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54	TITLE OF INVENTION

Anti-loading treatments

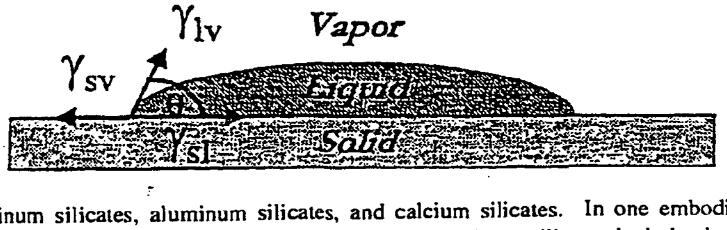
57	ABSTRACT (NOT MORE THAN 150 WORDS)

NUMBER OF SHEETS 28

The sheet(s) containing the abstract is/are attached.

If no classification is furnished, Form P.9 should accompany this form.
The figure of the drawing to which the abstract refers is attached.

A&A P208



[redacted] **Abstract:** An abrasive is oversized with a layer consisting essentially of an inorganic anti-loading agent selected from the group consisting of metal silicates, silicas, metal carbonates, and metal sulfates. The metal silicates can be selected from the group consisting of magnesium silicates, potassium aluminum silicates, aluminum silicates, and calcium silicates. In one embodiment, the magnesium silicates include talc, the potassium aluminum silicates include micas, the aluminum silicates include clays, and the calcium silicates include wollastonite. The silicas can be selected from the group consisting of fused silica, fumed silica, and precipitated amorphous silica. The metal carbonates can inlude calcium carbonate. The metal sulfates can inlcude hydrous calcium sulfate or anhydrous calcium sulfate.

ANTI-LOADING TREATMENTS

BACKGROUND OF THE INVENTION

Coated abrasive products are used to sand a wide variety of substrates, which can include soft, difficult to finish materials, such as painted surfaces. When finishing these soft materials the coated abrasive products cannot perform to their maximum potential because of premature loading. Loading is the coalescence of swarfs which clog the spaces between abrasive grains, thus preventing the abrasive product from being able to continue to effectively abrade the work substrate or surface. The abrasives industry approach is to utilize chemical compounds, such as metal soaps (i.e., zinc stearates, calcium stearates) applied as an oversize coating, or incorporated into the size coat, which is typically referred to as the first sizing coating. Stearate technology provides adequate stock removal and anti-loading characteristics. However, metal stearates leave a residue of low surface energy material on the work surface, that can potentially cause post-processing problems, such as coating defects in down stream painting processes.

Contamination of this low surface energy material can be detected by measuring the water contact angle on the sanded substrate. The typical practice to address this issue is to clean the sanded surface with solvent wipes to insure that preferably all the contamination is removed, or finish with a non-stearated product.

SUMMARY OF THE INVENTION

It would be preferable to eliminate the step of cleaning the sanded surface with solvent wipes, which expends valuable time and money in the painting process. Further, non-stearated products generally do not provide long life.

In one embodiment, an abrasive, such as coated or composite abrasive, is oversized with a layer consisting essentially of an inorganic, anti-loading agent selected from the group consisting of metal silicates, silicas, metal carbonates, and metal sulfates.

The layer consists essentially of the inorganic anti-loading additive and this is meant to indicate that the layer comprises no additive having organic components such as typify conventional anti-loading additives, including metal salts of organic acids, organophosphate, organosilicates, organoborates and the like. It does not however preclude the presence of a cured binder component that provides the vehicle by which the inorganic loading agent is applied.

The metal silicates can be selected from the group consisting of magnesium silicates, potassium aluminum silicates, aluminum silicates, and calcium silicates. In one embodiment, the magnesium silicates include talc, the potassium aluminum silicates include micas, the aluminum silicates include clays, and the calcium silicates include wollastonite. The silicas can be selected from the group consisting of fused silica, fumed silica, and precipitated amorphous silica. The metal carbonates can include calcium carbonate. The metal sulfates can include hydrous calcium sulfate or anhydrous calcium sulfate.

