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PROVISIONAL SPECIFICATION.

IMPROVEMENTS IN OR RELATING TO THE PRODUCTION OF SILVER POWDER SUITABLE FOR MAKING CONDUCTING INKS.

COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH, RAJI MARG, NEW DELHI-1, INDIA, AN INDIAN REGISTERED BODY INCORPORATED UNDER THE REGISTRATION OF SOCIETIES ACT (ACT XXI OF 1860).

THIS IS AN INVENTION BY HANDADY VENKATAKRISHNA UDUPA, SCIENTIST, AND PENNAGARAM VYASA RAO VASUDEVA RAO, SCIENTIST, BOTH OF THE CENTRAL ELECTROCHEMICAL RESEARCH INSTITUTE, KARAIKUDI-3, INDIA, BOTH INDIAN CITIZENS.

The following specification describes the nature of this invention.

This invention relates to improvement in of relating to production of silver powder suitable for making conducting inks.

Hitherto the practice has been to suspend silver powder in a suitable medium which is volatile and evaporates on exposure to air and leaves the suspended silver powder behind. A suitable binder which is soluble in the medium keeps the silver powder particles bound together so that when they are dry, they make a continuous contact. Finding a suitable medium and also preparation of very fine silver powder that can be kept suspended in the medium have been major difficulties encountered. The resistance of the dried silver film is also considerably high.

By the present method, it has been found possible to prepare very fine silver powder and by suspending the same in a suitable medium (medium+binder hereafter called vehicle) it has also been possible to prepare a conducting ink which possesses superior characteristics to those available at present.

The object of the invention is (1) to prepare very fine silver powder suitable for suspending in (2) a proper vehicle for preparing conducting inks.

To these ends, the invention broadly consists in (a) method for the preparation of very fine silver powder by direct reduction of silver oxide or any other suitable compound of silver, (b) design of proper cell arrangement for achieving (a), (c) a method for preparing conducting inks from the silver powder obtained from (a); and (d) suitable vehicles for preparing conducting inks as at (c).

The cell arrangement consists of a silver, stainless steel or silver plated copper container in which the silver oxide or any other suitable compound of silver is kept as a layer at the bottom. The container itself is used as the cathode. The anode assembly consists of a nickel, stainless steel or platinum wire mesh or sheet perforated suitably, disposed over the bed of the silver compound and mounted on a frame in such a way that while kept in an electrolyte of potassium or sodium hydroxide solution of suitable strength will allow uniform current distribution on the cathode surface. The anode is kept in such a way that the cell voltage is as low as possible. When current is passed, the silver compound in contact with the bottom of the container gets converted to silver powder. The powder is discharged from the cell, washed free from the electrolyte and dried in an air oven below 100°C.

The method of making the conducting ink is as follows:

The silver powder is sieved through a 325 mesh sieve to remove any coarse particles than -325 size. A suitable vehicle (medium+binder) is prepared and the silver powder is added to the same in a predetermined ratio and mixed thoroughly by a suitable mixing mechanism. The vehicle is prepared as follows:

An organic solvent like benzene, trichloroethylene, hexachloromethylene, cyclohexanone or any other

suitable solvent is taken and a plastic such as methyl methacrylate, polystyrene, polyvinyl chloride or a polyamide of high molecular weight is added to the same to prepare a solution which when exposed to atmosphere or heated evaporates quickly leaving behind a uniform continuous layer of the plastic material.

The following typical example is given to illustrate the invention:

Example

In an experiment to prepare silver powder, the following conditions were adopted:

1. Material: Silver oxide—50 g.
2. Base: Silver plated copper.
3. Electrolyte: 10 per cent. sodium hydroxide.
4. Current passed: 5 amp.
5. Current efficiency 98 per cent.
6. Conversion efficiency: 100 per cent.
7. Particle size: -325 100 per cent.

Typical formula of the vehicle:

Perspex powder: 2 g.
Trichloroethylene: 100 cc.

Typical formula for the ink:

Vehicle as prepared above: 50 cc.
Silver powder as prepared above: 25 g.
made into a mixture

Application:

The mixture as above is well stirred before applying. The powder as prepared above can also be used for preparing silver incorporated carbon brushes etc.

The following are among the main advantages of the invention:

(a) This method of a making fine silver powder is itself novel and does not appear to have been adopted earlier.

(b) Very fine silver powder suitable for making conducting inks and products such as carbon brushes, etc., can be produced.

(c) Conducting ink possessing superior qualities can be prepared with the silver powder obtained as above.

(d) A suitable vehicle has been worked out for keeping the silver powder in suspension.

(e) The contacts made with this ink have lower resistance than those made with the conducting ink prepared from silver powder produced by conventional processes.

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Dated this 10th day of November, 1965.

COMPLETE SPECIFICATION.

IMPROVEMENTS IN OR RELATING TO THE PRODUCTION OF CONDUCTING INK OR SILVER PAINT.

COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH, RAJF MARG, NEW DELHI-1, INDIA, AN INDIAN REGISTERED BODY INCORPORATED UNDER THE REGISTRATION OF SOCIETIES ACT (ACT XXI OF 1860).

