



(51) International Patent Classification:

C23C 14/00 (2006.01)

C08L 29/14 (2006.01)

Published:

— with international search report (Art. 21(3))

(21) International Application Number:

PCT/IN2021/050694

(22) International Filing Date:

18 July 2021 (18.07.2021)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

202031031663

24 July 2020 (24.07.2020)

IN

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(81) Designated States (unless otherwise indicated, for every
kind of national protection available): AE, AG, AL, AM,
AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ,
CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO,
DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN,
HR, HU, ID, IL, IN, IR, IS, IT, JO, JP, KE, KG, KH, KN,
KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD,
ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO,
NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW,
SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN,
TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every
kind of regional protection available): ARIPO (BW, GH,
GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ,
UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ,
TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK,
EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV,
MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM,
TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,
KM, ML, MR, NE, SN, TD, TG).

(54) Title: SURFACE TOLERANT PROTECTIVE COATING AND PREPARATION THEREOF

(57) Abstract: Description of a two component surface tolerant air drying corrosion protective coating is presented detailing its composition, preparation and method of application. This coating has multiple desirable features such as thermal resistance and intumescence, absence of toxic elements in its composition, outstanding scratch hardness, and, exceptional adhesion to nominally prepared ferrous and non-ferrous substrates, thus eliminating hazardous blasting as a precursor to its application. Comprehensive corrosion protection is obtained by application of this coating on pre-rusted steel and mill scale covered black hot rolled steel. Coating composition comprises a vinyl terpolymer containing acetyl, hydroxyl and formal groups, a short oil alkyd resin, alkoxy amino resins, o-phosphoric and p-toluene sulphonic acid catalysts, extenders and pigment, in a blend of organic solvents such as toluene and n-butanol. Individual components are stable up to a year while the mixed composition has a pot life of at least 8 hours under ambient conditions.



SURFACE TOLERANT PROTECTIVE COATING COMPOSITION AND PREPARATION THEREOF

FIELD OF INVENTION

The present invention relates to a surface tolerant protective coating composition and preparation thereof. More particularly this invention pertains to a surface tolerant, self priming, air drying, cost effective protective coating composition for ferrous and non-ferrous metal substrates based on a vinyl terpolymer of polyvinyl formal, polyvinyl alcohol and polyvinyl acetate, an alkyd resin, and alkoxylated amino resins and also narrates a procedure for arriving at said protective coating which is user friendly, easy to apply on any type of metal surface and does not pose any environmental hazard. The coating is air-drying and requires no major surface preparation such as sand/shot/grit blasting, when applied on new as well as old corroded steel/metalized steel substrates. It has good barrier properties, chemical and thermal resistance, flexibility, and hardness, and provides excellent corrosion protection to structures exposed to environmental degradation caused by industrial pollutants and/or coastal salinity. The coating withstands sustained exposure to a wide range of temperature (-50°C to 150°C) and is fire retardant.

BACKGROUND OF INVENTION

Worldwide attention is focused on protection of metal structures from corrosive degradation. Pre-erected structures pose problems due to the extent of surface preparation often required by protective coatings/paints. Adherence of coatings to pre-corroded steel surface after preparation by mechanical cleaning is far from satisfactory and is the cause of further interfacial corrosion and eventual coating detachment from the metal surface. Hence sand/grit blasting is prescribed. This is seldom practical apart from being polluting and expensive. New hot rolled steel with mill scale also requires similar preparation and a primer has to be applied immediately after blasting to prevent rusting before the application of intermediate/tie coats etc. Often, chromates and other toxic ingredients are used in some form as part of the primer. Self priming air-drying coatings have been developed for metal structures (U.S. Patent nos. 5539032, 5427821, 5403880, 5236983, 5491185, 5202367, 5130361, and 5274021), but such formulations are not applicable on hot rolled steel with mill scale or pre-rusted steel. Polysiloxane based elastomeric self priming air-drying coating has been disclosed in U.S. Patent Application no. US2011308424A1. This coating exhibits good chemical resistance and water repellency however no data has been presented on creep corrosion propagation under continuous or cyclic exposure to salt fog. Moreover, no data has been presented on oxidized steel/metalized steel substrates. The present invention addresses a pressing need for self priming air-drying protective coating devoid of toxic corrosion inhibiting agents such as lead or chromates, and ingredients containing halogens and isocyanates. The said protective coat can perform on nominally

