Design and Development of EDM Process Electrode Through Powder Metallurgy Route

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***Abstract*:- Spark machining is the best one for machining the intricate shapes on hardest materials like alloys and composites with high level of accuracy. The major drawback is the electrode wear of during machining in Electric Discharging Machining process. Electrode requires high accuracy in shape and size in order to obtain good surface finish. In the present work, composite electrodes were prepared by using tungsten and graphite powder through powder metallurgy route. The two types of composite electrodes were prepared by taking weight percentage Graphite 90% -Tungsten 10% and Graphite 80% -Tungsten 20%. The optical microscope image of two composite electrodes was investigated and also hardness values are studied.**

Keywords: Powder Metallurgy, Microstructure, hardness, tungsten, graphite.

INTRODUCTION

Today tungsten based composite is on huge demand, due to its superior mechanical characteristics, for example; specific stiffness, wear resistance, hardness, high modulus and fatigue. These metal matrix composites have been considered as excellent candidates. There are different manufacturing techniques for reinforcing composite such as spray decomposition, liquid metal infiltration, powder metallurgy, Squeeze casting, Mechanical alloying and compo casting. Powder metallurgy is highly developed technique for manufacturing composites. graphite – tungsten prepared through Liquid Metallurgy (LM) process by the authors has reported following problems. The segregation in the graphite – tungsten composite processed through the LM technique is mainly caused by sedimentation force and conventional convection. Very limited solid solubility between graphite and tungsten and the formation of intermetallic compounds between tungsten and graphite are observed. Powder metallurgy process offers very distinct advantages compared to all other manufacturing processes. In powder metallurgy, composite powders are prepared at room temperature using ball milling method. The components prepared using this method have merits such as less residual voids, no dissolved gases in products, good interface bonding between inclusions and metal matrix, near-net shape of compacts.

MATERIALS AND METHODS

Material Used

Tungsten: Tungsten, also known as Wolfram, lapis ponderous or Heavy Stone, has highest melting point of all elements except carbon - sources in scientific literature vary between 3387 °C and 3422 °C. It also has excellent high temperature mechanical properties and the lowest expansion coefficient of all metals. Tungsten: W-99.9% purity, Size: 150 microns**.**

Graphite: A soft black lustrous form of carbon that conducts electricity called Graphite. It is used in lead pencils, electrolytic anodes as a lubricant, and as a moderator in nuclear reactors. A composite material in which carbon fibers are the reinforcing material. Graphite -99.0% purity, Size: 150 microns

Tungsten powder 150 micron

Graphite powder 150 micron

Powder Mixing

Required amount of Graphite and tungsten were measured and taken as per the required weight percentage of Graphite 90% -Tungsten 10% and Graphite 80% -Tungsten 20%. The powders were mixed thoroughly in a mixing ball mill, manually for obtaining homogeneity. Each sample was grounded for 30min in order to attain homogeneity in composition.

Table .1 Powder Mixing Ratios

Materials used	**Tool 1**	**Tool 2**
Tungsten	10%	20%
Graphite	90%	80%

Compaction

For compaction each sample takes twenty minutes for cold compact in high speed steel, Die which is in cylindrical shape. The force required for the compaction of graphite-tungsten powder is 5 ton. This is the used value only for 9mm diameter compact made on the 10mm of diameter Die with 1mm clearance at punch.

Sintering

The compacted performs were then placed in a muffle furnace for sintering. Sintering is usually carried out in lowest melting metal, Sintering is essential process for bonding solid bodies by atomic forces. Sintering forces tends to decrease with increase in temperature. Since bonding particles is greatly affected by surface films, the formation of undesirable surface films, Sintering is done at a controlled Argon atmosphere in order to prevent oxides formation of Graphite and Tungsten samples were placed inside the furnace in particular order and furnace was made air tight seal with Glass Wool.. Temperature was set at 1650°C. Samples were soaked for 30min. At that temperature and allowed to cool within the furnace at inert atmosphere.

RESULT AND DISCUSSION

Microstructure:

Microstructures of the tungsten samples were observed under computerized optical microscope (Model: Olympus BX51, Essex, UK). The Graphite- Tungsten samples of different weight composition, Etching was done using the Keller's reagent.. The micrographs of the samples were obtained.

