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# IMPACT OF CONDITIONING TEMPERATURE

## PURPOSE

To measure the impact of conditioning temperature on pellet durability with and without binder.

## RESULT

- Increasing conditioning temperature improved pellet durability and reduced motor load.
- Ameri-Bond 2X and LignoBond DD gave similar binding performances and were especially effective at lower conditioning temperatures when they were most needed.
- Conditioning steam increased temperature by 13.9°C for each percentage of moisture that condensed into the meal.

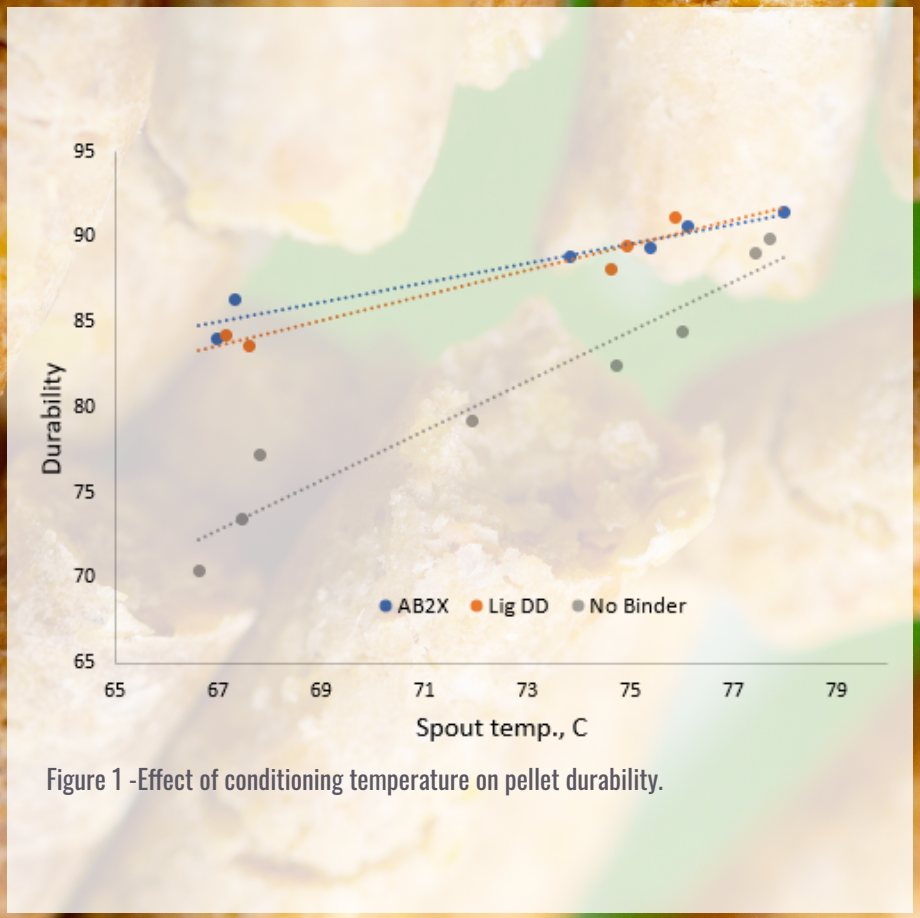


Figure 1 -Effect of conditioning temperature on pellet durability.



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# PROCEDURE

The basal mix for this experiment was recently received from Marathon Feed. It consisted of: fine ground corn, 60%; soybean meal, 30%; and dried distillers grains, 10%. This was supplemented with 0.5% Dicalcium Phosphate. Dry matter content was 88.4%. Twenty-four batches of basal mix were weighed into plastic buckets. Binder, either Ameri-Bond 2X or LignoBond DD, was applied at a rate of 20-g on 4-kg of mix (0.5%) into some of the batches. Arrangement of treatments is listed in Table 1.

Pelleting was done on a CPM CL-Type 2 pellet mill fitted with a 5/32” x 1” die (L/D = 6.4). Meal was conditioned by direct addition of 40 psi steam. The volume of steam was increased continuously during the test to produce conditioning temperatures ranging between 60oC and 78.9oC. Pelleting conditions were: Feeder Setting = 1.6 (1600-g/min); Steam Settings were 1.6 – 2.6. Data loggers recorded Motor Load and Spout Temperature at 5 second intervals. Average values for Motor load (%) and Spout Temperature (°C) were calculated for the 2nd minute of each treatment. The data logger temperature probe was also used to measure the temperature of the basal mix prior to pelleting.

