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Evaluation of Bagging to Extend Storage Life of Wet and Modified Distillers Grains—A Demonstration Project

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Abstract
The ethanol industry is rapidly expanding. As much as 40% of the energy cost is associated with drying the feed co-products. Distillers grains are excellent sources of nutrients for the diets of beef cattle, but have a short shelf life. To expand the use of wet distillers feeds to more producers, longer term storage methods are required.

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Evaluation of Bagging to Extend Storage Life of Wet and Modified Distillers Grains—A Demonstration Project

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Introduction

The ethanol industry is rapidly expanding. As much as 40% of the energy cost is associated with drying the feed co-products. Distillers grains are excellent sources of nutrients for the diets of beef cattle, but have a short shelf life. To expand the use of wet distillers feeds to more producers, longer term storage methods are required.

Materials and Methods

On October 18, 2006 two loads of wet distillers grains (WDG) from Pine Lake Corn Processors LLC, Steamboat Rock, IA were delivered to the ISU McNay Research Farm southwest of Chariton, IA via walking bed semi (Picture 1). The analysis of that product is given in Table 1. The previous day, October 17, three loads of modified distillers grain with solubles (MDGS, analysis see Table 3) from Big River Resources LLC, West Burlington, Iowa were delivered.

The storage procedure for the WDG product was to mix it with tub ground, poor quality hay (Table 1 for analysis) and pack it into a plastic bag utilizing a Kelly Ryan bagger (Picture 2). This tub ground hay was typical of poor quality hays in Iowa; sufficient in protein to meet a gestating beef cow's needs, but insufficient in energy for beef cow maintenance at 49.68% total digestible nutrients. Macro minerals in the hay were lower than previous Iowa survey work; however, this was logical due to the hay being stored outside for more than one year.

Starting at 12:45 pm on October 18, 2006, the farm crew at the McNay Research Farm in addition to Animal Science staff started the process of loading, mixing, and hauling the mixed product to the bagger for the storage procedure. Two different mixing wagons, Oswalt and Artsway, were used in the process. The objective of this storage procedure was to mix 80% WDG and 20% hay on an as-fed basis. Because WDG is a sticky product and tends to create globs, it is difficult to exactly incorporate this product with hay when using a loader tractor. However, as Table 2 shows the average incorporation rate with hay came out reasonably accurate. The range of WDG incorporation into the mixer wagons was from 77.3% to 86.0% with an average of 80.5%.

A total of 37 mixed wagon loads were delivered to the bagger and put into the plastic bag. During the process, a time log was written with the first load going into the bagger at 12:57 pm and the last finishing up at 5:29 pm for a total time period of 4 hours and 32 minutes or 7.35 minutes/load. The efficiency of this operation would likely be improved if larger mixer wagons were available. The average time to unload and pack each mixer wagon was 5 minutes and 22 seconds for an unloading and packing rate of 579 lb/minute. Bagger down time between loads averaged 2 minutes and 21 seconds. While bagging was taking place, the feeding throat area of the bagger plugged three times which caused short delays during the unloading stage of the operation.

A total of 57.51 tons of mixed product were stored in the 8 ft bag (Table 2). On an as-moisture basis the product mix ended up being 80.5% wet distillers grain and 19.5% dry tub ground hay (Picture 3). On a dry matter basis the mixed product was 61.2% wet distillers

grain and 38.8% tub ground hay. The analysis going into the bag via grab samples was 52.78% dry matter and 20.51% crude protein. However, after opening the bag sample analysis showed it was 38.95% dry matter and 24.48% crude protein (Table 1).

The second bag was straight MDGS. This product was packed into a plastic bag utilizing a Kelly Ryan bagger (Picture 2). There were no forage additions to the MDGS.

At 8:30 am on October 18, 2006 the bagging routine started with three McNay Farm crew, three Animal Science staff, and the custom operator running the bagging tractor and machine. McNay Farm crew members were involved in loading the MDGS into two mixing wagons for delivery to the bagging machine. A total of 27 loads involving Artsway and Oswalt mixer wagons were delivered to the bagger from the start time until it was finished at 11:17 am for a total time of 2 hours and 37 minutes or 5.8 minutes per load. This product posed no problems during the bagging routine and there were no machine plug ups. It is likely with larger delivery mixer wagons or trucks this process could be done somewhat faster because down time between mixer wagon loads averaged 2 minutes and 35 seconds. The average amount of time to unload a mixer wagon was 4 minutes and 7 seconds for an unloading and bag packing rate of 1,265 lb/per minute.

