



DESIGNING AND INSTALLING GREASE INTERCEPTORS IN ARIZONA

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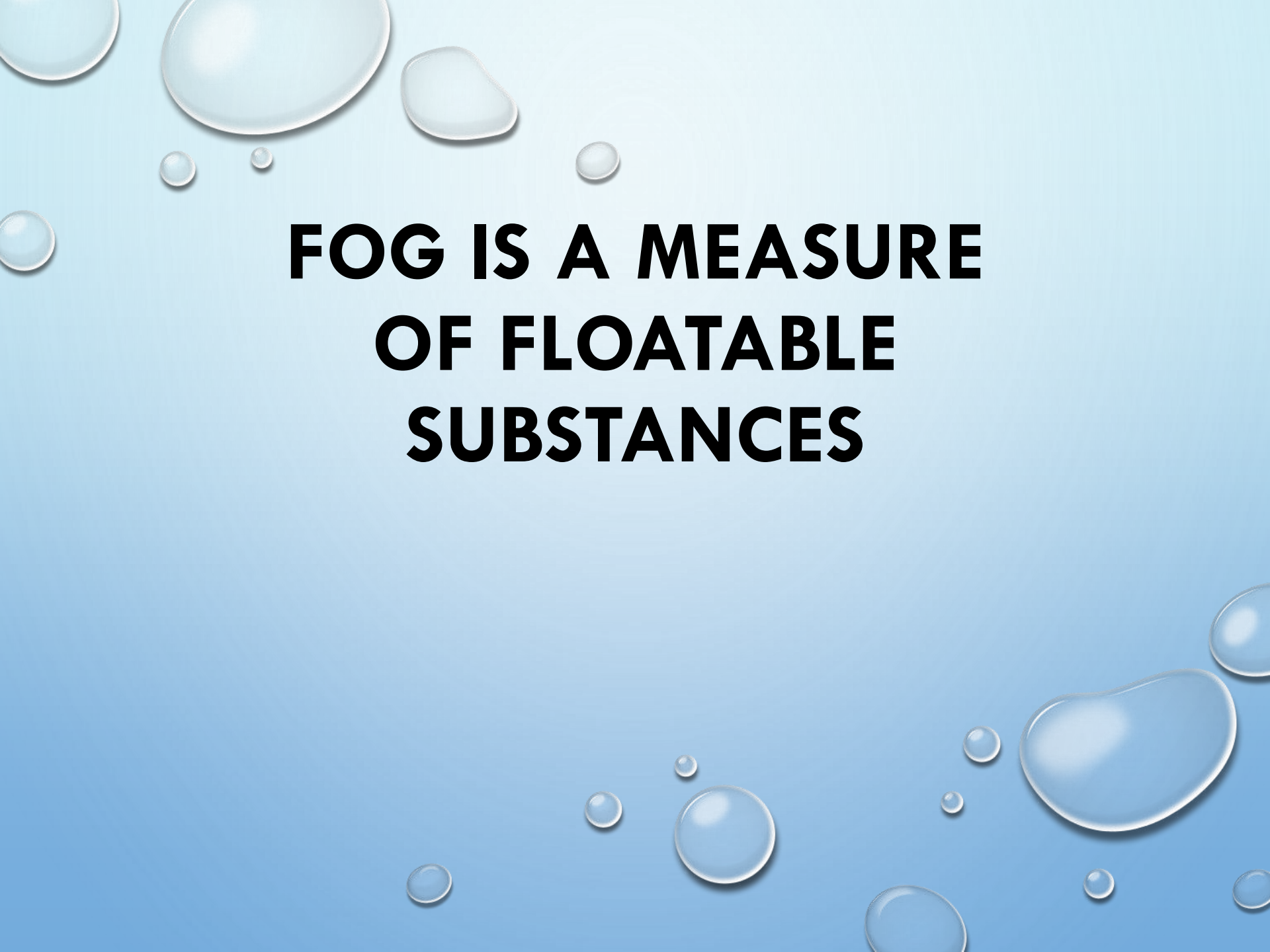
and

