PENTAIR

WATER AND ITS EFFECTS – IMPORTANCE OF WELL TANKS, AND FILTRATION SYSTEMS FOR THE HOME

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IMPORTANCE OF WELL TANKS
BAFFLE FACTOR/ CONTACT TIME

WHAT IS BAFFLE FACTOR

Effectiveness of the Disinfection Process

- Disinfection performance can be improved by:
  - Increasing the concentration of disinfectant
  - Increasing the disinfectant contact time
  - Decreasing the flow rate
  - Increasing the tank volume
  - Increasing the temperature
  - Increasing the baffling factor.
- The only performance factor that we can affect, by design, is the baffle factor.

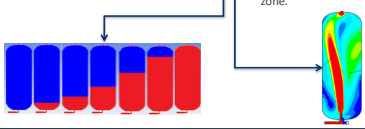
Baffle Factor

- The measure of a fluid's short-circuiting inside of a tank
- Value ranges from 0 to 1.0

1.0: Best for the disinfection process. Tank fluid is first in, first out (plug flow)

0.# Some degree of mixing

– 0.0: Perfect short circuit. Incoming fluid goes directly to the outlet, rest of tank is a dead zone.



Measures of fluid short-circuiting

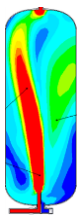
HOW TO DETERMINE THE BAFFLE FACTOR

- **Chlorine/Chloride Tracer Study**
  - The most effective method to determine a system's baffle factor is to perform a chlorine/chloride tracer study on the tank.
    - Feed water to contain a known concentration of chlorine
    - Test tank to contain chlorine-free water
    - The feed solution is pumped into the tank, and the tank's outlet is monitored for chlorine.
      - T (system time) = Tank Capacity / Flow Rate
      - T_{10} (T "ten" time) = Time at which the tank's output reaches 10% of the feed concentration
      - For a given flow rate, the Baffle Factor = T_{10} / T
  - Example Calculation:
    - 120 gallon tank
    - Flow rate of 3 GPM
    - T = 120 gallons / 3 GPM = 40 minutes
    - Experimental Result: Outlet concentration of tank reaches 10% of feed concentration at the 12 minute mark (T_{10} = 12).
    - Baffle Factor = 12 minutes / 40 minutes = 0.30

Determine experimentally

ORIGINAL UT TANK, NO INTERNAL WATER ROUTING

- POOR BAFFLING
- Channeling and no mixing, yielding a baffle factor of 0.5
- IF customers were running tanks in series…baffle factor would be improved



Current design without internals channeled through the water flow

WHAT IS NEW

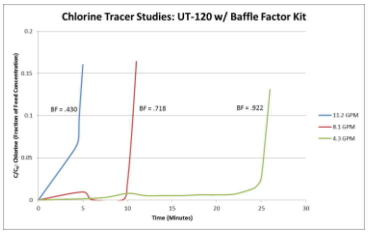
Inlet/Outlet & Blowdown Port

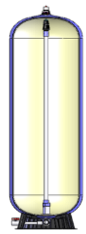
Baffle Kit available as a conversion kit

New design improves baffle factor above .3

CHLORINE TRACER STUDIES @ WQA

- **UT-120 Tank**





- **Conclusion**
  - In-house testing shows that we can obtain the flow improvement needed to achieve a minimum baffle factor of 0.3.

Testing at Pentair lab confirms WQA results

BAFFLE FACTOR

FILTRATION SYSTEMS FOR THE HOME

DEFINITIONS

- **FILTRATION**
  - A process of separation of solids from a fluid by passing through a porous medium that retains the solids but allows the fluid to pass through
- **CLARIFICATION**
  - When solids are present in very low concentration (i.e., not exceeding 1.0% w/v), the process of solids separation from liquid is called clarification

MECHANISM OF FILTRATION

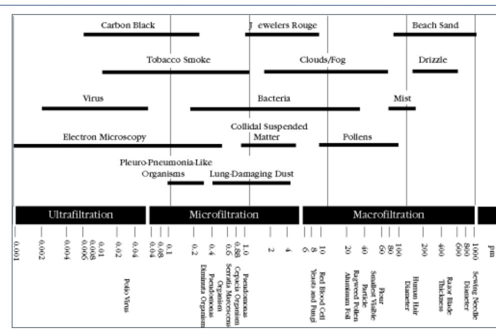
Straining
- Similar to sieving, i.e., particles of larger size can't pass through smaller pore size of filter medium.

Impingement
- Solids having the momentum move along the path of streaming flow and strike (impinge) the filter medium. Thus the solids are retained on the filter medium.

Entanglement
- Particles become entwined (entangled) in the masses of fibres (of cloths with fine hairy surface or porous felt) due to smaller size of particles than the pore size. Thus solids are retained within filter medium.

Attractive forces
- Solids are retained on the filter medium as a result of attractive force between particles and filter medium, as in case of electrostatic filtration.

SEDIMENT FILTRATION



THINGS TO CONSIDER

- A micron is 1/1,000,000 of a meter or 1/1000 of a millimeter
  - 25 microns is 1/1000 of an inch

- Red blood cell = 10 microns in size
- Human hair = 80 microns wide
- Aluminum foil = 20 microns thick
- Razor blade = 400 microns thick

A Micron-Size Dust Particle on a Pin Head

PARTICLE	SIZE
Table salt	100 microns
Human hair	40-70 microns
Talcum powder	10 microns
Fine test dust	0.5 microns
Pseudomonas diminuta	0.3 microns

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THINGS TO CONSIDER

- What's in your water that creates the drive for filtration products?

