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LIGNO-CELLULOSE AGGREGATE AND BLAST
CLEANING PROCESS EMPLOYING THE SAMEJoseph W. Ayers, Easton, Pa., assignor to
Agrashell, Inc., a corporation of DelawareNo Drawing. Application March 1, 1948,
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This invention relates to processes for removing coatings and deposits from the surface of various materials and to improved so-called "soft-grit" impact cleaners for use in such processes. More specifically, it relates to the cleaning of metals and other relatively hard substances and involves the removal of incrustations thereon by bombardment or impingement of the surfaces thereof using various hard, dense, tough ligno-cellulose materials in particles of certain shape and size.

Surfaces of stone, iron and the like are cleaned by bombardment with sand or other abrasives projected in a stream of compressed air or other fluid, and although the cleaning is effectively accomplished, the abrasive qualities of the sand score, etch, and pit the surfaces treated thereby limiting the field of utility of such processes. During World War II, and since then, carbon-encrusted surfaces of cylinders and other engine parts, first soaked in solvents, have been cleaned by projecting a stream of compressed air containing cracked or ground walnut shells in the form of angular particles against the surface of such parts. This blasting operation successfully cleans the metal surfaces without scoring or denting the same, but the abrasion and the impact of the angular particles is not sufficient to remove many deposits, which cannot be conveniently softened with solvents, nor adequate to accomplish the cleaning in as short a period of time as is desirable.

An object of the present invention is to provide an improved impact material or aggregate capable of removing tenacious deposits or encrustations on metals and other materials without etching or indenting the surface to be cleaned and capable of providing a sufficiently forceful impact to accomplish the cleaning operation more effectively or in a shorter period of time than when the soft grit materials heretofore suggested are used. Another object is to provide a process not requiring the use of solvents.

The impact aggregate of the present invention may be described as being composed of substantially spherical or rounded particles of ligno-cellulose materials having densities of at least 1.20, the said particles being of a size or sizes within the range of from 12 to 40 mesh. The ligno-cellulose materials suitable include hard, dense, tough nut shells and seed stones or fruit pits, such as the shells of pecan nuts, almond nuts, black walnuts, English walnuts, apricot pits, peach pits and olive pits, coconut shells, palm nut shells, and other such materials having a hardness of at

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least 15 on the Vickers scale. The materials best suited for most cleaning operations have been determined to be those having a distribution of particles throughout the range of 14 to 30 mesh.

In preparing the aggregate of the present invention, the ligno-cellulose material is ground in such manner as to provide the particles in rounded shape, a suitable grinding apparatus and procedure being disclosed in my co-pending application Serial No. 683,226, filed July 12, 1946, and now Patent No. 2,561,043 as of July 17, 1951. The ground product composed of the round particles of widely varying sizes is classified or screened to provide a cut within the range of 12 to 40 mesh. Particles outside of this range either have decidedly less cleaning power or are actually inoperable when employed in air blasting.

In accordance with a limited embodiment of the invention, a superior cleaning aggregate is obtained when both small and large particles within the range are present, each in a substantial amount. For example, in a product containing particles of from 14 to 30 mesh, most forceful results are ordinarily obtained when the aggregate is composed predominantly of larger particles or those of 14 to 20 mesh, for example about 54 per cent, by weight. In a 12 to 40 mesh product a major portion should be between 12 and 18 mesh.

In the impact cleaning process using rounded particles, the action is neither a cutting, grinding nor abrading in the accepted meaning of these terms, but is essentially a pounding, battering, or bombarding by successive impact of flying particles against the surface to which the blast is applied. The energy of each particle is small, but such energy is expended by the rounded particles upon an extremely small surface area. The cumulative effect of the thousands of particles successively hitting the same area loosens a surprisingly large number of hard, tenacious incrustations.

An outstanding advantage of the ligno-cellulose impact aggregates of the present invention is their resistance to fracture or disintegration during the cleaning operation. This toughness is of particular importance in view of the economic necessity for reuse of the aggregate a number of times. The superior ligno-cellulose aggregates of the invention, such as walnut shell particles and apricot pit particles can be recycled through the blasting equipment approximately one hundred times before being reduced to ineffective sizes. In other words, the dust lost per cycle of use is approximately 1% of the weight of the

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charge of the aggregate in the blasting equipment. By comparison sand is reduced to fines in only about five cycles.

As compared with the angular particles of ground walnut shells heretofore suggested, the rounded particles of the same shells of the same size show, on test, from four to eight times the cleaning efficiency. This means that through the use of the rounded particles more tenacious incrustations may be removed or that the same coatings may be removed more quickly and hence at less expense.

