RYZNAR	Lang Sat Ind	pH	Alk	Ca	TCa	°C	Cond	TDS
Err:502	Err:502	7.2	190	180	72	45	600	300
					coc	1		
	Enter System Parameters Here							
				as				
				CaCO3				
RYZNAR	Lang Sat Ind	pH	Alk	Ca	TCa	°C	Cond	TDS
Err:502	Err:502	8.6	380	360	144	45	1200	600
					coc	2		
	Enter System Parameters Here							
				as				
				CaCO3				
RYZNAR	Lang Sat Ind	pH	Alk	Ca	TCa	°C	Cond	TDS
Err:502	Err:502	9	570	540	216	45	1800	900
					coc	3		
	Enter System Parameters Here							
				as				
				CaCO3				
RYZNAR	Lang Sat Ind	pH	Alk	Ca	TCa	°C	Cond	TDS
#N/A	#N/A	9.2	760	720	288	45	2400	1200
					coc	4		
	Enter System Parameters Here							
				as				
				CaCO3				
RYZNAR	Lang Sat Ind	pH	Alk	Ca	TCa	°C	Cond	TDS
#N/A	#N/A	9.4	950	900	360	45	3000	1500
					coc	5		
	Enter System Parameters Here							
				as				
				CaCO3				
RYZNAR	Lang Sat Ind	pH	Alk	Ca	TCa	°C	Cond	TDS
Err:502	Err:502	9.5	1140	1080	432	45	3600	1800
					coc	6		
	Enter System Parameters Here							

				as				
				CaCO3				
RYZNAR	Lang Sat Ind	pH	Alk	Ca	TCa	°C	Cond	TDS
Err:502	Err:502	9.6	1330	1260	504	45	4200	2100
					coc	7		
	Enter System Parameters Here							
				as				
				CaCO3				
RYZNAR	Lang Sat Ind	pH	Alk	Ca	TCa	°C	Cond	TDS
Err:502	Err:502	9.8	1520	1440	576	45	4800	2400
					coc	8		
	Enter System Parameters Here							
				as				
				CaCO3				
RYZNAR	Lang Sat Ind	pH	Alk	Ca	TCa	°C	Cond	TDS
1.0	4.4	9.9	1710	1620	648	45	5400	2700
					coc	9		
	Enter System Parameters Here							
				as				
				CaCO3				
RYZNAR	Lang Sat Ind	pH	Alk	Ca	TCa	°C	Cond	TDS
6455.4	-3222.7	10	1900	1800	720	45	6000	3000
					coc	10		

pHs			Spreadsheet for the calculation of Ryznar & Langellier I								
Err:502											
			Input the data below:								
			Parameter		**Value**	FILL IN					
Required p			Total Solids:		300	ppm as total solids					
to giv			Temperature:		45	oC					
pHs			Calcium Hardness		20	ppm as CaCO3					
Err:502			Methyl Alkalinity:		6	ppm as CaCO3					
			pH		6.5						
			CLICK BELOW								
			Calculed Data:								
Required p			pHs	Saturation pH:			#N/A				
to giv			L	Langellier Index:			#N/A	Positive = scaling, Negative = co			
pHs			R	Ryznar Index:			#N/A	Less than 6 = scaling, Greater th			
Err:502											
			Calculation Details:								
			Langelier Index (L) = pH - pHs								
			where:								
Required p			pHs = 9.3 + A + B - C - D								
to giv											
pHs									Value	Function	
#N/A			A	Function of TOTAL SOLIDS					300	#N/A	
			B	Function of TEMPERATURE					45	1.6	
			C	Function of CALCIUM HARDNESS					20	0.9	
			D	Function of ALKALINITY TO METHYL OR					6	#N/A	
Required p				pH					6.5		
to giv				**Saturati**	**pHs**					**#N/A**	
pHs			L	**Langelli**	**L**					**#N/A**	
#N/A			**R**	**Ryznar Index:**						**#N/A**	
			TDS Total Solids ppm	Factor A		Water Temperature °C	Factor B		Calcium Hardness ppm CaCO3	Factor C	
			500	0.1		0	2.6		10	0.6	
Required p			4000	0.2		2	2.5		12	0.7	
to giv						7	2.4		14	0.8	
pHs						10	2.3		18	0.9	
Err:502						14	2.2		23	1	
						18	2.1		29	1.1	
						22	2.0		35	1.2	
						28	1.9		44	1.3	

Required p						32	1.8		56	1.4
to giv						38	1.7		70	1.5
pHs						44	1.6		88	1.6
Err:502						51	1.5		111	1.7
						57	1.4		139	1.8
						64	1.3		175	1.9
						72	1.2		230	2.0
Required p									280	2.1
to giv									350	2.2
pHs									440	2.3
Err:502									560	2.4
									700	2.5
									880	2.6
Required p							END			
to giv										
pHs										
5.4695993										
			Enter System Parameters Here							
Required p							as			
to giv							CaCO3			
pHs			RYZNAR	ang Sat Ind	pH	Alk	Ca	TCa	°C	Cond
3232.7064			6.7	0.6	8	180	96	38.4	45	1410

