passionate people;
passionate about food

Maple Leaf Foods' Biodiesel Production

A project not for the faint of heart…

Maple Leaf Foods
June 6th, 2008
Anne Tennier, P.Eng., VP Environmental Affairs

Rothsay

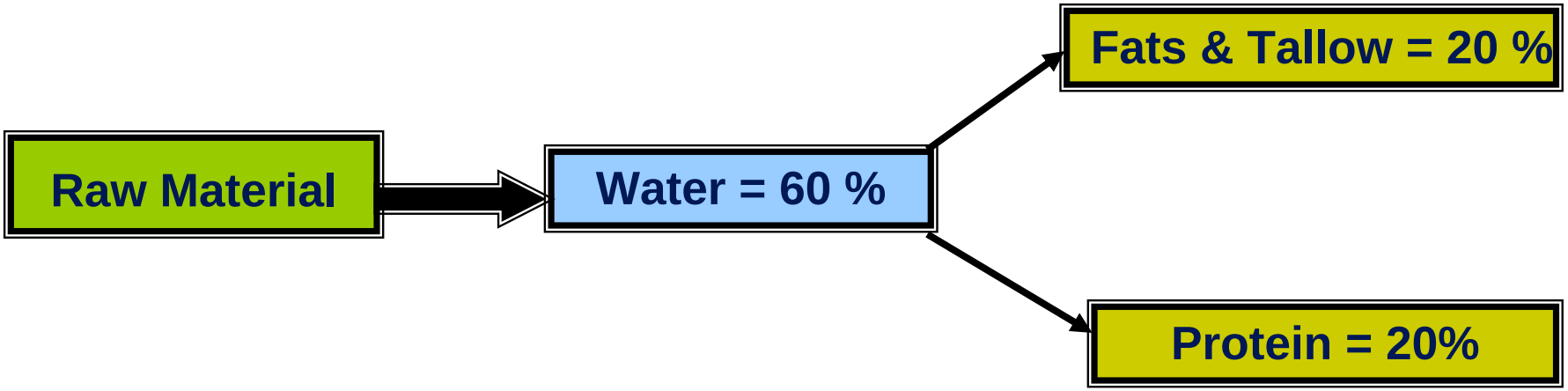
- A wholly owned division of Maple Leaf Foods
- Canada's largest renderer
- 7 locations
- Launched in 2005, first commercial scale biodiesel plant in Canada, producing 35 ML/yr.
- Produced biodiesel at our Montreal site since 2001.

Rothsay Locations

The Basics of Rendering Production

Basic Yield Equation

- 100 kgs of raw material = approx. *40 kgs of finished product



*Note: All values are approximate and can change based on type and quality of material being processed

Raw Material

Raw material is collected from butcher shops (abattoirs), restaurants, supermarkets, packing houses, etc.

- **Abattoirs**
  - ✓ Abington Meat Packers
  - ✓ Quality Meat Packers
  - ✓ Genesis Meat Packers
  - ✓ Conestoga Meat Packers
- **Restaurants**
  - ✓ KFC
  - ✓ East Side Marios
  - ✓ Kelseys
  - ✓ Crabby Joes
  - ✓ Emma's Back Porch
- **Supermarkets (trimmings, fish)**
  - ✓ Fortinos
  - ✓ A&P
  - ✓ Superfresh
  - ✓ Sobeys
  - ✓ Safeway
- **Kill Floor / Packing Houses**
  - ✓ Maple Leaf Pork
  - ✓ Maple Leaf Poultry
  - ✓ Better Beef
  - ✓ Quality Meat Packers
  - ✓ Granny's Poultry

Why Biodiesel?

The Catalyst

Global Mad Cow Cases

Feed Fat Markets

The Solution

- ✓ Inedible by-product
- ✓ Non Feed use
- ✓ Integrated with MLF Rendering operations
- ✓ Have infrastructure
- ✓ Higher value - Energy

The BioBus project

- Rothsay produced 500,000 litres of BioDiesel in 2002-2003
- Ran 122 municipal buses on B20 in downtown Montreal for one year
- Largest mass transit project in North America
- Proved Biodiesel works in cold climates
- First project to use fry-oil based Biodiesel
- Significant reductions in emissions
- No negative effects on engines

The BioMer Project

- Rothsay provided 200,000 litres of Biodiesel in 2004
- Ran 9 boats in the Old Montreal Marina for 4 months
- Used B5 and B100 blends
- Successfully demonstrated B100 use in boats
- Significant reductions in emissions
- No negative effects on engines
- Positive results on emissions and engines