The first minute of each treatment was discarded and pellets were collected over the next 90 seconds. Hot pellets were collected directly into plastic beakers for even numbered batches. This was done 60 seconds into each batch. These pellets were allowed to cool and equilibrate overnight, after which moisture was determined by weight loss after 2-hours in a 110°C drying oven. Moistures were run in duplicate. Temperature increase in the conditioner (ΔT) was compared to the increase in Moisture Content (ΔMC) for each of these samples.

The main portion of hot pellets were returned to ambient temperature by evaporative cooling under a stream of forced air. Pellet durabilities were measured in duplicate on the New Holmen Portable Tester (30s, 70 mbar, no filter).



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# DATA

## Table 1 - pelleting results in consecutive order

| Batch | Treatment | Time intiated | Motor load, % | Spout temp., C | NHPT Durability #1 | #2 | Mean |
|---|---|---|---|---|---|---|---|
| 1 | No Binder | 13:13:25 | 91.2 | 60.4 | 70.0 | 70.8 | 70.4 |
| 2 | AB2X | 13:16:50 | 91.8 | 60.6 | 84.2 | 83.8 | 84.0 |
| 3 | No Binder | 13:18:35 | 90.4 | 60.7 | 74.4 | 72.5 | 73.5 |
| 4 | Lig DD | 13:21:10 | 88.2 | 61.1 | 84.1 | 84.4 | 84.3 |
| 5 | AB2X | 13:23:55 | 84.6 | 63.9 | 86.3 | 86.4 | 86.4 |
| 6 | Lig DD | 13:26:20 | 84.7 | 64.3 | 83.4 | 83.9 | 83.7 |
| 7 | No Binder | 13.29:00 | 84.2 | 64.8 | 77.4 | 77.1 | 77.3 |
| 8 | No Binder | 13:31.35 | 83.4 | 67.6 | 79.5 | 78.9 | 79.2 |
| 9 | AB2X | 13:33:55 | 82.6 | 68.2 | 89.2 | 88.4 | 88.8 |
| 10 | Lig DD | 13:36:25 | 81.0 | 68.8 | 87.9 | 88.4 | 88.2 |
| 11 | No Binder | 13:39:10 | 78.0 | 72.3 | 82.9 | 81.9 | 82.4 |
| 12 | Lig DD | 13:41:40 | 76.7 | 73.8 | 89.6 | 89.4 | 89.5 |
| 13 | AB2X | 13:44:10 | 80.2 | 74.0 | 89.3 | 89.4 | 89.4 |
| 14 | No Binder | 13:46:25 | 78.1 | 75.4 | 85.1 | 83.8 | 84.5 |
| 15 | AB2X | 13:49:25 | 78.4 | 76.2 | 89.8 | 91.4 | 90.6 |
| 16 | Lig DD | 13:52:05 | 79.2 | 76.0 | 91.4 | 90.8 | 91.1 |
| 17 | No Binder | 13:54:30 | 78.1 | 77.2 | 89.0 | 89.0 | 89.0 |
| 18 | No Binder | 13:57:10 | 77.3 | 77.9 | 90.2 | 89.5 | 89.9 |

## Table 2 - Moisture in starting meal and hot pellets on 7/23

| Pan# | Batch | Form | Drying weights, g Tare | Gross | Dry | Spout temp., °C | MC% | Δ T | Δ MC | ΔT: ΔMC | ΔT: ΔMC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 20 | Meal | 1.06 | 8.74 | 7.85 | 25.0 | 11.55 | | | | |
| 2 | 22 | Meal | 1.06 | 6.85 | 6.17 | 25.0 | 11.64 | | | | |
| 3 | 24 | Meal | 1.01 | 9.36 | 8.40 | 25.0 | 11.45 | | | | |
| 4 | 2 | Pellet | 1.03 | 16.69 | 14.36 | 60.6 | 14.70 | 35.6 | 3.15 | 11.3 | 13.2 |
| 5 | 4 | Pellet | 1.04 | 17.60 | 15.19 | 61.1 | 14.18 | 36.1 | 2.63 | 13.7 | |
| 6 | 6 | Pellet | 1.01 | 20.40 | 17.55 | 64.3 | 14.25 | 39.3 | 2.70 | 14.6 | |
| 7 | 8 | Pellet | 1.02 | 21.06 | 18.08 | 67.6 | 14.46 | 42.6 | 2.91 | 14.6 | 14.1 |
| 8 | 10 | Pellet | 1.03 | 21.19 | 18.16 | 68.8 | 14.60 | 43.8 | 3.05 | 14.3 | |
| 9 | 12 | Pellet | 1.01 | 18.25 | 15.57 | 73.8 | 15.25 | 48.8 | 3.70 | 14.2 | |
| 10 | 14 | Pellet | 1.02 | 17.97 | 15.38 | 75.4 | 14.96 | 50.4 | 3.41 | 14.8 | 14.5 |
| 11 | 16 | Pellet | 1.07 | 18.29 | 15.70 | 76.0 | 14.86 | 51.0 | 3.31 | 15.4 | |
| 12 | 18 | Pellet | 1.06 | 22.81 | 19.34 | 77.9 | 15.53 | 52.9 | 3.98 | 13.3 | |

