Flow Equalization

Using the WHOLE Day

Flow Equalization

- What is it?
- Why use it?
- What is a Time-dosed System?
- How to Calculate Storage Volume
  - Sizing the Equalization Tank
- Design Example
  - Timer Settings and Float Settings
  - Measuring Actual Flows
  - Calibrating the System

Flow Equalization is…

- Storing and dosing the wastewater over an extended period (24 hours; week; month)
- The start of "Managing" Treatment
- **System-determined flow rate**

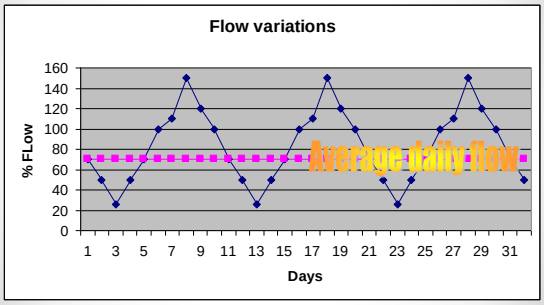
Water Saving Devices

- Decrease the flow rate
- Clip flow peaks
- Little to No effect on overall:
  - Organic load
  - Nutrients

Flow Equalization Systems

- Makes the flow introduced to the treatment system more consistent.
- Flow equalization is important if
  - The average flow is ≥ 70% of the design capacity
  - Water use habits or facility operations are variable- churches; schools; restaurants
  - Frequent peaks exceed system capacity
    - Wash day: cleaning service

Effects of Flow Equalization



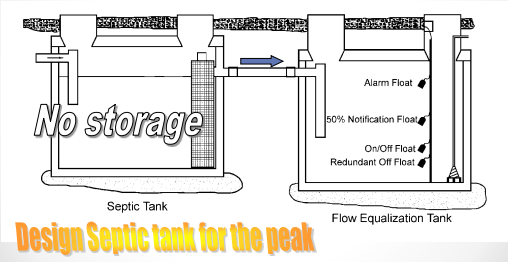
Why Bother?

- Spreads out hydraulic and organic loading
  - Regular Resting
  - Allows for oxygen recovery in the soil
- Flow equalization
  - Uses the whole day
  - OR even the whole week

Other Benefits of a Flow Equalization System

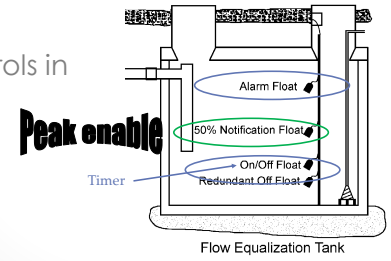
- Regular feeding the hungry population of microbes that are used for treatment.
- Monitoring of flows from the surge tank may help detect
  - major changes in flow patterns
  - leaking effluent
  - clogging orifices
- Provide storage and spread out water delivery after a power outage.
- Can save money

Flow Equalization System



Flow Equalization Tank

- Timer
- Controls in tank



What is a Timer System?

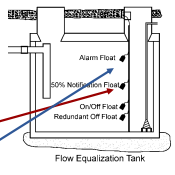
- Flow controlled by time
- Timers
  - ON: OFF
- Programmable Logic Controller or
- Programmable Logic Unit
  - PLC (PLU)
  - Computer

Control Panel Needs Timer

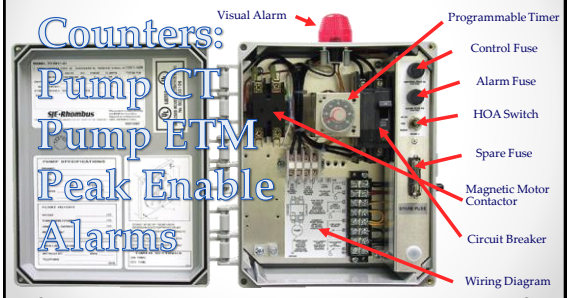
- Track doses (counter)
- Track time of pump run
  - Flow measurement

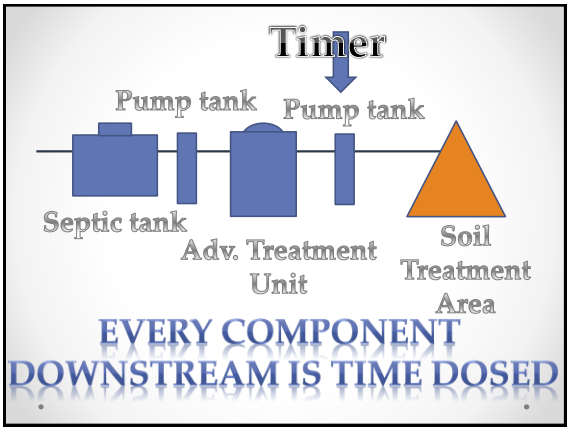
Track Peak Enable

Track High Water Alarms



Anatomy of a Timed Dose Panel





Calculating Storage Volume

Design Criteria

- Design Flows
  - Average daily flow
    - During peak week or peak month
  - Peak daily flow
- **Storage Volume** takes the incoming peak flows, and controls them based on limitations of the downstream components
  - "Reverse Design"

