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SPECIAL REPORT

FEED MANUFACTURING

Precision in mash moisture management improves pellet

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Increased precision in mash moisture management has been found by Kansas State University researchers to lead to an improvement in pellet quality and consistency, as measured by the pellet durability index (PDI).

Since the beginning of modern feed manufacturing practices, grain and ingredient moisture content has played a significant role in both equipment operation and final product quality. Options available to feed mill operator for either monitoring or controlling ingredient moisture content on-line have been quite limited. Research at Kansas State University has evaluated the potential effect of precisely controlled ingredient moisture content on pellet quality and pellet mill operation.

For that evaluation, the Kansas State research team, led by Dr. Fred Fairchild, used a Sprout Waldon Model B-37, double ribbon mixer with a shaft speed of 34 rpm and a capacity of 1,000 lb. The pellet mill used was a CPM Master Model HD Series 1000 with a 3/16 in. x 1.5 in. die. A new on-line moisture monitoring system, developed by AgriChem, Inc., of Anoka, Minn., was used to monitor moisture. A surfactant solution from AgriChem was used as the moisture source for the manufacture of a non-medicated, corn-soybean hog-finishing ration.

The study was conducted in two parts. The objectives of the first phase were to determine the moisture control accuracy of the on-line moisture monitoring system and to do a preliminary evaluation of the effect mash moisture content has on pellet production. Five moisture levels were selected for evaluation. Each level was replicated three times for a total of 15 separate replications. Mash feed rates through the pellet mill conditioner were held as constant as possible.

The second part of the study was designed to evaluate the possible interaction between moisture content and pellet production rates. Two separate moisture levels were pelleted at three different mash feed rates through the pellet mill conditioner, for a total of 18 separate replications.

Data collected were mash moisture content, pellet durability, production rates and pellet mill energy consumption.

Table 1 presents a summary of the data gathered in the first phase. The top row of the table, target mash moisture, shows the five mash moisture contents selected as the experimental variable. The untreated mash moisture was determined by laboratory oven-dry procedures preformed on samples taken from the mixer after the dry ingredients had been mixed for three minutes. The treated mash moisture was also determined in the laboratory from samples taken after the on-line system had adjusted the mash moisture content and the mash was mixed for an additional three minutes before sampling. The specific energy is the difference in power demand between the pellet mill running empty and under the load imposed by the particular mash being pelleted, the researchers said.

For the feed formulation processed in the pellet mill, a mash content of 14% produced the best combination of pellet quality and pellet mill operations, the researchers said. Figure 1 is a graphical presentation of the production data, which, the researchers said, clearly indicate that there is not much room for error in moisture management. When the mash moisture was raised to more than 14%, they said, power demand increased sharply, production dropped sharply and the pellet durability index returned to the control levels.

The data generated in the second phase of this study was presented graphically for the 13% moisture mash in Figure 2. Figure 3 presents the 14% mash data. Shown in the figure are production rate in pounds per minute, average specific horsepower per minute and pellet durability index. The three different mash feed rates are indicated in the specific horsepower plots, the researchers said.

Patterns shown by production data frequently provide a more accurate picture of

TABLES

1. Summary of data from preliminary pelleting study

Target Mash Moisture (%)	12	13	14	15	16
Untreated Mash Moisture	11.95[a,b]	11.81[a,b]	11.51[b]	12.44[a]	12.02[a,b]
Treated Mash Moisture	11.64[a]	12.65[b]	13.80[c]	14.77[d]	15.94[e]
Pellet Durability Index (PDI)	85.4	84.8	88.6	84.5	86.0
Specific Energy Use (HP/ton)	8.5	8.1	7.7	14.1	19.7
Pellet Bulk Density (lb./ft)	37.8	36.3	37.8	36.2	34.3
% fines					
Conditioner Discharge Temp	180.2	180.3	181.0	179.7	180.7
Pellet Mill Discharge Temp	182.5	181.7	182.5	181.2	185.0

[a,b,c,d,e] Values with different superscripts in a row differ ($P<0.05$)

2. The Effect of Mash Moisture on Pellet Production

Production Rate (lb/min)		40 to 55	60 to 72	70 to 76
13% Moisture	Maximum PDI	86.30	87.37	90.12
	Minimum PDI	76.44	81.88	81.48
	Average PDI	81.61	84.80	84.26
	Std. Dev.	3.65	1.78	3.36
	Ave. Sp. HP	9.90	14.87	19.27
14% Moisture	Maximum PDI	89.10	90.02	89.54
	Minimum PDI	81.09	82.54	88.57
	Average PDI	85.42	86.41	89.10
	Std. Dev.	3.01	2.85	0.33
	Ave. Sp. HP	10.63	14.63	19.97

the process being monitored than do isolated data
points, particularly when large continuous flow processes are being monitored, the researchers said.

