New Technologies

In the Dry Grind Corn Ethanol Industry

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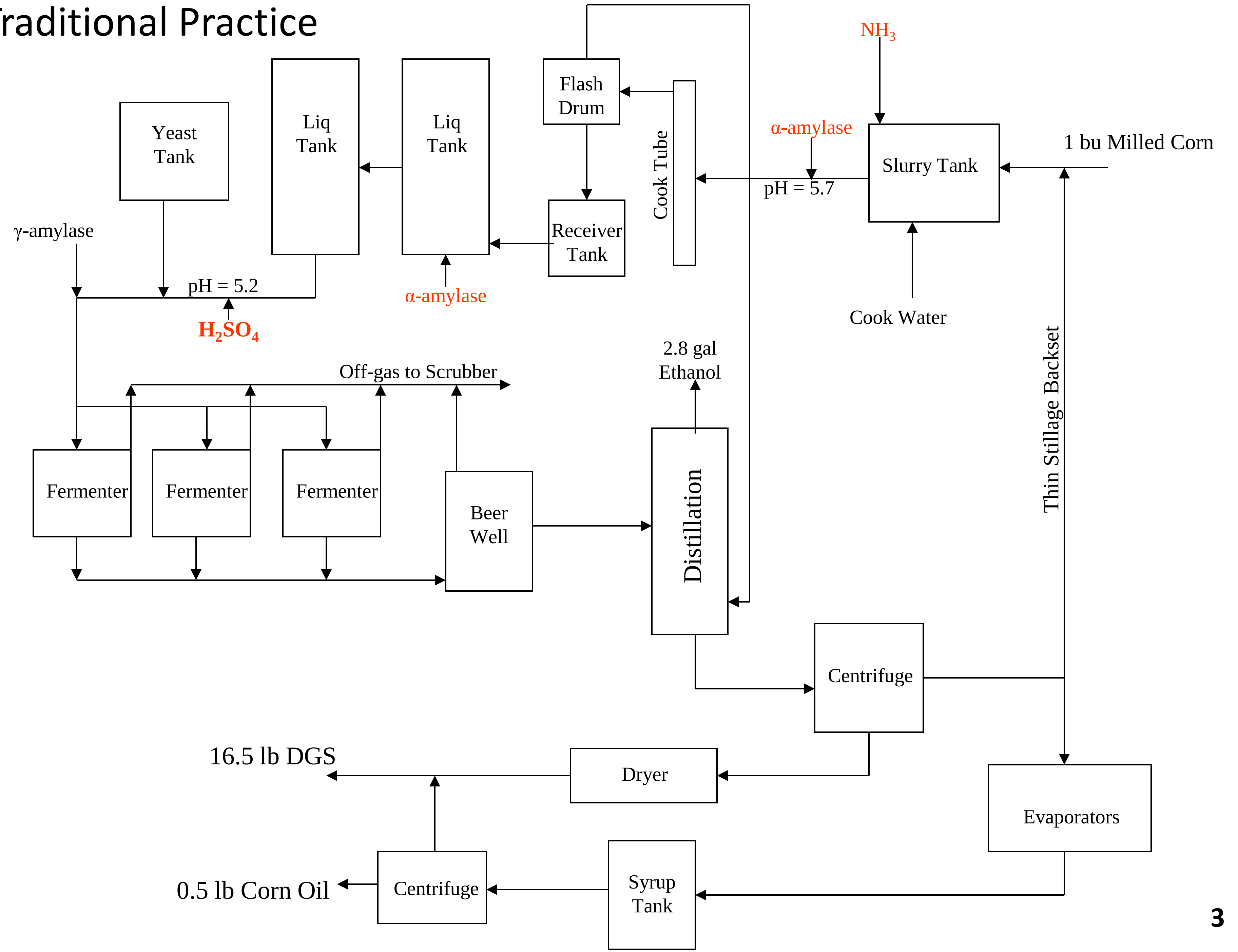
NDEQ Ethanol Workshop, Grand Island, NE
11/18/2015

Presentation Outline

- Traditional Practices
- Recently Adopted Technology
- Less Common Technologies being “Tested”

