PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 :		(11) International Publication Number:
B24C X	A2	WO 90/11163
		(43) International Publication Date: 4 October 1990 (04.10.90)

(21) International Application Number: PCT/US90/04203

(22) International Filing Date: 14 March 1990 (14.03.90)

(30) Priority data:
323,412 14 March 1989 (14.03.89) US

(71) Applicant: CHURCH & DWIGHT CO., INC. [US/US]; 496 Harrison Street, Princeton, NJ 08540 (US).

(72) Inventor: KIRSCHNER, Lawrence ; 33 Deer Path Drive, Flanders, NJ 07836 (US).

(74) Agent: GROSS, Marc, S.; Bryan, Cave, McPheeters & McRoberts, 245 Park Avenue, New York, NY 10167 (US).

(81) Designated States: AT (European patent), AU, BE (European patent), BR, CA, CH (European patent), DE (European patent), DK, DK (European patent), ES (European patent), FI, FR (European patent), GB (European patent), HU, IT (European patent), JP, KR, LU (European patent), NL (European patent), NO, RO, SE (European patent), SU.

Published
Without international search report and to be republished upon receipt of that report.

(54) Title: PROCESS FOR REMOVING COATINGS FROM SENSITIVE SUBSTRATES, AND BLASTING MEDIA USEFUL THEREIN

(57) Abstract

Blasting media for removing coatings from sensitive metal and composite surfaces, and a process useful therewith, wherein the blasting media comprise mixtures of water-soluble bicarbonate particles, e.g., sodium bicarbonate particles, with a hydrophobic silica flow/anti-caking agent.

+ See back of page

DESIGNATIONS OF "DE"

Until further notice, any designation of "DE" in any international application whose international filing date is prior to October 3, 1990, shall have effect in the territory of the Federal Republic of Germany with the exception of the territory of the former German Democratic Republic.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	ES	Spain	MG	Madagascar
AU	Australia	FI	Finland	ML	Mali
BB	Barbados	FR	France	MR	Mauritania
BE	Belgium	GA	Gabon	MW	Malawi
BF	Burkina Faso	GB	United Kingdom	NL	Netherlands
BG	Bulgaria	HU	Hungary	NO	Norway
BJ	Benin	IT	Italy	RO	Romania
BR	Brazil	JP	Japan	SD	Sudan
CA	Canada	KP	Democratic People's Republic of Korea	SE	Sweden
CF	Central African Republic			SN	Senegal
CG	Congo	KR	Republic of Korea	SU	Soviet Union
CH	Switzerland	LI	Liechtenstein	TD	Chad
CM	Cameroon	LK	Sri Lanka	TG	Togo
DE	Germany, Federal Republic of	LU	Luxembourg	US	United States of America
DK	Denmark	MC	Monaco		

PROCESS FOR REMOVING COATINGS FROM SENSITIVE SUBSTRATES, AND BLASTING MEDIA USEFUL THEREIN

This invention relates to a process for removing coatings from sensitive metal and composite surfaces or like substrates, and to blasting media useful therein.

BACKGROUND OF THE INVENTION

It is often desirable to clean or remove coatings from the surfaces of various types of structures and equipment, varying from buildings to industrial devices. Numerous techniques are known for such purposes, ranging from mechanical abrasion techniques to the application of chemicals for cleaning or removing surface coatings such as paint, sealants, lacquers or the like. Hard, durable surfaces, such as granite walls or heavy steel plating may be cleaned or stripped by vigorous abrasive techniques such as sand blasting. More delicate surfaces may require less aggressive treatments to prevent damage to the substrates.

Both commercial airlines and military agencies spend large sums in periodically stripping or abrading paint and other coatings from the exterior surfaces of modern aircraft. These surfaces comprise light weight aluminum or other metal alloys, or composites, which are relatively soft and from which paint or other coatings must be carefully removed to avoid excessive abrasion or

chemical damage. Such damage may, in extreme cases, lead to mechanical failure.

Various improved stripping techniques, similar to sand blasting, have been proposed for removing coatings from sensitive metal and composite aircraft or like surfaces. Blasting media useful for such purposes should, preferably, meet the following criteria:

1. They should be relatively non-aggressive (Mohs hardness of about 2.0-3.0);
2. They should be available in various particle size distributions for the treatment of different substrates;
3. They should be free-flowing under high humidity conditions and throughout a broad range of air pressure and media flow rates; and
4. They should be water soluble and non-polluting to facilitate easy separation from the insoluble paints and resins stripped to facilitate waste disposal.