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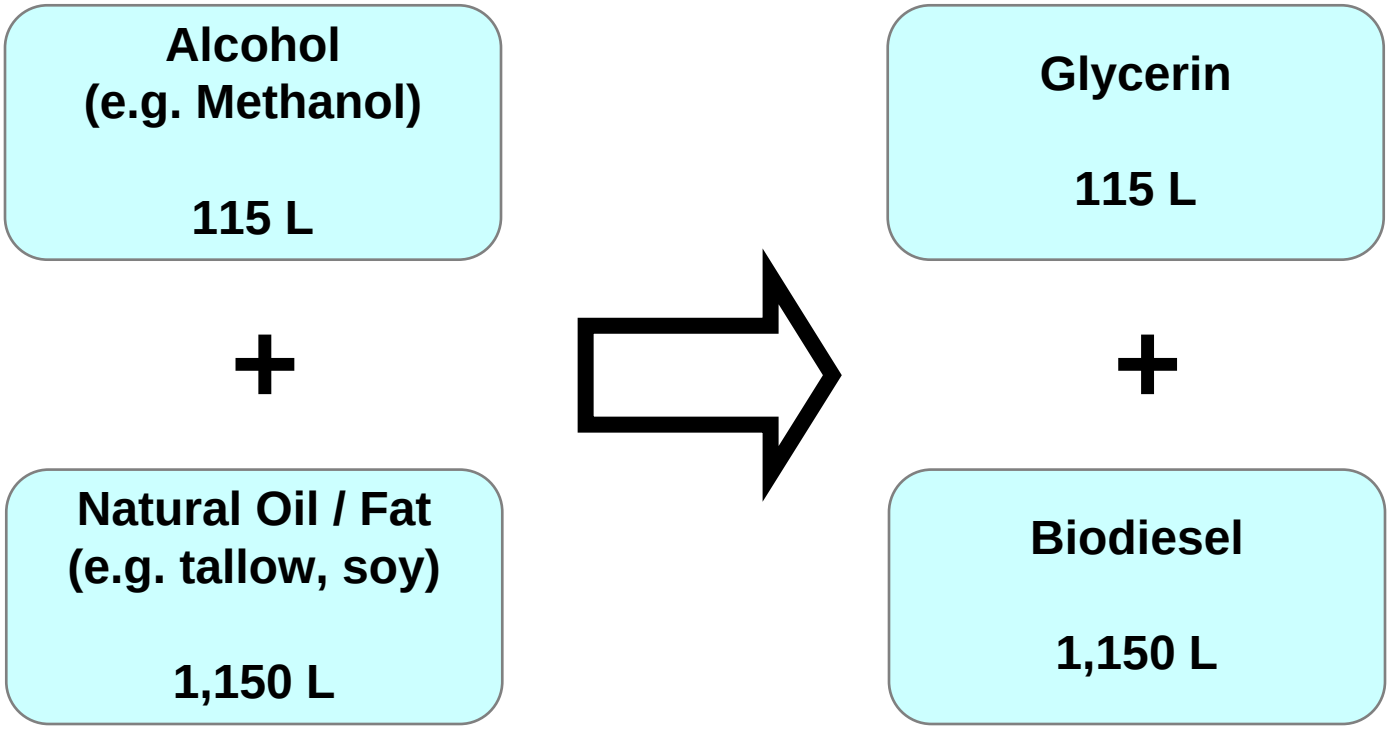
The Basics of Biodiesel

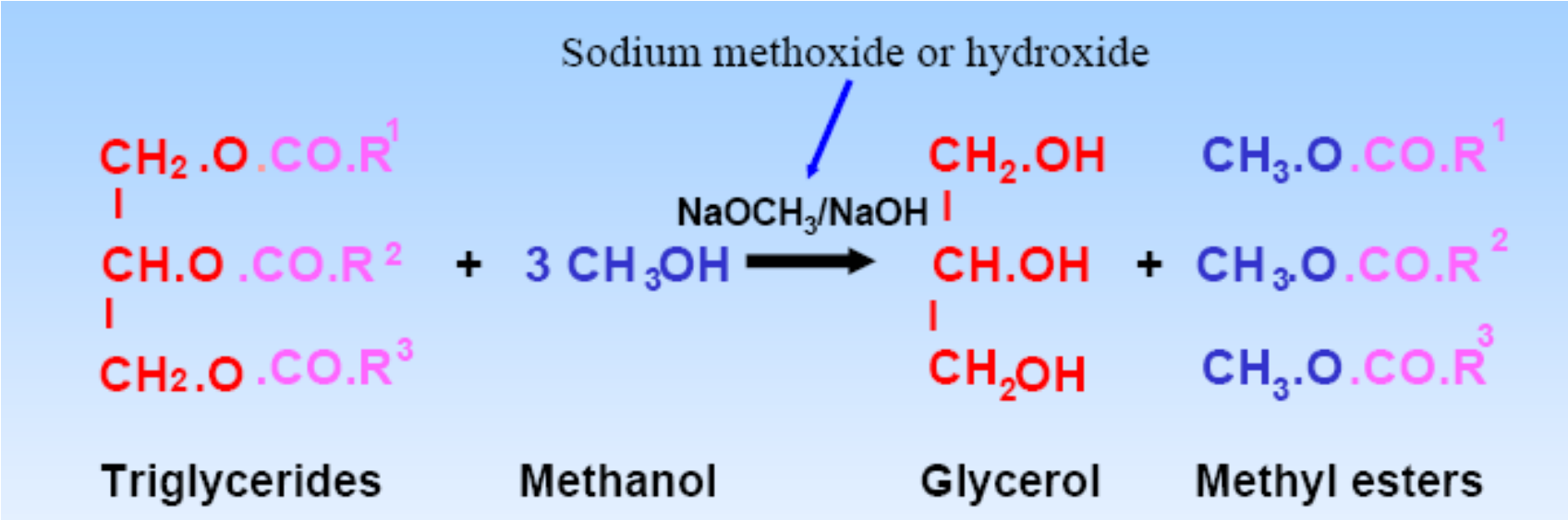
Biodiesel Production



What is Biodiesel?

- Alkyl ester derived from natural oils (i.e., triglycerides)
- Created by reacting an alcohol with a triglyceride
- Glycerin is produced as a by-product

