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ABSTRACT

An aqueous-based adhesive compound comprises: clay; a gelling/thickening agent derived from cellulose; and a water soluble or dispersible polymeric binder. The proportion of each of the clay, cellulosic gel/thickener and water soluble/dispersible polymer may be varied so as to provide a predetermined rheology to the compound. The compound can be provided as a premix and can be employed to adhere components such as cornices, ceiling roses, etc to plasterboard, fibre-cement and masonry.

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ADHESIVE COMPOUND

TECHNICAL FIELD

An adhesive compound for use with plasterboard, fibre-cement and masonry is disclosed. The compound finds particular, though not exclusive, application with the adhesion to plasterboard, fibre-cement and masonry of components such as cornices, ceiling roses, etc, and will be described in this context.

BACKGROUND

A known plaster-based cornice cement used in the building industry comprises a two part compound which requires the addition of water before use. In this regard, the cement is not "premixed", ready-for-use. For example, the plaster-based cornice cement can comprise calcium sulphate hemihydrate as the principal raw material. When the dry calcium sulphate hemihydrate is mixed with water, it causes the compound to set and harden as a result of the reaction:

$$CaSO_4.0.5H_2O + 1.5H_20 \rightarrow CaSO_4.2H_2O$$

Such a cement may be used for the adhesion to plasterboard of components such as cornices, ceiling roses, and the like. Modifications to such a compound can also enable it to be used as a flushing compound, as a crack filler and in the forming of a skim coat.

The above references to the background art do not constitute an admission that the art forms part of the common general knowledge of a person of ordinary skill in the art. The above references are also not intended to limit the application of the adhesive compound as disclosed herein.

SUMMARY OF DISCLOSURE

Disclosed herein is an aqueous-based adhesive compound. The compound can be employed to adhere components such as cornices, ceiling roses, etc to plasterboard, fibre-cement and masonry. The compound comprises a clay, a gelling/thickening agent derived from cellulose, a water soluble and/or dispersible polymeric binder and water. Additionally, the compound can comprise one or more mineral fillers.

It has been observed that by appropriately varying the proportion of each of the clay, cellulosic gel/thickener and water soluble/dispersible polymeric binder can provide a

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compound with a suitable rheology to provide for good initial "grab" (i.e. degree/extent of adhesion), sag resistance in use (e.g. resistance to movement under gravity due to the weight of the component being adhered), and good water retention properties (the latter which can improve workability and wet-edge quality).

For example, the weight % proportion in the compound of each of the clay, cellulosic gel/thickener and water soluble/dispersible polymer can be:

- clay (e.g. attapulgite) in the range: 0.5-2.0%;
- cellulosic gelling/thickening agent (e.g. hydroxy ethyl cellulose (HEC); hydroxy propyl methyl cellulose (HPMC)) in the range: 0.2-1.0%;
- water soluble/dispersible polymer (e.g. polyvinyl alcohol) in the range: 0.2-1.0%.

The clay can comprise a clay mineral that is selected for water retention (e.g. to provide a shelf life stability and to provide a paste-like quality to the compound). For example, the clay may comprise a hydrous aluminium and/or magnesium silicate.

More particularly, the clay can comprise a so-called "2:1" class of clay. A 2:1 clay comprises an octahedral sheet structure that is sandwiched between two tetrahedral sheets. Examples of such clays that can be suitable for use in the present compound include one or more of: attapulgite $\{(Mg,Al)_2Si_4O_{10}(OH)\cdot 4(H_2O)\}$; sepiolite $\{Mg_4Si_6O_{15}(OH)_2\cdot 6H_2O\}$; or montmorillonite. The weight % proportion of the attapulgite or sepiolite in the compound can be in the range: 0.5-2.0%.

The gelling/thickening agent derived from cellulose can comprise one or more of: hydroxy ethyl cellulose; hydroxy propyl methyl cellulose; or methyl cellulose. The weight % proportion of the cellulosic gelling/thickening agent in the compound can be in the range: 0.2-1.0%.

In an embodiment, the water soluble or dispersible polymeric binder may comprise polyvinyl alcohol or starch. The weight % proportion of the polyvinyl alcohol/ starch in the compound can be in the range: 0.2-2.0%.