Traditional Practice



Low pH α-amylase

Example

- Novozymes Liquozyme® LpH

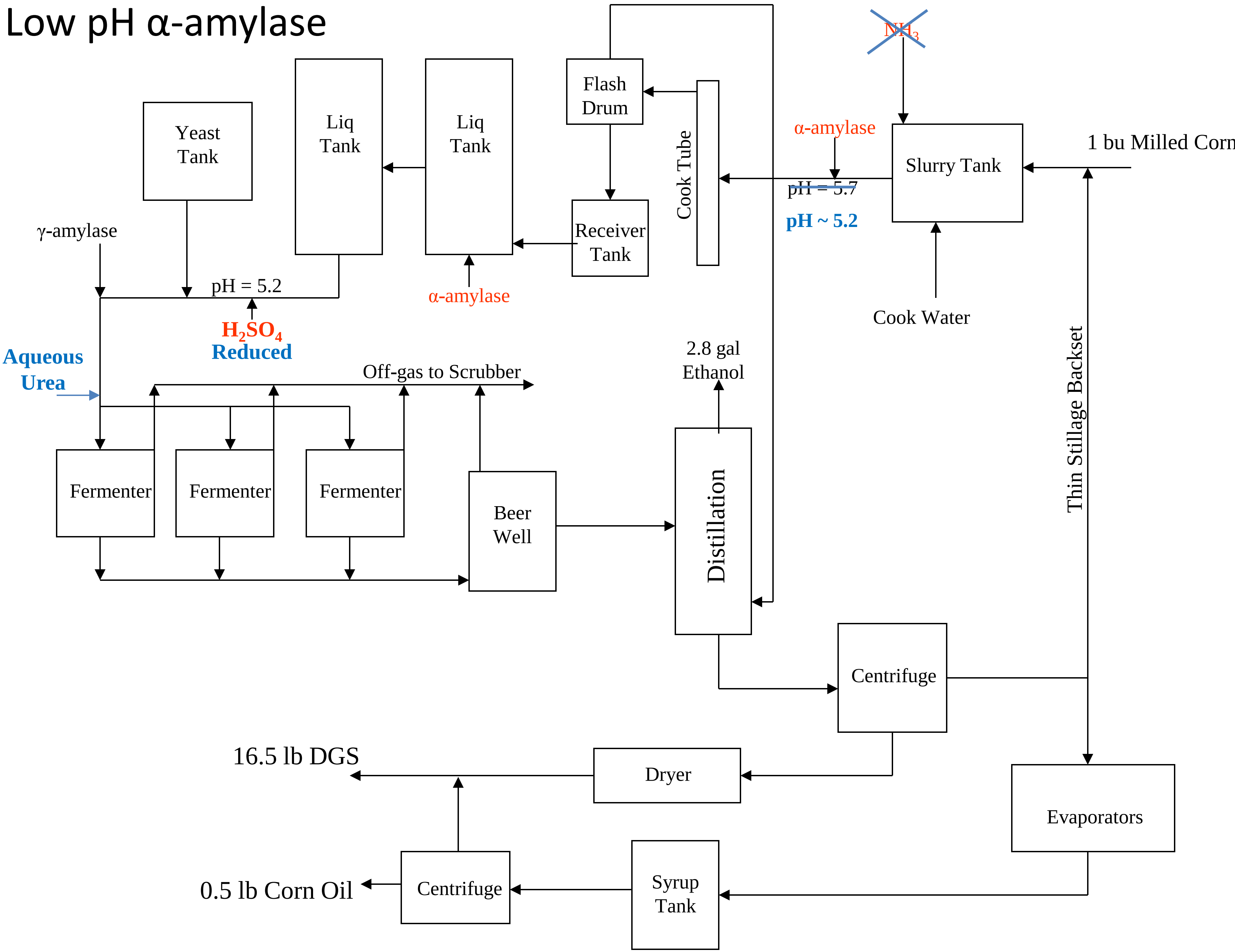
Process Change / Capital Investment

- Minimal

Advantages

- Viscosity reduction at Low pH
- Reduce or eliminate ammonia usage for pH adjustment
- Reduce sulfuric acid use
- Potential to reduce viscosity and increase throughput

Low pH α-amylase



No Cook Process

Example

- POET BPX®

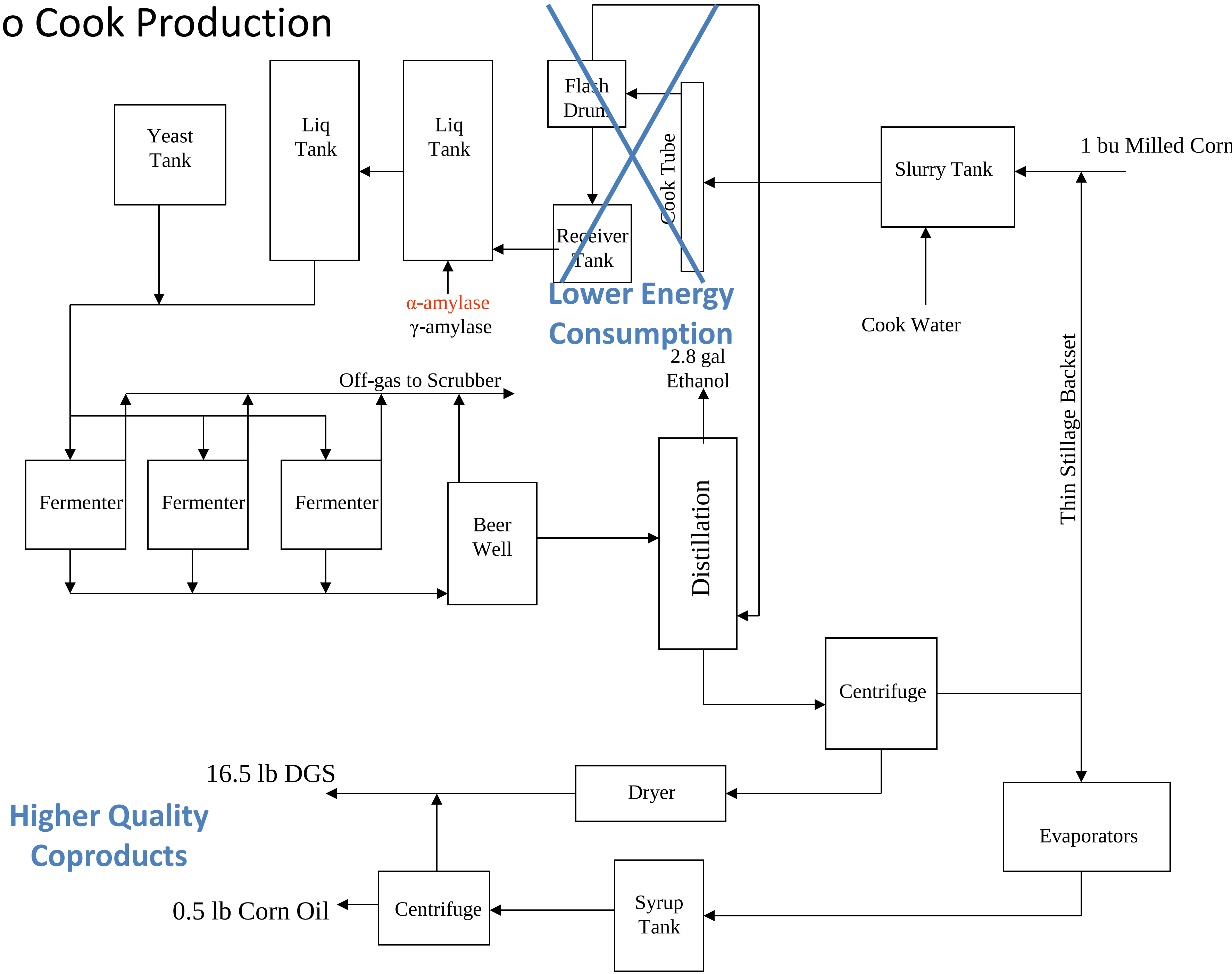
Process Change / Capital Investment

- Substantial

Advantages

- Simultaneous saccharification and fermentation while eliminating cooking.
- Lower energy and GHG emissions.
- Higher quality distillers grain feed products.
- Low free fatty acid corn oil.