Carr U.S. Patent No. 4,731,125 granted March 15, 1988 describes the use of plastic media for the blast cleaning of sensitive metal and composite surfaces. Such materials are however, relatively expensive, and their use may impose waste disposal problems.

Sodium bicarbonate has also been proposed as a blasting medium for removing coatings from sensitive substrates such as aircraft parts. Bicarbonate is an ideal choice for such a medium

since it readily meets criteria 1, 2 and 4 above. Thus, it is relatively non-aggressive (Mohs hardness of about 2.5), is available in a variety of particle sizes, and is both water soluble and commonly utilized to treat sewage treatment facilities for the control of alkalinity and pH. The mild abrasive characteristics of sodium bicarbonate have previously been utilized, for example, in polishing media for teeth. See, for example, U.S. Patents Nos. 3,882,638; 3,972,123; 4,174,571; 4,412,402; 4,214,871; 4,462,803; 4,482,322; 4,487,582; 4,492,575; 4,494,932, and 4,522,597.

The principal disadvantage attendant to the use of sodium bicarbonate as a blasting medium is its tendency to cake either by compaction or, more importantly, by exposure to high humidity conditions. This is particularly acute in commercial blasting operations, the compressed air streams for which are substantially saturated with moisture, i.e., have 90% or higher relative humidities, and contain oily contaminants from air compressors. In addition, commercially available sodium bicarbonate products have intrinsically poor flow characteristics due to their normal particle size distributions and crystal shapes.

The addition of flow aids to sodium bicarbonate to improve its flow and anti-caking properties is known. Thus, the blending of tricalcium phosphate (TCP) with sodium bicarbonate in baking formulas and dental air jet prophylaxis media has previously been proposed. The addition of such material substantially improves the flow and anti-caking characteristics of the bicarbonate.

TCP-treated sodium bicarbonate is however, restricted to a 3 to 6 month shelf life under ambient conditions, since the TCP absorbs moisture until saturated, after which the product cakes.

It is, accordingly, among the objects of the present invention to provide bicarbonate-containing blasting media, and a process utilizing such media for removing coatings from sensitive metal and composite surfaces. Bicarbonate blasting media which may be so utilized are free flowing and have long storage lives under adverse commercial blasting conditions, and may be utilized as blasting media at high humidities and under a broad range of finely controlled, high flow rates and air pressures. Other objects and advantages of the invention will be apparent from the following description of preferred forms thereof.

SUMMARY OF THE INVENTION

In accordance with this invention, a process for removing coatings from sensitive substrates is provided in which the surfaces are blasted with substantially saturated compressed air streams under pressures of about 10-150 psi, utilizing as a blasting medium water-soluble bicarbonate particles having particle sizes within the range of about 10-500 microns in admixture with at least about 0.2%, preferably about 0.2-3%, of a hydrophobic silica flow/anti-caking agent, by weight of the bicarbonate. Such hydrophobic silica-containing media exhibit significantly better flow characteristics than comparable media which are either free of flow aids or which contain other conventional flow aids such as TCP or hydrophilic

silica. In addition, bicarbonate blasting media incorporating the hydrophobic silica flow aid of the invention have significantly longer, substantially indefinite shelf lives, and exhibit superior resistance to the high relative humidities of commercial compressed air streams.

It is preferred to utilize sodium bicarbonate as the abrasive material in the blasting media of this invention. It is, however, intended that other water-soluble bicarbonates, e.g., alkali metal bicarbonates such as potassium bicarbonate, or ammonium bicarbonate may similarly be employed. Accordingly, while the following description principally refers to the preferred sodium bicarbonate-containing blasting media, it will be understood that the invention embraces blasting media incorporating olther water-soluble bicarbonate abrasives as well.

Hydrophobic silica has previously been utilized in admixture with hydrophilic silica as a flow aid in polishing media for dental prophylaxis. Such media are applied under conditions which differ dramatically from commercial blasting media. Thus, dental prophylaxis media contain bicarbonate particles having particle sizes of about 65-70 microns, and are applied at rates of about 3 grams per minute through 1/16-1/32 inch nozzles under the pressure of clean, laboratory compressed air supplies under pressures of about 50-100 psi. Most important, such air supplies are not substantially saturated with moisture, and present quite different flow and caking problems from those inherent in the application of commercial blasting media at high thruputs in saturated compressed air blast streams.

