Greater New Haven Water Pollution Control Authority (GNHWPCA)

FOG to Biodiesel Pilot Facility at GNHWPCA's East Shore WPAF

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Agenda

1. Background
2. Feedstock Material
3. Technology
4. Project Overview
5. Benefits

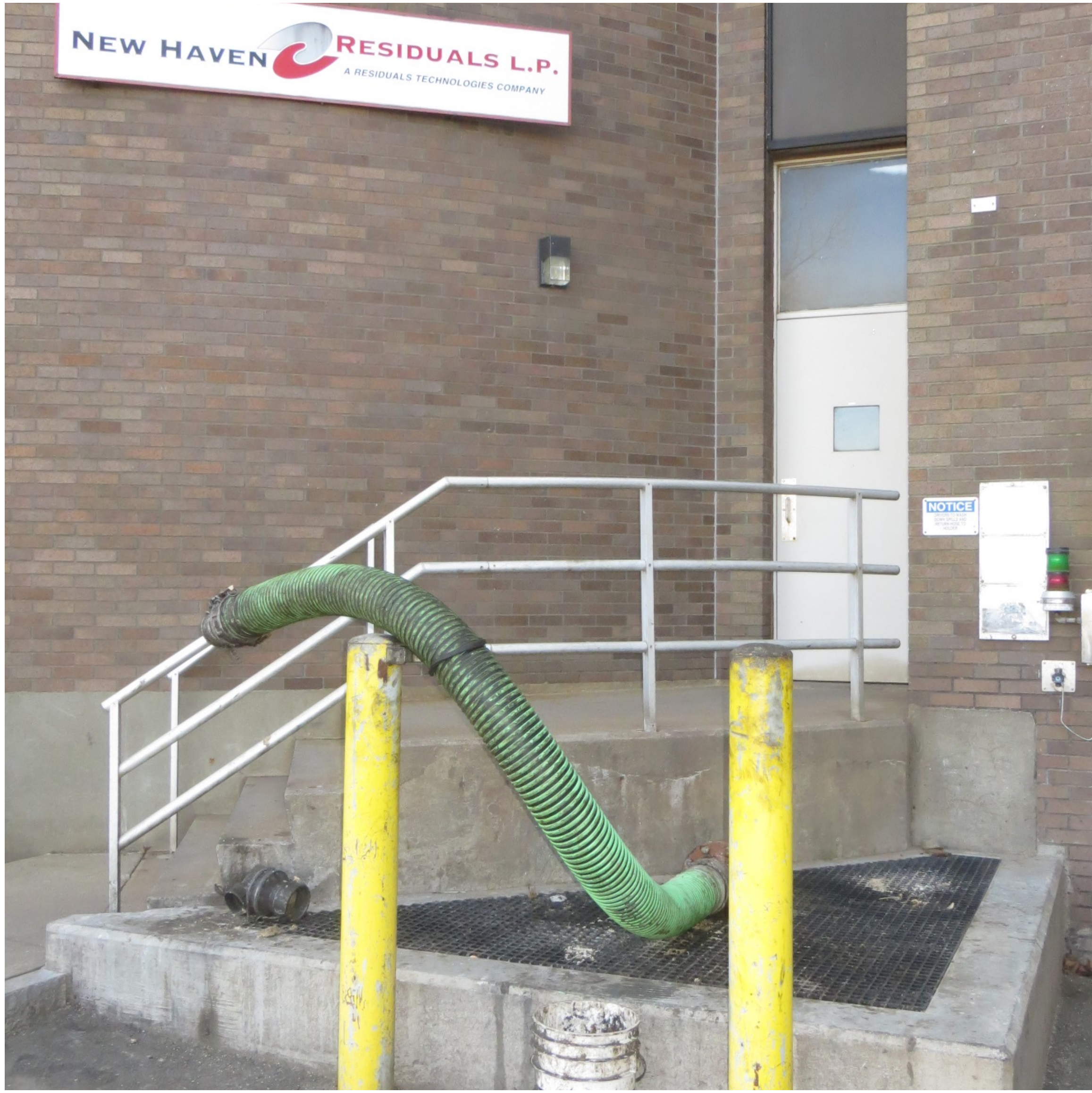
East Shore WPAF

- Owned and Operated by the Greater New Haven WPCA
- Plant Flow
  - 27 MGD Average Daily Flow
  - 40 MGD Average Design Capacity
  - 100 MGD Wet Weather Peak Flow
- Effluent discharges into Long Island Sound
- Regional Sewage Sludge Incinerator (SSI) operated by Synagro

