Industrial Waste Pretreatment Conference

# Controlling FOG from Industrial Users – DAF & Treatment Technologies

Presented By


## Heath A. Edelman, P.E., CHMM

Entech Engineering, Inc.
717-626-6666 – hedelman@entecheng.com
www.entecheng.com


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# TODAY'S PRESENTATION

- Section 1: What are Fats, Oils, & Grease (FOG)
- Section 2: Commercial & Industrial Sources of FOG
- Section 3: The Problem of FOG
- Section 4: Controlling FOG
- Section 5: Treatment Options
- Section 6: Design & Control Considerations
- Section 7: Case Studies – Bakery Wastewater

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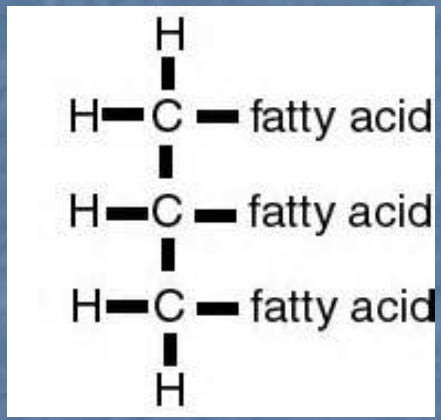
# What are Fats, Oils, & Grease (FOG)

- FOG: Organic polar compounds derived from vegetable/plant or animal sources that are composed of long chain triglycerides
- Triglyceride: 3 fatty acid molecules with one glycerol
- Glycerol: also referred to as glycerin; exists in natural oils as the base
- FOG is derived from living cells of animals and vegetable matter

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# Fatty Acids

- Saturated fatty acids are found in high concentrations in solid fats (butter, lard, beef tallow)
- Unsaturated fatty acids have lower boiling points and are generally found in higher concentrations in oils (olive oil, corn, peanut)
- Hydrogenation (add hydrogen) of an oil produces a fat (hydrogenated oil)
- Partially hydrogenation oils (which contain trans fat) have become a health concern
  - Replacement vegetable oils are problem in wastewater – more on that later

# You have FOG in Your House!



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# Non-Domestic Sources of FOG

- Institutions – prisons, schools, universities, government
  - food preparation & kitchens

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# Non-Domestic Sources of FOG

- Commercial – restaurants, pizza shops, hotels, convenience stores

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# Non-Domestic Sources of FOG

- Industrial
  - Parking & Motor Vehicle Repair
  - Food Manufacturing – bakeries, dairies, snacks, canners/bottlers
  - Meat Processing – slaughterhouses, processing, prepared foods
  - Other Industries

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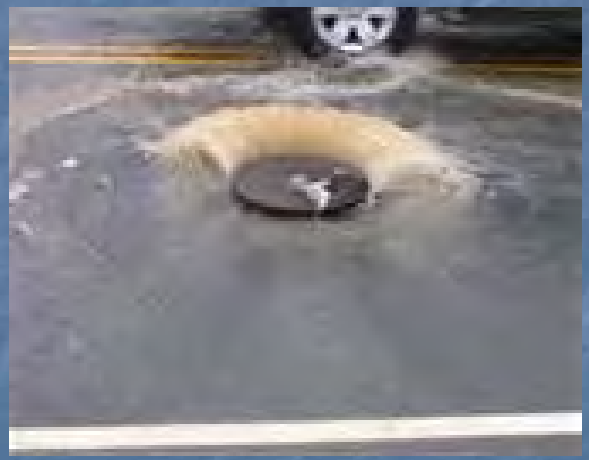
# The Problem of FOG

- Let's Follow it "downstream"
  - Clogging Laterals & Mains
    - Odors
    - Flow Restrictions & Sanitary Sewer Overflows
  - In 40-50% of overflows, FOG is all or part of the cause



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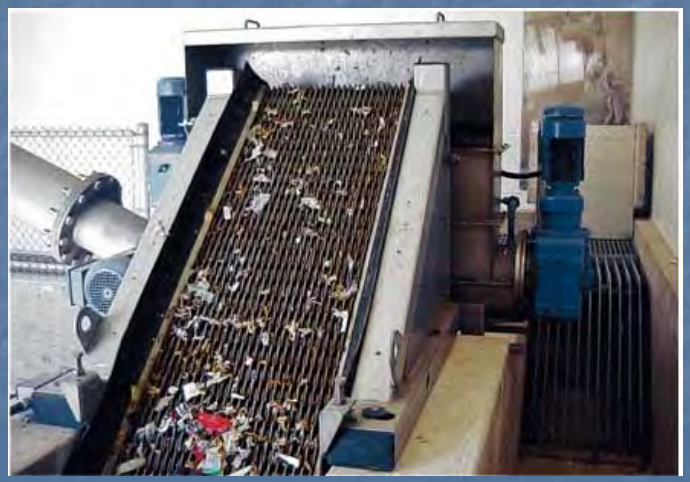
# The Problem of FOG

- Clogging/Maintenance of pumps, lift stations, grinders, and collection system equipment
  - Same as laterals/mains plus:
    - safety issues
    - coating of instrumentation & controls (floats & probes)
    - Maintenance to pump grease or add chemical agents

# The Problem of FOG

- Headworks & Primary Treatment Issues
  - Same as pump stations & collection system equipment plus:
    - screen blinding
    - coating of clarifier mechanisms



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# The Problem of FOG

- Biological treatment
  - Interference with biological microorganisms
  - Foaming
  - Excessive air requirements – high BOD
  - Poor treatability
- Compliance – upsets, discharge to stream
- All of these cost money ($$$$$$)
  - Your Rate Payers all Pay the Price cause of Others