The blasting media of the invention consist essentially of the water-soluble bicarbonate, e.g., sodium bicarbonate, in admixture with hydrophobic silica particles. Hydrophobic silica, unlike known hydrophilic silicas, is substantially free of non-hydrogen bonded silanol groups and adsorbed water.

One preferred hydrophobic silica which may be utilized in the blasting media hereof is Aerosil R 972, a product which is available from Degussa AG. This material is a pure coagulated silicon dioxide aerosol, in which about 75% of the silanol groups on the surface thereof are chemically reacted with dimethyldichlorosilane, the resulting product having about 0.7 mmol of chemically combined methyl groups per $100m^2$ of surface area and containing about 1% carbon. Its particles vary in diameter between about 10-40 nanometers and have a specific surface area of about 110 m^2/gram. It may be prepared by flame hydrolysis of a hydrophilic silica as more fully described in Angew. Chem. 72, 744 (1960); F-PS 1,368,765; and DT-AS 1,163,784. Further details respecting such material are contained in the technical bulletin entitled "Basic Characteristics and Applications of AEROSIL", Degussa AG, August 1986.

The hydrophobic silica particles are admixed with the sodium bicarbonate blasting agent in the proportion of at least about 0.2%, and up to about 3% by weight thereof. The bicarbonate particles may be of any desired particle sizes, within the range of from about 10 to 500 microns. Preferably, when the blasting medium is utilized for

the removal of paint from exterior aircraft surfaces, it is preferred to utilize bicarbonate particles having average particle sizes of about 250-300 microns.

Blasting media thus constituted are useful for cleaning or de-coating sensitive metals, e.g., aluminum or aluminum alloys, or composite substrates, such as utilized on exterior aircraft surfaces, without abrading or otherwise damaging the substrates. Composites which can be treated with the blasting media hereof comprise matrices, e.g., epoxy resins, which may contain fibers such as glass strands, graphite or the like for reinforcement.

The blasting medium thus constituted is applied in commercial compressed air streams, i.e., streams which are substantially saturated with moisture (90% or higher relative humidities) and contain oil contaminants from compressors. The bicarbonate/hydrophobic silica blasting medium may be applied at flow rates of about 1-10 pounds per minute and under air pressures of about 10-150 psi, from 1/4 inch or larger blasting nozzles. As indicated above, and as more fully documented below, in accordance with the present invention it has been found that blasting media so constituted and employed do not cake, have excellent shelf lives, and are free-flowing. They may thus be readily employed in commercial blasting operations for removing coatings from sensitive metal and composite surfaces.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The following examples illustrate the non caking and free-flowing characteristics of the

blasting media of the present invention. In the examples, all parts and percentages are given by weight and all temperatures in ^{o}F unless otherwise indicated.

Examples 1 and 2 - Laboratory Test of Anti-Caking Properties of the Blasting Media of the Invention

The following formulations containing sodium bicarbonate particles having an average particle size of about 70 microns were evaluated for their relative cake-forming characteristics:

Example 1: $NaHCO_3$ + 0.2% hydrophobic silica (Aerosil R972)

Control A: " " " hydrophilic silica (Sylox 15)

Control B: " " " TCP

Example 2: $NaHCO_3$ + 0.5% hydrophobic silica (Aerosil R972)

Control C: " " " hydrophilic silica (Sylox 15)

Control D: " " " TCP

Control E: " without any flow aid

The formulations were evaluated for their resistance to cake-formation at 100% relative humidity in closed cardboard containers for 3 day test periods. Each formulation tested was poured on to a 20 mesh USA standard testing sieve and tapped lightly until all of the product (save for any caked product) had passed therethrough. The sieved products were thereafter poured into empty boxes and tapped firmly 5 times from a height of 1 inch. The boxes were thereafter sealed.

Triplicate samples of each formulation were placed randomly within an environmental chamber maintained at 100% relative humidity and ambient temperature, leaving at least 1/2 inch spacing between the respective samples. After 3 days aging within the environmental chamber, the samples were removed and equilibrated at ambient humidity and temperature for an additional 24 hours before being evaluated for cake formation.

