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Baisse de la rigidité d'interface entre couches successives dans la construction additive par extrusion

Weak bond strength between successive layers in extrusion-based additive manufacturing

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Weak bond strength is often reported to result from a low level of intermixing between successive layers. It is often concluded that there seems to exist an upper limit either on structuration rate or on resting time between layers, above which thixotropy is at the origin of so-called “cold joints”. In parallel to intermixing issues, our results show that the superficial drying of the resting layer seems to also contribute to weaker interfaces bonds. We plot in the figure below the relative interface strength measured using a splitting test as a function of the resting time between layers for an interface protected from drying and an interface exposed to drying. The material is a W/C = 0.2 thixotropic mortar, for which the structuration rate A_{thix} was measured to be above 0.4Pa/s. We see that, even after 5 hours rest between layers, the interface strength is still higher than 90% of the reference interface strength if the material is protected from drying. However, if exposed to drying, the interface strength drops by 50% in a matter of a couple tens of minutes. As printable materials are often accelerated in order to improve their ability to quickly build up a structure, we can expect some increase in temperature resulting from this increase in chemical activity. This shall, in turn, increase drying rate and make these printable materials extremely sensitive to the external environment (temperature and humidity) or to the so-called printing environment.

Références

- [1] Emmanuel Keita, Hela Bessaies-Bey, Wenqiang Zuo, Patrick Belin and Nicolas Roussel, « Weak bond strength between successive layers in extrusion-based additive manufacturing: measurement and physical origin ». *Submitted*
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