As well as: Sediment, Chloramines, Hydrogen Sulfide and more

UNDERSTANDING BASIC FILTER FUNCTION

- A filter removes debris based on pore size
- Filter life is dependent upon how much debris of what size it can hold
- Filters require a driving force to push the filtrate through the filter
- As the amount of dirt held by the filter increases pressure drops and flow diminishes

- **Things to consider:**
  - **Filtration efficiency and micron rating**
    - Filter efficiency is dependent on flow rate
    - A nominal micron rating = filter is 85% efficient
    - An absolute micron rating = filter is 99.99% efficient

FACTORS INFLUENCING FILTRATION

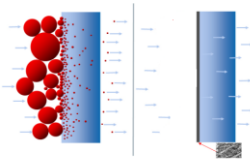
Properties of solids	Properties of liquids	Properties of media	Objectives	Temperature
• Particle shape • Particle size • Particle charge • Density • Particle size distribution • Rigidity or compressibility of solid under pressure • Tendency of particle to flocculate or adhere together	• Density • Viscosity • Corrosiveness	• Proper formation of filter cake especially in early stage of filtration • Number of effective adsorption sites • Depth or surface media	• Whether the solid or liquid or both are to be collected	• Temperature of suspension

IMPACT OF PRESSURE ON FILTER LIFE

- Operating pressure range: 10-125 PSI

Pressure	10 PSI	40 PSI	60 PSI	80 PSI	100 PSI	125 PSI	140 PSI
Filter life	Shortest: Lack of driving force	Shorter: Lower driving force	Optimal	Optimal	May experience breakthrough	May experience shorter life due to breakthrough	Will experience breakthrough with possible filter damage

HOW LOW AND PRESSURE DROP



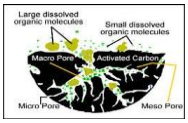
Pressure Drop on the left is due to the filter media plus dirt load.

Pressure Drop on the right is due to the filter media.

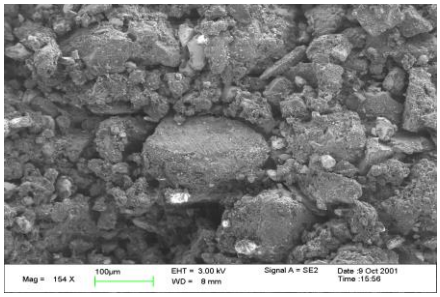
As dirtload increases pressure drop get larger eventually total pressure drop and flow loss.

FILTRATION VS. ACTIVATED CARBON

- Filtration is a mechanical process not chemical
- Some filter media have chemical removal properties, independent of their filtration properties



MOLDED/ EXTRUDED BLOCK STRUCTURES



CHLORINE REDUCTION

- **Chlorine is not removed by adsorption but through a catalytic process**
- **Chlorine used in water treatment is typically sodium hypochlorite**
  - Active ingredient in household bleach
  - Sodium ion is inert
  - Hypochlorite ion is what tastes and smells bad and is what disinfects the water (free chlorine)
- **Chlorine is never "removed"**
  - Carbon transforms the chlorine from a version that you can taste (hypochlorite) to one that you cannot (chloride)

$$C^* + HOCl^- \longrightarrow CO^* + H^+ + Cl^-$$

CARBON

- Utilizing activated carbon and other activated materials to remove contaminants from water
- Most chemical reduction filters also use mechanical filtration as well, so both sediment and chemicals can be removed
- Contaminants are adsorbed (stick) onto the surface of the activated carbon
- Surface area of 5 grams is equal to the surface area of a football field.

Colors	Pesticides	MTBE
Tannin	Herbicides	VOC
Chloramines	Industrial Pollutants	TTHMs
	Lead	

SURFACE FILTRATION VS. DEPTH FILTRATION

Surface filtration

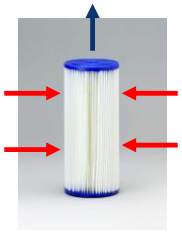
- The size of particles retained is slightly higher than the mean pore size of medium
- Mechanical strength of filter medium is less, unless it is made of stainless steel
- It has lower capacity
- The size of particles retained is more predictable

Depth filtration

- The size of particles retained is much smaller than the mean pore size of medium
- Mechanical strength of filter medium is high
- It has high capacity
- The size of particles retained is less predictable
- Equipment is cheaper because ancillary equipment is not required

THINGS TO CONSIDER

- **Cartridge flow**
  - Radial flow
    - Pleated
    - String wound
    - Polypropylene spun
    - Paper carbon
    - Carbon block
    - Granular Carbon
    - Specialty



SEDIMENT FILTER

- Cellulose based filters should be used on chlorinated supplies ONLY
- Synthetic filters can be used on chlorinated or non-chlorinated supplies

THINGS TO CONSIDER

- **Two types of filtration**
  - Point of Entry (POE)
  - Point of use (POU)

Note: less than 2% of water in the home is used for drinking and cooking

QUESTIONS?