The process of the present invention using rounded ligno-cellulose particles, which are non-abrasive, do not cause appreciable wear of the nozzles through which the particles are projected. In contrast thereto processes employing sand generally wear out the nozzles in as little as one week of normal or constant use.

The product and process of the present invention may be employed to clean a wide variety of materials including both hard and relatively soft substances as iron, steel, brass, bronze and aluminum. The softer materials, however, require gentler treatment than the harder ferrous metals. The blasting of soft metals ordinarily may be satisfactorily accomplished by using lower pressures or lower particle velocity, or employing particles of smaller diameter within the stated range, or selecting ligno-cellulose materials of lower specific gravity, or employing any combination of such procedures. If the surfaces of soft metals are to be cleaned without denting them, it is of course necessary that a ligno-cellulose material be employed which has a hardness which is not greater than the hardness of the surface to be cleaned.

Ordinarily, aluminum die castings can be cleaned sufficiently without damage to the surface of the metal, but when aluminum sand castings are porous due to faulty production, the blasting process of the present invention will cause small air holes to appear in the casting. The present process may also be employed to clean chrome plating on aluminum provided the aluminum alloy under the plating is not too soft. Chrome plated steel surfaces may be speedily and efficiently cleaned.

One of the outstanding applications of the product and process of the present invention lies in the cleaning of tire molds and other rubber molds. Conventional methods for cleaning tire molds involving acetylene burning and wire brush treatment have long been considered costly and time consuming because of the danger from explosions and fires and the hand labor required. Such treatment, furthermore, plays havoc with mold surfaces and it cannot be used at all on aluminum molds.

The cleaning of such molds using the product of the present invention provides speedy, economical and thorough cleaning without damaging the molds and without involving operating hazards. The small particles of the ligno-cellulose reach remote corners and crevices of the molds not accessible by conventional cleaning methods. The blasting treatment not only accomplishes cleaning, but also the surfaces are polished due to the deposition of a thin coating of wax contained in the ligno-cellulose material. Such wax produces a protective coating and also avoids the necessity of breaking in the molds after the cleaning has been accomplished. The cost of cleaning using the blasting process is substantially less, or about one-third to one-ninth as much as the conventional process.

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This cleaning process will also remove baked enamels from the surface of glass, and paints from metal surfaces; synthetic resin flash from molded parts containing metal units, particularly those used for electrical circuits and connections, and for the peening of washed metal surfaces such as aluminum to increase their strength.

For the successful operation of the present invention, it is ordinary necessary that high air pressures, long nozzles of relatively small diameter and well-cleaned, dust-free ligno-cellulose material be employed. Conventional machines employing high pressure air may be used in the practice of the invention and these may be either of the suction feed type or the direct pressure feed type. The latter type equipment is ordinarily preferred, for it is capable of providing greater impact and hence superior cleaning results. The impact material may be used in fluid mediums other than air, as in water, steam, vapor or other liquids or gaseous media.

When suction feed blasting equipment is employed, the aggregate is continuously recycled through such equipment without the necessity for recharging until the particles are broken down, worn away or shattered to fine dust. The nozzle used on this type of equipment is designed with a suction venturi which pumps the particles from the bottom of the container holding them through a hose to the nozzle where they are picked up by the air stream going through the nozzle against the surface being blasted. They fall into a hopper below the apparatus from which they are again withdrawn by suction and recycled through the nozzle. In this type of equipment, a portion of the available kinetic energy is consumed in recycling the particles through the system by the Venturi action. A satisfactory nozzle is one of $\frac{1}{2}$ inch size having a 3 inch length providing a jet of $\frac{1}{4}$ inch size. In operating the process using such nozzle an air pressure of approximately 90 pounds per square inch is required.

When the present process is employed using direct pressure, the equipment includes a generator or pressure tank into which the aggregate is charged, and air pressure is applied to such tank in such manner as to force the particles into a mixing chamber. Beneath the tank an air stream picks up the particles as they leave the mixing chamber and carries them through the hose leading to the blasting nozzle from which they are expelled at high velocity.

In operation the amount of the ground material must be carefully controlled in relation to the air stream leaving the nozzle. If the amount of ground material carried by the air stream is too great, the velocity of the particles decreases and the blasting efficiency drops off sharply. This direct pressure type equipment should likewise be supplemented by some means of conveying the used particles which accumulate in the hopper below the blasting equipment back to the generator or pressure tank. This may be easily accomplished by means of a screw conveyor and bucket elevator, or by airveying with a suction system, or the particles may be transferred by hand.

With direct pressure equipment a nozzle of three to five inches length may be employed having a diameter of $\frac{1}{2}$ inch or $\frac{3}{8}$ inch size. When such nozzle is used, an air pressure of 90 pounds per square inch minimum in the pressure tank should be employed.

