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(54) **Tribo-electrical coating of bodies of low electrical conductivity.**

(57) Earthed bodies, such as foundry sand moulds and cores, having an electrical resistivity of more than 10^9 ohm. cm. at 10 kv, have an electrically conductive liquid applied to them prior to being coated by bringing tribo-electrically charged particles of coating material having an electrical resistivity of at least 10^{10} ohm.cm. at 10 kv into contact with them. The electrically conductive liquid may be water or an aliphatic or aromatic alcohol, carboxylic acid, sulphonic acid or amine, and preferably contains an electrolyte such as a salt containing chloride, nitrate, sulphate, carbonate or phosphate anions and sodium, potassium, lithium, ammonium, hydrazinium or guadinium cations.

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This invention relates to a method of tribo-electrically coating bodies of low electrical conductivity.

European Patent No. 0024067 describes a method of coating an expendable substrate which in use contacts molten metal, and which has an electrical resistivity of less than 10^9 ohm.cm. at 10 kv, comprising earthing the substrate and bringing charged particles of refractory material coated with an organic binder and having an electrical resistivity of least 10^{10} ohm.cm. at 10 kv into contact with the earthed substrate so as to coat the substrate with a coherent layer of particles.

The method is particularly applicable to the coating of foundry sand moulds or cores but may also be used for other applications for example the coating of an expendable lining in a molten metal container such as a ladle or a tundish.

The suitability of the process to the application of a coating to a foundry sand mould or core is dependent on the type of binder which is used to bond the sand, because the binder determines the electrical resistivity of the mould or core. Sands bonded with sodium silicate or an acid catalysed resol phenol-formaldehyde resin can be used in the process because they have an electrical resistivity of less than 10^9 ohm.cm. at 10 kv but sands bonded with linseed oil and with certain other types of resin have an electrical resistivity of more than 10^9 ohm.cm. at 10 kv and cannot be used in the process.

It has been found that such sands can be coated with a refractory coating of tribo-electrically charged particles if the sand is first coated with an electrically conductive liquid.

According to the invention there is provided a method of coating a body in which the body is earthed and coated by bringing tribo-electrically charged particles of coating material having an electrical resistivity of at least 10^{10} ohm.cm. at 10 kv into contact with the earthed body characterised in that the body has an electrical resistivity of more than 10^9 ohm.cm. at 10 kv, and prior to being coated with the tribo-electrically charged particles an electrically conductive liquid is applied to the body.

In a preferred embodiment the body is a foundry sand mould or core of the required electrical resistivity made from a composition comprising a particulate refractory material and a binder. The particulate refractory material may be for example silica, chamotte, zircon, chromite or magnesite, and the binder may be one or more resins such as a phenol-formaldehyde resin which in the cured state is substantially water free, a urea-formaldehyde resin, a melamine-formaldehyde resin, an unsaturated polyester resin, an epoxide resin, a polyurethane resin or a furfuryl alcohol resin.

The electrically conductive liquid may be water, an aliphatic or aromatic alcohol, an aliphatic or aromatic carboxylic acid, an aliphatic or aromatic sulphonic acid or an aliphatic or aromatic amine.

It is important that the electrically conductive liquid does not penetrate too deeply into the mould or core otherwise the strength of the mould or core may be seriously reduced. It is also important that the liquid forms a homogeneous layer on the mould or core in order to achieve a uniform coating of the tribo-electrically charged particles.

It is therefore preferred that the liquid contains a rheological additive to increase the viscosity of the liquid and prevent it penetrating too deeply into the mould or core and a surfactant to promote wetting and even coating of the mould or core.

Suitable rheological additives include cellulose derivatives, starch and guar gum and its derivatives and suitable surfactants include anionic and non-ionic surfactants.

In order to increase the electrical conductivity of the liquid it is preferable to add to the liquid an electrolyte. Suitable electrolytes are for example salts containing chloride, nitrate, sulphate, carbonate or phosphate anions and sodium, potassium, lithium, ammonium, hydrazinium or guadinium cations.

When the additives are used the liquid will usually contain 0.05 - 2% by weight of rheological additive, 0.1 - 2% by weight of surfactant and 0.05 - 5% by weight electrolyte, based on the total weight of the liquid and additives.

If desired the liquid coating may also contain a dye in order to make it easier to determine whether a mould or core has been adequately coated.

The liquid coating may be applied to the mould or core by a variety of methods such as spraying, brushing, dipping or over pouring.

The particles which are applied to the liquid coated body tribo-electrically are preferably of refractory material such as silica, zircon, alumina, bauxite, pyrophyllite, graphite, coke, chamotte, talc or magnesite or mixtures thereof, coated with an organic binder such as phenol-formaldehyde, urea-formaldehyde, melamine formaldehyde or epoxide resin. The particles will usually be coated with 1 - 5% by weight of resin based on the weight of the particles.

Substantially all the particles of refractory material should be wholly coated with the binder and the coated particles should preferably have an electrical resistivity of at least 10^{12} ohm.cm. at 10 kv.

