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THE BEI HYDROLYSIS PROCESS & REACTOR SYSTEM
REFINED ENGINEERING PROTO-TYPE

BEI Pilot-Plant Improvement and Operations Demonstrations

Quarterly Report for 4th. Period
July - September, 1999

by:

Donald L. Brelsford
President and Principal Engineer

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THE BEI HYDROLYSIS PROCESS & REACTOR SYSTEM
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Technical Progress Report - Quarterly No. 4.

USDOE ERIP OSIT Project: DE-FG36-98GO10322

by:

Donald L. Brelsford, President and Principal Engineer
BRELSFORD ENGINEERING, INC. (BEI)

Project Aim:

To demonstrate the suitability, efficiency and potential validity of "The BEI Hydrolysis Process and Reactor System" (BEI-HP&RS), in the form of the small-scale "Refined-Engineering Proto-Type (RE-PT) Unit" located at the BEI Pilot-Plant Facility, near Bozeman, MT.

This BEI Project involves BEI-HP&RS's applications toward potential commercial validity demonstrations for dilute-acid corn-fiber cellulose-hydrolysis processing. This BEI Pilot-Plant Processing Project has various corn-fiber feed-stocks, which are: 1. Distillers Dried Grains with Solubles (DDGS), 2. Distillers Wet Grains (DWG) and 3. Corn Gluten Feed (CGF). Currently, these corn-fiber feed-stocks are Commercial Livestock Feedstuffs By-Products; currently in high-volume and low-cost supply in the U.S. Corn Starch to Fuel Ethanol (CS-FE) Industry. These CS-FE By-Products are currently being processed on this Project into a variety of pentose and hexose fermentable sugars, for preliminary commercial-validation demonstration, toward subsequent potential Corn-Fiber Processing into Fuel-Ethanol-Production; with higher-protein feedstuff co-products.

Project Objectives:

A. BEI Pilot-Plant Processing, of Corn-Fiber Cellulose-Hydrolysis (CF-CH) feedstocks, will identify and optimize the chemical reaction processing steps for moderate-temperature dilute-acid cellulose hydrolysis of their corn-fiber, into fermentable sugars and a higher-protein co-product.

B. This Project's corn-fiber (CF) hydrolysis processing improvements, through the use-of "The BEI HP&RS Refined-Engineering Proto-Type (RE-PT) Pilot-Plant" currently includes: 1. processing feedstock preparation, 2. reaction process heating controls, 2. cellulose hydrolysis reaction process controls, 3. fermentable sugar products quality analysis and 4. higher-protein co-product recovery.

C. BEI will optimize the BEI HP&RS Refined Engineering Proto-Type process, toward industrial operating parameters.

Technical Progress Report - 4th Quarter

Task 1: Feedstock Preparation System.

Chemical process engineering selections have been completed for the BEI RE-PT corn-fiber cellulose hydrolysis processing feedstock dilute-acid slurry-preparation sub-system for the CS-FE Commercial DDGS, DWG & CGF Livestock Feedstuff By-Products.

An IN-SINK ERATOR; i.e., a 3/4HP Heavy-Duty Biomass Grinder-Mixer; from Emerson Electric Co., has been identified, purchased and installed by BEI, for the BEI RE-PT. Currently, it is used for adequate preparation for BEI corn-fiber feedstock grinding, milling and dilute-acid slurry-mixing, as a BEI Pilot-Plant operations improvement; as a needed sub-system addition to the existing BEI-HP&RS Refined-Engineering Proto-Type (RE-PT).

Task 2: Automatic Process Heat Control Sub-System

A Cellulose-Hydrolysis Process Heating and Temperature Control sub-system addition, to the BEI RE-PT, has been designed, installed and checked-out, including instrumentation, piping and process monitoring improvements. Check-out for Automatic Control, for the Cellulose-Hydrolysis Process Heating supply, was for the in-place liquid thermal heating fluid sub-system; which included Process Heat (PH) recovery and recycle, by PH flashing and PH re-use operations; all within the BEI RE-PT Cellulose-Hydrolysis Process Heating System.

Task 3: Automatic Process Control Equipment

Check-out has been completed of an improved and adequate Automatic Process Control System, for the Corn Fiber (CF) Cellulose-Hydrolysis Feedstock Slurry; which includes: slurry preparation, pumping, monitoring and control sub-systems; within the BEI RE-PT Process Control System.

