

## Fabrication of an Abrasive Wheel using Garnet Sand

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### Introduction

Economic sand accumulations are found along Eastern and Southern coastal belts of Sri Lanka. These mineral sand deposits consist of ilmenite, rutile, zircon, garnet, magnetite, monazite, sillimanite and quartz. Mineral sand separation plants separate minerals using their physical properties such as specific gravity, magnetic properties and conductivity. Garnet is produced as a by-product of this separation process and is removed as a tailing. Southern coastal areas of Sri Lanka such as Tangalle, Ussangoda and Kirinda are known for large scale garnet sand accumulations.

Garnet is a mineral with relatively high hardness value. Therefore it can be used as an abrasive material for various applications such as tool sharpening, wood polishing, and metal polishing. Water jet cutting machines use garnet in fine powder form as the abrasive material. There are two types of abrasive materials, namely coated abrasives and bonded abrasives which can be made out of garnet sand. Bonded abrasives are used mainly in abrasive wheels where a suitable bonding material binds the abrasive. These abrasive wheels can be used for removing very fine quantities of material from the work piece. Grinding is a process of removal of particles and surface generation used to shape and finish components made of metals, wood and other materials. Grinding process needs an abrasive product usually a rotating wheel in contact with a work surface. The grinding wheel is composed of abrasive grains held together in a binder. These abrasive grains act as cutting tools and remove very small chips of material from the work piece. Bonded abrasives are used for this sort of applications. Various bonding materials such as vitrified bond, rubber bond, shellac bond, metal bond are used in abrasive wheels. This research was carried out to produce an abrasive wheel using Sri Lankan garnet sands and different types of bonding agents. Performance of each combination was tested.

### Methodology

Rubber and resin organic bonding materials were used to fabricate the abrasive wheel. Latex and dry rubber, which are natural rubber forms were used for the rubber bonded abrasive wheel. Resin bonded abrasive wheel was made with polyester resin.

Table 1. Material composition of dry rubber bonded abrasive wheel.

Ingredient	Parts by weight
Natural dry rubber	100
Zinc Oxide	5
Stearic acid	1
Carbon black	50
Garnet sand	212
Processing oil	5
Sulphur	2.5
Accelerator (CBS/TBBS)	1.5
Anti Oxidant (IPPD)	2

A rounded disk wheel was made using steel. Rubber latex bonded abrasive wheel was produced with a composition of rubber latex, garnet sand and conc. H<sub>2</sub>SO<sub>4</sub>. Dry rubber bonded abrasive wheel was produced with the composition given in Table 1.

Ingredients were mixed together using Banbury mixture and two roll mills. Then the compound was applied to the abrasive wheel mould followed by vulcanizing. Properties like abrasion, compression, resilience and hardness were tested.

Resin bonded abrasive wheel was made with the composition given in Table 2.

Table 2. Material composition of the resin bonded abrasive wheel.

Ingredients	Amount
Garnet sand	528g
Polyester resin	100ml
MEKP catalyst (hardner)	10ml
Acrylic paint	2.5ml
Accelerator	10ml
Fibre glass mat	Three pieces

Ingredients were mixed and applied to the abrasive wheel mould and kept for one hour. The resin bonded abrasive wheel was tested for its material removal ability.

### Results and Discussion

Rubber latex bonded abrasive wheel failed to retain its shape and geometry because it was difficult to mix the sand particles with latex. Dry rubber bonded abrasive wheel proved to have all the physical properties required for an abrasive wheel. It was difficult to retain the sand particles in the surface of the dry rubber bonded abrasive wheel during its vulcanization process. Resin bonded abrasive wheel can be used to polish the wooden surfaces and metal surfaces.

### Conclusions

Rubber latex is not a potential bonding material for garnet sand abrasive wheel. Vulcanization destabilizes dry rubber bonded garnet sand in the abrasive wheel. It can be concluded that the most suitable bond type for this abrasive wheel, is resin bond and the resin bonded garnet abrasive wheel can be used for polishing the wooden surfaces and metal surfaces.