Fats, Oil and Grease (FOG) Management

Regional FOG Receiving Facility

- Developed in 2000; Upgraded in 2011
  - Unloading Station
  - Pre-Treatment
    - Rock trap grinder and transfer pump
  - 1st stage decanting
    - Two (2) heated 4,500 gal tanks
  - 2nd Stage Decanting
    - Two (2) heated 10,000 gal tanks
  - Pumped to Incinerator
    - Supplemental fuel source



Feedstock Sources

Regional FOG Receiving Facility

- Annual Volume
  - 4,000,000 gpy from FOG haulers
- Trap Waste Oil and Grease Concentration
  - 30,000 - 50,000 mg/l (3-5%)
- Brown Grease Feedstock
  - Range: 120,000 - 200,000 gpy
  - Average: 160,000 gpy

Feedstock Sources

Plant Scum

- Influent Oil and Grease Concentration
  - Plant Samples: 55-75 mg/l
  - WEF MOP 8: 50-150 mg/l
- Plant Flow: 27 MGD ADF
  - 540,000 – 740,000 gpy brown grease
- Decanted Scum
  - 1,600,000 gpy – blended with sludge
  - Oil and Grease: 40%
- Total Brown Grease Feedstock
  - Plant Scum: 640,000 gpy
  - FOG Receiving: 160,000 gpy
- Wetwell Pumpings: 30 Stations

FOG Resource Recovery Technologies

- Anaerobic Digestion
  - Biogas and Heat Recovery
  - <10% of WRRFs include AD
  - High Capital Cost
  - Large Footprint
  - Side stream: NH_3 and P
- Incineration
  - Heat Recovery
  - Supplemental Fuel Source
  - Air Emission Control
- FOG to Biodiesel
  - Biofuel
  - FOG only

FOG to Biodiesel History

- Blackgold Biodiesel Pilot Facility – San Francisco
  - 2010-2011 – 2-year period
  - Produced < 50-gal biodiesel
  - High Sulfur
  - Preprocessing Issues
  - Corrosive Environment
- Argent Energy – UK
  - Biodiesel from brown grease
  - Acceptance of fatberg material
  - Supply biodiesel for bus fleets

REA FOG to Biodiesel Technology

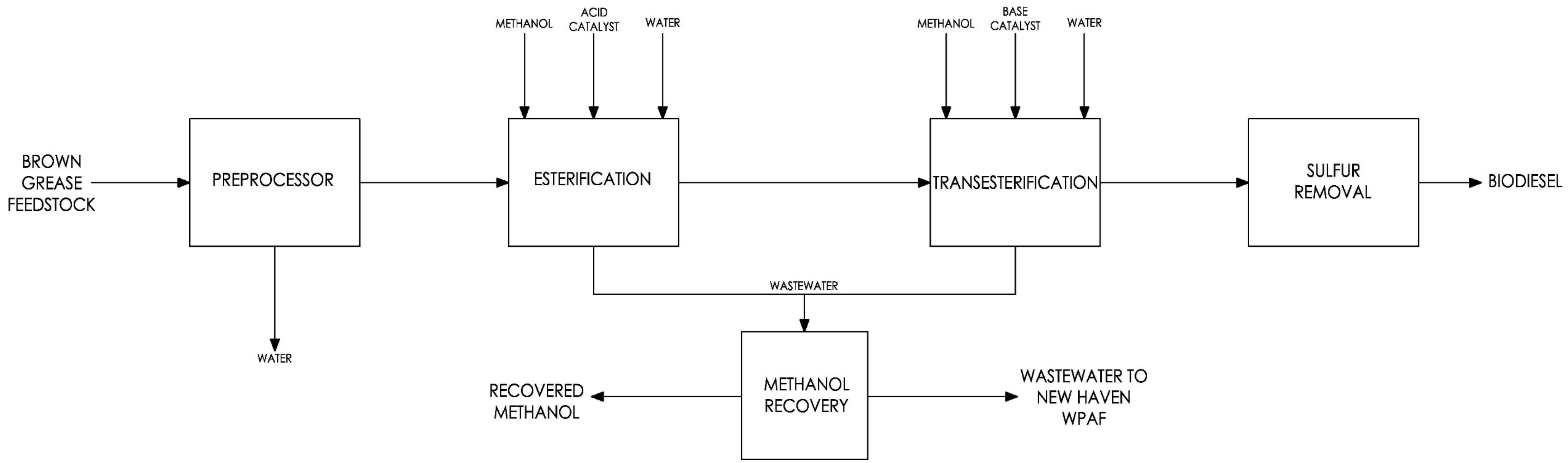
- Developed at UCONN
  - Research and Development
  - Bench Scale Testing
  - Continuous Flow Reactors
- Target Feedstock
  - Brown Grease
  - FFA up to 100%
- REA founded in 2017
  - Pilot Facility Design
  - Raised Capital