The following example will serve to illustrate the invention:-

A sand core bonded with an amine cured phenolic resin/disocyanate binder and having an electrical

resistivity of in excess of 10^9 ohm.cm. at 10 kv, for use in the production of an automotive casting was sprayed with a solution of the following composition by weight:-

sodium chloride	2.89%
carboxy methyl cellulose	0.48%
blue dye	0.29%
isopropanol	9.63%
water	86.71%

so as to produce a coating layer over the whole core.

The liquid coated core was then tribo-electrostatically sprayed with epoxy resin coated zircon particles using a tribo-charging spray gun so that the whole surface of the core was coated with zircon. The coated core was then dried in an oven at 200 ° C for 1 hour to cure the coating.

Claims

1. A method of coating a body in which the body is earthed and coated by bringing tribo-electrically charged particles of coating material having an electrical resistivity of at least 10^{10} ohm.cm. at 10 kv into contact with the earthed body characterised in that the body has an electrical resistivity of more than 10^9 ohm.cm. at 10 kv, and prior to being coated with the tribo-electrically charged particles an electrically conductive liquid is applied to the body.

2. A method of coating a body according to Claim 1 characterised in that the body is a foundry sand mould or core made from a composition comprising a particulate refractory material and a binder.

3. A method of coating a body according to Claim 2 characterised in that the particulate material is silica, chamotte, zircon, chromite or magnesite.

4. A method of coating a body according to Claim 2 characterised in that the binder is a phenol-formaldehyde resin which in the cured state is substantially water free, a urea-formaldehyde resin, a melamine-formaldehyde resin, an unsaturated polyester resin, an epoxide resin, a polyurethane resin or a furfuryl alcohol resin.

5. A method of coating a body according to any one of Claims 1 to 4 characterised in that the electrically conductive liquid is water, an aliphatic or aromatic alcohol, an aliphatic or aromatic carboxylic acid, an aliphatic or aromatic sulphonic acid or an aliphatic or aromatic amine.

6. A method of coating a body according to any one of Claims 1 to 5 characterised in that the electrically conductive liquid contains a rheological additive.

7. A method of coating a body according to Claim 6 characterised in that the electrically conductive liquid contains 0.05 - 2% by weight of the rheological additive.

8. A method of coating a body according to Claim 6 or Claim 7 characterised in that the rheological additive is a cellulose derivative, starch, guar gum or a guar gum derivative.

9. A method of coating a body according to any one of Claims 1 to 8 characterised in that the electrically conductive liquid contains a surfactant.

10. A method of coating a body according to Claim 9 characterised in that the electrically conductive liquid contains 0.1 - 2 % by weight of surfactant.

11. A method of coating a body according to Claim 9 or Claim 10 characterised in that the surfactant is anionic or non-ionic.

12. A method of coating a body according to any one of Claims 1 to 11 characterised in that the electrically conductive liquids contains an electrolyte.

13. A method of coating a body according to Claim 12 characterised in that the electrically conductive liquid contains 0.05 to 5% by weight of electrolyte.

14. A method of coating a body according to Claim 12 or Claim 13 characterised in that the electrolyte is a salt containing chloride, nitrate, sulphate, carbonate or phosphate anions and sodium, potassium, lithium, ammonium, hydrazinium or guadinium cations.

15. A method of coating a body according to any one of Claims 1 to 14 characterised in that the electrically conductive liquid is applied by spraying, brushing, dipping or overpouring.

16. A method of coating a body according to any one of Claims 1 to 15 characterised in that the tribo-electrically charged particles are of refractory material coated with an organic binder.

17. A method of coating a body according to any one of Claims 1 to 16 characterised in that the tribo-electrically charged particles have an electrical resistivity of at least 10^{12} ohm.cm. at 10 kv.

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 92 30 2278

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X Y	US-A-3 996 410 (GRUETZMAN) 7 December 1976 * abstract *	1 2-17	B22C3/00 B05B5/047 B05D1/06
Y,D	WO-A-8 001 654 (FOSECO INTERNATIONAL LIMITED) 21 August 1980 * claims *	2-17	B22C23/02 B22D41/02
A	US-A-2 992 139 (ARHART) 11 July 1961 * column 1, line 27 - column 2, line 15 *	1-17	
A	US-A-4 013 804 (GRUETZMAN) 22 March 1977 * column 11, line 19 - line 56 *	1-17	
A	DE-A-2 753 104 (HEINRICH WAGNER MASCHINENFABRIK) 9 November 1978 * column 3, line 14 - column 4, line 33 * * figure *	1-17	
A	DE-A-2 450 260 (JENAER GLASWERK SCHOTT & GEN.) 6 May 1976 * page 2, line 1 - line 25 * * page 3, line 22 - page 5, line 3 *	1-17	TECHNICAL FIELDS SEARCHED (Int. Cl.5)
A	IBM TECHNICAL DISCLOSURE BULLETIN vol. 15, no. 9, February 1973, pages 2726 - 2727; ELLIS ET AL: 'Selective Electrostatic Coating of Nonconductive Substrates'	1,9-11	B22C B05B B05D B22D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	03 AUGUST 1992	RIBA VILANOVA M.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

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