

## Biodiesel Process

**Sponsor:** Crown Iron Works (CIW)

**Sponsor's Mission:** Crown's objective is to provide the best available service, equipment and engineering to their customers in the oilseed processing, edible oil refining and related consumer product industries.

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**Senior Design Clinic I-II (ENGR 480-1) Project Description:** Model the industrial, continuous process for the transesterification of biodiesel marketed by CIW in a batch-scale design and evaluate the effects of ultrasonic irradiation upon this process.

### Major Design Requirements:

1. Execution of process representing Crown Iron Works' commercial technology as a control.
2. Execution of ultrasonic reaction process for comparison.
3. In order for the comparison to be fair, both processes will:
  - a. Be carried out in two-step reactions with product separation by gravity decantation in between each reaction step.
  - b. Finish with a neutralizing wash/gravity decantation step.
  - c. Use the same feed raw materials, catalyst loading, methanol excesses, and reaction/processing times.
4. Basis of comparison will be reaction completion after 1<sup>st</sup> reaction, after 2<sup>nd</sup> reaction and after final wash/neutralization/separation step

**Senior Design Project Summary:** Crown Iron Works, a world-leading designer and manufacturer of oilseed processing equipment, presented a project in which the final goal was to determine if the transesterification process of biodiesel could be improved by implementing ultrasonic irradiation to induce cavitation in the two reaction stages of the mixing process. For this to be determined, a batch control process was first created to model the CIW continuous process. Using this design, five 20-gallon batches of biodiesel were created and tested using gas chromatography to determine the amount of residual mono-, di- and tri- glycerides remaining in the fatty acid methyl esters. An inline ultrasonic device was then added to the control design to create the test setup, and five batches of 20 gallons were created at each frequency (20 kHz and 40 kHz). When these new batches of biodiesel were analyzed via gas chromatography—so as to compare transesterification using sonication to that without—favorable results were garnered.

