PATENT SPECIFICATION

505,710

Application Date: April 4, 1938. No. 10241/38.

Complete Specification Accepted: May 16, 1939.

COMPLETE SPECIFICATION

Improvements in and connected with Silicated Compositions

I, VICTOR CHARLES JOHN NIGHTINGALL, a Subject of the King of Great Britain, of 79, Mount Street, Heidelberg, in the State of Victoria, Commonwealth of Australia, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to improvements in and connected with silicated compositions and refers especially, but is not limited, to the formation of protective coatings from materials containing soluble silicates and finely divided zinc or alloy containing zinc such coatings being applicable to the surfaces of metal, glass, concrete and other materials.

The invention also comprehends the formation of articles of manufacture from materials of the same general character.

It has previously been proposed to employ mixtures containing soluble silicates and finely divided metals as cements, paints and the like.

It has also been proposed to form protective and like coatings on metals by applying thereto a mixture containing water glass and finely divided aluminium or magnesium or alloys thereof, such coatings being alloyed to the base metal by a subsequent heat treatment.

Now, the object of the present invention is to provide improvements in the formation of coatings and moulded bodies from mixtures containing silicates and finely divided zinc or alloy containing zinc.

The invention broadly resides in the method of production of a silicated composition including the steps of forming a mixture comprising finely divided zinc or alloy containing zinc and an aqueous solution of a silicate and converting the mixture to a substantially insoluble condition.

For this purpose the mixture may be heated in an atmosphere of CO_2 in order to bring about the conversion thereof to a substantially insoluble condition.

It is preferred, however, to incorporate a bicarbonate in the mixture whereby CO_2 will be released when heat is applied thereto.

A salient form of the invention resides in a coating material containing zinc dust, sodium silicate and sodium bicarbonate.

For some purposes hereinafter referred to the coating material may advantageously contain basic oxides or hydroxides (e.g. magnesium oxide and calcium hydroxide) and/or zinc oxide in conjunction with a bicarbonate according to the nature of the surface to be treated.

Another feature of the invention, which is particularly applicable to the formation of firmly adherent coatings on metals and glass, resides in the provision, in the coating mixture, of a borate, such as borax.

A modification of the invention resides in incorporating a finely divided reagent, such as graphite, in the coating to impart antifriction properties thereto.

The ingredients may be mixed together and then applied to a surface as by spraying, brushing or dipping, or alternatively, the metallic powder and an aqueous solution of silicate and bicarbonate may be applied separately to the surface or may be admixed in a spray immediately prior to their being applied to the surface.

The coating so applied is allowed to set and, except in the circumstances hereinafter described, is then heated to a temperature usually above 200° F., for a sufficient time to convert the coating to substantially insoluble condition.

According to modified forms of the invention which hereinafter are fully described, a substantially insoluble coating is produced without the necessity of applying heat to the coating material.

Moulded articles may be formed from mixtures comprising the materials above referred to, such articles being subsequently rendered substantially insoluble as above indicated and hereinafter described.

Other objects and features of the invention are set forth in the ensuing detailed description of practical applications thereof.

[Price 1/-]

EXAMPLE 1.

A vehicle suitable for applying coatings to iron, steel and glass was prepared from the following ingredients:—

100 parts by vol. of aqueous solution of sodium silicate (water glass) about 1.4 specific gravity.

12 parts by vol. of an aqueous solution of sodium bicarbonate which solution is substantially saturated at 60° F.

6 parts by vol. of an aqueous solution of borax, said solution being substantially saturated at 60° F.

These ingredients were intimately mixed at normal temperatures and in the order stated.

This liquid vehicle was then intimately mixed with an equal part by weight of commercial zinc dust and the mixture was then immediately brushed (in a like manner to paint) onto a lightly oxidised steel sheet, a specimen of wood and a specimen of glass.

The surfaces of the test pieces were previously treated to remove any oil or grease therefrom as it has been found that the presence of such substances is detrimental to the formation of satisfactory coatings.