5.8 to 6.2

rrosive

an 6 = corrosive

Negative = corrosive

Positive = scaling

	Methyl Orange Alkalinity ppm CaCO3	Factor D
	10	1.0
	12	1.1
	14	1.2
	18	1.3
	22	1.4
	29	1.5
	36	1.6
	45	1.8

	56	1.8								
	70	1.9								
	88	2.0								
	111	2.1								
	140	2.2								
	177	2.3								
	230	2.4								
	280	2.5								
	360	2.6								
	450	2.7								
	560	2.8								
	700	2.9								
	880	3.0								
	Required pH and alk		hould not be changed!							
	to give Zero LSI									
TDS	pHs	ReqpH	Req ALK	I	sqrt I	A	E	T	pKw	pK2
918	7.3676941	7.6838471	86.530505	0.02256	0.1501999	0.5309584	71.445312	318.2	13.391903	10.195596

pKs	pfm	gmolCa	pCa	gmolALK	pALK	New pHs	Req pALK	
8.6199894	0.0657421	0.00096	3.0177288	0.0036	2.4456478	0.0035953	2.7618008	1.0031868

MAKE UP WATER ANALYSIS VERSES COC VERSES WATER INDEXES INDICATI

COC RUN TABLE-1

MAKE UP	COC-1	COC-2	COC-3	COC-4	COC-5	COC-6	COC-7	COC-8	COC-9
pH	7.2	8.6	9.0	9.2	9.4	9.5	9.6	9.8	9.9
Sp.Cond.	600	1200	1800	2400	3000	3600	4200	4800	5400
TDS	300	600	900	1200	1500	1800	2100	2400	2700
P	0	30	60	90	0	0	0	0	0
M	190	380	570	760	950	1140	1330	1520	1710
TH	280	560	840	1120	1400	1680	1960	2240	2520
CaH	180	360	540	720	900	1080	1260	1440	1620
CL	54	108	162	216	270	324	378	432	486
SO4	63	126	189	252	315	378	441	504	567
SiO2	33	66	99	132	165	198	231	264	297
TEMP	45								

RESULTS TABLE-3

pHs	Err:502	Err:502	Err:502	#N/A	#N/A	Err:502	Err:502	Err:502	5.5
pHeq	7.9	8.3	8.6	8.8	8.9	9.0	9.1	9.2	9.3

INDEXES	COC-1	COC-2	COC-3	COC-4	COC-5	COC-6	COC-7	COC-8	COC-9
LSI	Err:502	Err:502	Err:502	#N/A	#N/A	Err:502	Err:502	Err:502	4.4
RSI	Err:502	Err:502	Err:502	#N/A	#N/A	Err:502	Err:502	Err:502	1.0
PSI	Err:502	Err:502	Err:502	#N/A	#N/A	Err:502	Err:502	Err:502	1.7
L&S	0.18	0.20	0.21	0.21	0.18	0.18	0.18	0.18	0.18
H2SO4									
L1S1									
H2SO4									
SI									

NOTE : L & S INDEX

0 to 0.2 is safe from corrosion

0.2 to 0.6 is moderately safe from corrosion

0.6 to 0.8 may corrode

1
2
3

			0.8 and above may lead to localise pittings and blisterings								4
											5
		FURTHER HINTS									6
		(A) RANGE <0.8 CHLORIDE & SULPHATE ARE UNLIKELY TO INTERFERE -									7
		THE NATURAL FILM PROTECTION ON CARBON STEEL.									8
		(B) RANGE 0.8 TO 1.2 THEY MAY SIMILARILY INERFERE AS ABOVE.									9
											10
		(C) RANGE > 1.2 HIGH RATES OF LOCALIZED CORROSION ARE LIKELY.									11
											12
		FOR ONCE THROUGH SYSTEM									13

ON		M -ALK. TABLE-2						
		pH	P	M		VARIOUS WATER INDEX I		
		7.0		35				
COC-10		7.5		50			LSI	LANGELI
10.0		7.8		100				
6000		8.0		150			RSI	RIZNER S
3000		8.3	5	200				
0		8.4	10	250			PSI	PUCKORI
1900		8.5	20	300				
2800		8.6	30	350			L & S	LARSON
1800		8.7	40	400				
540		8.8	50	450			alongwith	pH at Satur
630		9.0	60	500				
330		9.0	70	550		CALCULATED ON COC-I TO CO		
		9.1	80	600				
		9.1	90	650				
		9.2	100	700				
		9.2	110	750				
		9.3	120	800				
3232.7		9.3	130	850				
9.3		9.4	140	900				
		9.4	150	940				
COC-10		9.5	160	1000		Operational Hints		
								[1]
-3222.7								[2]
								[3]
6455.4								
								[1]
6456.1								[2]
		LSI						[3]
0.18		RSI						[4]
		PSI						
		L & S						
		(B) EXAMPLE- FOR M -ALKALINITY-500,						
		THE ANTICIPATED WOULD BE P-ALKALINITY- 60 AND pH-						
		THE INTERPRETATION OF INDEX RESULTS ARE TABULATED BE						
		LSI/RSI/PSI INDEXES						
		INTERPRETATIONS						