No Cook Production



GMO Corn Containing α-amylase

Example

- Syngenta® Enogen®

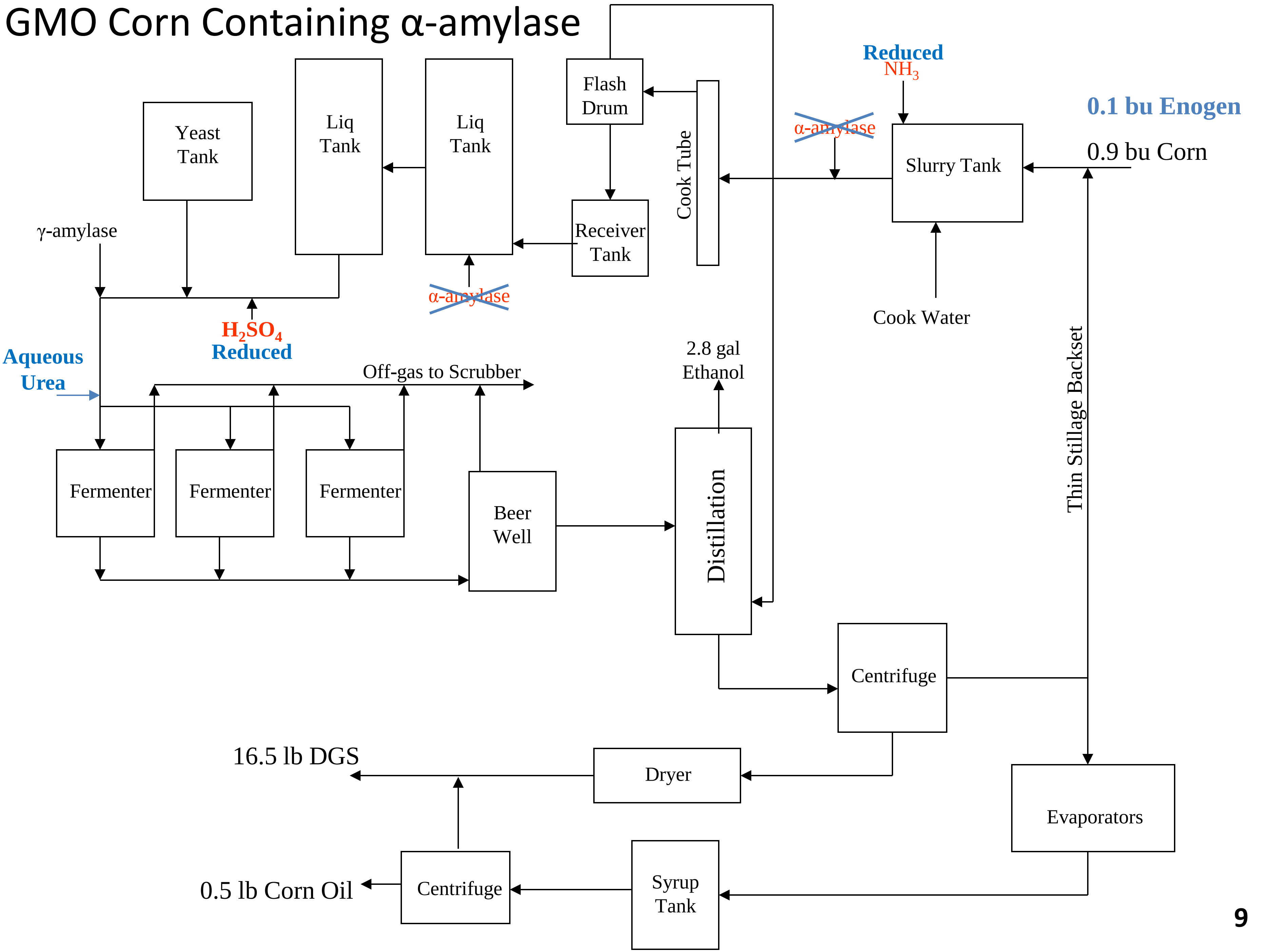
Process Change / Capital Investment

- Minimal

Advantages

- Eliminate α-amylase addition
- Viscosity Reduction at Low pH
- Reduce or eliminate ammonia usage for pH adjustment
- Reduce sulfuric acid use
- Potential to reduce viscosity and increase throughput
- Potential to reduce energy requirements

