United States Patent Office 2,897,095
Patented July 28, 1959

2,897,095

METHOD OF PRODUCING ALUMINIZED PAPER

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No Drawing. Application March 1, 1955
Serial No. 491,532

5 Claims. (Cl. 117—70)

The present invention is directed to coating and more particularly to the production of an aluminized paper.

A principal object of the present invention is to provide a process for producing aluminized paper having a shiny aluminum surface.

Another object of the invention is to provide a process of the above type which gives a final product which is inexpensive as well as being satisfactory.

Still another object of the invention is to provide a process of the above type which furnishes an aluminized product having a strongly adherent aluminum coating.

Other objects of the invention will in part be obvious and will in part appear hereinafter.

The invention accordingly comprises the process involving the several steps and the relation and the order of one or more of such steps with respect to each of the others, and the product possessing the features, properties and the relation of components which are exemplified in the following detailed disclosure, and the scope of the application of which will be indicated in the claims.

For a fuller understanding of the nature and objects of the invention, reference should be had to the following detailed description.

Workers in the coating art have long endeavored to find methods of providing inexpensive metallic finishes for paper. In the past such finishes have usually been provided by laminating aluminum or other metallic foil to a paper base. In some cases, vacuum metallizing has been accomplished on paper bases which have been treated with an organic lacquer to provide a shiny, smooth surface. However, such lacquers are much too expensive for large-scale use and have not met with any appreciable commercial success. Equally, other treatments of the paper base such as sizing have been tried from time to time but these have been found to be lacking in certain respects, such as inadequate adherence of aluminum, excessive outgasing during coating, diffuse reflection of the final coating, and numerous other defects.

We have ascertained that water glass (hydrated sodium silicate), if properly applied to paper, makes an excellent base for aluminizing. In practicing the present invention, we have discovered that the water glass coating is preferably applied in two relatively thin films. These films are preferably on the order of about one pound of water glass per thousand square feet of paper. Thus, with two coatings, a final film containing about two pounds of water glass per thousand square feet of paper is obtained. This is enough to provide a relatively smooth, shiny base for the aluminum. It is also preferred that at least the first water glass coating be applied under pressure so that this film is mechanically worked into the surface of the paper. It has also been found highly desirable to bake each film separately. This baking is preferably accomplished in an oven where the

temperature is on the order of 170°–250° F. and above. The oven also advantageously includes a source of infra red heat although the primary baking seems to be accomplished by conduction from the hot air in the oven. This baking is preferably continued for a sufficiently long time, at the temperature employed, to remove a substantial amount of the water of hydration from the sodium silicate coating. It is believed that this may also accomplish a certain amount of conversion of the water glass to a silicon oxide.

Paper, which has been treated in accordance with the above described techniques can be, without further treatment, placed in a vacuum tank which is then pumped to a free air pressure on the order of 1 micron or so. The paper is then aluminized by being passed over a source of aluminum vapors such as those illustrated in U.S. Patents 2,665,223–4–5–6–7–8–9, issued January 4, 1954. If the pressure during coating remains below about 5 microns and preferably below about 3 microns Hg abs., it has been found that a shiny, adherent aluminum film is obtained.

In a preferred embodiment of the invention, a shiny, heat-reflecting paper is produced in accordance with the following non-limiting example:

A roll of 40 pound "coffee bag" kraft paper is coated with water glass applied by means of a doctor blade. This doctor blade rubs the coating into the surface of the kraft paper and is preferably so adjusted as to provide a coating of about 1 pound of water glass per thousand square feet of paper. In a preferred embodiment of the invention the water glass is a commercial sodium silicate known as "K" brand, containing approximately 11 percent Na_2O and 31.9 percent SiO_2 (weight ratio of $Na_2O:SiO_2$ of 1:2.90). This mixture had a specific gravity of about 47° Bé. and a viscosity of about 9.6 poises. The "K" brand had a solid content of about 42.9 percent, the remainder being water. This was diluted somewhat by adding three quarts of water to 4.5 gallons of the "K" brand silicate, thus forming a thin syrup. The coated paper, immediately after coating, is passed through a 12-foot drying oven which is maintained at about 170°–190° F., the paper passing at a speed of about 100 feet per minute through the oven. The paper is then given another coating of water glass of about the same thickness as the first coating and again dried under substantially the same conditions. Without further treatment, the thus coated paper is placed in a vacuum coating chamber. The coating chamber is pumped to a low total pressure on the order of 1 or 2 microns and the paper is passed over the source of aluminum vapors, the coated side facing the source. This provides a shiny, strongly adherent, opaque aluminum film on the paper.

