- FOG Numerical Limits
- Sampling
- Additives

FOG NUMERICAL LIMITS

Where did you get your Oil and Grease (FOG) limit?

How were the Oil and Grease (FOG) limits for Non-domestic / Industrial Users developed?

MMS
MONITORING AND MANAGEMENT SERVICES

FOG NUMERICAL LIMITS

- In 1949 the Federation of Sewage Works Association (now known as Water Environment Federation – WEF) published *Manual of Practice* (MOP) in which it recommended 100 mg/L as a maximum limit for oil & grease.
- In 1973...MOP3 was published and cited FOG domestic concentrations to be in the range of 16 mg/L to 105 mg/L. They further recommended a limit of 25 mg/L for petroleum based oil.

FOG NUMERICAL LIMITS

- Remember that limits need to be site specific. What works well in one location will not work in another location.

- Need to differentiate between animal/vegetable FOG limitation and the Petroleum based oil limitation

FOG NUMERICAL LIMITS

- Littleton/Englewood, CO 200 mg/L
- Lexington, Ky 100 mg/L
- Lakehaven, WA 50 mg/L
- Austin, TX 100 mg/L
- Los Angeles, CA 600 mg/L (“dispersed” O&G, total)

  Floatable-None visible
- Cary, NC 325 mg/L (method 1664)

  275 mg/L (method 413.1)

Can facilities meet 100 mg/L?

- Yes. Based on data collected by MMS a full service american style food restaurant consistently meets 100 mg/L.
  - Implement BMPs (dry wiping, employee training emphasized)
  - Pumps 1500 gallon interceptor monthly.
  - After 30 days from pumping the interceptor...the interceptor effluent was sampled. Results were 68 mg/L.

FOG NUMERICAL LIMITS

- Other Limits used for monitoring FSEs...
  - TEMPERATURE: limits range from 85*F to 140*F
  - pH: 5 to 10 s.u.
  - Depth of grease layer and solids layer in grease interceptor (such as 25% total volume of interceptor including grease and bottom solids depth, or some cities list 10” or 12” for maximum grease layer depth).

Oil & Grease Sampling

- GRAB SAMPLE only
- Container: GLASS, wide mouth
- Sample Volume: 1 liter (do not completely fill a 1 liter container, closer to 800 to 900 mls.)

Oil & Grease Sampling

- Sample should be collected directly into O&G Sample Container (thus, need for sample location that allows holding sample container and collecting sample). Many FSEs will only have effluent T or downstream MH sites and this will not allow direct collection into sample container.
- Preserve sample w/ hydrochloric acid to pH < 2

Oil & Grease Sampling

- WHEN you sample is a factor
  - Consider FSE's hours of operation
  - Consider cleaning/maintenance practices

The Time of day that the sample is collected can make a difference in results.

Oil & Grease Sampling
O&G results

- Chinese Restaurant – open from 10am-10pm
  - 9:25 am 22 mg/L
  - 12:40 pm 530 mg/L
  - 3:30 pm 150 mg/L
- Cafeteria-American style food- open from 11am – 8pm
  - 11:00 am 60 mg/L
  - 12:50 pm 390 mg/L
  - 1:30 pm 230 mg/L
  - 2:45 pm 340 mg/L

Oil & Grease Sampling
O&G results

- American Style Food Full Service- 7am to 4pm
  - 8:00 am 68 mg/L
  - 10:45 am 320 mg/L
  - 12:30 pm 305 mg/L
  - 3:15 pm 270 mg/L
  - 5:15 pm 80 mg/L (after clean up)

Oil & Grease Sampling Expected O&G ranges

- St Louis Study
  - Collected 660 oil and grease samples before any treatment
  - Study did not provide the time of sample collection
  - Assumed average grease interceptor and trap FOG removal efficiency to be 75%

Oil & Grease Sampling
Expected O&G ranges

- St. Louis Study results for 660 restaurants

Sample results (untreated)	% of total	(75% removal efficiency assumed)
– 0-200 mg/L	32%	(0-50 mg/L)
– 200-500 mg/L	29%	(50-125 mg/L)
– 500-1000 mg/L	21%	(125-250 mg/L)
– Above 1000 mg/L	18%	(> 250 mg/L)