prepared oxidized steel surfaces of fresh as well as pre-rusted existing structures, for cost effective, environment friendly and long-term corrosion protection. The subject application incorporates some information/data given in an earlier Patent Application no.1575/KOL/2008 which were arrived at, by one of the present applicants in the capacity of sole inventor, the said Patent Application having subsequently been withdrawn. New features and preparative procedures disclosed in the subject specification are unique and the novel coating composition has surprisingly been found to ensure dramatic reduction in life-cycle cost of structures protected therewith.

From the foregoing description it may logically be inferred that till date no protective coating has been formulated which will protect nominally prepared oxidized metal structures over long periods of time, be stable, non-toxic, cost-effective and user friendly.

The principal object of this invention is to provide a surface tolerant protective coating which is long lasting, affords stability to structures coated therewith, does not necessitate repeated application at repeated intervals and ensures considerable reduction in life-cycle cost of metal substrates protected therewith.

A further object of this invention is to evolve a procedure to arrive at a surface tolerant protective coating composition, the application of which requires no

sophisticated machinery and can be carried out under ambient conditions without being energy intensive and without damaging the environment.

A still further object of this invention is to maximize solids maintaining the stability of the of the subject liquid coating composition and simultaneously achieve quickest possible ambient cure using non-toxic ingredients.

The foregoing objects were achieved by the present invention wherein it was surprisingly observed that a linear vinyl terpolymer with randomly distributed acetyl, formal, and hydroxyl groups can be incorporated with a short oil alkyd resin and a dryer therefor, alkoxylated amino resins, ortho-phosphoric acid and an acid catalyst like p-toluene sulphonic acid. The composition may also incorporate extenders like mica, zinc phosphate, talc, micro-fined silica and pigment like red oxide, resulting in an air-drying coating of dry film thickness varying between 50-150 micrometers for long lasting protection of steel, metalized steel and ferrous alloys under hostile atmosphere. Such coating applied on clean as well as oxidized metal substrates has been found to be quick curing, and creates a passive coating-metal interface, provides an excellent balance of thermo-mechanical properties and effective resistance to deleterious chemicals. Only loose scale, moisture, grease, residual paint and such other surface contaminants need to be removed from newly laid or existing structures/substrates. Such coating functions equally on conventionally cleaned steel and metalized steel.

The essential constituents of the surface tolerant protective coating may be laid down as under, computed on the basis of 100% solid state by weight, and listing an optimal range of each of the constituents per part of the vinyl terpolymer:

- (i) Short oil alkyd - 3-4;
- (ii) Partially isobutylated urea formaldehyde - 0.5-0.55;
- (iii) Methylated Melamine - 0.45-0.55;
- (iv) O-phosphoric acid - 0.2-0.3; and
- (v) P-toluene sulphonic acid - 0.04-0.06

In formulating the surface coating composition of this invention, choice of alkyd co-resin has been found to play an important role. A short oil alkyd with an oil length of approximately 40 and a hydroxyl number of 100-110 was found optimal to permit solid loading of 45-50% by weight. A solvent blend comprising 45-50 parts of n-butanol and 50-55 parts of toluene provides best air-drying properties. Incorporation of suitable metallic dryer for the alkyd resin such as cobalt/manganese/zinc naphthenate or octoate, used singly or in combination, acid catalysts such as p-toluene sulfonic acid and o-phosphoric acid, and a combination of alkoxylated amino resins with alkyl group containing 1 to 4 carbon atoms provide accelerated cure in ambient conditions. The coating may be pigmented with red oxide and produced as a two component system to be mixed prior to application. The pot life achievable is 8