GMO Corn Containing α-amylase



GMO Yeast Expressing ϒ-amylase

Example

- TransFerm® Yield Plus

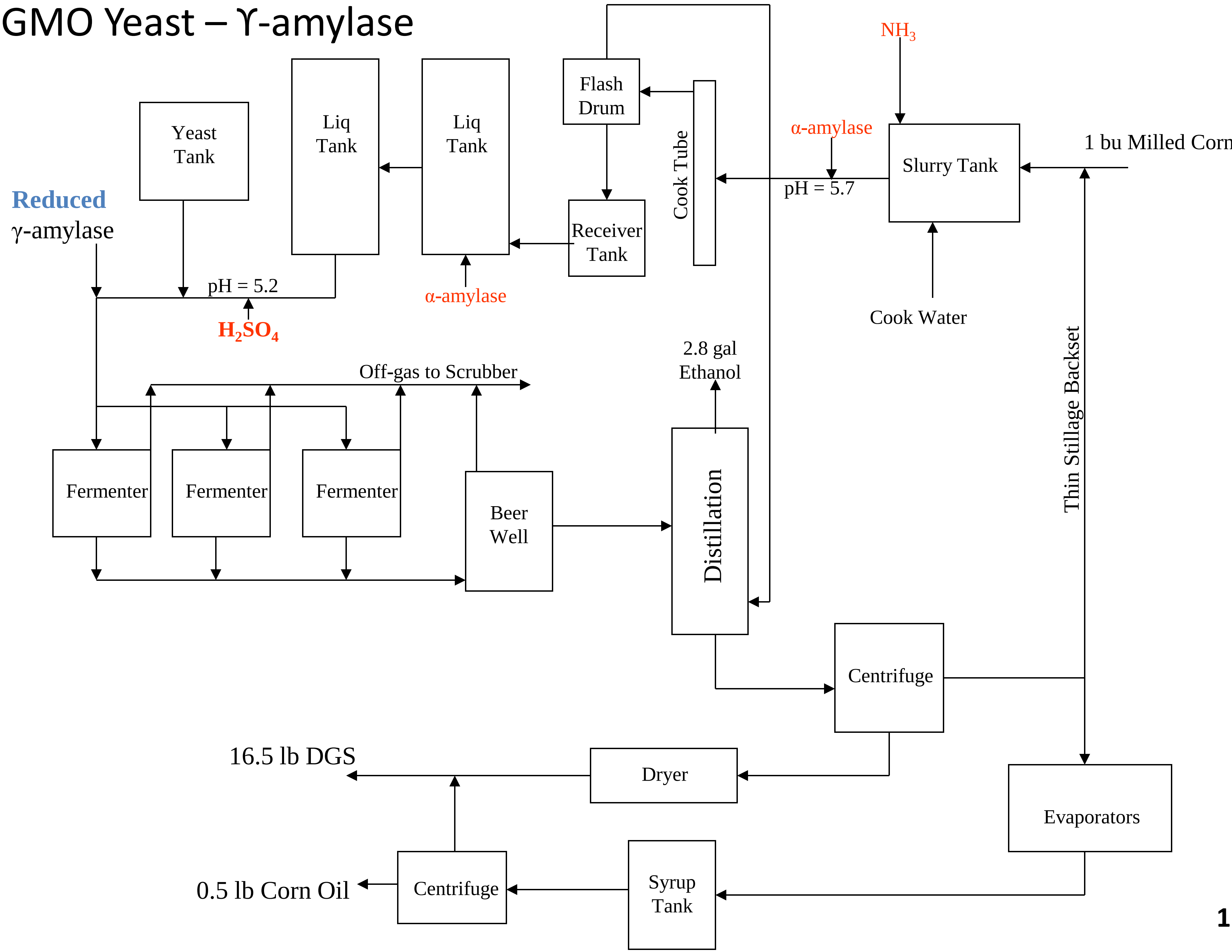
Process Change / Capital Investment

- Minimal

Advantages

- Reduce ϒ-amylase addition
- Reduce substrate inhibition during fermentation resulting in increased ethanol production and decreased glycerol production.

GMO Yeast – ϒ-amylase



α-amylase Enzyme Cocktails

Example

- Avantec® Amp by Novozymes

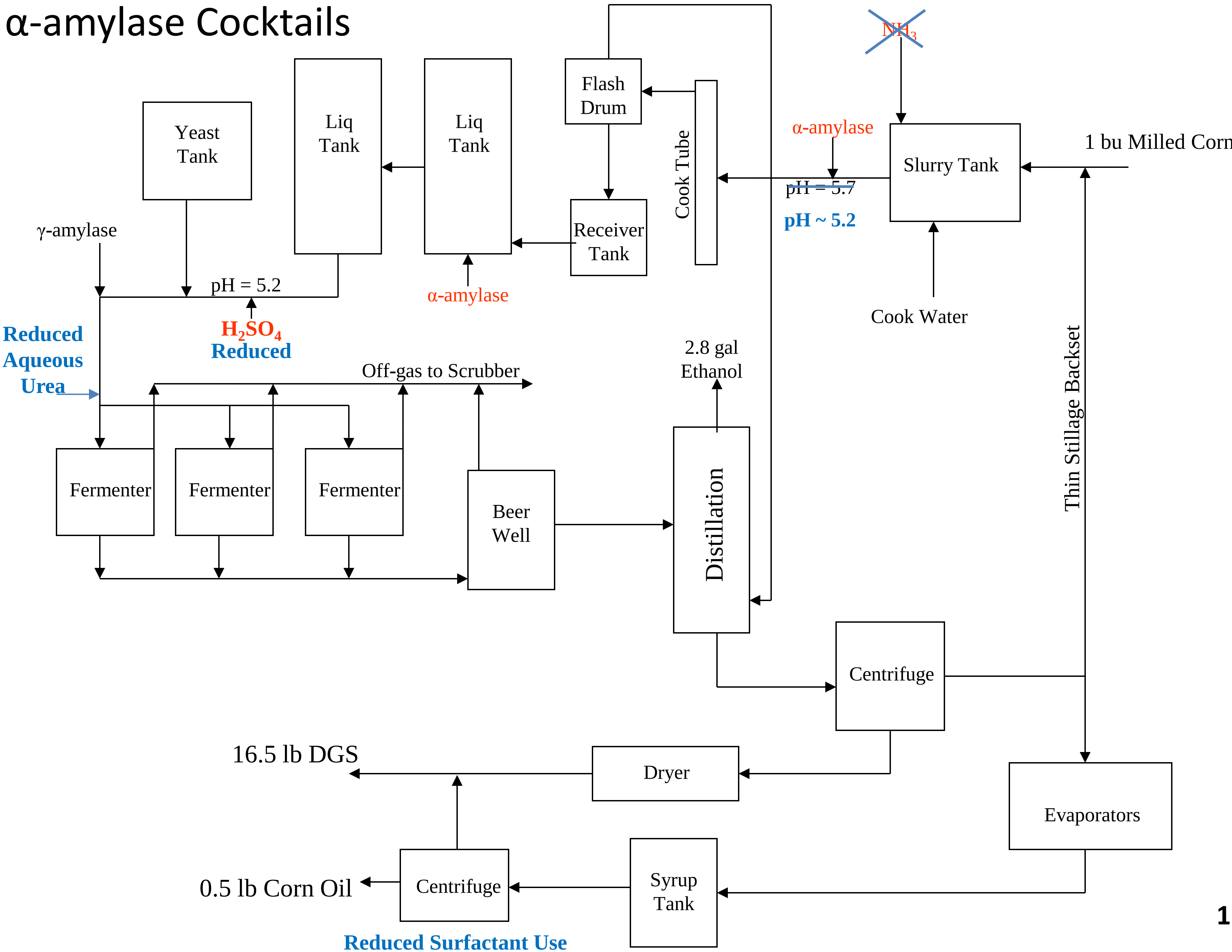
Process Change / Capital Investment

- Minimal

Advantages

- Eliminate the need to add stand-alone proteases.
- Reduce urea and ammonia use by 70%.
- Reduce surfactant use and increase corn oil recovery.
- Effective at a wide pH range giving process flexibility.

