ABSTRACT

Clementson, Clairmont Learmond. Ph.D., Purdue University, August, 2010. The granulometric heterogeneity of distillers dried grains with solubles (DDGS) and its effect on the bulk physical and chemical properties. Major Professor: Dr Klein E. Ileleji.

The ethanol industry has increased ethanol production significantly in the past few years. As a consequence the production of distillers dried grains with solubles (DDGS); a co-product produced by the most common production process has also increased significantly. The marketability of DDGS has significant implications for the ethanol industry and its profitability because it can be a source of revenue. DDGS has important nutrient properties that make it valuable as livestock feed. Challenges as a consequence to logistics and handling has been a hindrance to its utilization. These challenges are as a result of the heterogeneous nature of DDGS material hence understanding the extent of the heterogeneity and the effect it has on the logistical and handling challenges will help in minimizing these challenges.

To fully address the root cause of these challenges, quantification of the heterogeneity of DDGS particles should be first determined. Additionally knowledge of the production process is vital because of its influence on the DDGS produced; hence DDGS was produced under known conditions as an initial step. Morphological, physical and chemical analyses were done on the DDGS particles to understand the trends in terms of particle size, shape, packing

and composition. There were trends of morphology, densities and chemical composition with particle size and condense soluble addition.

Ensuing from the heterogeneity of DDGS particles, particle segregation is a possible when handling DDGS bulk and contribute to the challenges to its utilization. Piling dried distillers grains with solubles and loading railcars using gravity discharge is common in the corn-ethanol industry. This work investigated the occurrence of particle segregation within piles of DDGS formed by gravity discharge and subsequent spatial nutrient variability, and the bulk density variability of DDGS during filling of railcar hoppers. The results of this study show that segregation occur during both handling scenarios and contribute to the variability reported in literature. Discrete element method was used to simulate the bulk density observed experimentally. The simulated result supports the hypothesis that due to the heterogeneity of DDGS it does not facilitate true mass flow irrespective of the flow mode design. Further analysis is required to validate this notion. The information obtained in this study provides some in-depth knowledge of the DDGS particle that is essential to the effective handling and utilization of DDGS and other granular heterogeneous bulk materials.