General

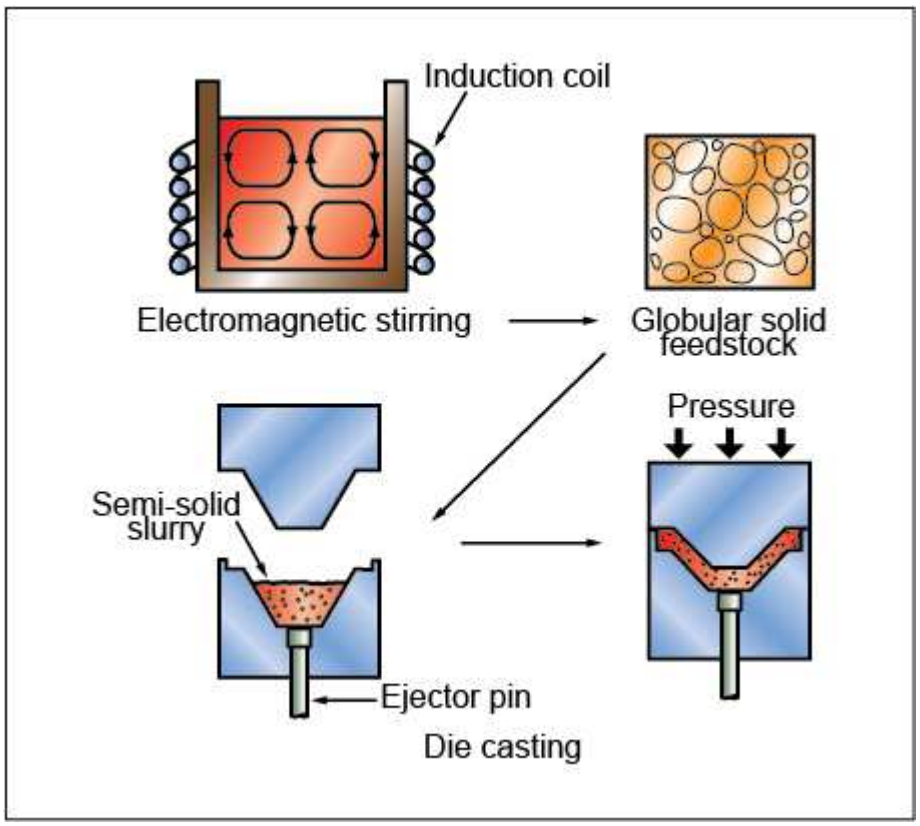
Designation

Casting: Thixocasting

The process

Thixocasting is a two stage Semi-Solid Metal (SSM) casting process. Before casting, a feedstock with a globular (non-dendritic) microstructure is produced by stirring the melt whilst solidifying, often through magnetic induction. It is then reheated to a temperature at which it becomes a semi-solid slurry and injected into a die. The process combines the minimal porosity of forging or squeeze casting with the higher production rates and tool life of die casting. It also requires lower operating temperatures than conventional die casting (5 - 10°C above the liquidus temperature). The result is a very high quality cast with good dimensional accuracy, mechanical properties and surface finish due to reduced porosity. The disadvantage of thixocasting compared to conventional casting is the extra time and money required to make the special feedstock.

Process schematic



Shape

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

Physical attributes

Mass range	0,05	-	15	kg
Range of section thickness	1	-	8	mm
Tolerance	0,15	-	0,5	mm
Roughness	0,8	-	1,6	µm

Process characteristics

Primary shaping processes	✓
Secondary shaping processes	✗
Machining processes	✗
Prototyping	✗
Discrete	✓
Continuous	✗

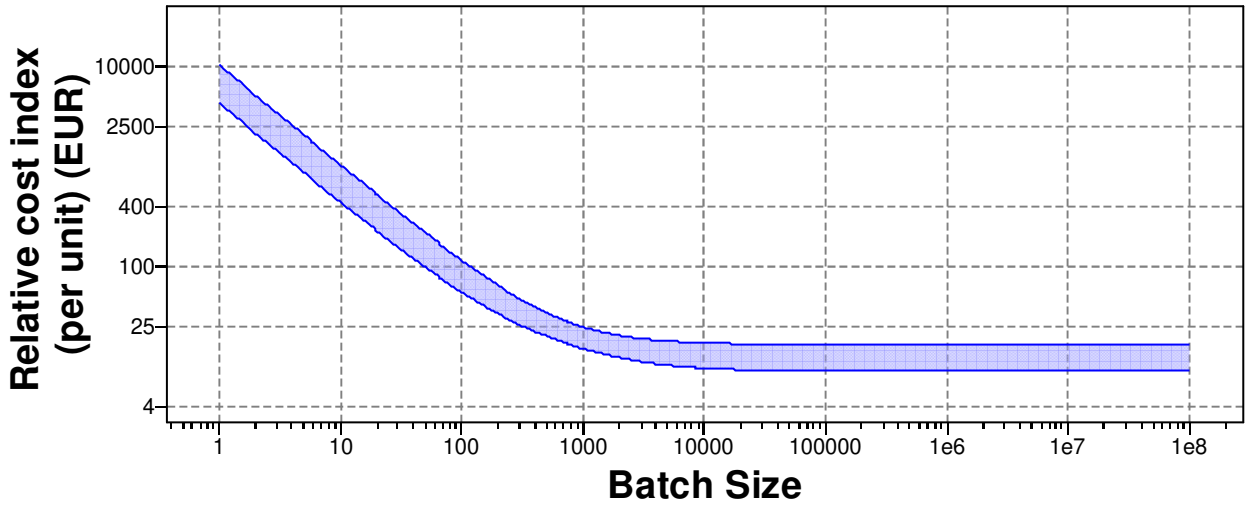
Economic attributes

Economic batch size (units)	5e3	-	1e6	
Labor intensity	low			

Cost modeling

Relative cost index (per unit)	14,9	-	24,5	EUR

Parameters: Material Cost = 6,77EUR/kg, Component Mass = 1kg, Batch Size = 1e3, Overhead Rate = 127EUR/hr, Discount Rate = 5%, Capital Write-off Time = 5yrs, Load Factor = 0,5



Component Mass=1kg, Component Length=1m, Material Cost=6,77EUR/kg, Overhead Rate=127EUR/hr, Capital Write-off Time=5yrs, Discount Rate=5%, Load Factor=0,5

Capital cost	1,6e5	-	7,98e5	EUR
Material utilization fraction	0,75	-	0,85	
Production rate (units)	20	-	600	/hr
Tool life (units)	9e4	-	1,1e5	
Tooling cost	4,23e3	-	1,01e4	EUR

Supporting information

Design guidelines

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

Technical notes

Feedstock with a non-dendritic microstructure is essential for this process to work. This must either be manufactured as described or special thixocasting grades used when casting. The temperatures of slurry and die, injection speed and injection pressure must be tightly controlled to avoid casting defects. Mostly used for two-phase casting aluminum alloys which otherwise must be processed using squeeze casting, as well as copper and magnesium alloys.

Links

MaterialUniverse

Shape