α-amylase Cocktails



Whole Stillage Fermentation

Example

- Cellerate™ Syngenta®

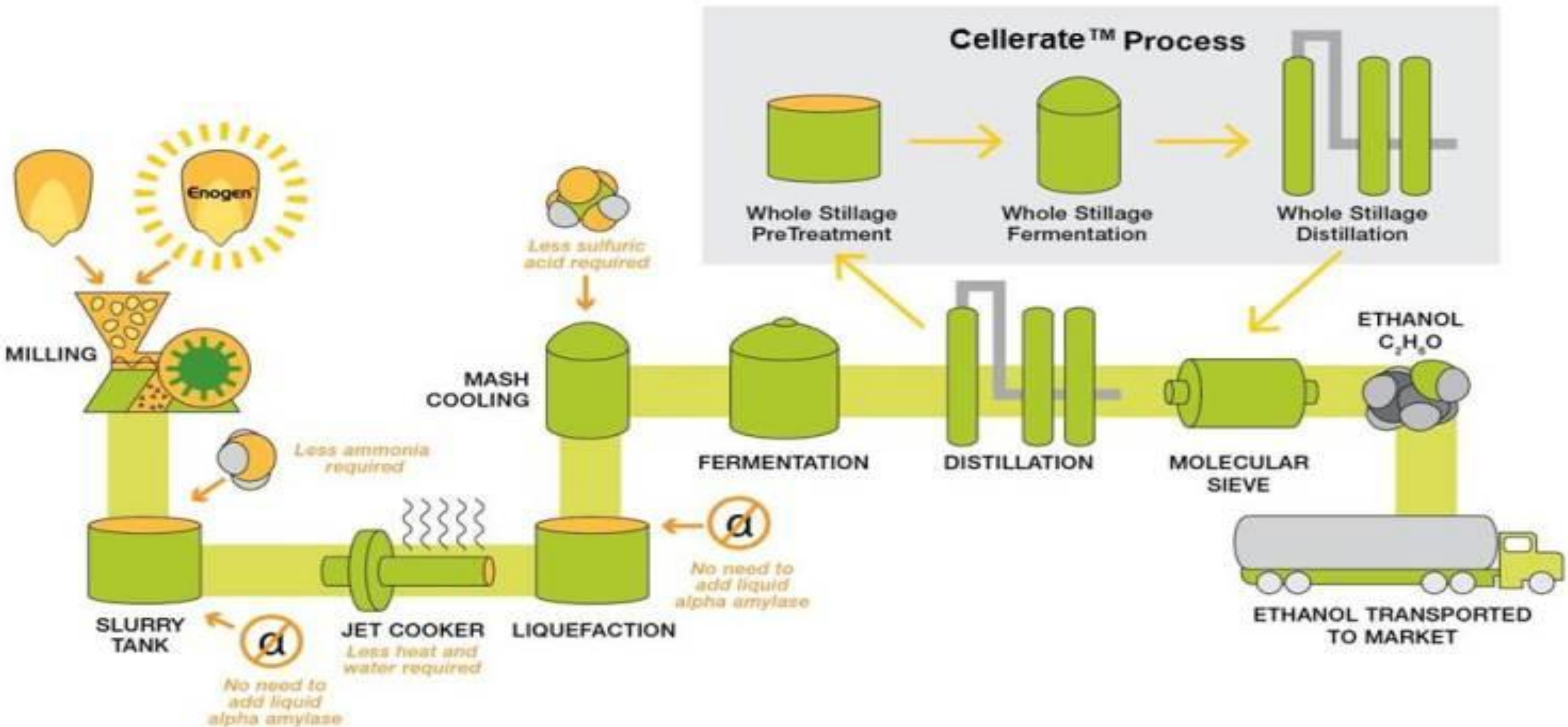
Process Change / Capital Investment

- Significant

Advantages

- Residual starch converted to ethanol.
- C6 cellulosic sugars converted to ethanol.
- D3 RINs to increase profitability.
- Increased oil yield.
- Increased protein content of DDGS.