hours at 30C. Excellent adhesion of the subject coating composition to a) mill scale covered hot rolled steel that is cleaned with a volatile solvent, b) pre-rusted steel merely freed from loose scale, c) blast cleaned steel surface, and d) galvanized steel without any pre-treatment, is achieved, which addresses a critical need in the protection of new and/or pre-erected steel/metalized steel structures/substrates exposed to environmental attack without elaborate, time consuming and expensive surface preparation.

The present invention relates to a surface tolerant, self-priming, air drying coating composition, for providing protection to ferrous and non-ferrous metal substrates, characterized in that the said composition comprises in combination

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- a) a Vinyl terpolymer of weight average molecular weight between 20000 and 50000Daltons, constituted of randomly distributed acetyl, hydroxyl, and formal groups along the vinyl backbone with polyvinyl acetate, polyvinyl alcohol, and polyvinyl formal content by weight of 9-15%; 6-15%; and 70-84% respectively;
- b) a short oil alkyd resin of oil length approximately 40 and hydroxyl number varying between 90 and 120;
- c) metal dryer(s) for the alkyd resin;
- d) alkoxy amino resins used singly or in combination with 1-4 carbon atoms in the alkyl group;
- e) ortho-phosphoric acid;
- f) one or more acids additionally used as co-catalysts to accelerate ambient cure;

g) a mix of toluene and n-butanol as solvents in weight ratio of 50-60 to 40-50 respectively; and

h) chromate free extenders and pigments.

This invention also pertains to preparation of the above composition which is formulated as a two component system

If it is desired to provide extra protection against vagaries of weather or resistance to chemical attack, especially in industrial and/or marine applications, then a top coat of acrylic or silicone paint may be applied.

DETAILED DESCRIPTION OF THE INVENTION

The present invention may be summarized as self priming air-drying (chromate free) corrosion resistant coating composition comprising:

- a) a linear vinyl terpolymer of weight average molecular weight 20000-50000 Daltons, made up pre-dominantly of polyvinyl formal with polyvinyl alcohol and polyvinyl acetate as the two other co-polymers;
- b) a short oil alkyd resin of oil length approximately 40 and hydroxyl number varying between 90 and 120 (measured as mg. potassium hydroxide per gram of resin);
- c) an alkoxyated urea formaldehyde resin;
- d) an alkoxyated melamine formaldehyde resin;
- e) ortho-phosphoric acid with another acid(s) catalyst for accelerating ambient cure;

- f) metal dryers for the alkyd resin;
- g) organic solvents like toluene and normal butanol in a weight ratio of 50-55:45-50;
- h) (chromate free) extenders such as talc, mica and zinc phosphate, micro-fine silica; and
- i) pigment like red oxide

Preferred components used in the composition of this invention are a) dryer - cobalt naphthenate or octoate; b) acid catalyst - para-toluene sulphonic acid; and c) number of carbon atoms in the alkyl part of alkoxyated amino resins varying between 1 and 4.

This invention also includes within its scope the procedure for arriving at the subject protective coating composition which can be briefly outlined as under:

A linear vinyl terpolymer with randomly distributed pendant groups of hydroxyl, acetyl and formal was selected wherein weight percentage of polyvinyl alcohol, polyvinyl acetate and polyvinyl formal in the terpolymer could vary from 6%-15%, 9%-15%, and 70-84%, respectively, and more preferably 6%- 7.5%, 10%- 13%, and 80- 83%, respectively. The weight average molecular weight could vary between 20000 and 50000 Daltons, preferably between 30000 and 40000 Daltons. This polymer was used in combination with a short oil alkyd resin of oil length 40 approximately and a hydroxyl number

between 90 and 120, preferably between 100 and 110, with solids ranging from 70-80%, the balance being xylene. Such an alkyd may be prepared by mono-glyceride process, from linseed oil, glycerol and isophthalic acid with a catalyst like lithium carbonate for esterification and an aromatic solvent like xylene/toluene. The alkoxyated amino resins preferably had 1 to 4 carbon atoms in the alkyl group and preferably were a combination of a partially isobutylated urea formaldehyde resin, containing 60% solids in a mix of xylene and iso-butanol, and a methylated melamine formaldehyde resin containing more than 97% solids.

