SUPPLIERS' TIPS

How can I determine whether convection or conduction drying is best for my material?

In general, conduction drying is accomplished by taking the material to be dried and raising its liquid component's temperature to the boiling point so it will evaporate. In conduction drying, this is done by raising the temperature of the heat transfer fluid (steam, hot water, or hot oil). If the material isn't temperature-sensitive and can tolerate a heat transfer fluid temperature of at least 50 to 100ºF higher than the liquid's boiling point, then conduction drying may be an acceptable drying method. (The material's temperature sensitivity may be its melting point, sticking point, discoloration temperature, or product degradation temperature. You can do bench-scale testing using the Kofler hot bench to determine the maximum allowable heat transfer fluid temperature.)

Note that the primary benefit of conduction drying is its high thermal efficiency, which is around 1,200 Btu/lb of evaporated water. This high thermal efficiency results from the low air (or nitrogen) flow required for the drying operation. The drying gas flow is used to sweep the evaporation out of the dryer and isn't used as the heat source as in convection drying. The less drying gas exiting the dryer, the less the exhaust gas enthalpy and the higher the dryer's thermal efficiency. For a convection dryer to achieve a similar thermal efficiency, its heated inlet gas temperature would typically be over 1,000ºF with an outlet gas temperature of 180 to 200ºF.

Conduction drying is particularly useful when evaporating solvent from the material in a closed-cycle drying circuit. The lower dryer outlet gas flow will result in smaller solvent recovery equipment and lower chilled water requirements for the condensing operation. Not only will this drying method achieve higher drying thermal efficiency, but it will also achieve higher thermal efficiency in the solvent-recovery stage.

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Your material's physical characteristics will generally help determine the drying method that should be considered.

A conduction dryer requires mixing to introduce all the material surfaces to the heat transfer surfaces. Typical materials dried with a conduction dryer include a range of liquids, slurries, and small particles. Bulk materials that don't require a fixed particle size are good material candidates for this equipment. Some temperature-sensitve materials may not be good candidates for conduction drying because contact with the heated surface may result in color or physical characteristic changes or both.

Convection dryers include fluid-bed dryers, flash dryers, spray dryers, and conveyor dryers. Fluid-bed dryers and flash dryers are used for small particles with high surface-to-volume ratios, spray dryers are typically used for liquids or slurries, and conveyor dryers are typically used for larger particles or friable materials that often require a static material bed to minimize attrition.

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Equipment suppliers are a valuable source of information about equipment and processes. In light of this, each month we ask suppliers a question of concern to our readers. Answers reflect the suppliers' general expertise and don't promote the suppliers' equipment. If you have a question you'd like suppliers to answer, send it to Kayla Carrigan, Associate Editor, Powder and Bulk Engineering, 1155 Northland Drive, St. Paul, MN 55120; fax 651-287-5650 (kcarrigan@cscpub.com).