

Ask Joe! Column

Material Temperature Effect on Pneumatic Conveying

Guest article by Paul Solt, Pneumatic Conveying Consultants



In many pneumatic conveying systems, the temperature of the material being conveyed can be overlooked, however, under some circumstances, a serious problem can be encountered if we ignore this temperature.

Pickup Velocity

Many systems are designed with a conveying air pickup velocity. If we assume that the air will be heated by the material, and thus expand, and we can use less air, we are wrong. At the pickup point the air is the air temperature and the velocity must be calculated without any consideration of the material temperature.

Air Volume Changes Due To Material Temperature

If the material being conveyed is very hot or very cold, and the conveying distance is significant enough that the air is heated or cooled by the material, ultimately we would come to an equilibrium temperature. But this requires time for this heat transfer to take place.

If you are calculating the time for the heat transfer, don't make the mistake in assuming that the airflow over the particle is equal to the pickup velocity. This is only true for the first foot of conveying. As the material accelerates to its conveying velocity, it will probably approach about 80% of the gas velocity (depending on particle size and density).

As Temperature Changes - Velocity Changes

If we ignore this affect of material temperature, the calculation of the conveying system may be very undersized.

For example, when conveying hot ash at about 400 degrees F, the air supplied in a pressure system might be between 100 and 200 degrees F, depending on the air source and distance from the feed point. We may have selected a volume of conveying gas to result in a pickup velocity of 3600 feet/minute with 150-degree air. If this air now is heated to 300 degrees F, the volume will increase by the absolute temperature ratio of $760 / 610 = 24\%$. This increase in velocity will increase the air friction losses and thus increase the system operating pressure or require the reduction in capacity.

Now that wasn't so serious, but in some system we have designed where the material being conveyed is in the range of 800 degrees C (1472 F) this creates a major consideration in the design of the system.

Solution For High Temperature Materials

It would appear that the simple stepping of the conveying line (increasing the diameter of the pipe along the conveying line) would solve the problem, and it very well might. But remember now that you have designed a system to work with hot material. What happens on start up if the material isn't hot? Will the system work?

Usually (hopefully) during startup the capacity is lower and thus the operating pressure is lower, resulting in sufficient air velocity to convey the material through the system. Frequently, a startup time, or warm up time, must be considered when the system has been idle for a period of time.

Unusual Application - Ice

A design was required for the conveying of ice!

In the fishing industry, when fishing ships are being unloaded, the fish are elevated through the use of a bucket elevator and dropped into the storage bin. In this case they wanted to mix ice with the fish as they were deposited.

An ice making machine was obtained, which created a sheet of ice, about 6' wide and about 0.5" thick. As the ice extended off the end of the conveyor portion of the machine it would break off, by its own weight and drop into a funnel type feed. This ice was then conveyed to the fish storage tank, and blown in at the same time the fish were being unloaded, packing the fish in ice.

The only unusual design consideration for this system was cooling of the conveying air to as low a temperature as practical, and then designing the system for an almost constant temperature conveying.

Once again I will say, "Anything can be conveyed, if you have the money!"

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Welcome to Ask Joe!, a monthly column by our resident materials handling guru, Joe Marinelli of Solids Handling Technologies. Joe addresses the issues that bug you the most. And Joe knows!! Formerly with Jenike & Johanson, Solids Flow and Peabody TecTank, Joe is an expert on materials handling.

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Guest articles for the **Ask Joe!** Column are always welcome, for more information please contact Joe Marinelli directly at his email address: joe@solidshandlingtech.com.

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