LSI	RSI/PSI	
3.0	3.0	
2.0	4.0	

1.0	5.0	
0.5	5.5	
0.2	5.8	
0.0	6.0	
-0.2	6.5	
-0.5	7.0	
-1.0	8.0	
-2.0	9.0	
-3.0	10.0	
REMARKS	NA	

FUNCTIONINGS ON ONE SHEET
ER SATURATION INDEX
TABILITY INDEX
US SCALING INDEX
& SKOLDS CORROSION INDEX
ation pHs and pH at eqilibrium pHeq.
OC-IO INSTANTLY.
TO FILL COOLING TOWER WATER MAXIMUM TEMP.(DEG.CENT) IN CELL D-18.(IN TABLE NO-1.
TO FILL COOLING TOWER MAKE UP WATER ANALYSIS IN CELLS D-7 TO D-16.(IN TABLE NO-1)
TO READ WATER INDEX RESULTS IN COLUMN D IN TABLE NO-3.FOR ONE COC RUN.
FOR HIGHER COC RUN SAY -2 TO 10 COC RUN, PROCEED AS GIVEN BELOW.
TO MULTIPLY M VALUE(OF ONE COC) WITH COC NUMBER TO GET MVALUE AT THAT COC RUN.
TO TAKE MULTIPLIED M VALUE AND READ CO RELATED pH AND P VALUES INTABLE NO-2.
TO TAKE THESE SPECIFIED VALUES AND FILL THEM IN ROW NO 10(Pvalue) AND pH in ROW NO-7.
TO READ WATER INDEX RESULTS IN ROWS NO-27 TO 33 IN TABLE NO-3.FOR RESPECTIVE COC RUN
9.0.
LOW IN GENERAL.
INTERPRETATIONS IN TERMS OF SCALING/CORROSION
EXTREMELY SEVERE SCALING
VERY SEVERE SCALING

SEVERE SCALING
MODERATE SCALING
SLIGHT SCALING
STABLE WATER
VERY SLIGHTLY SCALE DISSOLVING
SLIGHTLY SCALE DISSOLVING
MODERATELY SCALE DISSOLVING
STRONGLY SCALE DISSOLVING
VERY STRONGLY SCALE DISSOLVING
ACCEPTABLE RANGE-LSI=0.5 TO -0.5.

NS FOR COC-1.

by S.C.Bharadwaj.

APPLICATION AND LIMITATION
WATER) AS INDICATE

ppm P (P A	A	0		COC-1				
ppm M (To	B	250						
					Eq.Wt			
ppm Chlori	C	54			Cl	35.5		
ppm Sulpha	D	3			SO4	48		
ppm Bicarbonate		250			HCO3	61		
ppm Carbonate		500			CO3	30		
L & S IND	=	A/eq wt Cl	+	B/eq wt So4				
		C/eq wt HC	+	D/eq wt Co3				
	=							
		1.52	+	0.06				
		4.10	+	16.67				
	=	1.58						
		20.77						
L & S IND	=	0.08						
ppm P (P A	A	30		COC-2				
ppm M (To	B	250						

						Eq.Wt		
	ppm Chlori	C	108			Cl	35.5	
	ppm Sulpha	D	256			SO4	48	
	ppm Bicarbonate		190			HCO3	61	
	ppm Carbonate		440			CO3	30	
	L & S IND	=	A/eq wt Cl	+	B/eq wt So4			
			C/eq wt HC	+	D/eq wt Co3			
		=						
			3.04	+	5.33			
			3.11	+	14.67			
		=	8.38					
			17.78					
	L & S IND	=	0.47					
	ppm P (P A	A	0		COC-5			
	ppm M (To	B	250					
						Eq.Wt		
	ppm Chlori	C	270			Cl	35.5	
	ppm Sulpha	D	1015			SO4	48	
	ppm Bicarbonate		250			HCO3	61	

	ppm Carbonate		500			CO3	30	
	L & S IND	=	A/eq wt Cl	+	B/eq wt So4			
			C/eq wt HC	+	D/eq wt Co3			
		=						
			7.61	+	21.15			
			4.10	+	16.67			
		=	28.75					
			20.77					
	L & S IND	=	1.38					
	ppm P (P A	A	0		COC-8			
	ppm M (To	B	250					
						Eq.Wt		
	ppm Chlori	C	432			Cl	35.5	
	ppm Sulpha	D	1774			SO4	48	
	ppm Bicarbonate		250			HCO3	61	
	ppm Carbonate		500			CO3	30	
	L & S IND	=	A/eq wt Cl	+	B/eq wt So4			
			C/eq wt HC	+	D/eq wt Co3			
		=						
			12.17	+	36.96			
			4.10	+	16.67			

