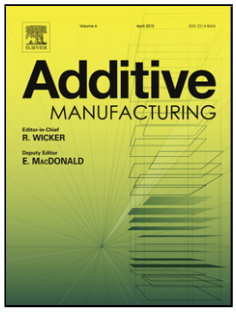

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PII: S2214-8604(17)30458-X
DOI: https://doi.org/10.1016/j.addma.2018.04.030
Reference: ADDMA 357

To appear in:

Received date: 7-10-2017
Revised date: 23-4-2018
Accepted date: 25-4-2018

Please cite this article as: Osswald TA, Puentes J, Kattinger J, Fused filament fabrication melting model, *Additive Manufacturing* (2010), https://doi.org/10.1016/j.addma.2018.04.030

Fused Filament Fabrication Melting Model

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Abstract

This paper presents an analytical melting model inside the nozzle of a fused filament fabrication process. The model presents the limiting case scenario where the maximum melting rate is controlled by the applied force. Here, instead of having a nozzle filled with polymer melt, the melt is reduced to a melt film at the tip of the filament as it is pushed against the exit of the nozzle. The model uses a mode of melting that is governed by melting with pressure flow melt removal. The model includes effects of initial filament temperatures, heater temperature, applied force, nozzle tip angle, capillary diameter and length as well as rheological and thermal properties. The analytical solution is compared to controlled experiments done on a specially designed set-up. Furthermore, the model is used to assess the effect of nozzle tip angle, heater temperature and initial filament temperature on the melting rate within the nozzle. The comparison between the experiments and the model show that assumptions used for the model development are plausible, and that the model can be used to optimize the