



General Terminology related to COOLING WATER:

1. Hold up of system- $H \text{ m}^3$ (Basin + Pipeline + System)
2. ReCirculation rate- $R \text{ m}^3/\text{hr}$
3. Cycle of concentration- $C = \frac{\text{Cl/Si/Mg-H in circulating water in ppm}}{\text{Cl/Si/Mg-H in make up water in ppm}}$
4. Temperature diff - $\Delta T \text{ }^\circ\text{C}$
5. Evaporation rate- $E = \frac{R * \Delta T}{653} = \text{m}^3/\text{hr}$
6. Drift loss- $D = (0.3\% \text{ of } R)$
7. Blow down- $B = \frac{E - D}{(C-1)}$
8. Make up $M = E + D + B. = \text{m}^3/\text{day}$
9. H.T.I. $= \frac{0.693 * \text{Hold up}}{\text{Bleed off}} = (\text{days})$

Indices

Langelier index = pH – pHs

Where pH= Actual pH of water

pHs= Saturation pH

$$\text{pHs} = 9.3 + A + B - (C + D)$$

The value of A, B, C and D is taken from the table given in the next page.



TABLE for A, B, C and D

Total Solids	A	Calcium Hardness (ppm as CaCO ₃)		C	M.O. Alkalinity (ppm as CaCO ₃)		D
50-300	0.1	10	11	0.6	10	11	1.0
		12	13	0.7	11	13	1.1
400-1000	0.2	14	17	0.8	14	17	1.2
		18	22	0.9	18	22	1.3
		23	27	1.0	23	27	1.4
		28	34	1.1	27	35	1.5
Temperature °F	B	35	43	1.2	36	44	1.6
		44	55	1.3	45	55	1.7
		56	69	1.4	56	69	1.8
		70	87	1.5	70	88	1.9
		88	110	1.6	89	110	2.0
		111	138	1.7	111	139	2.1
		139	174	1.8	140	176	2.2
		175	220	1.9	176	200	2.3
		221	270	2.0	230	270	2.4
		280	340	2.1	280	350	2.5
		350	430	2.2	360	440	2.6
		440	550	2.3	450	550	2.7
		560	690	2.4	560	690	2.8
		700	870	2.5	700	880	2.9
		800	1000	2.6	890	1000	3.0
		148	160	1.3			
162	178	1.2					

1. Obtain Values of A, B, C and D
2. pHs = (9.3 + A + B) - (C + D)
3. Saturation index = pH - pHs



TABLE

Prediction of Water Characteristics by the Langelier Index

L.S.I	Tendency of Water
+2-0	Scale-forming and for practical purposes non corrosive
+0.5	Slightly scaling and non corrosive
0.0	Balanced but pitting corrosion possible
-0.5	Slightly corrosive and non scale-forming
-2.0	Highly corrosive

Ryznar Stability Index

Ryznar Stability Index (RSI) = $2pH_s - pH$

Where pH = Actual pH of water

pH_s = Saturation pH

The predictive nature of the Ryznar Index is shown in the Table below:

Prediction of Water Characteristics by the Ryznar Index

Ryznar Stability Index	Tendency of Water
4.0 - 5.0	Heavy Scale
5.0 - 6.0	Light Scale
6.0 - 7.0	Little Scale or Corrosion
7.0 - 7.5	Corrosion Significant
7.5 - 9.0	Heavy Corrosion
9.0 and Higher	Corrosion Intolerable



In the recent trend, some limitation of the above indices produces dilemma to determine exact tendency of water. To overcome the limitations of the above indices, Puckarious indice is introduced for the same.

Puckarious equation: P.S.I.

$$\text{pH eqb} = 1.465 \log \text{M. alkalinity} + 4.54$$

Where pH eqb is the equilibrium pH

$$\text{PSI} = 2\text{pHs} - \text{pHeq.}$$

PSI is greater than 6, the water has tendency to dissolve scale and PSI is lesser than 6, the water has scale forming tendency.

Acid Requirement calculation:

$$\text{H}_2\text{SO}_4 = \frac{0.83 \times \text{M/W (m}^3/\text{day)} \times [\text{M-Alk. in M/W} - (\text{Desired Alk /CoC})]}{1000}$$

= Kg/day.

It is the quantity of acid to be dosed in the cooling water sump to maintain the desired pH range.

Where:

M/W = Make up Water quantity per day

M - Alk = M. Alkalinity in make up water

Desired Alk = Desired alkalinity to be maintained in circulating water