		=	49.13						
			20.77						
	L & S IND	=	2.37						

OF SULPHURIC ACID ADDTION (IN MAKE UP
) BY LARSON AND SCOLDS INDEX

TABLE-1

MAKE UP	COC-1	COC-2	COC-3	COC-4	COC-5	COC-6	COC-7	COC-8	COC-9
pH	7.2	8.6	9.0	9.2	9.4	9.5	9.6	9.8	9.9
Sp.Cond.	600	1200	1800	2400	3000	3600	4200	4800	5400
TDS	300	600	900	1200	1500	1800	2100	2400	2700
P	0	30	60	90	0	0	0	0	0
M	190	380	570	760	950	1140	1330	1520	1710
TH	280	560	840	1120	1400	1680	1960	2240	2520
CaH	180	360	540	720	900	1080	1260	1440	1620
CL	54	108	162	216	270	324	378	432	486
SO4	63	126	189	252	315	378	441	504	567
SiO2	33	66	99	132	165	198	231	264	297

formula :- Acid required -ppm=final SO4-previous SO4 c

formula SO4FINAL=M-250+SO4previous √

formula :- Acid required on make up basis ppm=on cir.ba

RESULT SHEET

MAKE UP	COC-1	COC-2	COC-3	COC-4	COC-5	COC-6	COC-7	COC-8	COC-9
P	0	30	60	90	0	0	0	0	0
M	250	250	250	250	250	250	250	250	250
CL	54	108	162	216	270	324	378	432	486
SO4	3	256	509	762	1015	1268	1521	1774	2027
H2SO4	-60	130	320	510	700	890	1080	1270	1460
H2SO4	-60	65	107	128	140	148	180	159	162
L1&S1	0.08	0.47	1.02	1.86	1.38	1.71	2.04	2.37	2.69

NOTE:- (1)ACID ADDITION IN CIRCULATION WATER SHALL BE LIMITED BY

(A) L&S <0.8 **(B) SO4 <1200 PPM**

ppm P (P A	A	60		COC-3					ppm P (P A
ppm M (Tc	B	250							ppm M (Tc

					Eq.Wt				
ppm Chlori	C	162			Cl	35.5			ppm Chlori
ppm Sulpha	D	509			SO4	48			ppm Sulpha
ppm Bicarbonate		130			HCO3	61			ppm Bicarb
ppm Carbonate		380			CO3	30			ppm Carbo
L & S IND	=	A/eq wt Cl	+	B/eq wt So4					**L & S IND**
		C/eq wt HC	+	D/eq wt Co3					
	=								
		4.56	+	10.60					
		2.13	+	12.67					
	=	15.17							
		14.80							
L & S IND	=	1.02							**L & S IND**
ppm P (P A	A	0		COC-6					ppm P (P A
ppm M (To	B	250							ppm M (To
					Eq.Wt				
ppm Chlori	C	324			Cl	35.5			ppm Chlori
ppm Sulpha	D	1268			SO4	48			ppm Sulpha
ppm Bicarbonate		250			HCO3	61			ppm Bicarb

ppm Carbonate		500			CO3	30			ppm Carbo
L & S IND	=	A/eq wt Cl	+	B/eq wt So4					L & S IND
		C/eq wt HC	+	D/eq wt Co3					
	=								
		9.13	+	26.42					
		4.10	+	16.67					
	=	35.54							
		20.77							
L & S IND	=	1.71							L & S IND
ppm P (P A	A	0		COC-9					ppm P (P A
ppm M (To	B	250							ppm M (To
					Eq.Wt				
ppm Chlori	C	486			Cl	35.5			ppm Chlori
ppm Sulpha	D	2027			SO4	48			ppm Sulpha
ppm Bicarbonate		250			HCO3	61			ppm Bicarb
ppm Carbonate		500			CO3	30			ppm Carbo
L & S IND	=	A/eq wt Cl	+	B/eq wt So4					L & S IND
		C/eq wt HC	+	D/eq wt Co3					
	=								
		13.69	+	42.23					
		4.10	+	16.67					

	=	55.92							
		20.77							
L & S IND	=	2.69							**L & S IND**

COC-10						
10.0						
6000						
3000						
0						
1900						
2800						
1800						
540						
630	previous					
330						
on circulation basis						
asis/coc						
COC-10						
0						
250						
540						
2280	final					
1650	required	ON CIRCULATION BASIS				
165	in ppm	ON MAKE UP BASIS				
3.02						
A	90		COC-4			
B	250					

				Eq.Wt		
C	216			Cl	35.5	
D	762			SO4	48	
onate	70			HCO3	61	
nate	320			CO3	30	
=	A/eq wt Cl	+	B/eq wt So4			
	C/eq wt HC	+	D/eq wt Co3			
=						
	6.08	+	15.88			
	1.15	+	10.67			
=	21.96					
	11.81					
=	1.86					