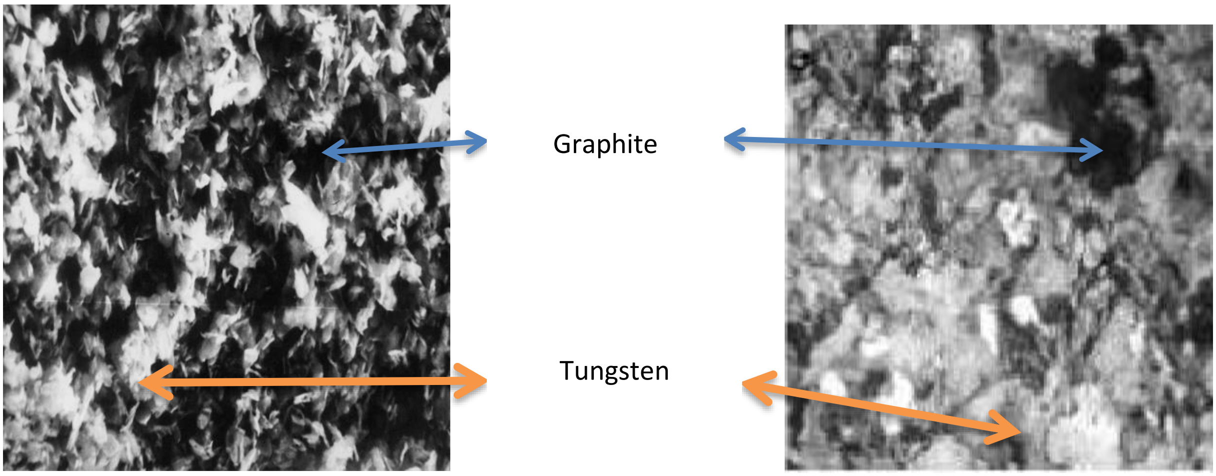

Fig: 1 Fig: 2

Fig. 1 shows the microstructure of Graphite 90% & tungsten10% electrode. From the micro structure, it revealed the distribution of tungsten is even.

Fig. 2 shows the microstructure of Graphite 80% & tungsten 20% electrode .From the microstructure, it was evidenced the presence of tungsten .

HARDNESS TEST:

Brinell hardness number

A Brinell hardness result measures the hardness number of specimen. The applied load during the testing was 500 kgf, with a dwell time of 15sec It is defined as the resistance for indentation on the given specimen. By measuring the indentation on specimen under the micro scope and ball diameter (d) of indenter (D) and load applied on specimen for indentation and subsume the values in formula Brinell hardness number can be obtained.

Table 2 Brinell hardness number

S.NO	Composite	Brinell Hardness			Avg Value
		Reding 1	Reding 2	Reding 3	
1	90% G – 10 % W	80.8	81.1	80.6	80.5
2	80% G – 20 % W	119.4	118.7	119.1	119

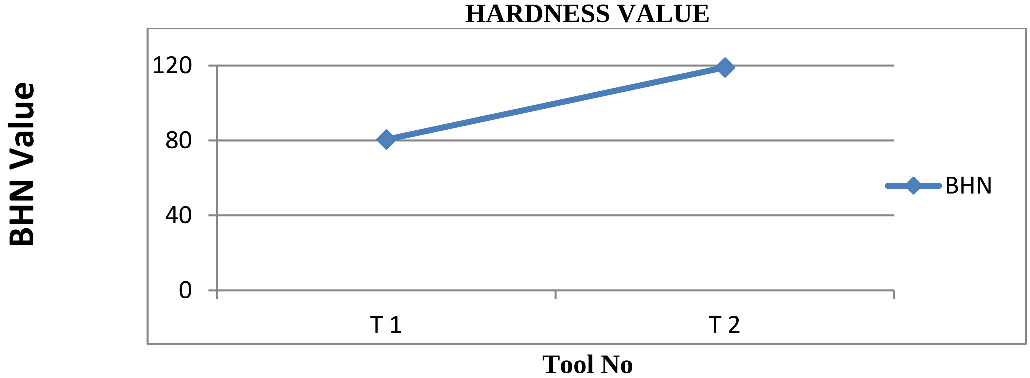

Fig 3 (Tool No vs BHN)

Fig.3 shows the comparison of two electrode T2 more hardness than in T1 because the weight percentage of tungsten due to the increment of tungsten amount.

CONCLUSIONS

A series of Graphite – Tungsten powders composites were produced through powder metallurgy process successfully. Large amount of tungsten up to 20% by weight was incorporated successfully through P/M process. Graphite – Tungsten powder Composite was synthesized successfully without using any binder. Prepared Graphite – Tungsten powders composites with uniform distribution of tungsten particles throughout the matrix of Graphite with good bonding between them. The optical microscopic examination results definite that distribution between the reinforcement and matrix powder was even. Hardness of the Graphite – Tungsten powder composite increases with the increment the amount of tungsten powder.

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