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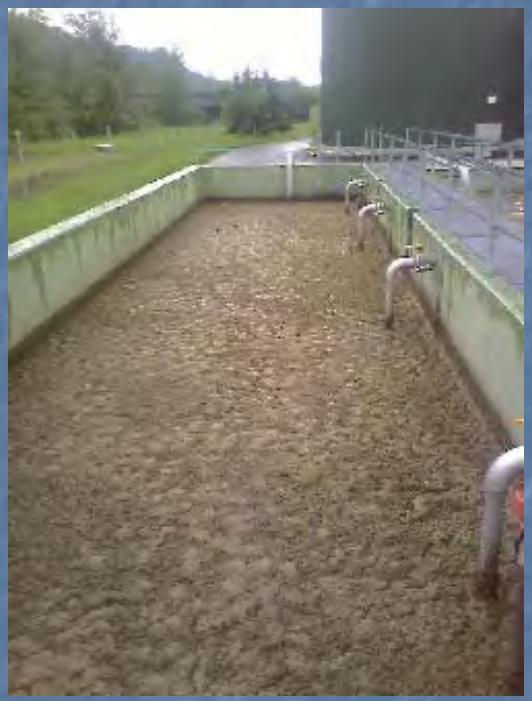

Foaming in
Aeration Basins

Nocardioforms

Microthrix parvicella

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# What makes FOG a problem

- It hates water!
  - “hydrophobic”
  - It will do anything to get away
    - Include binding to particles, coating surfaces/pipes/walls, floating, and grabbing whatever it can (including MLSS)


- Its sensitive to pH & temperature
- It is loaded with BOD & difficult to treat

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# Key Elements of FOG Program

- EPA CMOM Policy Document
  - Legal Authority
  - *Plan Review & Design Standards*
  - Inspections
  - *Permitting / Control Mechanisms*
  - Enforcement
  - Communication
  - *Performance Measures*
  - Public Education
  - Information Mgt. System

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# Goals of a FOG Management Plan

- Reduce spills & clogs
- Protect wastewater systems
- Control O&M costs
  - Reduce pumping frequency
  - Improve treatment efficiency
  - Reduce equipment wear & tear
- Reduce property & environmental damage & clean-up costs
- Protect public health & worker safety
- Maintain regulatory compliance

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# Control FOG at the Source

- Education
- Pretreatment Equipment
  - Grease Interceptors (Passive or Automatic)
  - Grease Traps
  - Oil-Water Separators – Motor oils & free oil only!!!
  - API Separators
  - Dissolved Air Floatation – more on that later

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# Grease Interceptors

Passive Grease Interceptor

Automatic Grease Interceptor

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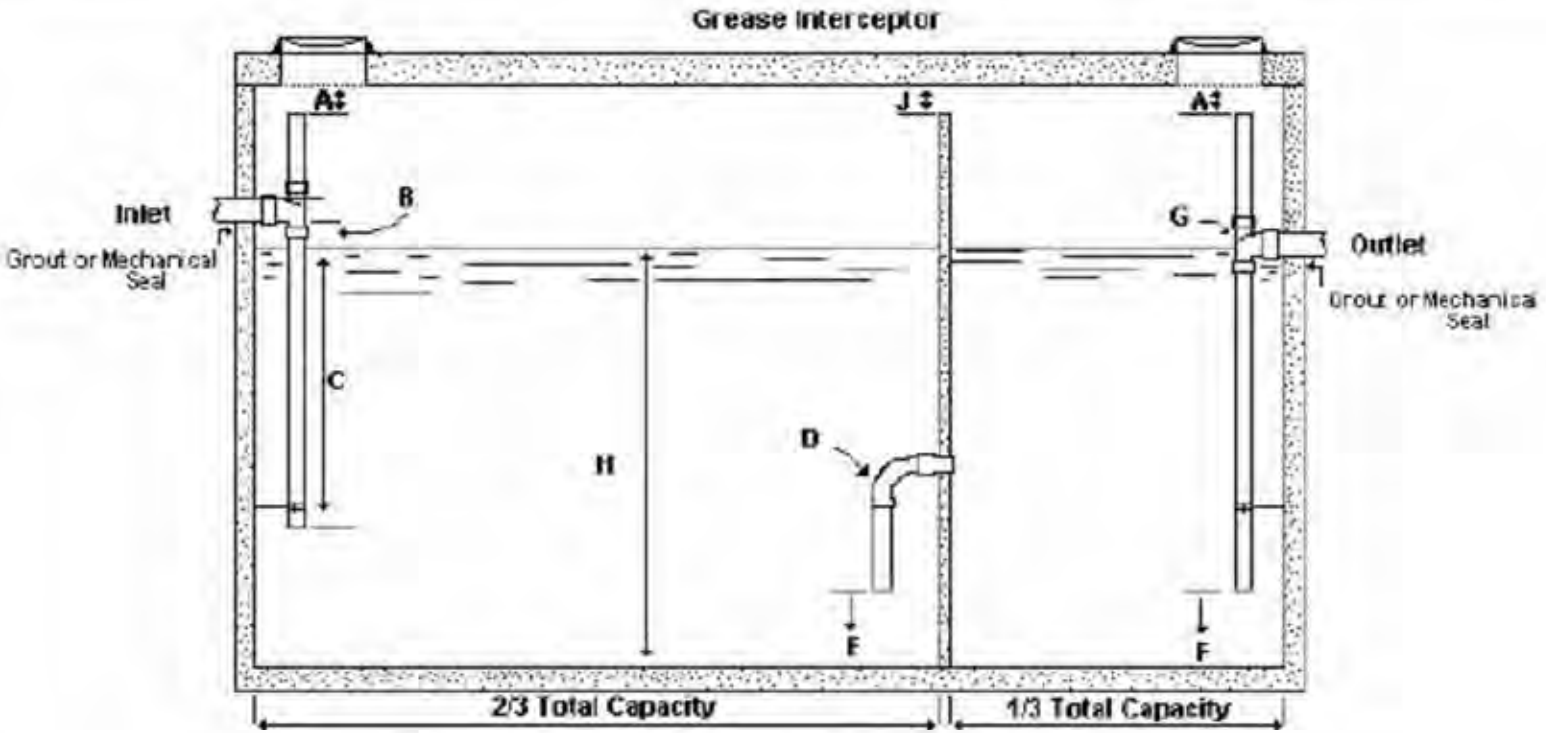
# Typical Manual Grease Interceptor




A.) Minimum 6", but not less than pipe diameter.
B.) Inlet pipe invert to be 2 1/2" above liquid surface.
C.) Inlet pipe to terminate 2/3 depth of water level.
D.) 90 degree Sweep, minimum size - 6".
E.) 12" from floor to end of sweep.
F.) 12" from floor to end of outlet pipe.
G.) Outlet pipe no smaller than inlet pipe, minimum - 4".
H.) Minimum depth of liquid capacity - 42".
J.) Maximum distance from ceiling - 6".

