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(74) Agent: BUSKOP LAW GROUP, PC; 4511 Dacoma Street, Houston, TX 77092 (US).

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(71) Applicant (*for all designated States except US*):  
**ZAP-LOK PIPELINE SYSTEMS, INC.** [US/US];  
22 Hilliard Street, 3rd Floor, Cambridge, MA 02138 (US).

(72) Inventors; and

(75) Inventors/Applicants (*for US only*): **LOGAN, Robert** [US/US]; 12100 West Little York Road, Houston, TX 77041 (US). **BARR, Teresa** [US/US]; 1908 Orchard Road, Hood River, OR 97031 (US).

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**WO 2008/077075 A1**

(54) Title: METHOD FOR MAKING A FAST SETTING EPOXY COMPOSITION

(57) Abstract: A method for joining tubulars that includes preparing a fast-setting epoxy compound, wherein the preparing comprises: mixing a first micro-crystalline filler into an epoxidized glycerol fatty ester, mixing a titanium oxide, a first talc, and a flattening agent into the first mixture, mixing a hydrocarbon resin into the second mixture, and mixing a hardenable epoxide containing liquid to form an epoxy base. A second micro-crystalline filler, a second talc, and a glycidyl ether are mixed into a phthalocyanine, a hybrid reactive polyamide is mixed into this mixture, a modified aliphatic amine is mixed into the resulting mixture, and a methylamine accelerator is added to form an epoxy accelerator. Substantially equal portions of the epoxy base and the epoxy accelerator are mixed to form the fast-setting epoxy compound.

**TITLE: METHOD FOR MAKING A FAST SETTING EPOXY COMPOSITION****CROSS REFERENCE TO RELATED APPLICATIONS**

**[0001]** This application claims the priority benefit of US Patent Application Serial No.11/760,587 filed June 8, 2007, which claims priority to US Patent Applications Serial No.11/612,376, Serial No. 11/612,362, and Serial No. 11/612,349, all filed on December 18, 2006.

**FIELD**

**[0002]** The present embodiments relate to a method for making a fast-setting epoxy compound.

**BACKGROUND**

**[0003]** A need exists for a method for making a fast-setting epoxy compound capable of curing rapidly, in as little as two to twelve minutes, to allow the use of coated materials, such as subsea pipe joints, very soon after application, rather than waiting hours for conventional epoxy to cure.

**[0004]** A further need exists for a method for making a fast-setting epoxy compound capable of lubricating surfaces, such as galvanized steel pipes, to enable connections and interference fits without galling or bending the material, then curing rapidly to avoid separation of connected materials, that is resistant to blushing and bubbling, to allow for even and smooth application to surfaces.

**[0005]** An additional need exists for a method for making a fast-setting epoxy compound that cures rapidly at ambient temperatures and high humidity, and is therefore ideal for marine and subsea use.

**[0006]** A need exists for a method for making a fast-setting epoxy compound that is easy,

efficient, and cost effective.

[0007] The present embodiments meet these needs.

### **DETAILED DESCRIPTION OF THE EMBODIMENTS**

[0008] Before explaining the present embodiments in detail, it is to be understood that the embodiments are not limited to the particular embodiments and that they can be practiced or carried out in various ways.

[0009] One advantage of the present method is that the present method produces a fast-setting epoxy compound that can provide lubrication to surfaces, especially metal surfaces, such as those of galvanized steel pipes. Through suspension of a micro-crystalline filler, such as graphite, in the composition, high lubricity is achieved, while the micro-crystalline filler simultaneously fills porous surfaces such as those of galvanized steel pipes.

[00010] The fast-setting epoxy compound is that the epoxy compound can cure in as little as two to twelve minutes. Conventional epoxies can require multiple hours to fully cure. This fast-curing nature allows connections formed using lubricated surfaces, such as interference fits in metal pipe joints, to be assembled and used rapidly. An interference fit or another connection can become disassembled during use if the lubricating compound used to form the connection has not yet fully cured.

