LACO TECHNOLOGIES

APPLICATION NOTE

NOTE #05-12

VACUUM BAKE-OUT OF PARTS

SCOPE

This application note covers the topic of vacuum baking of components to clean them for use in ultra high vacuum or ultra high purity systems. In these cases, the components are typically heated to an elevated temperature while under high vacuum to remove the small amounts of residual water vapor, cleaning residues or other contaminants that may have absorbed onto the surface of the part. In this case, the amount of water vapor and other contaminants removed is typically quite low compared to other vacuum drying methods like freeze drying. For applications where large amounts of water or other solvents are removed from a product refer to Application Note 05-07 Vacuum Drying.

BACKGROUND

Many high and ultra high vacuum applications as well as high purity applications require parts that are free from absorbed volatile materials that may contaminate the system. Absorbed water vapor is the most common contaminant. A combination of heat and high vacuum is an effective way of removing these absorbed contaminants, though other effective methods do exist.

DESCRIPTION

A vacuum baking system consists of a vacuum chamber with heating capabilities in excess of 200° C along with a pumping system capable of reaching vacuum levels below 10^{-6} Torr (commonly a turbomolecular pump). A vacuum baking system consists of a vacuum chamber with a pumping system capable of reaching vacuum levels below 10-6 Torr (commonly a turbomolecular pump), along with a heating system capable of reaching temperatures in excess of 200° C. Heat is commonly applied via one of three methods: externally heating the chamber walls via electrical elements or a fluid jacket which radiates heat from the chamber walls, an internal infrared (IR) heating element which radiates heat in a line of sight from the elements, or a heated platen which conducts heat directly to the product in contact with the platen. Prior to vacuum baking, it is critical that all parts be chemically cleaned and effectively rinsed in ultrapure solvents, of which water is the most typical. This insures that minimal contaminants are introduced to the part from the rinse solvent itself. The parts should be dry, and only handled with gloved hands.

Water vapor, the most common contaminant (either as a cleaning residue, or absorbed from the atmosphere), absorbs to surfaces. Additional layers of water accumulate bonding the water molecules to each other. To remove the layers of water molecules a typical temperature of approximately 100° C is required under vacuum conditions. In order to remove water molecules tightly bonded to a pristine surface (for ultra-high purity applications) may require temperatures as high as 600° C.

In many cases it is also critical to remove other residues, such as hydrocarbons, in order to provide acceptable functionality. This may require extended vacuum baking times and temperatures.

DESCRIPTION (CONTINUED)

A common method for determining the cleanliness of the parts being baked out is to use a residual gas analyzer (RGA) in the vacuum system. The RGA can measure the partial pressure of the constituents in the vacuum system and help determine whether the desired contaminants have been removed. An RGA scan of a clean and empty vacuum bake-out chamber can provide a baseline and be compared to the RGA scan of a chamber full of parts being vacuum baked

SUMMARY

Time, vacuum and temperature all play a role in removing residual contaminants on parts that are used in high purity applications. A heated vacuum chamber with the proper vacuum system can be an effective tool to help achieve the desired level of cleanliness.

PRODUCTS

LACO Technologies designs and manufactures standard and custom vacuum chambers and turn-key systems that can be used to vacuum bake parts for high purity applications.

REFERENCES

- Application Note 05-07 Vacuum Drying