

# FOOD IS FUEL BE A BIOENERGY SPECIALIST

## Instruction Sheet

Imagine filling your car's tank with ears of corn. You don't need to be a car expert to know that this would be a bad idea. Yet, we can use fuel made from corn (biofuel). *How is this possible?* In this activity, you will learn more about how we convert biomass feedstock (like corn) into useful biofuel by making your own yogurt!

### MATERIALS

**Make sure you have adult supervision when using the stove.**

- 32 oz of milk (whole milk is preferred but 2% is fine)
  - 3/4 tbsp yogurt with active or live cultures
  - A large pot and a lid
  - A large bowl
  - A mesh sieve
  - Very strong paper towels
  - A stove top
  - Measuring cup
  - Timer/Clock
- Optional:**
- Another type of milk (dairy or non-dairy)
  - A cheese cloth



Photography: Patty Campbell / Argonne National Laboratory

### INTRODUCTION

Argonne scientists researching bioenergy convert bio-feedstocks, like corn, soybean, wheat and even garbage into fuel. These researchers start off with one material (i.e. corn) and convert it into something different (i.e. fuel), just like you'll do today. A big part of that process is dewatering--a method to reduce the amount of water within a mixture. Dewatering is an important upstream (before) and downstream (after) of conversion processes. It is an important pre-treatment that basically separates solids and liquids so that the parts that are important in the conversion process are more concentrated. During the downstream separation it is important because valuable acids or alcohols are recovered.

Also, when dewatering happens after the conversion process, the resulting product's volume is lower—which decreases how much energy is needed to process and transport it. Argonne scientists try to make biofuels in ways that are more energy efficient than using traditional fossil fuels. If the energy costs of creating, transporting, storing, and using biofuels are more than the costs for traditional fuels, then the scientists are not fulfilling their goals of being sustainable.

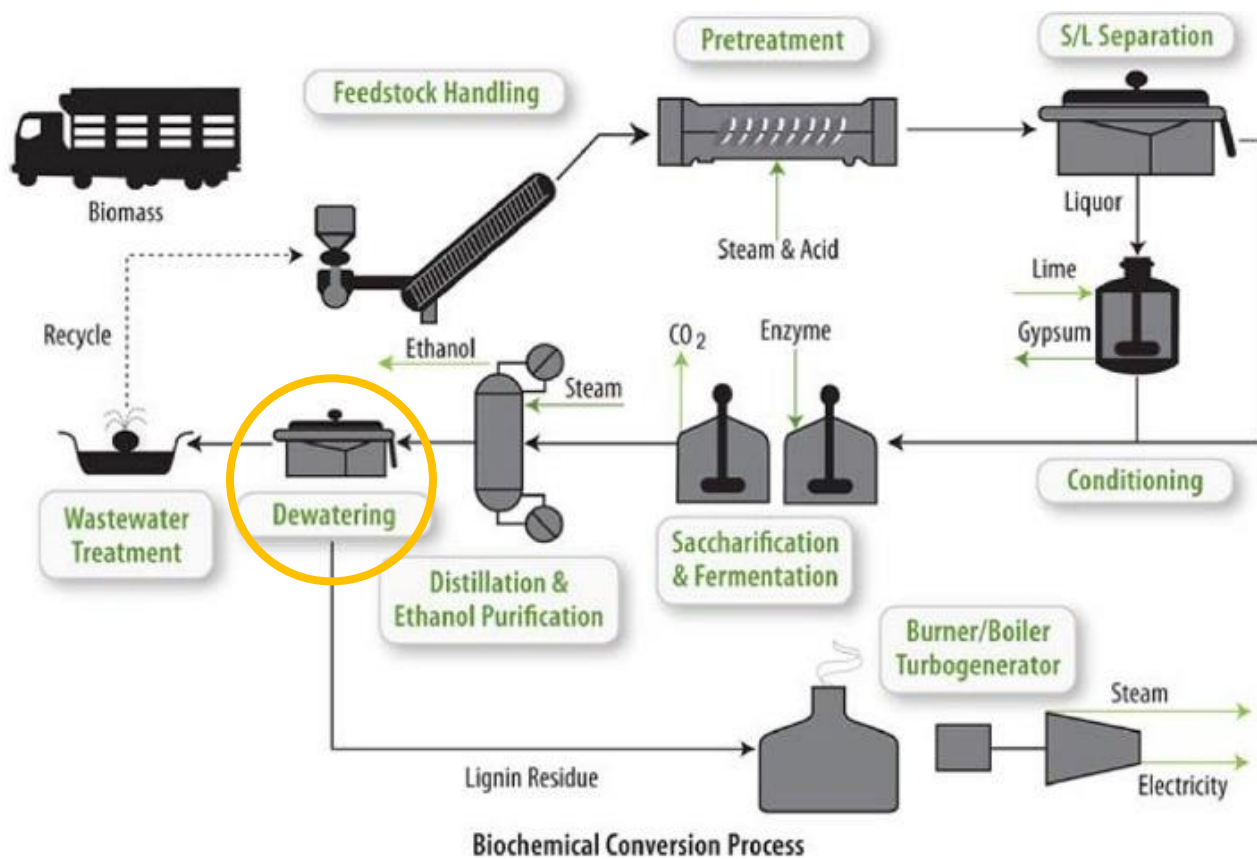
In this experiment, when you let your mixture sit over the paper towels, you'll be doing dewatering, too:

*"How do you think the yogurt's mass and volume will compare to the milk's?"*

*"Will this make the yogurt more 'energy efficient' than the milk?"*

### ACTIVITY HIGHLIGHTS

- Model the bioenergy production process!**
- Create yogurt using a catalyst and dewatering a technique.**
- Experiment with different filters and feedstocks!**
- Share your results with Argonne Education!**



The image above shows dewatering happening after the conversion process. Note it does not show the ethanol (product) undergoing dewatering.

Image Source: NREL <https://www.nrel.gov/bioenergy/biochemical-conversion-techno-economic-analysis.htm>

## PROCESS / PROCEDURE STEPS

### Part 1 – Dewatering



**Make sure you have adult supervision when using the stove.**

1. Pour your milk into the pot and bring to a boil on medium, or medium low heat if uncovered.
2. Once at a boil, turn off the stove and move the pot off the hot stove. Allow the milk to cool until it is just hotter than room temperature.
3. Add in the yogurt and stir well.
4. Cover your pot with a lid. Keep the pot at room temperature for about 6 hours (you may need up to 10 if your house is a little colder).
5. Place your mesh sieve over a large bowl. Line the sieve with your cheese cloth or very strong paper towels. Pour your yogurt into the filter.
6. Place your filter bowl into the fridge. You'll notice water slowly collecting at the bottom of the bowl.
7. Measure the rate of dewatering. Use the data table provided. Every 30 minutes, pour out the water that has come from the yogurt and measure it. Make sure to record the information!
8. After you reach 3.5 hours, you don't need to measure anymore. Keep the yogurt in the fridge. Once your yogurt is as thick as you want it, you're done!

### Part 2 – Let's experiment!

Try and change your feedstock or your filtration material to see what changes in your results!

- Try and switch out your "feedstocks" (the milk) with another type of milk! You can use another type of dairy milk or even a non-dairy milk. Repeat your experiment and record the differences!
- Since you used paper towels as your filter the first time, try a cheese cloth this time! Make sure to use the same feedstock as you did in your first experiment, so you don't have too many changing variables. Repeat the experiment and record the differences!



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### Data Sheet

#### Dewatering Measurement Table

Record the rate of filtration here.

| Time Passed   | Amount of water released        | Characteristics of Yogurt |
|---|---------------------------------|---------------------------|
| 0 minutes   |                                 |                           |
| 30 minutes  |                                 |                           |
| 60 minutes  |                                 |                           |
| 1.5 hours   |                                 |                           |
| 2 hours   |                                 |                           |
| 2.5 hours   |                                 |                           |
| 3 hours   |                                 |                           |
| 3.5 hours   |                                 |                           |
| Average rate = total water released/time in minutes<br>Average rate = | Total amount of water released: |                           |