Reducing Pump-Down Time with Dry Air Venting

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ABSTRACT

In most vacuum coating systems, water vapor introduced during the previous cycle chamber venting is the predominant contaminant affecting adhesion, color, and film properties. Common pumping systems slowly remove water vapor. More expensive cryo-trapping systems are much faster at removing water vapor, but require system down time for regeneration. Dry gas venting with nitrogen greatly reduces pump down times, but is also expensive. Back-filling the vacuum chamber with filtered, ultra-dry compressed air is a reliable and inexpensive way to re-pressurize a system without the introduction of water vapor during the venting process.

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Water vapor is the predominant gas load contaminant commonly introduced to the vacuum chamber from venting with ambient air. Venting or re-pressurizing the system with this moisture-laden air, traps water vapor on the chamber liners and the collected coating build up on the liners. As the humidity level of the ambient air increases, so does the high vacuum pump down time portion of high and especially ultra-high vacuum systems. The use of momentum transfer pumps (i.e. diffusion or turbo molecular) has little effect in removing water vapor. Water vapor removed with the use of Cryo-trapping pumps is faster than momentum transfer pumps, but is still slow and may require system downtime for regeneration.

Air quality in the coating room and the geographical location affecting air quality, are major factors in the overall quality of coatings. Some companies have gone to great expense of using a clean or environmentally controlled room to control the quality of ambient coating room air. With the constant drive to lower costs and increase productivity, the use of clean rooms or environmentally controlled rooms may not be cost effective. Some controlled atmosphere rooms can see major price increases with every 10% decrease of relative humidity.

When nitrogen or argon is used as a purging gas, they can be easily removed from the coating build up on chamber walls and liners. Venting with dry air produces the same affect at a fraction of the cost, especially with larger chambers.

An inexpensive and reliable alternative method of re-pressurizing a vacuum system is to use ultra-dry filtered compressed air. Desiccant dryers and sub-micron filters are used to ensure maximum contaminant removal from the venting air. These contaminants include oil, dust and water vapor. The low cost air system is uncomplicated, easily maintained and minimizes process venting expenses. There have been no adverse adhesion or coating quality problems to VTI customers using desiccant dry systems. This method of drying and filtering compressed air can drive the dew point as low as -140°F. This low dew point air yields a faster process and higher cycle to cycle consistencies.

Pre-filters are used to remove initial water vapor and oils from the compressed air. After-filters are used to keep desiccant dust from reaching the surge tank and vacuum chamber. The surge tank stores a clean volume of air for faster venting and also reduces the size of the desiccant dryer. Yearly desiccant and filter cartridge changes are recommended.

CONCLUSION

Systems upgraded with the dry air venting packages have realized up to a 20% reduction of cycle time. These systems run more consistently from cycle to cycle and produce higher quality coatings. With the use of simple, inexpensive desiccant dryers the customer's cost savings and returns can be tremendous.