# DISCUSSION

It is well documented that increasing conditioning temperature of a corn-based pellet increases pellet durability and reduces motor load. Furthermore, lignosulfonate binders are very effective under lower conditioning temperatures, where their benefit is most needed. The intention of this experiment was to create a set of data to be available on Borregaard's web site that would:

1. Answer the question: 'Is conditioning important?'
2. Demonstrate that performance of Ameri-Bond 2X and LignoBond DD are similar.
3. Demonstrate the both Ameri-Bond 2X and LignoBond DD are highly effective and not temperature dependent.

That goal was achieved here, but it had previously failed. In the previous experiment, conditioning temperature did not have an effect of pellet durability and ΔT/ΔMC was high at 18.3°C. Several changes in procedure were instituted to give the correct results.

1. Testing began at a lower conditioning temperature; 60°C rather than 67°C. This made the impact of low temperature more dramatic.
2. The system was pre-warmed only to the starting temperature. Previously the system was pre-warmed to a higher temperature and then steam was reduced to achieve a lower mash temperature at the beginning of the experiment. With that procedure residual heat from the metal was transferred to the meal, causing the ΔT/ΔMC to be unusually high.
3. The same temperature probe was used to measure the starting meal and the conditioned meal temperatures. Previously two different probes were used and their differences contributed to the high ΔT/ΔMC.
4. Hot pellets were collected in a 100-mL plastic beaker. The beaker was filled with pellets directly off the die, sealed, and allowed to equilibrate overnight. Larger portions, 15 – 20 grams, were used to determine moisture, thus reducing local variation within the sample.

It was disappointing that the die choked at 78°C. It would have been nice to get to 85°C. This could be done by easing the passage of the meal through the die by: adding 0.5% fat; using PellTech; or switching to a thinner die These changes might shift the working range to 70 - 85°C but the lower temperatures might have extremely poor pellet quality.

Motor load decreased with increasing temperature. This is due to lubrication of the condensed steam and also softening of the meal. Lubrication is often observed when lignosulfonate is added. That was not the case here. LignoBond DD appeared similar to No Binder and Ameri-Bond 2X appeared to be slightly higher.

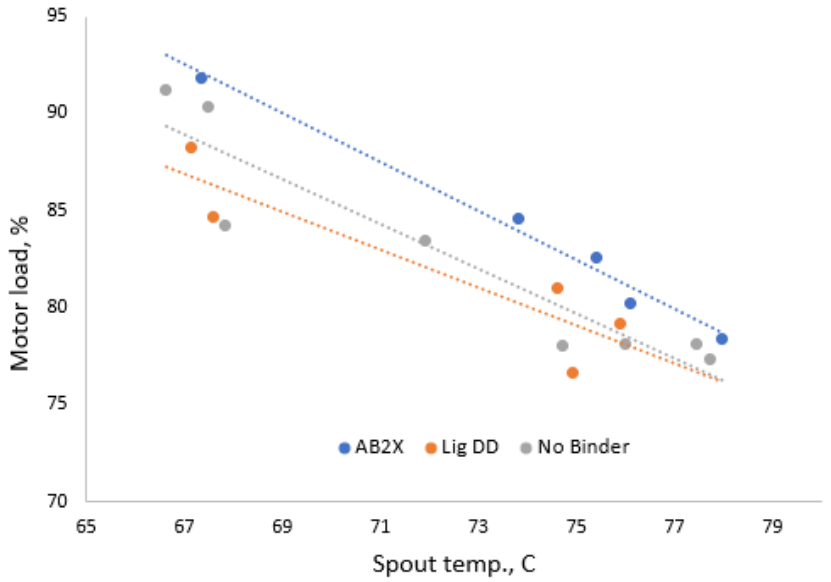


Figure 2 - Impact of conditioning on motor load.

