

Storing Wet Grain Commodities

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Abstract

Nearly one-third of the energy required for ethanol production comes from drying wet distillers grain or gluten feed. Because of the reduced drying costs, the wet products can be purchased at a lower price on an equal dry matter (**DM**) basis compared to the dry distillers grains or corn gluten feed. Due of their low pH (< 4.2), these products will reduce fermentation losses when mixed with other feedstuffs prior to ensiling. Because these products encourage the production of acetic acid, enhanced aerobic stability of the resulting silage is an added benefit. Wet distillers and corn gluten feed have been successfully stored in silo bags, bunkers, and upright silos. Bags required the wet product be mixed with other feeds like wheat straw, corn stalks, or grass and legume hays. These co-products have also been stored by themselves or mixed with other forages and ensiled in bunkers. Storage in upright silos requires these products be mixed with other feedstuffs to prevent the plugging of the blower pipes. Storage costs will vary with the type of equipment required, labor, and depreciation. The combined spoilage and shrink will usually range between 10 and 20% of the DM. Molds or mycotoxins have not been identified as a significant risk factor.

Introduction

Over 3 billion bushels of corn will be fermented to ethanol this year. For each bushel of

corn fermented through the dry grind process, approximately 18 lb of distillers dried grain plus solubles are produced. For each bushel of corn that is wet-milled, approximately 5.9 lb of corn gluten feed and 3.4 lb of corn steep liquor DM are produced. Wet corn gluten feed is made by pressing the bran to approximately 35% DM and combining it with corn steep liquor, so the mixture contains around 40% DM. The demand for these byproduct feeds is often lowest in the summer when the supply is the greatest. Consequently, the price is often lowest in the summer and highest in the winter. Nearly one-third of the energy required for ethanol production comes from drying wet distillers grain or gluten feed. Both wet distillers grains and wet corn gluten feed are excellent sources of energy and protein for ruminants. Because of the reduced drying costs, they can often be purchased at a lower price on an equal DM basis compared to the dry distillers grains or corn gluten feed. Technology to efficiently store these wet products for several months is key for dairy farmers to take advantage of the seasonal price swings. The purpose of this paper is to review recent research concerning the long-term storage of both wet distillers grains and corn gluten feed.

Ensiling

Both dry and wet distillers grains and corn gluten feed have properties that are advantageous to the ensiling process. Both products have a pH below 4.2, which helps to reduce the pH of the ensiling mass and should reduce fermentation losses.

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The dry distillers or gluten feed can be used as a decant to dry down wet forages, while the wet products reduce the water needs when ensiled with dry feedstuffs. For example in a University of Illinois research trial, corn silage was chopped at 73% moisture and layered into a bunker silo in 3 to 4 inch sheets. A frontend loader was used to pack the silage and to add layers of dry distillers or gluten feed to the bunker silo. On a DM basis, the mixtures were 72% chopped whole-plant corn and 28% byproduct. The distillers grains-corn silage mixture was 33.6% DM, 14.5% crude protein (CP), 0.20% calcium, 0.46% phosphorus, 0.34% sulfur, 43.0% NDF, and 77.0% total digestible nutrients (TDN) on a DM basis. The gluten fed-corn silage mixture was 33.9% DM, 12.0% CP, 0.21% calcium, 0.46% phosphorus, 0.24% sulfur, 41.6% NDF and 73.0% TDN. The mixtures were allowed to ensile 88 days and then fed at 90% of the diet to growing steers. The same field of corn was harvested 11 days later at 32% DM, ensiled, and mixed with the same levels of distillers grain or corn gluten feed at feeding. All steers gained approximately 2.8 lb/day for 84 days, with small differences between dietary treatments.

Mixing the distillers grains or gluten feed with the chopped whole corn plant produced a palatable silage. Aerobic stability of the silages was determined by putting the silages in styrofoam coolers at ambient temperature and measuring the amount of time required before the silages started to heat. Within 2 days, the control silages were starting to heat; however, the distillers grains and gluten feed silage required 12 and 10 days, respectively, before they started to heat.

Kalscheur et al. (2003) reported similar findings with wet distillers grains and corn silage. When 50:50 and 75:25 ratios (as-fed) of whole corn plant and wet distillers were ensiled, the mixtures did not start to heat (4° F change) for 648 and 312 hours at ambient temperature, respectively. The straight corn silage started to heat after 42 hours at room temperature. Acetic acid in the silage increases

aerobic stability. When compared to the straight corn silage, acetic acid concentrations increased by 70 and 286%, respectively, for the 75:25 and 50:50 mixtures after 3 days of ensiling. After one week of ensiling, acetic acid concentrations exceeded 4% in the 50:50 mixture. Kalscheur et al. (2002) reported that a 70:30 blend (as-fed) of soy hulls and wet distillers grains had an initial pH of 4.3. Soy hulls were chosen because they are low in protein, fat, phosphorus, and sulfur and thus compliment the wet distillers grains, while at the same time being an excellent source of digestible fiber. The ensiled mixture had excellent preservation and palatability. Beet pulp has also been ensiled with wet distillers grains with similar results (Kalscheur et al., 2004).

