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FIRE PROTECTION COMPOSITION, USE THEREOF, AND METHOD OF PRODUCING AND APPLYING SAME

5 Field

The present invention relates to a composition which when applied to a surface provides a heat insulation layer and/or an oxygen barrier on the surface that is capable of providing protection from fire. The present invention also relates to the use of the composition as a
10 fire barrier, fire extinguisher and/or fire retardant. In addition, the present invention provides a process for preparing the composition and an apparatus for applying the composition.

Background

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Forest fires (or bush fires) have been responsible for the destruction of property and loss of life in many parts of the world. There have been numerous methods, technology and management techniques developed to try to prevent, or at least reduce such loss. However to date many parts of the world are still subject to the devastating effects of forest fires on
20 a frequent basis.

One method is to regularly conduct controlled burns to prevent the build up of decomposing vegetation which can be a fuel source for forest fires. The idea being that these burns prevent the build up of this fuel source and therefore lessen the intensity of
25 future forest fires. However, it has been shown that regular burning does not prevent fires altogether and there is also a significant drawback associated with the excessive greenhouse gas emissions that result from regular controlled burns.

Another safety measure is to douse property and vegetation with water when a forest fire
30 is detected in the vicinity. However, during intense forest fires water does not function as a significant fire retardant and evaporates quickly as soon as the temperature surrounding the

- 2 -

property increases.

Accordingly, there is a need for a method of protecting property and/or the vegetation surrounding property which may be at risk of being destroyed or damaged by forest fires.

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Another issue where fires are also a major hazard is in work areas that may include highly flammable elements such as for example engine rooms on ships, oil rigs, refineries and other industrial and semi-industrial environments. If for example electrical maintenance is being conducted in such a work area there is a significant risk that an electrical spark could
10 ignite flammable material within the work area and cause a potential harmful and sometimes fatal fire situation.

Accordingly, there is also need for a method of reducing the risk of fire in hazardous work environments.

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Summary

According to one aspect the present invention provides a thermal insulating layer that may be applied to a surface, wherein the thermal insulating layer is prepared from a
20 composition including water and a solid particulate material suspended within the composition.

In one form the composition further includes a foaming agent.

25 In one form the foaming agent is chosen from one or more surfactants. The one or more surfactants may be chosen from ionic, non-ionic, anionic, cationic and/or zwitterionic surfactants. In one form the surfactant is an anionic surfactant. In a further form the surfactant is a sulphonated anionic surfactant.

30 In one form the surfactant has a molecular weight of between 100 and 400 and in a preferred form 200 to 300.

- 3 -

In one form the solid particulate material has an average particle size of about 10 to about 200 μm . In a further form the solid particulate material has an average particle size of about 20 μm to about 70 μm . In a further form, the solid particulate material has an average particle size of about 50 μm . In one form, the solid particulate material may be chosen from an inert and/or environmentally stable material. In a further form, the solid particulate material is chosen from a fire resistant and/or non flammable material, and/or a solid particulate material which is stable at an elevated temperature about 250 $^{\circ}\text{C}$.

In one form, the solid particulate material is selected from one or more or a combination of the following: calcium carbonate; sodium carbonate, kaolin, bentonite, dolomite, fly ash and silica sand. In one form the solid particulate material is calcium carbonate.

In one form, the solid particulate material does not include Portland cement or calcium oxide, or the like.

In one form the composition includes about 1.0 to 1.5 litres of water for every 1 kilogram of solid particulate material. In another form the composition includes about 1.25 litres of water for every 1 kilogram of solid particulate material.

In one form, the composition includes about 0.1 to 5 % volume of foaming agent. In another form the composition includes about 0.5 to 2.5% volume of foaming agent. In a further form the composition includes about 0.6 to 1.2 % volume. In a further form the composition includes about 0.75% volume.

In one form the composition includes:

- (a) about 20 wt% to about 70 wt% of water;
- (b) about 30 wt% to about 80 wt% of the solid particulate material; and,
- (c) about 0.1 wt% to about 2.0 wt% of the foaming agent.

In one form the composition includes about 30 wt% to about 50 wt% water and in another

- 4 -

form about 35 wt% to about 45 wt% water.

In one form the composition includes about 40 wt% to about 70 wt % of solid particulate material and in another form about 55 wt% to about 65 wt% of the solid particulate
5 material.

In one form the composition includes about 0.3 wt% to about 1.7 wt% of the foaming agent and in another form about 0.5 wt% to about 1.2 wt % of the foaming agent.

10 In one form the thermal insulating layer is produced by first preparing the composition by adding the solid particulate material to the water together with the foaming agent. The resulting composition is then aerated which produces an aerated slurry including a cellular foam like structure. The aerated slurry may then be applied to a surface which thereby forms the thermal insulating layer capable of insulating the surface from a heat source.

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In one form the composition has a density before aeration of about 1.3 Kg/l to about 1.9 Kg/l. In one form the composition has a density before aeration of about 1.5 Kg/l to about 1.7 Kg/l.

20 In one form the composition has a density after aeration of about 0.1 Kg/l to about 1.0 Kg/l. In one form the composition has a density after aeration of about 0.4 to about 0.8 Kg/l.

In one form the thermal insulating layer also provides an oxygen barrier between the
25 surface and the atmosphere. In one form the thermal insulating layer provides protection of the surface upon which it is applied from fire.

In one form the composition after aeration has substantial adhesion properties whereby the composition is able to stick, or adhere to various surfaces thereby forming the insulating
30 layer of substantial thickness. The surfaces may be any typical surface such as found on buildings and other man made structures as well as natural surfaces and vegetation.

- 5 -

In one form, the thermal insulating layer is at least about 5 mm to about 100mm in thickness. In another form, the thermal insulating layer is at about 15 mm to about 50 mm in thickness.

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In one form, the thermal insulating layer is allowed to dry on the surface. When dried the thermal insulating layer is still capable of insulating the surface from a heat source.

10 In one form, the thermal insulating layer is water soluble and maybe removed from the surface before drying, or after drying, with the application of water.

