### UNITS AND CONVERSION FACTORS

- 1 cubic foot of water weighs 62.3832 lb
- 1 gallon of water weighs 8.34 lb
- 1 liter of water weighs 1,000 gm
- 1 mg/L = 1 part per million (ppm)
- 1% = 10,000 ppm
- ft² = square feet and ft³ = cubic feet
- 1 mile = 5,280 feet (ft)
- 1 yd³ = 27 ft³ and 1 yard = 3 feet
- 1 acre (a) = 43,560 square feet (ft²)
- 1 acre foot = 325,851 gallons
- 1 cubic foot (ft³) = 7.48 gallons (gal)
- 1 gal = 3.785 liters (L)
- 1 L = 1,000 milliliters (ml)
- 1 pound (lb) = 454 grams (gm)
- 1 lb = 7,000 grains (gr)
- 1 grain per gallon (gpg) = 17.1 mg/L
- 1 gm = 1,000 milligrams (mg)
- 1 day = 24 hr = 1,440 min = 86,400 sec
- 1,000,000 gal/day = 86,400 sec/day = 7.48 gal/cu ft
- 1 = 1.55 cu ft/sec/MGD

### CHLORINATION

- Dosage, mg/l = (Demand, mg/l) + (Residual, mg/l)

  (Gas) lbs = Vol, MG x ppm or mg/L x 8.34 lbs/gal

  HTH Solid (lbs) = (Vol, MG) x (ppm or mg/L) x 8.34 lbs/gal

  (% Strength / 100)

  Liquid (gal) = (Vol, MG) x (ppm or mg/L) x 8.34 lbs/gal

  (% Strength / 100) x Chemical Wt. (lbs/gal)

### PRESSURE

- PSI = (Head, ft.)
- PSI = Head, ft. x 0.433 PSI/ft
- 2.31 ft²/lbf

- lbs Force = (0.785) (D, ft.²) x 144 in²/ft² x PSI.

### VOLUME

- Rectangular Basin, Volume, gal = (Length, ft) x (Width, ft) x (Height, ft) x 7.48 gal/cu ft

- Cylinder, Volume, gal = (0.785) x (Dia, ft)² x (Height, Depth, or Length in ft) x 7.48 gal/ft²

- Time, Hrs. = (Pumping Rate, GPM) x 60 Min/Hr

- Supply, Hrs. = Storage Volume, Gals

  (Flow In, GPM - Flow Out, GPM) x 60 Min/Hr

### SOLUTIONS

- Lbs/Gal = (Solution %) x 8.34 lbs/gal x Specific Gravity

- Lbs Chemical = Specific Gravity x 8.34 lbs/gal x Solution(gal)

- Specific Gravity = Chemical Wt. (lbs/gal)

  8.34 (lbs/gal)

- % of Chemical in Solution = (Dry Chemical, lbs) x 100

  (Dry Wt. Chemical, lbs) + (Water, lbs)

### GPD

- (MGD) x (ppm or mg/L) x 8.34 lbs/gal

- (% purity) x Chemical Wt. (lbs/gal)

- GPD = (Feed, ml/min x 1,440 min/day)

  (1,000 ml/L x 3.785 L/gal)

### Two-Normal Equations:

a) \( C_1V_1 = C_2V_2 \quad Q_1 = Q_2 \quad \frac{V_1}{V_2} = \frac{Q_2}{Q_1} \)

b) \( C_1V_1 + C_2V_2 = C_3V_3 \)

- C = Concentration
- V = Volume
- Q = Flow

### PUMPING

1 horsepower (Hp) = 746 watts = 0.746 kw = 3,960 gal/min/ft

- Water Hp = (GPM) x (Total Head, ft)

  (3,960 gal/min/ft)

- Brake Hp = (GPM) x (Total Head, ft)

  (3,960) x (Pump % Efficiency)

- Motor Hp = (GPM) x (Total Head, ft)

  (3,960) x Pump % Eff. x Motor % Eff.

"Wire-to-Water" Efficiency

\( \frac{\text{Motor, % Efficiency} \times \text{Pump % Efficiency}}{\text{Operating Hrs.}} \times \text{cents/Kw-Hr} \)

### Flow, velocity, area

- Q = A x V

- Quantity = Area x Velocity

- Flow (ft³/sec) = Area (ft²) x Velocity (ft/sec)

- \( \text{MGD} \times 1.55 \text{ cu ft/sec/MGD} = \frac{\text{cu ft/sec}}{\text{ft/sec}} \times 0.785 \text{ x pipe diameter ft x pipe diameter ft} = \text{ sq ft} \)

### General

- ($/Cost/day = lbs/day x ($) Cost/lb

- Removal, Percent = (In - Out) x 100

- In

- Specific Capacity, GPM/ft = Well Yield, GPM

- Drawdown, ft.