[00011] Conventional epoxies also do not combine a suspended micro-crystalline filler with a fast curing time.

[00012] Still another advantage of the present method is that the present method produces a fast-setting epoxy able to cure at ambient temperatures in high humidity conditions. Conventional epoxies often do not cure, or cure more slowly in the presence of moisture or in very high or low ambient temperatures, while the epoxy produced by the present method is extremely resistant to moisture and blushing. This moisture resistance helps to inhibit bubbling, allowing the fast-setting epoxy compound to be applied smoothly and evenly to surfaces.

- [00013] The present method is advantageous due to its substantially simple nature. Using inexpensive and easily acquired equipment, such as mixers and substantially airtight containers, a combination of uniquely effective ingredients can be efficiently combined, producing a fast-setting epoxy having high lubricity that cures rapidly, leaving previously lubricated equipment ready for use in as two to twelve minutes.
- [00014] At ambient temperature and pressure, a first micro-crystalline filler, such as graphite, can be mixed into an epoxidized glycerol fatty ester, such as epoxidized soybean oil, forming a first base mixture.
- [00015] A titanium oxide, a first talc, which can be a platy talc, and a flatting agent, such as zinc, can then be mixed into the first mixture, forming a second base mixture.
- [00016] A hydrocarbon resin, which can be a polyetheramine, is mixed into the second base mixture, forming a third base mixture.
- [00017] A hardenable epoxide containing liquid is mixed into the third base mixture, forming an epoxy base.
- [00018] If homogeneity is not achieved during the mixing process, heat can be added to the first base mixture, the second base mixture, the third base mixture, or combinations thereof to promote homogeneous mixing. It is contemplated that temperatures of up to 160 degrees Centigrade can be used to promote homogeneous mixing.
- [00019] It is further contemplated that the epoxy base, once produced, can be covered quickly, such as by placing the epoxy base within a substantially airtight container to avoid exposure to air. In an embodiment, the mixing of the epoxy base can be performed in an airtight container to avoid exposure to air. It is also contemplated that the epoxy base can be prepared in a mechanical or automated mixing container, such as a banbury mixer, a high shear mixer, or other mixers. The shear speed or mixing speed can be adjusted as needed to maintain the homogeneity of the epoxy base and to produce small amounts of heat to further promote homogeneity.

- [00020] In an embodiment, the mixing of the epoxy base can be performed using a high speed dispersion machine, under vacuum pressure and sealing.
- [00021] A second micro-crystalline filler, such as fumed silica, a second talc, which can be a platy talc, and a glycidyl ether, such as butyl glycidyl ether are mixed into a phthalocyanine, forming a first accelerator mixture.
- [00022] A hybrid reactive polyamide, such as polychloroprene, is mixed into the first accelerator mixture, forming a second accelerator mixture.
- [00023] A modified aliphatic amine, which can be a modified cycloaliphatic amine, is mixed into the second accelerator mixture, forming a third accelerator mixture.
- [00024] A methylamino-accelerator, such as a combination of triethanolamine (65% to 79.9% by weight), piperazine (20% to 34.99% by weight), and N-aminoethylpiperazine (10% to 19.99% by weight), is mixed into the third accelerator mixture, forming an epoxy accelerator.
- [00025] If homogeneity is not achieved during the mixing process, heat can be added to the first accelerator mixture, the second accelerator mixture, the third accelerator mixture, or combinations thereof to promote homogeneous mixing. It is contemplated that temperatures of up to 160 degrees Centigrade can be used to promote homogeneous mixing.
- [00026] It is further contemplated that the epoxy accelerator, once produced, can be covered quickly to avoid exposure to air, such as by placing the epoxy accelerator into a substantially airtight container. In an embodiment, the epoxy accelerator can be prepared in an airtight container to avoid exposure to air. It is also contemplated that the epoxy accelerator can be prepared in a mechanical or automated mixing container, such as a banbury mixer or a high shear mixer. The shear speed or mixing speed of the mixer can be adjusted as needed to maintain the homogeneity of the epoxy accelerator and to produce small amounts of heat to further promote homogeneity.
- [00027] In an embodiment, the mixing of the epoxy accelerator can be performed using a high speed dispersion machine, under vacuum pressure and sealing.