The Biodiesel Reaction – Base Catalyzed Transesterification

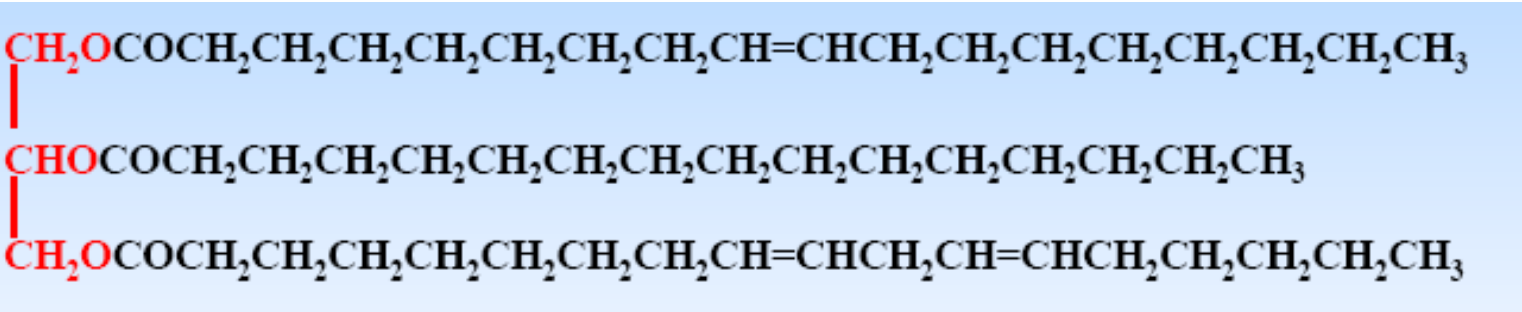


R^1, R^2, and R^3 are hydrocarbon chains typically 15 to 17 carbons long.

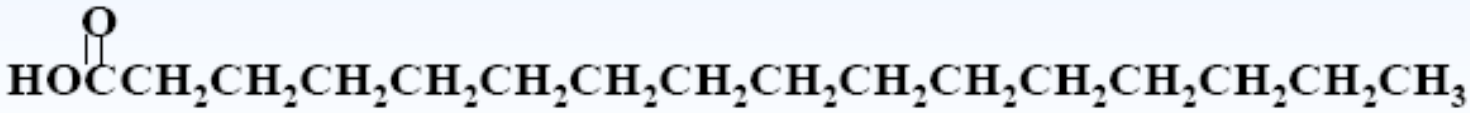
Biodiesel Chemistry

- **Animal fats and recycled oils also contain degraded triglycerides, called free fatty acids (FFA).**

Triglycerides…

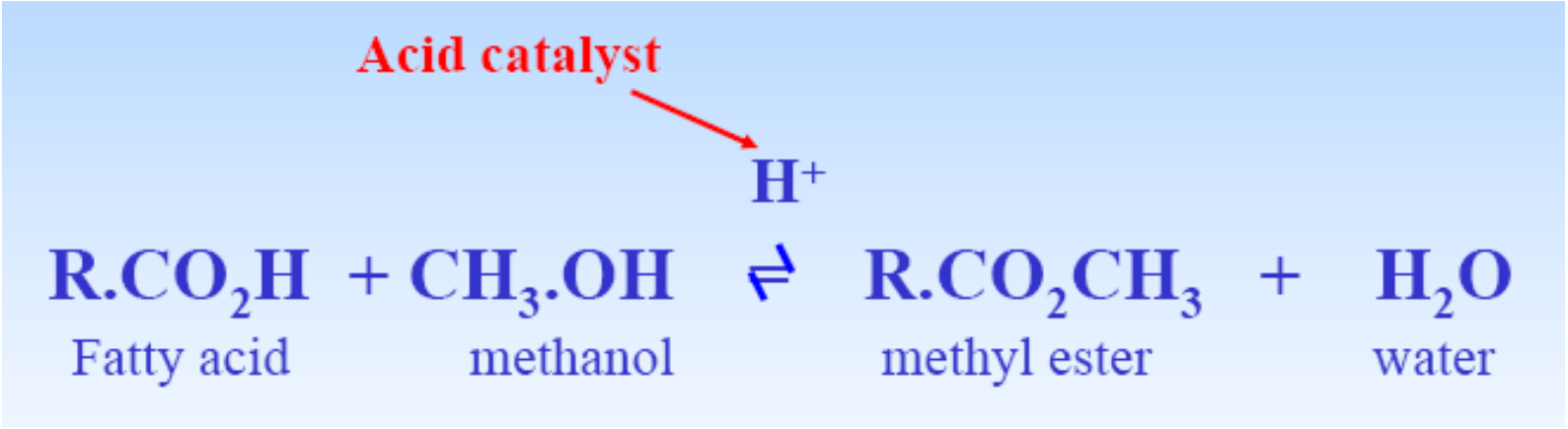


Break down into FFA…



Biodiesel chemistry

- The FFA must be pre-processed in a separate reaction using an acid catalyst. If not, it will react with the alkaline transesterification catalyst and make soap



- Typically, rendered fats and recycled oils contain 1% to 25% FFA

Biodiesel Definitions

- **B100,B20,B5 etc.**
  - ✓ The stands for the percentage of Diesel ie. B20 = 20 % Biodiesel and 80% petroleum Diesel
- **Tallow**
  - ✓ This is the rendered fats from Cattle, Pork or Poultry
- **Yellow Grease**
  - ✓ This is the recycled restaurant grease or used cooking oil from food production facilities