Plaster of paris had previously been rubbed into the surface of the wood specimen to fill the pores thereof and provide a foundation for the coating.

The coated specimens were then allowed to stand at normal temperature for a period of six hours during which time the coatings became set.

The coated specimens were then subjected to heat treatment in an oven. In the case of the sheet of steel, the temperature of the oven was 450° F. and the duration of the treatment was 2 hours.

The specimen of wood was subjected to a temperature of 180° F. for a period of 2 hours whilst the specimen of glass was subjected to a temperature of almost 700° F., for a period of 2 hours.

At the conclusion of the respective heat treatments the specimens were allowed to cool and the coatings thereon were then washed with warm water to remove soluble alkali therefrom.

It was found that in each case the finished coating was insoluble or practically insoluble in both cold and boiling water and that the coatings were firmly adherent and resistant to moderate heat. The coatings were somewhat different in character according to the temperatures at which the heat treatments were effected and it appeared that higher temperatures tended to the formation of harder and firmer coatings than lower temperatures.

In the case of the steel sheet it was found by a subsequent test that the coating protected the underlying surface of the sheet against corrosion.

It may here be pointed out that various experiments have demonstrated that, in applying coatings to iron and steel surfaces, in accordance with the present invention, it is advantageous for such surfaces to be lightly oxidised or rusted, as in such cases a more firmly adherent coating is then formed thereon. If, however, a surface is heavily rusted, any loose scale should be removed prior to the application of the coating.

Experiments made with different varieties of zinc dust suggest that it is advantageous to expose some varieties to the atmosphere before mixing with the liquid vehicle.

It should also be pointed out that, when zinc dust is mixed with the liquid vehicle as above described, a comparatively slow reaction takes place with evolution of hydrogen and it is accordingly necessary to use the mixture fairly promptly. This reaction may be retarded to some extent by incorporating in the mixture a small proportion of tung oil or a colloidal substance or a proportion of powdered zinc oxide.

In lieu of brushing the mixture onto the surfaces to be treated, it may be applied thereto in any other desired manner, as e.g. by spraying or dipping.

Coatings produced as above described are suitable for a variety of uses including the protection of iron and steel sheets, ships' bottoms and iron and steel structures which are subject to corrosive influences. In the case of structures or parts which become heated to a sufficient temperature during normal use (e.g. boilers, stoves and exhaust manifolds of internal combustion engines), the aforesaid heat treatment may, if desired, be effected by such normal use.

The finished coatings, when produced as above described, are dull in appearance, but a metallic lustre may be imparted thereto by rubbing same as with a wire brush at the conclusion of the heat treatment and before the coatings are allowed to become cool.

The proportion of zinc dust in the mixture may be varied considerably according to the nature of the coating desired. For general purposes, however, it is preferred to use about one to two parts by weight of zinc dust to one part of the liquid vehicle.

In lieu of or in addition to zinc dust, I may employ finely divided alloys of zinc e.g. magnesium-zinc, aluminium-zinc, calcium zinc and cadmium zinc.

In lieu of employing sodium silicate as in the above-described example, I may use potassium silicate or mixtures thereof or alternatively other soluble silicates such as aluminium silicates and calcium silicates, may also be used though the latter are not considered to be as satisfactory. It should also be understood that sodium silicate of different specific gravities may be used and that the proportion of sodium silicate to sodium bicarbonate may be varied.

Furthermore, potassium bicarbonate or other bicarbonate may be substituted for sodium bicarbonate. It is preferred, however, to employ sodium bicarbonate or potassium bicarbonate.

The above-mentioned composition and method may also be employed for coating concrete, plaster ceramic and other materials and compositions. However, in the formation of coatings on concrete, plaster and other like materials having a silica-lime base, the omission of borax from the coating mixture does not materially affect the satisfactory character of the coating.