- [00028] The mixing of the first base mixture, the second base mixture, the third base mixture, the first accelerator mixture, the second accelerator, the third accelerator mixture, and combinations thereof can be performed using constant agitation, such as by using an automated mixer.
- [00029] Substantially equal amounts of the epoxy base and the epoxy accelerator are then mixed, forming a fast-setting epoxy compound. The fast-setting epoxy compound has a high lubricity, sufficient to press two segments of galvanized steel pipe in an interference fit using a hydraulic press without damaging the pipe segments or galling the metal. The fast-setting epoxy compound has a curing time ranging from two minutes or less to twelve minutes, allowing sufficient time for the epoxy compound to be applied to lubricate a surface and used before curing, but enabling the epoxy compound to cure very shortly after use.
- [00030] It is contemplated that the combination of multiple particulates and ground materials throughout the present method can cause agglomerates and lumps to form, which cannot be dispersed through conventional stirring and require use of a dispersion machine or a similar apparatus. Dispersion machines typically include at least one impeller, which not only mixes components, but breaks apart adherent particles using powerful mechanical force. Deagglomerated particles that are dispersed by the impeller often collide with one another at high speeds, further dispersing and deagglomerating any non-homogeneous portions of the mixture.
- [00031] The speed of the one or more impellers can be altered to provide the necessary mechanical force to promote homogeneity in each mixture. Additionally, the speed of the impellers can cause the temperature of a mixture to increase, further promoting homogeneity. It is contemplated that a dispersion machine can produce a homogeneous epoxy base or epoxy accelerator in forty minutes or less.
- [00032] In an embodiment, a sixty cycle dispersion machine having motors which vary from one horsepower to 300 horsepower, with a voltage of 230, 460, or lower can be used. The dispersion machine can have both a low speed and a high speed impeller connected to separate shafts.

- [00033] In this embodiment, the present method can further include adding ingredients to a vacuum tank operably connected to the dispersion machine, evacuating air from the vacuum tank before mixing to prevent entrapment of air, then starting the impellers to promote rapid dispersion with no air entrapment. The low speed impeller is started at its lowest speed, which is gradually increased to increase circulation. The high speed shaft can then be increased to its maximum speed. The speeds of both shafts can then be adjusted to achieve optimal dispersion without creating cavitation. If the temperature approaches or exceeds 160 degrees centigrade, the high speed shaft can be slowed, or the dispersion machine can be stopped until the mixture cools. After the mixture has been dispersed, both shafts can continue operation until a homogeneous state is achieved.
- [00034] The fast-setting epoxy compound is formed by mixing substantially equal amounts of an epoxy base and an epoxy accelerator.
- [00035] The epoxy base contains a hardenable epoxide containing liquid, an epoxidized glycerol fatty ester, a hydrocarbon resin, a titanium dioxide, a first micro-crystalline filler, a first talc, and a flatting agent.
- [00036] The epoxy accelerator contains a glycidyl ether, a hybrid reactive polyamide, a modified aliphatic amine, a dimethylamino-accelerator, a copper phthalocyanine dispersion, a second talc, and a second micro-crystalline filler.
- [00037] The hardenable epoxide containing liquid of the epoxy base is used as an epoxy resin and can be selected from the group commonly known as bisphenol A (epichlorohydrin). The hardenable epoxide containing liquid can include a diglycidyl ether of 1,4-butanediol, a diglycidyl ether of neopentylglycol, a diglycidyl ether of cyclohexane dimethanol, and combinations thereof.
- [00038] It is contemplated that the hardenable epoxide containing liquid can comprise from 50 to 90 percent of the epoxy base by weight, with a preferred weight percent of approximately 60%.
- [00039] The epoxidized glycerol fatty ester is used as a dispersion agent. The epoxidized glycerol fatty ester can be epoxidized soybean oil, epoxidized linseed oil, other

epoxidized oleochemicals, and combinations thereof. A preferred epoxidized glycerol fatty ester is epoxidized soybean oil.