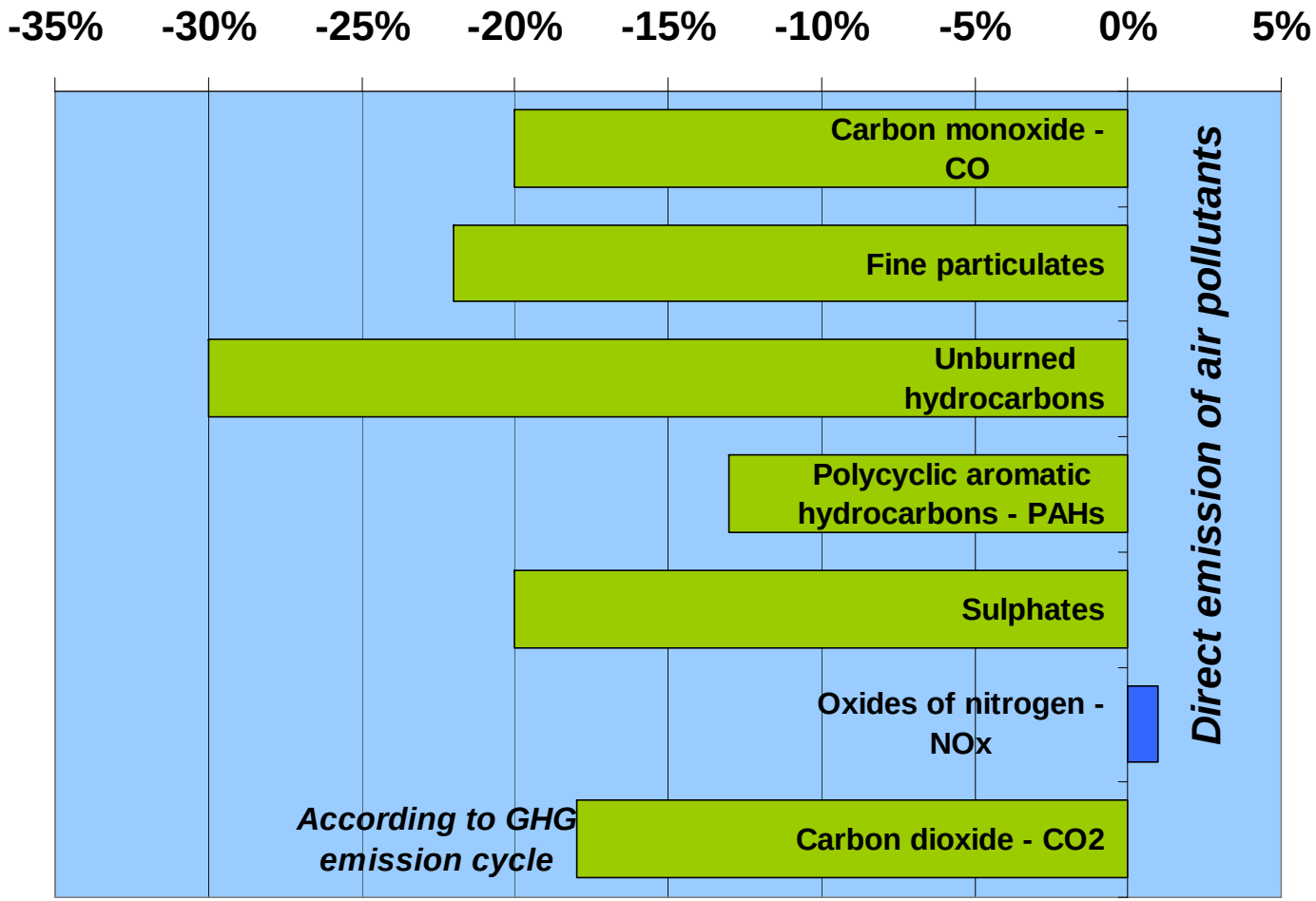
Why Biodiesel Is the Right "Green Fuel"

- **Low capital investment by the end user**
  - ✓ Works with today's engines without modifications
- **Accepted by engine manufacturers**
  - ✓ Most manufacturers warranty engines using Biodiesel blends
- **Extend engine life**
  - ✓ Adds lubricity to petro-diesel when blended at as low as 2% (B2)
  - ✓ Adds lubricity to Ultra Low Sulphur Diesel which was legislated in 2007 – 15 PPM

Biodiesel benefits

- Less smoke - 11% oxygen by weight
- Contains low sulfur (3 to 11 PPM)
- Does not effect power output, and engine torque
- As biodegradable as sugar
- 10 times less toxic than table salt
- Approximately 80% less carbon dioxide emissions
- 100% less sulfur dioxide emissions
- 90% reduction in total unburned hydrocarbons
- 75-90% reduction in aromatic hydrocarbons.