Oil & Grease Sampling
Expected O&G ranges

- Sample ranges from MMS sampling...
  - 8 mg/L to 10,000 mg/L
- Factors to consider
  - The Time of day that the sample was collected
  - Type of Grease Control Equipment installed
  - Maintenance/cleaning of Grease Control Equipment
  - Best Mgt Practices used (can be a difference in same “name” store based on manager’s emphasis on BMPs

A D D I T I V E S

- Most people refer to anything you add to the interceptor for removal of FOG or “treatment” as either...
  - Bacteria, or
  - Bugs, or
  - Enzymes, or
  - Chemicals

WE NEED TO DIFFERENTIATE BETWEEN THE VARIOUS TYPES OF “ADDITIVES” and not group under one classification

A D D I T I V E S
The Categories...

- Caustics
- Acids
- Soaps
- Surfactants
- Solvents
- Enzymes
- Bacteria

A D D I T I V E S

- Caustics, Acids & Solvents
  - Dangerous to use. Safety consideration.
  - pH problem possible, lead to corrosion issues in the wastewater collection system
  - Kill off beneficial bacteria
  - Solvent (prohibited from being discharged to wastewater collection system)
- Soaps & Surfactants
  - Emulsify and keep FOG in solution.
  - Surfactants have been linked as possible cause of biomonitoring violations.
  - Just pushes FOG downstream

A D D I T I V E S

- Enzymes
  - Produced by cells (bacterial, plant or animal)
  - Protein molecules that are made up of amino acids linked via a peptide bond
  - Only work on specific substrates
  - **LIPASE** is enzyme produced by *Bacillus* and *Pseudomonas* bacteria.
    - **<u>Lipase is the most predominate enzyme in additives</u>**
    - Lipase acts on fats (triglycerides) and breaks down into shorter chain fatty acids (di- glycerides and mono-glycerides), but then reaction slows or stops due to specific work of enzyme. The shorter chain molecules are more water soluble and can be flushed out of Grease Interceptor

ADDITIVES

- BACTERIA
  - Two Types
    - Spore Forming
      - 99% cultured from Bacillus bacteria
      - Studies indicate that it takes 24 hours before spore forming bacteria are ready to consume FOG.
      - Optimal conditions necessary or will stay as spore
      - Some products add soaps, surfactants or enzymes to the “bacteria” so the “additives” to the product can emulsify or liquefy the FOG. Why do they need to add emulsifying products to bacteria?
    - Non Spore Forming, referred to as live vegetative microbes, or BACTERIA only
      - Bacteria cultures that are suppose to be 100% bacteria with no additional additives.

Do Bacteria work in Grease Interceptors?

Yes, but it all depends...

- Type of Facility
  - Many bacteria strains prefer other sources of materials or food (like glycerol, carbohydrates, proteins) over fatty acids as the food source. Food sources vary from FSE to FSE.
  - Oils & Greases used at FSE. Remember we discussed that FOG products are more complex now and can be harder to break down
- Retention Time
  - Long retention times are generally necessary for bacteria to breakdown FOG
  - Many interceptors do not have sufficient retention time during peak cleaning flows
    - This allows partially digested or broken down FOG in a liquid or emulsified state to be discharged. Have to help overcome this by keeping insoluble grease and solids pumped out of interceptor.

Do Bacteria work in Grease Interceptors?

Yes, but it all depends...

- Temperature
  - Fluctuations in temperature effect bacteria
    - Hot water from dishwasher (140*F to 160*F)
    - Optimum temperature range is normally 75*F to 100*F
- pH
  - Fluctuations in pH effect bacteria
    - Optimum range for most bacteria is 6 to 8 standard units
    - Additives w/ Caustics, Acids, Solvents, Soaps and Enzymes can effect pH
    - Soft drinks discharged to interceptor can lower pH
    - Cleaners used on floor & washed down floor drain to the interceptor

Do Bacteria work in Grease Interceptors?
Yes, but it all depends...