JEREMY GRIFFIN, Apollo Drain and Septic Service

FOG – FATS, OILS & GREASE

- FATS ARE OF ANIMAL ORIGIN, SOLID @ 68°F
- OILS ARE OF PLANT ORIGIN, LIQUID @ 68°F
- GREASE MAN-MADE, USED AS A LUBRICANT
- COLLECT SAMPLE IN AMBER GLASS JAR
- MIX KNOWN VOLUME OF SAMPLE WITH HEXANE (A POWERFUL SOLVENT LIGHTER THAN WATER) IN A SEPARATORY FUNNEL
- TOP LAYER PLACED IN PRE-WEIGHED CONTAINER **INSIDE A FUME HOOD**
- ALLOW HEXANE TO EVAPORATE. RECORD MG WEIGHT INCREASE PER LITER OF SAMPLE (MG/L)



The background is a light blue gradient with several realistic water droplets of various sizes scattered across it. The droplets have highlights and shadows, giving them a three-dimensional appearance. The text is centered in the upper half of the image.

**FOG IS A MEASURE
OF FLOATABLE
SUBSTANCES**

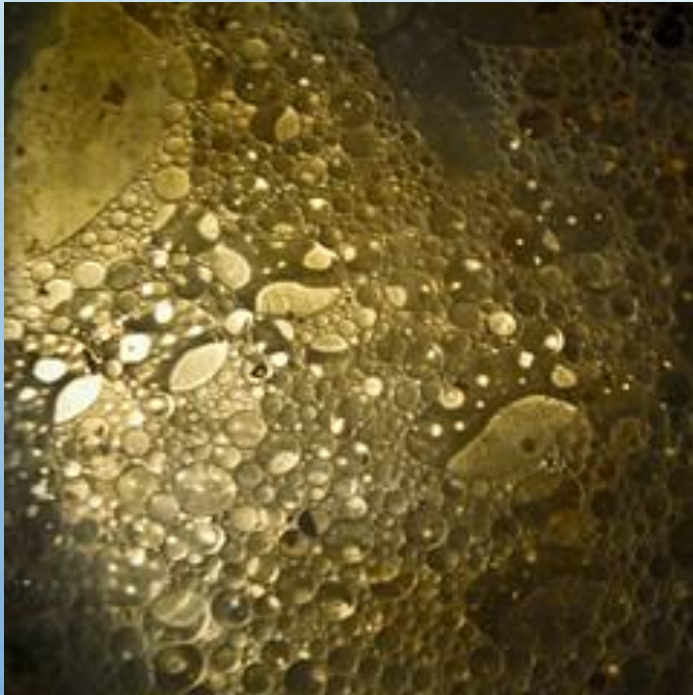
WHAT IS A DESIGN CONCEPT?

- A BRIEF EXPLANATION OF WHAT A DEVICE IS INTENDED TO DO
- EYEGASSES: IMPROVE VISION
- SUN GLASSES : PROTECT VISION IN BRIGHT SUN,
FASHION STATEMENT



What Are We Trying to Achieve?

- Take wastewater with high levels of FOG and food solids and effectively retain much of those solids and FOG as possible.
- Release treatable wastewater into the next downstream component



Design Concept for a Gravity Grease Interceptor

- Accepts the FOG-laden liquids from a food service establishment
 - hold it and let the contained liquid cool
 - the lighter than water FOG fraction rises to form an upper layer
 - solids settle on the floor of in a sludge layer
 - flotation and settling must occur under *calm* conditions
- Allow a cooled, clarified liquid to exit the interceptor(s) by hydraulic displacement

- Gravity Grease Interceptor (GGI)



- Hydromechanical (HGI)



- Automatic (AGI)