- Gals/Day = (Population) x (Gals/Capita/Day)

- GPD = (Motor Read 2 - Motor Read 1)

- (Number of Days)

- Volume, Gals = GPM x Time, minutes

- SCADA = 4 mA to 20 mA analog signal

  (L vivo signal mA - 4 mA offset) x process unit and range

  (16 mA span)

- 4 mA = 0 20 mA full-range
### FILTRATION

**Filtration Rate (GPM/sq.ft)** = \( \frac{\text{Filter Production (gallons per day)}}{\text{sq. ft. = square feet (Filter area sq. ft.)}} \times (1,440 \text{ min/day}) \)

**Loading Rate (GPM/ sq. ft.)** = \( \frac{\text{Flow Rate, GPM}}{\text{Filter Area, sq. ft.}} \)

**Daily Filter Production (GPD)** = \( \text{Filter Area, sq. ft.} \times (\text{GPM/sq. ft.} \times 1,440 \text{ min/day}) \)

**Backwash Pumping Rate (GPM)** = \( \text{Filter Area, sq. ft.} \times (\text{Backwash Rate, GPM/sq. ft.}) \)

**Backwash Volume (Gallons)** = \( \frac{(\text{Filter Area, sq. ft.}) \times (\text{Backwash Rate, GPM/sq. ft.}) \times (\text{Time, min})}{7.48 \text{ gal/cu.ft.}} \)

**Backwash Rate, GPM/ sq. ft.** = \( \frac{(\text{Backwash Volume, gallons})}{(\text{Filter Area, sq. ft.}) \times (\text{Time, min})} \)

**Rate of Rise (inches per min.)** = \( \frac{(\text{Backwash Rate gpm/sq.ft.}) \times 12 \text{ inches /ft}}{7.48 \text{ gal/cu.ft.}} \)

**Unit Filter Run Volume, (UFRV)** = \( \frac{(\text{gallons produced in a filter run})}{\text{Filter Area sq. ft.}} \)

### CHEMICAL DOSAGE CALCULATIONS

*Note: (% purity) and (% commercial purity) used in decimal form*

**Lbs/day gas feed dry** = \( \text{MGD} \times (\text{ppm or mg/L}) \times 8.34 \text{ lbs/gal} \)

**Lbs/day** = \( \frac{\text{MGD} \times (\text{ppm or mg/L}) \times 8.34 \text{ lbs/gal}}{\% \text{ purity}} \)

**GPD** = \( \frac{\text{MGD} \times (\text{ppm or mg/L}) \times 8.34 \text{ lbs/gal}}{\% \text{ purity} \times \text{lbs/gal}} \)

**GPD** = \( \frac{\text{MGD} \times (\text{commercial purity} \%)}{\times (\text{ion purity} \%) \times (\text{lbs/gal})} \)

**ppm or mg/l** = \( \frac{\text{lbs/day}}{\text{MGD} \times 8.34 \text{ lbs/gal}} \) or \( \frac{\text{gallons x % purity x lbs/gal}}{\text{MG} \times 8.34 \text{ lbs/gal}} \)

### C•T CALCULATIONS

\[ \text{C•t} = \frac{\text{Chlorine Residual, mg/L} \times \text{Time, minutes}}{\text{(Chlorine Residual, mg/L)}} \]

\[ \text{Time, minutes} = \frac{\text{C•t}}{\text{(Chlorine Residual, mg/L)}} \]

\[ \text{Chlorine Residual (mg/L)} = \frac{\text{(C•t)}}{\text{(Time, minutes)}} \]

\[ \text{Inactivation Ratio} = \frac{\text{(Actual System C•t)}}{\text{(Table "E" C•t)}} \]

\[ \text{C•t Calculated} = \frac{T_{10} \text{ Value, minutes} \times \text{Chlorine Residual, mg/L}}{1.0 - \% \text{ Removal} \times \log \text{key} \times (-1)} \]

\[ \text{Log Removal} = \frac{1.0 - \% \text{ Removal}}{100} \times \log \text{key} \times (-1) \]

### SEDIMENTATION

**Surface Loading Rate, (GPD/ sq. ft.)** = \( \frac{(\text{Total Flow, GPD})}{\text{(Surface Area, sq.ft.)}} \)

**Detention Time** = \( \frac{\text{Volume}}{\text{flow}} \)

**Detention Time hours** = \( \frac{\text{volume (cu ft) \times 7.48 gal/cu ft \times 24 hr/day}}{\text{Gal/day}} \)

**Flow Rate** = \( \frac{\text{Volume}}{\text{Time}} \)

**Weir Overflow Rate, GPD/L.F.** = \( \frac{(\text{Flow, GPD})}{\text{(Weir length, ft.)}} \)