- [00040] Epoxy functionalized oleochemicals are typically used as plasticizer and stabilizer materials, provide excellent heat and light stability, and can be used as pigment dispersion agents, acid/mercaptan scavenging agents, and epoxy reactive diluents.
- [00041] It is contemplated that the epoxidized glycerol fatty ester can comprise from 0.001 to 15 percent of the epoxy base by weight, with a preferred weight percent of approximately 2%.
- [00042] The hydrocarbon resin of the epoxy base can be a polyetheramine, such as alpha-(2-Aminomethylethyl)-omega-(2-aminomethylethoxy)-poly(oxy(methyl-1,2-ethanediyl)), or other polyetheramines, obtained from the Huntsman Corporation under the trade names of Jeffamine D-230, D-400, and D-2000.
- [00043] Polyetheramines have a repeating polyether backbone structure and can also contain repeating oxypropylene units. They are functionally terminated with primary amine groups positioned on secondary carbon atoms.
- [00044] It is contemplated that the hydrocarbon resin can comprise from 0.001 to 15 percent of the epoxy base by weight, with a preferred weight percent of approximately 4%.
- [00045] Titanium oxide, present in the epoxy base, can be a titanium dioxide, which can be obtained from Huntsman Tioxide under the trade names of TR60 and TR93, a titanium trioxide, or combinations thereof. Titanium dioxide can be used both as a dispersion agent and a pigment.
- [00046] It is contemplated that titanium oxide can comprise from 0.01 to 15 percent of the epoxy base by weight, with a preferred weight percent of 4%.
- [00047] The first micro-crystalline filler of the epoxy base can be crystalline silica, sodium silica, crystalline cellulose, amorphous silica, clay, calcium carbonate, graphite, carbon black, powdered copper, powdered aluminum, powdered barite, fumed silica, fused silica, and combinations thereof.



- [00048] A preferable first micro-crystalline filler is graphite, due added lubricity provided by graphite, as well as the ability of graphite to act as a filler for porous surfaces, such as galvanized steel. However, other micro-crystalline fillers can also provide lubricity and fill porous surfaces.
- [00049] It is contemplated that the first micro-crystalline filler can comprise from 0.01 to 25 percent of the epoxy base by weight, with a preferred weight percent of 15%.
- [00050] The first talc, present in the epoxy base, can be a platy talc. Although talc is hydrophobic, it disperses easily in both aqueous and solventborne coatings. Due to its shape, talc has a beneficial effect on rheology and contributes to improved brushability, leveling, and sag resistance. Talc is also generally self-suspending in epoxy vehicles and assists in keeping other pigments suspended. Further, talc is readily redispersed.
- [00051] Talc improves the toughness and durability of the fast-setting epoxy. Talc plates can align with the flow of an epoxy coating to be parallel to the substrate after the epoxy cures, creating a physical barrier to the transmission of moisture, thereby improving water and humidity resistance. The reinforcement provided by platy talc can improve the resistance of the cured epoxy to cracking or rupture due to stretching and flexing, thus better insulating the epoxy from the environment.
- [00052] The barrier properties, alkaline pH, and reinforcement provided by talc contributes to inhibition of corrosion. Micronized talcs, such as 6 Hegman and finer, can be used for titanium dioxide extension, provide good low angle sheen, and good burnishing resistance. Macrocrystalline talcs can be used as a flattening agent.
- [00053] It is contemplated that the first talc can comprise from 0.5 to 25 percent of the epoxy base by weight, with a preferred weight percent of 15%.
- [00054] The flattening agent of the epoxy base can be titanium dioxide, talc, zinc, amorphous silica, and combinations thereof. A preferred flattening agent is zinc, due to zinc's added function as an anti-corrosive agent.