3 KEYS TO GRAVITY GREASE INTERCEPTOR PERFORMANCE

- **TIME** - FUNCTION OF TOTAL CAPACITY AND FLOW PATH (USE BAFFLES & COMPARTMENTS TO PREVENT SHORT CIRCUITING). COMMERCIAL GRADE FILTRATION CAN ALSO BE BENEFICIAL
- **TEMPERATURE** - FUNCTION OF HOT WATER SETTINGS, DETENTION TIME AND SURFACE AREA
- **TURBULENCE** - DON'T WANT ANY. ALLOW MATERIAL TO SETTLE BASED ON ITS SPECIFIC GRAVITY

MORE ON TEMPERATURE

- A commercial dishwasher will discharge 170°F water. Switching to a chemical sanitizer allows lowering water temperature to 130°F
- This lower temperature is significant, because some animal fats will begin to solidify at ~90 to 100°F
- Some designers have used air lines to strip temperature out of a grease interceptor. But doing this makes the tank turbulent!

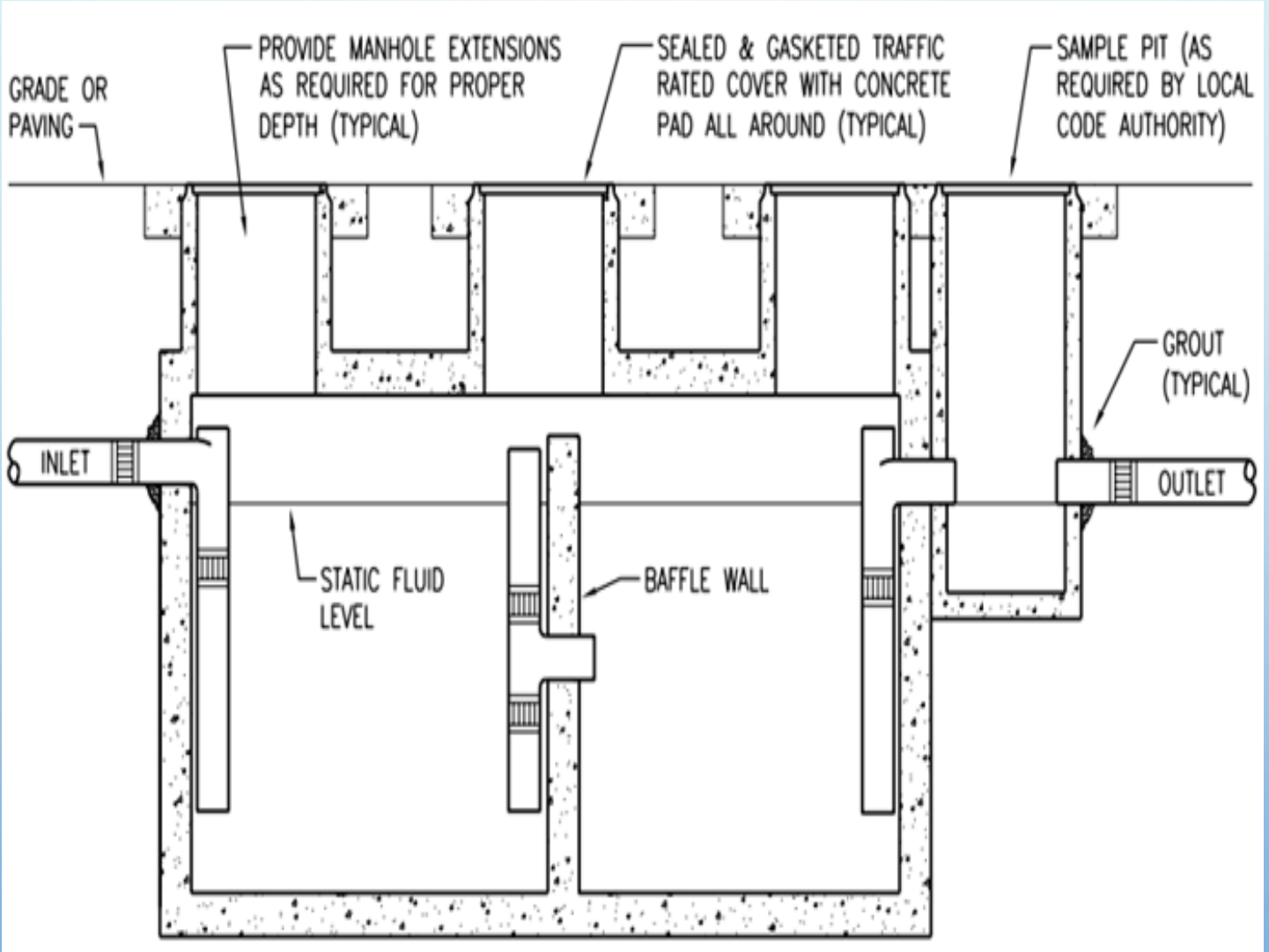
MELTING POINTS OF VARIOUS LIPIDS

Source	Pig	Sheep	Cattle (corn fed)	Butter	Olive oil
Melting Point °F	84°	104°	90°	90°	43°

- Melting points are different based on the species of animal/plant
- Melting points are different for lipids taken from different parts of the same animal.
- Melting points are different based on the animal's diet

MORE ON TURBULENCE

- FOG SPECIFIC GRAVITY <1 , FLOATS
- SUSPENDED SOLIDS SG >1 , SINKS
- PLACE INTAKE OF OUTLET DEVICE DEEPER THAN IN STANDARD SEPTIC TANK