Whole Stillage Fermentation



Fiber Separation Technology

Example

- ICM Fiber Separation

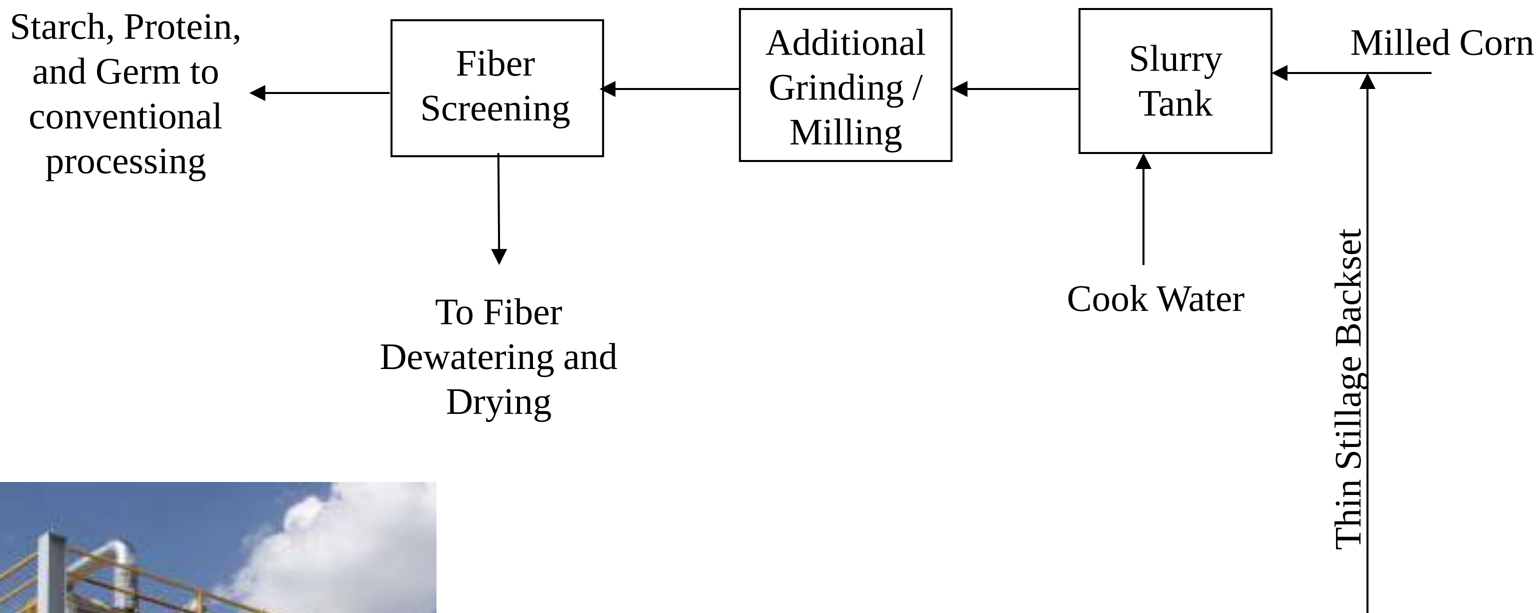
Process Change / Capital Investment

- Significant

Advantages

- Increase plant throughput while decreasing energy use and GHG emissions.
- Increase oil recovery.
- Create a high protein, low fiber coproduct.
- Create a high fiber, low protein coproduct.

Fiber Separation



ICMs selective milling technology used for wet grinding slurry.

Biobutanol Conversion

Example

- Gevo Biobutanol

Process Change / Capital Investment

- Significant

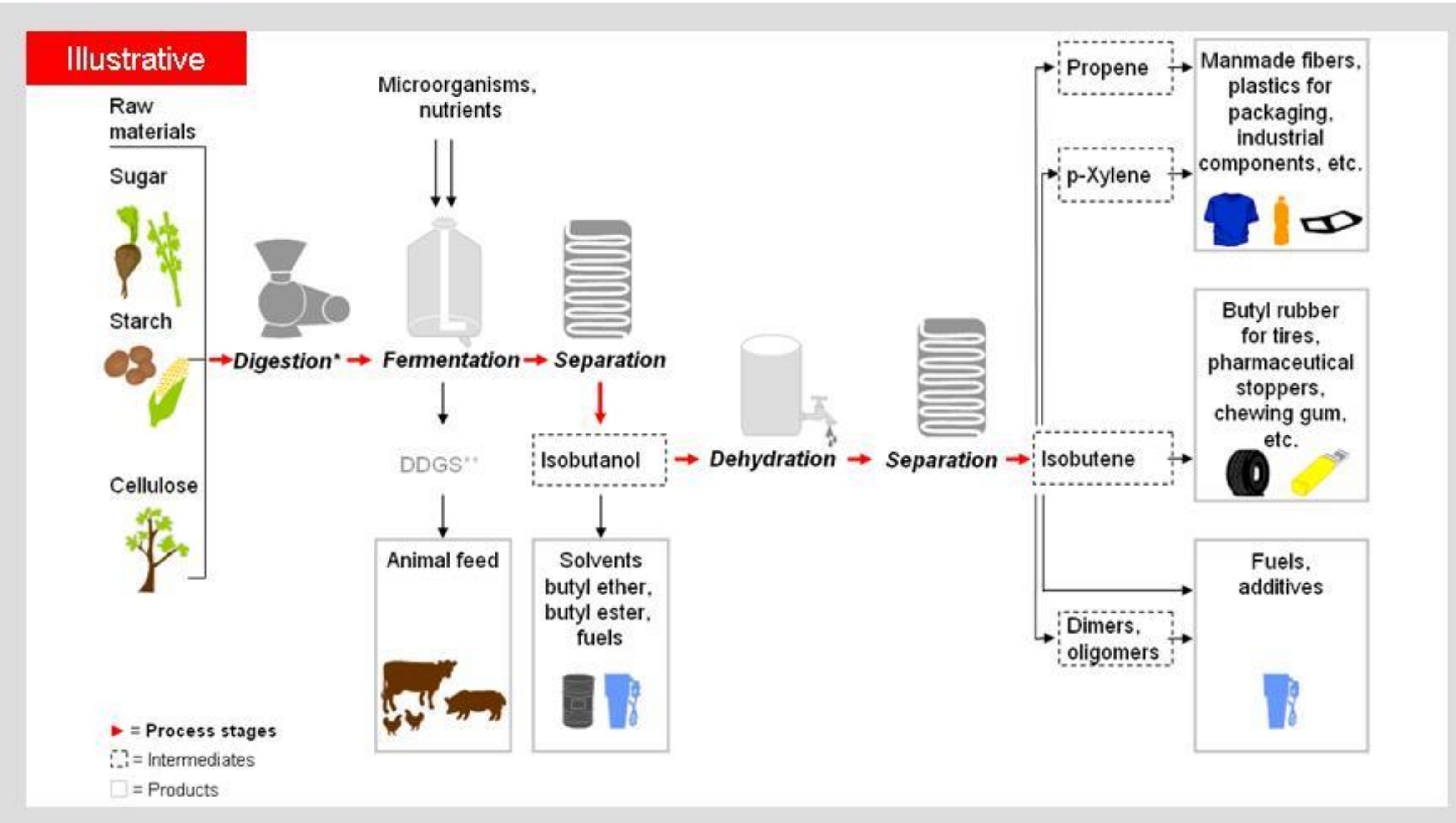
Advantages

- Isobutanol is chemically similar to gasoline.
- Isobutanol can be used to produce petrochemicals as a petroleum substitute.