Furthermore, even in the treatment of iron, steel and glass surfaces, it is not essential to include borax in the coating mixture, though its presence, under such circumstances, assists the formation of a more resistant and more tenacious coating. If desired, borax may be formed in situ by adding a proportion of boric acid in the aforesaid mixture in lieu of borax.

If the bicarbonate is omitted from the mixture described in the foregoing example, coatings formed with the mixture may be converted to a substantially insoluble condition by carrying out the heat treatment in an atmosphere of CO_2. The coatings so produced, however, are less firmly adherent and less homogeneous than those produced from a mixture containing bicarbonate.

Coatings suitable for some purposes may also be formed by using only a small proportion of finely divided zinc or zinc alloy in conjunction with finely divided metal oxides (particularly zinc oxide and/or manganese dioxide) and/or metallic carbonates.

EXAMPLE 2.

A liquid vehicle was prepared from the ingredients and in the manner described in Example 1. A film of the liquid vehicle was then sprayed onto the surface of a lightly oxidised steel sheet which was free of oil and grease. A coating of zinc dust was then sprayed onto the film of the liquid vehicle whereby a mixture thereof was formed in situ and the coated sheet was allowed to stand for a period of several hours until the coating had set.

The coated sheet was then heated in an oven for a period of 3 hours at a temperature of 450° F. and after removal from the oven it was allowed to cool and was then washed with warm water.

The coating produced in this way was generally similar in appearance and properties to the coating formed on the steel sheet referred to in Example 1.

This procedure has the advantage that it avoids the mixing of the zinc dust and the liquid vehicle before same are applied to the surface to be coated.

Alternatively the zinc dust and the liquid vehicle may be simultaneously applied to the surface preferably by means of a spraying device in which separate streams of the vehicle and of the zinc dust are intimately mixed.

In general it may be stated that different ingredients of the coating mixtures described herein may be separately applied to a surface to form the requisite mixture in situ or said ingredients may be admixed in a spray immediately prior to their application to the surface.

EXAMPLE 3.

To a liquid vehicle prepared in the manner and from the ingredients described in Example 1, there was added about 10% by weight of a mixture of approximately equal parts of magnesium oxide and calcium hydroxide.

This vehicle was used as described in Example 1—that is to say, it was intimately mixed with an equal part by weight of zinc dust and was then brushed onto the surface of a steel sheet.

The coated sheet was allowed to stand at normal temperature for a period of 12 hrs. at the conclusion of which it was found that the coating had been converted to the substantially insoluble condition. The inclusion in the mixture of the magnesium oxide and calcium hydroxide had obviated the formation of a significant proportion of soluble alkali in the coating and it was therefore unnecessary to wash it as in the foregoing examples.

This composition is therefore particularly useful in circumstances where it is inconvenient or impracticable to subject the coated article to a heat treatment.

Furthermore, owing to the absence of substantial amounts of soluble alkali in the coating, it is particularly suitable as a base for a paint or other finish coat.

Whilst as above stated it is possible to dispense with the heat treatment when

magnesium oxide and calcium hydroxide are included in the mixture, it is preferred, when practicable, to employ the heat treatment in order to consolidate the coating.

It will be clear from the description following Example 1 that, if desired, borax could be omitted from the mixture described in Example 4 also.

Furthermore, when magnesium oxide and calcium hydroxide are used in the mixture, quite satisfactory coatings may be formed on concrete even if the bicarbonate is omitted. This result is probably due to the presence of sufficient carbonates in the concrete surface.

The proportions of magnesium oxide and calcium hydroxide may be varied considerably and either may be used without the other. Other oxides (such as manganese dioxide) and hydroxides may also be employed in substitution for or in addition to magnesium oxide and calcium hydroxide.

EXAMPLE 4.

A mixture of liquid vehicle and zinc dust was prepared from the ingredients and in the manner specified in Example 1 and this mixture was brushed onto a lightly oxidised steel surface to form a coating.