According to another aspect the present invention provides a method of insulating a surface from a heat source, the method including:

- 15 • preparing a composition including water and a solid particulate material and optionally a foaming agent;
- aerating the composition to form an aerated slurry including a cellular foam like structure; and,
- applying the aerated slurry to the surface to form a thermal insulating layer on the surface.

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In one form, the thermal insulating layer is allowed to dry on the surface.

In one form the aerated slurry is applied to a surface by spraying the aerated slurry on to the surface.

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In one form the surface may be chosen from any surface that may be subject to a heat source. In one form, the surface may be subject to the threat of a forest fire. In this form, the surface may be a surface on a living organism such as a plant, grass, tree or the like, or the surface may be on a non-living item such as a fence, house, wall, roof or other man made structure. In this aspect the thermal insulating layer applied to one or more of these
30 surfaces provides protection of the one or more surfaces from fire.

- 6 -

In another form the surface may be an area that may be in danger of catching fire such as for example an engine room on a ship, oil rig, refinery or other industrial area. In this form, the aerated slurry may be applied to all or part of the surfaces within the area to provide a
5 heat insulating layer to these surfaces and thereby decreasing the risk of a fire commencing in that area.

According to another aspect the present invention provides an apparatus for applying the aerated slurry to a surface to provide a thermal insulating layer, the apparatus including a
10 dispenser for spraying the aerated slurry on to the surface.

In one form the apparatus further includes a containment portion for containing the aerated slurry which is fluidly coupled to the dispenser. In one form, the composition including water, a particulate material and optionally a foaming agent may be provided in the
15 container whereby the container includes a mixing device and/or an inlet for delivering air into the containment portion to assist in producing the aerated slurry.

Detailed Description and Embodiments

20 In certain embodiments of the present invention, a thermal insulating layer may be applied on a surface whereby the thermal insulating layer may then act as a thermal barrier protecting the surface from a heat source. In addition, the thermal insulating layer can act as an oxygen barrier which provides that the surface is not supplied with sufficient oxygen to form a combustion reaction. Individually and in combination providing a thermal
25 insulating layer and/or an oxygen barrier provides that a surface can be significantly protected in the instance of a fire, be it a forest fire, or a localized fire.

In certain embodiments, the thermal insulating layer is provided on a surface by applying an aerated slurry. The aerated slurry is made up of a composition including water, solid particulate material and optionally a foaming agent. This composition is then formed into
30 the aerated slurry by passing air (or another gas) into the mixture and forming a thick foam like composition with gas bubbles forming a cellular foam like structure and the solid

- 7 -

particulate material incorporated within the walls of the cellular foam like structure and thereby suspended throughout. The cellular foam like structure of the aerated slurry allows the composition to be applied to a surface and form a thermal insulating layer as the cellular foam like structure is maintained for an extended period of time. Indeed the
5 cellular foam like structure may be maintained for anywhere up to several days or weeks which allows the thermal insulating layer to substantially dry and maintain the cellular foam like structure and its heat insulating and/or oxygen barrier characteristics.

In certain embodiments, the thermal insulating layer provided by the aerated slurry provides an evaporative cooling effect on the surface to which it is applied at least until the
10 water or liquid included in the thermal insulating layer has evaporated. Even beyond this stage, the thermal insulating layer even when dried continues to provide a insulating layer or oxygen barrier which protects the surface upon which it is applied

In certain embodiments the gas used to aerate the composition to produce the aerated slurry may be selected from air, or any other suitable gas. In certain embodiments, it is
15 preferable the gas does not substantially react with the components of the composition.

In certain embodiments, the gas used to aerate the composition to produce the aerated slurry may be introduced via a compressor, however in an alternative form, the gas may be introduced by delivering the gas into the suction side of a pump that is pumping the composition as herein described. This requires the pump to pump gas as well as slurry,
20 however this removes the need for a compressor. This method may cause the pump to lose suction, necessitating re-priming of the pump if it has been stopped for a period of time. This can be overcome by fitting a recirculation valve after the pump, so that instead of starting and stopping the pump, the pump is run continuously, and the recirculation valve used to divert the product between the delivery hose and the tank.

25 The solid particulate material may be chosen from any suitable material. Although it is advantageous that the solid particulate material has an average particle size that enables the particles to be held in suspension within the aerated slurry and particularly when in the form of a cellular foam like structure. A suitable particle size may be an average particle

- 8 -

size of 10 to 200 μm . In certain embodiments the solid particulate material has an average particle size of about 20 μm to about 70 μm and in some instances about 50 μm .

The solid particulate material may be chosen from an inert and/or environmentally stable material. It may also be advantageous to choose the solid particulate material from a fire resistant or non flammable material. In certain embodiments the solid particulate material is selected from one or more or a combination of the following: calcium carbonate; sodium carbonate, kaolin, bentonite, dolomite, fly ash and silica sand. In a preferred form, the solid particulate material is chosen from calcium carbonate.

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The foaming agent may be chosen from any suitable foaming agent and may include a surfactant. In certain embodiments, the surfactant is chosen from ionic, non-ionic, anionic, cationic and/or zwitterionic surfactants.

15 In certain embodiments, the surfactant is an anionic surfactant. As used herein, the term anionic surfactant refers to a surfactant containing anionic functional groups, such as sulphate, sulphonate, phosphate, and carboxylates. Anionic surfactants include alkyl sulphates such as ammonium lauryl sulphate, sodium lauryl sulphate (SDS, sodium dodecyl sulphate, another name for the compound) and alkyl-ether sulphates sodium laureth sulphate, also known as sodium lauryl ether sulfate (SLES), sodium myreth sulfate, docusates including dioctyl sodium sulfosuccinate, perfluorooctanesulfonate (PFOS),
20 perfluorobutanesulfonate, linear alkylbenzene sulfonates (LABs), alkyl-aryl ether phosphates and alkyl ether phosphates, carboxylates including alkyl carboxylates, such as sodium stearate; sodium lauroyl sarcosinate and carboxylate-based fluorosurfactants such
25 as perfluorononanoate, perfluorooctanoate (PFOA or PFO).

In one preferred form the surfactant selected as the foaming agent is a sulphonated anionic surfactant. In a further preferred form, the surfactant has a molecular weight of between 100 and 400 and in a more preferred form a molecular weight of between 200 to 300.