Fuel Properties

	Gasoline	Ethanol	Isobutanol
Octane	87	120	102
Blending RVP (psi)	7 - 15	18 - 20	5 - 6
% Energy of Gasoline	100	66	84
Oxygent (wt%)	0	34.7	21.6

LANXESS Invests in Gevo's Production Process



* Mechanic, chemical und enzymatic; **DDGS – Distillers' Dried Grains with Solubles

Zein Extraction

Example

- Prairie Gold Inc. Front End Zein Extraction

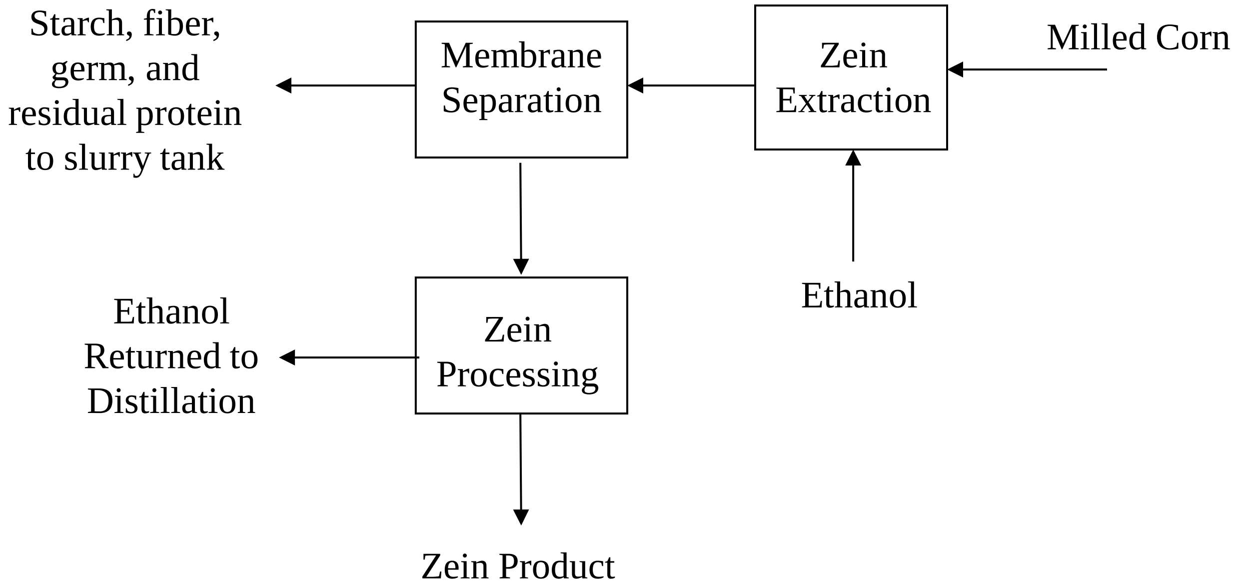
Process Change / Capital Investment

- Significant

Advantages

- Produces a byproduct which can be used for pharmaceuticals, films and packaging, and biopolymers.
- Higher quality zein than wet milling extraction by avoiding the steeping process.
- Increase in fermenter capacity.
- Increase in protein quality of DDGS.

