Why steam conditionning?

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Pellets cost money, and good pellets cost more money.

Operators are constantly challenged for maximizing production while improving product quality. Feed formulation, particle size, die selection, cooling, etc. can help them meet this challenge, but controlling the conditioning system is a pre-requisite for the production of quality pellets and optimizing production.

The conditioning process is the most important component of any feed pelleting system, as far as pellet quality is concerned. In the conditioning process, a great deal of attention must be paid to moisture content, steam quantity and control, retention time and blending action within the conditioner.

The basic objectives for conditioning are:

1. Blend
2. Hydrate
3. Heat

During the conditioning process, moisture and heat penetrate the surface to the core of each particle in the ingredients of the feed, disrupting the structure of starch. By altering the starch structure, the digestive enzymes can breakdown starch more effectively to be utilized straightforwardly, improving digestibility of the product. Gelatinization of starches is a function of temperature, moisture and time.

Temperature and moisture are required to activate starch and proteins (natural binders) to make high quality pellets. Another benefit of conditioning at high temperatures and for the right amount of time is to minimize pathogen and spoiling microorganisms contamination in the feed. Other benefits are to reduce power requirement (specific energy consumption) and to decrease die wear. The moisture acts as a lubricant decreasing the amount of friction (abrasion index) created by the feed passing through the die hole, doing less work to form the pellets. Production efficiency can be increased and fines are reduced.

Conditioning uses steam because of these two main reasons:

Heat

a. Gelatinization of starch
b. Plasticize protein
c. Minimize pathogen organisms

Moisture

a. Gelatinization
b. Lubrication
c. Soften
d.Overcome shrinkage

Steam can be delivered to the conditioning system in three forms (figure 1):

1. Wet – High proportion of moisture in the form of water droples
2. Saturated – All the moisture has been vaporized
3. Superheated – Saturated steam heated further

	WET	SATURATED	SUPERHEATED
TEMPERATURE	SATURATION (212°F @ ATM PRESSURE)	SATURATION (212°F @ ATM PRESSURE)	HIGHER THAN SATURATION
ENERGY CONTENT	956 BTU/LB @ 212°F (80% STEAM QUALITY)	1150 BTU/LB @ 212°F	1384 BTU/LB @ 700°F
PHASE	LIQUID & VAPOR	VAPOR ONLY	VAPOR ONLY
CONDENSATION	IMMEDIATE	IMMEDIATE	MUST COOL FIRST
TEMPERATURE RISE PER PERCENT MOISTURE ADDITION	LOW	MEDIUM	HIGH

FIGURE 1

The most effective mean of moisture and heat addition to the feed is using dry saturated steam because this maximizes the relationship between feed temperature and percent of moisture. Wet steam produces less feed temperature because of moisture limits. Superheated steam maximizes feed temperature with limited amount of water addition from condensation (must cool first). Dry saturated steam is a prerequisite for proper conditioning.

Once the condensation takes place on the surface of the mash feed particles, both the heat and moisture begin to migrate inside because of the difference between the surface temperature and the interior temperature of the particle. This follows the principle of diffusion: where there is movement of heat and moisture from areas of high concentration to areas of low concentration. The heat supplied by the condensed steam provides the energy to drive the imigration.

The ingredients of the mash feeds typically have low heat transfer coefficients so the process of heat and moisture migration is relatively slow. This brings into focus issues related to mash particle size, retention times, and optimum conditioning. The smaller the particle size, the more thorough the heat and moisture can penetrate to the core of the mash feed particles in a given amount of time, resulting in a soft, moist particle
core that will elasticize for ideal conditioning and pellet formation (figure 2).

