PNWS-AWWA Conference
Boise, ID
May 4, 2011

Chemical Feed Facility Layout, Safety, and Efficiency

MWH®

BUILDING A BETTER WORLD

Facility Layout

Need to know:

- Delivery vehicle fleet; what combination of vehicles will need to be accommodated
- Reliability of supply (proximity, weather, road/bridge access, etc)
- Number of suppliers (competition & redundancy)
- Delivery contract terms (!!)

Facility Layout

Site Considerations:

- Pavement & subgrade loading design
- Turning radius around curves
- Backup and turnaround space
- Consider drainage regulations (limits impervious surface – can't make driveway too big)

Facility Layout

Outdoor Considerations

- Freezing (pipes, valves and tanks). Insulate and accommodate flushing. Heat tracing if necessary
- Heat & UV (degradation, etc)
- Weather protection at delivery point (Snow, wind, stormwater, etc)
- No rotameters (algae can form in sunlight)

Facility Layout

- Corrosion of other materials in the chemical room (separate rooms if possible; use plastic, etc)
- HVAC (vent corrosive air outside; also OSHA safety)
- Venting, particularly for hazardous or explosive fumes (hydrogen from hypochlorite generation, etc)
- Future removal/replacement of tanks (knock-out walls, roll-up doors, removable ceiling panel, etc)

Facility Layout

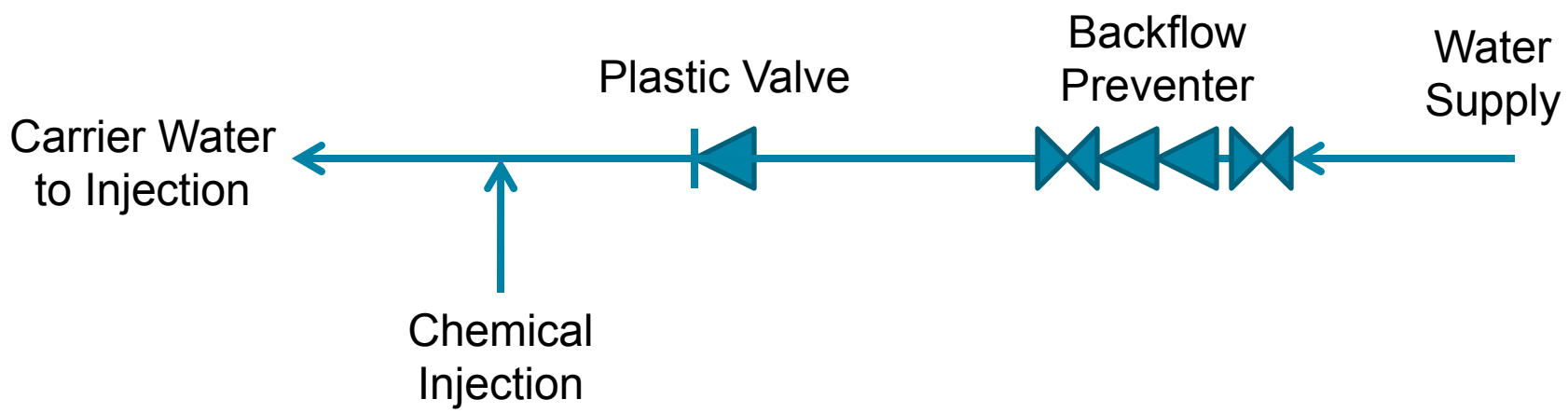
Secondary Containment:

- Do not mix chemicals. In particular: Acids & bases; Oxidants (chlorine, potassium permanganate) & organics (polymer, activated carbon)
- Vehicle access to tanks (load limits on grating)
- Include pumps, fittings, valves, etc where possible, and extend containment to loading and receiving areas

Facility Layout

Carrier Water:

- Only works with some chemicals (dilution limits)
- Too much flow wastes energy
- Add a plastic check valve on feed line, in case of metering pump malfunction with no carrier flow



Facility Layout

Hydraulics:

- Flooded suction/ min suction head requirements
- Piping slopes: Avoid high points and low points
- Variable injection pressures (flow-paced metering pumps may need to be calibrated for both pressures)
- Flow splitting; consistency and predictability of flow through parallel treatment trains

Facility Layout

- Washdown facilities (hose bibbs, hose racks, etc)
- Backflow Prevention (for saturators or carrier water system; washdown; utility water; possibly safety shower/eye wash)
- Access for cleaning & disassembly
- Working bench, storage, scullery sink
  - Locate outside of corrosive area
- O&M Manuals and MSDS Sheets