Other water soluble or dispersible polymeric binder/thickeners that can be employed, in addition to or in place of the polyvinyl alcohol, include one or more copolymer emulsions of: ethylene vinyl acetate; polyvinyl acetate; acrylic; styrene acrylic; styrene butadiene rubber; polyacrylamide; polyacrylate. The one or more of the polymer emulsions (EVA, PVAc, acrylic, SA, SBR, etc) can be present in the compound at 0 – 10wt. %.

Usually the compound further comprises one or more mineral filler materials. The mineral filler material may comprise a principal raw material of the compound (e.g. greater than 50 and up to e.g. 80wt. % of the compound). For example, the mineral filler may

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comprise a metal carbonate-based such as calcium carbonate (sometimes referred to as "whiting" and also known as calcite, calcium carbonate or limestone). The calcium carbonate can be provided with a desirable particle size distribution so as to provide a smooth, grit-free consistency to the compound once formulated.

Other mineral fillers may be used in combination with calcium carbonate such as: phyllosilicate-based fillers (i.e. one or more hydrated magnesium silicates, such as talc, mica, vermiculite, etc); dolomite, silica, quartz, gypsum, barium sulphate, magnesium carbonate and the like. Such mineral fillers can be incorporated into the compound in the weight % proportion > 0 and up to 10%.

The formulation of the compound can take into account factors that affect the rate of hardening, including atmospheric conditions, porosity of the surfaces that are in contact with the compound and the thickness of compound application.

A biocide can be added to the compound for the control of bacteria and fungi, to improve shelf life and mould resistance of the dried compound. The biocide may comprise, for example, 2[(hydroxymethyl) amino] ethanol in an amount of 0.05 – 0.5 wt. %. Other suitable aqueous-based biocides such as methylisothiazolinone (MIT), methyl-bromoisothiazolinone (MBIT), chloro-methylisothiazolinone (CMIT) –type biocides, etc can be employed, as set forth hereafter.

Sorbitol and/or mannitol can also be added to the compound when, for example, the compound is employed to adhere components such as cornices, ceiling roses, etc to plasterboard. Plasterboard and such components may typically contain boric acid or other borate, and the sorbitol and/or mannitol can be added to the compound in an amount such as to counteract the reaction of polyvinyl alcohol with borate.

Also disclosed herein is an aqueous-based adhesive compound comprising clay, a gelling/thickening agent derived from cellulose and a water soluble or dispersible polymeric binder. The proportion of each of the clay, cellulosic gel/thickener and water soluble/dispersible polymer can be varied so as to provide a predetermined rheology to the compound.

For example, the weight % proportion in the compound of each of the clay, cellulosic gel/thickener and water soluble/dispersible polymer can be: clay (e.g. attapulgite) in the range: 0.5-2.0%; cellulosic gelling/thickening agent (e.g. HEC/HPMC) in the range: 0.2-1.0%; and water soluble/dispersible polymer (e.g. polyvinyl alcohol) in the range: 0.2-1.0%.

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Also disclosed herein is a method of formulating a compound as set forth above. Such a method can, for example, optimise the formulation of a one-part, ready-to-use premixed compound.

The method comprises dry mixing the clay, gelling/thickening agent and water soluble or dispersible polymeric binder, together with one or more mineral fillers.

The clay, gelling/thickening agent, water soluble and filler material can be dry mixed in a ribbon blender. Use of a ribbon blender can provide a requisite uniformity to the mix. Alternative blenders, such as a paddle-type or air-jet blender can be employed.

The method also comprises transferring this mixture into an aqueous solution/ dispersion and then mixing the resultant dispersion (which can then form a paste).

The aqueous solution/dispersion into which the dry mixture is transferred can comprise a pre-mixed solution/dispersion comprising, in addition to water, an emulsion of water soluble or dispersible polymer, and a water soluble or dispersible biocide.

The emulsion of water soluble or dispersible polymer comprises a polymer emulsion of one or more of: ethylene vinyl acetate; polyvinyl acetate; acrylic; polyacrylamide; polyacrylate; styrene acrylic; styrene butadiene rubber. In a specific embodiment, as described below, a copolymer emulsion of ethylene vinyl acetate can be employed.