Front End Zein Extraction



Prairie Gold Inc. Class 1 Div. 1 Pilot Plant

Renewable Diesel

Example

- UOP

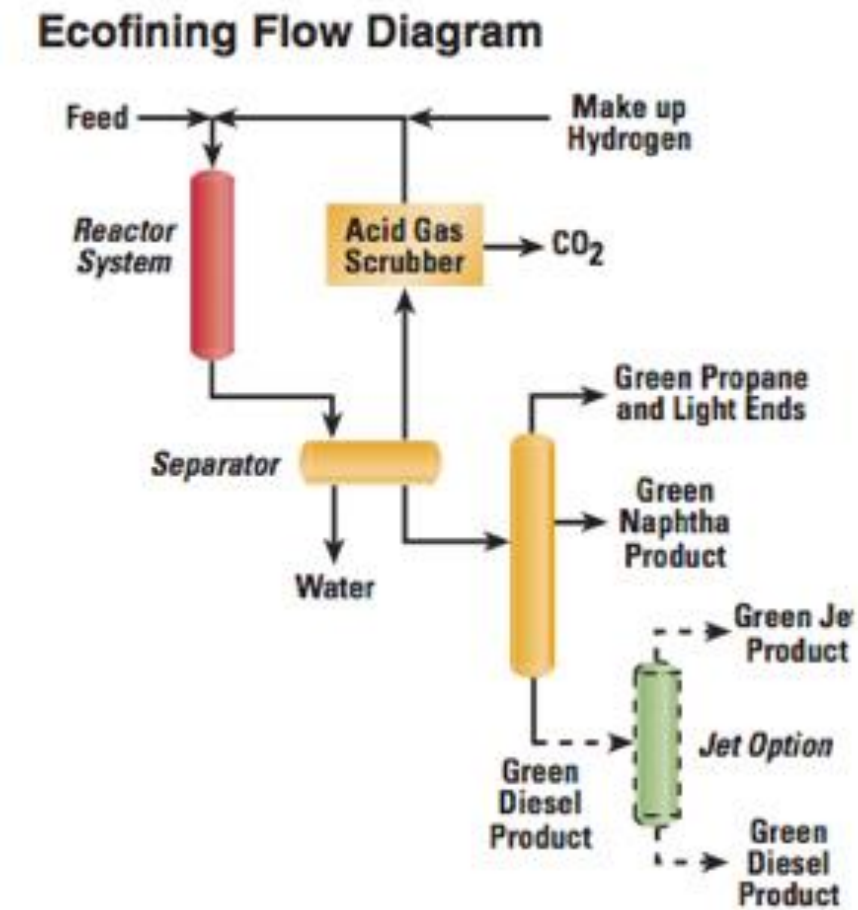
Process Change / Capital Investment

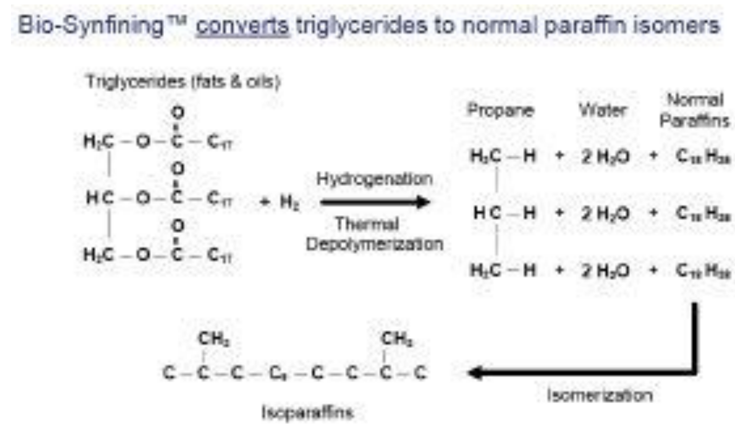
- New Plant

Advantages

- Produces ASTM premium grade diesel fuel from vegetable oils and animals fats using classic oil refining technology (hydrotreating).
- Chemically equivalent to petroleum derived diesel.

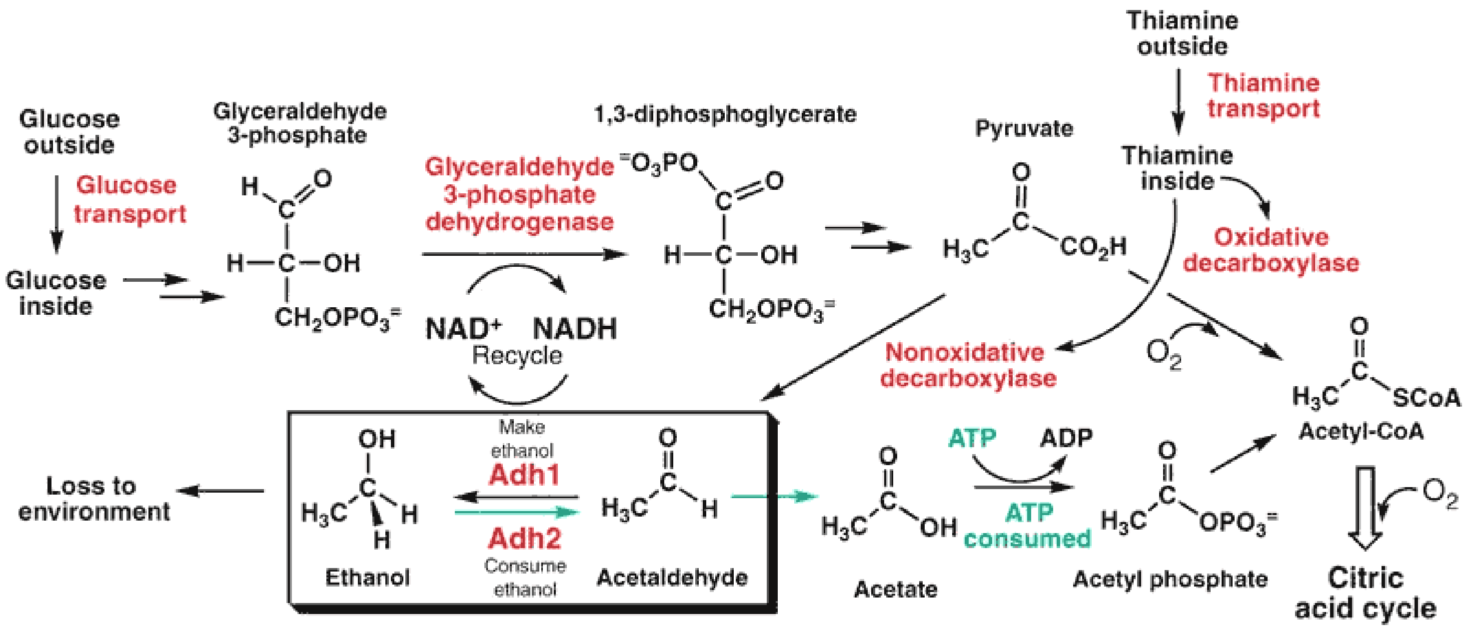
Renewable Diesel Production from Corn Oil





Acetaldehyde Emissions

Any process change which affects fermentation which includes changes in enzymes, enzyme dosage, yeast, fermentation temperature, etc may influence acetaldehyde emissions.



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Short Course
PROCESS CONTROL ESSENTIALS

nemep.unl.edu/pce-2016

DESCRIPTION
This course will provide industrial bioprocess personnel with a better understanding of all elements in a PID control loop including the sensor, actuator, process, and controller. Participants will gain hands-on experience operating and tuning loops using pilot scale equipment. Several different tuning methods and control structures will be explored.

BENEFITS OF ATTENDING
Combining lecture and demonstrations, participants will gain the ability to:

- Define and understand concepts and parameters of PID control
- Evaluate the stability of different open and closed loop processes
- Identify and troubleshoot common control loop problems
- Tune control loops using different methods
- Apply and understand the advantages of cascade control loops over single PID control

INTENDED AUDIENCE
Plant operators, maintenance personnel, and engineers of any experience level who use or maintain control equipment and/or DCS systems.

INSTRUCTORS
Dr. Hunter Flodman, Assistant Professor of Practice, University of Nebraska Chemical & Biomolecular Engineering
Scott Harmeier, Process Optimization Manager, Archer Daniels Midland Company, Columbus, NE

DATES & LOCATION
Coming Summer 2016 to Lincoln, Nebraska (Dates to be determined).
This two-day course is to be held at the College of Engineering (Othmer Hall / 820 N 16th Street) at the University of Nebraska-Lincoln.

CONTACT
For additional information, contact Matthew Jorgensen at (308) 293-5884 or mjorgensen@unl.edu.

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Questions and Discussion

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