The anti-loading agent can have a Mohs hardness value of less than about 7, and preferably less than about 3. The anti-loading agent can have a mean particle diameter size of less than about 30 micrometers and preferably in the range of between about 1 and about 20 micrometers. This allows the anti-loading agent to form sufficiently small particles that combine with swarf from a sanded surface, such as a painted metal surface, to prevent sufficient agglomerating loading of swarf in a surface of the coated abrasive. That is, the particles of the anti-loading agent are of such a size that, upon sanding a painted surface using the coated abrasive to produce abraded swarf, particles of the anti-loading agent are released that combine with and inhibit the agglomeration of such swarf particles.

In a further embodiment, the concentration of the anti-loading agent is concentrated predominantly in the oversized layer. For example, the concentration can be at least 10 percent, by volume, and preferably at least about 60 percent, by volume, of the oversized layer.

The anti-loading agent is preferably dispersed in a binder, for example, comprising a thermoplastic or thermoset resin. For example, the thermoplastic resin can include latex and the thermoset resin can be selected from the group consisting of urea formaldehyde, phenolic, epoxy, urethane, and radiation curable resin systems.

An abrasive, such as a coated or composite abrasive, is also provided which includes a backing layer having a first surface, an abrasive layer having a plurality of abrasive particles disposed on the first surface of the backing layer, and a layer consisting essentially of an inorganic anti-loading agent disposed over the abrasive layer. In one embodiment, the anti-loading agent is deposited on a cured size coat.

A method for forming an abrasive, such as a coated or composite abrasive, is also provided which includes attaching a plurality of abrasive particles to a first surface of a backing layer and depositing a layer consisting essentially of an anti-loading agent over the abrasive particles.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing and other objects, features and advantages of the invention will be apparent from the following more particular description of preferred embodiments of the invention. The accompanying drawing is not necessarily to scale, emphasis instead being placed upon illustrating the principles of the invention.

The Figure illustrates a contact angle θ given a solid, liquid, and vapor.

DETAILED DESCRIPTION OF THE INVENTION

Coated abrasives generally comprise those products having abrasive grits adhered to a support backing which can be used to abrade or otherwise wear down a surface of an article to which they are applied.

The support backing of a coated abrasive may be rigid, but generally is flexible and typically comprises a web of material, such as paper, cloth, fibrous pad, polymeric film, vulcanized fiber, or a combination of such materials and the like. In some applications, the support backing initially includes a collection of loose fibers, to which the abrasive grits are added, with or without further binder material, to provide an abrasive web having grits throughout. The loose collection of fibers and grits may be compressed, if no adhering binder is present, or otherwise fixed or cured when a binder is present to form the coated abrasive.

The abrasive grits can generally be any material which has the capability of abrading the workpiece article and typically includes sand, flint, corundum, metallic oxides such as aluminum oxide, aluminum-zirconia, ceramic alumina, diamond, silicon carbide, garnet, rouge, crocus, and the like. The grits typically have sharp edges which act as the abrading means, but the quality and quantity of the sharp edges depends upon the utility. The grits can be embedded into or intermingled with the support backing, but, more typically are adhered to the support backing by an appropriate binder material. The grits can be applied or intermingled with the web in a specific pattern or grain or may be randomly distributed. Typically elaborate measures are taken to assure that the coated abrasive has a fixed grain with an appropriate distribution of granular cutting edges in one or more layers.

The binder material is generally any convenient material which can act to adhere the grits to the support backing and have resistance to negating the abrading process. Typical binder materials include the phenolic resins, hide glues, varnishes, epoxy resins, acrylates, multi-functional acrylates, urea-formaldehyde resins, trifunctional urethanes, polyurethane resins, lacquers, enamels and any of a wide variety of other materials which have the ability to stabilize the grits in adhering relationship to the support backing. Generally, the binding material is carefully chosen to provide maximum efficiency of the coated abrasive for the abrading surface contemplated. Care is taken in selecting binder materials which can resist softening or burning or both due to overheating yet provide adequate adherency.

The grits can be sprayed or otherwise coated with the binder material and deposited on or about the support backing, or the support backing may be coated with the binder material and the grits thereafter deposited thereon. Many alternate forms of support backings, granular materials, binder materials, means of arranging the grits on the support backing, means of adhering the grits and the like are known in the prior art and are seen as variation contemplated as within the scope of this invention.

