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54 **A method of manufacturing a photoconductor drum.**

57 In the manufacture of a photoconductor drum which is a photoconductive layer on the outer circumferential surface thereof, the drum is cleaned with a cleaning fluid, before applying the coating solution containing a photoconductive substance to the outer circumferential surface of the drum thereby removing foreign matter deposited on the drum. Thereafter, the drum is subjected to heat treatment, and the coating liquid is applied on the outer circumferential surface of the drum.

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A METHOD OF MANUFACTURING A PHOTOCONDUCTOR DRUM

The present invention relates to a method of manufacturing a photoconductor drum which is used, for example, in an electrophotographic copying machine. More particularly, the invention relates to a method of manufacturing a photoconductor drum, wherein a coating solution containing a photoconductive substance is applied onto the pretreated outer circumferential surface of a drum and then dried to form a photoconductive layer thereon.

Generally, a photoconductor drum used in an electrophotographic copying machine is manufactured by treating a conductive aluminum drum which is processed into Alumite to form an alumite layer thereon and then applying a coating solution consisting of a photoconductive substance dissolved in an organic solvent onto the outer circumferential surface of the drum to form a photoconductive layer thereon. The drum, much as an aluminum drum, is cleaned in a prescribed process before being coated with the coating solution containing the photoconductive substance.

Usually, the drum is cleaned as it is rotatingly moved up and down through an annular brush disposed in a cleaning fluid tank containing a quick drying chlorine-type cleaning fluid such as fron, (chlorofluorocarbon) dichloromethane, etc., thereby cleaning the outer circumferential surface of the drum. Thereafter, the drum surface is further cleaned for degreasing with dichloromethane. Since the outer circumferential surface of the drum is thus cleaned for removal of oils and other foreign matter deposited thereon, it is possible not only to form a photoconductive layer of a prescribed thickness uniformly but also to prevent the coating solution from being contaminated when the drum is immersed in the coating solution for coating the outer circumferential surface thereof. The brush cleaning and degreasing cleaning are usually performed of a temperature of about 50° C.

The coating solution containing the photoconductive substance is applied onto the thus cleaned outer circumferential surface of the drum, and is dried so as to manufacture a photoconductor drum having a photoconductive layer formed on the outer circumferential surface thereof.

However, when the coating solution is dried after being applied onto a drum such as an aluminum drum, minute air bubbles are formed in the photoconductive layer, hampering uniform formation of the photoconductive layer. The air bubbles are created when the water adhering to the drum vaporizes during drying. When an image is formed using a photoconductor drum having such air bubbles, pinholes appear in the produced image,

therefore, it is not possible to produce an image of high quality.

To prevent creation of air bubbles when drying the coating solution, a method has been proposed wherein the coating solution is applied after heat-treating the aluminum drum at a temperature higher than 120° C. Since the water adhering to the drum is vaporized by heating before the coating solution is applied, there is no possibility of air bubbles being created when the coating solution is dried after the coating process.

Such heat treatment is usually performed before the cleaning process. This is to prevent the cleaned outer surface of the drum from being marred after the cleaning process by performing treatment other than the application of the coating solution. Because the drum after being cleaned should be maintained in an extremely cleaned condition until the coating solution is applied to the outer circumferential surface of the drum. However, if foreign matter having low melting points (for example, 50 to 120° C) have been deposited on the drum surface, such matter will melt when the drum is heated before cleaning and then harden again after the heat is removed. The thus hardened substances may adhere to the drum surface more firmly than before the heating. The foreign substances thus made to firmly adhere to the drum surface cannot be removed completely in the subsequent drum cleaning process, thus causing the problem that the photoconductive layer cannot be uniformly formed on the outer circumferential surface of the drum in the subsequent coating process.