Emissions: B20 vs Petro-diesel



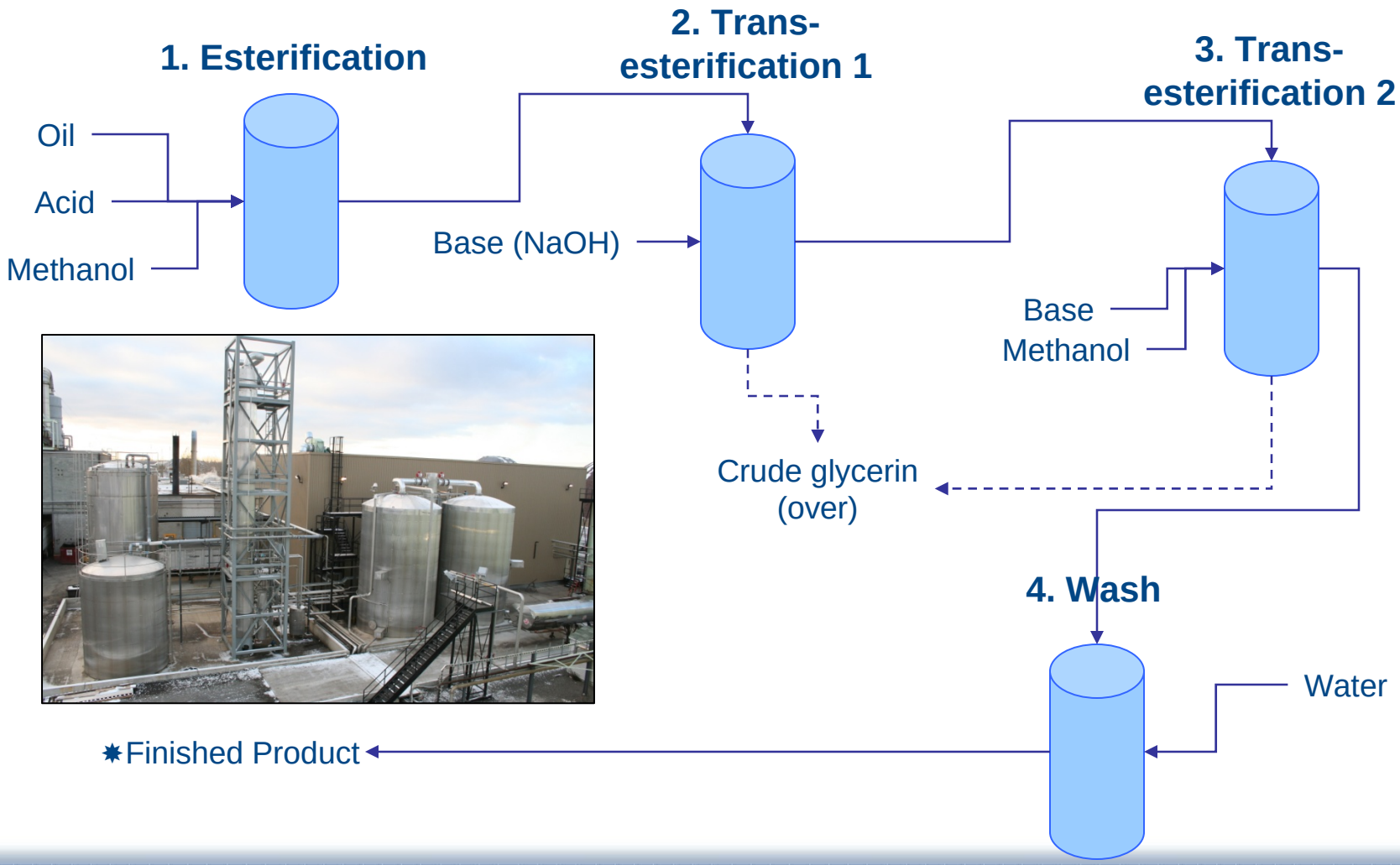
Source : *National Biodiesel Board*

Rothsay Biodiesel Model

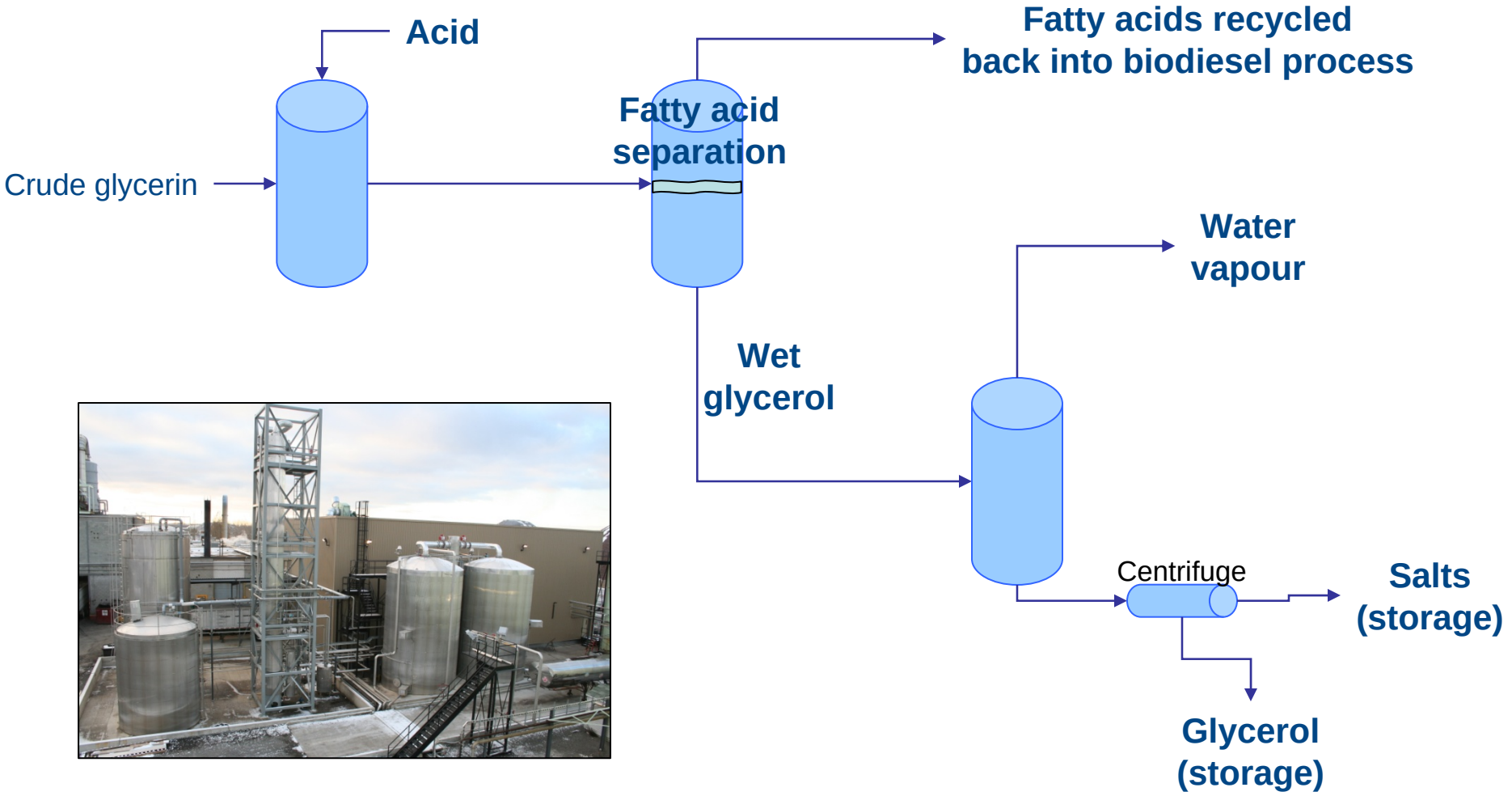
- **Manufactured from our own feed-stock supplied by our rendering facilities – value adding to our basic materials**
  - ✓ Tallow Bases going to the US because of blenders credit
  - ✓ Yellow Grease Bases staying in Canada because of higher blends in colder weather
- **One of a few plants in North America operating on Animal Fats and recycled products**
- **Meets the ASTM-6751-03**
  - ✓ Working to become BQ 9000 certified

