Introduction

- During ethanol production in a dry-grind plant, the whole kernel is ground and corn oil can be extracted as a co-product.
- One bushel of corn contains 1.55 pounds of corn oil (2.8% by weight), as can be seen in Figure 1.
- 15 billion gallons of ethanol production from corn could generate almost 400 million gallons worth of vegetable oil if only ½ pound of oil was extracted from each bushel of corn [4].
- By capturing and selling the corn oil as a co-product, the ethanol plant receives an additional revenue of $0.15-0.20 per gallon of ethanol [3].
- Uses of corn oil include: cooking oil, soap, paint, ink, and insecticides. It is also a key ingredient in margarine [2].
- More importantly, corn oil can be used as a biodiesel feedstock.

Background Information

- In ethanol manufacturing, the most common storage carbohydrate, starch, is used to be hydrolyzed into a monosaccharide.
- In the hydrolysis process, seen in Figure 2, using enzymes significantly increases the fuel and oil yield in cellulosic ethanol manufacturing.
- In the same condition, the addition of an enzyme solution to the ground germ suspension prior to churning (aqueous enzymatic extraction) will give an oil yield twice high as the aqueous extraction yield.

Constraints and Opportunities

- Constraints:
  - Price varies for additional revenue for oil as a co-product.
    - Best case - $1.00 additive for $10 more oil [3]
    - Worst case - $1.00 in additive for $2.00 return in oil [3]
- Enzyme technology is still in the developing stages and the best enzyme technology may not yet be on the market.
- Transportation costs for a finished oil co-product may exceed the incentive to actually buy enzymes for enhancing oil recovery.
- Enzymatic hydrolysis may also take several days to complete compared to acid hydrolysis which can be completed much faster.
- Opportunities for enzymes:
  - DuPont Industrial Biosciences
  - FermaSure® XL
  - Novozymes
  - Avantec® Amp
- Because of the mild conditions used in Enzymatic hydrolysis, there are also some underlying incentives such as:
  - low utility consumption
  - low corrosion problems
  - low toxicity of hydrolyzates

Potential Solutions

- By utilizing an enzyme such as Novozymes’ Avantec® Amp, these goals may be achieved [1]:
  - the highest possible ethanol yield and throughput
  - increased corn oil yield
  - reduced chemical costs
  - simplified operations
- The addition of Avantec® Amp reduces the amount of urea and ammonia added to the fermentation process by 70%-90%. These chemicals eliminate the need for adding protease during fermentation; simplifying the production process and reducing costs [1].

References