Task 4: BEI RE-PT Operations Demonstrations

Two adequate BEI RE-PT Processing Corn-Fiber Cellulose-Hydrolysis (CF-CH) Feedstock Supplies were received, from two Commercial Corn-Starch-to-Fuel-Ethanol (CF-FE) Production Plants; which are: Distillers Dried Grains w/ Solubles (DDGS) and Distillers Wet Grains (DWG) commercial livestock feed-stuffs by-products. Corn Gluten Feed (CGF) is now being requested from Commercial Wet-Milling Corn-Starch-to-Fuel-Ethanol (CF-FE) Production Plants.

Immediately in October 1999, thru-completion by December 31, 1999, BEI RE-PT Processing will be carried-out on adequate representative supplies of currently available CS-FE Commercial DDGS, DWG and CGF livestock feed-stuffs by-products.

These BEI RE-PT CF-CH Processing Feedstocks are being used by the BEI Cellulose Hydrolysis Process and Reactor System BEI HP&RS) for dilute-acid hydrolysis chemical processing of their Hemi-Cellulose (HC) and Alpha-Cellulose (AC) fractions; which will be into HC and AC Hydrolysates, containing pentose and hexose sugars, in-solution and readily suitable to be potentially used as highly economical fermentation substrates for additional Fuel-Ethanol Production; which could typically be at practically any of the presently operating CS-FE Production Plants.

Task 5: Chemical Analysis Instrument System

A BEI chemical analysis system has been purchased as an addition to the BEI Pilot-Plant. It is being used for the analysis and evaluation of the BEI CF-CH processing runs, for CF-HC and -AC hydrolysate sugars, results of Task 4. This Photo-Voltic Meter will provide BEI with accurate chemical-quantity and -quality analysis and determinations of the CF-HC and CF-AC hydrolysate sugars, and sugar-decompositions; on the basis of Dextrose Equivalents (DE). A Commercial laboratory services firm has been located; which provides BEI w/ High-Performance Liquid-Chromatographic (HP-LC) CF-CH hydrolysate sugar-analysis system services; which will be used and reported as appropriate.

Task 6: Preparing of the Final Project Report will be Dec. 1999.

OUTLINE: BEI HP&RS TECHNOLOGY COMMERCIAL PLAN

At the present time, mid-1999, BEI is actively and aggressively working toward planning, promoting, financing and constructing the Commercial Validation and Production Preparation Stage of the BEI HP&RS TECHNOLOGY'S COMMERCIAL PLAN. A variety of BEI Technology Briefs are being circulated; such-as the latest being at the 15th Anniversary: "1999 INTERNATIONAL FUEL ETHANOL WORKSHOP & TRADE SHOW, June 22-25, in Cedar Rapids Iowa.

The U. S. Corn-Starch to Fuel-Ethanol (CS-FE) Production Industry is currently facing several very serious marketing problems; which can directly result in negative economics:

#1.) The present substantial production and excessive supply, with related excess supply and low-selling prices, for CS-FE's major corn- protein livestock-feedstuff by-product: Corn Distillers Dried Grains w/ Solubles (DDGS).

#2.) Significant decline in the current over-seas market-demand for CS-FE's DDGS, particularly in Europe.

#3.) The substantial added-weight of the value-less fiber-fraction of DDGS; which directly increases the DDGS's freight shipping and handling costs, and it's required selling price.

#4.) The expanding industrial-development, financing and construction of numerous new U.S. Corn-Starch to Fuel-Ethanol (CS-FE) Production Plants, along with their necessary increased production of DDGS by-product; with it's 1998 low-market-value; in direct response to U.S. Congressional approval of the Federal Producers Incentive for Fuel Ethanol Production to 2007 AD.

Minnesota's Fuel Ethanol Production Companies, with Corn Grain Dry-Milling Operations, produce almost one-half million tons per year of Corn Distillers-Dried-Grains-with-Solubles (DDGS). which is sold into the established, currently flooded U.S. Livestock Feedstuff Market for DDGS. In November 1998, Corn Distillers Dried Grains w/ Solubles (DDGS) had a market price of \$65/tn; which is 55% lower than it's \$145/tn. Nov.'96 market price. In Minnesota, there is presently the potential for CORN PLUS to Purchase the available DDGS, from nine (9) Producers. CORN PLUS could then Process that DDGS; by The BEI Hydrolysis Process; for increased CORN PLUS's Lower-Cost Fuel Ethanol Production.