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# Water and Oil Density

| SUBSTANCE | lbs./gallon |
|---|---|
| Water | 8.34 |
| Peanut oil | 7.62 |
| Olive oil | 7.66 |
| Soybean oil | 7.73 |
| Corn oil | 7.69 |
| Cocoa butter | 8.04 |
| Coconut oil | 7.67 |

Water has higher density than oil so the oil will be on top of the water.

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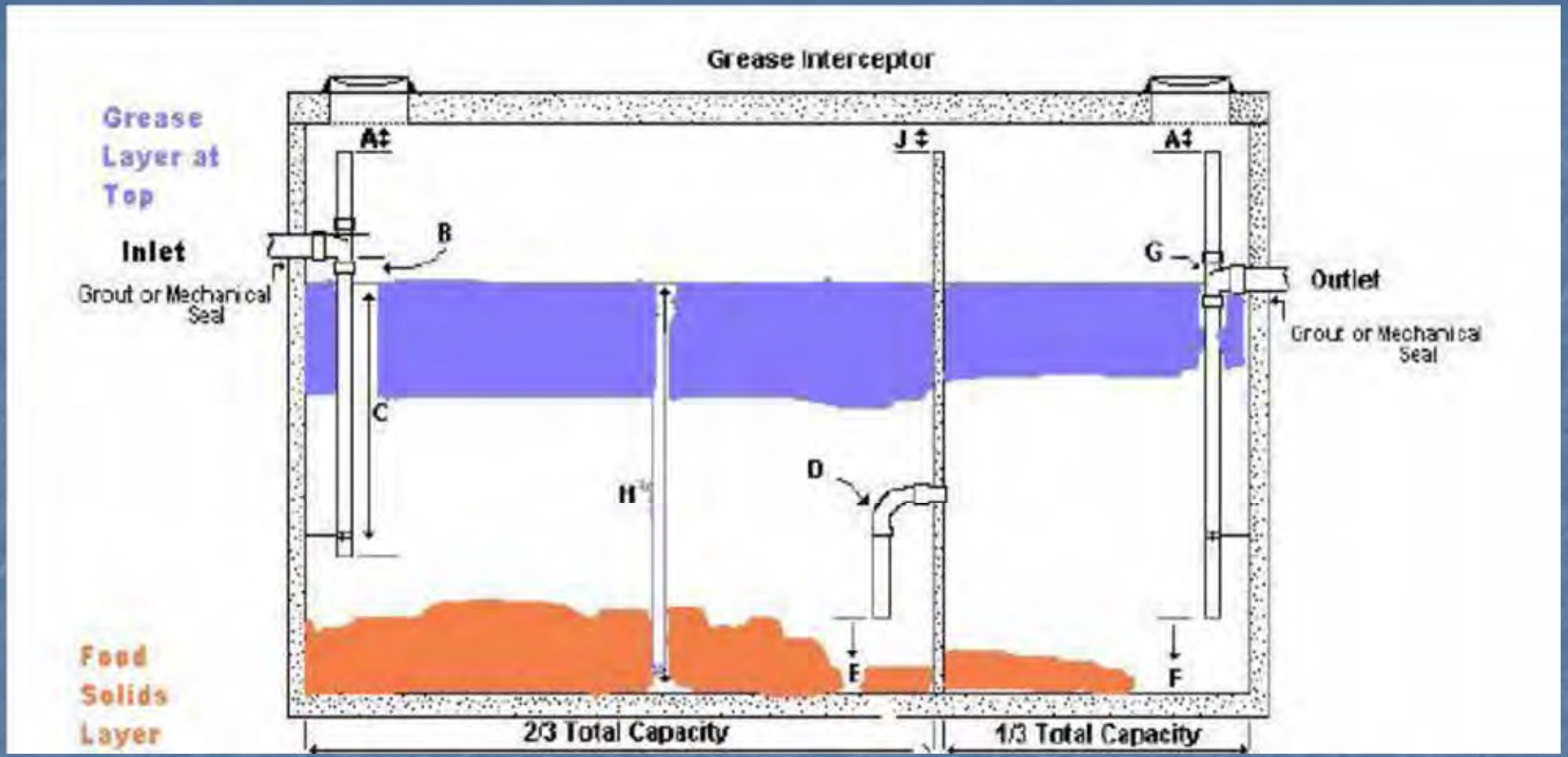


- Main components: Inlet T, Midwall Baffle, Outlet T
- The top layer is the FOG layer, bottom layer is food solids layer
- Normally, the food solids layer will be 1x to 2x the FOG layer, but not always.
- Thus, some FSEs may need to pump more often than others.
- The 25% rule should be observed: When the FOG layer and Food Solids layer are 25% or greater than the depth of the tank then it needs to be pumped. Why?
  - Reduced removal efficiency, and short-circuiting

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# Grease Traps

- Smaller applications
- Often used under a sink, in the floor of a kitchen, etc.

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# Plan Review & Design Standards

- There are dozens of grease interceptor and grease trap sizing formulas –most of which are not very good.
- Recommend adopting minimum grease interceptor sizes for types of food service establishments (FSEs)
  - Example: Fast Food Facilities-1,000 gallons; Full Service Restaurants-1,500 gallons; Prisons, hospitals-2,000 gallons. Recommend minimum size standards as well.
- Select a sizing formula that uses fixture units and the size of pipe
- Details on the design, installation and maintenance of the interceptor should be in the FOG Mgt. Policy, FOG Ordinance, or Pretreatment Ordinance.

