

## 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- $C = \frac{\text{Cl/Si/Mg-H in circulating water in ppm}}{\text{Cl/Si/Mg-H in makeup water in ppm}}$
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.  $= \frac{0.693 \times \text{Hold up}}{\text{Bleed off}} = (\text{days})$

### 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.

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TABLE for A, B, C and D

Total Solids	A	Calcium Hardness (ppm as CaCO <sub>3</sub> )		C	M.O. Alkalinity (ppm as CaCO <sub>3</sub> )		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
Temperature °F	B	28	34	1.1	27	35	1.5
		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

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## 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<sub>s</sub> = 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

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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.**

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

Desired Alk = Desired alkalinity to be maintained in circulating water

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