The rate that feed mash passes through the conditioner is controlled by two factors that can be adjusted to obtimize retention time. These two factors are interrelated, not independent:

1. Pick (paddle) angle
2. Shaft speed

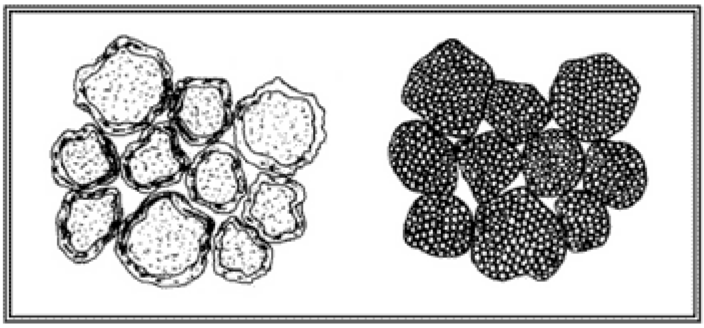

FIGURE 2

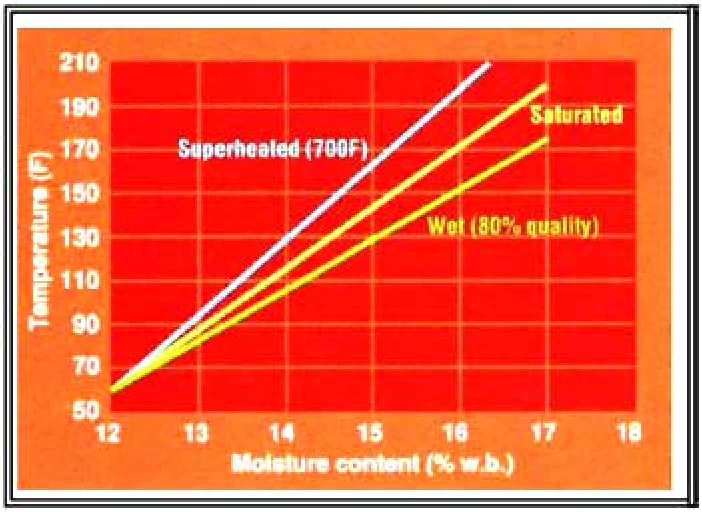

Figure 3 illustrates the relationship of percent of moisture and feed temperature.

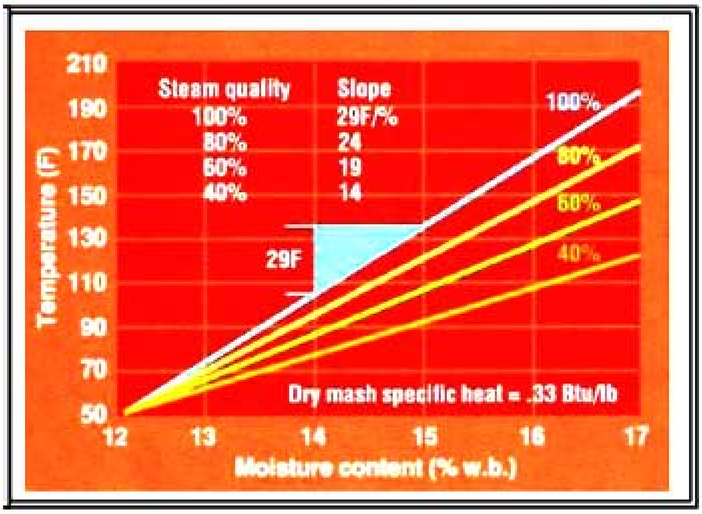

Figure 4 illustrates the rise in temperature per moisture percent.

A properly designed and functioning steam system will maximize conditioning temperatures in feeds for different moisture contents.

A properly designed and functioning steam system should have the following objectives:

1. Properly sized components (pipes, valves, etc.) and adequate insulation that permit the use of low pressure saturated steam

2. Components that have desired performanc caracteristics. Precise steam pressure control, flow control, and effective condensate removal are critical in the addition of heat and moisture to the feed

3. A balanced system to provide a consistent steam quality and to eliminate unwanted free water from the steam flow

4. Components of the steam system providing accurate information to the operator and the control system, so proper and fast adjustments can be made.

Payback comes in the form of more efficient use of the feed by the animal (better conversion rates). Improved efficiency is due in part to heat processing which reduces pathogens and makes starches more digestible.

Durable pellets reduce waste, reduce segregation, improve palatability, increase water stability, and reduce water pollution. All these factors contribute to optimized feed efficiency. It must be remembered, however, that all factors involved in pellet quality are interrelated and must ultimately be addressed if the pelleting process is to be successful.

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