In a series of commercial tests made on the cleaning of 600 x 16 size cast steel rubber tire

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molds it was found that the time required to clean one mold with rounded particles of ligno-cellulose aggregates of 14 to 30 mesh size was from 7 to 8 minutes. When ligno-cellulose aggregates of the same size and made from the same raw material, but ground to an angular shape, were used, the time required for cleaning one mold ranged from 30 to 45 minutes.

Example

In the table below a comparison is made of the breakdown tendencies of apricot pit aggregate composed of particles of round configuration with an aggregate composed of particles of apricot pits of angular configuration, the particles in both instances being of the same size, that is a cut between 20 and 30 mesh. The operation was carried out in a suction feed blasting equipment in which the aggregates were projected through a $\frac{1}{4}$ inch jet and a $\frac{1}{2}$ inch nozzle for three minutes of continuous blasting, the amount of pressure being from 90 to 100 pounds.

Mesh—	Rounded Particles		Angular Particles	
	Gms.	Percent	Gms.	Percent
on 20.....	5.0	.64	T	0.00
on 30.....	349.5	45.00	161.5	24.00
on 40.....	315.5	46.40	280.0	41.90
on 60.....	56.5	7.28	125.0	18.70
on 100.....	15.0	1.93	41.0	6.14
—100.....	36.5	4.75	62.0	9.26
	778.0	100.00	669.5	100.00

The data in the above table shows that angular particles break down faster to finer sizes in the same length of time of blasting. In other words, the angular particles wear out faster than rounded ones.

It should be understood that the present invention is not limited to the specific materials or procedures hereinbefore described, but that it extends to all equivalents which will occur to those skilled in the art upon consideration of the scope of the claims appended hereto.

I claim:

1. An impact cleaner for use in blasting to remove coatings on metals and other surfaces comprising an aggregate composed of rounded particles of ligno-cellulose material having a density of at least 1.20, the said particles being of a size within the range of from 12 to 40 mesh.

2. An impact cleaner for use in blasting to remove coatings on metals and other surfaces comprising an aggregate composed of rounded particles of ligno-cellulose material having a density of at least 1.20, the said particles being of mixed sizes of 12-40 mesh, a substantial proportion of which is between 12 and 18 mesh and another substantial proportion of which is between 18 and 40 mesh.

3. An impact cleaner for use in blasting to remove coatings on metals and other surfaces comprising an aggregate composed of rounded particles of ligno-cellulose material having a density of at least 1.20, the said particles being between about 12 to 40 mesh size and predominantly of 12 to 18 mesh size.

4. An impact cleaner for use in blasting to remove coatings on metals and other surfaces

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comprising an aggregate composed of rounded particles of hard, dense, tough, nut shells of a hardness of at least 15 and in sizes within the range of 12 to 40 mesh.

5. An impact cleaner for use in blasting to remove coatings on metals and other surfaces comprising an aggregate composed of rounded particles of walnut shells in sizes within the range of 12 to 40 mesh.

6. An impact cleaner for use in blasting to remove coatings on metals and other surfaces comprising an aggregate composed of rounded particles of fruit pit shells in sizes within the range of 12 to 40 mesh.

7. An impact cleaner for use in blasting to remove coatings on metals and other surfaces comprising an aggregate composed of rounded particles of apricot pit shells in sizes within the range of 12 to 40 mesh.

8. A process for removing coatings and deposits from surfaces of metals and other materials which comprises bombarding the same with an aggregate composed of rounded particles of a ligno-cellulose material having a density of at least 1.20, the said particles being of a size within the range of from 12 to 40 mesh.

9. A process for removing coatings and deposits from surfaces of metals and other materials which comprises directing against the same a high velocity fluid stream containing an aggregate composed of rounded particles of a hard, dense, tough, ligno-cellulose material of a hardness of at least 15 and of varying sizes within the ranges of from 12 to 40 mesh.

10. A process for removing coatings and deposits from surfaces of metals and other materials which comprises bombarding the same with a high velocity compressed fluid stream containing an aggregate composed of rounded particles of a ligno-cellulose material having a density of at least 1.20, said particles being of mixed sizes of 12-40 mesh a substantial proportion of which is between 12 and 18 mesh and another substantial proportion of which is between 18 and 40 mesh.

11. A process for removing coatings and deposits from surfaces of metals and other materials which comprises bombarding the same with a high velocity compressed fluid stream containing an aggregate composed of rounded particles of a ligno-cellulose material having a density of at least 1.20, said particles being of about 14 to 30 mesh and predominantly of 14 to 20 mesh.

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