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(54) Coated abrasives

(57) A coated abrasive article comprises a support member and, bonded to the support member, both sintered hard metal carbide particles and particles of another abrasive. The sintered hard metal carbide may provide 5 to 25% of the total volume of the abrasive particles and may be tungsten carbide. The other abrasive may be a harder abrasive e.g. fused alumina, zirconia-alumina, natural corundum, silicon carbide or emery. Improved performances over use of hard metal carbide or other abrasive alone is obtained. The article is particularly useful for abrading metallic e.g. steel substrates.

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SPECIFICATION

Coated Abrasives

The invention concerns coated abrasives.

Coated abrasive articles comprise a support member and, bonded to the support member, abrasives particles. Depending on the purpose for which the article is required, a wide variety of abrasive particles may be used e.g. very hard particles such as fused aluminium oxide if the article is for abrading hard surfaces such as steel or much softer particles such as crushed glass if the article is for abrading by hand relatively soft surfaces such as wood.

According to the present invention a coated abrasive article comprises a support member and, bonded to the support member, both sintered hard metal carbide particles and particles of another abrasive.

An example of a sintered hard metal carbide is sintered tungsten carbide. This has been known for many years and used for tool tips and other wear resistant components and surfaces. In crushed, particulate for it has been used for abrading relatively soft surfaces such as wood and plastics. However, we are not aware of sintered tungsten carbide being used in a coated abrasive for abrading a hard surface such as steel. Sintered tungsten carbide is of high density and this is a disadvantage in coated abrasives. Coated abrasives having a high loading of a dense abrasive are prone to loss of structural integrity in use, with possibty dangerous consequences, unless a specially strong support member is used. The weight of the coated abrasive would be reduced by using widely spaced grits but it is well known that coated abrasives having widely spaced grits are always prone to failure by grit stripping if used for grinding hard surfaces e.g. of metal. Moreover, alumina abrasives, often used in coated abrasives, although less tough than sintered tungsten carbide, are harder than that and have the additional advantage of being of substantially lower density and also cheaper.

In accordance with the present invention it has been found that using other abrasive particles together with sintered hard metal carbide particles in coated abrasives very surprisingly enables products giving improved performance to be obtained. Thus although the inclusion of a proportion of other abrasive particles reduces the proportion of the tough sintered hard metal carbide, enhanced rather than reduced performance is obtainable.

The performance of a coated abrasive has various aspects. First, the effective life of the product is important as this relates to how frequently the product requires replacement. Secondly, the rate at which the product abrades a substrate is important as this relates to the time required for a particular abrading operation to be completed. Articles according to the invention can be made having a combination of these properties superior to that of comparable articles in which all the abrasive particles are of sintered hard metal carbide. Thus, even though the effective life of an article of the invention may be somewhat less than that of an article where all the abrasive is sintered hard metal carbide, the mean rate of abrasion of a substrate by the article of the invention over its effective life may be very substantially higher, thus giving an article having a superior combination of properties.

The sintered hard metal carbide in articles of the invention may be crushed sintered tungsten carbide from a variety of sources. The tungsten carbide may contain a proportion of titanium carbide and/or tantalum carbide. Alternatively, the sintered hard metal carbide may contain a large proportion of titanium, tantalum or molybdenum carbide whether or not tungsten is also present. The matrix metal in the bonded sintered carbide may be one or more of cobalt, nickel and chromium and may be present in a total amount of 1 to 10% by weight, typically in a total amount of about 6% by weight. The sintered hard metal carbide particles are preferably of sharp, angular shape.

The particles of other abrasive are preferably harder than the sintered hard metal carbide particles and suitable materials include, for example, fused alumina, zirconia-alumina, natural corundum, silicon carbide and emery. Whether or not the other abrasive is harder than the sintered hard metal carbide, the high toughness of the latter is valuable.

It is much preferred that the sintered hard metal carbide should provide at least 2% of the total volume of the abrasive particles. With smaller amounts of sintered hard metal carbide, the carbide has a relatively small influence on the overall properties of the product. It is also preferred that the sintered hard metal carbide should not provide more than 60% of the total volume of the abrasive particles as the desirable influence of the other abrasive particles on the overall properties of the product is less marked at higher sintered hard metal carbide percentages. Moreover, high sintered hard metal carbide proportions increase the weight and cost of the product. Preferably the sintered hard metal carbide provides 5 to 25% of the total volume of the abrasive particles.

The support member in an article of the invention may be of conventional material and construction for coated abrasive manufacture. The support member is preferably flexible and may in particular be of paper, plastics, sheet material, vulcanised fibre or fibrous fabric. The fibrous fabric may be non-woven but is preferably woven and the fibres may be natural and/or synthetic. The support member may be impregnated or otherwise pretreated in order to increase its strength and/or resistance to liquids e.g. water that may be employed with the abrasive article when in use. The support member is preferably in the form of a disc or an endless belt.

The binder used to bond the abrasive particles to the support member may be as conventionally used in coated abrasives. Preferably the binder is a resin, especially a phenolic resin.

It is generally preferred that the abrasive-coated surface of the article should be substantially fully coated with abrasive particles.

Because of the presence of, for example, cobalt, certain sintered hard metal carbides have significant magnetic properties and, in the production of the coated abrasives of the invention, an electromagnetic field may be used during the deposition of the abrasive particles onto the support member in order to achieve an advantageous orientation of the hard metal carbide particles.

The articles of the invention are especially valuable for use on metallic substrates e.g. of steel.