- [00055] It is contemplated that the flattening agent can comprise from 0.001 to 10 percent of the epoxy base by weight, with a preferred weight percent of 1%.
- [00056] The glycidyl ether of the epoxy accelerator can be used as an epoxy reactive diluent. The glycidyl ether can be butyl glycidyl ether, 2-ethylhexyl glycidyl ether, t-butyl glycidyl ether, phenyl glycidyl ether, o-cresyl glycidyl ether, c12-c14 alkyl glycidyl ether, a diglycidyl ether of 1,4-butanediol, and combinations thereof. A preferred glycidyl ether is butyl glycidyl ether.
- [00057] The glycidyl ether is primarily a low molecular weight epoxy resin, which can be used in high concentration with little effect on the properties of the cured epoxy compound. A glycidyl ether can be employed to make selective improvements on certain epoxy properties, such as adhesion, thermal cycling resistance, and impact strength.
- [00058] The glycidyl ether can be used as a "chain stopper" to inhibit crosslinks from forming. The extent to which the properties of the cured epoxy are affected is dependent on the concentration of the glycidyl ether added to the composition. Generally, the addition of glycidyl ether causes a reduction in viscosity and an improvement in impact and thermal shock resistance, with slightly reduced thermal resistance. Thermal expansion of a cured epoxy resin is increased by the presence of a monofunctional glycidyl ether.
- [00059] It is contemplated that the glycidyl ether can comprise from 0.01 to 10 percent of the epoxy accelerator by weight, with a preferred weight percent of 4%.
- [00060] The hybrid reactive polyamide of the epoxy accelerator can be polychloroprene, polyurethane, an acrylic copolymer, a styrene-butadiene copolymer, nylon, rubber, and combinations thereof. A preferred hybrid reactive polyamide can be polychloroprene, available from Dupont-Dow elastomers under the trade name Neoprene AD.
- [00061] It is contemplated that the hybrid reactive polyamide can comprise from 0.01 to 20 percent of the epoxy accelerator by weight, with a preferred weight percent of 10%.

- [00062] The modified aliphatic amine of the epoxy accelerator can be used as an epoxy curing agent. Modified aliphatic amines are available from Aditya Birla chemicals under the trade name TH7905. Modified cycloaliphatic amines are preferred due to exhibiting a rapid cure time at room temperature in the presence of humidity.
- [00063] Modified aliphatic amines can be used to cure the fast-setting epoxy compound by reacting with epoxide groups or promoting self-polymerization of the epoxy by catalytic action.
- [00064] Modified aliphatic amines are room temperature reacting curing agents derived from aliphatic amines that have been modified to reduce their vapor-pressure and thereby reduce their corrosiveness. The modifications optimize the hardness, reactivity, handling time, and the carbonation resistance of the aliphatic amines.
- [00065] Modified aliphatic amines exhibit high reactivity, low viscosity, and excellent resistance to organic acids and solvents with good adhesion to concrete and steel. Modified aliphatic amines can be cured at low temperature and in the presence of high humidity.
- [00066] It is contemplated that the modified aliphatic amine can comprise from 20 to 50 percent of the epoxy accelerator by weight, with a preferred weight percent of 35%.
- [00067] The methylamino accelerator of the epoxy accelerator can be a dimethylamino accelerator, a trimethylamino accelerator, or combinations thereof. The methylamino accelerator can be dimethylaminoethanol, dimethylethanolamine, n,n,-dimethylaminoethanol, 2-(dimethylamino)ethanol, N,N,-dimethyl-2-hydroxyethylamine, triethanolamine, piperazine, n-aminoethylpiperazine, and combinations thereof.
- [00068] A preferred accelerator can be a combination of triethanolamine (65% to 79.9% by weight), piperazine (20% to 34.99% by weight), and N-aminoethylpiperazine (10% to 19.99% by weight).

