United States Patent Office

2,733,138

Patented Jan. 31, 1956



2,733,138

# AGRICULTURAL RESIDUE ABRASIVES

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No Drawing. Application June 14, 1950, Serial No. 168,141

4 Claims. (Cl. 51—303)

(Granted under Title 35, U. S. Code (1952), sec. 266)

The invention herein described may be manufactured and used by or for the Government of the United States of America for governmental purposes throughout the world without the payment to me of any royalty thereon.

This invention relates to novel abrasive compositions and articles of manufacture for abrading and polishing surfaces of metals, plastics, and related materials, particularly surfaces of the softer metals and alloys.

This invention has among its objects the provision of abrasive compositions embodying agricultural residue material. Still another object is the provision of an abrasive composition having unique properties, particularly for use upon surfaces which are normally torn or gouged by prior types of abrasives. Still another object is the utilization of agricultural residue material, heretofore considered of very little value, but which has been discovered to possess valuable abrasive and polishing properties when bonded together by suitable agents in the form of coverings for traveling belts, cloths, paper or in the form of solid bodies, such as wheels. Still another object of this invention is the provision of novel abrasive compositions, the use of which eliminates many operations and vehicles heretofore employed in the process of abrading, grinding, and finishing of surfaces.

According to conventional processes, surfaces of metals, including the ferrous, copper and aluminum alloys, plastics, hard-molded rubber and similar materials are abraded or ground and then finished in a series of operations. For the purpose of this specification, objects to be abraded or ground and then polished, either for the purpose of reduction to exact size or for shaping, finishing, etc., will be referred to as surfaces to be abraded.

This process has been accomplished in the prior art by using bonded vitrified materials or inorganic abrasives, such as sand, emery, carborundum, Alundum, sand stone, and the like for an initial series of abrading steps in which coarser bonded particles are first employed, followed by bonded abrasives of decreasing particle size. The final or finish operation is accomplished by using extremely fine inorganic materials, such as jewelers' rouge, calcium carbonate, aluminum oxide, silica, carborundum dust and similar materials. Those materials of particularly fine particle size are frequently employed in an unbonded state, such as suspended in water or other suitable medium, or are embodied in wax or tallow. They are customarily applied to cloth or rag wheels.

Thus in finishing the surface of a given material, a series of grinding operations is first employed involving the use of wheels, traveling belts, papers or discs carrying the abrasive. These initial grinding processes usually involve the successive use of different abrasion or grinding steps, in which wheels may be followed by traveling belts, then papers or discs; each successive stage involving a decreased particle size of the abrasive used. The finer abrasives used in the finish operation are usually applied either suspended or embodied in a liquid or semi-solid medium as previously described.

Grinding and finishing operations have always been a source of inconvenience and expense, because of the plurality of operations involved, and the necessity for elaborate exhaust systems for shielding the operators and for removing the dust and abrasive particles that are associated therewith. The airborne dust, being a distinct health hazard, has heretofore required the use of elaborate protective masks and breathing devices to protect the operators. Moreover, certain soft metals and alloys, when abraded by the usual abrasive compositions, tend to be torn, leaving the surface in an unsatisfactory condition. The soft metals that are removed chunkwise are picked up by the abrasive wheel or other agency, filling the pores and destroying its abrasive properties. Besides damage to the wheel, this frequently results in damage to the surface being abraded.

According to this invention it has been discovered that various agricultural residue materials, in particular nut shells, fruit pit shells, corncobs, grain hulls and similar substances that can be prepared as angular or granular particles, when bonded by a suitable bonding medium have surprisingly good abrasive properties. For the purpose of this specification such materials will be referred to as "agricultural residue grits" and "agricultural residue grit material." Our compositions have a greatly reduced tendency to foul when used with soft metals and are capable of removing substantial quantities of material from a surface to be abraded, yet at the same time leave the surface in smooth, clean and unscratched condition. They are thus capable of combining the finer grinding operations with the finishing process.

This invention is not to be confused with the use of nut shells, ground corncobs and similar material as cleaning agents by grit blasting. The characteristics of the agricultural residues which make them desirable materials for grit blasting, i. e., their peculiar combination of toughness, hardness and resiliency, likewise make them suitable as ingredients in the abrasive compositions of this invention. Nevertheless, the object in grit blasting of removing a minimum of material from the surface to be cleaned is directly opposite to the object realized by this invention, when these materials are bonded together and employed as abrasives.