The invention is illustrated by the following Examples.

Example 1

Crushed cemented tungsten carbide was graded to a P36 grit size distribution as defined by the FEPA (Federation of European Producers of Abrasive Products) specification and a high purity brown alumina abrasive grit was graded to the same grit size distribution. A mixture was prepared consisting of 25% by volume of the tungsten carbide and 75% by volume of the alumina grit.

To a 0.8 mm thick vulcanised fibre support member, an adhesive composition of 112 parts by weight of a 75% solids liquid resole phenolic resin, 80 parts by weight micronised dolomite filler and 3 parts by weight of water was applied at a rate of 310 g.m^{-2}.

The abrasive mixture was then sprinkled on to the adhesive-coated support member at a rate of 200 g.cm.$^{-2}$. In view of the wide difference between the densities of the abrasives the mixture was repeatedly shaken during application to maintain homogeniety.

After the abrasive application was complete, the resultant product was heated at 60°C for one hour, at 70°C for one hour and then at 95°C for 1.5 hours.

A size composition of 112 parts by weight of the same resin as above, 128 parts by weight of cryolite filler and 20 parts by weight of water was applied to the abrasive-coated surface of the support member at a rate of 390 g.cm^{-2}. For drying and curing purposes the product was then heated at 60°C for one hour, at 70°C for 1.5 hours, at 80°C for one hour and at 100°C for two hours. A 178 mm diameter disc having a 22 mm central hole was cut from the product and the disc subjected to a final curing step by heating at 145°C for two hours.

The disc, after being humidified overnight at 50% humidity and double flexed in directions perpendicular to each other was reinforced on the back with a fibrous disc 0.6 mm thick. The disc was then tested on an angle grinding machine using as test piece a mild steel strip 1.59 mm thick, 457 mm long and 95.2 mm wide. The disc was rotated at 6000 revolutions per minute and loaded with a 2 kg. weight onto one of the long edges of the test piece, which passed in a series of cycles under the disc. The disc face was at a 10° angle to the test piece. The rate of removal of steel from the test piece was measured and the end of the effective life of the disc noted, this being taken as the point when the rate of steel removal had fallen to 0.1 of the initial rate.

For comparison purposes two similar discs but having in one case the alumina grit, applied at 1400 g.m^{-2}, as sole abrasive and in the other case the tungsten carbide, applied at 4500 g.m^{-2}, as sole abrasive were similarly made and tested. Both were reinforced in the same manner as the first disc.

For the three discs, the effective life (L) expressed as number of passes over the test piece, the mean rate (R) of steel removed over the effective life of the disc and a quality factor (Q) defined as the total steel removed during the effective life of the disc multiplied by the mean cutting rate of the disc per pass were as follows:

Abrasive	L	R	Q
tungsten carbide-alumina	125	2.4	749
tungsten-carbide	155	1.6	390
alumina	45	3.5	561

It can be seen from the above table that although the mean rate of steel removal for the alumina disc was relatively high the value of this is greatly reduced by the short effective life of the disc. Also, although the effective life of the tungsten carbide disc was long, the mean rate of steel removal was low, much lower than for the alumina disc. The tungsten carbide-alumina disc had a combination of a relatively long effective life, far longer than for the alumina disc, and a relatively high mean rate of steel removal, much higher than for the tungsten carbide disc.

Example 2

Two discs were made by the method described in Example 1, using as the abrasive in one case a mixture of 5% by volume of crushed cemented tungsten carbide particles and 95% by volume of aluminium oxide abrasive particles and in the other case 100% of the aluminium oxide abrasive particles. In this Example the discs were not reinforced on the back as the discs in question did not include one with a hard metal carbide as sole abrasive, such discs being prone to fracture during testing.

The discs were tested as described in Example 1 and the following results obtained:

Abrasive	L	R	Q
tungsten carbide/ alumina (5/95% by volume)	500	2.6	3306
alumina	80	3.2	823

The results show that even the inclusion of the small proportion of the carbide greatly increases the performance of the disc as compared with the disc having the alumina as the sole abrasive. The fact that the results for the disc having alumina alone are rather better in Example 2 than in Example 1 (in Example 2 L is much greater, R a little lower and Q substantially greater) is probably wholly or chiefly a consequence of the fact that, unlike Example 1, the discs in Example 2 were not reinforced on the back.

CLAIMS

1. A coated abrasive article comprising a support member and, bonded to the support member, both sintered hard metal carbide particles and particles of another abrasive.

2. An article according to claim 1 in which the sintered hard metal carbide particles are particles of crushed sintered tungsten carbide.

3. An article according to claim 1 or claim 2 in which the particles of the other abrasive are harder than those of the sintered hard metal carbide.

4. An article according to claim 3 in which the other abrasive comprises at least one chosen from fused alumina, zirconia-alumina, natural corundum, silicon carbide and emery.

5. An article according to any of claims 1 to 4 in which the sintered hard metal carbide particles provide 2 to 60% of the total volume of the abrasive particles.

6. An article according to claim 5 in which the sintered hard metal carbide particles provide 5 to 25% of the total volume of the abrasive particles.

7. An article according to any of claims 1 to 6 in which the abrasive-coated surface of the article is substantially fully coated with the abrasive particles.

8. An article according to claim 1 substantially as hereinbefore described with reference to Example 1.

9. An article according to claim 1 substantially as hereinbefore described with reference to Example 2.

10. A method in which a metallic substrate is abraded by use of an article according to any of claims 1 to 9.

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