Safety

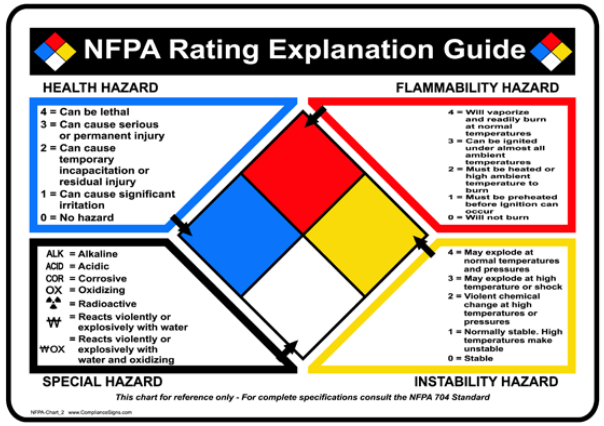
- Limit frequency of chemical delivery/transfer
- Provide safe access to manways and top of tanks (can elevated walkways be provided?)
- Metering pumps may need to be on the floor for adequate suction head conditions, but calibration columns, valves, etc could be higher

Safety

- Minimize physical labor
  - Pallet ramps & forklifts
  - loading dock height
  - buried vaults
  - hose connections
- Eye wash & safety shower
- Fire Code Requirements
- Egress
  - Don’t block exits during delivery

Safety

Chemical Hazard Communication



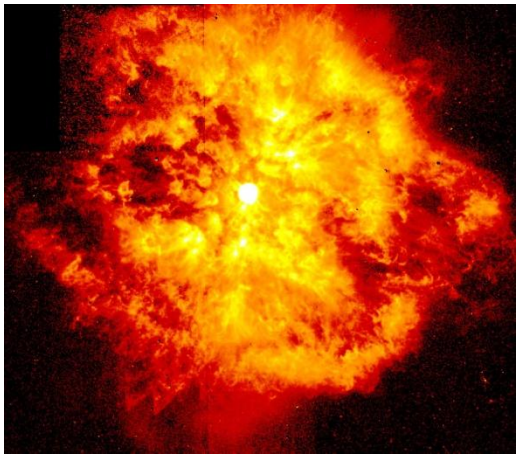
Relevant Rules & Laws:

- Washington: WAC 296-800-170
- Oregon: OR-OSHA Rules, Divisio
- Idaho: ID General Safety & Health Standard 301
- Everywhere: US Federal OSHA 1910.1200

Safety

Dust Hazards:

- Powdered chemicals
  - Severe inhalation hazard (fluoride, etc). Use crystalline form.
  - Explosive (powdered activated carbon)
  - Nuisance and mess



- Dust Control Tools
  - Ventilators
  - Hood with vacuum Collection system
  - Bag filters on tank vents

Safety

- Safety shower/eye wash
  - Provide tepid water
- Tanks are confined space
  - Ventilation, monitoring
- Staffing
  - Avoid working alone
  - Do not work alone with “hazardous” chemicals, per non-mandatory OSHA Recommendations

    (29 CFR Part 1910.1450 Appendix A)

Efficiency

Tank Sizing and Solution Strength:

- Space constraints
- Peak dosage (# days supply?)
- Minimum dosage (degradation/shelf life)
- Volume Components:

  Appropriate re-order quantity

  + Largest available shipment

  + Head space

  = Minimum volume

Efficiency

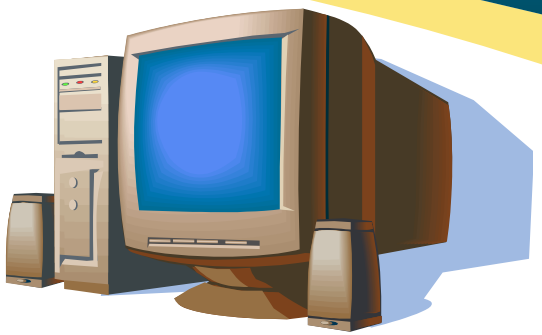
Controls & Analysis – Control Feedback Loops!

- Minimize lag time between injection and sampling
- Sample and injector locations
  - First consider regulatory requirements
  - Allow adequate mixing before sample
- Sample Lines
  - Minimize piping length if possible
  - Increase velocity if needed
  - Flush sample lines if not continuous