REA FOG to Biodiesel Pilot Facility

- Project Objective
  - Produce ASTM B100 biodiesel from wastewater FOG “brown grease”
  - Establish commercial viability
- Design Flows
  - 300 gpd brown grease feedstock
  - 250 gpd biodiesel
  - 600 gpd wastewater side stream
- Housed in steel shipping containers
- Generator Building
  - Electricity
  - Potable Water
  - Air

REA Schedule - Phase Approach

- Phase I: Produce Biodiesel
  - June 2018 – September 2018
  - Equipment Installation and Startup
  - Produced 250-Gal Biodiesel
  - B5: Heating Fuel Blend Quality
- Phase 2: Process Optimization
  - In Progress
  - Methanol Recovery
  - Sulfur Removal: <15 ppm
  - ASTM B100 Quality
- Phase 3: Production Maximization
  - Spring 2019
  - Full Scale Optimization
  - Routine Testing Program
  - Material Quantities



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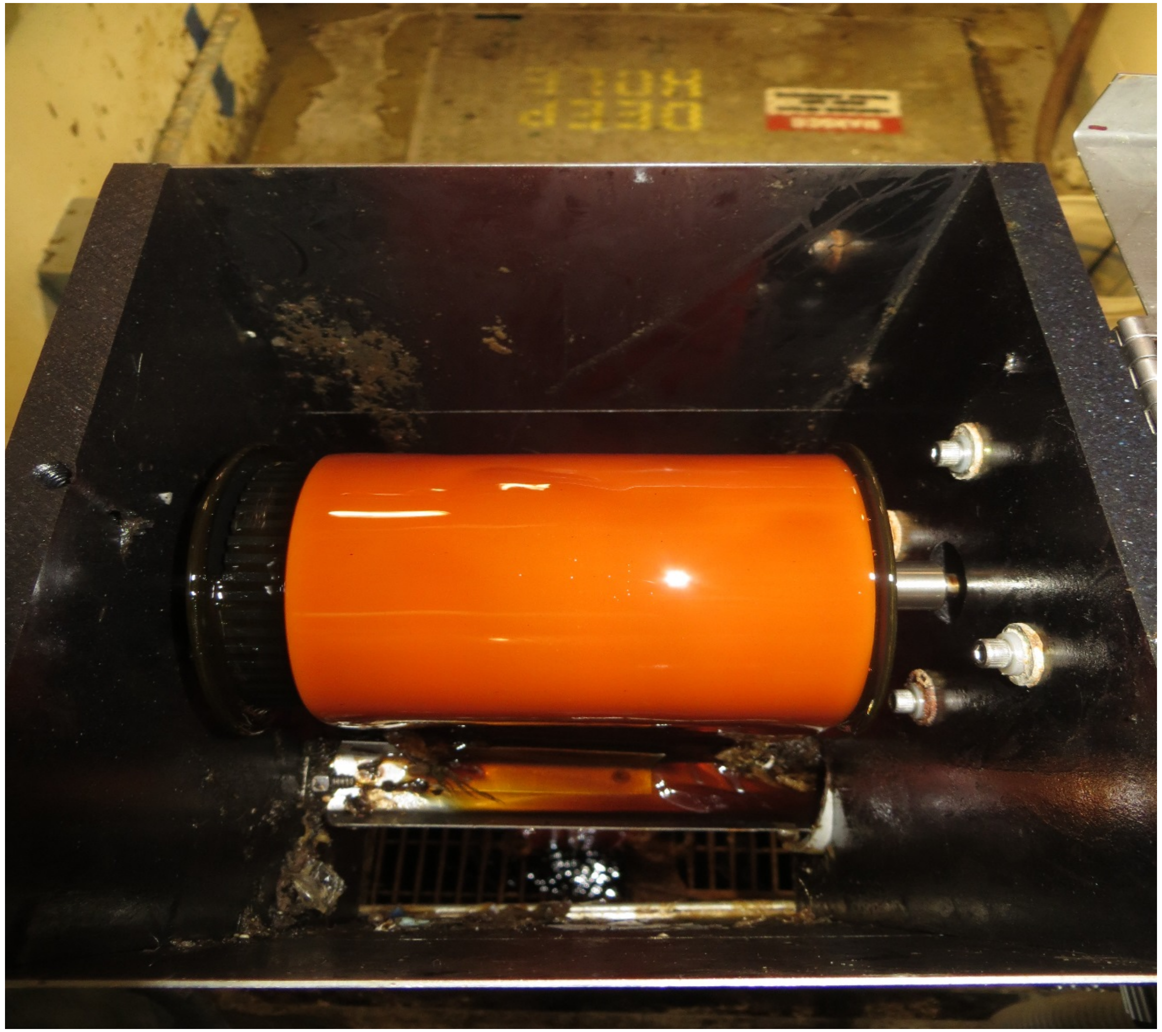
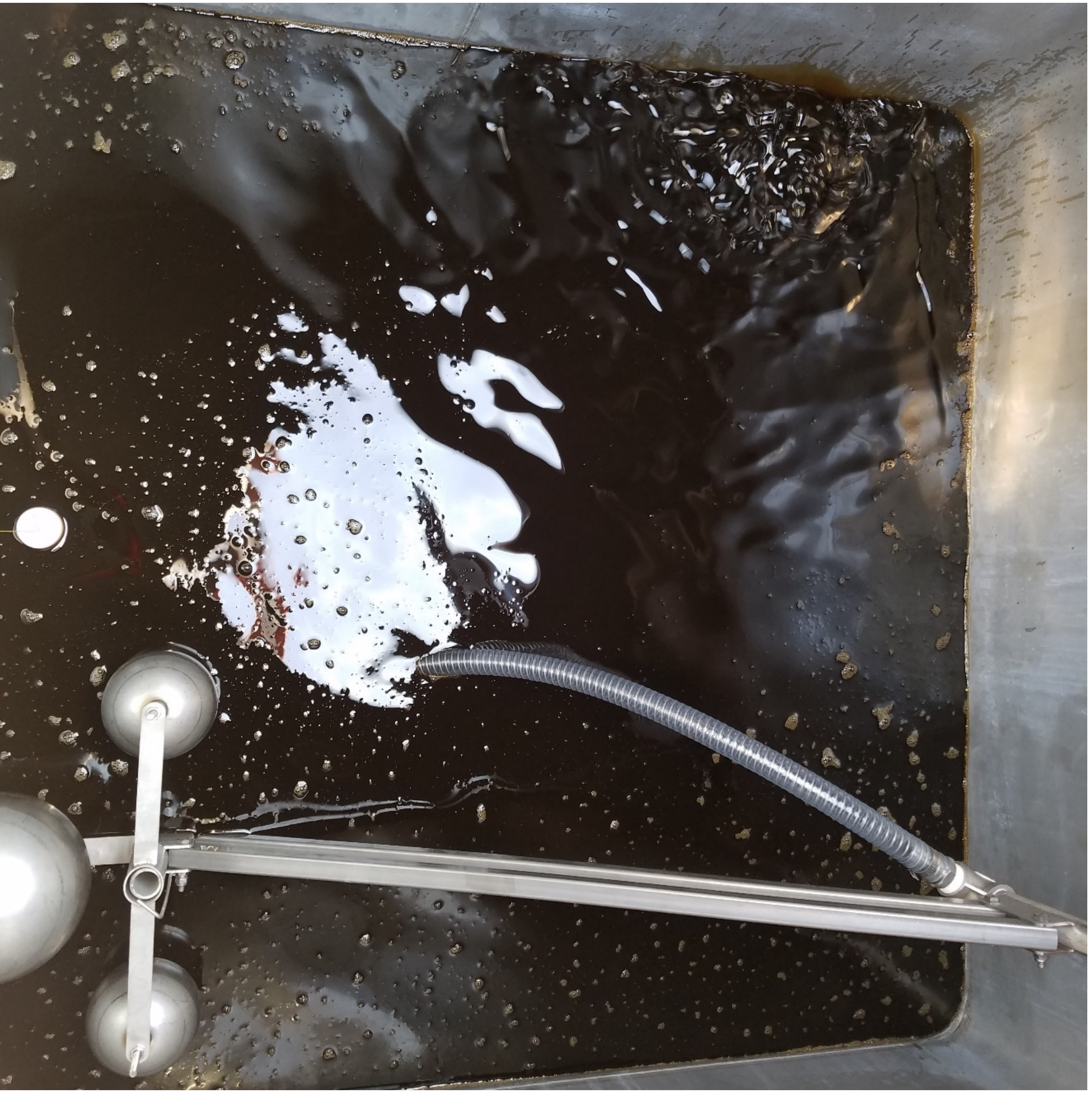
FOG-TO-BIODIESEL PILOT FACILITY PROCESS FLOW DIAGRAM