- Chemical use
  - Chlorine used in cleaning and also in tap water can kill bacteria
  - Oxidizers & other disinfectants used in cleaning can kill bacteria
  - Deodorizers and other products can contain chemicals (phenols, etc) that can inhibit bacteria

Also, note that some bacteria contain pathogenic (disease causing) bacteria. Caution if handling, esp. in food service facility. Ask bacteria manufacturer or supplier. Also good to ask for full disclosure MSDS or USDA certifications on products.

Comments on Additives

- If additives are used by Food Service Establishments, recommend only using 100 % bacteria (with no other additives to bacteria culture like soaps, surfactants or solvents)
- Use of bacteria does not mean that cleaning or pumping of the grease interceptor can be stopped.
  - Insoluble (not in solution) FOG and bottom solids (food particles, dough, etc) take up capacity of interceptor which leads to short circuiting and discharge of FOG.

1998 Bioremediation Study Results

- Data is presented from WEF & EPA “Control of FOG Advanced Training Course”, March 2003 Module 10-Additives
- Four (4) Case Studies presented
  - Australia
  - Texas
  - California
  - Toronto
- No details provided on type of bioremediation “additive” used in each study

Australian Study

- Hamburger Restaurant & Seafood Restaurant

- Hamburger Restaurant
  - Length of test: 6 weeks
  - pH range 4.2 to 5.8
  - Interceptor size: 211 gallons
  - Results
    - BOD reduced by 22%
    - TSS reduced by 43%
    - O&G increased by 4%

Australian Study

- Seafood Restaurant
  - Interceptor size: 530 gallons
  - pH range 4.1 to 5.5
  - Duration: 6 weeks
  - Results
    - BOD reduced by 32%
    - TSS reduced by 44%
    - O&G increased by 44%

Texas Study

- Steakhouse Restaurant
  - Duration: 8 weeks
    - 4 weeks baseline
    - 4 weeks actual test w/ bioremediation
  - Interceptor size: 500 gallons
  - Results
    - BOD decreased by 49%
    - TSS decreased by 18%
    - O&G increased by 136%

California Study

- Duration of test: 20 weeks
  - Background: 6 samples over 10 weeks
  - Test: 6 samples over 10 weeks
- Results
  - Background Oil & Grease results
    - High 194
    - Low 132
    - Average 164
  - Test Oil & Grease results
    - High 496
    - Low 221
    - Average 310

Nashville Grease Interceptor Study

Includes Bacteria Assessment – Study not completed

- Bacteria (100% bacteria product) added to American style food full service restaurant
- Interceptor Size: 1000 gallons
- Test to be performed w/ following conditions:
  - Bacteria addition to interceptor
  - Bacteria addition and aeration to 1st chamber of interceptor
  - No Bacteria added to interceptor

Nashville Grease Interceptor Study
Includes Bacteria Assessment – Study not completed

Interceptor 1st chamber under aeration

Nashville Grease Interceptor Study
Includes Bacteria Assessment – Study not completed

- Preliminary results
  - O&G method used: 413.1 (freon)
  - Bacteria (only) added and 20 days after pumping
    - O&G (11:05am) 130 mg/L
    - O&G (3:50pm) 66 mg/L

Nashville Grease Interceptor Study
Includes Bacteria Assessment – Study not completed

- Preliminary Results
  - Bacteria added and 1st chamber of interceptor under aeration. After 30 days.
    - Interceptor Influent- Average results from 5 samples throughout day
      - O&G 1,476 mg/L
      - BOD 1,872 mg/L
      - TSS 692 mg/L
    - Interceptor Effluent- Average results from 5 samples throughout day
      - O&G 230 mg/L (84.4% removal)
      - BOD 2,040 mg/L (- 9 %)
      - TSS 882 mg/L (-27.5%)

Nashville Grease Interceptor Study Includes Bacteria Assessment – Study not completed

- Preliminary results
  - Indicate that bacteria use without aeration appears to work better
    - Air pressure could have been too great and caused BOD and TSS washout, or O&G being consumed by bacteria but affects the BOD and TSS concentrations
    - O&G removal efficiency was 84% with aeration but the effluent levels still exceeded 100 mg/L