The terpolymer was dissolved in the solvent mix to obtain a concentrated solution which was added to a mill base containing the alkyd, pigment and extenders. Ortho-phosphoric acid and p-toluene sulfonic acid were added with the requisite amount of solvent blend required to achieve a sprayable consistency. This formed one component of a two-component coating. The other component comprised a blend of the alkoxyated amino resins in the solvent mix in proportions illustrated below. The two components upon mixing together prior to application was found to be stable for 8 hours at 30°C. The product was formulated with a solid content of a minimum of 45% by weight for the mixed composition. A dry film thickness of 100 micrometers or more of the mixed coating is recommended for hot rolled/cold rolled steel and a minimum of 50 micrometers for galvanized steel. Complete ambient cure

required about 10 days depending on weather conditions. This was found to be equivalent to a forced cure of one hour at 70°C.

The dry coating could also be top coated, if required with top coats such as acrylic or silicone paints for improved chemical resistance and/or aggressive weather conditions.

Examples:

The summarized narration of the constituent components used in forming the corrosion resistant, self priming, air-drying coating composition may be suitably elaborated in the following examples which are given by way of illustration and not by way of limitation.

EXAMPLE 1

COMPONENT 1

ITEMS	RANGE OF PERCENTAGE BY WEIGHT
Short Oil Alkyd(70% solids)	16.0-18.0
Vinyl Terpolymer	3.5
Synthetic Red Oxide	6.0-10.0
Mica Powder (10 microns avg.)	8.0-10.0
Zinc Phosphate	8.0-10.0
Talc Powder (2 microns avg.)	1.0-2.0
Toluene	26.5-29.0
n-Butanol	23.5-26.0
o-Phosphoric Acid	0.7-1.0
p-Toluene Sulfonic Acid	0.15-.20
Cobalt Naphthenate or Octoate (8% active metal)	0.30-.50

COMPONENT 2

ITEMS	RANGE OF PERCENTAGE BY WEIGHT
Methylated Melamine Formaldehyde Resin (97%-100% solids)	21-23
Partially iso-Butylated Urea Formaldehyde resin in a mix of Xylene and iso-Butanol (60% solids)	37-39
Toluene	22-24
n-Butanol	18-20

EXAMPLE 2

A specific red pigmented composition was prepared from the following ingredients in the indicated weight proportions:

COMPONENT 1

ITEMS	PERCENTAGE BY WEIGHT
Short Oil Alkyd(70% solids)	17.25
Vinyl Terpolymer	3.83
Synthetic Red Oxide	8.29
Mica Powder (10 microns avg.)	9.67
Zinc Phosphate	9.67
Talc Powder (2 microns avg.)	1.47
Toluene	26.90
n-Butanol	21.38
o-Phosphoric Acid	0.97

p-Toluene Sulphonic Acid	0.19
Cobalt Naphthenate or Octoate (8% active metal)	0.39

COMPONENT 2

ITEMS	PERCENTAGE BY WEIGHT
Methylated Melamine Formaldehyde resin (97%-100% solids)	22.15
Partially iso-Butylated Urea Formaldehyde resin in a mix of Xylene and iso-Butanol (60% solids)	38.07
Toluene	22.07
n-Butanol	17.71

After preparing the two components of the coating individually as described earlier, 100 parts of component 1 was mixed with 8 parts of component 2 to obtain the final coating composition which contained 45% solids by weight. The individual components are stable for one year at 30°C. The viscosity of the final mixed composition was found to be 45±10 seconds measured by Ford Cup B4 at 30°C, and the composition was stable and usable for at least 8 hours at 30°C.

