Wang, Fujing, Ph.D., “Electrostatic spray coating with fine powders”, The University of Western Ontario, September 2004 (co-supervisor: R. Martinuzzi from May 2003).

Abstract

The work described in this thesis was carried out to evaluate the performance of electrostatic spray coating process using fine polyester powders as opposed to regular powders with the same chemistry. The regular coating powders have an average diameter of 35 μm and the fine powders with a diameter of 15 μm. The evaluation was carried out with respects to film quality, charging characteristics and first pass transfer efficiency. Parameters affecting both the q/m ratios and the first pass transfer efficiency such as charging voltage and spray distance were investigated. It is found that the relationships between transfer efficiency and process parameters such as operating voltages and spray distance differ dramatically between the traditional regular powder and the “new” fine powder. The higher charging voltage increases the transfer efficiency for the regular powder, but lowers it for the fine powder.

Experimental studies of particle trajectory were also conducted in an isolated plexiglass coating booth on both powders. Particles were injected with a Norsdon. spray gun with a fixed distance from the gun to a grounded plate. Using a Dantec. Particle Dynamic Analyzer, the particle velocity and size distribution were measured simultaneously. The experimental results showed that for both powders the effect of electrostatics charging on the particle trajectory is strong in the close vicinity of the target, but can be neglected at locations away from the target. The influence on particle size and velocity profile due to the electric field between the charged particles and grounded target was weakened as more particles deposited on the target.

When no charge is introduced on the regular coating powder, particle segregation is observed for particles larger than 100 μm. Particle gravitational settlement is noticed even near the gun tip. However, particle charging largely eliminates the segregation at a gun-to-target distance of 25 cm. During the spraying of regular powders, the gun-totarget velocities of larger particles exhibited noticeable deviation from those of the flow field as the grounded target was approached.

Extensive particle agglomeration is observed during the fine powder spraying under no charge or low charge. The agglomeration results in lower charge-to-mass ratio for fine powders than theoretical achievable. It is found that high operating voltage can eliminate agglomeration but induce severe back-ionization.

The study revealed that the onset of electrostatic coating is an important period that can affect the transfer efficiency and film thickness