While we do not fully understand all of the reasons why the present invention produces such a superior product, there are certain physical chemical relationships which may explain the excellent results. Water glass (hydrated sodium silicate) is an extremely complex chemical. It can assume many different forms with numerous ratios of atoms being possible. It is believed that the baking treatment provides a surface for the water glass film which is substantially free of water of hydration. It also seems quite possible that the surface molecules of sodium silicate have been decomposed, at least in part, so as to provide considerable free silica. Accordingly, it is quite conceivable that the initial aluminum vapors contacting the surface of the dehydrated water glass may react with the completely or partially decomposed silicate to form complex silicates and aluminates, thus forming a chemical as well as a mechanical bond with the subsequently deposited crystalline aluminum film. It also appears that the water glass coating enor-

mously reduces the surface area of the paper by filling the interstices between the fibers of paper. This is believed to decrease, correspondingly, the amount of adsorbed air and water vapor which is given off by the paper as it is unrolled in the vacuum chamber. This water glass film is believed to also serve, at least partially, as a vapor barrier for trapping, within the paper, gases and vapors which might otherwise be released during the very short time that the paper is exposed to the hot aluminum vapors and the radiant heat from the source of aluminum vapors. The fact that the water glass film has been at least partially dehydrated may also impart to the film desiccant properties which permit it to absorb water vapor diffusing slowly through the film.

While the specific example given above demonstrates one preferred embodiment of the invention, it should not be considered as limiting. Numerous other commercially available sodium silicates may be employed having a wide range of permissible viscosities, specific gravities and solids contents. Equally, the ratio of sodium oxide to silicon dioxide can be widely varied. The range of temperatures utilized for drying the sodium silicate film can be considerably wider than the specific range of temperatures mentioned in the specific example, and flame drying can be employed where care is taken not to burn the paper. Numerous other techniques well-known in the art of coating papers can be employed in connection with the preparation of the silicate coating.

Since certain changes may be made in the above process and product without departing from the scope of the invention herein involved, it is intended that all matter contained in the above description shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. The process of coating paper to provide a shiny aluminum surface thereon which comprises the steps of applying a film of water glass to the paper, baking the water glass film at a temperature on the order of 170°–200° F., applying a second film of water glass over the first film, baking the second water glass film at a temperature on the order of 170°–200° F. and above, and passing the thus coated and baked paper over a source of aluminum vapors in a chamber evacuated to a free air pressure of less than 5 microns Hg abs. to deposit a thin adherent shiny film of aluminum on said baked water glass coating.

2. The process of claim 1 wherein each of said coatings contains about 1 pound of sodium silicate (on a dry basis) per 1000 square feet of paper.

3. The process of claim 1 wherein at least the first water glass film is applied under pressure.

4. The process of claim 1 wherein the paper base comprises a calendered kraft paper.

5. The process of coating paper to provide a shiny aluminum surface thereon which comprises the steps of applying a film of water glass to the paper, baking the water glass film for a sufficiently long time to remove a substantial amount of the water of hydration, at least from the surface thereof, applying a second film of water glass over the first film, baking the second water glass film at a temperature above 170° F. for a sufficiently long time to decompose an appreciable portion of the sodium silicate molecules at the surface of the film, and passing the thus coated and baked paper over a source of aluminum vapors in a chamber evacuated to a free air pressure of less than 5 microns Hg abs. to deposit aluminum on the coated paper, the first depositing aluminum forming complex aluminates and silicates with the sodium silicate decomposition products on the surface of the baked film.

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