The coating was allowed to stand at normal temperature until it had set after which a solution prepared by dissolving 10% of magnesium chloride in water was brushed thereon. It was found that a hard and substantially insoluble coating was rapidly produced in this way and without subjecting the material to a heat treatment.

It is believed that the magnesium chloride solution reacts with the silicate and the bicarbonate in the mixture to form silicated magnesium carbonates and magnesite.

This form of the invention therefore is particularly useful in circumstances where it is not practicable or convenient to subject the coated articles to a heat treatment, although if desired the coatings, after treatment with the magnesium chloride solution may be subjected to a heat treatment.

The strength of the solution may be varied within wide limits.

In lieu of magnesium chloride, a solution of calcium chloride or of a mixture of magnesium chloride and calcium chloride may be employed, in which case dolomite will be formed.

It should be understood that this treatment with magnesium chloride may also be usefully employed if borax is omitted from the coating mixture or if the latter is varied in any other manner described with reference to Example 1.

Furthermore the coating mixture may if desired contain basic oxides and/or hydroxides as described in Example 3.

EXAMPLE 5.

A liquid vehicle was prepared in the manner and from the ingredients specified in Example 1.

A corresponding proportion by weight of zinc dust was then intimately mixed with the vehicle and in addition a proportion of commercial powdered graphite equal to 4% by weight of the zinc, was incorporated therein.

The mixture was then brushed thickly onto the surface of a strip of spring steel and after being allowed to dry at normal temperature the coated strip was subjected to a heat treatment at a temperature of 450° F. for a period of 12 hours.

The coatings so produced had antifriction and corrosion resisting properties.

This form of the invention is particularly suitable for the formation of coatings on the leaves of automobile suspension springs. Such coatings may also be advantageously employed on other sliding parts and on shaft bearings.

The proportion of the graphite and the quality thereof may vary within fairly wide limits depending largely on the purpose for which the coating is required. In the case of leaf springs the proportion of graphite may advantageously be about 4% by weight of the zinc, as in the above described example, though 10% or more could be used if desired. In the case of a coating for a shaft bearing, the proportion of graphite may, in some cases, be as low as or even less than 0.5% by weight.

In lieu of mixing all of the ingredients before applying them to the articles to be treated, the graphite and/or zinc dust may be sprayed onto the articles either after the liquid vehicle has been applied thereto or simultaneously with the application of the liquid vehicle. Furthermore, the zinc dust and graphite may be admixed and may be applied to the surface without previous admixture with the liquid vehicle.

A further application of the invention resides in the formation of sound absorbent coatings for various purposes, such e.g. as on the interior surfaces of steel panels employed in the bodywork of closed motor vehicles.

In this application of the invention it is preferred to use a smaller preparation of the metallic coating agent and to incorporate in the mixture one or more

ingredients such as cork dust, the presence of which will conduce to the formation of a softer coating.

It has previously been indicated that the compositions and methods of this invention may be employed in the formation of articles of manufacture. For example, a mixture prepared substantially in the manner described in preceding Example 1 may be placed in a mould of suitable shape, such material then being preferably but not necessarily subjected to a high pressure to increase its density and to cause it to closely conform to the contour of the mould.

The pressed article is then permitted to dry at a normal temperature following which it is subjected to a heat treatment at a temperature of about 185° F. or more in order to complete the reaction and convert the material from a water-soluble to a substantially water-insoluble condition. If desired, an inert filler may be included in the mixture.

This form of the invention is applicable to the manufacture of relatively thin articles, such e.g. as stereotype blocks, liners for bearings, and the like.

In a modification the ingredients may be mixed preferably with an excess of water, the mixture then being permitted to dry or set. The dry mixture is then broken up into a granular or powdered condition and is used as a thermo-setting composition which may be placed in moulds compressed and converted to the substantially insoluble condition upon the application of heat thereto.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. A process for the production of a silicated composition including the steps of forming a mixture comprising finely divided zinc or alloy containing zinc and an aqueous solution of a silicate, and converting the mixture to a substantially insoluble condition by and in the presence of carbon dioxide.

