCI has manufactured various components in different materials (ceramics and metals), mainly by using starch consolidation, as this is the most developed technique so far. The improvement of the protein-forming technique, however, continues and fully densified Si_3N_4, Al_2O_3 and ZrO_2 components, for instance, have been produced using this technique.

SCI can provide support when it comes to selecting materials and designing components or by a direct manufacture of prototypes. In a subsequent commercialisation help can be given in etablishing contacts with potential producers and in the transfer of technology.



In protein forming, the consolidation, the transformation from suspension to rigidity, occurs through the gelling of the protein, whereas the ability of the starch granules to absorb water is the driving consolidation mechanism in starch consolidation.

References

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

Processing of Porous Ceramics by 'Starch Consolidation', Lyckfeldt O and Ferreira J M F, J. Eur. Ceram. Soc., 18, 131–40, 1998

Pressureless Net Shape Manufacture of PM Parts, Magelhães S, Nyborg L, Lyckfeldt O and Carlström E, pp. 308–313 in Proceedings of the Powder Metallurgy World Congress & Exhibition 1998, European Powder Metallurgy Association, 1998

Protein Forming – A Novel Shaping Technique for Ceramics, Lyckfeldt O, Brandt J and Lesca S, J. Eur. Ceram. Soc., 20, 2551–2559, 2000

Si_3N_4 Powders Applied for Water-based DCT, Lyckfeldt O and Rundgren K, pp. 47–62 in Ceramic Transactions, Vol 142, 2003.

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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