

[54] ELECTROSTATIC TONER COMPOSITION
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[22] Filed: Nov. 1, 1972
[21] Appl. No.: 302,885

[52] U.S. Cl. 252/62.1, 96/1 R
[51] Int. Cl. G03g 9/04
[58] Field of Search 252/62.1; 260/33.6 UA

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[57] ABSTRACT
An electrostatic toner composition capable of providing a visible image in an electrostatic reproduction process comprising an electrically insulating carrier liquid; a pigment or coloring agent, a metallic soap, and a polymeric material which preferably comprises a copolymer of a vinyl ether and maleic anhydride.

7 Claims, No Drawings

ELECTROSTATIC TONER COMPOSITION

The present invention relates to a liquid toner composition for use in electrostatic printing processes; more particularly, the present invention relates to a negatively charged liquid toner system comprising an electrically insulating carrier liquid, a pigment or coloring agent, a metallic soap and a polymer.

In one type of electrostatic process in which a liquid toner is employed, an overall negative electrostatic charge is produced on a photoconductive surface, e.g. zinc oxide dispersed in a binder. This is followed by an imagewise discharge through light exposure so as to leave a negative charge in the unexposed areas. It is at this point that the liquid toner composition is applied. In the case of positively charged toners, the particles of the toner composition comprising the pigment or coloring agent are directed to the negatively charged areas of the latent image. In the case of the electrostatic reproduction process briefly described above, this results in the production of an identical reproduction of the original.

In the case of negatively charged toners, however, the particles of toner, e.g., carbon black or similar pigment or coloring agent are repelled by the negative latent electrostatic image and deposited in the discharge areas, resulting in a reverse image from the original.

In another type of electrostatic process in which a liquid toner is employed, an overall positive electrostatic charge is produced on a photoconductive surface, e.g., zinc oxide dispersed in a binder. This is followed by an imagewise discharge through light exposure so as to leave a positive charge in the unexposed areas. It is at this point that the liquid toner composition is applied.

In the case of negatively charged toners, the particles of the toner composition comprising the pigment or coloring agent are directed to the positively charged areas of the latent image. In the case of the electrostatic reproduction process briefly described above, this results in the production of an identical reproduction of the original.

In the case of positively charged toners, however, the particles of toner, e.g., carbon black or similar pigment or coloring agent, are repelled by the positive latent electrostatic image and deposited in the discharged areas, resulting in a reverse image from the original.

One serious problem in the production of negatively charged toners is the development of a composition or system which will remain in suspension and yield a clear and full high contrast reproduction print.

The above deficiencies and disadvantages of prior art negatively charged liquid toner compositions for electrostatic printing processes have been overcome in accordance with the present invention through the development of a negatively charged liquid toner system which comprises an electrically insulating carrier liquid containing a pigment or coloring agent, a metallic soap, and a polymeric material.

Accordingly, it is a principal object of the present invention to provide such a negatively charged liquid toner system for use in electrostatic printing processes which negatively charged liquid toner eliminates the inherent deficiencies and disadvantages of the prior art.

A further object of the present invention is to provide such a negatively charged liquid toner system comprising an electrically insulating carrier liquid, a pigment or a coloring agent, a metallic soap, and a polymeric material.

A still further object of the present invention is to provide such a negatively charged liquid toner composition for use in electrostatic printing processes comprising an electrically insulating carrier liquid, a pigment, e.g., carbon black, a metallic soap, and a polymeric material said polymeric material comprising a copolymer of a vinyl ether and maleic anhydride.

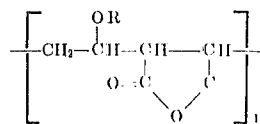
Still further objects and advantages of the novel negative-working liquid toner composition of the present invention will become more apparent from the following more detailed description thereof.