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# CONCLUSIONS AND RECOMMENDATIONS

Increasing conditioning temperature in a corn/soy mix improves pellet durability and reduces motor load. The response was linear until the choke point was reached, in this case, at 15.3% moisture content. Meal temperature increased by 14°C for every percentage of moisture increase from condensing steam.

LignoBond DD and Ameri-Bond 2X were both effective binders and could be used interchangeably. They were both especially effective at low conditioning temperature where pellet durability would otherwise be unacceptable.

## THIS WORK WAS PERFORMED AND REPORTED BY BORREGAARD

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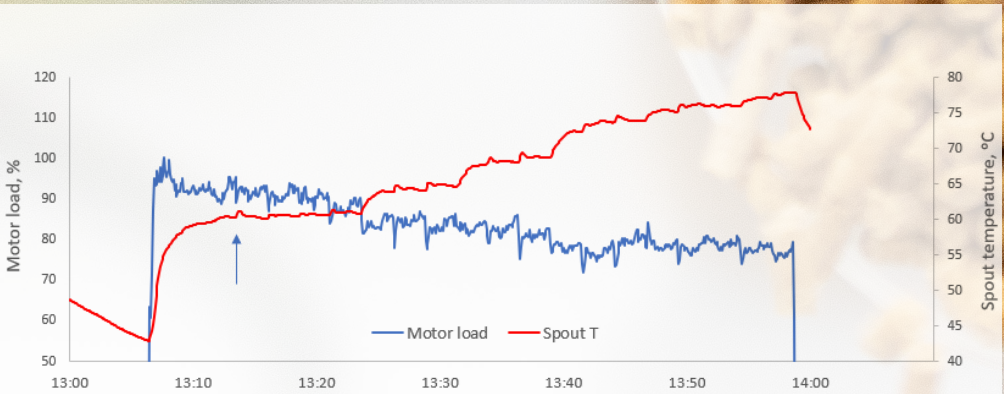


Figure 3 - Data logger record of Motor Load and spout Temperature on July 23rd

### COMMENTS

13:13:25
Begin first treatment – Batch #1. Each new batch is marked by an up-tick in T and a down-spike in motor load.

13:58:40
Experiment concludes with a high temperature choke during Batch #18. Moisture content was 15.3%.

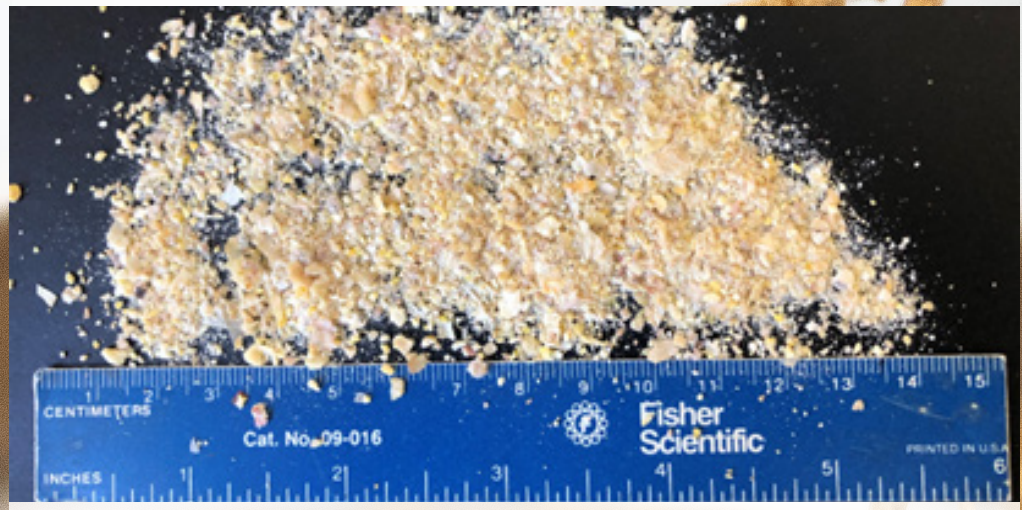


Figure 4 - Photo of basal mix showing particle size



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