Nebraska researchers have evaluated the type and level of forage needed to successfully bag wet distillers grains and wet gluten feed (Erickson et al., 2007). The initial DM for the wet distillers grains was approximately 35%. When the wet products were bagged by themselves, the bags were much flatter and wider than normal. If typical pressures were applied during bagging, the bags would split. Mixing the wet distillers with chopped forages returned the bag to a more normal shape and prevented splitting. The minimal amount of the three chopped forages on a DM basis was 12.5% wheat straw, 15% grass hay, and 22.5% alfalfa hay at 300 psi pressure on the bagger. When the mixtures were ensiled in mini-bunker silos, approximately 30% wheat straw and 40% grass hay were required to get good preservation (Rasby et al., 2008).

Because of the low pH, it is also possible to preserve wet distillers grains without mixing it with other feedstuffs. The key is to keep it anaerobic and covered so that rain does not washout the acid on the surface. At the University of Illinois, modified wet distillers grains (50% DM) has been stored for over a year in a concrete bunker silo. The bunker had 10 feet high walls, and the product

was pushed as high as the walls with a frontend loader. One pound of stock salt was applied per square foot of surface before it was covered with plastic. The salt dissolved into the top few inches and helps to prevent mold growth. The plastic was weighted down with tires. After the product had been stored for a year, the surface was almost mold free. The top 18 inches were darker in color, but below that, the product appeared the same as the day it was put into the silo. Regular wet distillers grains (35% DM) have also been stored this way with similar results. Some producers have stored these products without the salt. Surface spoilage is minimized as long as the plastic is tight against the surface. Because these products have the consistency of wet oatmeal, the mass will move to the point of least resistance. Stacking big round bales in the end of the silo will help keep the wet distillers from oozing out.

We have also stored modified wet distillers grains (50% DM) in an oxygen limiting silo for over a year. The biggest challenge was getting the product to blow without plugging the blower pipe. We found that adding 20% whole corn or ground corn cobs (DM basis) provided enough abrasiveness to the blower pipe walls that the mixture could be blown into a structure 60 feet tall. The product stored extremely well and could be unloaded with a silage unloader.

Molds and Mycotoxins

There is limited research evaluating molds and mycotoxins that can occur when wet distillers grains or corn gluten feed are stored. Munkvold (2007) evaluated the fungal colonization and mycotoxin contamination of periodic samples of wet distillers grains, modified wet distillers, dried distillers grains, condensed distillers soluble, and a hay-condensed distillers soluble mixture. Samples were taken from September through March. Condensed distillers solubles were stored in a tank and had little fungal contamination. Dried distillers grains had low

levels of *Aspergillus flavus* present, but there was no visible growth throughout the sampling period.

Several types of *penicillium* were found on both the wet and modified distillers grains. The surface of the wet and modified distillers grains tested positive for *Fusarium* species. At each sampling date, the modified distillers consistently had higher levels of fungal contamination and types of fungi than the wet distillers grains. Visibly moldy samples of wet and modified distillers grains tested positive for fumonisins. There were no aflatoxins, zearalenone, or zearalenol detected. The potential for fumonisin and aflatoxin exist; however, it was not clear from this study whether hazardous levels can be reached during typical storage periods (Munkvold, 2007). Similar studies for wet corn gluten feed are not available.

Costs

The costs to store wet distillers or corn gluten feed can vary greatly. For example, if the wet products are going to be consumed within a week of delivery, then nothing more is needed, than to keep the pile covered to minimize runoff. If longer term storage is needed, then a bag, bunker, or upright silo is recommended. Input costs for bagging will include the cost of the wet co-product, forage, forage processing, mixing equipment, bagger costs or rent, bag, fuel, plastic disposal, and labor. Input cost for a bunker without mixing it with other feedstuffs include the co-product, frontend loader, plastic, tires, salt if applied to the surface, and depreciation on the bunker. Shrink and spoilage cost will vary greatly. Illinois feedlots have observed 10 to 20% shrink and spoilage, depending on the type of structure and length of storage. Bags and well-managed bunkers should be on the lower end of that range.

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