The resultant dispersion (paste) can be mixed under vacuum. Mixing of the resultant paste under vacuum can reduce aeration of a high viscosity mix.

DETAILED DESCRIPTION OF SPECIFIC EMBODIMENTS

In the following detailed description, the illustrative embodiments described are not intended to be limiting. Other embodiments may be utilised and other changes may be made without departing from the spirit or scope of the subject matter disclosed herein. It will be readily understood that the aspects of the present disclosure, as generally described herein, can be arranged, substituted, combined, separated and designed in a wide variety of different configurations, all of which are contemplated in this disclosure.

A compound according to the present disclosure finds particular application to adhesively attaching components such as cornices, ceiling roses, etc to plasterboard, fibre-cement and masonry. The compound comprises a combination of mineral fillers, an inorganic clay, cellulosic thickeners and one or more binders. When a suitable proportion/combination of these four components is selected, this enables the compound to achieve a good initial grab (i.e. good initial adhesion between the cornice and plasterboard), good sag resistance (i.e. an

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ability to not flow excessively under gravity) and good shelf life stability of the compound. The compound can be formulated as a premixed product (i.e. a one-part adhesive that doesn't require addition of water), so that it can be supplied ready for immediate use.

Example 1 – Formulation for Premixed Cornice Compound

A cornice adhesive compound formulation comprising mineral fillers, clay, a cellulosic thickener and a number of water soluble/dispersible polymeric binders/thickeners was prepared. The preferred formulation comprised an appropriate proportion/combination of the clay – attapulgite (example: Palygel PC, Min-u-gel 400) - in the range: 0.5-2.0 wt. %; the cellulosic thickener - hydroxy ethyl cellulose (HEC) in the range: 0.2-1.0wt. %, and the polymeric binder - polyvinyl alcohol - in the range: 0.2-1.0wt. %.

The cornice adhesive compound was formulated so as to achieve a suitable rheology. In this regard, a rheology which gave a good initial grab and good thixotropic properties (sag resistance) in use, and which possessed suitable water retention properties to enhance its shelf life stability.

The formulation of this example comprised the inorganic mineral filler: hydrated magnesium silicate (talc) - in the range: 4-5wt. %.

The principal raw material of the compound (i.e. > 50-70wt. %) was calcium carbonate (grade: 60/16) at around 65 wt. %. This particular grade of calcium carbonate had a desirable particle size distribution and so provided a smooth, grit-free consistency to the compound once formulated.

In addition to polyvinyl alcohol, the formulation also comprised the binder/thickeners polyacrylamide – around 0.013wt. %, as well ethylene vinyl acetate emulsion (EVA) - around 3 wt. %. These also helped to promote good adhesion properties of the compound to plasterboard, fibre-cement and masonry substrates.

A biocide was also added to the compound to control bacterial and fungal growth therein, to improve shelf life as well as mould resistance *in situ.* The biocide added was 2[(hydroxymethyl) amino] ethanol - around 0.1wt. %. Other suitable aqueous-based biocides to be used included e.g. Kathon LX 1.5, Acticide HHB, or biocides such as methylisothiazolinone (MIT), methyl-bromoisothiazolinone (MBIT), chloro-methylisothiazolinone (CMIT). A fungicide (e.g. Ziram (dithiocarbamate) at 0.1wt%) was also able to be included in the compound.

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Sorbitol and/or mannitol - around 0.15 wt. % was also added to the compound, being an amount to counteract the presence of boric acid (in the form of metal borate) in plasterboard. Otherwise, the metal borate reacts with and coagulates the polyvinyl alcohol.

A preferred cornice compound had the following formulation:

Premixed Cornice Adhesive Compound Formulation	
RAW MATERIAL DESCRIPTION	**COMPOSITION (%)**
Calcium Carbonate	65.3
Talc (off white)	4.2
Attapulgite	1.4
Polyvinyl alcohol	0.4
Hydroxy Ethyl Cellulose	0.4
Sorbitol	0.15
Polyacrylamide	0.01
Water*	24.84
Ethylene Vinyl Acetate (EVA) Emulsion	3.2
Biocide	0.1
Total	100

* Note - the water proportion can be varied slightly from batch to batch in order to achieve a specified viscosity. In this regard, the viscosity can be affected by variations in the water absorption of the raw materials from time to time and by variations in the mixing time and mixing temperature.