Generally in the manufacture of a conventional coated abrasive, a backing, (with or without a pre-treatment), is given a maker coat of a binder resin is applied and, while the resin is still tacky, abrasive grits are applied over the maker coat, and the binder is cured so as to hold the grits in place. A size coat, comprising essentially a binder resin and optionally fillers, grinding aids and the like, is then applied over the grits and cured. The primary function of the size coat is to anchor the grits in place and allow them to abrade a workpiece without being pulled from the coated abrasive structure before their grinding capability had been exhausted. In some cases, a supersize layer is deposited over the size coat. The function of this layer is to place on the surface of the coated abrasive an additive that provides a special characteristic, such as enhanced grinding capability, surface lubrication, anti-static properties or, in this case, anti-loading properties. The supersize layer generally, but not necessarily, plays no part in securing the grits in place on the coated abrasive.

The additive may be applied as a dispersion in a binder (which will be subsequently cured), or in a liquid dispersion which will simply dry leaving the additive on the surface. In one embodiment, the binder includes a thermoplastic or thermoset resin. For example, the thermoplastic resin can include latex and the thermoset resin can be selected from the group consisting of urea formaldehyde, phenolic, epoxy, urethane, and radiation curable resin systems. With some additives, adhesion to the surface can be achieved without the need for a dispersion medium.

In accordance with the present invention, the anti-loading agents, which are applied over the size coating, can be selected from the group consisting of metal silicates, silicas, metal carbonates, and metal sulfates. The metal silicates can be selected from the group consisting of magnesium silicates, potassium aluminum silicates, aluminum silicates, and calcium silicates. In one embodiment, the magnesium silicates include talc, the potassium aluminum silicates include micas, the aluminum silicates include clays, and the calcium silicates include wollastonite. The silicas can be selected from the group consisting of fused silica, fumed silica, and precipitated amorphous silica. The metal carbonates can include calcium carbonate. The metal sulfates can include hydrous calcium sulfate or anhydrous calcium sulfate.

In accordance with the present invention, the inorganic anti-loading agent, in the course of use, appears to release fine particles that coat fine swarf particles generated by the grinding process thus preventing them form agglomerating to form troublesome larger particles that get trapped on the coated abrasive surface, (known as "loading"), reducing its effectiveness. Thus loading of the coated abrasive is reduced without causing the problems associated with the use of the conventional stearated anti-loading layers. With such additives, a fine coat of low energy material is smeared on the abraded surface which makes subsequent painting or polishing of the surface very difficult unless this coat is removed.

The anti-loading agent of the present invention, in one embodiment, is relatively soft, for example, having a Mohs hardness value of less than about 7, and preferably less than about 3. In one embodiment, the loading agent has a mean particle diameter size range of less than about 30 micrometers and preferably between about 1 and about 20 micrometers as finer particles size materials appear to function better as an anti-loading agent.

It is believed that one mechanism for providing a non-loading characteristic is for the anti-loading agent to prevent the swarf particles from adhering to each other, therefore reducing loading. This approach produces fine dust during sanding, while without the inorganic anti-loading agent, the swarf tends to form balls or large chips which become lodged in between the grain particles, which prevent effective grinding, and reduce the life of the coated abrasive. The difference in the appearance of the swarf resulted from sanding with stearated and non-stearated products are visible.

In accordance with the present invention, the concentration of the anti-loading agent in a sanding surface of the oversized layer is greater than about 10 percent, by volume, and preferably greater than about 60 percent. This assures the anti-loading agent is sufficiently present to be effective to produce the find dust which prevents the swarf from agglomerating.

The anti-loading agent can be used with other abrasives, such as composite (non-woven) abrasives.

Example 1: Hydrous Magnesium Silicate (Talc) in different median particle sizes

In the following Example and those following a standard conventional coated abrasive is used. The backing material is an A-weight paper and the make coat and size coat comprise a urea-formaldehyde binder. In each case the abrasive particles are P320 aluminum oxide. To this base coated abrasive, an oversize coat is applied comprising an anti-load additive. In one case, no additive was applied for comparative purposes. In a second case, an oversize coating containing zinc stearate is applied and in three other cases the applied coating was hydrous magnesium silicate (talc) with different particle size. The additives were applied as dispersion in latex and water.