- [00069] It is contemplated that the methylamino-accelerator can comprise from 0.01 to 20 percent of the epoxy accelerator by weight, with a preferred weight percent of 10%.
- [00070] The phthalocyanine present in the epoxy accelerator can be a metal phthalocyanine, such as copper phthalocyanine, gold phthalocyanine, titanium phthalocyanine, cobalt phthalocyanine, and combinations thereof. Copper phthalocyanine is a phthalo blue dispersion, which can be used as a pigment. The use of copper phthalo cyanine is advantageous because it does not cause flocculation, which is the aggregation or grouping together of pigment particles, causing a reduction in pigment tinting power. Copper phthalo cyanine exhibits a clean tint and good light qualities.
- [00071] The second talc, present in the epoxy accelerator, can be a platy talc, a micronized talc, such as 6 Hegman or finer, a macrocrystalline talc, or another talc. The second talc can be the same type of talc as the first talc, or a different kind of talc.
- [00072] It is contemplated that the second talc can comprise from 10 to 30 percent of the epoxy accelerator by weight, with a preferred weight percent of 20%.
- [00073] The second micro-crystalline filler of the epoxy accelerator can be crystalline silica, sodium silica, crystalline cellulose, amorphous silica, clay, calcium carbonate, graphite, carbon black, powdered copper, powdered aluminum, powdered barite, fumed silica, fused silica, and combinations thereof.
- [00074] A preferred second micro-crystalline filler can be fumed silica. Fumed silica is a thixotropic additive which, when dispersed, increases viscosity, imparts thixotropic behavior, and adds anti-sag and anti-setting characteristics. Fumed silica can be obtained from the Degussas Corporation under the trade name Aerosil 300.
- [00075] Synthetic fused silica is an alternative preferred second micro-crystalline filler. Synthetic fused silica is made from a silica-rich chemical precursor, resulting in a transparent amorphous solid with an ultra-high purity and excellent optical transmission.

[00076] It is contemplated that the second micro-crystalline filler can comprise from 5 to 30 percent of the epoxy accelerator by weight, with a preferred weight percent of 20%.

[00077] While these embodiments have been described with emphasis on the embodiments, it should be understood that within the scope of the appended claims, the embodiments might be practiced other than as specifically described herein.

## CLAIMS

What is claimed is:

1. A method for joining tubulars comprising: preparing a lubricating fast-setting epoxy composition, applying the lubricating fast-setting epoxy composition to at least a first end of a tubular, and joining the first end of the tubular with an end of another tubular; wherein the preparing comprises:
  - mixing under vacuum dispersion a first micro-crystalline filler, a first talc, and a titanium oxide into a hardenable epoxide containing liquid, forming an epoxy base;
  - mixing under vacuum dispersion a second micro-crystalline filler, a second talc, and a hydrocarbon resin, forming an accelerator mixture;
  - mixing under vacuum dispersion a methylamino accelerator into the accelerator mixture, forming an epoxy accelerator;
  - mixing substantially equal amounts of the epoxy base with the epoxy accelerator at an ambient temperature, forming the lubricating fast-setting epoxy composition having a high lubricity and a curing time ranging from two minutes to twelve minutes at an ambient temperature.
2. The method of claim 1, further comprising mixing under vacuum dispersion a flattening agent into the hardenable epoxide containing liquid.
3. The method of claim 1, further comprising mixing under vacuum dispersion a modified aliphatic amine, an acrylic resin, a coloring agent, or combinations thereof into the accelerator mixture.
4. The method of claim 1, wherein the mixing to form the epoxy base, the mixing to form the accelerator mixture, the mixing to form the epoxy accelerator, the mixing to form the lubricating fast-setting epoxy composition, or combinations thereof is done using a banbury mixer, a high shear mixer, a dispersion machine, a stone mill, a ball mill, a roller mill, a vacuum tank operably in communication with a dispersion machine having at least one impeller, or combinations thereof.