Example 2 - Formulation Methodology

Calcium carbonate and talc were first weighed to an accuracy of ± 2%. The other raw materials were weighed to an accuracy of ± 1%. The materials were sieved (as required) to remove grit and lumps.

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The dry powders (calcium carbonate, talc, attapulgite, polyvinyl alcohol, HEC, Sorbitol and polyacrylamide in the table above) were then added to a ribbon blender. A ribbon blender was employed as it provided the requisite uniformity to the mix, with minimal dusting as well as minimal damage to the dry components. The dry powders were mixed for 10 minutes.

Instead of a ribbon blender, a paddle mixer or air-jet blender can be employed, with an air jet blender mixing more rapidly.

The liquid mixture (water, EVA emulsion and biocide in the table above) was prepared as follows. 725 litres of water, 96 litres of EVA emulsion and 3.2 litres of biocide were added to a wet blender and stirred.

The mixed dry blend was then transferred to the wet mix in the wet blender, and the wet and dry materials were mixed under a vacuum for 15 minutes to form a paste. Mixing of the formulation under vacuum reduced the aeration of the paste, resulting in a paste with smoother appearance, higher density and a stronger product.

The viscosity of the resultant formulation was tested. If required, additional water was added to reduce the viscosity and the paste was remixed for a further 5 minutes under vacuum. When the viscosity was satisfactory (i.e. approximately 700 B.U. at 25°C), the product was transferred to a storage tank, reading for packaging.

Example 3 – Comparative Analysis

A comparative analysis of the "Present Formulation" from Example 1 was made against two known types of plaster-based, two-part, cornice compounds ("Plaster-based 1" and "Plaster-based 2"), as follows:

Test	Units	Plaster-based 1	Plaster-based 2	Present Formulation
Colour	-	Off-White	Off-white	Off-white
Basic ingredient	-	Plaster	Plaster	Calcium carbonate
Mixability with water	G,F,P	Good	Good	Good

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Viscosity @ 25°C	BU	-	-	690
Density, wet	g/cc	-	-	1.7
Rheology	G,F,P	Poor	Good	Good
Water Content @ Trowel consistency	%	37.5	34.2	25.8
Trowelability	G,F,P	Good	Fair	Good
pH	PH	10.5	13.3	8.4
Iodine test-surface	Colour	Purple-blue	Dark blue	Grey-pink
Iodine test - below surface	Colour	Purple-blue	Pale purple	Grey
Equivalent HPMC content	%	0.31	0.32	0.37
Water retention	VG,GF,P	Good	Good	Very Good
Grab test	Pass/Fail	Pass	Pass	Pass
Shrinkage, ring 23°C/50% RH	%	6.8	13.8	15.4
Tape Adhesion 23° C	%	90	0	100
Tape Adhesion 40°C	%	0	0	100
Tape Edge Cracking 40°C	%	0	100	0
Check Cracking 40°C	0-10	0	0	0
Coverage	G,F,P	Good	Poor	Good

From these test results, it can be seen that the Present Formulation compares favourably with existing cornice compound formulations in all respects, and yet is a one part, ready-to-use formulation.

Whilst a number of specific adhesive compound embodiments have been described, it should be appreciated that the compound may be embodied in other forms.

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In the claims which follow and in the preceding summary except where the context requires otherwise due to express language or necessary implication, the word "comprising" is used in the sense of "including", that is, various features may be associated with further features in various embodiments.

Variations and modifications may be made to the parts previously described without departing from the spirit or ambit of the disclosure.

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CLAIMS

1. An aqueous-based adhesive compound comprising:

a clay;

a gelling/thickening agent derived from cellulose;

a water soluble or dispersible polymeric binder.

2. A compound as claimed in claim 1, wherein the proportion of each of the clay, cellulosic gel/thickener and water soluble/dispersible polymer is varied so as to provide a rheology to the compound which provides an acceptable level of grab, sag resistance and stability.

3. A compound as claimed in any one of the preceding claims, wherein the clay comprises a clay mineral that is selected for high water absorption.