Efficiency

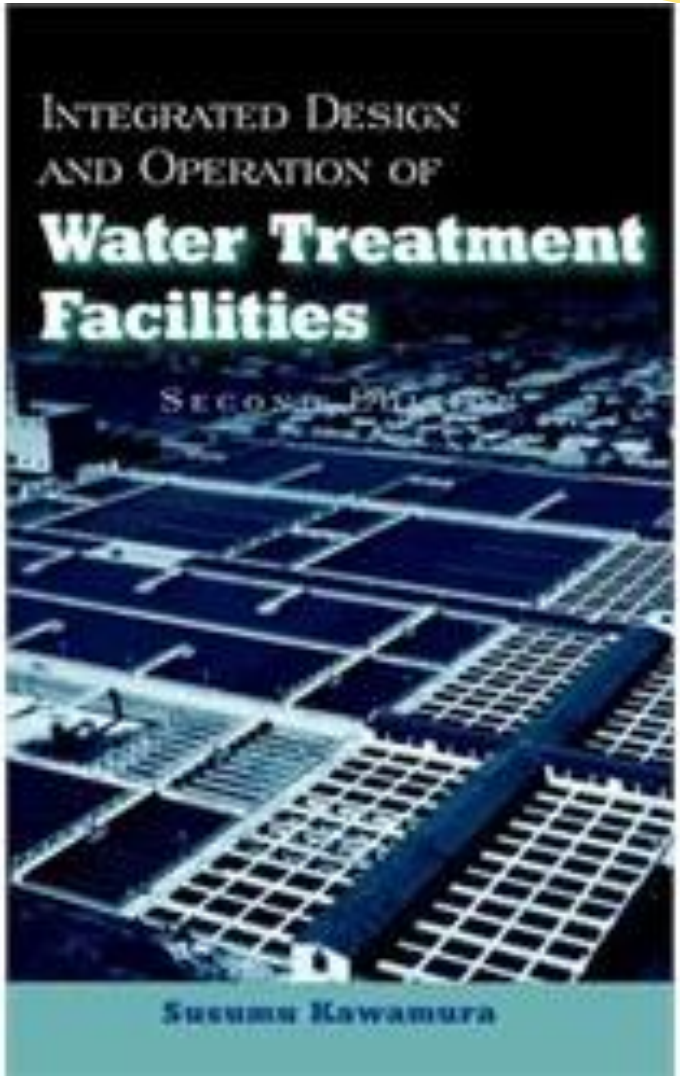
Record Keeping:

- Allows better monitoring of inventory
- Chemical feed rates can be back-checked with chemical supply used (should match)
- Monitor performance (is equipment doing what it's supposed to?)
- EPA Risk Management Program
- Valuable info for plant modifications
- It's good practice



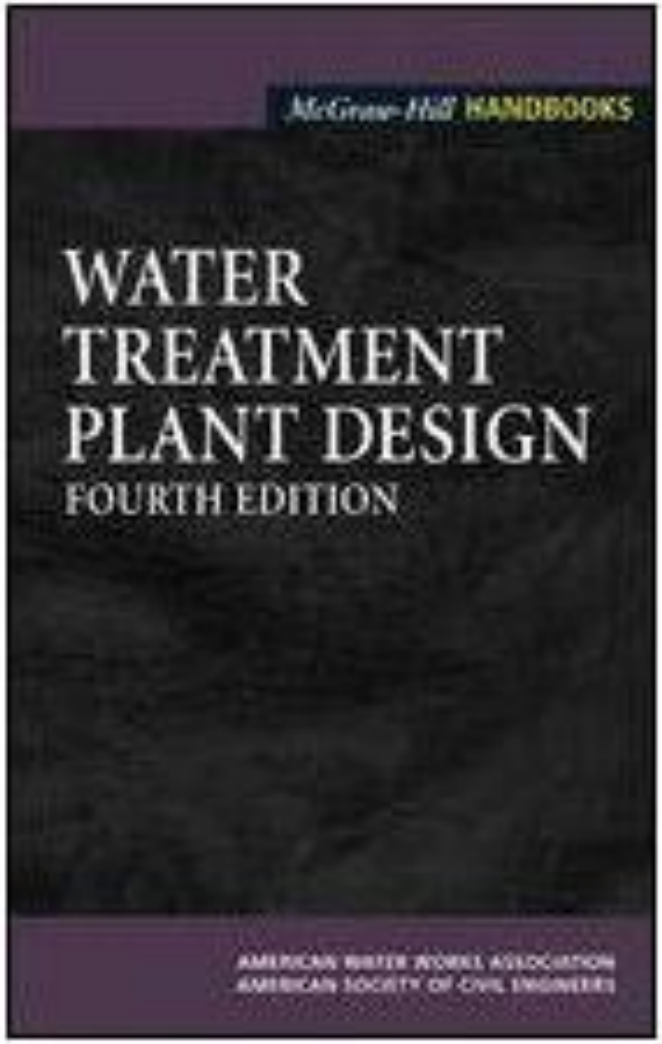
Reference

- Susumu Kawamura, *Integrated Design and Operation of Water Treatment Facilities*, 2nd Ed., John Wiley & Sons, Inc., 2000.



Reference

- AWWA/ASCE, *Water Treatment Plant Design*, 4th Ed., McGraw-Hill Handbooks.
- Chapter 15 by Jerry Anderson, P.E.



Questions?