

TECHNICAL BULLETIN – DDR17

SUBJECT: EFFECT OF DRUM DRYING UNDER VACUUM CONDITIONS

Drum drying of a food product under vacuum conditions lowers the boiling point of the product slurry being dried and increases the rate of heat transfer from the interior of the drum to the cooler product on the surface of the drum. Lowering the product boiling point can have beneficial results in product quality, etc., while increasing the heat transfer rate can result in a higher rate of production.

An example of the effect of drying under vacuum on productivity follows:

The heat energy transferred to a product to remove water is determined by the following formula:

Rate of heat transfer	Heat transfer area	Temperature differential	Coefficient of heat transfer
(BTU/MIN) =	(Sq. Ft.) x	($\Delta T^{\circ}F$) x	(U)
Condition 1 (Atmospheric)	42" x 120" Area	ΔT 80 PSI – Steam Atmospheric	U (particular drum) 323.9°F <u>212.0°F</u> 111.9°F
Condition 2 (26" Vacuum)	42" x 120" Area	ΔT 80 PSI – Steam Vacuum	U (particular drum) 323.9°F <u>124.6°F</u> 199.3°F

An increase in temperature differential (ΔT) directly increases the heat transfer rate.

ΔT Atmospheric	111.9°F
ΔT 26" Vacuum	199.3°F
Increase in ΔT	87.4°F
Percent of increase	<u>78%</u>

To realize the same effect at atmospheric conditions would require raising the system temperature by 79.4°F to 403.3°F, which would require a steam pressure of 380 psig.

Note: Relative potential productivity increases in drum drying:

- | | |
|---|---------------------|
| 1. Increase slurry solids from 20 to 25% | 33% increase |
| 2. Increase heat transfer under vacuum conditions | <u>78% increase</u> |
| Potential productivity increase: | 111% |

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