AMT

INTRODUCTION TO METAL INJECTION MOLDING (MIM)

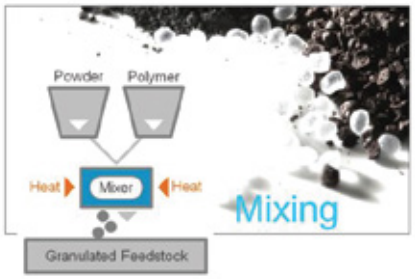
Overview of Metal Injection Molding

Metal injection molding (MIM) is a manufacturing solution that uses the shaping advantage of the injection molding technology. MIM, using fine (<20 um) metal powder, is capable of transforming complex concepts & designs into high precision, complex geometry net-shaped products from a wide range of materials such as carbon steels, low alloy steels, stainless steels, low expansion alloys (kovar and invar), tool steels, soft magnetic alloys, super alloys and non-ferrous materials like tungsten and copper.

MIM is ideal for the mass production of intricate engineering parts in medium to high volumes (over 10,000 parts annually). It is well suited for parts weighing from 0.05 gm to 250 gm. Wall thickness is typically about 0.7 mm (0.003 in). However, AMT has demonstrated the possibility of producing parts with 0.3 to 0.7mm wall thickness. Tolerances are on the order of ±0.3 to 0.5%, albeit specific dimensions can be held as close as ±0.1%.

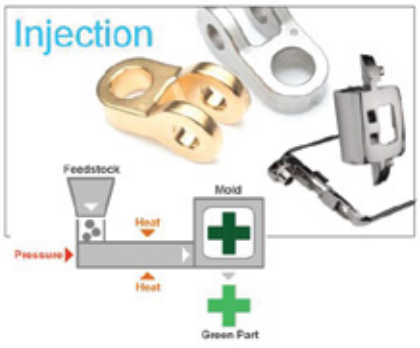
The Process

Mixing



Very fine metal powders are mixed with thermoplastic polymer (known as the binder) to form a homogeneous mixture of ingredients that is pelletized and directly fed into a injection molding machine. This pelletized powder-polymer mixture is known as feedstock.

Injection

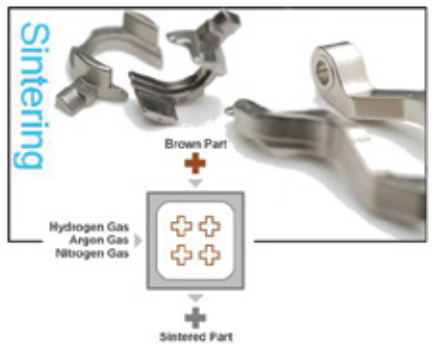


In this process, the feedstock is heated to melt the binder content in order to form the desired component geometry. The molded part is known as the green part.

Debinding

The polymeric binder is removed from green part by thermal heating to approximately 400°C or 752°F. The result is known as the brown part that still contains its original geometry and size.

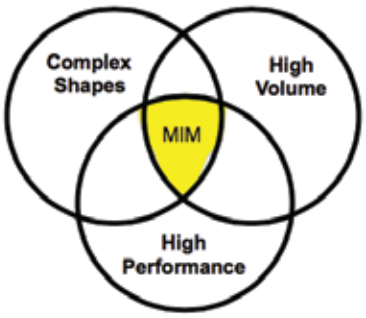
Sintering



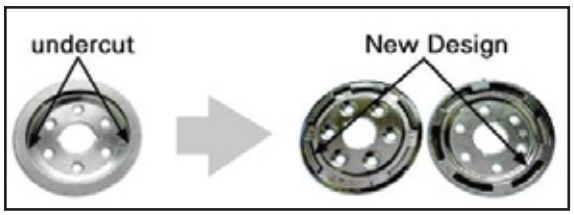
In this process, the brown part is heated to approximately 85% of the material's melting temperature, allowing densification and shrinking of the powder into a dense solid with the elimination of pores. The sintered density is approximately 98% of theoretical. The end result is a net shape or near net-shape metal component, with properties similar to that of bar stock.

Process Attributes and Advantages

Simply put, this process is best suited for the fabrication of complex components, especially those that would otherwise require multiple assembly or forming operations.



This venn diagram above suggest the main justifications for MIM component production - shape complexity, high performance and high production quantity required. Beyond these primary advantages, it is possible to leverage this technology in producing complex



internal channels, otherwise termed as undercuts. Such features which would otherwise be “impossible” to be machined. Or create products with bi-material characteristics - for example, magnetic & non-magnetic.

In Summary

Many objects we encounter in everyday life such as cars, mobile phones, watches, domestic appliances, surgical tools etc contain MIM parts. The typical MIM product combines a relatively small size, highly complex shape alongside high performance manufactured at high volumes.