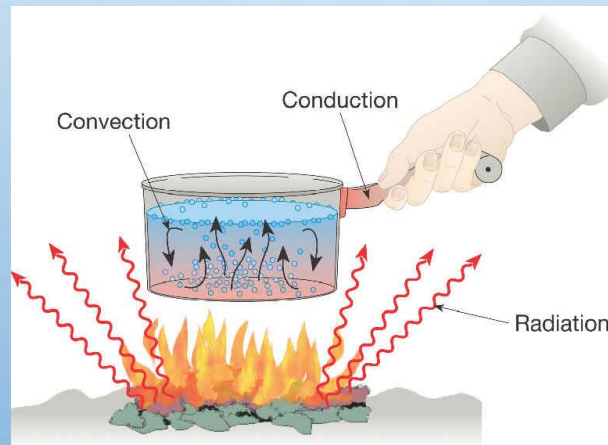
GRAVITY GREASE INTERCEPTOR PLACEMENT

- Located outside of food preparation areas
- Distance from building a factor
too close - water too hot and emulsified fat, oil & grease get through interceptor(s) - BAD
too far - sewer line clogs before discharge reaches interceptor - WORSE
- Menu has an impact - vegetable oils are somewhat water soluble and will only be retained if there is some animal fat for them to coat



HEAT TRANSFER MODES

- Convection – caused by fluid (liquid or gas) moving close to hot surface
- Conduction – transmitted through solids or stationary fluids (heat diffusion through a 2nd material)
- Radiation – heat transmitted as electromagnetic waves



DENSITY OF AIR AT ATMOSPHERIC PRESSURE AS A FUNCTION OF TEMPERATURE

Air Temperature °F	Density in pounds per cubic foot
60°	0.076
70°	0.075
80°	0.074
90°	0.072
100°	0.070
110°	0.069
120°	0.068

* Source: The Engineering Toolbox

ARIZONA 'TWISTS'

- CODE INTERCEPTOR SIZING EQUATION
- TEMPERATURES ARE EXTREMELY HIGH SEASONALLY AND IN URBAN HEAT ISLANDS
- POSITIVE: USE OF LARD IN RECIPES HELPS THE INTERCEPTOR'S OPERATION

GRAVITY GREASE INTERCEPTOR DESIGN CONSIDERATIONS

- PEAK FLOW RATES
- SURFACE AREA (COOLING)
- TOTAL STORAGE VOLUME
(RETENTION TIME)
- BAFFLES/FILTERS, ETC.