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The composition may be prepared by mixing about 1.0 to 1.5 litres of water for every 1

- 9 -

kilogram of solid particulate material and including includes about 1 to 5 % volume of foaming agent. In a specific embodiment, the composition includes about 1.25 litres of water for every 1 kilogram of solid particulate material about 2.5% volume of foaming agent.

5

Once the aerated slurry is applied to a surface in sufficient quantity, the aerated slurry substantially covers the surface providing a thick insulating layer which is able to act as a thermal insulating layer, or thermal barrier, thereby protecting the surface from a heat source. In certain embodiments the thermal insulating layer is at least 5 mm thick. In a
10 preferred embodiment, the thermal insulating layer is at least 15 mm thick.

The thermal insulating layer provides a thermal barrier as soon as it is applied to a surface. At this time, the thermal insulating layer may also provide a barrier to oxygen from the surface. Once the aerated slurry dries, the thermal insulating layer remains in place on the
15 surface and continues to act as a thermal barrier and/or a barrier to oxygen.

It is also advantageous that the thermal insulating layer is water soluble and maybe removed from the surface once applied and even after drying with the application of water.

20 The ease of applying the aerated slurry to form a thermal insulating layer on a surface provides that the present invention may be used in many different applications.

It is envisaged that the present invention may be used to protect vegetation and/or man made structures in the event of forest fires. In one embodiment, the aerated slurry may be
25 applied to surfaces such as grassland, vegetation and other plants as well as man made structures such as fences, houses, sheds, barns and vehicles providing a layer of about 5 mm to 20 mm on all surfaces. The resulting thermal insulating layer protects the surfaces of the vegetation and the man made structures providing a barrier to heat from the forest fires and also providing a barrier to oxygen which significantly hinders the combustion of
30 the vegetation or man made structure.

- 10 -

In particular it has been surprisingly found that when the aerated slurry as herein described is applied to a structure such as a house, garage, shed or barn, the aerated slurry fills any cavities found in the structure such as around doors, windows and eaves as well as providing a protective layer over the remainder of the surface of the structure. By filling
5 the cavities it was found that the aerated slurry reduced the egress of any fire into the interior of the structure from a fire impacting on or located adjacent the structure. As a result, the cavity filling effect of the aerated slurry when applied to a structure significantly reduces the ability of a fire to penetrate into the interior of a structure or building which increases the fire resistance of the structure or building significantly.

10

Another environment over which the aerated slurry may be provided is in work areas that may have an increased risk of fire breaking out such as boat engine rooms or other industrial environments. Quite often maintenance work in such environments required electrical and/or welding or other maintenance which could increase the risk of fire in
15 these areas. In such an instance, the aerated slurry may be applied to the various surfaces in that environment which thereby provides a thermal insulating layer protecting the surfaces from a heat source as well as providing a barrier to oxygen. In this embodiment, a thermal insulating layer of thickness of about 30 mm to about 100 mm may be required to provide sufficient thermal insulation. Once the aerated slurry is applied, the resulting thermal
20 insulating layer provides an effective thermal barrier as well as an oxygen barrier to the surface upon which it is applied. If the thermal insulating barrier is subjected to heat from a fire in these situations, the evaporative effect of the water within the thermal insulating layer maintains the surface upon which it is applied at close to 100 °C

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The present invention will become better understood from the following example of a preferred but non-limiting embodiment thereof.

Example 1

- 11 -

A composition including 25 litres of water, and 20 kilograms of calcium carbonate was mixed together with 600 millilitres of a foaming agent which was selected from a sulphonated anionic surfactant with a molecular weight of between 200 to 300. The subsequent mixture was then aerated until an aerated slurry was formed.

- 5 The aerated slurry was then applied to a wooden fence paling providing a layer of aerated slurry with an average thickness of 15 mm. Another control fence paling was also provided after which an oxyacetylene torch was applied to the surface of the fence paling including the layer of aerated slurry for a period of 45 seconds at a distance of 15 cms. The oxyacetylene torch was then applied to the control fence paling for 45 seconds at the same
10 distance of 15 cms.

The aerated slurry was then washed off the first fence paling and the damage caused by the oxyacetylene torch on the two fence palings was compared. It was quite apparent that the fence paling including the aerated slurry was far less damaged from the heat emitted by the oxyacetylene torch than the second control fence paling.

15 **Example 2**

Four (4) Small scale thermal tests were conducted using a four burner gas stove. Each ring can be individually adjusted. K type Thermocouples connected to a data logger were used to record temperatures against time.

Determining Heat of Burner

- 20 To determine the heat being delivered by the gas burners, a cast iron pot was filled with 1 litre of water and placed on the burner. Only the two inner gas rings were lit.

The heat input into the water is given by:

$$Q = kAm\Delta T$$

Where:

- 25 Q=heat in Kj

- 12 -

K = specific heat = 4.12 Kj/KgK for water

M =mass of water

ΔT = temperature rise

From this experiment, Q/A for the two inner rings only was found to be:

5 37kW/m^2

“Bushfire Attack Level” (BAL) is used to assess the intensity of radiant heat exposure as per AS3959 (Australian Standard AS3959) in relation to building practices. There are 6 levels, the highest being “BAL-FZ” which refers to the “Flame Zone”, and this corresponds to a heat load greater than 40 kW/m^2 .

10 Hence the gas burner approximates the radiant heat likely to be experienced in the worst bushfire (forest fire) conditions.

Test 1

15 To determine the thermal properties of various formulations of compositions in accordance with embodiments of the present invention, a test was devised using the cast iron pot on the burner.

The pot was filled with approximately 1 litre of composition that had been aerated to form an aerated slurry with a foam like cellular structure, and heated using the inner two burner rings of the burner. This corresponded to a heat input of 37kW/M^2 .

20 Two thermocouples were embedded into the sample, one just above the base, and the other 12mm higher. This provided a “thickness” of the thermal insulating layer formed by the aerated composition of 12mm.

