

**Distillers Grains and Sulfur White Paper**  
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During fall and winter 2003 many questions were raised regarding the level of sulfur in the co-products from ethanol dry grind mills and its safety for use in ruminant rations. Questions ranged from “why is sulfur in distillers grains?” to “are DDGS still safe for my cattle?” The South Dakota Department of Agriculture went so far as to single out the mineral and regulate it within feed products transported into or created in South Dakota for use in ruminant rations. This white paper will address the presence of sulfur in distillers grains and the presence of sulfur in livestock diets.

Why is Sulfur in DDGS?

- Sulfuric, hydrochloric, and citric acids are acids that can be used in the dry grind ethanol process to keep pH levels conducive to yeast cells, eg: *sachcromyces cerevesiae* propagation and fermentation
- These products are generally recognized as safe (GRAS) ingredients according to the US Code of Federal Regulation (21 CFR 582) and are listed as food additives (21 CFR 573) <sup>1</sup>
- Sulfuric Acid is commonly used in dry grind applications due to the fact that it is more economical than other acid
- Sulfur is also intrinsic to corn distillers dried grains with solubles to the fact that the corn kernel contains on average 0.12% on a dry weight basis<sup>2</sup>
- It is estimated that the sulfur is distributed in a 74:26 ratio in corn from endosperm to germ
- This sulfur is then concentrated by a factor of 3 in the fermentation and distillation process into the mash and solubles to a level on average of .33%<sup>3</sup>
- Sulfur is also present in the proximate composition of yeast at a rate of 3.9g/kg, dry basis<sup>4</sup>
- Yeast naturally creates some sulfites during fermentation, which will also add to the final components in the distillers grains
- It is important to note that while sulfur has long been considered an issue with corn gluten feed and steep liquor, that the wet mill process is different from the dry grind process, and that products from dry grind have not been steeped in sulfuric acid

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<sup>1</sup> AAFCO Official Publication 2004, page386

<sup>2</sup> Corn: Chemistry and Technology, 2<sup>nd</sup> Ed 2003, page 86, Table 4

<sup>3</sup> NCGA website [http://ncga.com/ethanol/co\\_products/nutrition\\_research.htm](http://ncga.com/ethanol/co_products/nutrition_research.htm)

<sup>4</sup> Corn: Chemistry and Technology, 2<sup>nd</sup> Ed 2003, page 706, Table 4

### South Dakota Rule Change<sup>5</sup>

- South Dakota Department of Agriculture held a public hearing November 17, 2003 to consider the adoption and amendment of proposed rule number 12:53:01:18
- The rule reads 12:53:01:18 Maximum sulfur percentage required on label of distillers products and corn gluten feed. The label of distillers products and corn gluten feed, as defined in the Official Publication of the Association of American Feed Control Officials Incorporated, 2003 Edition, pages 244-245 and 263 must state the maximum sulfur in the product. The sulfur guarantee must be stated in terms of percentage.

Source:

General Authority: SDCL 39-14-60

Law Implemented: SDCL 39-14-60

- The effect of the rules will be to require those who manufacture distiller and corn gluten feed products to provide a maximum sulfur guarantee on the label of these products.
- The reason for adopting the rule is to provide livestock producers with the information they need to adjust their feed rations and/or management practice to avoid the effect of sulfur toxicity in livestock.

### Sulfur in Livestock Diets<sup>6</sup>

- Sulfur is an essential non-metallic element, generally representing about .25% of body weight in most animals, present in larger compounds
- Sulfur containing compounds, such as collagen, enzymes, hemoglobin, insulin, thiamine and biotin, as well as the four amino acids methionine, cystine, cysteine and taurine serve essential functions in the body
- Dietary inorganic sulfur supplementation is generally not necessary for the health of most monogastric animals due the fact that most animals do well with only the organic sulfur sources in their diets
- Ruminants may respond to inorganic sulfur supplementation, especially if the diet is high in non-protein nitrogen (NPN)
- The source of sulfur can determine its bioavailability, sulfates in water can be a major source of sulfur intake
- Digesti and Weeth (1976<sup>7</sup>) proposed that the maximum safe concentration of sulfates in drinking water for cattle was 2,500ppm
- Water sulfate concentration as high as 5,000 ppm have been reported in some studies
- Excess sulfur may impair animal performance by reducing the availability and absorption of other minerals

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<sup>5</sup> South Dakota Department of Agriculture Notice of Public Hearing to Adopt Rules November 17, 2003

<sup>6</sup> Berger, Larry L. PhD, *Sulfur Nutrition Affects Copper Requirement*, Salt Institute

<sup>7</sup> Digesti, R.D. and Weeth. 1976. Adefensible maximum for inorganic sulfate in drinking water of cattle. JAS. 42:1948

- When balancing sulfur in diets, all sulfur sources, including water should be examined

#### Polioencephalomalacia (PEM)

- One problem that can occur when high dietary sulfur leads to the production excess sulfide in the rumen is PEM, commonly termed “head pressers” or “star gazers”
- An abrupt switch from all forage to high concentrate diets can trigger PEM, due to a shift in rumen bacterial populations which produce thiaminase
- PEM is noted by the necrosis of cerebrocortical region of the brain, and if not treated with thiamine within 48 hours of symptom onset most animals will die
- Thiamine deficiency had been considered the common cause of PEM in ruminants, however recent research suggests sulfur may play a key role
- The exact interaction between dietary sulfur, thiaminase production, and PEM is not understood