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AEC-NASA TECH BRIEF

Copper—Acrylic Enamel Serves as Lubricant for Cold Drawing of Refractory Metals

The problem:

To lubricate refractory metal tubing during cold drawing operations so that the tubing surface remains free from scratches and nicks and does not seize in the die. Hydrocarbon lubricants and certain plastics often do not prevent seizure. Copper plating on the tubing gives a smooth surface and freedom from seizure, but replating is necessary before each successive drawing operation.

The solution:

An acrylic enamel containing metallic copper pigment is sprayed on the tubing prior to the drawing operation. The coating prevents seizure and surface defects and remains effective for several drawings through the die.

How it's done:

Any of the plastics now used as lubricants in metal cold drawing, when mixed with a dispersion of metallic copper powder of suitable size, will serve for this lubricant. A typical coating contains the following percentages by weight:

Copper powder pigment	5.23
Acrylic resin	3.41
Aromatic hydrocarbon and chlorinated hydrocarbon solvents	51.36
Fluorinated hydrocarbon propellant	40.00

In one test application, a tube of Zircaloy-2 with a 0.375-inch OD and a 0.325-inch ID was degreased in trichloroethylene and sprayed with a bright copper aerosol enamel of the above proportions until a thin, uniform coating was produced. The tube was passed successively without removing the coating through cold drawing dies of the following diameters in inches: 0.360, 0.345, 0.330, 0.314, and 0.300. A chlorinated hydrocarbon coolant was used to cool the tube as it passed through the dies. The lubricant was then removed and the tube cleaned with trichloroethylene, and the residual copper removed by immersing the tube in a 50% nitric acid solution for 1 minute. The tube was then rinsed in water, dried, and annealed. It was found to have a uniform outer diameter of 0.30 inch, uniform wall thickness, and to be free of surface defects.

Notes:

1. Zirconium, zirconium alloys, tantalum alloys, niobium alloys, vanadium alloys, and titanium alloys have been successfully drawn using this lubricant.
2. The size of the copper particles is not critical, as long as a true pigment dispersion can be maintained. Also, the proportions of the pigment to the resin, the solvent, and to the propellant are not critical as long as a thin, continuous enamel or lacquer coating can be produced by spraying, leaving sufficient copper to enhance the lubricating properties.
3. Water and soap solutions will also serve as coolants in addition to chlorinated hydrocarbon coolants.
4. Inquiries concerning this innovation may be directed to:

   Office of Industrial Cooperation
   Argonne National Laboratory
   9700 S. Cass Avenue
   Argonne, Illinois 60439
   Reference: B66-10471

(continued overleaf)

Patent status:

Inquiries about obtaining rights for commercial use of this innovation may be made to:

Mr. George H. Lee, Chief
Chicago Patent Group
U.S. Atomic Energy Commission
Chicago Operations Office
9800 S. Cass Avenue
Argonne, Illinois 60439

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