Proposal No. 2012_001_TC

The Andersons Research Grant Program
Team Competition

Project Title: Intrinsic Characteristics of Modified DDGS and Development of Effective Handling Strategies

Principal Investigator(s)

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Period of Proposed Project Dates:

Beginning: 01/01/2013 Ending: 12/31/2014

Amount Requested (maximum $75,000 per year for two years):

Year 1: $74,740 Year 2: $74,740

Problem Identification and Related Research

The United States produced 13,900 MMGY (million gallons per year) of ethanol in 2011 (RFA, 2012) and the production capacity is being increased to meet the Energy Independence and Security Act of 2007 which permits 14 billion gallons of the 36 billion gallons to come from corn feedstock. Dry-grind process is the most commonly used process by the corn processing industry, in the U.S., for fuel ethanol production. Distillers dried grains with solubles (DDGS) is a key coproduct from the dry grind ethanol production process other than wet distillers grains (WDG), syrup (condensed distillers solubles, CDS) and CO_2. DDGS is produced by blending and drying WDG and CDS. DDGS adds to the profitability of corn ethanol production because about 7.2 kg of DDGS and 10.6 L of ethanol are produced from 25.4 kg (one bushel) of corn (Johnston *et al*., 2009). DDGS has good market value for its high nutritive components such as protein, fat, minerals, and vitamins. With the increase in the use of corn for fuel ethanol production, DDGS production also continues to increase. The U.S. dry-grind corn processing industry produced about 32.5 million MT of DDGS in the year 2010 of which 9 million MT was exported (RFA, 2012).

With the increase in corn prices, livestock producers are replacing part of the corn used previously in animal diets with regular or modified DDGS without hurting animal production or quality. Due to their nutritional value and high energy content, the market demand for DDGS is constantly expanding throughout the World. Being inexpensive compared to other feed ingredients, as dietary ingredients are the major expenditure for animal diet formulation, DDGS has become a part of diet formulations. DDGS is palatable to animals and ruminants readily consume diets containing DDGS (Schingoethe *et al*., 1983). Though high fiber content limits the use of DDGS to ruminant diets, nevertheless, its energy content makes it suitable for lactating and growing animals.

For better handling characteristics and storability, DDGS are usually marketed at a moisture of about 10% (wet basis). The process parameter that is primarily controlled during drying is the blending amounts of WDG and CDS. Drying conditions, blending ratio, and final moisture content of DDGS affect characteristics such as nutritional quality, flow behavior and shelf-life. Also, similar to other bulk solids, DDGS absorbs or loses moisture when exposed to the environment. Its hygroscopic nature and interaction with the environment during cooling, storage and transport causes product quality loss. Furthermore, this interaction of DDGS with the environment causes logistical challenges during handling and transportation and is currently a major hurdle in marketing DDGS (Rosentrater, 2007). In the U.S., DDGS is primarily transported by rail and trucks within the country but is also transported to the coast via barges for export.

DDGS cakes and hardens in railcar hoppers during transport and this makes unloading a time consuming and laborious process. Extensive studies conducted at Purdue University, West Lafayette, Indiana and South Dakota State University, Brookings indicated that caking of DDGS occurs due to moisture sorption, temperature fluctuation and the effect of compression and time consolidation during transport. Research at these institutions indicated that chemical composition, particle size and shape, and moisture content influence the caking of DDGS. Caking of bulk solids, in general, originates due to moisture sorption/desorption, stickiness from temperature changes, particle interlocking, or electrostatic charging. Barbosa-Canovas ***et al.***