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PLASTEC NOTE 18

THE COATING OF ALUMINUM WITH PLASTICS BY THE FLUIDIZED-BED AND ELECTROSTATIC POWDER TECHNIQUES



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**THE COATING OF ALUMINUM WITH PLASTICS BY THE FLUIDIZED-
BED AND ELECTROSTATIC POWDER TECHNIQUES**

By

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ABSTRACT

This paper briefly describes plastic powder coating of metal objects, particularly aluminum, by the fluidized-bed and electrostatic powder techniques. It points out the importance of control of process parameters such as preheat and postheat temperatures and dwell times, particle size and particle size distribution, and immersion time. Recent developments in coating powders are discussed. Also noted are the particular attributes of aluminum with regard to fusion powder coating. A number of typical applications are described, and the limitations of the fluidized-bed process are noted.

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Notice:

If the reader is further interested in these coating techniques, he is referred to the previous PLASTEC output on this subject (See ADDITIONAL REFERENCES, p. 17).

1. INTRODUCTION

One of the more interesting developments in the last few years has been the growth of plastic powder coatings applied by the fluidized-bed and electrostatic spray techniques, or by combinations, or modifications of these two basic methods. By the use of such techniques coatings can be applied quickly and in relatively thick gauges without the use of solvents. With some resins these are the only known practical methods for applying coatings. Coatings applied by these techniques are frequently called fusion coatings. Such coatings are used primarily to provide resistance to corrosion and weathering, to insulate electric motors and other electric equipment, and to decrease friction in moving parts.

2. CONVENTIONAL FLUIDIZED-BED COATING

In the conventional fluidized-bed technique the metal part or object to be coated is heated in a preheat oven after thorough preparation of its surface. It is then transferred to the fluidized bed, as shown in Fig. 1. Agitation of some sort is usually required for optimum coating.

The bed or chamber in Fig. 1 is swept with a current of gas, usually air, at room temperature. The gas serves to levitate the resin powder in such a manner that it resembles a boiling liquid in appearance - hence the name "fluidized bed". Heating in the preheat oven is used to bring the object to be coated to a temperature high enough above the melting or sintering point of the resin so that, after the object is removed from the heat source, it retains enough heat on its surface to melt or sinter the resin powder particles, which then form an adherent coating.

Postheating, or heating after removal from the fluidized bed, may or may not be used, depending upon a number of factors. Postheating serves to smooth thermoplastic powder coatings and to cure thermosets.

In commercial practice, eight separate steps are involved as follows:

Jigging and Masking

Common to all methods of coating is the need to hold the part while applying the coating. Proper jigging for the coating operation requires that the part be held rigidly, since adequate motion must be given to the part if a uniform coating is to be obtained. Hot or cold jigs may be used. Hot jigs are attached to the part throughout the preheating, coating and postheating operations. The jig is actually heated and will become at least partially coated. As for the cold jigs, there are two basic types. In one, the jig is not attached to the part until the coating operation is begun and thus the jig does not become coated. In the other type, the jig is attached during preheating, coating and postheating, but will not pick up a coating because of the nature of the jig material (Teflon, for example).

Masking is used to block the adhesion of coating onto certain selected areas of the object to be coated. A jig itself may be used as a mask; or several other techniques may be used, including the application of heat-resistant, pressure-sensitive tape.