Rothsay's Montreal Facility

The Commercial Plant Process



Glycerin Processing



Plant Start-up – July 2005

Not for the faint of heart…

- **Chemistry problems**
  - ✓ Incomplete reaction (!!!)
  - ✓ Soap/emulsions
  - ✓ Solidification (gel)
- **Gas Chromatograph (GC) problems**
  - ✓ Critical tool for monitoring reaction
  - ✓ Gave false data
- **Water coalescer**
  - ✓ Did not work at all.
  - ✓ Team designed from scratch an alternative

Plant Start-up – July 2005

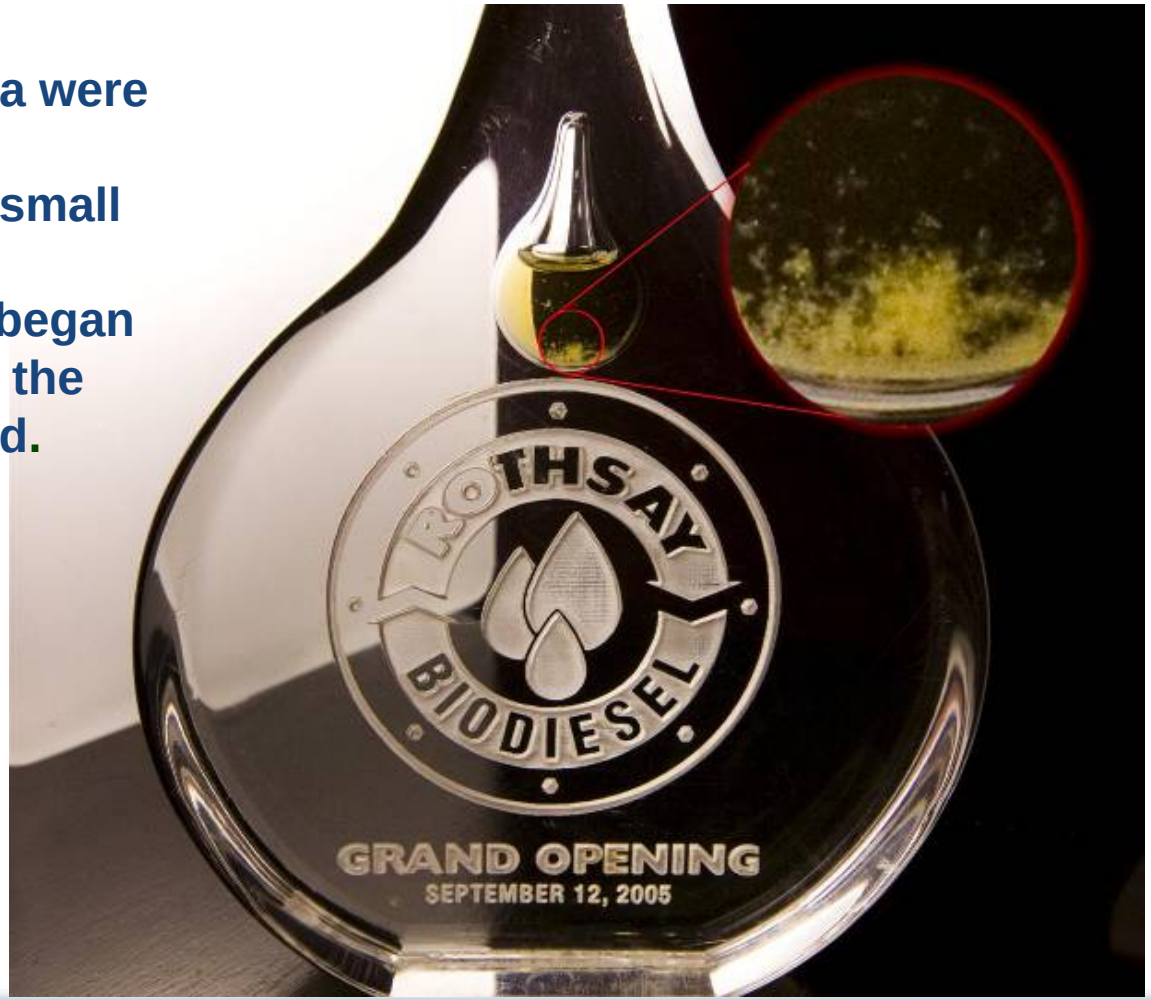
- **Incomplete reactions were not immediately detected because the GC was not working**
  - ✓ Lots of defective product produced
  - ✓ Incomplete reaction resulted in precipitation
  - ✓ Precipitation would only appear after several days!
  - ✓ Customer received and began to use the defective fuel.
  - ✓ Precipitates were insoluble in diesel, water, and very difficult to clean out of tanks.

Key Challenge: Precipitates

- Polyethylene and other polymers
- Proteins
- Phospholipids
- Mono and diglycerides (esp saturated).
- Soap