Test 1 used a composition with the following formulation:

- 13 -

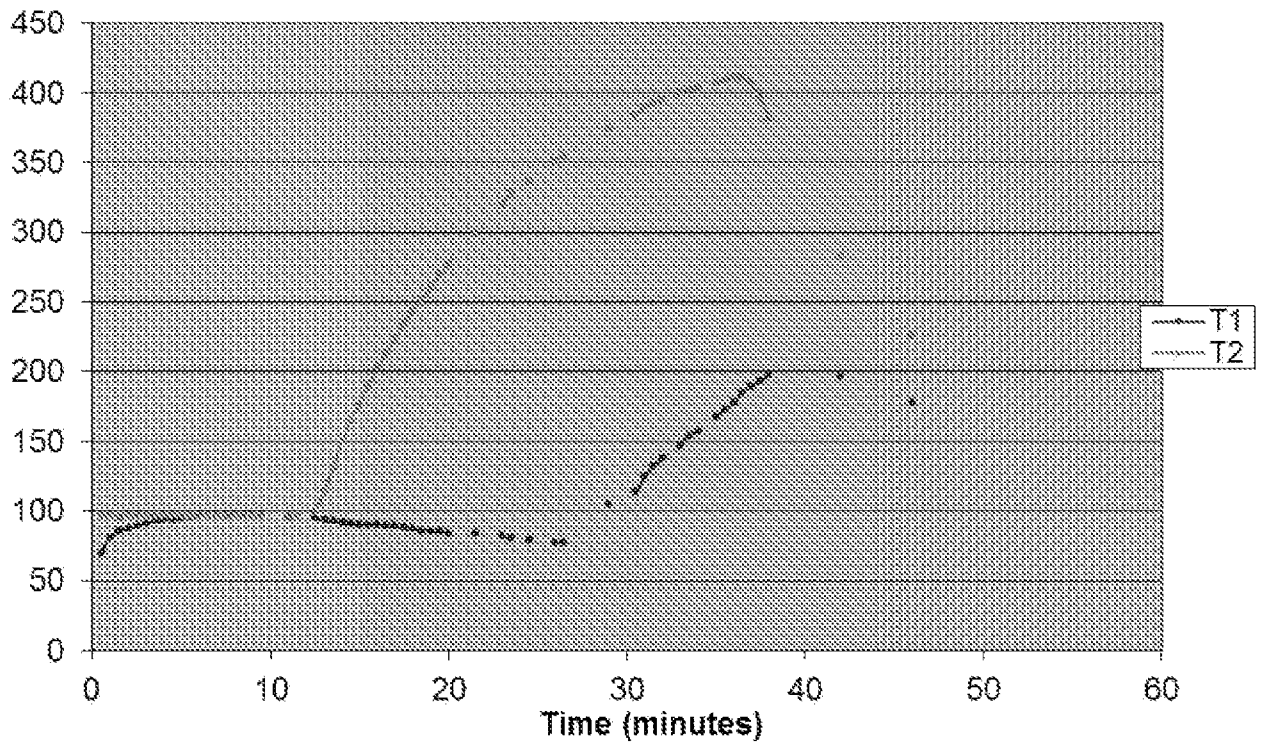
Solid particulate matter %	Water % Slurry	Surfactant Type	Surfactant % Water	Un-Foamed Density Kg/l	Foamed Density Kg/l
60%	40%	Anionic	1%	1.6	0.6

- The solid particulate matter was chosen from calcium carbonate and the surfactant was selected from a sulphonated anionic surfactant with a molecular weight of between 200 to 300. The sample was initially wet in the as foamed condition. During heating, the water within the formulation generates steam, and the sample expands. Whilst there is water within the sample, the temperature remains at around boiling point. It can be seen from the temperature traces below, that T2, the thermocouple nearest to the bottom of the pot, reaches 100 degrees soon after the experiment starts, however remains at this value for about 12 minutes.
- 5
- 10 T1, which is 12 mm higher than T2, also rises to about 100 degrees quickly, however takes about 28 minutes before the water is completely evaporated, and the temperature rises above 100 degrees.

- 14 -

The test was continued until the temperature difference had approached a steady 175 degrees.

Test 1 14/3/2014



- 5 The Specific Heat can be found as:

$$Q/A = \frac{-k\Delta T}{l}$$

For this first test k was found to be 2.5 W/mK

Test 2

The second test used the same method as Test 1, and used the following formulation:

- 15 -

Solid Particulate matter	Water % Slurry	Surfactant Type	Surfactant % Water	Un-Foamed Density Kg/l	Foamed Density Kg/l
60%	40%	Anionic	.75%	1.6	0.6

The solid particulate matter was chosen from calcium carbonate and the surfactant was selected from a sulphonated anionic surfactant with a molecular weight of between 200 to 300. In this test, the sample was initially wet in the as foamed condition. During heating,