5. The method of claim 1, wherein the mixing to form the epoxy base, the mixing to form the accelerator mixture, the mixing to form the epoxy accelerator, the mixing to form the lubricating fast-setting epoxy composition, or combinations thereof is performed using constant agitation, variable agitation, intermittent agitation, gradually increasing agitation, or combinations thereof.
6. The method of claim 1, further comprising heating the epoxy base, the accelerator mixture, the epoxy accelerator, or combinations thereof during mixing to a temperature ranging from 10 degrees centigrade to 160 degrees centigrade to promote homogeneity.
7. The method of claim 1, further comprising slowing the mixing to prevent the temperature of the epoxy base, the accelerator mixture, the epoxy accelerator, or combinations thereof from exceeding 160 degrees centigrade.
8. The method of claim 1, wherein the first micro-crystalline filler is selected from the group consisting of: crystalline silica, sodium silica, crystalline cellulose, amorphous silica, clay, calcium carbonate, graphite, carbon black, powdered copper, powdered aluminum, powdered barite, fumed silica, fused silica, and combinations thereof.
9. The method of claim 1, wherein the first talc is a platy talc.
10. The method of claim 1, wherein the hardenable epoxide containing liquid is selected from the group consisting of: an epichlorohydrin, a diglycidyl ether of 1,4-butanediol, a diglycidyl ether of neopentylglycol, a diglycidyl ether of cyclohexane dimethanol, and combinations thereof.
11. The method of claim 1, wherein the titanium oxide is titanium dioxide, titanium trioxide, or combinations thereof.
12. The method of claim 2, wherein the flattening agent is selected from the group consisting of: titanium dioxide, magnesium silica, zinc, amorphous silica, and combinations thereof.
13. The method of claim 1, wherein the second micro-crystalline filler is selected from the group consisting of: crystalline silica, sodium silica, crystalline cellulose,

amorphous silica, clay, calcium carbonate, graphite, carbon black, powdered copper, powdered aluminum, powdered barite, fumed silica, fused silica, and combinations thereof.

14. The method of claim 1, wherein the second talc is a platy talc.
15. The method of claim 1, wherein the methylamino accelerator is a dimethylamino accelerator, a trimethyl amino accelerator, or combinations thereof.
16. The method of claim 1, wherein the methylamino-accelerator is selected from the group consisting of: dimethylaminoethanol, dimethylethanolamine, n,n,-dimethylamino ethanol, 2-(dimethylamino)ethanol, N,N,-dimethyl-2-hydroxyethylamine, 2,4,6 Tri(dimethylaminomethyl) phenol, and combinations thereof.
17. The method of claim 1, wherein the hydrocarbon resin is a polyalphanethylstyrene.
18. The method of claim 3, wherein the modified aliphatic amine is an aliphatic polyaminoamide.
19. The method of claim 18, wherein the aliphatic polyaminoamide is a cycloaliphatic amine.
20. The method of claim 3, wherein the acrylic resin is a thermoplastic.
21. The method of claim 3, wherein the coloring agent is a phthalocyanine.
22. The method of claim 21, wherein the phthalocyanine is a metal phthalocyanine.
23. The method of claim 22, wherein the metal phthalocyanine is copper phthalocyanine, gold phthalocyanine, titanium phthalocyanine, cobalt phthalocyanine, or combinations thereof.
24. A lubricating fast-setting epoxy composition made by a process comprising:

forming an epoxy base by mixing under vacuum dispersion:



from 0.01 weight percent to 35 weight percent of a first micro-crystalline filler;

from 0.50 weight percent to 25 weight percent of a first talc;

from 0.01 weight percent to 15 weight percent of a titanium oxide; and

from 50 weight percent to 90 weight percent of a hardenable epoxide containing liquid;