Also, heat treatment at a high temperature (about 140° C) is required to remove the water adhering to the drum surface, but at such a high temperature, there is a possibility that cracks may be caused in the surface of the drum. The formation of cracks is not only undesirable in the manufacturing of the photoconductor drum since the cracks hamper uniform application of the coating solution in the subsequent coating process, but also causes water to be caught in the cracks in the subsequent cleaning process, making it impossible to prevent creation of air bubbles.

Furthermore, in the case of applying the coating solution continuously after the heating and cleaning processes, it is required that the coating solution be applied immediately after the drum is cleaned in order to enhance work efficiency. This limits the selection of cleaning fluids to quick drying chlorine solvents such as dichloromethane, fron, etc. However, using fron is not desirable since they damage the environment.

The method of manufacturing a photoconductor drum of this invention, which overcomes the above-discussed and numerous other disadvantages and deficiencies of the prior art, comprises a coating solution containing a photoconductive substance that is applied onto the outer circumferential surface of a drum and then dried to form a photoconductive layer thereon, the method including, before the process of applying the coating solution to the outer circumferential surface of the drum, the processes of: cleaning the drum in a cleaning fluid; and heat-treating the cleaned drum to remove water from the outer circumferential surface thereof.

In a preferred embodiment, the cleaning fluid is a hydrophilic solvent preferably having a lower boiling point than that of water.

It is preferred for the cleaning process to include brush cleaning the outer circumferential surface of the drum using a brush along with the cleaning fluid and degreasing cleaning for removing oily deposits on the outer circumferential surface of the drum after the brush cleaning. The degreasing cleaning may be accomplished by ultrasonic cleaning wherein the drum is immersed in a cleaning tank containing the cleaning fluid to which ultrasonic vibrations are applied. Alternatively, the degreasing cleaning may be accomplished by shower cleaning wherein the cleaning fluid is sprayed like a shower. It is also possible for the degreasing cleaning be accomplished by steam cleaning wherein steam of solvent is sprayed onto the outer circumferential surface the drum.

In a preferred embodiment, the heating process is performed using a temperature of from 110 to 120°C.

Thus, according to the method of the present invention for manufacturing a photoconductor drum, since the drum is heat-treated to remove adhering water after the drum is cleaned, even if foreign substances having low melting points are deposited on the drum surface, there is no possibility of such substances melting and then hardening to firmly adhere to the outer circumferential surface of the drum. Therefore, the foreign substances can be removed easily from the drum surface. Also, since a hydrophilic solvent is used as the cleaning fluid in the cleaning process preceding the heat treating process, the cleaning fluid can also be removed easily from the outer circumferential surface of the drum. Accordingly, there is no possibility of air bubbles being included in the photoconductive layer formed on the outer circumferential surface of the drum. Also, at this time, there is no need to heat the drum at a high temperature, thus eliminating the possibility of causing cracks in the drum. Furthermore, since it is not required to use from or other quick drying solvents as the cleaning fluid, there is no concern about damage to the environ-

ment. As a result, the photoconductor drum can be produced having a uniform photoconductive layer without adhesion of foreign substances, thus assuring production of images of good quality.

According to the method of the present invention for manufacturing a photoconductor drum, a drum such as an aluminum drum which is processed into Alumite is first subjected to brush cleaning for cleaning the outer circumferential surface thereof. In the brush cleaning, the outer circumferential surface of the drum is cleaned by being brushed as the drum is passed through an annular brush immersed in a cleaning fluid which uses a solvent.

The drum, the outer circumferential surface of which is thus cleaned by the brush, is then subjected to degreasing cleaning. The degreasing cleaning is accomplished by means of ultrasonic cleaning wherein the drum is immersed into a cleaning tank containing solvent. Then ultrasonic vibrations are applied, shower cleaning wherein a solvent is sprayed like a shower onto the outer circumferential surface of the drum, or steam cleaning wherein steam of the solvent is sprayed onto the outer circumferential surface of the drum. In the degreasing cleaning, oil, fingerprint stains, etc., adhering to the drum surface are removed.