After aging and equilibrating, the sample boxes were opened and the weights of the total bicarbonate contents and the residual caked portions (after light shaking) were determined. The proportions of the respective samples which had caked were then determined and reported as the average percentages of the 3 samples of each formulation. The following results were obtained:

Example or Control	Flow Aid	% of Sample Caked
Example 1	0.2% Aerosil R-972	12.3%
Control A	0.2% Sylox 15	39.7%
Control B	0.2% TCP	35.8%
Example 2	0.5% Aerosil R-972	0.6%
Control C	0.5% Sylox 15	22.0%
Control D	0.5% TCP	31.7%
Control E	No Flow Aid	32.1%

From the preceding, it may be seen that the formulations incorporating the hydrophobic silica anti-caking aid (Aerosil R-972) (Examples 1 and 2) exhibited markedly superior anti-caking properties relative to the formulas incorporating other flow aids (Controls A - D) or no flow aid (Control E).

Example 3 - Field Testing of Sodium Bicarbonate - Containing Blasting Media

Two sodium bicarbonate samples, each having an average particle size of about 250-300 microns, and one in admixture with 0.5% Aerosil R-972 hydrophobic silica, were used as media in a standard sand blasting apparatus. The apparatus was a Schmidt Accustrip System, manufactured by Schmidt Manufacturing, Inc. of Houston, Texas, having a 0.5 inch nozzle diameter and a Thompson valve connected to a 6 cubic foot blast pot and an 800 cfm compressor. The blast pot was mounted on a scale so that media flow rates could be determined.

The respective bicarbonate formulations were blasted through the nozzle at 60 psig pressure utilizing ambient compressed air which was saturated with moisture as it passed through the blasting media in the blast pot.

The sodium bicarbonate particles absent the hydrophobic silica flow aid flowed intermittently through the system, rapidly clogging the nozzle and preventing further flow. Sustained flow could not be maintained.

The bicarbonate-hydrophobic silica formulation flowed continuously through the system for more than 65 hours at controllable rates varying from 1 pound per minute to 5 pounds per minute. No flow problems were encountered therewith.

From the preceding disclosure, it will be seen that the present invention provides an improved process for cleaning or removing paint or other coatings from the surfaces of sensitive substrates, and to sodium bicarbonate-containing blasting media useful therein. It will be understood that various changes may be made in the blasting process and blasting media exemplified in the preferred embodiments described hereinabove without departing from the scope of the invention. Accordingly, the preceding description should be construed as illustrative and not in a limiting sense.

We claim:

1. A process for removing coatings from sensitive metal and composite surfaces, which comprises blasting said surfaces with a substantially saturated compressed air stream under pressures of 10-150 psi, said stream containing as a blasting medium water-soluble bicarbonate particles selected from the group consisting of alkali metal and ammonium bicarbonates, said bicarbonate particles having particle sizes within the range of 10-500 microns, in admixture with at least 0.2% of a hydrophobic silica flow/anti-caking agent, by weight of the bicarbonate.

2. The process of claim 1, wherein the bicarbonate is sodium bicarbonate, and the hydrophobic silica is substantially free of non-hydrogen bonded silanol groups and adsorbed water.

3. The process of claim 1, wherein the blast stream is applied to the surface treated at a rate of 1-10 pounds of the sodium bicarbonate particles per minute.

4. The process of claim 1, wherein the blast medium contains 0.2-3% of the hydrophobic silica, by weight of the bicarbonate.

5. The process of claim 1, wherein the bicarbonate has particle sizes within the range of 250-300 microns.

6. A blasting medium for removing coatings from sensitive metal and composite surfaces, which consists essentially of water-soluble bicarbonate particles selected from the group consisting of alkali metal and ammonium

bicarbonates, said bicarbonate particles having particle sizes within the range of 10-500 microns, in admixture with at least 0.2% of a hydrophobic silica flow/anti-caking agent, by weight of the bicarbonate.

7. The blasting medium of claim 6, wherein the bicarbonate is sodium bicarbonate, and the hydrophobic silica is substantially free of non-hydrogen bonded silanol groups and adsorbed water.

8. The blasting medium of claim 6, wherein the blasting medium contains 0.2-3% of the hydrophobic silica.

9. The blasting medium of claim 6, wherein the bicarbonate has particle sizes within the range of 250-300 microns.