IN FOOD SERVICE APPLICATIONS

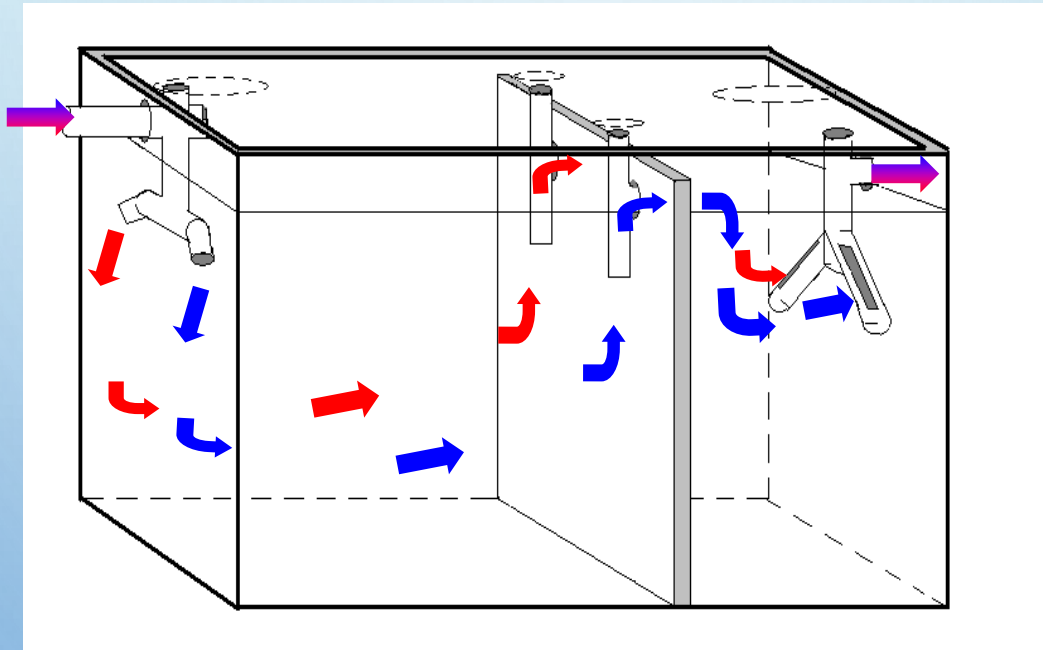
- the kitchen flow must be routed to a gravity grease interceptor **BEFORE** being routed to the septic tank

GRAVITY GREASE INTERCEPTOR LOCATION AND SERVICE FREQUENCY

- Parking Lot
- Loading dock
- Under decks (with hinged access)
- 30 days to 90 days between service typical
- If more frequent service needed, interceptor is severely undersized
- If you can stand inside the interceptor on solid fat, its too long without service!

WAYS TO PREVENT SHORT-CIRCUITING

- Larger or multiple pass throughs in compartment wall(s)
- Use a distributed inlet/outlet to create multiple flow paths



Courtesy Leon Holt, Cary, NC

MULTIPLE FILTERS

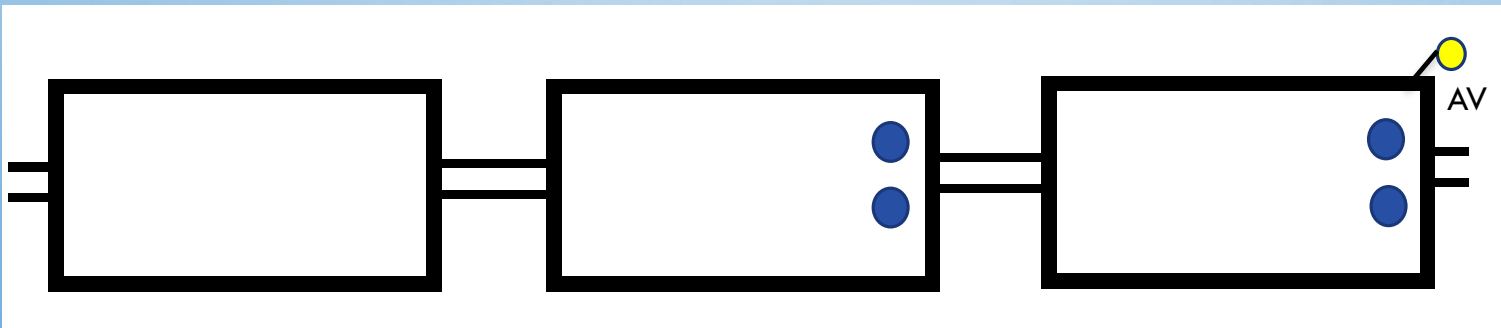


FAT SOLIDIFIED AND STARTED CATCHING OILS!