The coated abrasives were then used to abrade an acrylic panel using a dual action sander for six contacts of two minute interval each. The grinding was done by a 12.7 cm (5-inch) disc with a 4.5 kg (10-lb.) load. The amount of cut after the total grinding time of 12 minutes was recorded, and the grinding performance was measured as percent cut of the control. The average surface roughness values, Ra (the arithmetic average of roughness) were also measured. The results are recorded in the Table 1 below which demonstrates that talc is as effective as the more conventional zinc stearate.

Anti-load Material	None	Zinc Stearate	Hydrous Magnesium Silicate (Talc)	Hydrous Magnesium Silicate (Talc)	Hydrous Magnesium Silicate (Talc)
Item	Base Control	Zinc Stearate	Vertal 1500	Supreme HT	Arctic Mist
Anti-load Median Particle Size	N/A	5.6 micron	15 micron	7 micron	1.9 micron
Dry coat weight (g/m^2)	N/A	14.80	~13.32	~13.32	~13.32
Filler volume % (Anti-loading Agent)	N/A	90	81	81	81
Binder volume %	N/A	9.05	11	11	11
Cut (% of Control)	100%	136%	121%	134%	137%
Surface Finish, Ra (μm)	0.46	0.41	0.46	0.46	0.46

Table 1

Vertal 1500, Supreme HT and Arctic Mist are talc's available from Luzenac America, Inc.

Example 2: Hydrous Magnesium Silicate (Talc), Supreme HT in different grit sizes

The following tables illustrate a comparison of grinding performance of Supreme HT Talc with zinc stearate, and a control with no anti-loading agent for an aluminum oxide coated abrasives in grits P80, P180, and P320 (Table 2, Table 3, and Table 4, respectively). The results show that the cut was higher with the incorporation of anti-load agent of the present invention versus base control especially in finer grits.

P80	Base Control	Witco Zn-St Dispersion	Supreme HT Talc
Dry coat weight (g/m^2)	N/A	14.80	~13.32
Filler volume % (Anti-loading agent)	N/A	90	81
Binder volume %	N/A	9.05	11
Cumulative Cut (g)	21.61	24.43	22.54
% Cut of Control	100%	113%	104%
Ra (µm)	1.88	1.96	2.05

Table 2

P180	Base Control	Witco Zn-St Dispersion	Supreme HT Talc
Dry coat weight (g/m^2)	N/A	14.80	~13.32
Filler volume % (Anti-loading agent)	N/A	90	81
Binder volume %	N/A	9.05	11
Cumulative Cut (g)	15.87	23.5	19.76
% Cut of Control	100%	148%	125%
Ra µm	0.84	0.89	0.89

Table 3

P320	Base Control	Witco Zn-St Dispersion	Supreme HT Talc
Dry coat weight (g/m^2)	N/A	14.80	~13.32
Filler volume % (Anti-loading agent)	N/A	90	81
Binder volume %	N/A	9.05	11
Cumulative Cut (g)	7.75	13.51	12.93
% Cut of Control	100%	174%	167%
Ra (µm)	0.46	0.41	0.43

Table 4

Example 3: Amorphous Silica, Calcium Silicate (Wollastonite), Aluminum Silicate (Clay), and Potassium Aluminum Silicate (Mica).

A standard P320 grit A-weight paper aluminum oxide conventional coated abrasive is used. To this base coated abrasive is applied an oversize coat comprising an anti-load additive of either Amorphous Silica, Calcium Silicate (Wollastonite), Aluminum Silicate (Clay) or Potassium Aluminum Silicate (Mica). The grinding results, set forth in Table 5 below, show that the cut was higher with the incorporation of anti-load agent of the present invention versus base control.

Anti-Load Material	N/A	Amorphous Silica	Calcium Silicate	Anhydrous Aluminum Silicate (Clay)	Hydrous Aluminum Silicate (Clay)	Hydrous Potassium Aluminum Silicate (Mica)
Item	Control	MN-23	Wollastonite	Optiwhite	Burgess 17	Mica 325
Dry coat weight (g/m^2)	N/A	4.44	51.80	7.40	16.28	2.96
Filler volume % (Anti-Loading agent)	N/A	81	83	80	79	79
Binder volume %	N/A	12	10	12	12	12
% Cut of Control	100%	161%	*113%*	179%	113%	*149%*
Surface roughness, Ra (µm)	0.61	0.51	0.43	0.53	0.61	0.38

Table 5

MN-23 is amorphous silica available from Eagle Pitcher.
Wollastonite 325 is a calcium silicate available from NYCO Minerals, Inc.
Optiwhite is clay available from Burgess Pigment Company.
Burgess 17 is a clay available from Burgess Pigment Company.
Mica 325 a mica available from Oglebay Norton Specialty Minerals.