A	0		COC-7			
B	250					
				Eq.Wt		
C	378			Cl	35.5	
D	1521			SO4	48	
onate	250			HCO3	61	

nate	**500**			CO3	30	
=	A/eq wt Cl	+	B/eq wt So4			
	C/eq wt HC	+	D/eq wt Co3			
=						
	10.65	+	31.69			
	4.10	+	16.67			
=	42.34					
	20.77					
=	2.04					
A	**0**		COC-10			
B	**250**					
				Eq.Wt		
C	**540**			Cl	35.5	
D	**2280**			SO4	48	
onate	**250**			HCO3	61	
nate	**500**			CO3	30	
=	A/eq wt Cl	+	B/eq wt So4			
	C/eq wt HC	+	D/eq wt Co3			
=						
	15.21	+	47.50			
	4.10	+	16.67			

=	62.71					
	20.77					
=	3.02					

WATER INDEXES AND INTERPRETATIONS

1	LSI	RSI/PSI	INTERPRETATIONS IN TERMS OF SCALING/CORROSION
2	3.0	3.0	EXTREMELY SEVERE SCALING
3	2.0	4.0	VERY SEVERE SCALING
4	1.0	5.0	SEVERE SCALING
5	0.5	5.5	MODERATE SCALING
6	0.2	5.8	SLIGHT SCALING
7	0.0	6.0	STABLE WATER
8	-0.2	6.5	VERY SLIGHTLY SCALE DISSOLVING
9	-0.5	7.0	SLIGHTLY SCALE DISSOLVING
10	-1.0	8.0	MODERATELY SCALE DISSOLVING
11	-2.0	9.0	STRONGLY SCALE DISSOLVING
12	-3.0	10.0	VERY STRONGLY SCALE DISSOLVING
13	**REMARKS**	NA	**ACCEPTABLE RANGE-LSI=0.5 TO -0.5.**