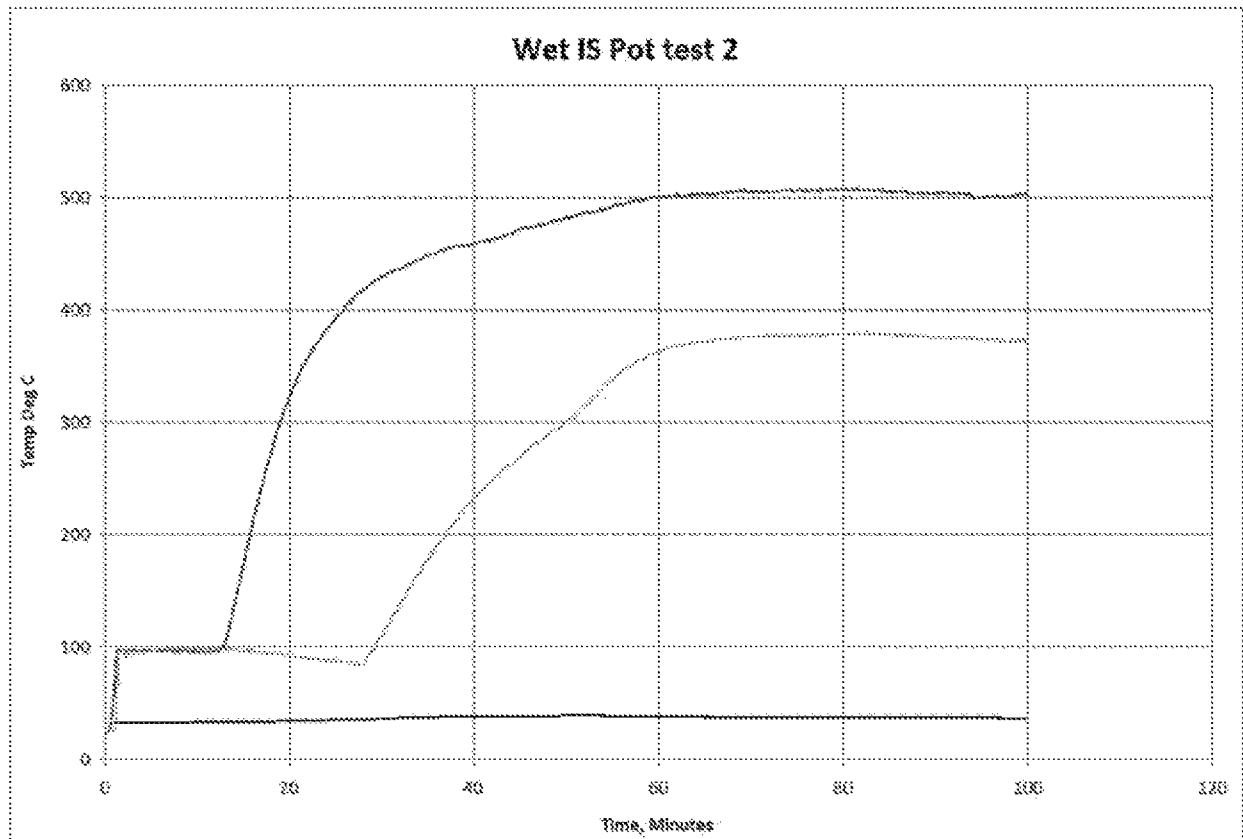
5 the water within the formulation generates steam, and the sample expands. Whilst there is water within the sample, the temperature remains at around boiling point. It can be seen from the temperature traces below, that T2, the thermocouple nearest to the bottom of the pot, reaches 100 degrees soon after the experiment starts, however remains at this value for about 12 minutes.

10 T1, which is 12 mm higher than T2, also rises to about 100 degrees quickly, however takes about 28 minutes before the water is completely evaporated, and the temperature rises above 100 degrees.

This test was continued until the temperatures had stabilised. The lower (near pot) temperature stabilised at about 507 degrees, while the upper temperature stabilised at 378

15 degrees. Note that this is not the surface temperature of the thermal insulating layer.

- 16 -



The Specific Heat can be found as:

$$Q/A = \frac{-k\Delta T}{l}$$

- 5 For this second test k was found to be 3.4 W/mK

Test 3

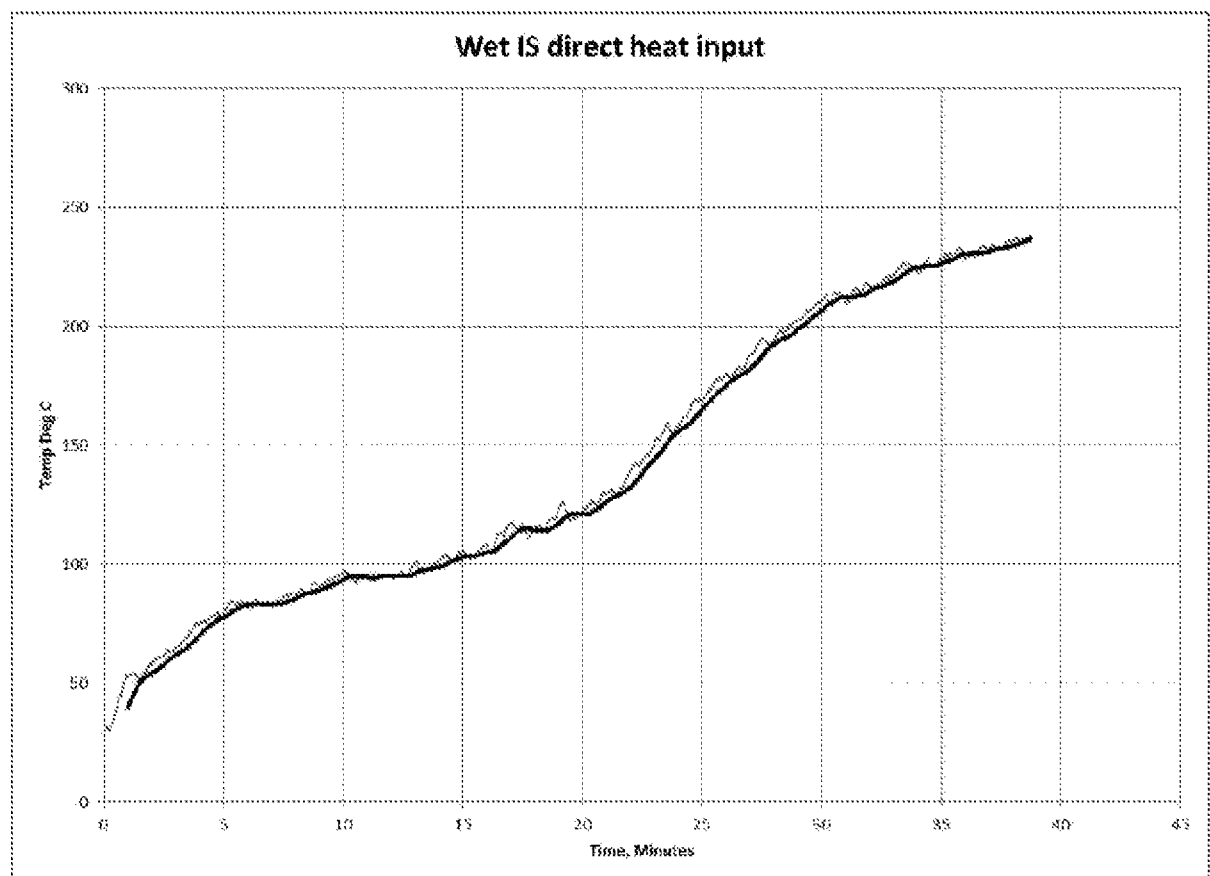
In the following tests, the pot was not used. Instead, samples were placed directly above the burners, and the temperature of a backing plate of Aluminium were logged.