Storage Volume (simplified)

- SV = Peak Daily Flow
- SV = Peak Daily Flow + Average Daily Flow
- SV = Peak Daily Flow x 1.5
- SV = Peak Daily Flow x 2
  - For systems that can have an unusually large peak flows in a day

Storage Volume (a closer look)

- How many doses per day do we want?
  - Every hour – 24 doses per day
  - Every 2 hours?
  - Four times a day?
  - Once a day?
- How much water comes into the system during that interval?
- Storage Volume increases and decreases
  - Sometimes In < Out
  - Sometimes In > Out

1400 GPD School

Time Interval	Hourly Flow Volume (gal)	Hourly Volume to or from storage (gal)	Cumulative Flow to or from storage (gal)
4-6 am	0	-117	-117
6-8	25	-92	-208
8-10	75	-42	-250
10-12	300	183	-67
12-2 pm	300	183	117
2-4	300	183	300
4-6	200	83	383
6-8	150	33	417
8-10	50	-67	350
10-12	0	-117	233
12-2 am	0	-117	117
2-4	0	-117	0
Total (GPD)	1400		
Gal per dose	117		
Storage Volume		417 - (-250) = 667 gallons	

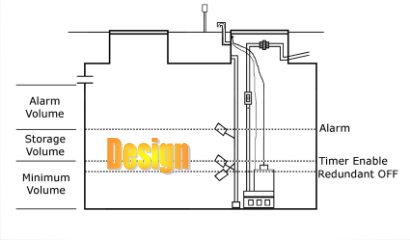
- 1400 GPD (peak day)
- Dose every 2 hours
  - 117 gallons per dose
- Total storage = highest volume minus lowest volume

Daily Flow Example

Time Interval	Daily Flow Volume (gal)	Hourly Volume to or from storage (gal)	Cumulative Flow to or from storage (gal)
Wednesday	275	-236	-236
Thursday	275	-236	-471
Friday	925	414	-57
Saturday	1400	889	832
Sunday	700	189	1021
Monday	0	-511	511
Tuesday	0	-511	0
Total	3575		
Daily dose	511		
Storage Volume		1021 - (-471) = 1492 gallons	

- 1400 GPD (peak day)
- Closed Mon and Tues
- Equalize the week
- 511 GPD average
- Total storage = highest volume plus lowest volume
- 1492 gallons of storage

Required Volumes



Design Example

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Mel's Diner

Estimate Design Flows

FOOD SERVICE ESTABLISHMENT	AVERAGE GPD	BOD_5 IN POUNDS PER DAY
Restaurant open 1 or 2 meals per seat	50	.06/meal
24-hour restaurant per seat	75	.07/meal served
Restaurant with paper service only per seat	25	.01/meal served
Additional for bars and cocktail lounges per seat	30	.02
Drive-in restaurant per car space	50	.02

When possible, DO NOT rely on published design criteria for estimating flows

EVEN Designing for new construction

REAL FLOWS ARE CRITICAL

Customers and hydraulic flows are related

Example – Mel's Diner

- Design flow = 1,400 gpd
- Weekend Peaks
- Grease trap ~ 1,400 gal
- Septic tank ~ 4,200 gal
- Pre-treatment system for 1,400 GPD $$$$$$$$
- STA~ 2,800 sqft

CANNOT AFFORD IT!

Mel's Diner Flows

Time Interval	Daily Flow Volume (gal)	Hourly Volume to or from storage (gal)	Cumulative Flow to or from storage (gal)
Wednesday	275	-236	-236
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Friday	925	414	-57
Saturday	1400	889	832
Sunday	700	189	1021
Monday	0	-511	511
Tuesday	0	-511	0
Total	3575		
Daily dose	511		
Storage Volume = 1021 - (-471) = 1492 gallons			

Storage Vol

511 GPD Avg

Example – Mel's Diner

- Equalized Flow
- Average = Design flow = 511 gpd (downstream from EQ tank)
- Grease trap ~ 1,400 gal
- Septic tank ~ 4,200 gal
- Flow Equalization ~ 2,000 gal
- Pre-treatment system for 511 GPD $$
- STA~ 1,022 sqft

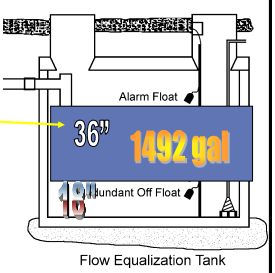
CAN AFFORD IT!