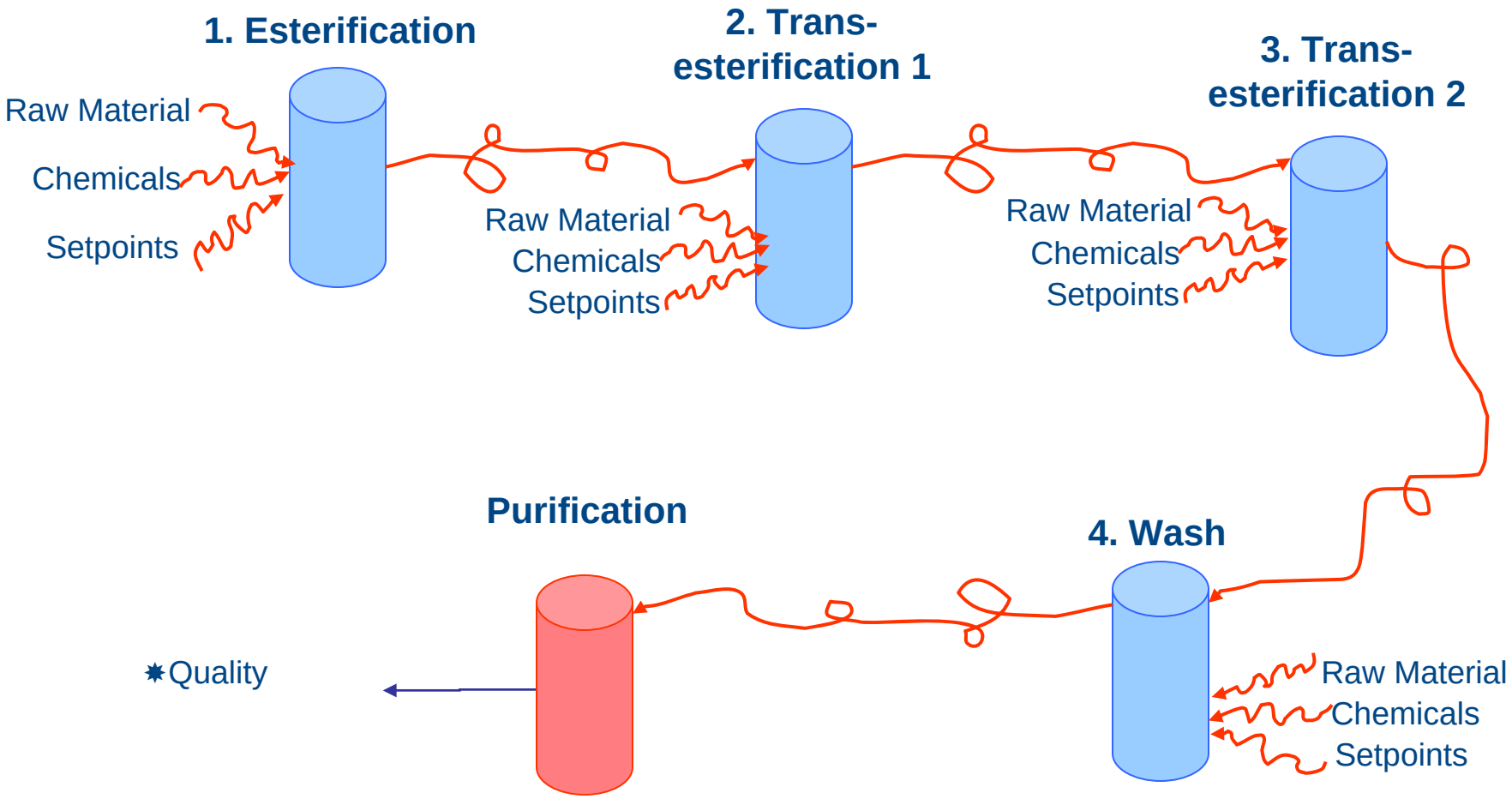
Plant Commissioning – Sept 2005

- Launch event cancelled due to plant production problems
- Premier of Quebec and media were invited
- Event memento contained a small sample of biodiesel
- Weeks afterwards sediment began to appear - fortunately, none of the mementos were ever distributed.