- 10 A composition that had been aerated to form an aerated slurry with a foam like cellular structure approximately 17mm thick was applied to a piece of 3mm aluminium, inverted and placed on the burner. A steel mesh was used to support the sample.

- 17 -

The below figure shows the temperature trace the top surface of the aluminium. It can be seen that the temperature rise slows around 100 degrees, corresponding to the evaporation of the water from the sample. Thereafter the temperature rises until a steady equilibrium is reached with the ambient air.

- 5 This test shows that it takes approximately 15 minutes to evaporate all the water from a 17 mm thick sample, and the maximum temperature recorded of around 230 degrees is reached after about 38 minutes.



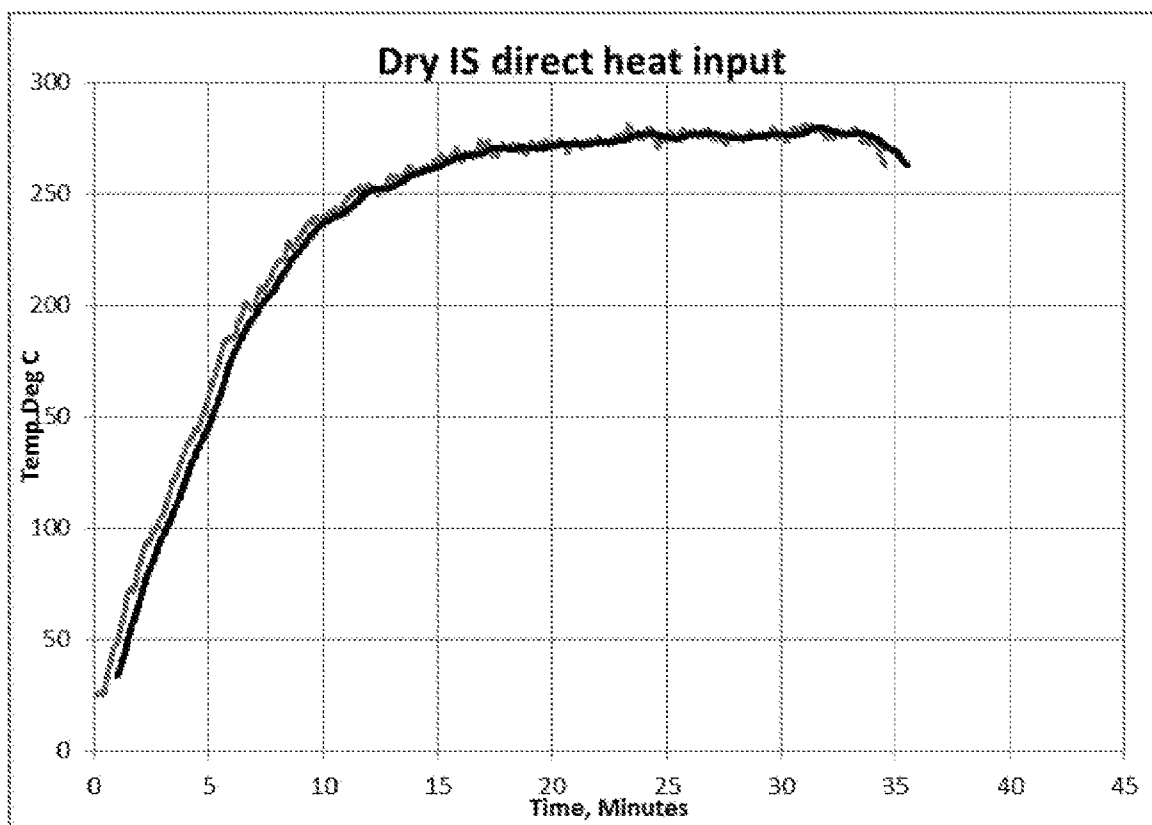
10 Test 3

Note that the temperature was asymptotically reaching a steady state temperature of approximately 280 degrees.

- 18 -

Test 4

The sample used in the previous test 3 was allowed to cool overnight before the heat being re-applied. Hence this sample had been completely dried, and allowed to return to ambient temperature (approx. 24 degrees). Note that the sample had cracked in places, and was now
5 only approximately 15mm thick. The temperature rise was similar to the previous test, however there was no “dwell” at 100 degrees. The steady state temperature was about 280 degrees.