Figures 2 and 3 present the trends observed in part two of the study, where the 14% mash consistently produced a harder and more uniform pellet at all three production rates than did the 13%, the researchers said. These observations, they said, are substantiated by the data plotted in Figure 4. Shown in bar charts are the maximum, minimum and average pellet durability index values for each production rate and moisture level. A summary of the plotted data is shown in Table 2.

Small changes in mash moisture content are shown to have a significant effect on pellet mill operations and pellet quality, as measured by the pellet durability index. In this particular combination of feed formulation and equipment, the researchers said there appears to be a very definite optimum combination of mash moisture content and production rate, as indicated in Figure 4. The 13% mash had the lease variation in the pellet durability index at the mid-production range and the average pellet durability index appeared to hit a plateau, the researchers said. By contrast, they said, the 14% mash continued to show gains in pellet durability at the higher production rate, plus variations in pellet durability were greatly reduced.

The researchers determined that increased precision in mash moisture management improves pellet quality and consistency, as measured by the pellet durability index. Optimum moisture content, they said, is within a narrow band that appears to be less than 1% wide, making an accurate and precise process moisture control system critically important to moisture management success. The researchers said the data also suggested that the effect of precise moisture control appears quickly. A large quantity of feed is not required for precise moisture control to produce a positive effect on pellet durability.