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# Grease Trap Sizing for Foodservice

- Uniform Plumbing Code, Appendix H
- Number of meals x waste flow x retention x storage = Size Requirement
- Per peak hour (1) rate (2) time (3) factor (4) (liquid capacity)
- Factors:
- 1) Number of meals served at peak operating hour (Seating Capacity) x Peak Factor
  - a. Where Peak Factor for Fast Food Restaurant is.....1.33
  - b. And, Peak Factor for all other food service types is....1.00
- 2) Waste Flow Rate:
  - a. With Dishwasher.....6 gallon flow
  - b. Without Dishwasher.....5 gallon flow
  - c. Single Service kitchen..... 2 gallon flow
  - d. Food waste disposer..... 1 gallon flow
- 3) Retention Times
  - a. Commercial kitchen waste/dishwasher.....2.5 hours
  - b. Single service kitchen/single serving.....1.5 hours
- 4) Storage Factors
  - a. Fully equipped commercial kitchen .....8 hr operation...1
  - b. .....16 hr operation...2
  - c. .....24 hr operation...3
  - d. Single Service Kitchen.....1.5

- The Uniform Plumbing code includes a built-in safety factor that can yield very large grease trap size specifications.

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# Automatic Grease Interceptors

- Generally superior to passive grease interceptors
  - Grease removal is automatic
  - Located close to process

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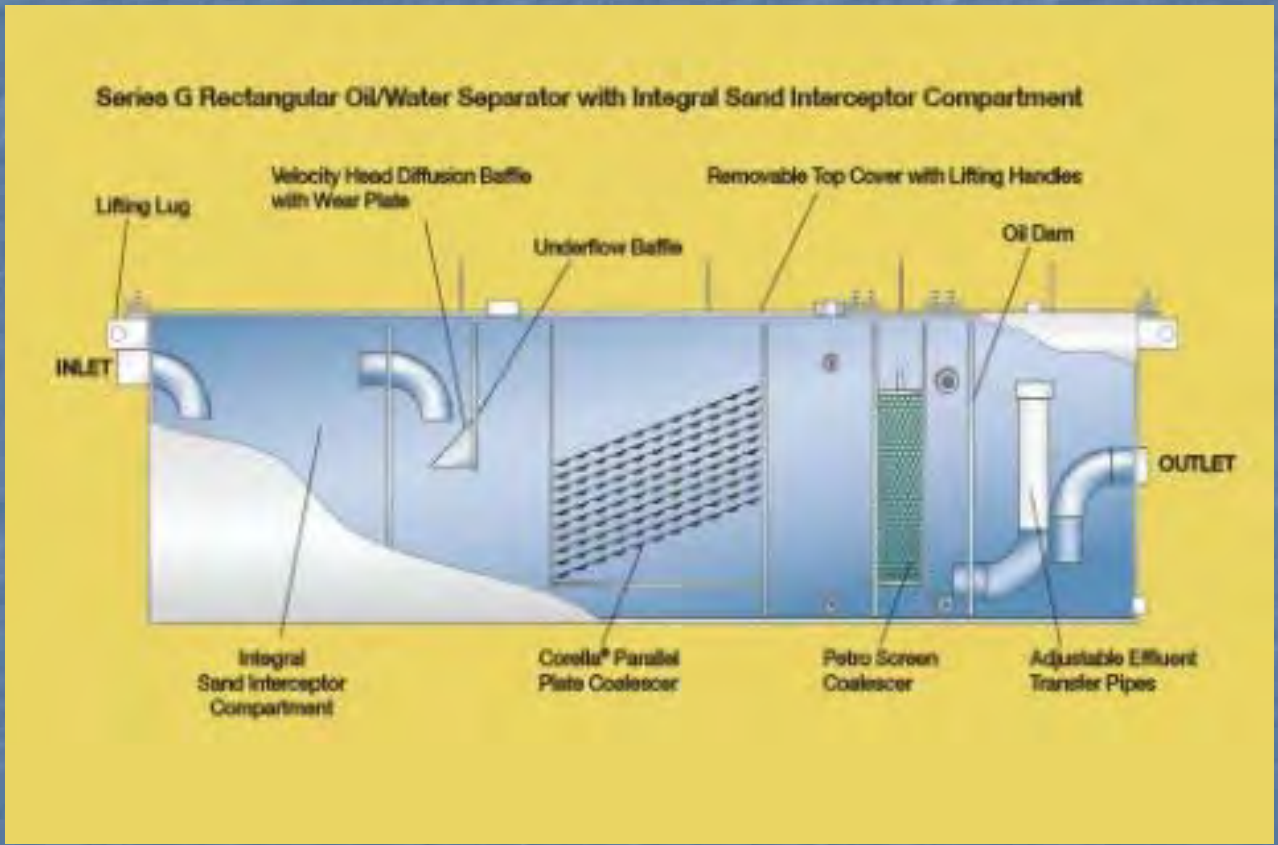
# Oil-Water Separator




NEVER, EVER use this in a food waste application!!!!!

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# So I've Got a Commercial Food Manufacturer Coming to Town and They Want to Send Wastewater to My POTW

- Start asking questions!
  - What is their proposed pre-treatment for FOG and pH control?
- If they are planning to use a grease trap or grease interceptor start asking more questions!!
- If they are proposing to use an oil-water separator or to do nothing then encourage them to find another town!!!

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# Heath's Most Recent Theory
# "All Environmental Problems are Controlled by One or More of These Things"

1. Surface Area
2. Turbulence
3. Time
4. pH
5. Temperature

With FOG Control pH & Temperature are most important!