controlling the mixing under vacuum dispersion to maintain a temperature for the epoxy base below 160 degrees centigrade;

forming an accelerator mixture by mixing under vacuum dispersion:

a second micro-crystalline filler; a second talc; and a hydrocarbon resin;

controlling the mixing under vacuum dispersion to maintain a temperature for the accelerator mixture below 160 degrees centigrade;

mixing under vacuum dispersion into the accelerator a methylamino accelerator, wherein the epoxy accelerator comprises: from 20 weight percent to 50 weight percent of the second micro-crystalline filler; from 10 weight percent to 30 weight percent of the second talc; from 0.01 weight percent to 60 weight percent of the methylamino accelerator; and from 0.001 weight percent to 15 weight percent of a hydrocarbon resin;

controlling the mixing under vacuum dispersion to maintain a temperature for the epoxy accelerator below 160 degrees centigrade; and

mixing substantially equal amounts of the epoxy base with the epoxy accelerator at an ambient temperature, wherein the mixing is controlled to maintain a temperature for the mixture of the epoxy base and epoxy accelerator below 160 degrees centigrade, forming a lubricating fast-setting epoxy composition having a high lubricity and a curing time ranging from two minutes to twelve minutes at an ambient temperature.

25. A lubricating fast-setting epoxy composition comprising:

an epoxy base comprising:

from 0.01 weight percent to 35 weight percent of a first micro-crystalline filler;

from 0.5 weight percent to 25 weight percent of a first talc,

from 50 weight percent to 90 weight percent of a hardenable epoxide containing liquid; and

from 0.01 to 15 percent of a titanium oxide; and

an epoxy accelerator comprising:

from 20 weight percent to 50 weight percent of a second micro-crystalline filler;

from 10 weight percent to 30 weight percent of a second talc;

from 0.01 weight percent to 60 weight percent of a methylamino accelerator; and

from 0.001 weight percent to 15 weight percent of a hydrocarbon resin, wherein the lubricating fast-setting epoxy composition cures in a time from 2 minutes to 12 minutes at an ambient temperature.

**INTERNATIONAL SEARCH REPORT**

International application No.

PCT/US 07/87995

**A. CLASSIFICATION OF SUBJECT MATTER**

IPC(8) - C09J 163/00 (2008.01)

USPC - 156/330

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

USPC - 156/330

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

USPC - 156/330, \$

Search Terms Below

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

PubWEST (USPT, PGPB, EPAB, JPAB); google.com

Search Terms Used: epoxy, vacuum mixing, fast setting, time, accelerator, vacuum dispersion, titanium oxide, dioxide, trioxide, pipe, pipes, tube, tubular, talc, methylamine, amine, joining, joined, join

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant-to claim No.
Y	US 3,954,898 A (Hirota et al.) 04 May 1976 (04.05.1976) entire document, especially Abstract; col. 1, ln. 33-37; col. 3, ln. 1-12; col. 3, ln. 45-67; col. 5, ln. 14-27; col. 6, ln. 1-7; col. 6, ln. 59-66; col. 7, ln. 1-7; co. 7, ln. 38-45	1-25
Y	US 4,426,243 A (Briggs) 17 January 1984 (17.01.1984) entire document, especially Abstract; col. 2, ln. 55-63; col. 4, ln. 54-61; col. 5, ln. 8-13	1-25
Y	US 5,192,816 A (Iikuza) 09 May 1993 (09.05.1993) entire document, especially Abstract; col. 12, ln. 65-67	1-24
A	US 5,929,241 (Lau et al.) 27 July 1999 (27.07.1999) entire document, especially Abstract	1-25

Further documents are listed in the continuation of Box C.

\* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"E" earlier application or patent but published on or after the international filing date	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search 18 March 2008 (18.03.2008)	Date of mailing of the international search report <b>18 APR 2008</b>
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