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ABRASIVE MATERIAL

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The present invention relates to improved loose granular abrasive materials of the character used in the finish grinding of hard surfaces, and to improved methods of making such materials. This application is a continuation-in-part of my copending application Serial No. 479,928, filed March 20, 1943.

In the finish grinding of certain articles, such, for example, as piezoelectric crystals, it is necessary to produce ground surfaces which are substantially free from scratches or other surface irregularities and are ground with precision accuracy to predetermined dimensions. From the standpoint of the per unit cost of each such grinding operation, it is desirable to use a low cost grinding material and to reduce the time of each grinding operation to a minimum. It has been discovered that by tumbling or agitating the articles to be ground in the presence of loose granular abrasive material, fast, uniform and accurate grinding is obtained with practically no labor cost. In utilizing this grinding method, however, the particular abrasive material used is of the utmost importance. Thus, each granule of the abrasive material must have weight and be provided with surfaces having a large number of small evenly distributed cutting points, if the grinding action is to proceed uniformly and at the proper speed. Abrasive crystals or granules of the correct size and weight necessary to obtain fast cutting are not only expensive, but in addition have a relatively small number of large cutting edges, with the result that they tend to scratch and chip the articles with which they are brought into engagement during a tumbling operation. Fine grinding powders are also very expensive and, although capable of grinding without scratching or chipping the articles with which they are brought into contact, perform the desired cutting very slowly. Moreover, if a mixture of fine and coarse abrasive materials is used, the effect of the fine material is lost, in that although a small amount of cutting or abrading is produced thereby, the predominant grinding action is produced by the larger abrasive granules, such that the surfaces of the articles are scratched or chipped to an extent not compensated for by the grinding action of the fine abrasive material.

It is an object of the present invention, therefore, to provide an improved grinding or abrasive material which is fast cutting, uniformly abrades the surfaces of articles agitated therewith, and does not produce scratches or other surface irregularities in the articles.

It is another object of the invention to provide an improved abrasive material, the individual granules of which are relatively heavy and include a large number of small cutting points uniformly distributed over the surfaces thereof.

It is a further object of the invention to provide an abrasive material having the above characteristics, which material utilizes a minimum of expensive substances and may be rapidly and cheaply made in any desired quantity.

It is a still further object of the invention to provide an improved and exceedingly simple method of making an abrasive material having improved grinding characteristics.

Generally considered, the present improved abrasive or grinding material is made up of a mass of granules or pellets of composite structure, each of which includes a core or body of cheap, easily obtainable material and a coat or surface layer formed of very fine grinding particles, which coat embraces all surface portions of the core and is formed by cementing the particles of grinding material to the surface of the core. More specifically, the body material may consist of relatively coarse granules of rock like material, such, for example, as garnet, crushed quartz, gravel, or aluminum oxide aggregate, either of the fused or unfused variety, having diameters ranging from .100" to .250". The abrasive coating which is applied to each granule of the body material consists of an admixture of a suitable bonding material, or binder, such, for example, as a sodium silicate cement, and the fine particles of a hard grinding medium, such, for example, as silicon carbide, boron carbide or diamond dust.

In the preparation of the abrasive material, the available body material is first sieved through sieves of the proper mesh in order to obtain granules having diameters within the range specified above, after which the selected body material is coated with a sodium silicate cement, lead borate, or other suitable binder or bonding agent. The adhesive coated body granules are then allowed partially to dry, after which they are mixed with an excess of the available grinding powder or material and the mixture is agitated by tumbling the same in a ball mill or the like. The fine grinding material preferably consists of 180 to 240 screen mesh boron carbide, silicon carbide or diamond dust. After the granules of body material have thus been coated with the grinding material, they are separated from each other and allowed to dry, the separation being required in order to prevent the

coated body granules from adhering to each other. After the abrasive coated granules of body material have dried sufficiently, they are baked at a temperature of approximately 300 degrees Fahrenheit for an interval of time sufficient to set the cement and thus rigidly bond the particles of grinding material to the surfaces of the body pellets.