NOTE : L & S INDEX

0 to 0.2 is safe from corrosion

0.2 to 0.6 is moderately safe from corrosion

0.6 to 0.8 may corrode

0.8 and above may lead to localise pittings and blisterings

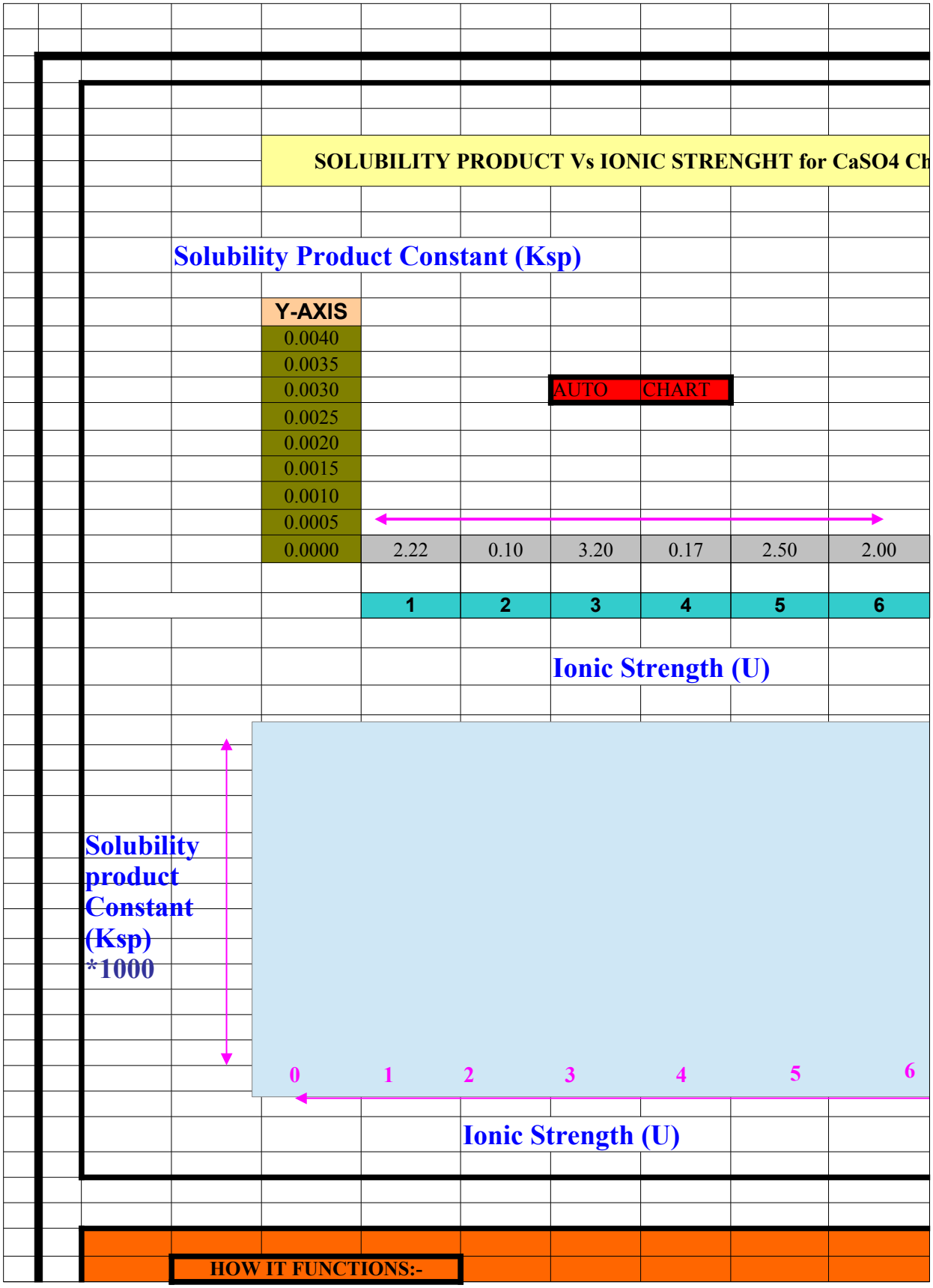
FURTHER HINTS:-

(A) RANGE <0.8 CHLORIDE & SULPHATE ARE UNLIKELY TO INTERFERE - THE NATURAL FILM PROTECTION ON CARBON STEEL.

(B) RANGE 0.8 TO 1.2 THEY MAY SIMILARILY INERFERE AS ABOVE.

(C) RANGE > 1.2 HIGH RATES OF LOCALIZED CORROSION ARE LIKELY.

FOR ONCE THROUGH SYSTEM


SOLUBILITY PRODUCT Vs IONIC STRENGHT for CaSO4 Ch
Solubility Product Constant (Ksp)
Y-AXIS
0.0040
0.0035
0.0030
0.0025
0.0020
0.0015
0.0010
0.0005
0.0000
AUTO
CHART
2.22
0.10
3.20
0.17
2.50
2.00
1
2
3
4
5
6
Ionic Strength (U)
Solubility product Constant (Ksp) *1000
0
1
2
3
4
5
6
Ionic Strength (U)
HOW IT FUNCTIONS:-

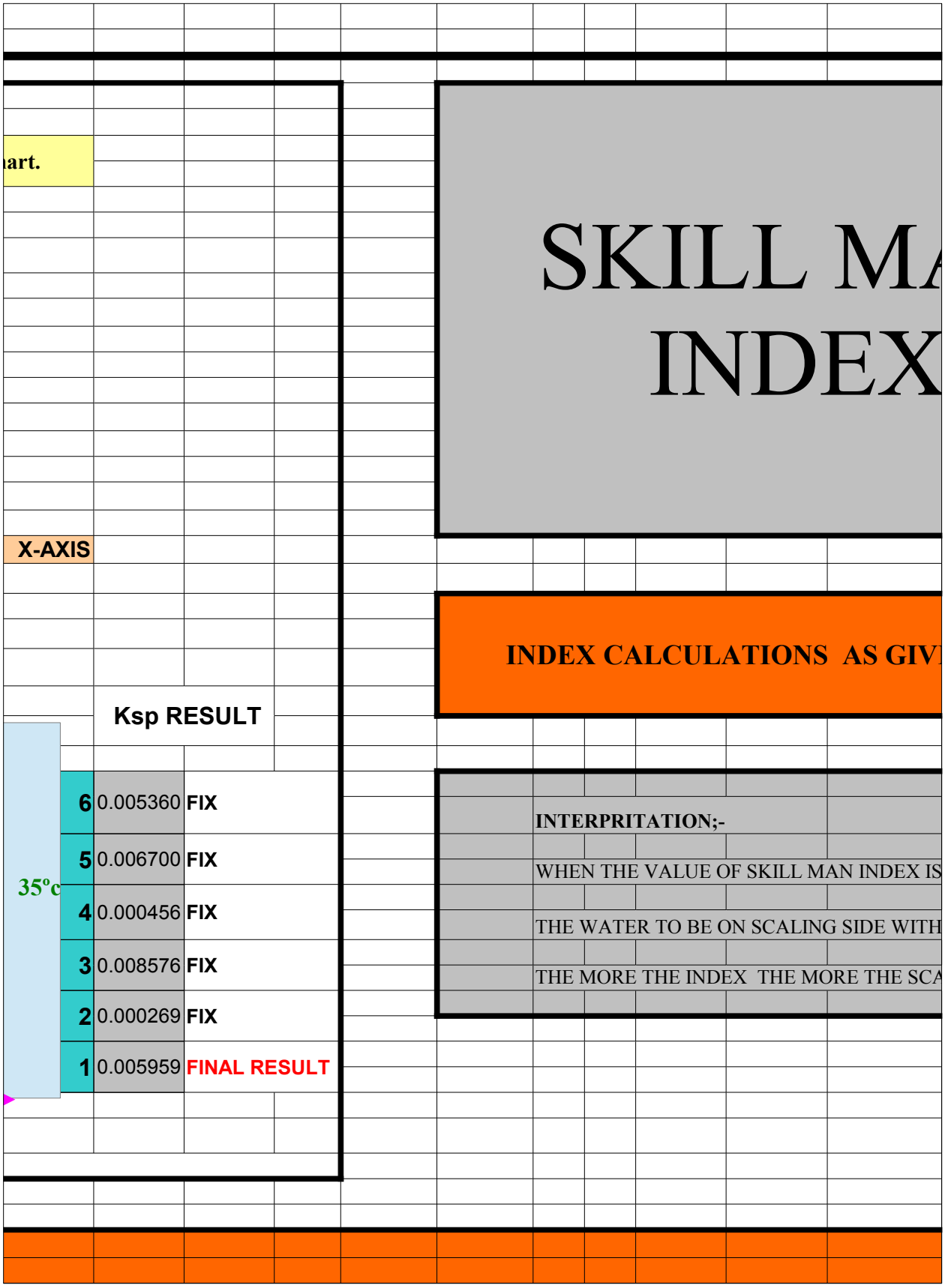
	STEP-1	-	**FILL IONIC VALUES IN COLUMN NUMBER D63 TO D71.**							
	STEP-2	-	**Incase H2SO4 addition desired, then enter additional SO4 value (a**							
	STEP-3	-	**TAKE THE POSITIVE VALUE AS DERIEVED IN CELL K80-8**							
	STEP-4	-	**FILL THE COC NUMBER IN CELL-J56 TO GET THE RESUL**							
	STEP-5	-	POSITIVE RESULT OF SO4 IN CELL K-80 OR POSIVE RESULT							
		mg/lit		FILL	asCaCO3				COC	
	MAKE UP as ions		IONIC FORM as CaCO3				TO FILL	10	IONS	
	pH			8.1						
	Sp.Cond.									
	TDS				as caco3					
	P				as caco3		P	94		
	M				as caco3		M	939		
	TH		2		as caco3					
	Ca++	10100	5	2020	as caco3	TOTAL	CaH	40400	404	
	CL^-	2835	1.4	2025	as caco3	SO4	CL	28350	1446.42857	
	$SO4^{--}$	4258.8	2.1	2028	as caco3	2028	SO4	42609	965.714286	
	$SO4^{--}$	0	2.1	0	as caco3				0	
	Mg++	1984.4	8.2	242			Mg	1984.4	29.5121951	
	SiO2	33			as caco3		Na		571.363636	
	Na+	2765.4	2.2	1257	as caco3		HCO3	81344	907.5	
	$HCO3^-$	580.8	0.8	726	as caco3		CO3	27650	212	
	CO3		3.3	0	as caco3		OH	3557.4	0	
	OH		3	0	as caco3		TOTAL	222337.4	mg/lit	
	TOTAL IONS		*1/100000					2.22		
				10040.4	/100000		ON COC BASIS			
	TOTAL IONIC STRENGTH			**0.10**	as caco3					
	SELECT	DIFFERENCE VALUE AMONG THE FOLLOWING					TWO		moles/lit.	
AS	INDICATED WITH + SIGN FOR							=		
x=	SO4	42609	*1/100000 MOLES PER LITER AS CaCO3				0.4260900		**0.022**	
	Ca	40400	*1/100000 MOLES PER LITER AS CaCO3				0.4040000			
									-0.02	
			TO FILL							
		x=	0.040400	**FILL THE " x" value manually which ever of the two is positive**						