Reverse Design

- Downstream Limitations
- Treatment System and STA set flow limitations from EQ system
- Septic tank design based on typical values

Floats: Setting Depths

- **Off Float**
  - Set at 18" up [Pump + Block]
- **Storage volume**
  - 1,492 gal ÷ 42 g/in= 39" up
- **Alarm Float**
  - Method 1
    - 18" + 39" = 57"
  - Method 2
    - 90% of Tank Depth



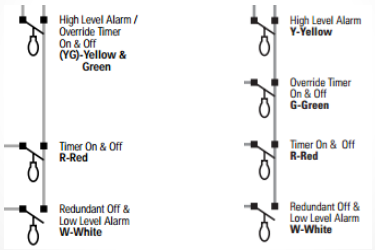
Setting the timer

- Start by setting the time for an average daily flow (can be estimated at 50% - 60% of the peak flow)
- Monitor System
  - No alarms - Good
  - Alarms- Up the flow
    - Shorter off
  - Low counts - Reduce the flow
    - Longer off
- Peak enable set at design

Timer Settings

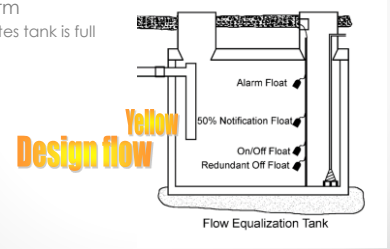
- Amount of time for a dose
- Dose = [Ave flow ÷ # of doses] + Drainback
- [640 gpd ÷ 4 times] + 12 gallons = 172 gallons
- 50 GPM pump
- Timer 'on' = 172 gal ÷ 50 gpm = 3.5 min
- Timer 'off' = 60 min – 3.5 min = 56.5 min

Float Function Options



Multiple Alarms

- Yellow "Amber" alarm as a management device
  - Indication to user that design volume has been met
- Red alarm
  - Indicates tank is full



Measuring Actual Flows

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Measuring Actual Flows

- **Number of people living in home**
  - Not accurate
  - WAG tending toward SWAG
- **Water meter**
  - Subject to challenges
- **Measuring on pump**
  - Elapsed time meter [gpm]
  - Cycle counter [Dose]
  - Often the best way
- **Wastewater meter**
  - Expensive

Measuring Flow: CC

- Using Cycle Counters (CC)
  - Days between readings
    - (only when in operation)
  - Change in value = Total number of cycles (NC)
  - Dose Volume (DV)
    - DVn= DV- drainback
  - Total flow
    - NC x DVn = Total flow
  - Total flow ÷ Days = Average Daily Flow

Measuring Flow: ETM

- Using Elapsed Time Meter (ETM)
  - Days between readings
    - (only when in operation)
  - Change in value = Total number of units
    - Minutes
    - Hours
  - Pump capacity (gpm)
  - Total flow = total minutes x gpm ÷ Days = Average daily flow

Time-Dosed Systems

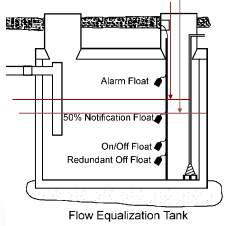
Calibrate the Flow = PDR

PDR= Pump Delivery Rate

Calibrating the Timer

- Pump rate ~ Calibration
- 4 inches in 3.5 minutes
- 4" x 42 gal/in ÷ 3.5 min = 48 gpm

3.5 minutes



Pump Delivery Rate (PDR)

Pump Calibration

Verified [Measured] Pump run time "On" (min)

- Pump out ÷ Pump run time "On" (min) = (GPM)

= 72 gal ÷ 3 min = 24 GPM

New Timer Settings

- Amount of time for a dose
- Dose = [Ave flow ÷ # of doses] + Drainback
- [500 gpd ÷ 4] + 12 gallons = 137 gallons
- 48 GPM pump
- Timer 'on' = 137 gal ÷ 48 gpm = 2.9 min
- Timer 'off' = 60 min – 2.9 min = 57.1 min

Changed from 3.5 min on
and 56.5 min off

Annual Event

- Special use
- Empty the Tanks
- Portables
- Washing schedule
- Pre cooking
- Clean up

Questions?