Understanding Pretreatment

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Industrial Water Usage

• Water is required in almost every industry
  For:
   • Cooling
   • Boiler feed
   • Process
   • Drinking
   • Cleaning

In 2005 it is estimated that USA industrial raw water consumption will exceed 2 million Mega-liters per day (500 billion gallons per day)
Water Quality

• Raw water contaminates include:
  – Dirt and sediment
  – Hardness (dissolved Ca & Mg)
  – Heavy metals like Pb, Zn, Cd, Hg, As, Fe etc.
  – Salts
  – Organics
  – Color
Water Quality

• Each industrial application requires a different level of finished water quality.
• Understanding the condition of the raw water and the finished water quality requirements enables us to configure the right equipment for the specific application.
Equipment & Process Selection

• Solids removal
  – Screening
  – Sedimentation
  – Flotation
  – Filtration

• Oily materials
  – Floatation
  – Sedimentation
  – Filtration

• Hardness removal
  – Chemical reaction
  – Sedimentation
  – Filtration

• Heavy Metals
  – Precipitation
  – Floatation
  – Sedimentation
  – Filtration
Solids Removal

- Screening
  - Remove coarse material, wastes and debris.
  - Protects downstream pumps and equipment.
  - Typically for material larger than 3mm.
Solids Removal

- There are many kinds of screening products WesTech can offer to meet a project need.
Solids Removal

- Sedimentation
  - Grit separators
  - Clarifiers
  - Thickeners

Stokes Law

\[ V = \frac{gD^2(\delta - \rho)}{18\eta} \]

From Stokes law we see that under the force of gravity a particle’s velocity in a fluid is proportional to its diameter and its density. The bigger the particle (or the bigger we can make it), the faster it will settle.
Solids Removal

• Coagulation
  – Most particles carry some amount of surface charge.
  – Charges of like pole tend to repel each other.
  – Coagulation is the conditioning of the particle surface and environment
Solids Removal

• Flocculation
  – Is the means by which we can make large particles from small ones.
  – This is particularly important when we have very fine particles that settle very slowly.
Solids Removal

- Sedimentation
  - Grit separators
  - Clarifiers
  - Thickeners
Solids Removal

Flotation

– Fats, oils, grease, emulsions and other materials that have low specific gravities or are so finely divided that they are difficult to settle, can be removed with dissolved air floatation.
Solids Removal

• Flotation
  – Microscopic size bubbles are created by dissolving gas into the feed under pressure. When the pressure drops the dissolved gas comes out of solution as very small bubbles which attach to and “float” the “solid” material to the top.
Solids Removal

- Filtration
  - Granular media
  - Membrane
Solids Removal

• Granular Media
  – Sand
  – Anthracite
  – Garnet

• Depth filtration
  – Function of flocculation
  – Particle collisions
  – Interstitial spacing
Solids Removal

- **Types of granular media filters**
  - Conventional
    - Gravity
    - Pressure
  - Multi-media
  - Self stored backwash
  - Continuous backwash
    - TechnaSand™
Solids Removal

• Membrane
  – Polymem™ Ultra filter
  – Physical barrier filtration at 0.01 micron size
  – Produces low SDI water which improves RO performance.
Hardness Removal

- Chemical precipitation
  - Cold lime softening
  - Warm lime softening
  - Caustic softening
  - Lime / soda ash

Converting highly soluble materials to less soluble forms that can be removed by techniques of liquid solid separation

$$Ca^{2+} + Na_2CO_3 \rightarrow CaCO_3 \downarrow + 2Na^+$$
Hardness Removal

- Solids recirculation
  - Solids Contact Clarifiers
  - External recirculation
  - External reactors

Spontaneous formations of precipitates are most often very fine and settle poorly. Once through reactions are prone to develop precipitates on equipment surfaces (scaling) because it is easier to propagate crystal growth.
Hardness Removal

- Solids Contact Clarifiers
Hardness Removal

- Solids Contact Clarifiers
Metals Removal

- Oxidation
  - Iron, manganese
- Reduction
  - Chrome$^{+6}$ to Chrome$^{+3}$
- Precipitation
  - Hydroxides
- Ion Exchange

Depending on the demands of the application, it may be necessary to combine chemical process and perform multi step reactions.
Systems

- Many applications will require multiple unit processes to achieve treatment. A systems approach in equipment is often needed.
- Combining unit processes for raw water pretreatment is one of WesTech’s strengths.
Questions?