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71 Applicant: **NORTON COMPANY**
1 New Bond Street
Worcester Massachusetts 01606(US)

72 Inventor: **Sioui, Richard H.**
18 Avery Heights Drive
Holden Massachusetts(US)

74 Representative: **Baillie, Iain Cameron et al**
c/o Ladas & Parry Isartorplatz 5
D-8000 München 2(DE)

54 **Grinding wheel.**

57 A composite grinding wheel having an abrasive rim containing super abrasive grits, an active halide filler, and particulate silver, mounted on an aluminum powder filled polymer core is improved as to electrolytic degradation between the rim and the core by substituting copper or some other non-aluminum filler for the aluminum in the core immediately adjacent toe grinding section of the wheel.

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The invention relates to grinding wheels having a non-abrasive core supporting an abrasive containing rim, in particular, a super abrasive material in which the rim abrasive section contains active filler material and silver powder.

5 Diamond grit or CBN grit containing grinding wheels are customarily made with an abrasive rim section and a supporting core. Because of the need for strength and thermal conductivity, the core is desirably an organic polymer filled with a metal powder. Aluminum is a particularly desirable filler metal for the core because of its relatively low density, high conductivity, and low cost.

U.S. Patent 3,868,233, teaches that such cores may employ aluminum, copper, or a mixture of aluminum and copper as a filler. In addition, graphite has been employed to facilitate dressing away of the core material near the abrasive rim in cup-type wheels. Such wheels may employ the graphite additive only 10 in the portion of the core adjacent to the abrasive rim.

With the advent of the use of cubic boron nitride abrasive grits, the use of active fillers in the abrasive rim section became commercially used to improve the grinding of ferrous and other metals. Such fillers, which improve the grindability of the metal work piece may also be used in cases where diamond is the abrasive, or where a blend of diamond and CBN is used. Secondary, non premium abrasives may also be used. The diamond and CBN are preferably metal clad. Nickel is a common cladding.

For optimum performance in the grinding of tool steels, the inclusion of silver powder in the abrasive section, together with the active filler has been found particularly advantageous. To reduce the power consumption it is also desirable to include a dry film lubricant filler in the abrasive rim. Such fillers include 20 Teflon, graphite, hexagonal boron nitride, and molybdenum disulphide. British published Application 2136011-A corresponding to West German Application 3404851-A, published July 16, 1984, discloses resin bonded grinding wheel rims containing CBN, active filler, dry film lubricant, and silver powder.

Although such wheels, when the rim is mounted on the core containing aluminum powder as a filler, have shown high efficiency in the grinding of difficult-to-grind tool steels, they have suffered from instability 25 when stored in a humid atmosphere. In such wheels the damage occurs at the interface between the abrasive rim and the aluminum bearing core, and in severe cases causes the rim to crumble apart.

Further investigation of the degradation effect in a humid atmosphere led to the discovery that the problem was caused by an electrolytic action between the aluminum in the core and the silver in the rim, in the presence of electrolytes such as the halogen salts used as active fillers. In accordance with the known 30 standard oxidation reduction potentials of silver salts and aluminum it is postulated that silver ions (Ag^+) from the surface of the silver particles migrate toward the core section due to the electrolytic effect of the couple between Ag^+ and aluminum metal. Since removal of the silver from the rim would reduce the grinding efficiency of the abrasive, and substitution of some other metal for aluminum would increase the cost, density, (resulting in balance problems) and/or thermal conductivity of the core, the solution to the 35 problem was not apparent.

The effective solution, the subject of this invention, was found to be a substitution of copper for the aluminum in the core at those portions of the core immediately adjacent the abrasive containing section, while retaining aluminum filler in the major portion of the core.

In the drawing, figure 1 shows a straight wheel with a composite core 10 of the aluminum filled resin, 40 with a non-aluminum section 11 adjacent to the abrasive rim 12, and a mounting hole 13.

Figure 2 shows a cup-type wheel with an aluminum filled core 20, and non-aluminum filled portion 21, an abrasive rim 22, and a mounting hole 23.

In the manufacture of cup-type wheels which were tested for reaction to a humid environment, reported below, first the core was formed in a mold oriented such that the portion cup shaped core which will be 45 adjacent to the CBN section in the bottom. Sufficient copper filled resin powder to build the section 21 in Figure 2 is placed in the mold, hand packed, and leveled. The aluminum powder containing resin is then placed on top, packed and leveled. The entire assembly is then pressed and the core removed from the mold. The lower portion of the core is then shaped on a lathe to provide a recess into which the drive rim section fits in a subsequent molding operation.

50 Various methods of constructing a composite wheel of this type, and various core compositions containing aluminum powder are discussed in U.S. Patent 3,868,233, incorporated herein by reference.

Typical molding conditions are 5 tons per square inch pressure, a temperature of $160^\circ C.$, and a molding time of 20 minutes. The final cure can be carried out in an air atmosphere oven for 24 hours at $175^\circ C.$ As is known in the art, the time and temperature of cure is varied to control the grade of hardness of 55 the wheel depending upon the specific application.

Abrasive rims were fabricated containing CBN (cubic boron nitride) abrasive grits, nickel clad, 25% by volume (based on the CBN volume), and mounted on cores of different composition. A suitable formulation for the bond and fillers for the rim is as follows:

	<u>Material</u>	<u>Volume %</u>
	KAlF ₄ active filler (powder)	25
5	Silver powder	20
	MoS ₂ powder (dry film lubricant)	10
	Phenolic resin (novolac powder	
	containing 2 vol % CaO based on	
10	total bond volume)	45

The mix for the rim sections was prepared by wetting the CBN abrasive grit material with furfural and blending it with the mixture of bond and fillers. The mix was cold pressed to a shape in the recess in the cup, and the whole assembly cured by heat.

Wheels, for test purposes, were made having unitary aluminum filled cores, and some having composite cores, as in Figures 1 and 2. Wheels having composite cores, in which the section adjacent the rim contained copper or no metallic filler survived a period of 8 days exposure to hot humid air (85 to 90% relative humidity at 120°C.), while the wheel with all-aluminum filled cores, suffered catastrophic degradation of the rim sections.

Other metals than copper, having a lower EMF difference than that between aluminum and silver may be used, such as nickel, iron, or cobalt. Copper is preferred as less active and of higher thermal conductivity. The core material may also contain graphite and other fillers. A suitable core composition is taught in U.S. Patent 3,868,233.

Claims

1. A grinding wheel having a core section and an abrasive-containing rim portion, the major portion of the core section being a resin polymer with an aluminum powder filler, a minor portion of the core adjacent the abrasive containing rim portion being a resin polymer free of aluminum powder filler, and the abrasive-containing portion including silver powder and an active filler, whereby significant electrolytic action between the aluminum-containing portion of the core and the abrasive-containing rim is blocked by the copper-containing core portion.

2. A grinding wheel according to claim 1, in which the active filler is a halide salt.

3. A grinding wheel according to claim 1 or 2, in which the abrasive is cubic boron nitride or diamond and is clad with nickel.

4. A grinding wheel according to any one of the preceding claims, which is the form of a cup-wheel.

5. A grinding wheel according to any one of the preceding claims, in which the portion of the core adjacent the rim contains copper powder filler.