INTERCEPTOR SIZE (VOLUME) A KEY DESIGN DECISION

- Multiple easily cleanable interceptors in series are better than one gigantic interceptor
- Goldilocks dilemma, first interceptor will be too hot
- Next interceptor may show fats solidifying (pump every trip)
- Final interceptor allows more floating/settling (pump as needed)



ARIZONA TITLE 18 CHAPTER 9 A315

- INTERCEPTOR SIZING BASED ON MULTIPLYING THE FOLLOWING 4 FACTORS
- M = NUMBER OF MEALS SERVED DURING PEAK HOUR
- F = APPLICABLE WASTE FLOW RATE (TAKEN FROM TABLE 1 UNIT DESIGN FLOWS)
- T = ESTIMATED RETENTION TIME (2.5 HRS COMMERCIAL KITCHEN,
1.5 HRS SINGLE SERVICE *DISPOSABLE* ITEMS)
- S = STORAGE FACTOR (FULLY EQUIPPED 8 HOURS OPERATION = 1.0;
FE 16 HOURS OPERATION = 2.0; FE 24 HOUR OPERATION = 3.0;
SINGLE SERVICE REGARDLESS OF HOURS OF OPERATION = 1.5

TABLE 1 UNIT DESIGN FLOWS

Wastewater Source (Add together all wastewater source line items applicable to the facility per applicable unit.)	Applicable Unit	Sewage Design Flow per Applicable Unit, Gallons Per Day
Restaurant/Cafeteria		
For each employee, add	Employee	20
With toilet, add	Customer	7
Kitchen waste – full plated service, add	Meal	6
Kitchen waste – disposable service, add	Meal	2
Garbage disposal, add	Meal	1
Cocktail lounge, add	Customer	2

SAMPLE PROBLEM STATEMENT

- A LUNCH & DINNER (12 HOUR) SIT-DOWN RESTAURANT WITHOUT A LOUNGE, WITH 5 EMPLOYEES, USING WASHABLE PLATE WARE, GLASS WARE AND CUTLERY. NO GARBAGE DISPOSAL.
- THE NUMBER OF MEALS SERVED DURING THE PEAK HOUR IS ESTIMATED TO BE 33
- WHAT SIZE GREASE INTERCEPTOR(S) WOULD 18.9. A315 REQUIRE FOR THIS FACILITY?

SAMPLE PROBLEM SOLUTION

- # MEALS SERVED DURING PEAK FLOW HOUR = **33 meals
hour**

- APPLICABLE WASTE FLOWRATE = **6 gallons
meal**

NOTE: Toilet flows and employee generated wastewater are not routed through the grease interceptor

- ESTIMATED RETENTION TIME = **2.5** hours

- STORAGE FACTOR (EXTRAPOLATE) = **1.5**

- INTERCEPTOR VOLUME $33 \frac{\text{meals}}{\text{hour}} * 6 \frac{\text{gallons}}{\text{meal}} * 2.5 \text{ hrs} * 1.5 = 743 \text{ gallons}$

COMMENTS ON A315 SIZING APPROACH

- ALL FOUR FACTORS ARE MULTIPLIED TOGETHER TO PRODUCE A RESULT IN GALLONS FOR THE INTERCEPTOR SIZE. THIS SIZE IS SMALLER THAN THE ONE WE WILL CALCULATE USING A DIFFERENT METHOD.
- SOME FACTORS IN THE EQUATION ARE ESTIMATES – WE WILL NOT KNOW # MEALS AT PEAK HOUR UNTIL THE BUSINESS HAS BEEN OPERATING FOR MONTHS

HERE IS HOW I WOULD SIZE GREASE INTERCEPTORS

SAMPLE PROBLEM STATEMENT

- A LUNCH & DINNER SIT-DOWN RESTAURANT HAS ONE DISHWASHER, ONE POT SINK, ONE MOP SINK, ONE FLOOR DRAIN AND ONE 3-COMPARTMENT SINK
- WHAT SIZE GREASE INTERCEPTOR(S) WOULD YOUR INSTRUCTORS DESIGN FOR THIS FACILITY USING THE PROCEDURE SUGGESTED HERE?

