Cerbide opts for low pressure powder injection moulding

Cerbide Inc. of Orchard Park, New York, USA, produces a patented hard material which is said to combine the properties of ceramics and cemented tungsten carbide enabling it to perform at high levels of abrasion, erosion, and corrosion resistance. The new polycrystalline tungsten carbide has a Vickers hardness of 2400 HV, transverse rupture strength of 240 ksi, fracture toughness of 5.9 MPa, and Young's Modulus of 620 GPa. The binderless sintered WC material is said to have eight times the corrosion resistance of WC-Ni binder materials after 144 hrs in nitric, acetic or sulphuric acids.

Since its introduction in 2004, Cerbide has been developing applications for this new material including complex shapes such as wear sleeves, tiles, angle and long venture nozzles, blades, etc. The company reports 2 to 15 times improvements in wear properties for these applications. One such application is a venture nozzle part shown in Fig.1 which posed some questions as to the most economical way this component shape could be produced. The company considered cold isostatic pressing (CIP) followed by green machining and then sintering, but found that CIP could only produce single billet parts having a starting weight of 118g thus requiring around 82g to be green machined off. The milled green material can be recovered and re-used but at additional cost for processing.

A longer rod with the cone could be CIPed or extruded and cut to size. However, this green billet would weigh 121g and require an additional milling operation to form the cone. As Cerbide does not operate a CIP machine in-house this part of the operation would have to be outsourced. The four additional machining operations would also need to be outsourced adding $4.25 to each billet including shipping.

Low pressure injection moulding

After looking at the cost of the CIP route the company decided to investigate metal injection moulding. Initially production was outsourced to a MIM moulder using high pressure injection moulding but after a year of disappointing results and the high cost of tooling Cerbide decided to investigate low pressure injection moulding (LPIM) using a Peltsman MIGL33 moulding machine (Fig.2). With its small footprint, lower power requirements, and lower tooling costs, the MIGL33 was deemed to be ideal for Cerbide's requirements.

The as-moulded part weighs 49 grams of which 10 grams is the sprue giving an initial material yield of 80.5% compared with 33.4% in CIP. The sprue can be immediately re-used hypothetically providing 100% yield.

Tooling for this part was obtained for less than $US 2000 and is a two cavity mould. The lower tooling cost is accounted for in that the moulds can be made from aluminium.

The opening to close cycle in this LPIM process is 1.5 minutes which provides a total output of 80 parts per hour in the 2-cavity mould. A change from forming Detail 1 to Detail 2 (Fig. 3) required only a change of core rod thus eliminating green machining.

Based on a raw material cost of US$90.00 per kg, plus labour costs the final price of the MIM part ($8.17) was one-third that of the same part produced by CIP + green machining ($25.14) ■

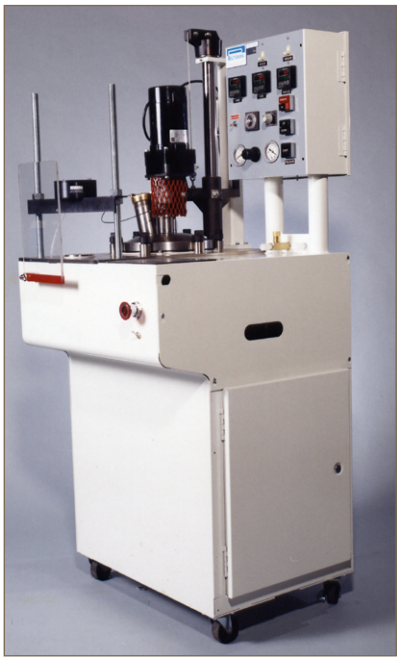

Fig. 2 Peltsman MIGL33 moulding machine

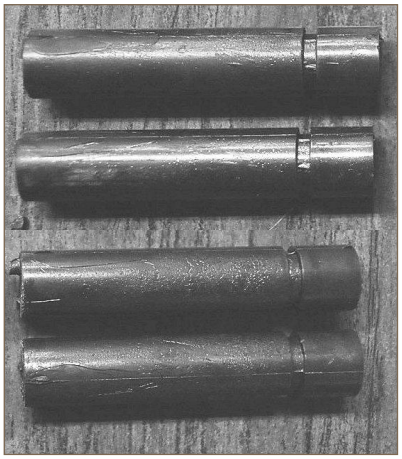

Fig. 3 LPIM parts showing Detail 1 and Detail 2

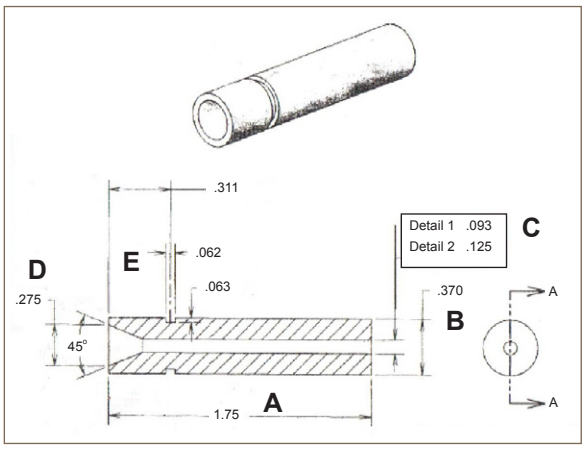

Fig. 1 Specification drawing for Cerbide part produced by LPIM

	Weight (gr)	Yield (%)	Cost (US$)
CIP – with cone	118	33.4	10.62
CIP – without cone	121	32.5	10.89
MIM	49	80.5	4.41
MIM - reverted	39	100	3.51

Table 1 Comparison of yield and cost of CIP and MIM for Cerbide nozzle production in green state

Cost per finished piece (US$)	Part – Detail 1 CIP	Low Pressure MIM
Billet	4.25	0.00
Material	10.89	4.41
Labour	10.00	3.76
TOTAL	25.14	8.17

Table 2 Comparison of CIP/green machining versus low pressure metal injection moulding