Due to low viscosity of the mixed composition the solids level of this composition may be increased up to 50% by weight.

Various tests were conducted on a variety of steel substrates. Hot rolled steel comprising a) fresh with mill scale, and b) sand blasted and cold rolled steel panels were included in the investigation. Cold rolled steel panels were cleaned with emery paper and washed with xylene to remove grit, oil and moisture. Black hot rolled steel panels were washed with xylene and used without any mechanical cleaning to remove mill scale. Sand blasted hot rolled steel panels were washed with xylene to remove all adhering particles. Coating was applied by spray on all the panels. The DFT of coating on cold rolled steel panels used for all tests except salt fog corrosion test was approximately 100 micrometers while that for salt fog corrosion test (ASTM B117) was approximately 150 micrometers. DFT of coating on hot rolled steel panels subjected to all tests was approximately 120 micrometers. All panels were force dried at 70°C for one hour.

TESTS AND RESULTS

a) Drying Time, maximum

i) Tack free: 4 hours at 30°C ii) hard dry: 8 hours at 30°C iii) full cure: 10 days at 30°C

b) Adhesion: All coated panels exhibited excellent adhesion passing ASTM D3359, cross hatch with classification 5A, and 2 mm grid with classification 5B.

c) Hardness: Metal scratch hardness wherein a sharp steel needle loaded with a specified weight is scratched on the coated surface and the minimum weight required to expose the metal underneath the coating is recorded as scratch hardness. All types of coated panels exhibited scratch hardness of 4Kg minimum.

d) Flexibility: Coated cold rolled steel panels were bent upon a mandrel of size 6mm and the coating examined around the bend. No visual damage or detachment of the coating was observed.

e) Impact Resistance: Coated cold rolled steel panels passed a direct impact resistance load of 75Kgf.cm.

f) Thermal Resistance: ASTM D 2485-91 Test Method A was followed for coated cold rolled steel panels exposed to 150°C. No dulling, blistering, cracking, loss of adhesion or flexibility was observed.

g) Recoatability: Some coated panels were exposed to normally prevailing weather conditions for 6 months and coated thereafter with the same coating after cleaning the surface with a dry cloth. All such panels showed good adhesion passing ASTM D3359, 2 mm grid with classification 5B.

h) Chemical Resistance: Coated panels were tested by a chemical spot test in accordance with ASTM D1308 (modified version incorporated in ASTM D3730) for 4 hours, with 5% aqueous solution of i) acetic acid, ii) sulfuric acid, iii) hydrochloric acid, iv) sodium hypochlorite, v) sodium carbonate. Results obtained were satisfactory with no swelling or softening of coating.

i) Corrosion Resistance (salt fog): All types of coated panels were scribed and exposed to neutral salt fog as per ASTM B117. At the conclusion of 1000 hours of continuous exposure no corrosion on the coated face as well as the stripped metal face and less than 1 mm. creep from scribe was observed. No swelling, blistering or loss of adhesion of coating was observed.

j) Corrosion Resistance (Prohesion): Prohesion tests as per ASTM G 85-94 A5 using aqueous solution of 0.05% sodium chloride and 0.35% ammonium sulfate (1 hour fog exposure and 1 hour dry) on all types of coated panels for 1000 hours revealed no rusting on coated face nor on the stripped metal. No blistering, swelling or loss of adhesion was observed.

k) Corrosion Resistance (cyclic corrosion): Coated cold rolled steel panels were subjected to cyclic humidity tests for 1000 hours as per ASTM G60-86 wherein dip aqueous solution of 1% sodium chloride, 1% calcium chloride and 0.1% sulfuric acid was used. The dip time was 5 minutes and the solution and chamber temperature was $52\pm 2^{\circ}\text{C}$. No blistering or rusting was observed though some discoloration of the coating was seen.