As agricultural residue grits we may employ a wide variety of materials, such as acorn shells, almond shells, brazil nut shells, butternut shells, cashew nut shells, chestnut shells, coconut shells, filbert shells, hickory nut shells, peanut shells, pecan shells, pistachio nut shells, walnut (English or black) shells, apricot pit shells, cherry pit shells, date pits, peach pit shells, plum pit shells, prune pit shells, rice hulls, oat hulls, rice hull ash, leoti hulls, corncobs, flax shives, cereal grain straws, and the like. The abrasive compositions may be in the form of abrasive wheels, traveling belts, cloth, paper, discs, and the like.

The harder and more dense residue grits may be employed singly or in combination with other grit materials. The relatively thin-walled, non-rigid grit materials, such as straws or grain hulls, are preferably not used alone, but are used in combination with the harder grits. We prefer for general purposes combination of residue grits, for example, nut shell or fruit pit shell grits or corncobs, combined with hulls, such as rice hulls. In addition to employing combinations of different kinds of grit materials, we may also vary the ratio of coarse and fine grit particles. Thus we are able to obtain a wide variety of materials, all of which have the general property of removing substantial quantities of material from the surface being abraded, and at the same time leaving a fine finish upon the surface.

The variations of grit particle size and the variations accomplished by combining different kinds of grit materials result in a class of novel abrasive compositions or articles of manufacture possessing the desirable properties referred

to previously, varying slightly in abrasiveness, density, and kind of resulting finish. The particular type of composition most suitable for a particuar abrading problem may be chosen readily by considering the type of surface to be abraded and the nature of abrading to be done. In general, wheels possessing the coarser grits, i. e., 30 mesh and larger, together with a small proportion of grain hulls, are more suitable for the straight removal of metal, while those wheels comprising finer grits, i. e., 30 mesh and smaller, particularly of the softer residues, are more suitable for straight polishing operations. In some compositions, especially for wheels having a resilient bond, such as rubber, grain hulls may constitute the sole abrasive. The proportion of the harder grits to the softer grits and of the coarse grits to the finer grits may vary over a wide range, for example 1:1 to 10:1. Furthermore, the variation in particle size for any particular grit material may also vary over a wide range.

In general, the total grit content of the article of this invention may vary from 65 percent to over 90 percent, the balance comprising bonding agent, curing catalysts, lubricants for molding, and the like. The articles, for example, abrasive wheels, may be made by mixing the grits with other molding ingredients and forming the article by conventional molding procedure.

The bonding agent may be a cold-setting, or a thermosetting resin, for example, a furane resin prepared by condensing furfuryl alcohol in the presence of lactic acid, and further condensing the product with phenol may be employed. We have obtained good results by employing a combination of liquid and powdered phenolic resin, by first coating the grit particles with the liquid, adding powdered resin to produce a free-flowing granular mass subject to uniform distribution in a mold. Other bonding materials normally compatible with the residue grit material may be used, for example, glue, shellac, rubber, nitrocellulose, polyamide resins or mixtures of such resins, and the like. It is to be understood that this invention is not limited to any particular kind of bonding material or molding procedure. The compositions may be prepared by methods appropriate to the bonding material employed. The grits and molten binder may be intimately mixed and cast as in the case of rubber, polyamide resins and the like, or the mixture may be molded under pressure in the case of phenolic resins. Likewise, catalysts, molding lubricants, pigments and the like may be used when desired. Any bonded composition possessing the proportion of materials previously described possesses the unique and advantageous abrasive properties which characterizes this invention.

It is to be further understood that this invention is not limited to any particular article of manufacture, as for example, abrasive wheels, since the agricultural residue grit material may likewise be applied to cloth or paper sheet material in the usual manner to form an abrasive covering for traveling belts and the like, or in general to provide an abrasive covering for either rigid or flexible surfaces. For the purpose of illustration this invention will be described in relation to the preparation and evaluation of abrasive wheels.

Prior to molding, the ingredients are preferably mixed in kneading type of equipment such as ribbon mixers, dough mixers and the like, although generally, any suitable type of conventional mixing device may be used.

