

Aerosil and Aeroxide in Powder Coatings

Whereas the fumed silica and fumed aluminum oxide, such as AEROSIL® 200, AEROSIL® R 812 and AEROXIDE® Alu C, are known to be exceptionally suitable for improving the desired properties of powder coatings, the present study shows that the newest developments – AEROXIDE® Alu C 805 and AEROXIDE® Alu 130 – offer even more advantages for the studied systems, such as in their flow behavior, transfer rate, or Faraday cage effect.

New Studies of AEROSIL® and AEROXIDE® in Powder Coatings

Although the powder coating industry has already made extensive use of hydrophilic and hydrophobic fumed silica (AEROSIL®) and hydrophilic aluminum oxides (AEROXIDE®), Evonik Degussa GmbH has developed new fumed oxides that can substantially improve the properties of powder coatings. This article provides an overview of the properties of fumed oxides in polyester-based powder coatings, making a distinction between a conventional ($d_{50} = 31.0 \mu\text{m}$, additive concentration: 0.3 wt.%) and a fine ($d_{50} = 21.5 \mu\text{m}$, additive concentration: 0.5 wt.%) powder coating. The additives were admixed in an ACM classifier mill.

Corona Application

In conventional and fine powder coatings alike, AEROXIDE® Alu C 805 exhibited its largest positive influence on the angle of repose. With respect to this property, the newly developed AEROXIDE® Alu 130 turned out to be the second-best product for both particle sizes. When fumed silicas were used, AEROSIL® R 812 and AEROSIL® 200 improved flowability to a much greater extent than all other tested fumed silica.

The test of the fluidization behavior, which was performed using a bed expansion test is depicted in Figures 1 and 2. The diagrams show the air flow velocity needed to produce a 20% fluidization. The air flow velocity of the control sample, without fumed silicas and aluminum oxides, was constant above 1 cm/s. In the fluidization test, all fumed silicas and aluminum oxides tested led to substantial improvement in the flowability of the powder coating.

For the fine powder coating, the aluminum oxides proved to be more effective in comparison to the silicas, AEROXIDE® Alu C 805 and AEROXIDE® Alu C being the two best. The hydrophobic AEROSIL® R 812 achieved the best results among the silicas.

Test of Fluidization Using Silicas and Aluminum Oxides in Fine Powder Coating

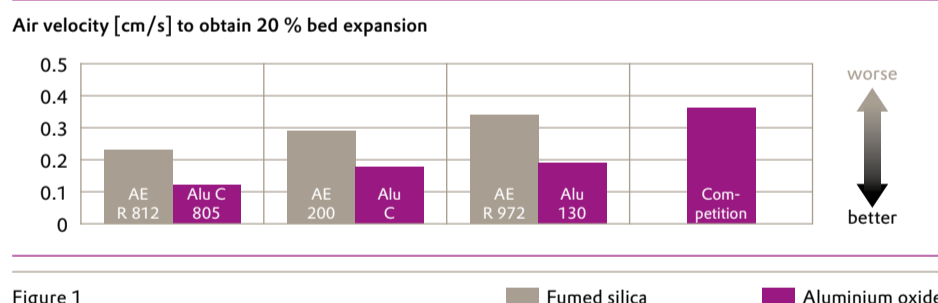


Figure 1

For conventional powder coating, the fumed silicas proved to be slightly better fluidization additives. Nevertheless, AEROXIDE® Alu C 805 and AEROXIDE® Alu 130 exhibited nearly identical performance.

The study of the transfer rate by means of a Corona application was performed using a GEMA manual spray gun. The better the powder coverage of the plates after the spraying, the greater the amount of powder coating that was transferred. It is clear that the results of the transfer rate depend very strongly on the particle size of the powder coating system. Additives that were able to improve the transfer rate of fine powder coatings tend to reduce the transfer rate in conventional powder coatings. AEROSIL® 200 and AEROSIL® R 812 achieved the best results for fine powders, while AEROXIDE® Alu 130 and AEROXIDE® Alu C proved better in conventional powders.

To test for the Faraday cage effect, we used a GEMA spray gun to spray the powder coatings onto an aluminum sheet that had a channel down its center. A maximum Faraday cage effect results in very poor homogeneous coverage, producing a low "R value." A value of $R = 1$, on the other hand, means that the Faraday cage effect is not present and that the powder coating produced uniform coverage both inside and outside the channel.