4. A compound as claimed in any one of the preceding claims, wherein the clay comprises a hydrous aluminium and/or magnesium silicate.

5. A compound as claimed in claim 4, wherein the clay comprises one or more of: attapulgite $\{(Mg,Al)_2Si_4O_{10}(OH)\cdot 4(H_2O)\}$; sepiolite $\{Mg_4Si_6O_{15}(OH)_2\cdot 6H_2O\}$; or montmorillonite.

6. A compound as claimed in claim 5, wherein the weight % proportion of the attapulgite or sepiolite in the compound is in the range: 0.5-2.0%.

7. A compound as claimed in any one of the preceding claims, wherein the gelling/thickening agent derived from cellulose comprises one or more of: hydroxy ethyl cellulose; hydroxy propyl methyl cellulose; or methyl cellulose.

8. A compound as claimed in claim 7, wherein the weight % proportion of the cellulosic gelling/thickening agent in the compound is in the range: 0.2-1.0%.

9. A compound as claimed in any one of claims, wherein the water soluble or dispersible polymeric binder comprises one or more of:

polyvinyl alcohol;

a polymer emulsion of: ethylene vinyl acetate; polyvinyl acetate; acrylic; polyacrylamide; styrene acrylic; styrene butadiene rubber.

10. A compound as claimed in claim 9, wherein the weight % proportion of the polyvinyl alcohol in the compound is in the range: 0.2-1.0%; and wherein the weight % proportion of the one or more of the polymer emulsions (EVA/PVAc/acrylic/polyacrylamide/SA/SBR) in the compound is >2.0%.

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11. A compound as claimed in any one of the preceding claims, further comprising one or more mineral fillers.

12. A compound as claimed in claim 11, wherein the mineral filler comprises a metal carbonate-based material such as calcium carbonate, alone or in combination with a material such as quartz, dolomite, silica, gypsum, barium sulphate, talc, mica, vermiculite and the like.

13. A compound as claimed in any one of the preceding claims, further comprising a biocide for control of bacteria and fungi.

14. A compound as claimed in claim 13, wherein the biocide comprises 2[(hydroxymethyl) amino] ethanol present in the compound in an amount of >0.05wt. %.

15. A compound as claimed in any one of the preceding claims, further comprising sorbitol and/or mannitol in an amount to counteract the presence of boric acid or borate ions in use of the compound with plasterboard material.

16. An aqueous-based adhesive compound comprising clay, a gelling/thickening agent derived from cellulose and a water soluble or dispersible polymeric binder, wherein the proportion of each of the clay, cellulosic gel/thickener and water soluble/dispersible polymer is varied so as to provide a predetermined rheology to the compound.

17. A compound as claimed in claim 16, wherein the weight % proportion in the compound of each of the clay, cellulosic gel/thickener and water soluble/dispersible polymer is:

clay, being attapulgite, in the range: 0.5-2.0%;

cellulosic gelling/thickening agent, in the range: 0.2-1.0%;

water soluble/dispersible polymer, being polyvinyl alcohol, in the range: 0.2-1.0%.

18. A method of formulating a compound as claimed in any one of the preceding claims, the method comprising:

dry mixing the clay, gelling/thickening agent and water soluble or dispersible polymeric binder, together with one or more mineral fillers; and

transferring this mixture into an aqueous solution and then mixing the resultant dispersion.

19. A method as claimed in claim 18 wherein the aqueous solution comprises a pre-mixed solution/dispersion that comprises, in addition to water, an emulsion of water soluble or dispersible polymer, and a water soluble or dispersible biocide.

20. A method as claimed in claim 19 wherein the emulsion of water soluble or dispersible polymer comprises a polymer emulsion of one or more of: ethylene vinyl acetate

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copolymer; polyvinyl acetate; acrylic; polyacrylamide; polyacrylate; styrene acrylic; styrene butadiene rubber.

21. A method as claimed in any one of claims 18 to 20 wherein the resultant dispersion is mixed under vacuum.

22. A method as claimed in any one of claims 18 to 21 wherein the clay, gelling/thickening agent, water soluble/dispersible polymer and mineral filler(s) are dry mixed in a ribbon blender.