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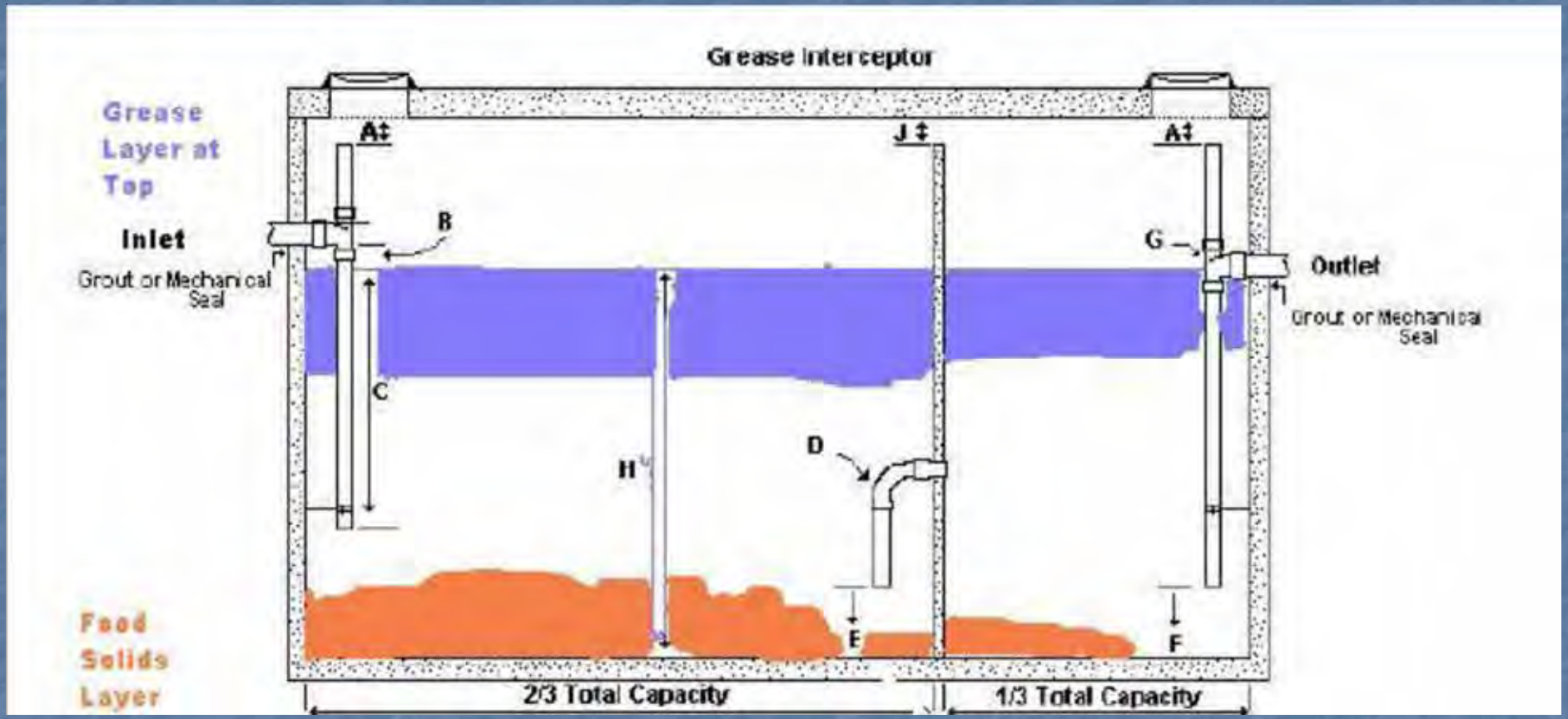
# Challenges with a Grease Interceptor




What happens when temperature goes up? Goes down?
What happens when pH goes up? pH Goes down?
What happens when detention time goes down? Goes up?
What happens when the surface area gets coated with oil?
What happens when too much flow moves through the unit?

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# Challenges with Industrial FOG

1. Surface Area – industrial emulsifiers, degreasers, and surfactants
2. Turbulence & Time – big surges from cleaning cycles – watch average flow!!!
3. pH – use of caustic soaps & acid metal cleaners
4. Temperature – large hot process equipment, very hot water used for cleaning

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# FOG Testing & Monitoring

- Almost as bad as the BOD test method. Well OK, nothing is that bad!
- Grab sample only – representative?
- Coordinators – consider using temperature and pH trending to predict and understand issues with FOG

# Case Study -Bakery Wastewater

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# Ingredients in Bakery Wastewater

- Flour (BOD, TSS)
- Eggs (BOD, FOG)
- Vegetable Oil/Shortening (FOG)
- Butter (FOG)
- Sugar (BOD)
- Fruit (BOD, TSS)
- Cocoa (BOD, FOG, TSS)

# Sources of Waste

- Cleanup Cycles
  - Can be several cycles per day as flavors and products change
  - To prevent cross-contamination of allergens.
  - Floors, process equipment, fryers

# Sources of Waste – Continued

- Product Spills
  - Measuring Raw Ingredients
  - Mixing
  - Placement in Pans
  - Baking/Frying
  - Packaging

# Pretreatment Standards

- 100 mg/l of FOG is typical
- 50 mg/l FOG petroleum based
- 50 mg/l FOG vegetable based
- “Levels shall not cause nuisance in Sewer System”
- No visible sheen
- Others??

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# Over the Limit? What to Do?

- Install Grease Traps??
- Clean Grease Traps??
- Clean Grease-laden Sewers??
  - build-ups can break loose
- Examine the Sources
  - minimize waste –YES!!!
- Install a DAF

