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CURING POWDER PAINT ON LOW MELT TEMPERATURE THERMOPLASTICS

Background

The use of composite materials and thermoplastics for part production, prototypes, and display units is becoming more prevalent in the manufacturing environment. Additive manufacturing technologies, also known as 3D printing, have escalated this trend dramatically. Customers frequently prefer that composite and thermoplastic parts have the same surface appearance as the original product and/or mating components. For example, a plastic additively manufactured panel used to cover a communication antenna or a radio frequency transmission device may need to be painted to blend in with the rest of the assembly and conceal the location of that device. In some applications, the coating itself may need to have some functionality such as electrostatic dissipative properties that can be added using powder coating. Application of powder coating to plastics has historically been limited by two factors.

The first is the requirement that electrostatically applied powder coating must be applied to parts that are electrically conductive. The second is the ability of the part to withstand the temperature required to cure the powder coating. Primers are now available that allow powder coating to be applied electrostatically to a plastic or non-conductive material. Many substrates, however, often have low melting points making it difficult to cure the powder coating without damaging the unit. The deformation temperature of many substrates, specifically thermoplastics, is lower than the cure temperature of the powder coating. The process described below has demonstrated the ability to overcome the challenge of curing the powder coating without deforming the substrate or changing the product's physical properties.

Description

This process is initiated by coating the non-conductive part with a conductive primer or by placing a large conductive fixture behind the relatively thin substrate to attract the electrostatically charged powder to the product. After the primer is cured or the conductive fixture is in place, the powder coating is applied to the part using standard methods. The unique factor in this process it that the powder coating is cured using pulsed infrared light, or other radiative heat source. By applying radiant energy in short pulses, it is possible to heat the powder coated part's outer surface to the cure temperature of the powder coating without heating the core of the plastic substrate above the melt temperature.

The shape and dimensions of the part are not affected by the heat if the pulses of light are carefully controlled and the heat buildup in the plastic part is monitored. Powder coating is distinctively suitable for this application because the curing mechanism for powder coating can be interrupted without affecting the final cure. If the internal temperature of the plastic substrate approaches a predetermined threshold before the powder coating reaches a fully cured state, the intensity or duration of the heat source can be reduced or halted. When the substrate temperature is cooled to a safe level, the heat source is reapplied to complete the cure of the powder coating. One method to control the pulse duration of the infrared light radiative heat striking a particular surface is to mount the part receiving the radiative heat on a rotational device and to use a unidirectional heat source. The pulse duration can then be controlled by speeding up or slowing down the rotational speed of the part as it is exposed to the heat source.

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Advantages

Powder coatings are harder, tougher and less permeable to fluids than liquid paints. Powder coating can be obtained in any color needed, is solvent free and will not react chemically with the plastic parts to which it is being applied. The ability to alter the appearance of an additively manufactured part to match that of the components with which it will be in contact will allow manufacturers greater opportunity to take advantage of the growing additive manufacturing market. To alter the appearance or change the surface characteristics of many thermoplastics or additively manufactured parts, currently, manufacturers must either purchase much more expensive and less available color matched material or coat the part with a liquid paint. In many locations, environmental restrictions are limiting the ability to spray liquid paints. Powder coating offers economic and/or environmental advantages over the current options.

Applications

Plastic parts coated for aesthetic appearance or functional surface characteristics combine the advantages of powder coatings with the flexibility of plastics and polymer based additive manufacturing production. For example, plastic or composite rocker panels and fenders on an automobile could be powder coated to match the vehicle color or retain a metallic finish while remaining rust free, lighter weight, and less susceptible to damage than steel panels. Electronic case components could be formed from low cost plastic with visually appealing and marketable electrostatic dissipative powder coating applied. Additionally, nonfunctional models used for display can be made much less expensively by using plastic materials which could be powder coated to appear to be made of the same material as the model subject.

- Use powder coating to match the color, gloss and surface texture of plastic parts to the mechanisms or assemblies to which they will be attached
- To make additive manufactured parts or low temperature thermoplastic parts appear to be made of some other material (e.g. aluminum or other metals)
- Conceal and protect a radio transmission device with a radio frequency transparent material that has the same appearance as the surrounding surface
- Tamper detection (a plastic panel powder coated in place could not be removed without visible evidence)
- To change the functional property of the plastic by coating it with a powder coating with desirable properties (e.g. electrostatic dissipation, hydrophobicity, ultra violet reflectivity, etc.)

This tool could easily be sold alongside pop rivets, pop rivet guns, and accessories. It can be fabricated inexpensively using plastic creating value for both the commercial and individual consumer markets.

Intellectual Property Status

This technology is patent pending under US Patent application number 14/990,534 filed 01/07/2016.

Keyword List

Low temperature powder coating, Powder coating plastics, Coating low melt thermoplastics, Powder coating Thermoplastics, Powder coating thermoplastics

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