Grinding material produced in the manner explained above is relatively very inexpensive because of the very small quantities of fine grinding powders which are required to produce the rather extensive grinding surfaces which coat the body pellets. In this regard, it is noted that during the tumbling or pebble milling of the adhesively coated body granules with the grinding powder, the surfaces of the granules are uniformly coated with the grinding powder, so that an exceedingly large number of very fine cutting points are formed on each unit surface area of each body granule. Accordingly, when the abrasive material is mixed with a batch of articles the surfaces of which are to be ground, and the mixture is tumbled or otherwise agitated, the grinding of the article surfaces proceeds at a rapid rate without the production of surface irregularities in the articles. The speed of grinding may be attributed to the weight afforded by the body of pellets. The absence of surface scratching and chipping may be attributed to the fact that only the very fine cutting points of the exposed grinding powder enter into the grinding operation, and to the additional fact that very low contact pressures are produced between the cutting points of the abrasive granules and the surfaces of the articles being ground. In addition to the advantages just mentioned, it is pointed out further that abrasive material of the character described may be separated from the articles being ground with great cleanliness, such that little additional cleaning of the articles is required after they have been separated from the abrasive material.

As indicated above, the improved abrasive material herein disclosed is particularly applicable for use in the grinding of piezoelectric crystals to predetermined dimensions, such that they are uniformly characterized by a predetermined resonant frequency characteristic. In performing such a grinding operation abrasive material formed in the manner described above may be mixed with 180 screen mesh carborundum in the ratio of four parts of abrasive material to one part carborundum. This mixture is then introduced into a tumbling or ball milling jar until the jar is approximately one-half full, after which the desired quantity of rough ground piezoelectric crystals are introduced into the mixture. When the jar is rotated at a speed of from 30 to 40 revolutions per minute, the crystals are rapidly and uniformly ground without chipping the edges thereof, without producing scratches or other irregularities in the surfaces thereof, and with the production of an appreciable amount of chamfering of the corners and edges of the crystals.

As a modification of the above-described method of making the abrasive material, it is pointed out that the cementing of the abrasive powder to the granules of body material may, if desired, be performed by a simple air drying, heat treating, fusion or vitrification of a mixture of the adhesive material, the body material, and the fine abrasive material or powder. In the latter case the abrasive powder should preferably be intermixed with the binder or bonding material before the vitrifying operation is started. If, more specifically, a glazing material is used as the bonding agent, this material should be mixed in the proper relative proportions with the abrasive material and the mixture then remixed with the body granules. The mixture may then be heated to a vitrifying temperature, agitated as required, and then allowed to cool in order to produce a bond between the body granules and the particles of abrasive material.

Although the invention has been described as being particularly applicable to the finish grinding of articles with precision accuracy, it is pointed out that it may be also utilized to produce a buffing or polishing material. To this end, body material formed of small pellets or particles of leather, wood or another soft substance may be mixed with a suitable buffing substance, such, for example, as white rouge, lime or powdered stone. This compound may be either cemented or otherwise adhesively applied to the surfaces of the pellets of soft body material, or a loose mixture of the body material and the buffing compound may be used. In either case, the polishing or buffing operation is carried out by tumbling or otherwise agitating the articles to be polished in the presence of the buffing material as formed in the manner just explained.

While different embodiments of the invention have been described, it will be understood that various modifications may be made therein, which are within the true spirit and scope of the invention.

I claim:

1. A preformed abrasive material comprising relatively large pieces of body material each provided with a substantially uninterrupted surface coating which includes a mixture of relatively fine abrasive powder and a set bonding agent rigidly securing the powder particles to the surfaces of the pieces of body material.

2. A preformed abrasive material comprising relatively large pieces of body material each provided with a substantially uninterrupted surface coating which includes 180 to 240 screen mesh boron carbide particles and a set bonding agent rigidly securing the boron carbide particles to the body piece surfaces.

3. A preformed abrasive material comprising relatively large pieces of a rock-like mineral material each provided with a substantially uninterrupted surface coating which includes a mixture of relatively fine silicon carbide and a set bonding agent rigidly securing the particles of silicon carbide to the mineral piece surfaces.

4. A preformed abrasive material comprising pieces of aluminum oxide having diameters ranging from .125 inch to .250 inch and having their respective surfaces substantially uniformly coated with a mixture consisting of 180 to 240 screen mesh boron carbide particles and a set sodium silicate cement rigidly bonding the boron carbide particles to the surfaces of said pieces.

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