PEAK FLOW AS A FUNCTION OF FIXTURE UNIT EQUIVALENTS

Equipment Name	Equivalent Fixture Units
Commercial Dishwasher	3 FU
Pot Sink	3 FU
Clean up/Mop sink	3 FU
Floor Drain	2 FU
3 compartment sink	2 FU

PROJECTED PEAK FLOW

Total Equivalent Fixture Units	Peak Flow
1 to 6	30 gallons/minute
7 to 9	40 gallons/minute
10 to 12	50 gallons/minute
Greater than 12	4.1 gpm/FU

DESIGN SURFACE AREA VS. PEAK FLOW

Peak Flow Rates	Required Surface Area (sq. ft)
30 gallons/minute	62
40 gallons/minute	82
50 gallons/minute	104
60 gallons/minute	124

SAMPLE PROBLEM SOLUTION

- PEAK FLOW = $3+3+3+2+2=13$ FU
- >12 FU = $13 * 4.1 = 53.3$ (ROUND UP)
- DESIGN SURFACE AREA (USE 60 GPM) = 124 SQ FT
- 3,000 GAL INTERCEPTOR HAS A SURFACE AREA OF 129 SQ FT
- RECOMMEND 3-1000 GALLON TANKS IF SPACE ALLOWS
- OR 2- 1,500 GALLON TANKS IN SERIES
(UPC 06 RECOMMENDS ONE 1,000 GALLON GGI)

FACILITY TIPS

- TYPICAL OPERATING HOURS (INFLUENCES PEAK FLOW)
- # MEALS SERVED PER DAY GIVES ANOTHER CHECK ON SIZING
- SELF-SERVE SALAD BAR #1 SOURCE OF FOG (OVERUSE OF DRESSING)
- BETTER PLATE SCRAPING (USE DISPOSABLE PAPER PLATES)
#1 IMPROVEMENT IN EFFLUENT FOG

FACILITY TIPS (CONT.)

- IS DEEP FAT FRYER MAKING ENOUGH MONEY TO BE WORTH THE COST OF DESIGN?
- ICE CREAM DRIPPINGS VERY HIGH IN BOD
- ICE MACHINE CAN SEND MANY GALLONS OF WATER TO SYSTEM UNNECESSARILY, MAKE SURE ITS NOT LEAKING

FIELD METHOD TO TROUBLESHOOT EFFLUENT CHARACTERISTICS

- IF TEMPERATURE AT EXIT OF LAST GRAVITY GREASE INTERCEPTOR ABOVE 110°F (YOU CAN'T HOLD YOUR GAUNTLETED HAND IN THERE), IT IS SHORT CIRCUITING OR IS TOO SMALL
- SOLUTION, CHEMICAL RINSE, DISTRIBUTED INLET, COMMERCIAL GRADE FILTERS (TWO IN PARALLEL), ADD AIR VENT TO LAST TANK, ADD MORE TANKS IF POSSIBLE
- IF pH IS LOW (UNDER 4) EXCESSIVE CHEMICAL USE

FINAL TIPS AND TRICKS

- IF EXCESSIVE FOG EVEN AT 90-100°F TEMPERATURE, MENU CHANGE TO VEGETABLE SHORTENING
- WILL SOLIDIFY AT A HIGHER TEMPERATURE AND WILL ALLOW VEGETABLE OILS (CANOLA, OLIVE) TO COAT
- SERVICE ALL TANKS JUST BEFORE MOTHER'S DAY