The **"x "** in the equation is the excess common-ion concentration of the calcium and sulphate ions as calculated

NOTE- If the value of Ca is lower of the two ,it is the one that limits the solubility as CaSO4 and the same is true for SO4.

5

SKILL MAN IND


art.
SKILL MA
INDEX
X-AXIS
INDEX CALCULATIONS AS GIV
Ksp RESULT
35°c
6 0.005360 FIX
5 0.006700 FIX
4 0.000456 FIX
3 0.008576 FIX
2 0.000269 FIX
1 0.005959 FINAL RESULT
INTERPRITATION;-
WHEN THE VALUE OF SKILL MAN INDEX IS
THE WATER TO BE ON SCALING SIDE WITH
THE MORE THE INDEX THE MORE THE SCA

s calculated on make up basis) in D66 CELL

1 AND FILL IT IN CELL E84.THEN CLICK OUT SIDE TO READ SI INDEX IN THE RESULT

LTS ON COC BASIS AT THE END.

T OF Ca IN CELL K-81 SHALL GOVERN THE SKILL MAN INDEX RESULT

PLEASE FILL THE COC NUMBER

SKILL MAN INDEX = S actual(analysed) concentration of limiting ion say Ca or SO4 as meq/liter / S theoretical concentration of limiting ion say Ca or SO4 as meq/liter

S theoretical = 1000 √(x*x + 4 Ksp) - x

S actual = for Ca(D59/20) FOR SO4(

S THEORETICAL=1000	Ksp	0.005959
	x*x	0.0016322
	+	
	4 Ksp	0.02383
	=	0.0254667
	√(….)	0.1595829856
	- x	0.1191829856
	*1000	119.183
S THEORETICAL=		**119.2**