Thus, in accordance with the present invention, the liquid toner composition or system comprises as a base fluid any of the conventional electrically insulating carrier liquids generally employed in liquid developer and toner compositions. Such electrically insulating carrier liquids generally comprise solvent materials having the necessary dielectric constant, e.g. less than 3 and volume resistivity, e.g. in excess of 10^{10} ohm centimeters so as to be acceptably employed in the electrostatic reproduction process. Thus, for example, the electrically insulating carrier liquid of the liquid toner system can comprise various solvents, e.g. cyclohexane, toluene, kerosene and mixtures thereof; various commercial petroleum and hydrocarbon solvents, e.g. Isopar G having a boiling range of from 318°–347°F, a product of Humble Oil & Refining Co.; Cyclosol 43, having a boiling range of 334°–390°F, or Shello-sol 71, having a boiling range of 346°–405°F; both products of the Shell Chemical Co.; or Freons, a trade name for fluorocarbon compounds of E.I. duPont de Nemours & Co., such as Freon TF which has a boiling point of 117.6°F.

The pigment or coloring agent employed in the negatively charged liquid electrostatic toner composition of the present invention can comprise any of those conventionally employed in electrostatic toners. Thus for example, the coloring agent or pigment can comprise carbon black and various forms thereof, e.g. channel black, furnace black, lamp black, and other black materials made by processes well known in the art, colored pigments including the phosphotungstates and phosphomolybdate colors, alkali blue, and many azo pigments as well as nigrosine dyestuffs and triphenyl methane dyes. For purposes of the present invention, however, it is preferable to employ one of the aforementioned carbon black materials which provide an excellent black background in the electrostatic print produced by employing the liquid toner composition of the present invention.

The pigment or coloring agent, e.g. carbon black, is suspended in the carrier liquid containing the metallic soap and in the polymeric material which also acts as a dispersing agent because of the surface active characteristics thereof. Generally, the pigment comprises from about 0.01 to about 10 percent of the toner system or composition. Of course, slightly lesser or greater amounts can be employed when desired for particular purposes.

The polymeric materials comprise copolymers of maleic anhydride and an alkyl vinyl ether and are represented by the following structural formula:



wherein R is an alkyl group of preferably 12 - 40 carbon atoms and n has a value of from about 1,000 to 25,000. The copolymers are produced by reacting maleic anhydride with a compound of the following formula:



wherein R is an alkyl of preferably 12 - 40 carbon atoms, so as to form the linear resinous copolymers of alkyl vinyl ether-maleic anhydride. The copolymers and their methods of preparation are disclosed in U.S. Pat. No. 2,047,398 (Reissue 23,514).

Since these copolymers possess anhydride groupings which are subject to entering into further chemical reaction, i.e. hydrolysis and/or esterification, the nature of the medium to which these copolymers are added as well as the other additives present can give rise to polymeric derivatives of these copolymers e.g., copolymers of alkyl vinyl ether-maleic acid and partial amides and esters of poly(alkyl vinyl ether-maleic acid). Such derivatives are equivalent to copolymers of alkyl vinyl ether-maleic anhydride for the purpose of this invention.

The polymer material is employed only in that amount necessary to provide a stable suspension or dispersion of the toner. Generally, such material is employed in the range of 0.1-1 times the weight of the pigment or coloring agent, and preferably within the range of 0.05 to 0.5 parts by weight of the pigment or coloring agent employed.

The metallic soaps employed in the negatively charged liquid toner composition of the present invention can be such compounds as the metallic salts of fatty acids containing at least 6-7 carbon atoms and including naphthenic acid which is a cyclic aliphatic acid. Among the preferable soaps in the practice of this invention are the salts of naphthenic and octanoic acids including lead, copper, zinc, cobalt, silver, magnesium, manganese, iridium, cadmium, silver, aluminum, potassium, titanium, cerium, zirconium, ferric, sodium, lithium, calcium, and nickel naphthenates and octoates. The terms octanoic acid and octoates as used in this description are meant to be broad enough to respectively cover the eight carbon 2-ethyl hexanoic acid and 2-ethyl hexanoates. Other metallic soaps such as the tallates, soyates, linoleates, resinates, palmitates, stearates and oleates may also be used.

In accordance with the present invention, the manner by which the liquid toner composition is produced is in no way critical, and accordingly, such composition can be prepared by conventional methods well known in the art. In this respect, it has been found that an ultrasonic dispersing unit, 3-roll mill, ball mill, colloid mills, high speed shear mixers, etc., are all applicable in the production of the dispersions employed in the liquid electrostatic toner system of the present invention. Thus for example, it is conventional to produce a concentrate of the toner and subsequently add such concentrate to further insulating carrier liquid to provide the liquid toner composition employed in the electrostatic reproduction process.