Example 4: Calcium Sulfate (anhydrous and hydrous)

A standard P320 grit A-weight paper aluminum oxide conventional coated abrasive is used. To this base coated abrasive is applied an oversize coat comprising an anti-load additive of Calcium Sulfate (anhydrous or hydrous). The results, set forth in Table 6 below, show that the cut was higher with the incorporation of anti-load agent of the present invention versus base control.

Anti-Load Material		Anhydrous Calcium Sulfate	Hydrous Calcium Sulfate
Item	Base Control	SNOW WHITE	TERRA ALBA
Dry coat weight (g/m^2)	N/A	34.04	29.60
Filler volume % (Anti-loading agent)	N/A	76	82
Binder volume %	N/A	14	9
% Cut of Control	100%	153%	141%
Surface roughness, Ra (µm)	0.51	0.41	0.43

Table 6

SNOW WHITE is an anhydrous calcium sulfate available from United States Gypsum Company.

TERRA ALBA is a hydrous calcium sulfate available from United States Gypsum Company.

Example 5: Water contact angle of sanded paint panels after sanded by with

Primer panels were sanded with P320 grit coated abrasives with oversize coating described in Examples 1 to 4. The same sanded procedure was used with each coated abrasive. A drop of water was then placed on each of the freshly ground panels and also on panel that had received no grinding and the contact angle (θ) as described in the Figure was recorded. The contact angle is the angle between the surface of a liquid and the surface of a solid plane at the line of contact. A higher contact angle is indicative of less wetting. The results are shown in the Table 7 which clearly indicates that the panel ground with a coated abrasive according to the present invention had essentially the same or lower contact angle as the panel ground using a coated abrasive without the anti-loading layer. The coated abrasive having the conventional zinc stearate anti-loading layer clearly deposited a low surface energy residue the presence of which is indicated by the very high water contact angle. The consequence of this is that paints applied to such a surface do not readily wet the surface and this leads to surface defects.

Anti-Load Material	N/A	Zinc Stearate	Hydrous Magnesium Silicate (Talc)	Hydrous Potassium Aluminum Silicate (Mica)	Calcium Silicate	Anhydrous Calcium Sulfate
Item	Base Control	Zinc Stearate	Supreme HT	Mica 325	Wollast-onite	SNOW WHITE
Dry coat weight (g/m^2)	N/A	14.80	~7.40-17.76	2.96	51.80	34.04
Filler volume % (Anti-loading agent)	N/A	90	81	79	83	76
Binder volume %	N/A	9.05	11	12	10	14
Water Contact Angle (degree)	115	140	114	119	86	107

Table 7

The water contact angle on panel that had received no grinding is 69 degrees.

While this invention has been particularly shown and described with references to preferred embodiments thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the scope of the invention encompassed by the appended claims.

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CLAIMS

What is claimed is:

1. An abrasive oversized with a layer consisting essentially of:
   (a) a thermoplastic or thermoset resin; and
   (b) an inorganic, anti-loading agent selected from the group consisting of metal silicates, silicas, metal carbonates, and metal sulfates.

2. The abrasive of Claim 1 wherein the metal silicates are selected from the group consisting of magnesium silicates, potassium aluminum silicates, aluminum silicates, and calcium silicates.

3. The abrasive of Claim 2 wherein the magnesium silicates include talc.

4. The abrasive of Claim 2 wherein the potassium aluminum silicates include micas.

5. The abrasive of Claim 2 wherein the aluminum silicates include clays.

6. The abrasive of Claim 2 wherein the calcium silicates include wollastonite.

7. The abrasive of Claim 1 wherein the silicas are selected from the group consisting of fused silica, fumed silica, and precipitated amorphous silica.