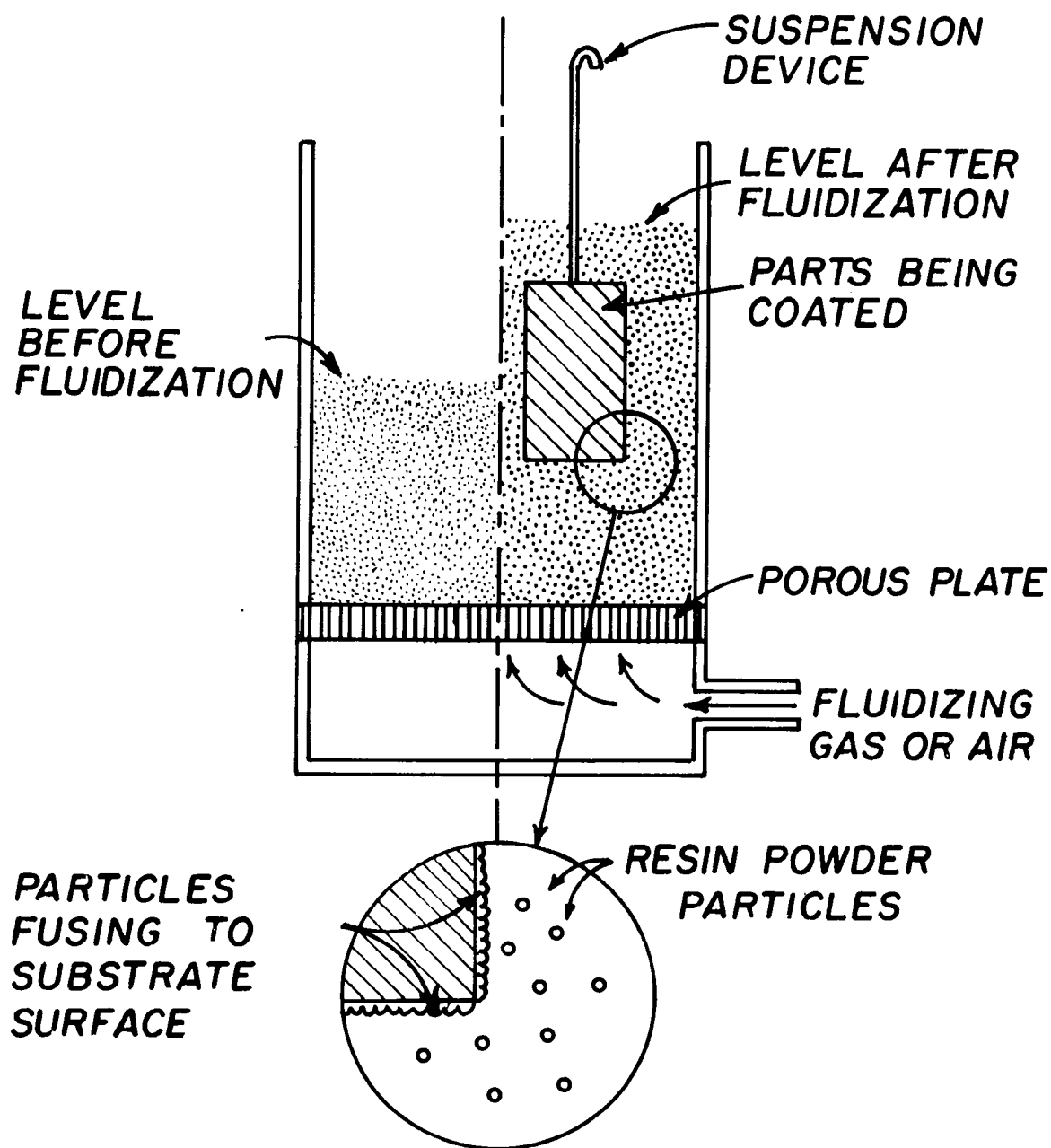


Figure 1. Diagram of typical fluidized bed used in powder coatings;
 left: before fluidization; right: after fluidization
 (After Pascoe, The Polymer Corporation)

Cleaning or Surface Pretreatment

The surface must be clean, dry and free from oils. Fortunately, in the case of aluminum, the simplest and cheapest substrate preparation is generally as good as the most elaborate. In many cases, particularly with aluminum sand castings, a simple alkaline or detergent wash, followed by a hot water rinse, is sufficient. Vapor degreasing is sometimes used preceding the alkali treatment.

Priming

Most plastic powder coatings require the use of primers when good adhesion to the substrate is required. Primers are usually used with cellulose acetate butyrate, nylons and vinyls. They are not normally used with polyethylene, epoxy and chlorinated polyether. Primers used for fluidized-bed coating may be applied by dipping, spraying, flow coating, or roller coating. Excess powder must be removed and the primer allowed to dry tack-free before being placed into the preheat oven. The preheating operation may be carried out immediately, or may be postponed. For the best results, coating should be completed within 24 hours after priming.

Preheating

This is the most critical step in fluidized-bed coating. Various methods of heating are used, including convection, radiant, resistance and induction heating. Generally, forced draft induction ovens are the most versatile. It is important not to overheat the primed part, since overheating decreases the adhesion between the primer and the coating. The choice of preheat temperatures is determined, in part, by economic considerations. It is generally desirable to keep the preheating time as short as possible to permit maximum production rates. Once a preheat temperature is selected, it is well to maintain it within close tolerances in order to achieve the same coating thickness on all parts being coated.

Coating (Dipping)

Upon removal of the part from the preheat oven it should be immersed into the fluidized bed quickly to keep heat loss to a minimum. While in the bed, motion must be imparted to the part. This may be a simple "to and fro" motion, or it may be vibratory. Such motion is necessary since the fluidized powder does not have as good fluidity as a true liquid. Immersion times vary from 3-20 seconds. Excess powder must be removed immediately after withdrawal of the part from the bed. This is accomplished by a brief blast of air or by tapping or vibrating action.

The principle behind the use of a fluidized bed is by no means new, but until recently it had been restricted to the mixing of powders and to the catalysis of chemical reactions in powder systems. Fluidization is achieved by passing a low-pressure air stream through the porous plate of a tank containing the powder. The powder then becomes buoyant in the air stream, its volume increasing by as much as 50 percent. The powder bed then acts very much like a liquid paint,