Investigation of Nozzle Clogging in Cold spray

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Nozzle fouling or nozzle clogging in cold spray happens because of particle collisions with the nozzle walls, resulting in the deposition of residual particle material on the walls. Although nozzle cooling can help prevent nozzle fouling, it does not eliminate it, and some cold spray applications are still limited to below-ideal processing temperatures to prevent fouling from occurring. The present study investigates the impact of cold spray powder particles on nozzle walls numerically. In a separate study, adhesion or erosion caused by Ni powder particles on WC-Co nozzle was investigated experimentally by spraying at an angle onto flat pieces of WC-Co substrate and traces of residual Ni were observed to be present on the WC-Co substrate. In order to gain insight to the mechanics of the particle-wall collisions, the impact of nickel (Ni) particles on a WC-Co surface was investigated numerically. Computational fluid dynamics (CFD) was used to compute the impact velocity and impact angle of the particles on the nozzle walls, then oblique particle impacts were simulated at these angles and velocities using the finite element method (FEM) with a coupled Eulerian-Lagrangian approach. The results show that the particle temperature sometimes exceeds the melting point near the contact location, suggesting that the particles can leave material residue on the nozzle walls. The amount of residual deposited material depends upon impact angle, impact velocity and particle radius. It was observed that the amount of particle material that undergoes melting is higher for higher impact angles, higher impact velocities and larger particle sizes. The results of the study aid in understanding of the underlying causes of fouling in cold spray nozzles, which is essential to developing solutions to prevent nozzle clogging, moving forward.