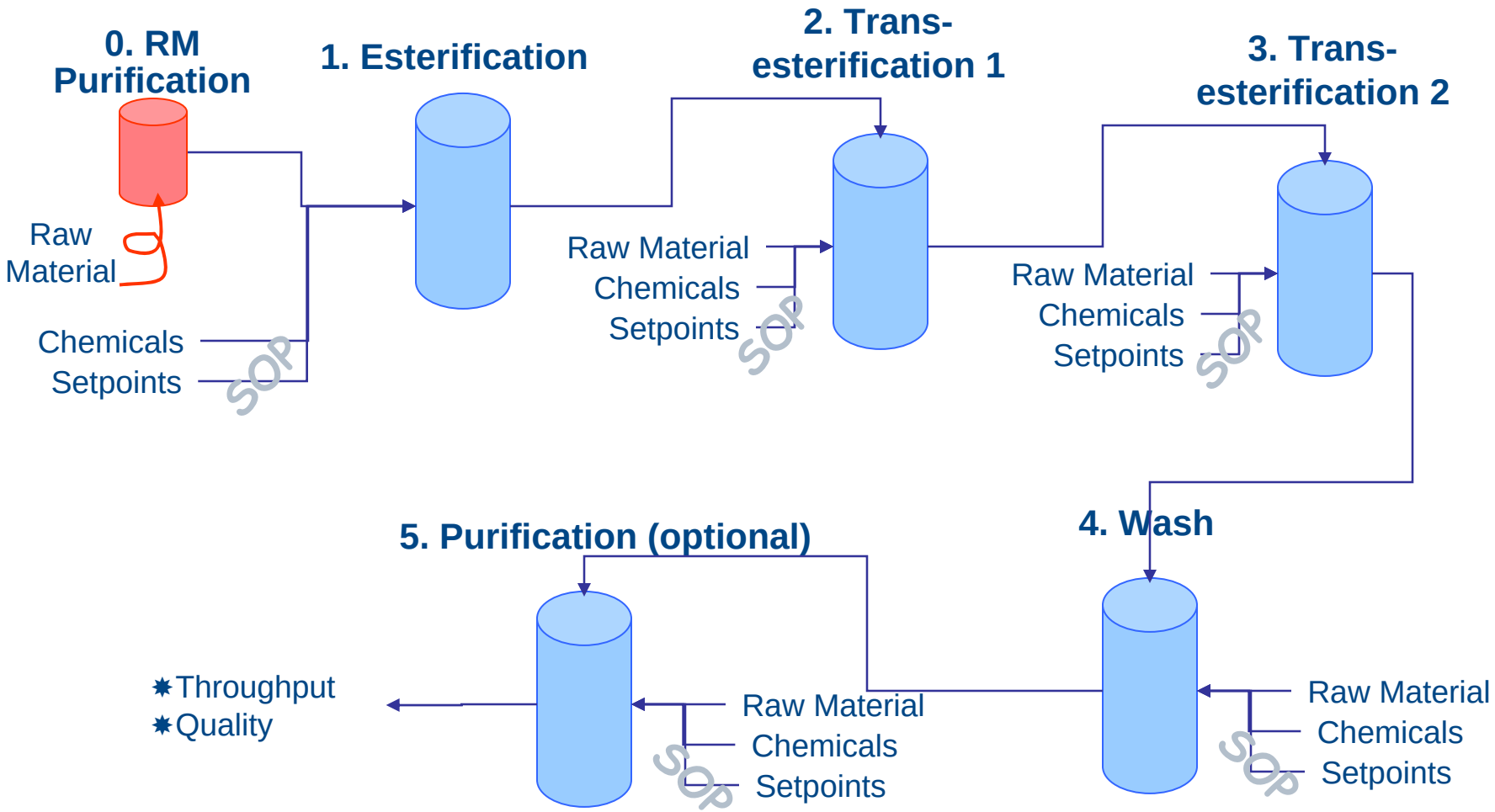


Key Challenge: Process Predictability

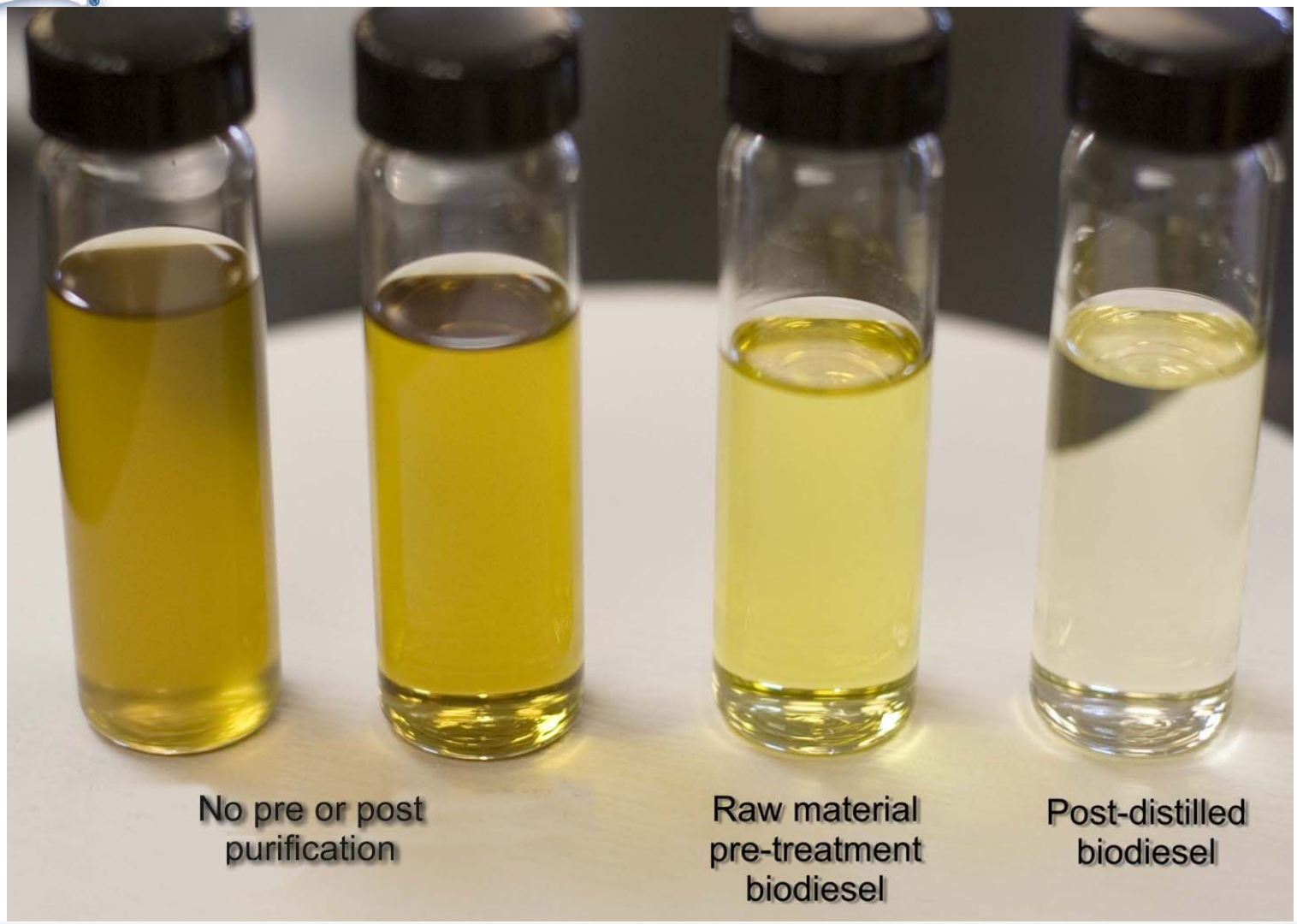
Many problems caused by variability in the process…



Raw Material Purification



Finished Product Quality



Future Challenges

- **Glycerin**
  - ✓ This by-product is almost worthless and we need to find new uses
- **Cloud Point**
  - ✓ This is an issue in higher blend levels of biodiesel and we need to find a solution
- **Why do some animal fat biodiesel fuels pass and others fail?**
  - ✓ Processing method?
  - ✓ Type of animal fat?
- **Feedstock prices**
- **Production costs**
- **Product performance (e.g., stability and cold flow)**
- **Alternative Uses**
  - ✓ Can we use methyl esters for other things?

Rothsay's Montreal Facility