After the brush cleaning and degreasing cleaning, the drum is subjected to heat treatment to remove the water adhering to the outer circumferential surface thereof. In the heat treatment, the drum is heated at a high temperature of about 110 to 120°C for about 15 to 20 minutes to vaporize the water adhering to the drum surface as well as the cleaning fluid remaining thereon as a result of the preceding cleaning process.

Thereafter, the heat-treated drum is immersed in a coating solution containing a photoconductive substance and then extracted therefrom, thereby coating the outer circumferential surface of the drum with the coating solution. The thus applied coating solution is then dried to form a photoconductive layer on the outer circumferential surface of the drum.

Thus, according to the present invention, since the drum is cleaned before subjecting it to heat treatment, even if foreign substances are deposited on the drum surface, they are not firmly adhering to the drum surface and therefore can be removed easily in the cleaning process.

Also, since the water adhering to the drum surface is removed to some degree in the cleaning process, it is not necessary to heat the drum at too high a temperature in the subsequent heat treating process, thus eliminating the possibility of causing cracks in the drum.

With the method of the present invention, a hydrophilic solvent is preferably used as the clean-

ing fluid in the cleaning process consisting of brush cleaning and degreasing cleaning steps. Using the hydrophilic solvent not only facilitates removal of dust, foreign matter, etc., but also helps remove the water adhering to the drum surface during the cleaning process. Therefore, in the subsequent heat treating process, the water adhering to the drum surface can be completely removed by heating at about 110 to 120°C, thereby preventing creation of air bubbles in the photoconductive layer when the coating solution is dried, while at the same time preventing cracks from being caused in the drum during heating.

Also, it is desirable that the cleaning solvent has a lower boiling point than that of water. A lower boiling point of the cleaning solvent serves to accelerate, during heat treatment, the vaporization of the solvent deposited on the drum surface, allowing the heating temperature to be set at a lower temperature and thus further assuring the above-mentioned effects. Hydrophilic solvents having lower boiling points than water include, for example, methanol (boiling point: 64.65°C), ethanol (boiling point: 78.3°C), acetone (boiling point: 56.3°C), tetrahydrofuran (boiling point: 66.0°C), etc. In the drying process, the drum coated with the coating solution is heated at a temperature of about 110°C for about 30 minutes. Since the water adhering to the outer circumferential surface of the drum is completely removed in the cleaning and heat treating processes, there is no possibility of air bubbles being formed in the photoconductive layer.

Claims

1. A method of manufacturing a photoconductor drum, therein a coating solution containing a photoconductive substance is applied onto the outer circumferential surface of a drum and then dried to form a photoconductive layer thereon, the method including, before the process of applying the coating solution to the outer circumferential surface of the drum, the processes of:
cleaning the drum in a cleaning fluid; and
heat-treating the cleaned drum to remove water from the outer circumferential surface thereof.
2. A method according to claim 1, wherein the cleaning fluid is a hydrophilic solvent.
3. A method according to claim 2, wherein the cleaning fluid has a lower boiling point than that of water.
4. A method according to any preceding claim, wherein the cleaning process includes brush cleaning the outer circumferential surface of the drum using a brush along with the cleaning fluid and degreasing cleaning for removing oily deposits on the outer circumferential surface of the drum after

the brush cleaning.

5. A method according to claim 4, wherein the degreasing cleaning is accomplished by ultrasonic cleaning wherein the drum is immersed in a cleaning tank containing the cleaning fluid to which ultrasonic vibrations are applied.

6. A method according to claim 4, wherein the degreasing cleaning is accomplished by shower cleaning wherein the cleaning fluid is sprayed like a shower.

7. A method according to claim 4, wherein the degreasing cleaning is accomplished by steam cleaning wherein steam of solvent is sprayed onto the outer circumferential surface of the drum.

8. A method according to any preceding claim, wherein the heating process is performed using a temperature of from 110 to 120°C.