PRODUCTION OF A GLASS-BASED ABRASIVE WHEEL

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ABSTRACT
This paper presents the procedures and products of a locally manufactured abrasive wheel from locally sourced natural materials such as glass, coke, sodium silicate, silica sand and sawdust with glass (quartz material) as the parent material. Five local raw material substitutes were identified as listed above through pilot study and with the initial mix of the identified materials. Suitable mould was constructed; the materials were measured and input into the furnace for a required period. The produced abrasive wheel is of very high quality suitable for use in grinding operations such as removal of weld marks, imperfections, rust, paint and dirt.

Keywords: Manufacture, Abrasive wheel, Grinding, Production, Materials, Glass, Optimal formulation.

INTRODUCTION
Abrasive grains are manufactured from various abrasive materials and they are very hard mineral materials used to shape, finish or polish other materials. There are two types of abrasive materials; natural and synthetic abrasive materials and the most important physical properties of abrasive materials are; hardness, brittleness, toughness, grain shape and size, character of fracture, purity and uniformity of grains (Onibonoje and Oyawale). Abrasive are often the only way to create part with precision dimension and high quality surface finishes. Infact, sharpening of the metal/object is an ancient process that has the beginning in the stone age. It was being used on farm tools, war weapons and other instruments. Today grinding wheel appear in nearly every manufacturing company where they are used either to cut steel or manson block, to sharpen knife, drill bits and many other tools or to clean and prepare surface for painting or planting.

Throughout the grinding wheel's history, the bonds that hold the abrasive grains together has power as important as the grains themselves. Grinding wheels are available in a wide variety of sizes, ranging from less than 62cm to hundred of centimeter. They are also available in numerous shapes.

To make a grinding wheel, the ingredient must first be mixed together. Some manufacturers simply mix all materials in a single mixer; others are separate steps to abrasive grains with
binder transfer the wet abrasive to a second mixer containing the powdered bonding materials and tumble the mixture. Next, the wheel is formed in a molding step, the ingredient mix is poured into the compacted container by a hydraulic press.

**METHODOLOGY**

Five local raw material substitutes were identified through pilot study and with the initial mix of the identified materials. These materials: Glass (1605g, 48.1%); Coke (250g, 34.6%); Sodium silicate (200g, 11.5%); Silica sand (1400g 34.6%); and Sawdust (20g, 0.96%) were grinded into the required size. The pattern was carefully prepared for the construction. The materials were sieved with the use of sieving equipment of 1.7 micron. The measurement of each material is done with the aid of sensitive weighing machine provided in the laboratory of the Federal institute of Research, Oshodi, Lagos (FIRO). The measured materials are then mixed perfectly.

Binder was added and mixed properly after which it was poured into the pattern and rammer is done. The more it is being rammed, the more it get compressed and compacted and the harder it becomes. The pattern containing the material is put inside the furnace as it was calcined at a high temperature between 500°C and 1200°C to remove the chemically bound water and the acidic residues, primarily nitrogen oxide which is extremely toxic and damaging, then heated to sintering temperature of up to 1650°C until a density of at least 85% of theoretical density is achieved.

<table>
<thead>
<tr>
<th>S/N</th>
<th>Varied Components</th>
<th>Proportion By Weight (g)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Glass (Quartz Material)</td>
<td>1605</td>
<td>48.1</td>
</tr>
<tr>
<td>2</td>
<td>Coke</td>
<td>250</td>
<td>4.8</td>
</tr>
<tr>
<td>3</td>
<td>Sodium Silicate</td>
<td>200</td>
<td>11.5</td>
</tr>
<tr>
<td>4</td>
<td>Silica Sand</td>
<td>1400</td>
<td>34.6</td>
</tr>
<tr>
<td>5</td>
<td>Sawdust</td>
<td>20</td>
<td>0.96</td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td><strong>3475</strong></td>
<td></td>
</tr>
</tbody>
</table>

**Figure 1:** Graphical Representation of Raw materials for the production of the Glass-Based Abrasive Wheel (GBAW)

<table>
<thead>
<tr>
<th>Material: Composite</th>
<th>Test: Compressive Strength</th>
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<tbody>
<tr>
<td>Match MODULE 5</td>
<td>Test Type: Compression</td>
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<tr>
<td>Location: Lagos</td>
<td>Date: 02-10-2015</td>
</tr>
<tr>
<td>Laboratory: FIIRO</td>
<td>Test Speed: 030.00 mm/min</td>
</tr>
</tbody>
</table>
RESULTS, DISCUSSIONS AND RECOMMENDATION

Test Characteristics: The manufactured Glass-Based Abrasive Wheel (GBAW) was very close to 150 standard and it was a standard one meant for use in operations such as offhand grinding, plain grinding, surface grinding and cleaning. However, it may not be used for polishing, buffing and lapping since it cannot produce a very smooth or glossy surface where plastic flow of the material is required than abrading. It is not advisable to use this product where rapid smoothing action with fast cuttings are required.

The Glass-Based Abrasive Wheel (GBAW) is highly recommended for use in reducing weld marks, weld imperfections, general lathe tool, planner tool, shaper tool and drill grinding. It is equally recommended for rust, paint or dirt removal in metals.

CONCLUSIONS

Abrasice grains wheel was formulated and manufactured using locally sourced raw materials which include Glass(quartz), Coke, Sodium Silicate, Silica Sand and Sawdust. These materials were locally sourced from different parts of the country under different conditions. As a result, they were properly beneficiated and processed before being mixed together. A table oven was used for the baking as the only available furnace for the work which did not allow impurities and other contaminants into the process. The formulation led to a series of reactions among the various raw materials used. An optimal formulation of abrasive wheel was accomplished while the formulation and manufacture of local abrasive wheel was successfully achieved.

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REFERENCES