EVALUATION OF THE PASSIVATION OF SINTAVIA'S POWDER CONDENSATE USING KBM'S RESIN PROCESS

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Abstract

Transportation and disposal of powder condensate created by the powder bed fusion additive manufacturing process remains a challenge from both environmental and commercial standpoints. Powder condensate is a unique waste stream composed of the splatter sieved out of a reused batch of metal powder[1]. Sintavia is currently working together with KBM Advanced Materials ("KBM") on finding alternatives to passivate powder condensate, mitigate potential hazardous material logistics, and recycle this waste stream. One of the alternatives under discussion is Sintavia utilizing KBM's patent-pending process for mixing powder condensate with a resin, supplied by KBM, instead of using silicon oil and sand (Sintavia's current procedure). This new mix will passivate powder condensate and make it non-hazardous, thus enabling it to be transported without regulatory restrictions. Upon receipt of this passivated powder, KBM will separate the resin from the metal powder, rendering the condensate suitable as a raw material to produce new metal products or powders. This white paper discusses the logistics and transportation aspects of this process.

[1] For purposes of this study, Sintavia includes filtered powder in its definition of "powder condensate", as this waste stream presents nearly identical disposal problems.

Introduction

During the powder bed fusion additive manufacturing (AM) process, solidified particles resulting from the evaporation of the metal alloys are deposited into a collection chamber within the AM printer. These solidified particles are called powder condensate and because of its nature is considered hazardous and requires to be disposed of accordingly. Depending on the different filtering systems on the machines, the powder condensate may or may not contain chalk.

As a founding member of the Additive Manufacturer Green Trade Association (AMGTA), Sintavia views the proper disposal of hazardous waste streams, in compliance with federal and local laws, as important as trying to re-use and recycle the waste powder. KBM is a supplier of metal powders and services to the AM industry and is concentrated on enhancing AM's sustainability and its positive impact on the environment.

The current passivation of Sintavia's condensate consists of mixing it with silicon oil and sand. This process passivates the condensate and make the transportation possible without risk of ignitability, but the metal powder cannot be economically recovered and must be transported as hazardous.

Sintavia is currently working together with KBM in testing alternatives to passivate powder condensate and be able to re-use and/or recycle the metal powder. One of these alternatives is mixing the powder condensate with a resin identified and supplied by KBM. This mix will passivate the condensate and make it be able to be transported without any hazardous risk, at which point KBM will be able to separate the resin from the metal powder, recovering the metal for future use.

In the need to find alternatives to recover the metal powder and mitigate hazardous material storage logistics, Sintavia performed trials to test passivation of the powder condensate using KBM resin following a procedure developed alongside KBM.

Sintavia tested the condensate passivation process using KBM's resin in two different types of nickel alloys—Inconel and Haynes. During these trials the quantity of resin was varied in order to try to find the most effective ratio. Inconel condensate contained chalk while Haynes condensate did not. The trials were performed in a controlled environment. The air quality was measured during the process and safety equipment was on hand.

Materials

- RFS 1.0 H282
- RFS 2.0 IN718
- KBM Resin
- Air Quality Portable Monitor S500

- Fire Extinguisher
- Fire Blanket
- Plastic Spoon
- Aluminum Tray
- Parchment Paper

Procedure

During these trials the powder condensate used were EOS RFS 1.0 H282 and EOS RFS 2.0 IN718. The RFS 1.0 and 2.0 designation related to the filtering system, as EOS RFS 1.0 does not contain chalk and EOS RFS 2.0 does contain chalk. Going forward, most condensate is expected to contain chalk. H282 and IN718 refers to Haynes and Inconel metal alloys, respectively.

The powder condensate was mixed with resin using a plastic spoon to the desired consistency to form a paste. It was then left to dry on an aluminum tray with parchment paper to prevent it from sticking. Three scenarios were evaluated:

1- 250g RFS 1.0 H282 + 5g KBM resin + 80mL solvent
2- 1kg RFS 1.0 H282 + 15g KBM resin + 150mL solvent
3- 237g RFS 2.0 IN718 + 5g resin + 40mL solvent

Results

All scenarios formed a dense paste that dried after a few hours. However, scenarios #1 and #2 were not completely solid and with little pressure became crumbs. Meanwhile, scenario #3 was completely solid.

During the trials no hazardous situations were reported, and the air quality remain within acceptable limits.

Discussion

Preliminary results from these trials determined that 237g of RFS 2.0 IN718 mixed with 5g of resin and 40 mL of solvent (scenario #3) formed a solid passivated block that can be safely transported. While trials #1 and #2 were also successful they resulted in a non-optimal, brittle output. Additional trials to optimize outputs of all condensate types will continue.

Conclusions

Further trials will be performed to evaluate how this procedure works with different types of powder condensate. Performing this trial has demonstrated that the procedure works, however, and no hazardous situation occurred. <u>It remains feasible that this process can be used to safely transport metal condensate waste without hazardous material logistical restrictions.</u>