Techno-Economic Analysis (TEA) of Using a Destoner to Fractionate Distillers Dried Grains with Solubles (DDGS)

Abstract

- US ethanol industry has grown rapidly in recent years and generated an amount of distillers dried grains with solubles (DDGS) as major co-products.
- Due to various particle compositions in DDGS, dividing DDGS into high protein and high fiber fractions could contribute extra economic benefit.
- A destoner is a simple and efficient machine to remove stones and soil from grains.
- In previous research, destoner fractionation has been proved as a somewhat efficient method to separate fractions of DDGS.

Computer Model

- SuperPro Designer (Intelligen, Inc., Scotch Plains, NJ) is a new industrial design software, which can facilitate modeling, evaluation and optimization of integrated processes.
- SuperPro Designer can produce a variety of reports based on mass and economic balances. These reports were generated for each simulation scenario in this study and used to compare the economic feasibility and sensitivities of processing scenarios and material prices.

Simulations

- Scale: 118,880 ton/year DDGS, produced by 40 million gallon dry-grind ethanol plant (Figure 1); 297,000 ton/year DDGS, produced by 100 million gallon dry-grind ethanol plant (Figure 2); 445,500 ton/year DDGS, produced by 150 million gallon dry-grind ethanol plant (Figure 3).
- DDGS: Original DDGS is $200/t; Medium protein DDGS is $214.45/t; High protein DDGS is $222.27/t.
- Standard Power: $0.046/kW-h.
- Labor Cost: $23.66/h.
- Installation Cost: Depends on various equipment.
- Destoner Cost: Small Scale included two types of $45,000 and 12,000; Medium Scale included two types of $50,000 and 12,000; Large Scale included two types of $85,000 and 22,000.
- Storage Cost: Depends on storage volume.
- Loan interest: 7.0% per year.

High Protein DDGs from Destoner Process

Results

Executive Summary (2013 prices)

- Small Capital Investment
- Medium Capital Investment
- Large Capital Investment
- Annual Operating Cost (AOC)
- Net Present Value (NPV, 7.0% Interest)
- Internal Rate of Return (IRR, 7.0% Interest)
- Payback Time

Fixed Capital Estimate Summary (2013 prices in $)

- Small Scale
- Medium Scale
- Large Scale

Process Summary (2013 prices)

- Capital Investment
- Annual Operating Cost
- Net Present Value
- Internal Rate of Return
- Payback Time

Profitability Analysis (2013 Prices)

- High Protein DDGs (Main Revenue)
- Solubles (Main Revenue)
- Medium Protein DDGs (Main Revenue)
- Low Protein DDGs (Main Revenue)
- Total

Conclusion

- Through the simulated scenarios, it can be concluded that destoner fractionation has a potential to play a vital role in increasing the market value of DDGS.
- The profits of destoner process in all scales are positive, but the net profit is still very low.