The present invention will now be described by reference to the following specific examples. It is to be understood, however, that such examples are presented for purposes of illustration only, and the present inven-

tion is in no way to be deemed as limited thereto. All parts and proportions referred to herein and in the appended claims are by weight unless otherwise indicated.

EXAMPLE I

The following materials were mixed together and irradiated for 20 minutes at 75°F. in a Blackstone 500 watt Ultrasonic Dispersing Unit:

Zirconium Octoate 6%	15 ml.
Isopar G ¹	200 ml.
Witco Continex EPF ²	4 gms.
Gantrez AN 8194 (40% Solution in toluene) ³	1 gram

¹. An aliphatic petroleum solvent having a boiling range of 318°-347°F., made by Humble Oil & Refining Co.

². Carbon Black

³. Poly(n-octadecyl vinyl ether-maleic anhydride) having a specific viscosity of 0.1-0.16 determined in a solution of 1 gm. of the copolymer in 100 ml. of toluene at 25°C.

2.5 cc. of the resulting tiner concentrate or ink was diluted to 0.5 liters with Isopar G. The optical density of this final dispersion was 3.

The toner composition was then employed in a conventional electrostatic copier to produce a reversed electrostatic reproduction when a negative charge is applied to the paper. The toner composition did not exhibit any tendency to settle out or to agglomerate. The print produced by the use of the toner composition of the present inventor was found to give a clear and sharp reproduction of the original having a reverse image, that is, the background areas of the reproduction were black whereas the printed material on the original was white. A copy having no background, good image fill, high black print density, and substantially no tendency to streak was obtained.

EXAMPLE II

Example I is repeated except that the copolymer employed to impart the negative-working characteristics to the liquid toner composition is replaced by a substantially equivalent amount of the following materials:

1. Poly(cetylvinylether-maleic anhydride)
2. Poly(tetradecylvinylether-maleic anhydride)
3. Poly(eicosylvinylether-maleic anhydride)
4. Poly(docosylvinylether-maleic anhydride)

In all cases, when such materials are employed in lieu of the poly(n-octadecylvinylether-maleic anhydride) utilized in Example I substantial equivalent results are obtained and a negativeworking electrostatic toner providing full, clear negative prints is obtained.

EXAMPLE III

Example I is repeated except that 2.5 cc of the resulting toner concentrate was diluted to 0.5 liters with Freon TF. Freon TF (duPont) is trichlorotrifluoroethane having a boiling point of 117.6°F, a dielectric constant of 2.41, and a specific resistivity of $> 2 \times 10^{15}$ ohm-cm.

The toner composition was then employed in a modified electrostatic copier characterized that the photoconductive zinc oxide binder layer was given an overall positive charge instead of an overall negative charge prior to imagewise exposure to produce an identical re-

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production of the original. A copy having no background, good image fill, high black print density, and substantially no tendency to streak was obtained.

While the present invention has been described primarily with respect to the foregoing specific examples, it is to be understood that the present invention is in no way to be deemed as limited thereto, but must be construed broadly as all or any equivalents thereof.

What is claimed is:

1. An electrostatic liquid toner comprising

- a. an electrically insulating carrier liquid comprising a hydrocarbon wherein said carrier liquid has a dielectric constant of less than 3 and a volume resistivity in excess of 10^{10} ohm centimeter;
- b. from about 0.01 to about 10 percent of a pigment;
- c. a metallic soap; and
- d. from 0.1 to 1 part by weight, per part by weight of

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said pigment, of a copolymer of an alkyl vinyl ether and maleic anhydride wherein the alkyl group of said alkyl ether contains 12 to 40 carbon atoms.

2. A toner as defined in claim 1 wherein said pigment is carbon black.

3. A toner as defined in claim 1 wherein said copolymer is poly(n-octadecyl vinyl ether-maleic anhydride).

4. A toner as defined in claim 3 wherein said metallic soap is zirconium octoate.

5. A toner as defined in claim 3 wherein said pigment is carbon black.

6. A toner as defined in claim 3 wherein said carrier liquid is a hydrocarbon.

7. A toner as defined in claim 1 wherein the copolymer is employed in the range of 0.05 to 0.5 parts by weight of the pigment.

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