l) Electrochemical impedance spectroscopy: This test was done only on the coated hot rolled steel panels which were top coated with an air-drying acrylic paint applied to a DFT of 50 micrometers approximately. Tests were designed to simulate marine exposure. No detectable change in polarization resistance was observed after 4350 hours of continuous exposure to salt solution containing 3.5% sodium chloride, and the value was maintained in the range of 1 to $2 \times 10^{10} \text{ohm.cm}^2$. At the conclusion of the test coating adherence was maintained.

m) A largely rusted cold rolled steel panel showing more than 50% surface rust was coated to a DFT of approximately 150 micrometers and exposed to neutral salt fog for 1000 hours. On conclusion of the test it was noted that the coated face showed no rusting and the coating maintained its adherence throughout the period of exposure. The stripped metal face also revealed no growth of rusting.

n) Fire Retardancy: Here general guidelines of ASTM D1360-98 for fire retardancy of paints were followed using coated wood substrate. A cylindrical cup as specified was filled with 5 ml of pure absolute ethanol. The same was ignited and the coated face exposed to the flame as described in the test. The flame did not burn or char the coating during duration of the test of 15 minutes. However, weight loss examination was not conducted. This constitutes a qualitative test for fire retardancy.

While the invention has been described in detail and with reference to the specific embodiments thereof, it will be apparent to one skilled in the art that various changes and modifications can be made without deviating or departing from the spirit and scope of the invention. Thus the disclosure contained herein includes within its ambit the obvious equivalents and substitutes as well.

We claim:

1. A surface tolerant, self priming, air drying coating composition, for providing corrosion protection to ferrous and non-ferrous metal substrates, characterized in that the said composition comprises in combination -

a) a Vinyl terpolymer of weight average molecular weight between 20000 and 50000 Daltons, constituted of randomly distributed acetyl, hydroxyl, and formal groups along the vinyl backbone with polyvinyl acetate, polyvinyl alcohol, and polyvinyl formal content by weight of 9-15%; 6-15%; and 70-84%; respectively

b) a short oil alkyd resin of oil length approximately 40 and hydroxyl number varying between 90 and 120;

c) metal dryer(s) for the alkyd resin;

d) Alkoxy amino resins used singly or in combination with 1-4 carbon atoms in the alkyl group;

e) Ortho-phosphoric acid;

f) one or more acids additionally used as co-catalysts to accelerate ambient cure;

f) a mix of toluene and n-butanol as solvents in weight ratio of 50-60 to 40-50 respectively; and

g) chromate free extenders and pigments.

2. The composition as claimed in Claim 1 wherein percentages by weight of polyvinyl acetate, polyvinyl alcohol, and polyvinyl formal, are preferably 10-13, 6-7.5, and 80-83, respectively, in the vinyl terpolymer.

3. The composition as claimed in Claims 1 and 2, wherein weight average molecular weight of the vinyl terpolymer chosen optimally lies between 20000 and 30000 Daltons.

4. The composition as claimed in Claim 1, wherein short oil alkyd resin is produced from linseed oil, glycerol, and isophthalic acid in xylene solvent with a hydroxyl number varying between 100 and 110.
5. The composition as claimed in Claim 1 wherein the alkoxy amino resins optimally comprise partially butylated urea formaldehyde and methylated melamine formaldehyde.
6. The composition as claimed in Claim 1 wherein metal dryer used for the alkyd resin is cobalt naphthenate or octoate (6-8% active metal) and co-catalyst acid used is preferably p-toluene sulphonic acid.
7. The composition as claimed in Claim 1 wherein extenders are chosen from the group of mica, talc, zinc phosphate, micro-fine silica and preferred pigment is red oxide.
8. The composition as claimed in Claims 1, 4, 5, and 6, wherein principal constituents on a 100% solids basis, per part of vinyl terpolymer, are computed as follows:
 - a. short oil alkyd - 3-4
 - b. partially isobutylated urea formaldehyde - 0.5-0.55
 - c. methylated melamine formaldehyde - 0.45-0.55
 - d. o-phosphoric acid - 0.2-0.3 and
 - e. p- toluene sulphonic acid - 0.04-0.06
9. The composition as claimed in Claims 1 and 8, is formulated as a two component system, to be mixed in proportion of 100:8 (by weight), with the mix having a pot life of at least 8 hours at ambient conditions, wherein the constituents are present in individual components as shown in the following range of weight percentages:

COMPONENT 1

ITEMS	RANGE OF PERCENTAGE BY WEIGHT
Short Oil Alkyd(70% solids)	16.0-18.0
Vinyl Terpolymer	3.5
Synthetic Red Oxide	6.0-10.0
Mica Powder (10 microns avg.)	8.0-10.0
Zinc Phosphate	8.0-10.0
Talc Powder (2 microns avg.)	1.0-2.0
Toluene	26.5-29.0
n-Butanol	23.5-26.0
o-Phosphoric Acid	0.7-1.0
p-Toluene Sulfonic Acid	0.15-.20
Cobalt Naphthenate or Octoate (8% active metal)	0.30-.50

COMPONENT 2

ITEMS	RANGE OF PERCENTAGE BY WEIGHT
Methylated Melamine Formaldehyde Resin (97%-100% solids)	21-23
Partially iso-Butylated Urea Formaldehyde resin in a mix of Xylene and iso-Butanol (60% solids)	37-39
Toluene	22-24
n-Butanol	18-20

10. The composition as claimed in Claims 1 and 9, formulated as 2 component system, requiring 100 parts of component 1 to be mixed with 8 parts of component 2 by weight before use, wherein the individual constituents are present in the individual components in specific weight percentages as shown below:

COMPONENT 1

ITEMS	PERCENTAGE BY WEIGHT
Short Oil Alkyd(70% solids)	17.25
Vinyl Terpolymer	3.83
Synthetic Red Oxide	8.29
Mica Powder (10 microns avg.)	9.67
Zinc Phosphate	9.67
Talc Powder (2 microns avg.)	1.47
Toluene	26.90
n-Butanol	21.38
o-Phosphoric Acid	0.97
p-Toluene Sulphonic Acid	0.19
Cobalt Naphthenate or Octoate (8% active metal)	0.39

COMPONENT 2

ITEMS	PERCENTAGE BY WEIGHT
Methylated Melamine Formaldehyde resin (97%-100% solids)	22.15
Partially iso-Butylated Urea Formaldehyde resin in a mix of Xylene and iso-Butanol (60% solids)	38.07
Toluene	22.07
n-Butanol	17.71

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IN2021/050694

A. CLASSIFICATION OF SUBJECT MATTER
C23C14/00, C08L29/14 Version=2021.01

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)

C23C, C08L

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

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

PatSeer, IPO Internal Database

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X; Y	US7205353B2, ROTOMAC ELECTRICALS PVT LTD; 17-04-2007 (07 APRIL 2007) see page 3; column 3: lines 60-68 to column 4: lines 1-14	1-7; 8-10
X; Y	IN-KOL-2008-01575A, ROTOMAC ELECTRICALS PVT LTD; 19-03-2010 (19 MAR 2010) see claim 1	1-7; 8-10
A	EP1499690A1, ROTOMAC ELECTRICALS PVT LTD; 26-01-2005 (26 JAN 2005) whole document	1-10

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:

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Date of the actual completion of the international search

16-09-2021

Date of mailing of the international search report

16-09-2021

Name and mailing address of the ISA/

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/IN2021/050694

Citation	Pub.Date	Family	Pub.Date
US 7205353 B2	17-04-2007	AU 2002368503 A1	22-07-2004
		CA 2464241 C	04-11-2008
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