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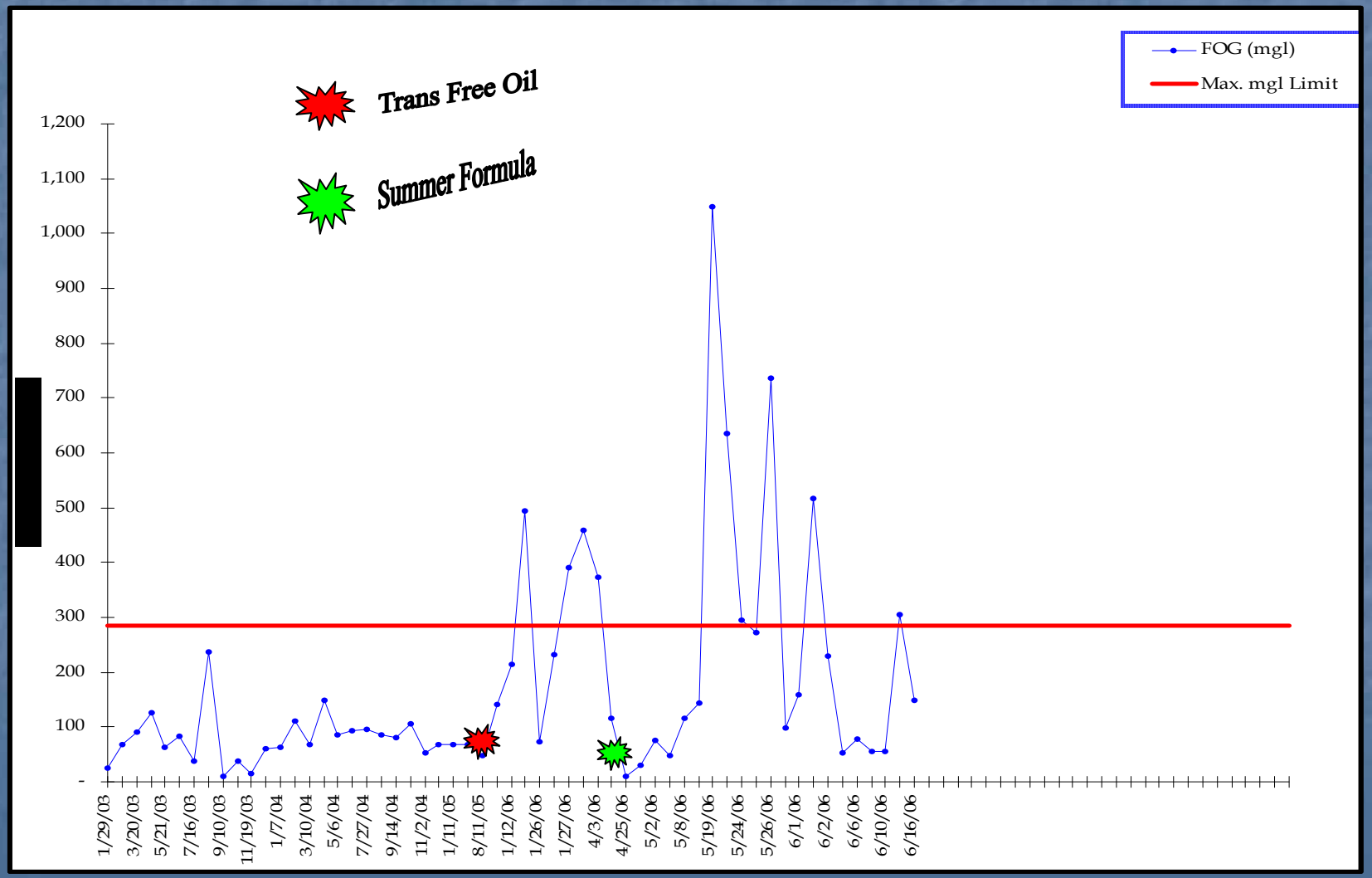
# Watch Out For “No Trans-Fat” Oil!

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# What's a DAF?

- Dissolved Air Floatation (DAF)
  - Air Dissolved in Water Under Pressure
  - FOG & TSS Flocculated with Chemicals
  - Pressure Released
  - Air Bubbles Expand & Attach to Floc
  - Float FOG & TSS to Top
- A Physical/Chemical Separation Process to Clarify Wastewater