Test of Fluidization Using Silicas and Aluminum Oxides in Conventional Powder Coating

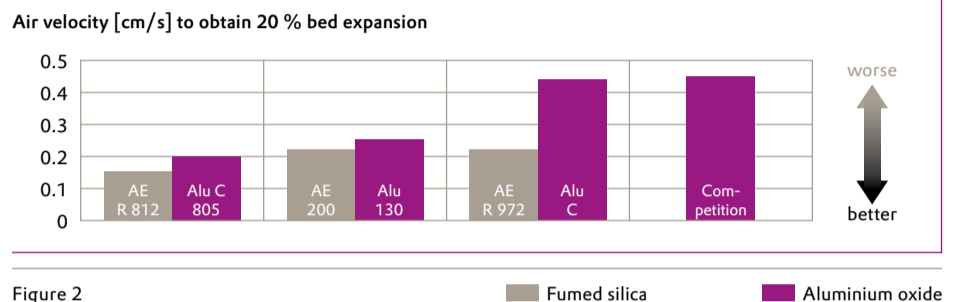


Figure 2

In fine powder coatings, the additives made of fumed silicas helped to suppress the Faraday cage effect and achieve a much more uniform coverage of the coated surface. The results show that AEROSIL® R 812 improves this performance characteristic quite significantly.

In conventional powder coatings, only AEROXIDE® Alu C 805 resulted in an improved coverage. All other silicas and aluminum oxides studied did not produce any significant improvement in the Faraday cage effect.

Influence of the Fumed Silica AEROSIL® on the Faraday Cage Effect in a Fine Powder Coating

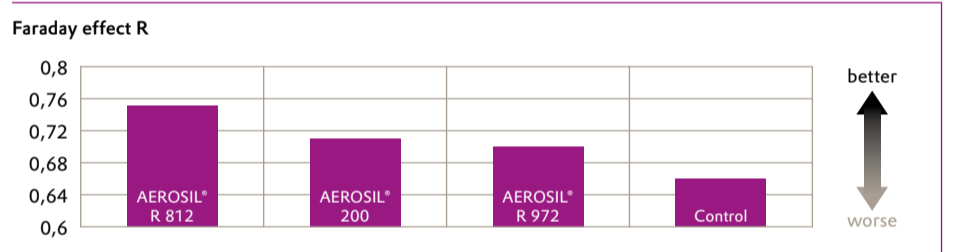


Figure 3

The test results show that additives made of fumed silicas generally reduce the gloss value (20° and 60°) more easily than aluminum additives. AEROXIDE® Alu C 805, which even increased the gloss value of the powder coating, produced excellent results.

Tribo Application

Fumed aluminum oxide is frequently used for tribo applications in order to improve the flow properties and also to stabilize the chargeability of powder coatings.

All of the aluminum oxides studied improved the transfer rate of polyester-based powder coatings. Whereas the results in the corona application depended strongly on the particle size of the powder coating, the use of AEROXIDE® Alu C 805 led to substantial improvements in the transfer rate in the tribo application, regardless of the particle size of the powder coating.

Transfer Rates of Aluminum Oxides in Polyester-Based Fine Powder Coatings

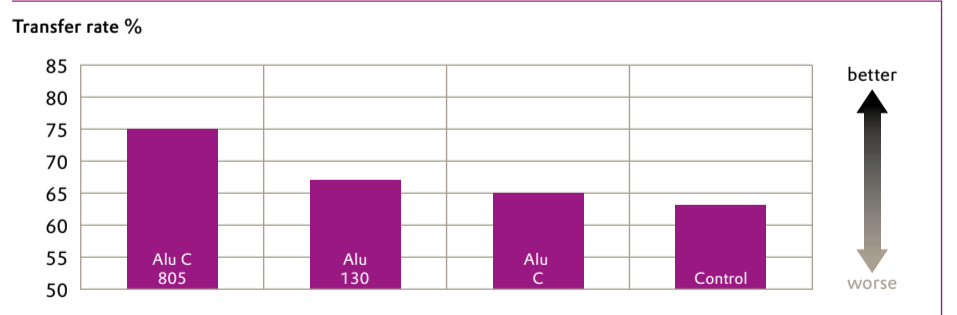
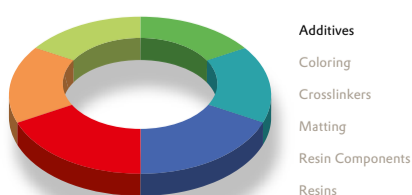


Figure 4



- >> For conventional powder coatings, it was possible to establish an improvement in coverage on the three-dimensional aluminum plate for all aluminum oxides examined. AEROXIDE® Alu C 805 and AEROXIDE® Alu 130 showed a substantial improvement in the coverage of the powder coating.

For fine powder coatings, only AEROXIDE® Alu 130 was able to help prevent the Faraday cage effect and to also increase the coverage of the powder coating on the poorly accessible locations on the aluminum plate.

Technical Contact

Europe: gabriele.leder@evonik.com

USA: marina.nargiello@evonik.com

China: lan.shen@evonik.com