Results and Discussion

There was a 1.8% shrink encountered with the wet distillers grain from purchase/invoice to the mixer wagon weights going into the bagger (Table 2).

Lactating, mature fall calving Angus cows in two groups were fed this mixed product for 39 days starting November 27, 2006. Therefore, the combination product was in storage for 39 to 90 days. It was utilized as a high protein, high energy supplement and fed to the cows on Monday, Wednesday, and Friday. At feeding time, this mixed product was mixed in with some additional tub ground hay to stretch the total product and then fed under an electric wire fence on the ground. That hay was 16.1% crude protein and 53.4% TDN on a dry matter basis. During the other days, cows were offered limited quantities of lower quality large round hay bales in big round bale feeders. At each feeding the average amount offered was 36.2 lb of the WDG/hay mix and 8.6 lb of the added hay. Palatability of this mixture was excellent and there was little to no refusal or waste at feeding time. Weather was very mild during this time period and no feeding challenges were noted.

Complete feeding records were maintained and total feed taken from the WDG/hay mixed bag and offered was accumulated during the feed out. Of the original 115,024 lb put into the bag, a total of 106,540 lb was fed (Table 2). WDG in this total amounted to 85,734 lb for further shrink of 6,827 lb or 7.2% of the total that was purchased. Thus the total WDG shrink from purchase to feeding was 9.0%.

The MDGS did not store as well in the bag as the WDG incorporated with dry hay. First offerings of this feed were to sheep during the week of December 4, 2006 after 35 days of storage in the bag. Considerable mold and spoilage was observed on opening the bag, especially close to where the vent was installed. Table 4 summarizes total MDGS going into the bag, amounts fed to project heifers and sheep, post-trial feed out and then discarded spoiled/moldy MDGS. The last feeding occurred the week of May 14, 2007, 207 days after it was packed into the bag. Feed quality at the end of the bag was very acceptable and no refusals were observed once the heifer trial started. However, on several occasions spoiled or moldy feed was discarded from the silo bag. There was a 3% shrink from the invoiced

purchase weight into the bags. Spoiled/moldy feed accounted for 5.1% of the total MDGS packed into the bag, while unaccounted for storage and feeding disappearance amounted to 8.6%. Thus in this demonstration project there was a total shrink from the purchase weight of 16.7%.

Compilation of Bagging Costs

Any time feed is stored, costs are incurred; distillers grains are no exception to this rule. Table 5 shows the accumulated costs on a cash- versus non-cash cost basis. Total custom bagging costs were assigned to each distillers grain product based on the amount of time and materials needed for each. Based on the hours to bag each product the MDGS required 37% of total custom bagging time whereas the WDG/hay combination product required 63%. Footage of bag (52% for MDGS and 48% for WDG/hay), number of seals and vents were nearly equal for the two products, however, differences are reflected in those costs. Incorporating dry forages with the WDG to make it a storable commodity in a bag adds significantly to the total cost, but based on previous work it is a necessary step.

FOB cost at the plant of the WDG was $15/ton, thus transportation, labor, bagging and fuel increase the cost to over $43/ton without shrinkage taken into account and over $47/ton when shrink is considered. If non-cash costs (farm labor and tractor use) are considered these costs are over $50/ton. MDGS was higher in its cost analysis (Table 5), but it has higher dry matter content and nutrient value.

Important to consider for the producer is how might these compare to purchasing dried distillers grain. The MDGS was 50.27% moisture, therefore, if one adjusts this product for moisture and put on a 10% moisture basis and take into account the shrink encountered it would put the price at $126/ton on a cash cost basis. In looking at the WDG/hay product in a similar comparison would place its price at $110/ton.

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Table 1. Analysis of wet distillers grains and ground hay used at the McNay Farm prior to and post bagging (100% dry matter basis).