THIS IS AN INVENTION BY HANDADY VENKATAKRISHNA UDUPA, SCIENTIST, AND PENNAGARAM VYASA RAO VASUDEVA RAO, SCIENTIST, BOTH OF THE CENTRAL ELECTROCHEMICAL RESEARCH INSTITUTE, KARAIKUDI-3, INDIA, BOTH INDIAN CITIZENS.

The following specification particularly describes and ascertains the nature of this invention and the manner in which it is to be performed.

This invention relates to the improvement in or relating to the production of conducting ink or silver paint.

In the hitherto known practice of preparing the silver paint or conducting ink by suspending silver powder in a suitable vehicle the main drawback has been that the particle size and shape of silver powder have not been found adequately suitable for making silver paint, as also the vehicles for suspending the same. The dried coating of the silver paint/conducting ink has been found to have resistance which is not always suitable for the purpose used, thereby leaving scope for further improvement, and also the adherence of the same to bases like glass has not been satisfactory. Silver powder has been found to settle down partially in such preparations.

The object of this invention is to obviate these difficulties with a suitable grade of silver powder and a vehicle so that the silver powder can be kept suspended in the vehicle and the silver paint/conducting ink applied over bases like glass will have good adherence as well as low resistance when dry. Settling down of silver powder is largely avoided in these preparations, because of low proportion of coarse particles in it.

According to the present invention, the method of preparation of conducting ink or silver paint, by suspending silver powder in a vehicle is characterised in that the vehicle consists of a solution of a plastic binder such as polythene, polystyrene polyacrylate or polyvinyl in a suitable organic solvent such as benzene, trichloroethylene, cyclohexane, methyl ethyl ketone singly or in suitable mixture of one or more of the solvents.

Silver powder obtained by the reduction of silver compounds, preferably of silver oxide, as described in Indian Patent No. 1,02,677, is used.

The final product of silver paint or conducting ink exhibits a low resistance on drying and good adherence to bases like glass.

Proportion of coarse particles in powder made as per Indian Patent No. 1,02,677 being low, settling down of the silver powder in the paint or ink is considerably reduced. Uniform particle size of the powder is thus advantageous.

A suitable vehicle is prepared as follows : An organic solvent like benzene, trichloroethylene, cyclohexane, methyl ethyl ketone or any other suitable solvent taken singly or as a mixture and a polymer such as polypropylene, polystyrene poly acrylic or poly vinyl plastic or any other plastic is dissolved in the same so that a homogenous solution of the plastic is obtained in the respective solvent. This solution is known as the vehicle. Fine silver powder having suitable particle size distribution and of fineness of the order of -325 mesh size is taken and mixed as a suspension in the vehicle to produce a uniform dispersion of the silver powder in the suspension. This suspension, when applied to a base such as glass or plastic, leaves behind a dry continuous film of silver particles bound together by the plastic material, having good conductivity and adherence. The following are the typical examples :

Example I.

Polymer of the acrylic group such as perspex—2 g.
Trichloroethylene—100 cc.

Silver powder (-325 mesh)—25 g

Resistance of a film

—1 cm × 1 cm × 0.15 cm = 0.10 ohms.

Weight required to cover this area—15 mg.

Adherence to bases such as glass : Good.

Example II.

Polyvinyl chloride—5 g.

Cyclo hexane

trichloroethylene } In suitable

methyl ethyl ketone } porportion—100 cc.

Silver powder (-325 mesh)—25 g.

Resistance of a film—1 cm × 1 cm × 0.15 cm = 0.10 ohms.

The main advantages are :

(a) The silver paint or conducting ink is a homogenous mixture and does not settle down in separate layers of coarse and fine particles.

(b) The covering property of the silver paint/conducting ink is good.

(c) The conducting ink/silver paint exhibits a very low resistance.

(d) The conducting ink/silver paint has a good adherence to bases such as glass or plastic.

(e) The contacts made with this silver paint/conducting ink have lower resistance than those prepared by powder prepared by conventional processes of electrolysis of solutions of silver salts.

Summary.

Conducting ink/silver paint is prepared by suspending silver powder preferably the silver powder prepared by the process of reduction of silver compounds, preferably of silver oxide as described in our co-pending Indian patent No. 1,02,677, in a vehicle prepared by dissolving appropriate plastic material in a suitable solvent such that a homogenous suspension is obtained which, on application to bases such as glass or plastic, leaves on drying in atmosphere or by application of heat a continuous adherent film having low resistance. The suspension does not settle down in layers of coarse and fine particles and if the solvent evaporates, the solid left behind can be made into a suspension by adding fresh solvent without any deterioration in its original properties.

We claim :

1. A method of preparing a conducting ink or silver paint by suspending silver powder in a vehicle which is characterised in that the vehicle consists of a solution of a plastic binder such as polythene, polystyrene polyacrylate or polyvinyl in a suitable organic solvent such as benzene, trichloroethylene, cyclohexane, methyl ethyl ketone singly or in suitable mixture of one or more of the solvents.

2. A method as claimed in Claim 1 wherein is used silver powder obtained by the reduction of silver compounds, preferably of silver oxide, in accordance with our co-pending Indian patent application No. 1,02,677.

3. A method of preparing a conducting ink or silver paint substantially as hereinbefore described.

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Date of this 18th day of August, 1966.