2. A process for the production of a silicated composition including the steps of forming a mixture comprising finely divided zinc or alloy containing zinc, an aqueous solution of a silicate and a bicarbonate, and converting the mixture to a substantially insoluble condition.

3. The process for the production of a silicated composition according to Claim 2, wherein one or more basic oxides and/or hydroxides is or are included in the said mixture.

4. The process for the production of a silicated composition according to any preceding claim, wherein the mixture is subjected to heat to effect or promote the conversion thereof to a substantially insoluble condition,

5. The process for the production of a silicated composition according to any preceding claim, wherein the said silicate comprises sodium silicate and/or potassium silicate.

6. The process for the production of a silicated composition according to any preceding claim, wherein approximately one to two parts by weight of said finely divided zinc or alloy containing zinc is used for each part of the said solution.

7. The process for the production of a silicated composition according to any preceding claim, wherein the mixture is heated to a temperature of about 200° F. or more.

8. The process for the production of a silicated composition according to Claim 2, wherein the mixture includes sodium silicate and sodium bicarbonate in the proportion of about 100 parts by vol. of aqueous solution of sodium silicate 1.4 specific gravity to about 12 parts by vol. of aqueous solution (saturated at 60° F.) of sodium bicarbonate, and wherein the mixture is heated to effect or promote the conversion thereof to the substantially insoluble condition,

9. The process for the production of a silicated composition according to any preceding claim, wherein a borate is included in the mixture.

10. The process for the production of a silicated composition according to any of Claims 1 to 9, wherein borax is included in the mixture.

11. The process for the production of a silicated composition according to any preceding claim wherein finely divided graphite is included in the mixture.

12. The process for the production of a silicated composition according to any preceding claim, wherein the mixture includes magnesium oxide and/or calcium hydroxide.

13. The process for the production of a silicated composition according to Claim 2, wherein a liquid vehicle is formed from said aqueous solution of silicate and an aqueous solution of said bicarbonate and the mixture includes magnesium oxide and calcium hydroxide, the combined weight of said magnesium oxide and calcium hydroxide being approximately equal to 10% of the weight of said liquid vehicle.

14. The process for the production of a silicated composition according to Claim 13, wherein magnesium oxide and calcium hydroxide are used in approximately equal parts by weight.

ingredients such as cork dust, the presence of which will conduce to the formation of a softer coating.

It has previously been indicated that the compositions and methods of this invention may be employed in the formation of articles of manufacture. For example, a mixture prepared substantially in the manner described in preceding Example 1 may be placed in a mould of suitable shape, such material then being preferably but not necessarily subjected to a high pressure to increase its density and to cause it to closely conform to the contour of the mould.

The pressed article is then permitted to dry at a normal temperature following which it is subjected to a heat treatment at a temperature of about 185° F. or more in order to complete the reaction and convert the material from a water-soluble to a substantially water-insoluble condition. If desired, an inert filler may be included in the mixture.

This form of the invention is applicable to the manufacture of relatively thin articles, such e.g. as stereotype blocks, liners for bearings, and the like.

In a modification the ingredients may be mixed preferably with an excess of water, the mixture then being permitted to dry or set. The dry mixture is then broken up into a granular or powdered condition and is used as a thermo-setting composition which may be placed in moulds compressed and converted to the substantially insoluble condition upon the application of heat thereto.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. A process for the production of a silicated composition including the steps of forming a mixture comprising finely divided zinc or alloy containing zinc and an aqueous solution of a silicate, and converting the mixture to a substantially insoluble condition by and in the presence of carbon dioxide.

2. A process for the production of a silicated composition including the steps of forming a mixture comprising finely divided zinc or alloy containing zinc, an aqueous solution of a silicate and a bicarbonate, and converting the mixture to a substantially insoluble condition.

