

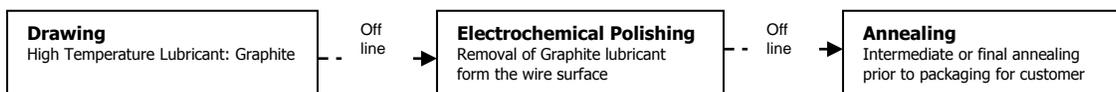
## GRAPHITE (DE)LUBRICATION MADE EASY – THANKS TO PLASMA.

**Hot drawing processes depend on Graphite as a drawing lubricant. The difficulty with the Graphite is that it is hard to remove effectively from the wire surface after drawing. This is particularly the case with Molybdenum wire used for lighting applications, where complete removal of Graphite is critical to quality of the end product. Up until now, Graphite could only be removed completely with an aggressive electro-polishing process that results in considerable waste of base material (Molybdenum). The loss of expensive Molybdenum can be very expensive especially for small diameter wires. This problem has now been solved with PlasmaGRAPH process developed by Plasmait GmbH.**

At Wire 2006 in Duesseldorf Plasmait GmbH will be presenting a PlasmaGRAPH process for heat treatment and Graphite de-lubrication of hot drawn materials. PlasmaGRAPH is based on Plasmait patented technology and is used for a range of metals (e.g. Molybdenum) that use Graphite lubricants as part of hot drawing process. Plasma process is capable to achieve 100% graphite-free wire surface. The surface cleanliness of the finished wire match the cleanliness achieved by electrochemical polishing. Unlike electrochemical polishing, Plasma process results in no loss of base material. This makes Plasma Graphite De-lubrication fast and cost-effective compared to traditional process. PlasmaGRAPH is available as a Graphite De-Greasing machine or as a combined Annealer/Graphite De-Greaser.

### Traditional Molybdenum Drawing Process:

The traditional process of drawing Molybdenum wire is based on three main process steps: Drawing, Annealing and Electrochemical Polishing (*Figure 1.*). Molybdenum is drawn at high temperatures with graphite lubricants. Electrochemical Polishing is used to remove Graphite lubricant from the wire surface after drawing. Electrochemical Polishing is a slow and inefficient process that can result in considerable loss of expensive base material. Up to 10% of expensive Molybdenum can be lost during Electrochemical Polishing, which results in considerable cost to the manufacturer. The percentage of the lost material depends on wire diameter and required cleanliness. In a traditional process, Electrochemical Polishing and Annealing are performed separately (offline) due to different processing speeds. This results in unnecessary cost of wire manipulation.

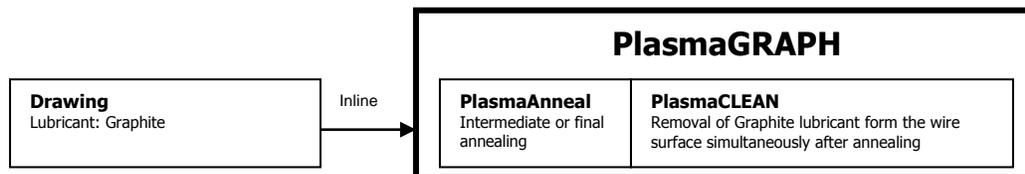


**Figure 1.: Traditional process of Molybdenum wire production.**

### PlasmaGRAPH Process:

To overcome the drawbacks of the traditional process Plasmait developed a new process that uses proven plasma technology to anneal and clean Graphite from the wire surface in a single step. The process was demonstrated with selected Molybdenum wire manufacturers. Drawn Molybdenum wire, contaminated with Graphite was annealed (*PlasmaANNEAL*) and cleaned (*PlasmaCLEAN*) on a Plasma machine (see *Figure 2*). Plasma process was performed at the speed of 2m/s on wires with the diameter between 0.2mm and 0.8mm. The process

resulted in smooth and super clean wire surface with no traces of Graphite whatsoever. Unlike with electrochemical polishing, erosion of Molybdenum from the wire surface was not detected. The requirements for mechanical properties of the finished wire were met. Energy efficiency of the Graph was over 70% depending on diameter.



**Figure 2.: Plasma Annealing and Plasma Cleaning of Graphite from Molybdenum wire surface.**



**Figure 3.: PlasmaGRAPH machine.**

### About Plasmait GmbH

Plasmait is a supplier of heat and surface treatment solutions for wire, cable, tube, strip and ribbon industry. Plasmait's solutions are based on a patented plasma treatment process that offers great advances in production efficiency, surface quality and process control and ecology. Plasmait provides heat and surface treatment solutions as individual machines or as turn-key production line deployments.

The company's head office and its production facility are located in Lebring, Austria. Next to it is a development and trial facility, which is used for process development and client trials.

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