

## HOW TO Reduce Energy Consumption in Dryers

*By James K. Plant, National Drying Machinery Co.*

Sizing the components for the exhaust system is a critical stage of the design of a dryer. Too much exhaust and you are literally throwing money away; too little exhaust and the product will not dry, and the machine will be out of air balance. Basic psychrometric laws mean that a certain volume of air can carry only so much water vapor. The amount of water vapor varies with temperature -- the higher the temperature, the more water it can hold.

An energy-efficient dryer will reuse or recirculate as much air as possible and only exhaust the minimal amount required to carry away the water. There also are circumstances where energy from the hot exhaust stream can be reutilized. The simplest and most cost-effective manner is to use the waste airstream to preheat the inlet airstream.

Special air-to-air heat exchangers designed with very large surface areas can be used for this purpose. The exchangers are designed for low pressure drop, so the increase in electrical demand for fans is negligible. This type of heat recovery unit provides two main advantages. First, it captures the available sensible heat from the temperature difference between exhaust and inlet. Second, it also captures latent heat as the humidity in the exhaust stream condenses. In the latter stages of drying, with lower humidity in the exhaust, sensible heat can still be recovered. These exchangers can reduce the energy lost to the exhaust by as much as 80 percent.

Some dryers are designed to use cascading or counterflow exhaust to maximize system efficiency. The basic principle is to take the air from the discharge end of the dryer, which would normally be exhausted to the atmosphere -- despite not being saturated -- and re-use this air in preceding zones where the product moisture will be much higher. The overall effect of this technique is to reduce the total amount of exhaust and reduce energy consumption by preheating the makeup air in the early drying stages. This "cascading air" system is combined with some individual zone control for proper air balancing of the process to maximize production.

It is also fundamentally important to dry product evenly. Uneven drying requires additional energy consumption to overdry some product so that the wetter product is at or below acceptable moisture content. A number of factors contribute to uneven drying. In the design stage, incorrect selection of fans or the air-distribution mechanisms can cause this problem. During production, uneven feed rates and nonuniform moisture contents are the most common causes.

Invariably, the latent heat of evaporation is the same in every drying process. The energy demand calculations are, however, skewed by variables such as equipment size, moisture content in and out, specific drying rate of the material being dried, and ambient temperature. In actual production, these numbers can be skewed further by fouled or plugged steam coils, colder-than-expected inlet temperature, and an improperly balanced conveyor dryer. Increasing energy efficiency of conveyor dryers will literally add straight to the bottom line. A few dollars saved every single hour of every day, six days a week for 52 weeks, will be significant.

### How to Checklist

Your equipment supplier should bring together its experience, practical capability, computer modeling and advanced monitoring techniques to help you manage the energy usage of your dryer.

- Drying is a function of time, energy and the physical properties of the product being dried.
- It is less costly to visualize and avoid problems before metal is cut while the dryer is still on the drawing board.
- Sizing of the components for the exhaust system is a critical stage of the design of a dryer. Too much exhaust results in excessive energy costs. Too little exhaust can lead to underdrying the product, and the machine will be out of balance.
- Consider using the waste airstream to preheat the inlet airstream.
- Uneven drying requires additional energy consumption to overdry some product so that the wetter product is at or below acceptable moisture contents.
- Good construction techniques such as tight door seals and adequate insulation will produce a more efficient dryer, and ongoing maintenance will ensure that the dryer integrity is not breached.

