

Evaluation of recycling process for polyamide 12 in laser-based powder bed fusion

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The laser-based powder bed fusion of polymers (PBF-LB/P) to increase the economy of the process often utilizes a blend of powders with varying degrees of degradation. Specifically, for polyamide 12, the traditional reuse schema involves mixing post-processed powder with virgin powder at a predetermined ratio before reintroducing it to the process. Given that only about 15% of the powder is utilized in part production, and powders are refreshed in equal proportions, there arises a challenge with the incremental accumulation of material across build cycles. To mitigate the consumption of fresh powder relative to the actual material usage, this study introduces the incorporation of recycled material into the PBF-LB/P process. This new powder reuse schema is presented for the first time, focusing on the laser sintering process. The investigations were carried out on commonly known polyamide 12 powder dedicated to the PBF-LB/P process (PA2200, EOS GmbH, Germany) in three states: *virgin* (new powder as supplied without heat treatment), *aged* (virgin powder after long-term heat exposure in the PBF-LB/P process), and *recycled* (the same aged powder, but after the recycling process). The recycling of the aged powder was carried out by GS-Pro GmbH (Chemnitz, Germany) according to the process described in the patent WO/2018/028728. The characteristics of the recycled powder were evaluated through scanning electron microscopy, differential scanning calorimetry, X-ray diffraction, particle size distribution, and dynamic powder flowability assessments. The findings reveal that waste powders can be effectively reused in PBF-LB/P to produce components with satisfactory mechanical properties, porosity levels, dimensional accuracy, and surface quality.

Take-home-Message:

- New powder reuse schema in powder bed fusion of polymers was demonstrated.
- The characteristics of the recycled PA12 powder were investigated.
- Recycled PA12 allowed to produce components with satisfactory properties.

Reference

[1] Olejarczyk, M., Gruber, P., Gazińska, M., Krokos, A., Ziółkowski, G., Szymczyk-Ziółkowska, P., Grochowska, E., & Kurzynowski, T. (2024). New powder reuse schema in laser-based powder bed fusion of polymers. *Waste Management (Elmsford)*, 187, 11–21. <https://doi.org/10.1016/j.wasman.2024.06.030>