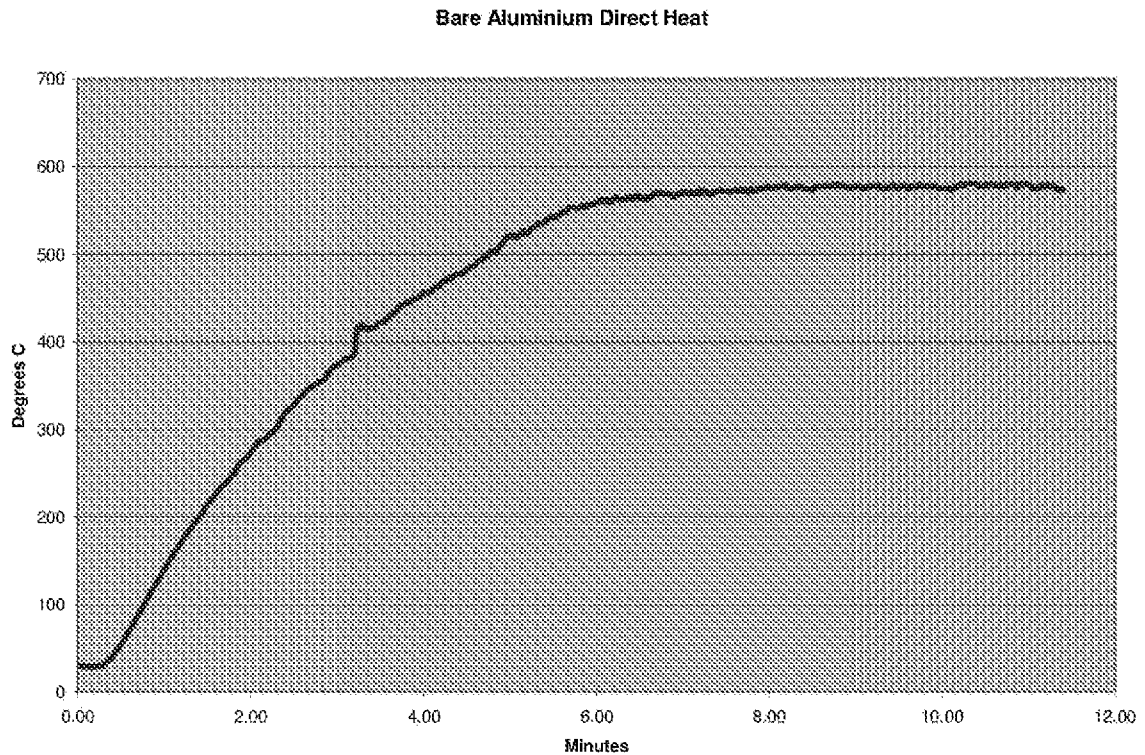


10 **Test 4**

Test 5

To provide a comparison, the aluminium panel used in the previous tests was placed on the burner.

- 19 -



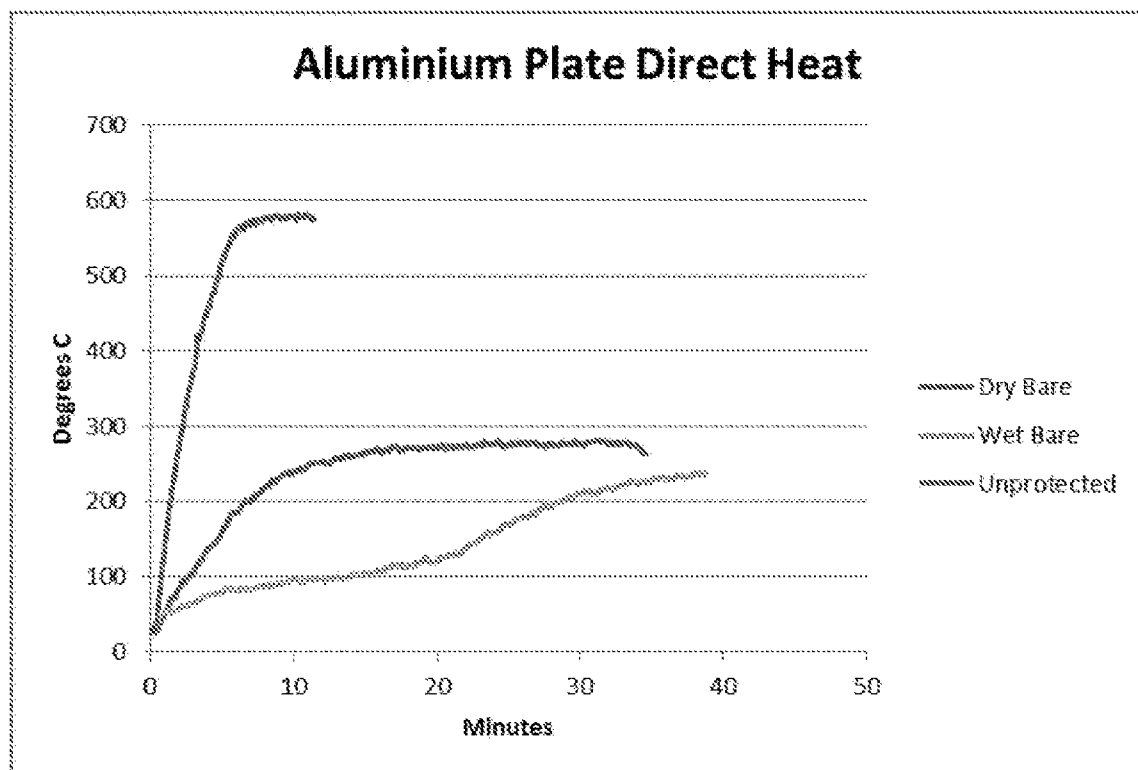
Unprotected Aluminium Plate in Direct Heat

Note that the steady state temperature was around 580 degrees, which corresponds to the melting point of some aluminium alloys. AT 400 degrees, some masking tape that was used to mount the thermocouple auto-ignited causing the small increase in the temperature at this point.

Comparison of Results

The following shows the results of Tests 3, 4 and 5 on the one graph:

- 20 -



The results clearly demonstrate the effectiveness of the thermal insulating properties of both the wet or dry sample. The unprotected aluminium plate reaches approximately 580 degrees (melting point) after about 4 minutes, whilst a layer of the sample will limit the maximum temperature to approximately 280 degrees, and increase the time taken to reach this point.

Mode of Preparation

In certain embodiments, and referring to Figures 1 and 2 the aerated composition suitable for producing a thermal insulating layer as herein described may be prepared by first mixing the solid particulate material 20 and water 10 to produce a slurry. Since a very high amount of solid particulate material 20 is to be mixed into the water 10, the solid particulate material 20 should ideally be added slowly to the water 10 while thorough mixing using a stirrer 70 is taking place. Once all the solid particulate material 20 is mixed, the surfactant or foaming agent 25 can be added. Finally air (or another suitable gas) 45 can be injected into a pump 60 recirculating the composition, and the mixture blended

- 21 -

finely using a mechanical emulsifier or pin mixer 65 to produce the foamed final product for producing a thermal insulating layer.

Figure 1 depicts an arrangement showing a batch process for producing the aerated final composition for producing a thermal insulating layer which further includes a recirculation
5 valve 35 that directs a portion or all of the flow exiting from the pin mixer 65 back to the tank 15 which effectively recycles the flow of the composition back through the pump 60 and pin mixer 35 thereby ensuring the cellular structure of the foamed composition is maximised, or at the ideal level before exiting 50 and used for its desired application.