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# DAF Flow Schematic

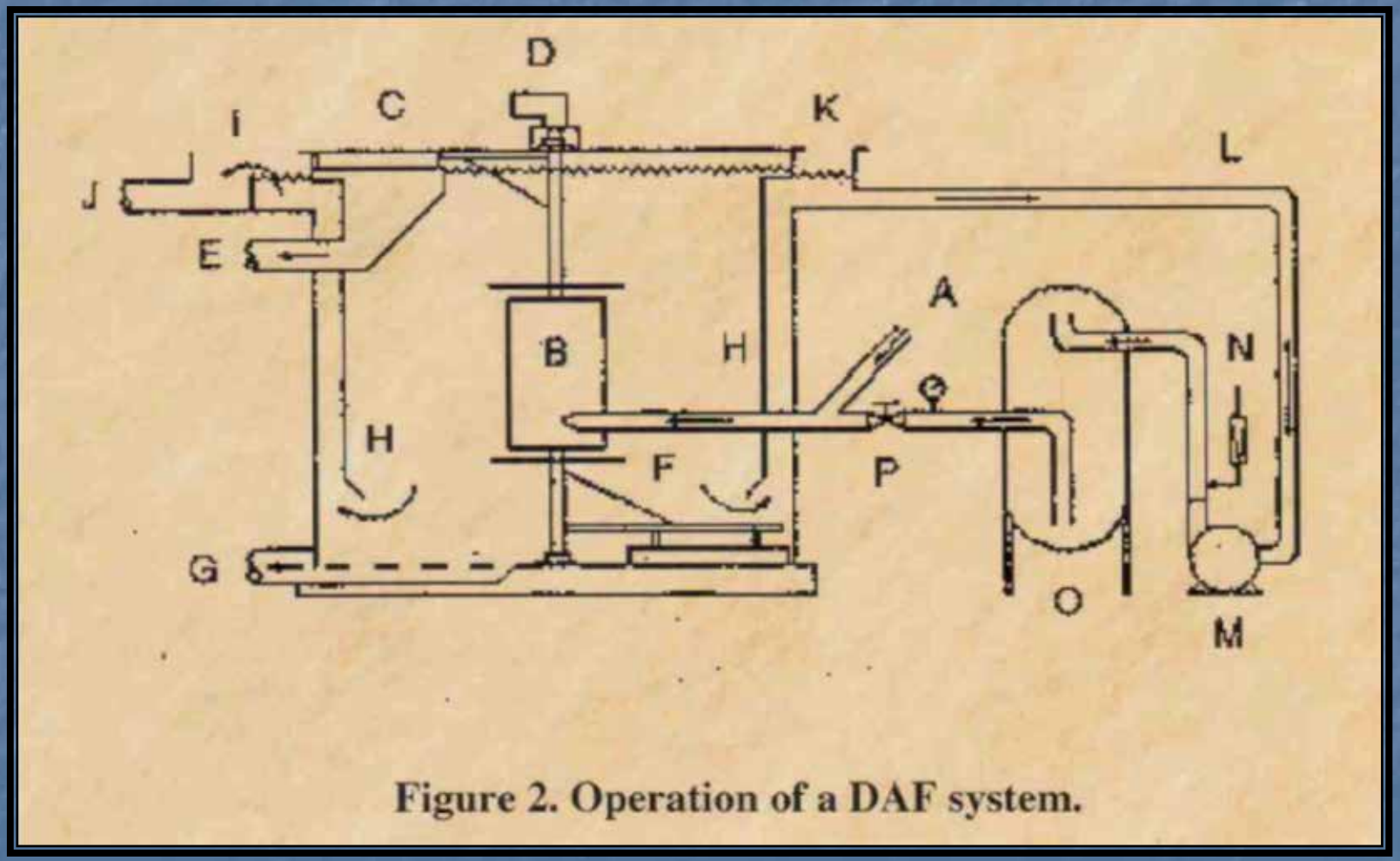


Figure 2. Operation of a DAF system.

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# Complete Facility Requires

- Pumping Station
- Equalization Tankage
- Screening
- Chemical Feed Systems
- Chemical Conditioning Tank
- Dissolved Air Floatation
- Float Storage/Holding
- Electrical & Controls

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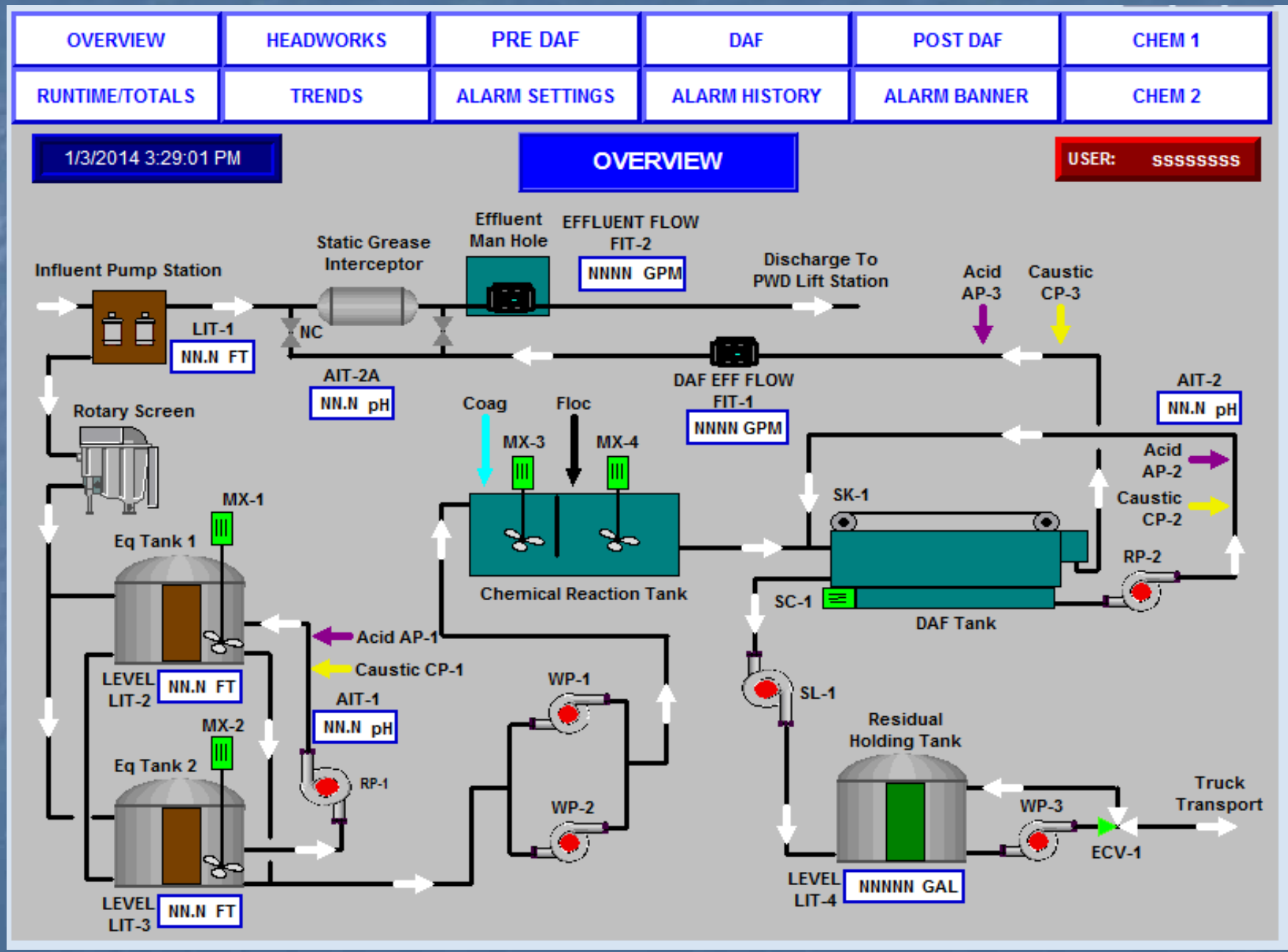
OVERVIEW
HEADWORKS
PRE DAF
DAF
POST DAF
CHEM 1
RUNTIME/TOTALS
TRENDS
ALARM SETTINGS
ALARM HISTORY
ALARM BANNER
CHEM 2
1/3/2014 3:29:01 PM
OVERVIEW
USER: ssssssss
Influent Pump Station
LIT-1
NN.N FT
Static Grease Interceptor
NC
Effluent Man Hole
EFFLUENT FLOW FIT-2
NNNN GPM
Discharge To PWD Lift Station
Acid AP-3
Caustic CP-3
AIT-2A
NN.N pH
DAF EFF FLOW FIT-1
NNNN GPM
AIT-2
NN.N pH
Rotary Screen
Coag
Floc
MX-3
MX-4
Acid AP-2
Caustic CP-2
SK-1
MX-1
Eq Tank 1
Chemical Reaction Tank
RP-2
SC-1
DAF Tank
Acid AP-1
Caustic CP-1
LEVEL LIT-2
NN.N FT
AIT-1
NN.N pH
WP-1
SL-1
MX-2
Eq Tank 2
RP-1
WP-2
Residual Holding Tank
Truck Transport
WP-3
ECV-1
LEVEL LIT-3
NN.N FT
LEVEL LIT-4
NNNNN GAL

