SUMMARY OF KEY DISTRIBUTION OPERATOR MATH FORMULAS

GENERAL

1. Lbs/Day = (Vol, MGD) x (Dosage, mg/l) x 8.34 lbs/gal)

2. Removal, Percent = $\frac{(\text{In} - \text{Out}) \times 100}{\text{In}}$

VOLUMES

3. Rectangular Basin Volume, gal =
(Length, ft) x (Width, ft) x (Height, ft) x7.48 gal/cu.ft.

4. Right Cylinder =
(0.785) x (D^2, ft) x (Height, Length, or Depth,in ft.) x 7.48 gals/cu.ft

5. Trapezoid, Volume cu.ft. = $\frac{(B_1 + B_2)}{2}$ x Height, ft x Length, ft x 7.48 gals/cu.ft

6. Gals / Day = (Population) x (Gals/Capita/Day)

7. GPD = $\frac{\text{(Meter Read 2, Gals - Meter Read 1, Gals)}}{\text{(Number of Days)}}$

8. Time, Hrs. = $\frac{\text{(Volume, gallons)}}{\text{(Pumping Rate, GPM, x 60 Min/Hr)}}$

9. Supply, Hrs. (Full to Tank Dry) = $\frac{\text{(Storage Volume, Gals)}}{\text{(Flow In, GPM – Flow Out, GPM) x 60 min/hr.)}}$

CHLORINATION

10. Gas Feed, Lbs/Day =
(Vol, MGD) x (Dosage, mgl) x (8.34 lbs/gal)

11. Dosage, mg/l = $\frac{\text{(Feed, lbs/day)}}{\text{(Vol, MGD) x 8.34 lbs/gal)}}$

12. Dosage, mg/l = (Demand, mg/l) + (Residual, mg/l)

13. HTH, lbs/Day = $\frac{\text{(Vol, MGD) x (Dosage, mg/l) x (8.34 lbs/gal)}}{\text{(0.65)}}$

14. GPD = $\frac{\text{(Vol, MGD) x (Dosage, mg/l) x (8.34 lbs/gal)}}{\frac{\%}{100} \text{ x 8.34 lbs/gal x S.G}}$

SOLUTIONS

15. Lbs/Gal = $\frac{\text{(Solution Percentage)}}{100}$ x 8.34 lbs/gal x S.G.

16. Lbs Chemical =
Specific Gravity x 8.34 lbs/gallons x Gallons of Solution

17. Specific Gravity = $\frac{\text{(8.34 lbs/gallon + Chemical Wt. Lbs/gallon)}}{\text{(8.34 lbs/gallon)}}$

18. Specific Gravity Lbs/gallon = (S.G. x 8.34 lbs/gal) – (8.34 lbs/gal)

19. %Percent of Chemical in Solution = $\frac{\text{(Dry Chemical, Lbs)}}{\text{(Dry Wt. Chemical, Lbs) + (Water, Lbs)}}$ x 100

20. Two – Normal Equations:
a) $C_1V_1 = C_2V_2$ b) $\frac{Q_1}{V_1} = \frac{Q_2}{V_2}$

21. Three Normal Equations:
a) $(C_1V_1) + (C_2V_2) = (C_3V_3)$

22. GPD = $\frac{\text{(Vol, MGD) x (Conc., mg/l) x (8.34 lb/gal)}}{\text{(\% x 8.34 lbs/gal x S.G. Lbs/gal)}}$ / 100

23. GPD = $\frac{\text{(Feed, ml/min. x 1,440 min/day)}}{\text{(1,000 ml/L x 3.785 L/Gal)}}$

24. ml/min = $\frac{\text{(GPD x 1,000 ml/L x 3.785 L/Gal)}}{\text{(1,440 min/day)}}$

PRESSURE

25. PSI = $\frac{\text{(Head, ft.)}}{\text{1.31Ft./psi}}$

26. PSI = Head, ft. x 0. 433 PSI/ft.

27. lbs Force = (0.785) (D, ft.)^2 x 144 sq.in/sq.ft. x PSI.

SCADA

28. Ft. Water =
$\frac{\text{(Process Variable, mA - 4.0 mA)}}{\text{(20 mA - 4.0 mA)}}$ x Tank Height, ft.
Live Signal

PUMPING

28. Volume, Gals = GPM x Time, minutes

30. Water Horsepower = $\frac{\text{(GPM) x (Total Head, ft)}}{\text{(3,960)}}$

31. Brake Horsepower = $\frac{\text{(GPM) x (Total Head, ft)}}{\text{(3,960) x (\% Efficiency)}}$

32. % Overall Effic. (Pump/Motor) =(Motor, % Effic. x Pump % Effic.)

