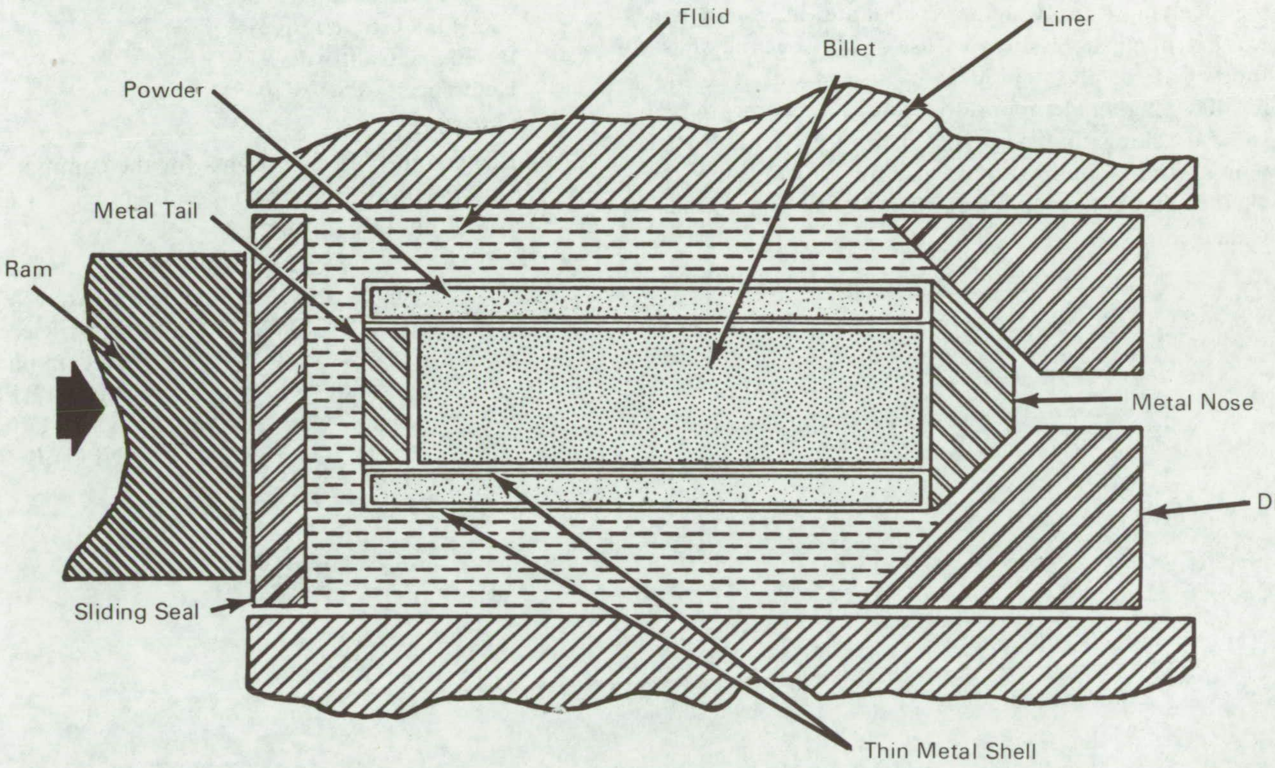
NASA TECH BRIEF

High-Temperature "Hydrostatic" Extrusion



Insulating Can for Hydrostatic Extrusion

The effect of hydrostatic extrusion (refs. 1–3) can be approached by extrusion with use of solids that are very much softer than the materials extruded; the former are quasi-fluids relative to the latter. The use of such solids as NaCl, CaF_2, or glasses as quasi-fluids, somewhat below their melting points, substantially reduces handling, corrosion, and sealing problems. Fluid-to-fluid extrusion is also possible by use of this technique; the isotactic back pressure can be controlled by the extrusion of a second soft solid through a second extrusion die.

Since the solid quasi-fluid can be heated with the billet separate from the press, it can have a higher temperature than the press liner (which is typically at only 400°C); thus the quasi-fluid helps to insulate the core material before and after extrusion.

The fact that a metal sheath is often needed to prevent contamination of the core by the quasi-fluid

(continued overleaf)

presents no problem. The sheath has led to the use of the insulating-can concept (see fig.) which was conceived and developed for extrusion of ceramics in thick-walled metal cans by conventional techniques. Use of a double-walled thin metal can, with the interwall space filled with a suitable ceramic powder, provides still more insulation. The layer of powder provides an additional barrier against the quasi-fluid in the event of a leak in the outer wall of the can. Commonly the powder is of the same composition as the core which is compatible with the chosen materials of the can; usually it is at $\geq 50\%$ of theoretical density.

Tests have shown that steel and molybdenum can be extruded with NaCl and CaF_2, respectively, used as the quasi-fluids; and that ceramics can be extruded by use of CaF_2 as the extruding fluid and of NaCl as the receiving fluid. Calcium carbonate (in a steel can) was extruded successfully by use of NaCl as the quasi-fluid; CaO at about 1150°C, by use of CaF_2. A 200° to 400° higher temperature would have prevented some cracking that occurred in the CaO; this higher temperature would still be usefully lower than the 1800°C that is needed for extrusion of CaO in a thick-walled can.

Reference:

1. Beresnev, B. I.: Vereshchagin, L. F.; Ryabinin, L. N.: and Livshits, L. D.: Large Plastic Deformation of Metals at High Pressures. Akad. Nauk Press, Moscow, 1960.
2. Pugh, H. L. D.; and Low, A. H.: The Hydrostatic Extrusion of Difficult Metals. J. Inst. Metals, vol. 93, March 1965, pp. 201–217.
3. Fiorentino, R. J.; Sabroff, A. M.; and Doulger, F. W.: Investigation of Hydrostatic Extrusion. Tech. Report AFML-TR-64-372, Jan. 1965.

Note:

Requests for further information may be directed to:

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Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

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