In the following experiments, nut shells and corncobs of 20/30 particle size were employed in combination with ground rice hulls. These materials together with the bonding material, catalyst, etc., were thoroughly mixed in a dough mixer. The mixed ingredients were then molded into wheels approximately 4" O. D. with a ¾" diameter hub. The wheels were approximately ⅝" thick.

The compositions of the following table were molded at temperatures of 300° F.–320° F. under pressures of 1000–2000 pounds per square inch.



*Table 1*

| Ingredient | Wheel No.— I Percent | II Percent | III Percent | IV Percent |
|---|---|---|---|---|
| Pecan shell grits | 61.25 | | | 71.6 |
| Corncob grits | | 71.6 | | |
| Black walnut shell grits | | | 71.6 | |
| Rice hulls | 26.25 | 17.9 | 17.9 | 17.9 |
| Liquid phenolic resin | | 4.0 | 4.0 | 4.0 |
| Powdered phenolic resin | | 6.0 | 6.0 | 6.0 |
| Furane resin | 10.4 | | | |

Tests were made whereby the conditions during abrading and polishing were comparable to those normally encountered in commercial grinding and polishing operations. Line contact between wheel and work was maintained by employing hollow metal cylinders as work pieces. These cylinders were rotated so that their surface travel was opposite to the surface travel of the wheel. The rotating piece also traversed the face of the wheel in an oscillating motion parallel to the axis of the wheel. A fixed load of five pounds per inch of wheel face was maintained, and the tests were conducted in a series of five-minute runs. The results are summarized below.

*Table 2*

| Wheel No. | Type of Metal Cylinder | Total No. of runs | Av. metal removed per 5-min. run [1] | Metal removed based on wheel diameter change for entire test |
|---|---|---|---|---|
| | | | *Mg.* | *Mg./Mil.* |
| I | Smooth aluminum | 10 | 132.1 | 19.0 |
| I | Smooth brass | 6 | 339.7 | 46.0 |
| II | Aluminum | 10 | 104.1 | 29.2 |
| II | Smooth aluminum | 7 | 60.1 | 29.6 |
| III | do | 10 | 57.1 | 12.7 |
| IV | Aluminum | 8 | 48.5 | 20.0 |
| IV | Knurled brass | 5 | 53.7 | 19.0 |

[1] Initial breaking-in run not included.

In all cases the surface condition of the ground specimen was smooth and bright.

I claim:

1. An abrasive composition essentially comprising an agricultural residue grit material taken from the group consisting of nut shells, fruit pit shells, grain hulls, and corncob material bonded in a resin matrix, said grit material being at least 65% of said composition and being substantially the sole abrasive material in said composition, said grit material being discrete granular particles of essentially angular shape and being chemically unaltered.

2. An abrasive composition essentially comprising an agricultural residue grit material taken from the group consisting of nut shells, fruit pit shells, grain hulls, and corncob material bonded in a resin matrix, said grit material being at least 65% of said composition and being substantially the sole abrasive material in said composition, said grit material being discrete granular particles of essentially angular shape and being chemically unaltered, said grit material including coarse and finer grits, the ratio of coarse grits to finer grits varying from 1:1 to 10:1, the dividing line between the coarse and the fine being 30 mesh.

3. An abrasive wheel made of a composition essentially comprising an agricultural residue grit material being a mixture of nut shell material of 20 to 30 mesh particle size and ground rice hulls bonded in a resin matrix, said grit material being at least 65% of said composition and being substantially the sole abrasive material in the said composition, said grit material being discrete granular particles of essentially angular shape and being chemically unaltered, said grit material including coarse and finer grits, the ratio of coarse grits

to finer grits varying from 1:1 to 10:1, the dividing line between the coarse and the fine being 30 mesh.

4. An abrasive wheel made of a composition essentially comprising an agricultural residue grit material being a mixture of corncob material of 20 to 30 mesh particle size and ground rice hulls bonded in a resin matrix, said grit material being at least 65% of said composition and being substantially the sole abrasive material in said composition, said grit material being discrete granular particles of essentially angular shape and being chemically unaltered, said grit material including coarse and finger grits, the ratio of coarse grits to finer grits varying from 1:1 to 10:1, the dividing line between the coarse and the fine being 30 mesh.



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