Brown Grease Extraction





Brown Grease Material Characteristics

- Oil and Grease: 98-99%
- Moisture: 1-2%
- pH: 3.8-4.5
- Solids: Fine Particulates
- Sulfur: 250-350 mg/L
- COD: 270,000-320,000 mg/L
- Volatile Solids: 99-100%

Preprocessor

- Storage
  - Two (2) 550-gal HDPE Tanks
  - Immersion Heaters – 120 °F
- Water Removal
  - Recycle with hot air
  - Moisture: < 0.5%
- Fine Particulate Removal
  - Series of Filters
  - 150 µm, 75 µm, 25 µm and 10 µm

Esterification

- Acid Catalyzed Reaction
- Converts FFAs to Biodiesel
  - Start: FFA > 75%
  - Finish: FFA < 1%
- Heat and Mixing
  - CSTR Reactors
- Chemicals
  - Methanol
  - Acid Catalyst
- Wash and Dry – Clean out Waste
  - Water, Methanol and Acid

Transesterification

- Base Catalyzed Reaction
- Converts Triglycerides to Biodiesel
  - Start: Triglycerides < 25%
  - Finish: Triglycerides < 1%
- Chemicals
  - Methanol
  - Base
- Wash and Dry – Clean out Waste
  - Water, Methanol, Glycerin and Base
- Patented Reactor
  - UCONN IP licensed by REA

Methanol Recovery

- Distillation Column
  - Ambient Pressure
- Recover Methanol from Waste
  - 85% Recovered
  - 15% to Plant
- Non-Hazardous Discharge
  - Flashpoint > 140 °F
- Recycle Methanol to Process
  - Reduce Methanol Volume
  - Cost Savings $$$

Sulfur Removal

- Distillation Column
  - Vacuum Pressure
- Sulfur
  - Start: B5 < 150 ppm
  - Finish: B100 < 15 ppm
- ASTM B100 Fuel
  - Increase Value
  - $2.75 per gal
- Comparable to H_2S and Siloxane Removal of Biogas

Waste Stream

- Discharged to Influent
  - 600 gpd
- Wastewater Contents
  - Water
  - Methanol
  - Glycerin
  - Acid
  - Base
- Phase 3: Sample Testing Protocol
  - COD
  - BOD
  - pH
  - TKN
  - NH_3
  - P

Benefits

Benefits of FOG to Biodiesel System

- Resource recovery of a negative value waste into a value-added product
- Generate Profit
  - Process 1,000,000-gal per year brown grease feedstock
  - Generate 825,000-gal biodiesel
  - Worth: $2.75 per gal
  - Cost: $1.50 per gal
  - Profit: $1.25 per gal
- Promote FOG Management
- Reduce Carbon Footprint

Questions?

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Special thank you to:

GNHWPCA Protecting the Environment

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