3. The process for the production of a silicated composition according to Claim 2, wherein one or more basic oxides and/or hydroxides is or are included in the said mixture.

4. The process for the production of a silicated composition according to any preceding claim, wherein the mixture is subjected to heat to effect or promote the conversion thereof to a substantially insoluble condition,

5. The process for the production of a silicated composition according to any preceding claim, wherein the said silicate comprises sodium silicate and/or potassium silicate.

6. The process for the production of a silicated composition according to any preceding claim, wherein approximately one to two parts by weight of said finely divided zinc or alloy containing zinc is used for each part of the said solution.

7. The process for the production of a silicated composition according to any preceding claim, wherein the mixture is heated to a temperature of about 200° F. or more.

8. The process for the production of a silicated composition according to Claim 2, wherein the mixture includes sodium silicate and sodium bicarbonate in the proportion of about 100 parts by vol. of aqueous solution of sodium silicate 1.4 specific gravity to about 12 parts by vol. of aqueous solution (saturated at 60° F.) of sodium bicarbonate, and wherein the mixture is heated to effect or promote the conversion thereof to the substantially insoluble condition,

9. The process for the production of a silicated composition according to any preceding claim, wherein a borate is included in the mixture.

10. The process for the production of a silicated composition according to any of Claims 1 to 9, wherein borax is included in the mixture.

11. The process for the production of a silicated composition according to any preceding claim wherein finely divided graphite is included in the mixture.

12. The process for the production of a silicated composition according to any preceding claim, wherein the mixture includes magnesium oxide and/or calcium hydroxide.

13. The process for the production of a silicated composition according to Claim 2, wherein a liquid vehicle is formed from said aqueous solution of silicate and an aqueous solution of said bicarbonate and the mixture includes magnesium oxide and calcium hydroxide, the combined weight of said magnesium oxide and calcium hydroxide being approximately equal to 10% of the weight of said liquid vehicle.

14. The process for the production of a silicated composition according to Claim 13, wherein magnesium oxide and calcium hydroxide are used in approximately equal parts by weight.

15. The process for the production of a silicated composition according to any of Claims 1 to 8 inclusive, wherein boric acid is included in the mixture.

16. The process for the production of a silicated composition according to any of Claims 1, 3, 9 and 11, wherein said mixture includes one or more of the following alloys in a finely divided condition—viz. magnesium-zinc, aluminium-zinc, calcium-zinc and cadmium-zinc.

17. The method of applying a coating to a surface consisting in forming on said surface a silicated composition in accordance with any preceding claim.

18. The method of applying a coating according to Claim 17, wherein said coating is converted to a substantially insoluble condition by or with the aid of a solution of magnesium chloride and/or calcium chloride.

19. The method of applying a coating to a surface according to Claim 17, wherein finely divided zinc oxide is incorporated in the mixture.

20. A coating material comprising in admixture an aqueous solution of an alkaline silicate, a bicarbonate and at least one finely divided agent selected from the group consisting of zinc, magnesium-zinc, aluminium-zinc, calcium-zinc and cadmium-zinc.

21. A coating material according to Claim 20, wherein a borate is included in the mixture.

22. In the production of a silicated composition according to any of Claims 1 to 4 inclusive, compressing the mixture in a mould and then subjecting the pressed material to heat to convert same to the substantially insoluble condition.

23. An article provided with a coating consisting of a silicated composition produced in accordance with any of Claims 1 to 18 inclusive.

24. A silicated composition produced in accordance with any of Claims 1 to 16 inclusive.

25. The method of forming a coating on a surface substantially as herein-before described.

26. The method of forming a silicated composition substantially as herein-before described.

Dated this 4th day of April, 1938.

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49, Chancery Lane, London, W.C.2 and
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Leamington Spa: Printed for His Majesty's Stationery Office, by the Courier Press.—1939.

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