In Figure 2, like features have been provided with like reference numerals where Figure 2
10 depicts an arrangement for the continuous process for producing the aerated composition for producing a thermal insulating layer. In addition the features shown in Figure 1, Figure 2 further includes a large cement style container 100 which may is filled with the solid particulate material 20 and this is delivered via a hopper to the tank 10 together with water 10 to produce the composition on a continuous basis.

15 Finally, it is to be understood that the inventive concept in any of its aspects can be incorporated in many different constructions so that the generality of the preceding description is not to be superseded by the particularity of the attached drawings. Various alterations, modifications and/or additions may be incorporated into the various constructions and arrangements of parts without departing from the spirit or ambit of the
20 invention.

The claims:

1. A composition for producing a thermal insulating layer applied to a surface, wherein the composition includes water and a solid particulate material suspended within the composition.
- 5 2. A composition according to claim 1 wherein the composition further includes a foaming agent.
3. A composition according to claim 2 wherein the foaming agent is chosen from one or more surfactants selected from ionic, non-ionic, anionic, cationic and/or zwitterionic surfactants.
- 10 4. A composition according to claim 2 wherein the foaming agent is an anionic surfactant.
5. A composition according to any one of the preceding claims wherein the solid particulate material has an average particle size of about 10 to about 200 μm .
- 15 6. A composition according to claim 5 wherein the solid particulate material has an average particle size of about 20 μm to about 70 μm .
7. A composition according to any one of the preceding claims wherein the solid particulate material is selected from an inert and/or environmentally stable material.
8. A composition according to any one of the preceding claims wherein the solid particulate material selected from a fire resistant and/or non flammable material, and/or a solid particulate material which is stable at an elevated temperature about 250 $^{\circ}\text{C}$.
- 20 9. A composition according to any one of the preceding claims wherein the solid particulate material is selected from one or more or a combination of the following: calcium carbonate; sodium carbonate, kaolin, bentonite, dolomite, fly ash and silica sand.
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- 23 -

10. A composition according to any one of the preceding claims wherein the solid particulate material is calcium carbonate.
11. A composition according to any one of the preceding claims wherein the solid particulate material does not include Portland cement or calcium oxide
- 5 12. A composition according to any one of the preceding claims wherein the composition includes:
 - (a) about 20 wt% to about 70 wt% of water;
 - (b) about 30 wt% to about 80 wt% of the solid particulate material; and,
 - (c) about 0.1 wt% to about 2.0 wt% of the foaming agent.
- 10 13. A composition according to any one of the preceding claims wherein the composition includes about 30 wt% to about 50 wt% water.
14. A composition according to any one of the preceding claims wherein the composition includes about 40 wt% to about 70 wt % of solid particulate material.
- 15 15. A composition according to any one of the preceding claims wherein the composition includes about 0.3 wt% to about 1.7 wt% of the foaming agent.
16. A thermal insulating layer produced from the composition according to any one of claims 1 to 15.
17. A thermal insulating layer according to claim 16 wherein the thermal insulating layer is produced by the following steps:
 - 20 • preparing the composition including: water, solid particulate material and a foaming agent;
 - aerating the composition by incorporation of a gas into the composition to form an aerated slurry including a cellular foam like structure; and,

- 24 -

- applying the aerated slurry to a surface to form the thermal insulating layer thereon.
18. A thermal insulating layer according to claim 17 wherein the composition has a density before aeration of about 1.3 Kg/l to about 3.0 Kg/l.
- 5 19. A thermal insulating layer according to claim 17 or claim 18 wherein the composition has a density after aeration of about 0.1 Kg/l to about 0.9 Kg/l.
20. A thermal insulating layer according to any one of claim 16 to 19 wherein the thermal insulating layer provides an oxygen barrier between the surface and the atmosphere.
- 10 21. A thermal insulating layer according to any one of claims 16 to 20 wherein the composition after aeration has substantial adhesion properties whereby the composition is able to stick, or adhere, to the surface.
22. A thermal insulating layer according to any one of claims 16 to 21 wherein the thermal insulating layer is at least about 5 mm to about 100mm in thickness.
- 15 23. A thermal insulating layer according to claim 22 wherein the thermal insulating layer is about 15 mm to about 50 mm in thickness.
24. A thermal insulating layer according to any one of claims 16 to 23 wherein the thermal insulating layer is allowed to dry on the surface.
25. A thermal insulating layer according to any one of claims 16 to 24 wherein the
20 thermal insulating layer is water soluble.
26. A method of insulating a surface from a heat source, the method including the following steps:
- preparing a composition including water and a solid particulate material and optionally a foaming agent;

- 25 -

- aerating the composition to form an aerated slurry including a cellular foam like structure; and,
- applying the aerated slurry to the surface to form a thermal insulating layer on the surface.

- 5 27. A method according to claim 26 wherein the thermal insulating layer is allowed to dry on the surface.
28. A method according to claim 26 or claim 27 wherein the aerated slurry is applied to a surface by spraying the aerated slurry on to the surface.
29. A method according to any one of claims 26 to 28 wherein the surface is selected
10 from any surface that may be subject to a heat source.
30. A method according to any one of claims 26 to 28 wherein the surface is selected from a surface that is subject to the threat of a forest fire including a surface on a living organism such as a plant, grass, tree or the like, or the surface is included on a non-living man made item including a fence, house, wall, roof or other man made
15 structure.
31. A method according to any one of claims 26 to 28 wherein the surface is selected from a surface that may be in danger of catching fire including: an engine room on a ship, oil rig, refinery or other industrial area.
32. An apparatus for applying an aerated slurry to a surface to provide a thermal
20 insulating layer on the surface, the apparatus including a dispenser for spraying the aerated slurry on to the surface.
33. An apparatus according to claim 32 further including a containment portion for containing the aerated slurry which is fluidly coupled to the dispenser.
34. An apparatus according to claim 32 or claim 33 wherein a composition including
25 water, a particulate material and optionally a foaming agent is provided in the

- 26 -

containment portion together with a mixing device and/or an inlet for delivering air into the containment portion to assist in producing the aerated slurry therein.