Level 2 High Pressure Die Casting

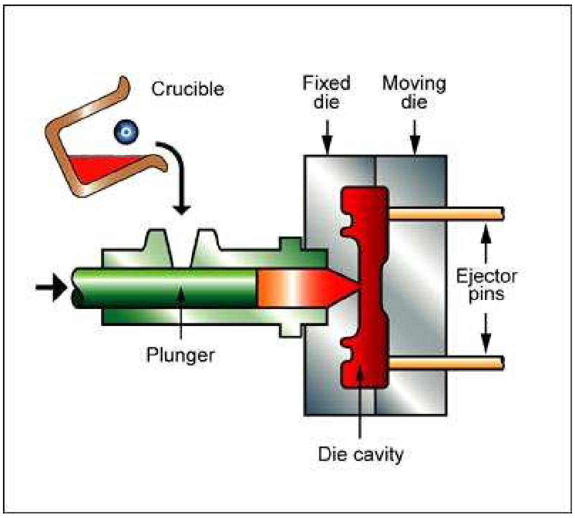
IMAGE

1) Die casting machine © PlugPray at Wikimedia Commons [Public domain] (2) A used in Handtmann Metallgusswerk 4000 tons die casting machine © Handtmann01 at Wikimedia Commons (CC BY 3.0)

THE PROCESS

In pressure die casting, molten metal is injected under high pressure into a metal die through a system of sprues and runners and pressure is maintained during solidification.
Afterwards, the die halves are opened and the casting is ejected. Because of the high pressures involved, the two die halves are held together by a high force and locked with toggle clamps. The dies are precision machined from heat resistant steel and are water-cooled. They often include several movable parts and are therefore complex and expensive. Two types of die casting machines are used. In the 'hot chamber' or gooseneck process, the molten metal is held in a furnace in which a gooseneck chamber is submerged. Upon each cycle, the gooseneck is filled with metal which is then forced into the die. Because of the prolonged contact between the metal and the injection system, this process is restricted to zinc-base alloys. In the 'cold chamber' process (see figure above), metal is melted in a separate furnace and then transported to the die casting machine. The cold chamber process can be used for a variety of alloys. Because of internal porosity, die castings cannot be heat-treated. The process is very competitive for producing large quantities of thin-walled castings.

PROCESS SCHEMATIC



MATERIAL-COMPATIBILITY

Metals - non-ferrous	True

SHAPE

Circular prismatic	True
Non-circular prismatic	True
Solid 3-D	True
Hollow 3-D	True

PHYSICAL ATTRIBUTES

Mass range	0.01	-	50	kg
Range of section thickness	0.5	-	12	mm
Tolerance	0.15	-	0.5	mm
Roughness	0.8	-	1.6	µm
Surface roughness (A=v. smooth)	A			

PROCESS CHARACTERISTICS

Primary shaping processes	True
Discrete	True

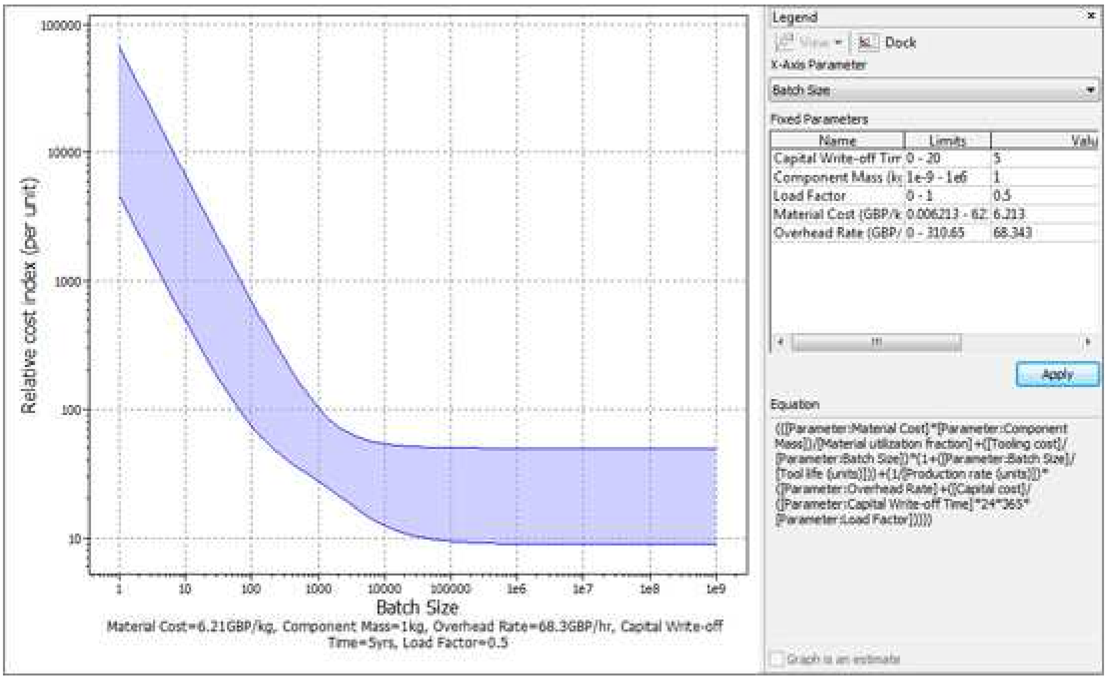
ECONOMIC ATTRIBUTES

Relative tooling cost	high		
Relative equipment cost	high		
Labor intensity	low		
Economic batch size (units)	1e4	-	1e6

COST MODELLING

Relative cost index (per unit)	*46.4	-	181	USD

Parameters: Material Cost = 6.21GBP/kg, Component Mass = 1kg, Batch Size = 1000, Overhead Rate = 68.3GBP/hr, Discount rate = 5%, Capital Write-off Time = 5yrs, Load Factor = 0.5



Capital cost	*1.64e5	-	8.2e5	USD
Material utilization fraction	*0.75	-	0.8	
Production rate (units)	*2	-	200	/hr
Tooling cost	*7.38e3	-	1.07e5	USD
Tool life (units)	*2e4	-	1e6	

SUPPORTING INFORMATION

Design guidelines

Shape complexity can be high, but elaborate movable cores increase tooling cost.

Technical notes

Usually restricted to lower melting point alloys (Tm<1200K); most usually aluminum and zinc alloys. High melting point alloys can be processed with a variant called the Ferro Di process. Wall thicknesses should be as uniform as possible. Excellent surface detail. Die castings are not renowned for their metallurgical integrity. Turbulent filling and fast cycles mean that castings exhibit gas and shrinkage porosity.

Typical uses

Automotive applications: carburetor and distributor bodies, clutch and gearbox housings; electrical applications: motor frames and cases, switchgear housings; general applications: pulleys, rotating parts, record player parts, etc.

The economics

Tooling cost range covers small and simple to large and complex dies. Production rate depends on complexity of component and number of cavities.

The environment

Aluminum, zinc and magnesium scrap can all be recycled. The process poses no particular environmental problems.

Links

Reference

MaterialUniverse

*No warranty is given for the accuracy of this data. Values marked * are estimates.*