8. The abrasive of Claim 1 wherein the metal carbonates include calcium carbonate.

9. The abrasive of Claim 1 wherein the metal sulfates include hydrous calcium sulfate or anhydrous calcium sulfate.

10. The abrasive of Claim 1 wherein the anti-loading agent has a Mohs hardness value of less than about 7.

11. The abrasive of Claim 1 wherein the anti-loading agent has a mean particle diameter size of less than about 30 micrometers.

12. The abrasive of Claim 11 wherein the anti-loading agent has a mean particle diameter size in the range of between 1 and 20 micrometers.

13. The abrasive of Claim 1 wherein the anti-loading agent is concentrated predominantly in the oversized layer.

AMENDED SHEET

14. The abrasive of Claim 1 wherein the anti-loading agent provides at least 10 percent volume of the oversized layer.

15. The abrasive of Claim 14 wherein the anti-loading agent provides at least 60 percent volume of the oversized layer.

16. The abrasive of Claim 1 in which particles of the anti-loading agent are of such a size that, upon sanding a painted surface using the coated abrasive to produce abraded swarf, particles of the anti-loading agent are released that combine with and inhibit the agglomeration of such swarf particles.

17. The abrasive of Claim 1 wherein the abrasive is selected from the group consisting of coated abrasives and composite abrasives.

18. The abrasive of Claim 1 wherein the layer consists essentially of a thermoplastic resin and an inorganic, anti-loading agent selected from the group consisting of metal silicates, silicas, metal carbonates, and metal sulfates.

19. The abrasive of Claim 1 wherein the thermoplastic resin includes latex.

20. The abrasive of Claim 1 wherein the thermoset resin is selected from the group consisting of urea formaldehyde, phenolic, epoxy, urethane, and radiation curable resin systems.

21. An abrasive comprising:
    (a) a backing layer having a first surface;
    (b) an abrasive layer having a plurality of abrasive particles disposed on the first surface of the backing layer; and
    (c) a layer consisting essentially of a thermoplastic or thermoset resin and an inorganic anti-loading agent and disposed over the abrasive layer.

22. The abrasive of Claim 21 wherein the anti-loading agent is selected from the group consisting of metal silicates, silicas, metal carbonates, and metal sulfates.

23. The abrasive of Claim 22 wherein the metal silicates are selected from the group consisting of magnesium silicates, potassium aluminum silicates, aluminum silicates, and calcium silicates.

24. The abrasive of Claim 21 in which particles of the anti-loading agent are of such a size that, upon sanding a painted surface using the coated abrasive to produce abraded swarf, particles of the anti-loading agent are released that combine with and inhibit the agglomeration of such swarf particles.

25. A method for forming an abrasive comprising:
    (a) attaching a plurality of abrasive particles to a first surface of a backing layer; and
    (b) depositing a layer over the abrasive particles consisting essentially of:
        (i) a thermoplastic or thermoset resin; and
        (ii) an anti-loading agent selected from the group consisting of metal silicates, silicas, metal carbonates, and metal sulfates.

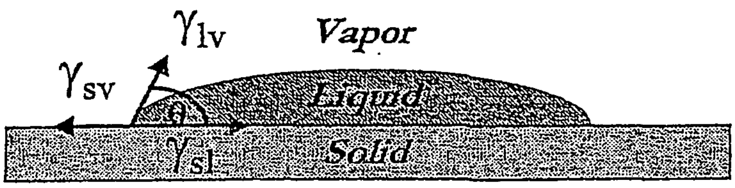
26. The method of Claim 25 wherein the metal silicates are selected from the group consisting of magnesium silicates, potassium aluminum silicates, aluminum silicates, and calcium silicates.

27. The method of Claim 26 wherein the magnesium silicates include talc.

28. The method of Claim 25 further comprising the step of depositing an intermediate layer comprising a thermoplastic or thermoset resin over the abrasive particles prior to depositing the layer of step (b).

29. The method of Claim 25 further comprising the step of forming a sanding surface of the abrasive such that the anti-loading agent is predominantly thereon.

30. The method of Claim 25 further comprising the step of dispersing the anti-loading agent in the thermoplastic or thermoset resin.


γ_{lv}
Vapor
γ_{sv}
Liquid
θ
γ_{sl}
Solid