CONTROLLING CYCLONE EFFICIENCY WITH A VACUUM INTERFACE

RELATED APPLICATIONS

The present application claims the benefit of pending U.S. provisional patent application Ser. No. 60/290,447 filed on May 11, 2001 for CONTROLLING CYCLONE EFFICIENCY WITH A VACUUM INTERFACE the entire disclosure of which is fully incorporated herein by reference. The present application is a continuation-in-part of pending U.S. patent application Ser. No. 09/888,679 filed on Jun. 25, 2001 for QUICK CHANGE POWDER COATING SPRAY SYSTEM which claims the benefit of U.S. Provisional patent application Ser. Nos. 60/277,149 filed on Mar. 19, 2001, and 60/238,277 filed on Oct. 5, 2000, the entire disclosures of which are fully incorporated herein by reference.

FIELD OF THE INVENTION

The invention relates generally to powder coating spray systems which use powder containment spray booths and power overspray recovery apparatus. More particularly, the invention relates to a powder coating spray system that uses negative pressure to influence cyclone efficiency by increasing the yield of powder particles recovered from the cyclone.

BACKGROUND OF THE INVENTION

Powder coatings are commonly applied to objects by powder spray guns that may be manually operated or automatic. In an automatic system, one or more spray guns are controlled to spray powder onto the objects as the objects are conveyed past the guns. In a manual gun operation, typically the object is suspended or otherwise positioned near a spray gun and the operator controls when the gun starts and stops spraying. A powder spray gun may be selected from a wide variety of gun designs. Since a spraying operation is intended to coat an object evenly, a common technique for spraying powder is to apply an electrostatic charge to the powder particles which causes the powder to better adhere to the object and also results in a more uniform application. Electrostatic spray guns include corona guns and tribocharging guns. In a corona type spray gun, a high voltage electrode is positioned in or near the powder flow path, either within the gun itself or just outside the gun near or at the gun nozzle. In a tribocharging type gun, the powder flow path through the gun body is made of suitable materials that impart an electrostatic charge to the powder as it is forced through the gun body.

The object being sprayed is electrically grounded such that the charged powder is attracted to and adheres to the object. This electrostatic attraction increases the transfer efficiency by increasing the amount of powder that adheres to the object. Transfer efficiency refers to the relationship between the amount of powder that adheres to the object being sprayed versus the amount of powder sprayed from the gun.

In most electrostatic spray systems, the powder is ejected from the gun nozzle as a cloud. This permits the powder spray to envelope the object to coat all the surfaces of the object, even when the object is irregular in geometric shape. Multiple guns may be positioned on different sides of the object and/or directed at different angles to increase the uniformity of the powder applied thereto. However, due to the inherent nature of the powder spray pattern, there is a

substantial amount of powder that does not adhere to the object and ends up either falling to the floor or collecting on other objects and structures in the immediate area. This non-adherent powder residue is generally referred to as powder overspray.

Known powder spray systems utilize a source of powder that feeds powder to the spray guns. The supply system is commonly referred to as a powder feed center and may include a number of powder pumps that transfer powder from a feed hopper through a series of power hoses to the spray guns inside the spray booth. In general, an "application system" includes, as the powder flow path, at least spray gun, a powder source such as a feed hopper, a powder pump and a powder feed hose that connects the pump to the gun. In a known feed center, a suction tube or lance extends down into the feed hopper at one end and is connected to a powder pump at an opposite end. The pump draws powder from the hopper and the powder then flows from the pump through the powder feed hose to the spray gun. In such known systems, the powder flow path typically includes one or more turns, of about ninety degrees or so for example, and these non-straight paths can inhibit thorough cleaning during a color change operation. The known feed centers also require substantial time to purge and clean as part of a color change operation.

The presence of powder overspray necessarily dictates that there must be more powder passing through the spray system than is actually used to coat the target object. In other words, a substantial amount of powder is cycled through a spray system in the form powder that collects in the booth and in various filter and collection systems, and this amount of powder is far greater than the actual amount of powder that adheres to a target object. This excess powder is subject to contamination and in general adds to the problem of purging and cleaning the spray system in preparation for a color changeover.

Because powder overspray is generated during each spraying operation, spraying operations typically are performed within a spray booth. The spray booth is used for powder containment and may only be partially enclosed. Most spray booths have an air flow system that contains the powder overspray within the structure of the booth by producing a negative pressure zone that draws air from the powder booth along with powder overspray that is entrained in the air flow. The powder laden air is then transferred to a cartridge filter system or cyclone separator system outside the spray booth to recover the powder. However, in known spray booth systems, the powder overspray still tends to collect on the booth walls, ceiling and the booth floor. In electrostatic systems especially, the powder overspray will also tend to be attracted to and collect on any structure that is electrically grounded. The powder particles tend to be very small and well dispersed and therefore can collect in the smallest of recesses, seams and crevices and irregular spray booth wall structures.

Powder overspray presents a two-fold challenge. First, if possible it is usually desirable to try to reclaim or recover powder overspray so that the powder can be re-used during subsequent spraying operations. Known powder recovery systems typically work on the basis of a large air volume that entrains the powder overspray. These air flow volumes are routinely generated by conventional high volume exhaust fans. The powder laden air is then filtered, such as for example using cartridge type air filters or cyclone separators. The separated powder is then sieved to remove impurities and returned to a hopper or powder feed center where it is supplied once again to the spray guns. In known systems, the