THE RELATIONSHIP OF PHYSICAL PROPERTIES OF GRAPHITE TO EDM PERFORMANCE

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Introduction

EDM (Electrical Discharge Machining) is a process that removes metal by utilizing the damaging effects of electric sparks, in a closely-controlled manner, between two conducting surfaces immersed in a dielectric medium.

Although EDM is considered a modern means of nonconventional metal removal, relatively few people realize that it has been employed in its present form since the mid-nineteen fifties. In fact, the process was first recognized during the Second World War by Lazarenko, a Soviet scientist. Lazarenko and his colleagues developed and designed the original circuitry for EDM, comprising of a condenser charged via a resistor and coupled across the gap between two electrodes. The Relaxation circuit, as this original design is known, is still found in some present day machines.

At the end of the War, the process was taken to the U. S., U. K. and Switzerland, where development continued and the manufacturing of EDM began. At this writing, there are some thirty-plus original equipment manufacturers supplying EDM, the majority featuring solid state technology in the generation of pulsed machining energy.

EDM applications have continued to grow as more and more exotic, difficult-to-machine materials are introduced to meet today's stringent demands on component life and reliability. These Space Age alloys and other materials must meet a basic condition for successful EDMing. They must be electrically conductive.

One of the most important component in an EDM operation is the electrode and the material from which it is manufactured. In the United States, the most versatile and widely used material is synthetic graphite readily available from a number of prominent manufacturers. This electrode material varies from coarse grain, low strength graphite to fine grain, high strength graphite.

Graphite as an Electrode Material

The acceptance of graphite as an electrode material was mainly due to the development of the pulse generator. The versatility of the control units enabled the EDM operator to select a wider range of machine parameters some of which particulary enhance the electrode characteristics of graphite when compared to metallic electrode materials.

One such characteristic of graphite is the ability to resist wear. The EDM process is explosive in nature and the temperature at the point of discharge is extremely high, in excess of 3000°C, high enough to vapourise most workpiece materials and unfortunately most electrode materials. Graphite, as a metalloid, sublimes at approximately 3,350°C; therefore, the spark temperature will not erode graphite at a rate even approaching that of metal.

Other EDM performance criteria are classified under the following headings.

Metal Removal Rate
Fine Finish Reproducibility
Machinability (Ease of Fabrication)

Conclusion

Experimentation has shown that all electrode materials have different optimum machining parameters for meeting these critrea and obtaining maximum performance. These optimum condition variances also occur between different grades of graphite electrodes material and can generally be related to the physical properties of the material.