

Research in Progress: On-Farm Storage of Ethanol Co-Products

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Introduction

In the past four years, five new dry-mill ethanol plants have been constructed in the northwest Iowa, and another one is under construction. These six mills will process 82 million bushels of corn to produce 217 million gallons of ethanol and almost 700,000 tons of co-products. In the production of one million gallons of ethanol yearly, almost 9 tons of co-product are produced daily. Consequently, the daily marketing of ethanol co-products is important.

Livestock producers, who take delivery of the co-products on a regular basis, are using various storage methods and management schemes. Unfortunately, research in the storage of dry-mill ethanol co-products on-farm is in its infancy, and there are many questions yet to be addressed. The Department of Animal Science at ISU began this on-farm research to help determine nutritional and storage losses of ethanol co-products stored on-farm. This research involved four on-farm storage trials.

Methods

In Trial One, 765 tons of wet distillers grains (WDG) were stored in a concrete open bunker silo at a local feedyard near Sioux Center. The WDG were deposited and pushed up with a payloader into the bunker between October 16, 2002 and November 2, 2002, left uncovered and sampled at four separate times during filling to determine the characteristics of the initial product. During the feed-out from the bunker (November 11, 2002 through November 25, 2002), nine samples were collected and submitted to ISU for nutritional analysis.

In Trial Two, 826 tons of WDG from the same ethanol plant were placed into the bunker in Trial One, beginning November 23, 2002 and concluding December 4, 2002. Between December 6, 2003 and December 14, 2003, the pile was covered with plastic and secured with tires on the top and with large hay bales at the front of the pile. During filling and covering of the pile, six samples were taken to characterize the initial product. This pile, opened on

January 24, 2003, was fed out January 24-29, 2003, with three samples collected for analysis.

In Trial Three, a layer of cracked dry corn (1800 pounds), a layer of ground brome hay (1000-1200 pounds) and a layer of WDG (26 tons) were placed on the floor of a bunker silo in Lyon County on August 14 and 15, 2003. A payloader was used to push the layers into a pile that was 7-8 feet high. On August 15th, a layer of corn condensed distillers solubles was applied to the top of the pile, and the pile was sealed with plastic within 24 hours. Temperatures, from two separate sites, were monitored five times with a compost thermometer by puncturing the plastic and re-sealing the hole with duct tape immediately after monitoring. During all temperature monitoring, the bunker was completely sealed. Four samples were taken from this bunker during feedout (November 17, 2003 through February 25, 2004) and submitted for chemical analysis at ISU.

Trial Four involved piling WDG in a field west of a farmstead in Lyon County. From August 14 through August 18, 2003, 84 semi-loads of WDG were dumped in to a windrow. The windrow was allowed to settle six hours to facilitate building a deeper pile. It was sprayed with corn condensed distillers solubles and formed a crust. Within 12 hours, the windrow was covered with a continuous tarp (no splices) and sealed with dirt on the edges and tires on the sides and top. Temperatures were taken in a manner similar to the procedure described in Trial 3, but as the pile was being fed. During the feedout (September 13, 2000 to November 7, 2003), four samples were gathered for nutritional analysis.

Results and Discussion

Data from Trials 1 and 2 is listed in Table 1. Computed on an as-fed basis, the loss of WDG was 9.64 and 8.55% for the uncovered and covered bunker, respectively. When analysis of the samples is completed, the data will be corrected to a dry matter basis. This should account for moisture accumulations from rain or snow and for losses due to steam evaporation from the pile. In another site involving WDG treated similarly as in Trial Four, as-fed losses of 8.3% were noted.

Surface spoilage in Trial One was as deep as 12 inches on November 17, 2002. In some spots, red and white mold formation had occurred. Surface spoilage in Trial 2 was more moderate and was estimated to be 3-4 inches. No red and white mold was noted.

Table 1. Storage of Wet Distillers Grains in Trials One and Two.

Storage Method	WDG Placed in Bunker, Tons	WDG Fed from Bunker, Tons	Loss of WDG in Storage, %*
Bunker Silo – Uncovered	765.41	691.61	9.64
Bunker Silo – Covered	826.37	755.71	8.55

* This loss is computed on an as-fed basis and has not yet been corrected to a dry matter basis.

Data from Trial 3 and Trial 4 is listed in Table 2. Temperatures from the bunker in Trial 3 tended to decline, stabilize and then increase slightly. The west monitoring site tended to have higher temperatures than the east site. The reason for this is unclear, but may be related to the north-south orientation of the bunker and sun exposure.

Temperatures from the dirt pile in Trial 4 had a linear decline throughout storage and feeding. The temperatures from the east monitoring site were consistently higher than those from the west site. In Trial 4, the WDG pile was oriented east and west.

Table 2. Temperatures of Wet Distillers Grain Piles Monitored During Storage.

Monitoring Date	Storage Method	East Monitoring Temperature, F°	West Monitoring Temperature, F°	Average Temperature, F°
Aug. 25, 2003	Bunker – Covered	110	110	110
Sept. 1, 2003	Bunker – Covered	103	103	103
Sept. 13, 2003	Bunker – Covered	95	98	96.5
Sept. 27, 2003	Bunker – Covered	94	100	97
Oct. 10, 2003	Bunker – Covered	96	105	100.5
Aug. 25, 2003	Dirt Pile – Covered	106	103	104.5
Sept. 1, 2003	Dirt Pile – Covered	95	91	93
Sept. 13, 2003	Dirt Pile – Covered	82	80	81
Sept. 27, 2003	Dirt Pile – Covered	75	69	72
Oct. 10, 2003	Dirt Pile – Covered	68	Not Sampled – Fed Out	68

Conclusions

Data from these four on-farm trials would suggest that ethanol co-products stored on-farm may experience shrinkage. The magnitude of this loss should be based upon dry matter content, and in these trials, varied with the method of storage (covered versus uncovered). The amount of mold appeared to be reduced with covering of the co-product.

Wet distillers grains stored in larger quantities did decline in temperature. However, the magnitude of this

decline may be dependent upon orientation of the storage structure and season of the year.

Samples collected for these studies are currently in the process of being analyzed for dry matter, crude protein as well as fiber components. These results will be reported in a future report.

Further research into shrinkage and nutritional changes of ethanol co-products stored on-farm is warranted. These conclusions may vary with different storage structures, co-products of varying moisture levels and other seasons (spring and summer).