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# Flow Equalization

- Equalization - 30,000 gal
  - Flow equalization
  - Allows Intermittent Operation
  - DAF Maintenance/Repair Time
  - pH Control & cooling
  - Homogenization

# Screening

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# Chemical Conditioning

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# Chemical Feed Systems

# Dissolved Air Floatation Unit


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# What is Float?


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# DAF Will Remove

- FOG which is BOD
- TSS which is BOD
- BOD which is FOG and TSS

# Bakery Wastewater Treatability Tests Laboratory Test Results

| **Parameter** | 0-Untreated | 1-Treated | 2-Treated | 3-Treated |
|---|---|---|---|---|
| **TSS** | 1130 | 10 | 16 | 10 |
| **Oil & Grease** | 337 | <8 | <8 | <8 |
| **BOD** | >2160 | >720 | >720 | >720 |
| **pH** | 8.9 | 7.4 | 7.4 | 7.4 |

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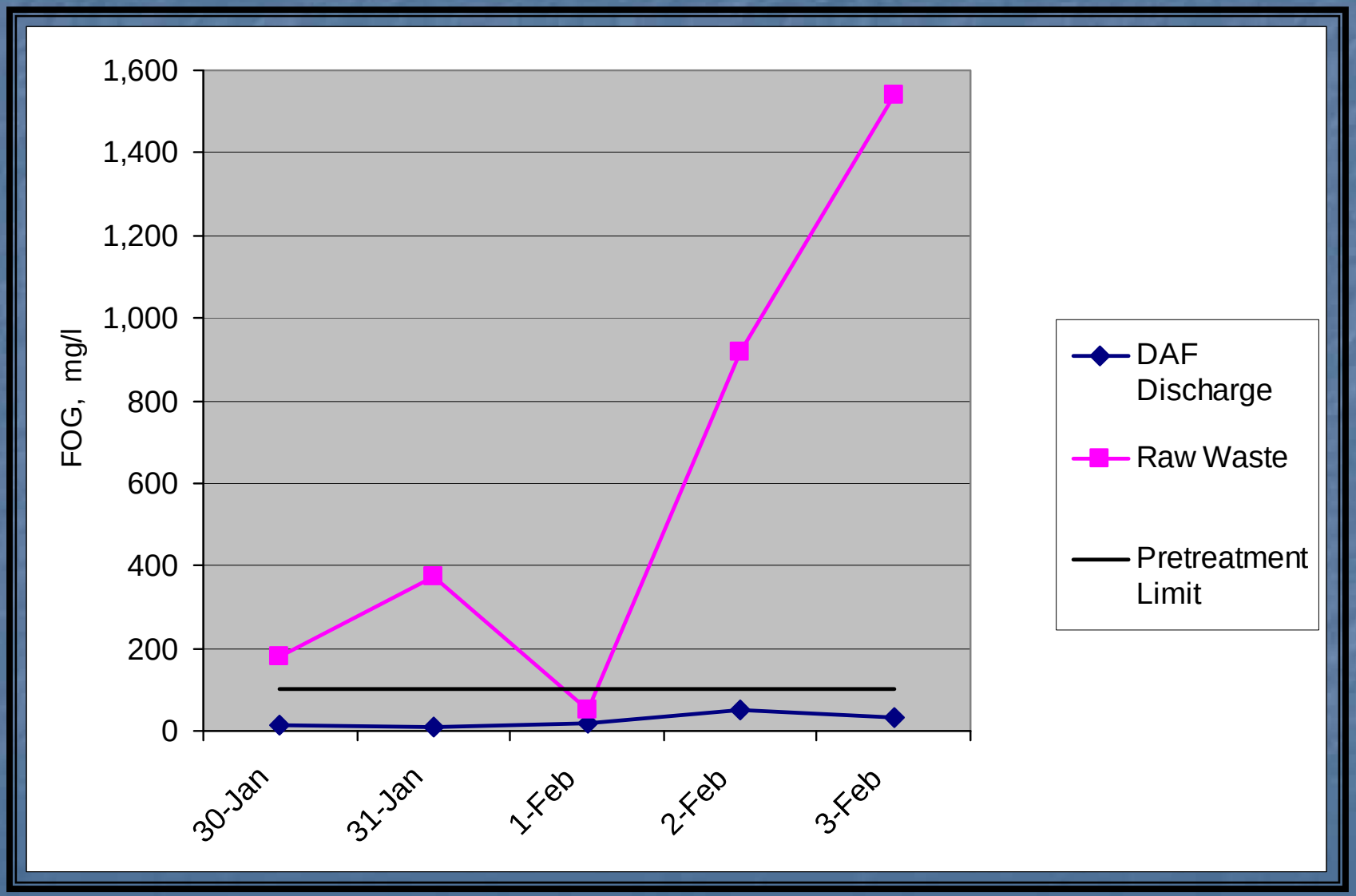
# DAF Performance Data

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# Summary

- Industrial FOG is not typical
- Flow equalization is IMPERATIVE
- pH & temperature control are critical
- DAF is a treatment option to consider

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