Application of Additive Manufacturing to Deliver Incremental Production of Conventional Powder Metal Components without Compaction Tooling.

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Abstract:

The conventional powder metal industry has always struggled with distributing the cost of compaction tooling and the need to maintain a competitive price of the final product. The result has historically limited the order size to high volume orders.

Although additive manufacturing of metal components has become more accepted, additive techniques such as laser powder bed fusion and traditional binder jet printing have been focused on production using small spherical particle sizes and materials that are less susceptible to oxidation like 316 and 17-4. This has prevented the application of AM as a low volume process to complement the conventional press and sinter production of traditional powder metal chemistries and parts.

Recently, a new approach to additive manufacturing has provided a technique for the printing of conventional powder metal chemistries and particle size distributions. Using an FC- 0208 powder, the physical properties and processing requirements will be reviewed to assess the application of this printing technique to expand the market for conventional press and sintering manufacturing.

Background:

The powder metal industry is rapidly evolving to fulfill product specifications and reduce inefficiencies. The industry is moving towards creating increasingly dense components that require complex symmetries. Innovative additive technologies are emerging to fulfill these needs. The conventional powder metal (PM) industry relies on compaction tooling to form a net shape part. Metal powder is packed into specialized tooling at high pressures to form a green part, after which sintering will be required to achieve full density. This technique is known as die pressing. The price of the specialized compaction tooling used in conventional PM limits order sizes as only large volume orders are economical. By today's standards, tooling costs customers between $25,000 and $50,000 per order. This prevents the industry from fulfilling small volume orders as the cost per part would be too great to justify. This research explores how sinter based additive manufacturing could expand this market by eliminating compaction tooling.

FC-0208 Powder:

Conventional powder metallurgists use a standard water atomized powder, FC-0208 having an irregular shape and higher oxygen levels than typical AM powder. This powder consists mainly of iron, blended with copper (2.0%), and carbon (0.8%). The powder utilized in this work was add mixed, meaning the elemental components of the feedstock were blended as individual powders. This powder consists of larger, more irregular particles, typically between 50 – 150 microns in diameter.