Figure 1: The Effect of Mash Moisture Content on a Pellet Mill Operation

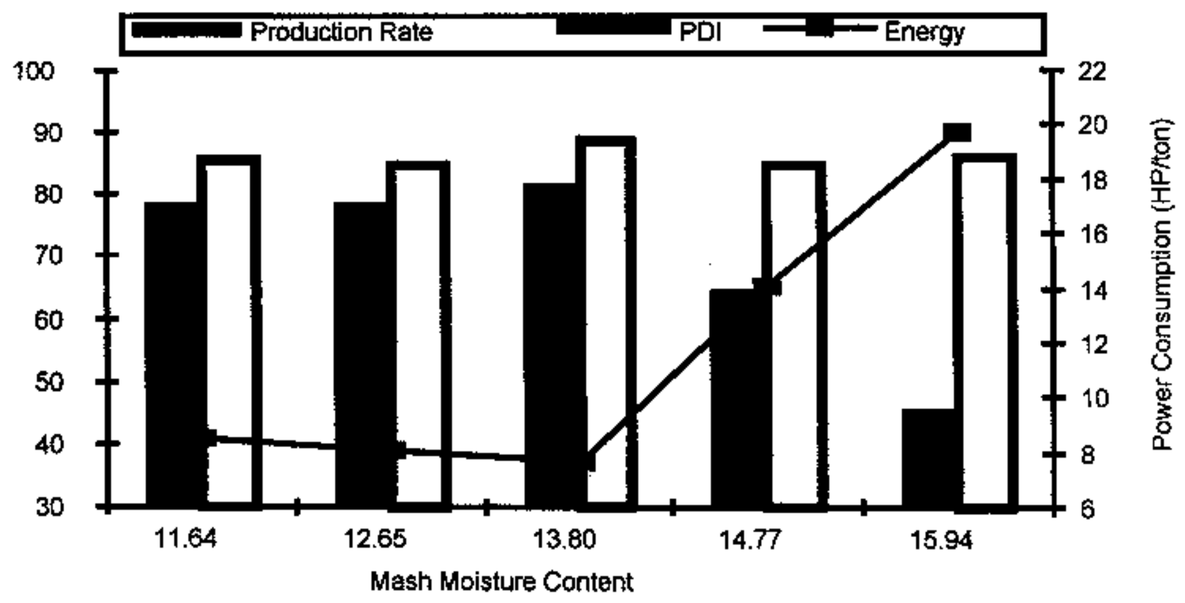

Figure 2: Production data from pelleting 13% moisture mash

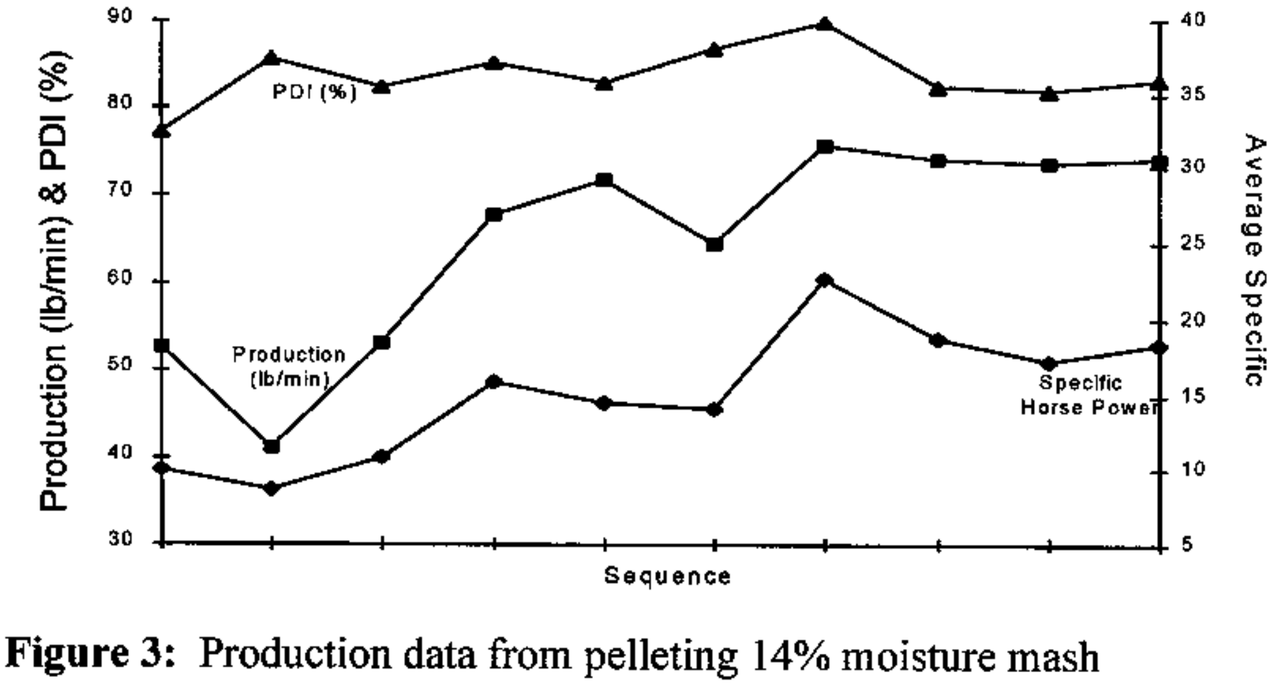

Figure 3: Production data from pelleting 14% moisture mash

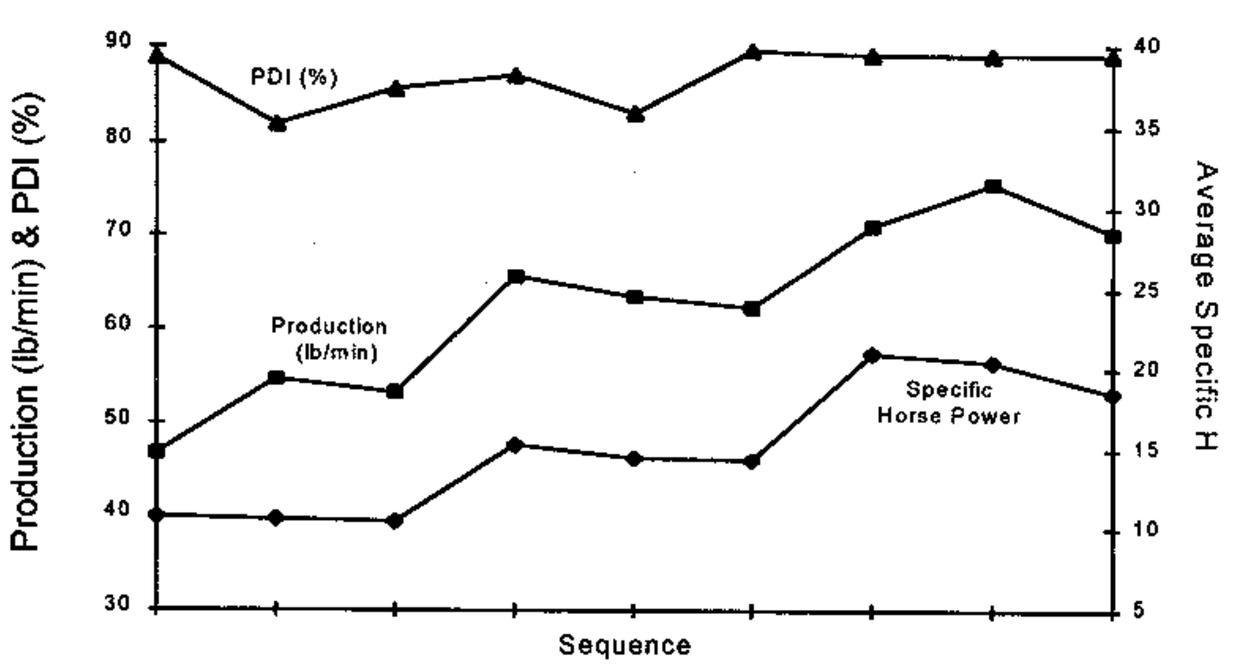

Figure 4: The effect of mash moisture on pellet PDI