33. Cost, $ =
(BHp) x (0.746 Kw/Hp) x (Operating Hrs.) x $\frac{¢/\text{Kw-Hr}}{100}$

34. Drawdown, ft. = Pumping Level, ft. - Static Level, ft.

35. Specific Capacity, GPM/ft. = $\frac{\text{Well Yield, GPM}}{\text{Drawdown, ft.}}$

VELOCITY

36. Q, cfs = (Area, sq. ft.) x (Velocity, fps)
$\frac{\text{(GPM)}}{\text{(448.8 GPM/cfs)}}$ = (0.785) x (D, ft)^2 x $\frac{\text{(Distance, ft)}}{\text{(Time, seconds)}}$

37. Velocity. fps = $\frac{\text{(Q, cfs)}}{\text{(Area, sq. ft.)}}$

COST

38. ($) Cost / day = Lbs/day x ($) Cost/lb

39. ($) Cost per day = Lbs / day Used x $\frac{\text{(\$) Cost per Ton}}{\text{2,000 lbs/Ton}}$

40. Temperature:
F° = (C° x 1.8) + 32°
C° = $\frac{(F° - 32°)}{(1.8)}$

41. Langelier Index = (pH - pH, Saturated)

ADDITIONAL KEY WATER PLANT OPERATOR MATH FORMULAS

FILTRATION

42. Filtration Rate, GPM = (Filter Area, sq.ft.) x (GPM/sq.ft. Loading Rate)

43. Loading Rate, GPM/sq.ft. = (Flow Rate, GPM) / (Filter Area, sq.ft.)

44. Filtration Rate Rate, GPD = (Filter Area, sq.ft.) x (GPM/sq.ft.) x 1,440 min/day

45. Backwash Pumping Rate, GPM = (Filter Area, sq.ft.) x (Backwash Rate, GPM/sq.ft.) (15 - 17)

46. Backwash Volume, Gallons = (Filter Area, sq.ft.) x (Backwash Rate, gpm/sq.ft.) x (Time, min).

47. Backwash Rate, GPM/sq.ft. = (Backwash Volume, gpm) / (Filter Area, sq.ft.)

48. Backwash, GPM = (Filter Area, sq.ft.) x (Height, Rise/Fall/Drop, ft/min) x (7.48 gals/cu.ft.)

49. Rate of Rise, GPM/Sq. Ft. = (Height, Rise/Fall/Drop, ft/min) x (7.48 gals/cu.ft.)

50. Rate of Rise, GPM/sq.ft. = (Time, min) x (Height, ft.) x 7.48 gals/cu.ft.

SEDIMENTATION

51. Surface Loading Rate, GPD/sq ft. = (Total Flow, GPD) / (Surface Area, sq.ft.)
Design Data: 800 - 1,200 GPD/Sq.ft.

52. Detention Time, Hrs. = (Volume, gals) x (24 Hrs./day) / (Total 24 Hr. Flow, Gals/day)
Design Data: 1 - 4 Hours; Average 2.5 Hrs.

53. Flow, GPD = (Volume, gals) x (24 Hrs./day) / (Detention Time, Hrs.)

54. Weir Overflow Rate, GPD/L.F. = (Flow, GPD) / (Weir length, ft.)
Design Data: 10,000 - 40,000 GPD/LF, Average 20,000 GPD/L.F.

C• T CALCULATIONS

55. C• t = (Chlorine Residual, mg/L) x (Time, minutes)

56. Time, minutes = (C• t) / (Chlorine Residual, mg/L)

57. Chlorine Residual, mg/L = (C• t) / (Time, minutes)

58. Inactivation Ratio = (Actual System C• t) / (Table "E" C• t)

59. C• t Calculated = T_{10} Value, minutes x Chlorine Residual, mg/L

60. Log Removal = [(1.0 - % Removal) / 100] x Log key x (-)

FLUORIDATION

61. Feed, Lbs/day = (MGD) x [(mg/L) / ((% Purity / 100) x (% Fluoride / 100))] x 8.34 lbs/gallon x S.G.

62. Adjusted Feed, Lbs/day = (MGD) x [(Desired mg/L - Existing mg/L) / ((% Purity / 100) x (% Fluoride / 100))] x 8.34 lbs/gallon x S.G.

63. Dosage, mg/L = (Feed, Lbs/day x (% Purity / 100) x (% Fluoride / 100)) / (MGD x 8.34 lbs/gallon x S.G.)

28. Feed, GPD = (MGD) x [(mg/L) / ((% Purity / 100) x (% Fluoride / 100))] / (% Solution / 100 x 8.34 lbs/gallon x S.G.)

CONVERSION FACTORS

Measurement	
62.4 Lbs/cu.ft.	5,280 Ft./Mile
7.48 gallons/cu.ft.	12 inches / foot
8.34 Lbs/gallon	27 Cu.ft. / Cu. Yard
1,000 mg/Gram	2,000 Lbs/ton
1,000 ml/Liter	
1,000 ug/L / mg/L	2.31 Ft/PSI
3.785 L/gallon	0.746 Kw/BHP
3,785 ml/Gallon	0.433 PSI / Head foot
43,560 sq.ft. / Acre	
325,828 gallons / Ac-ft.	
3.07 Ac.ft./MGD	
	454 grams/Lb
	17.1 mg/L/Grain per gal.
448.8 GPM/CFS	
1.55 CFS / MGD	
694.4 GPM / MGD	
60 seconds/minute	60 minutes/ Hour
1,440 minutes/Day	24 Hours / day
7 Days / week	30 Days / month
365 Days / year	