Item	Wet distillers grain	Ground hay	Mix after bagging
Dry matter	30.48%	79.79%	38.95%
Moisture	69.52%	20.21%	61.05%
Crude protein	27.97%	12.72%	24.48%
ADF	20.49%	50.35%	27.17%
NDF	32.20%	74.24%	na
Fat	11.11%	---------	
Ash	4.43%	---------	
Calcium	.10%	.43%	.33%
Phosphorus	.79%	.28%	.63%
Magnesium	.28%	.16%	.27%
Potassium	.97%	2.61%	1.40%
Sulfur	.75%	.18%	na
TDN (OARDC)	86.2%	49.68%	na
NEm (OARDC)	96.57 Mcal/cwt	43.47 Mcal/cwt	na
NEg (OARDC)	66.06 Mcal/cwt	18.68 Mcal/cwt	na
NEl (OARDC)	90.51 Mcal/cwt	-------	na
NEl (ADF)	74.16 Mcal/cwt	49.94 Mcal/cwt	na

na = not available

Table 2. Summary of mixing and bagging wet distillers grains with tub ground hay.

	As-is basis	% of total	Dry matter basis	% of total
Purchased wet DG	97,760		29,797	
Wet DG into pile for spoilage demonstration	3,500			
Net wet DG for bagging	94,260			
		Mixed product into bag		
Bagged wet DG	92,561	80.5%	28,213	61.2%
Bagged ground hay	22,463	19.5%	17,923	38.8%
Total	115,024		46,136	
		Mixed product fed to cows		
39 days fed amount	106,540			
Wet DG	85,734	80.5%	26,132	61.2%
Ground hay	20,806	19.5%	16,601	38.8%
% Wet DG shrink				
Purchase to bagging	1,699	1.8%		
Bagging to feeding	6,827	7.2%		
Total	8,526	9.0%		

Table 3. Analysis of modified distillers grain with solubles used at the ISU McNay Farm for bagging (100% dry matter basis).

Item	Modified distillers grain
Dry matter	49.73%
Moisture	50.27%
Crude protein	28.96%
ADF	12.11%
NDF	27.92%
Fat	13.57%
Ash	4.98%
Calcium	.04%
Phosphorus	1.01%
Magnesium	.33%
Potassium	1.21%
Sulfur	.86%
TDN (OARDC)	89.7%
NEm (OARDC)	101.27 Mcal/cwt
NEg (OARDC)	70.02 Mcal/cwt
NEl (OARDC)	94.44 Mcal/cwt
NEl (ADF)	78.64 Mcal/cwt

Table 4. Summary of bagging, storing and feeding modified distillers grains with solubles.

	lb
MDGS purchased	147,620
MDGS into pile for spoilage demonstration	2684
Net MDGS available for bagging	144,936
MDGS into bag	140,628
122 day heifer feedings	111,270
35 day sheep feedings	4,550
Post-heifer trial feedings	4,929
Spoiled/moldy feed discarded	7,355
% shrink: purchase to bagging	3.0%
% shrink: spoiled/moldy discard	5.1%
% shrink: unaccounted storage/feeding loss	8.6%
% shrink: total	16.7%

Table 5. Analysis of cost for bagged distillers grains with and without shrink accounting.

	Modified DGS		Wet DGS + hay	
	Per ton	Total	Per ton	Total
Purchased distillers grains		144,936		94,260
Hay additions				22,463
Total		144,936		116,723
Cash costs				
Delivered cost distillers' grains	$48.00	$3,478.46	$30.00	$1,413.90
Hay – poor quality			$30.00	$336.95
Cost of custom bagging machine	$6.61	$479.00	$8.64	$504.00
Cost of bags, seals and vents	$2.53	$183.00	$2.93	$171.00
Farm labor hours for bagging	0.108	7.85	0.233	13.6
Cost of fuel: 3 – 85 hp tractors (.044 gal/hp/hr** and $2.20/gal	$0.89	$64.59	$1.92	$111.90
Total cash cost	$58.03	$4,205.05	$43.48	$2,537.75
Total cash cost accounting for shrink	$69.66	$5,048.08	$47.78	$2,788.73
Non-cash costs	$/hour		$/hour	
Cost of 3 farm crew labor ($15/hr)	$15.00	$117.75	$15.00	$204.00
Cost of 3-85 hp tractors and mix wagons	$15.00	$117.75	$15.00	$204.00
	$/ton		$/ton	
Total non-cash cost	$3.25	$235.50	$6.99	$408.00
Total non-cash cost accounting for shrink	$3.90	$282.71	$7.68	$448.35
Total all costs	$61.28	$4,440.55	$50.47	$2,945.75
Total all costs accounting for shrink	$73.56	$5,330.80	$55.41	$3,237.08

**ISU Ag and Biosystems Engineering fuel estimate

Photo highlights from McNay MDGS and WDG bagging project.

Picture 1.

Picture 2.

Picture 3.

Picture 4.