Abstract

Two important results desired in most powder-coating applications are: (1) a high first-pass transfer efficiency (FPTE); and (2) uniformity of the powder layer covering the surface to be coated. Both of these desired outcomes are influenced by the properties of powder and spraying process parameters involved in the electrostatic coating process. Many industries are unable to switch from solvent-based coatings to powder coatings because of the long color-change time required in industrial powder coating processes. An FPTE greater than 90% may eliminate the need for recycling of the overspray in some applications, thereby permitting fast color changes. To obtain a high FPTE and good appearance of a thin film, all relevant coating parameters must be optimized. In many powder-coating applications, particularly in aircraft coating, it is necessary to reduce film thickness to reduce the weight of the paint layer. However, the film must not have any surface defects and must have strong resistance against corrosion, UV radiation, and temperature fluctuations. Since surface defects can be caused by the presence of back corona during the electrostatic spraying process, it is often desirable to spray powder at high FPTE with minimal free ion current. To minimize ion current, it is possible to operate the corona gun at a lower voltage, such as -60 kV in place of -100 kV, with only minor reduction of FPTE but a threefold reduction of Q/M of the deposited powder. However, since most of the polymer powder acquires a bipolar charge distribution during the fluidization and transport processes, low-voltage corona discharge operations did not produce unipolar charge distribution during the spraying process. A bipolar charge distribution of the powder appears to produce dendritic clusters in the powder layer, resulting in a nonuniform film surface, as measured by an optical diffusive reflectance analyzer. The best film appearance was achieved with powder applied at -100 kV and cured slowly. It therefore appears that each application process must be optimized by both experimental studies and theoretical modeling to achieve the highest possible FPTE with minimal surface defects