Report Out Day 2: Corn Wet and Dry Grinding Mills

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Corn Wet and Dry Grinding Mills

Corn Fiber Technologies

5 to 10%* Increase in Ethanol Production

Wet Mills RD&D Needs

1. Organisms for C5/C6 Fermentation

Feasibility: Economics of Corn Cost vs. Processing – Cost for Overall Production

Barriers:
- Robust
- Co-fermentation
- FDA/AAFCO Approved Residue
- Cost for developing the organism

Success Metric:
- 90% Conversion of C5s
- Rate Equivalent to that for Glucose
- 8% Minimum Ethanol Tolerance
- Successful Feeding Trials

Corn Wet and Dry Grinding Mills

Corn Fiber RD&D Needs for Wet Mills

2. Lower-Cost Saccharification

Barriers:
- Cost of enzymes
  - Protein Loading
  - Production Costs
- Fiber-Optimized Enzyme Cocktail

Success Metric:
- $0.11/gallon of ethanol

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Corn Fiber RD&D Needs for Dry Grinding Mills

5 to 10%* Increase in Ethanol Production

Benefit: Taking out the fiber will increase the value of DDG, reduce the volume and may expand the market

1. Robust microorganisms capable of C5/C6 conversion for 8 to 10% titers (current technology allows 5-6% titers)

Barriers:
- Existing microbes incapable of producing industrial-scale quantities

Success Metric:
- 80 to100 gm/l
- 40 hrs or less for fermentation
- Resistant to inhibitors

Corn Wet and Dry Grinding Mills

Corn Fiber RD&D Needs for Dry Grinding Mills

2. Efficient pretreatment and hydrolysis of corn fiber, including fermentation inhibitors

Barriers:
- What will happen to the syrup? (burned, new co-products, …)
- What do you do with the minerals in ash? (fertilizer, soil conditioner,…)
- How much fiber is needed to be left behind to carry protein in DDG

Success Metric:
- Establish Btu value of syrup as fuel source (syrup can not be used as feed
- $.11/gal enzyme cost

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Corn Fiber RD&D Needs for Dry Grinding Mills

3. Address liquids/solids handling needs in terms of equipment design/strategies (understand properties/requirements)

Barriers:
- Lack of data on physical properties
- High viscosity/complex properties
- Lack engineering data on material properties

Success Metric:
- Development of data

Corn Wet and Dry Grinding Mills

Corn Fiber RD&D Needs for Dry Grinding Mills

4. Improved milling and fractionation technologies

Barriers:
- Lack of value for co-products (needs new applications for oil, fiber)
- Regulatory approval for food use

Success Metric:
- New products (triesters, purified oils, tocopherols, nutraceutical compounds, etc.)

Corn Wet and Dry Grinding Mills

Corn Fiber RD&D Needs for Dry Grinding Mills

4. Optimizing of fiber pretreatment for maximum conversion with low capital and operating costs

Barriers:
- Formation of microbial inhibitors

A Concern: Mycotoxin in DDGS

Corn Wet and Dry Grinding Mills

Corn Fiber RD&D Needs for Dry Grinding Mills

5. Need to evaluate cost comparison for different paths for fiber to ethanol – process whole, fractionate fiber and then process, or convert to DDG and then process fiber

(Advantages for whole processing: Increase in ethanol yield – 3% from cellulose and 6% from hemicellulose; energy savings)

Barriers:
- Lack of data for cost comparison
- Resistance to change in the mills
- Economics
- Co-product quality
- Separate streams

Success Metric:
- Determining whether maximum yield is more cost-effective than grinding more corn (marginal cost for producing ethanol)

Corn Wet and Dry Grinding Mills

Corn Stover Technologies in Wet Mills

Future Contribution:
??

RD&D Needs

1. Need for study to evaluate what is the next best feedstock

Barriers:
- Geographic availability

Success Metric
- Profitability
- Knowledge base

Corn Wet and Dry Grinding Mills

Corn Stover RD&D Needs in Wet Mills

2. Compatible pretreatment processes – cleaning, grinding, traditional chemical treatments

Barriers:
- New terrain – processing cost unknown
- Abrasiveness

Success Metrics:
- Synergistic economics
- 15% ROI

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Corn Stover RD&D Needs in Dry Mills

1. Will require new plant infrastructure with separate methods for:
   - Pretreatment (e.g. starch, herbaceous, wood…)
   - Hydrolysis
   - Fermentation (microbes), and
   - Downstream recoveries

Barriers:
- Cost
- Existing markets for DDGS

Success Metrics: Marginal costs are competitive with
- $/gallon of ethanol
- $/ton DDGS
- $/million Btu

Corn Wet and Dry Grinding Mills

Corn Stover RD&D Needs in Dry Mills

2. Evaluate various biomass, including stover, for existing plants (such as Gatty and Fischer-Tropsch)

Barriers:
- Costs
- Pretreatment – enzymatic – fermentation
- Value of co-products

Success Metrics:
- $1.07-$1.50

Corn Wet and Dry Grinding Mills

Corn Stover RD&D Needs in Dry Mills

3. Optimization of pilot-scale plants – should kernel plants stay as is or have new ones that combine kernel and stover?

Barriers:
- Separate stover and kernel plants – 2 plants and reduced value
- Combined stover/kernel processing – making co-processing possible

Corn Wet and Dry Grinding Mills

Is DDGS a Limiting Factor on Growth of Corn Ethanol?

DDG has floor price equal to fuel
R&D Need: Optimize DDG combustion systems

DDG for Monogastric Livestock (w/o fiber)
R&D Need: Protein and oil extraction from DDG

Other R&D Needs:
Pelletizing DDG for no-stick flowability – easier to transport