XX. SHOP NOTES

HYDROGEN PROCESSING OF STAINLESS STEEL

Experience in the Tube Laboratory over a long period has shown that contamination of the hydrogen atmosphere in the regular ceramic muffle furnaces is almost invariably present, and that stainless and other steels are particularly sensitive to it. The exact nature of all of the contaminants has not been determined, but it is reasonably certain that air (i.e., oxygen) is one of them. It is also believed that water vapor is present, either from the air or from condensation and re-evaporation in the water-jacketed sections of the furnaces.

It is generally believed that some commonly used metals such as copper, nickel, kovar, tungsten, and molybdenum are apparently not affected by small amounts of water vapor and/or oxygen; indeed, the manufacturers of kovar recommend wet hydrogen for firing this alloy preparatory to glass sealing. However, stainless steel is ordinarily lightly coated with green chromium oxide after firing in the regular furnaces, and this coating prevents wetting by brazing materials (a property that is turned to advantage when stainless steel jigs and fixtures are used to hold copper, nickel, and other metals for brazing, and that also prevents the sticking of tungsten and molybdenum to previously oxidized stainless or steel mandrels on which they are to be annealed).

We have found that very little or no oxidation is produced on stainless steel when ordinary tank hydrogen is used in a glass, silica, or nonporous metal retort. As a note of caution, however, the dew point of the regular-grade tank hydrogen (Air Reduction Co.) should be measured, since some variation in moisture content is to be expected. For satisfactory results, the dew point should not be higher than -50°C. The use of a drying train and a "De-Oxo" (Baker and Co.) catalytic cartridge will assure good results. The drying train should be cleaned and replenished frequently; we have found that a spent drying tube can actually introduce moisture to the hydrogen.

The tube shown in Fig. XX-1 can also be used in a vertical position, with the hydrogen inlet at the top. In this case the work-piece can be supported in the center from a wire which passes upward through the inlet tube and is hooked over the edge. Connections

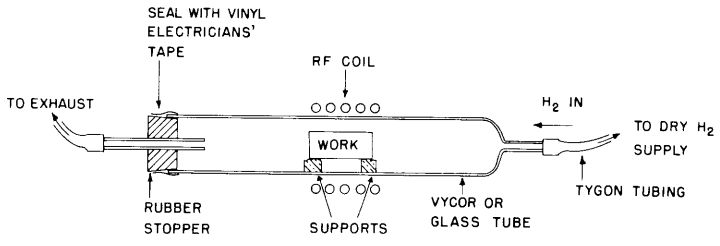

Fig. XX-1. Method of firing stainless steel in dry hydrogen.

from the hydrogen supply are made with Tygon (U. S. Stoneware Co.) tubing because rubber tubing has been found unsatisfactory.

Although the moisture content of ordinary tank hydrogen varies, it has been possible, by this technique, to fire austenitic stainless steel without oxidation, and even to remove entirely a moderate degree of oxidation that was previously present. It has also been possible to braze unplated and untreated stainless steel directly with silver-copper eutectic solder and other solders with higher melting points by the same procedure. In all cases the temperature of the stainless steel must be raised to at least 1000°C; at this temperature the dry hydrogen exercises a strong reducing effect. Measurements of the dew point of the hydrogen at the time of performing these operations gave values between -60°C and -70°C.

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