S actual concentration FOR Ca=

S actual concentration FOR SO4 =

0900

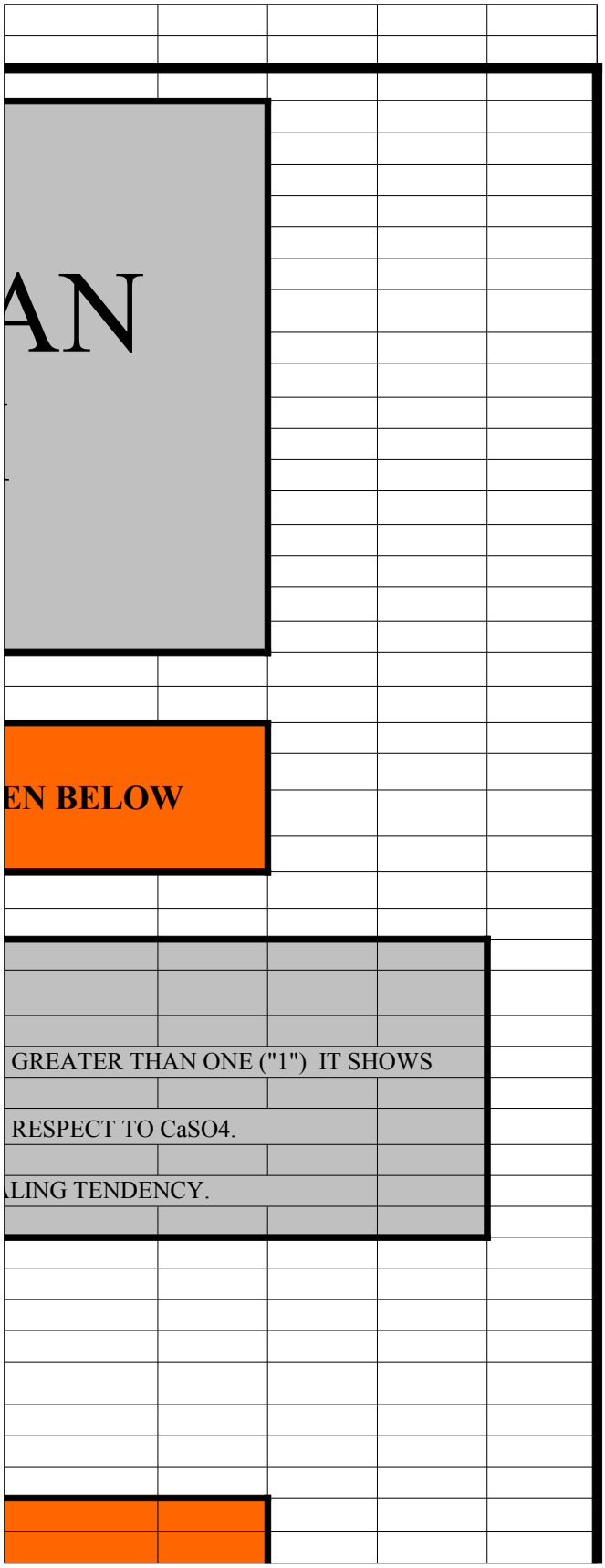
2090

S actual=	D59/20	for Ca		2020.00	=	**16.95**	**consider the result when lower than SO4 i**
S theoretical=				119.2			

EX

REASULT

	S actual=	D61/48	for SO4		887.7	=	**7.45**	**consider the result when**		
	S theoretical=				119.2			**lower than Ca ic**		
								by S.C. Bharadwaj		


AN
EN BELOW
GREATER THAN ONE ("1") IT SHOWS
RESPECT TO CaSO4.
LING TENDENCY.

F61/48)

2020.00

887.69

Ca ion concentration is
on concentration

si ready

SO4 ion concentration is ɔn concentration				
28/07/10				

	SOLUBILITY CONSTANTS			
				FIGURE*10-
	Al(OH)3		3	1
	CaCO3		3.36	1
	CaF2		3.45	1
	Ca3(PO4)2		2.07	1
	CaSO4.2H2O		3.14	1
	CaSO4		4.93	1
	Fe(PO4)2. 2H2O		9.91	1
	Fe(OH)2		4.87	1
	Fe(OH)3		2.79	1
	FeCO3		3.13	1
	Mg(OH)2		5.61	1
	COMPOUND			
			3.14	1

		SOLUBILITY OF IMPORTA			
n				Solubility Constant SQRT	
0		thirty four		1.7320508076	
1000000000		nine		1.833030278	
100000000000		eleven		1.8574175621	
10000000000000000000000000000000000		thirty three		1.438749457	
100000		five		1.7720045147	
100000		five		2.2203603311	
10000000000000000		sixteen		3.1480152477	
100000000000000000		seventeen		2.2068076491	
1000000000000000000000000000000000000000000		thirtynine		1.6703293088	
100000000000		eleven		1.7691806013	
				2.3685438565	
				0	
				0	
				0	
				0	
100000				1.7720045147	
				0	
				0	
				0	
				0	
				0	
				0	

NT COMPOUNDS		
Power Decimal Values	**Power SQRT**	**Result Solubility Constant SQRT in Decimal**
0.00	0.0000000	0.000000000000000
0.000000001	0.0000316	0.000057965506985
0.00000000001	0.0000032	0.000005873670062
0.0000000000000000000000000000000	0.0000000	0.000000000000000
0.00001	0.0031623	0.005603570290449
0.00001	0.0031623	0.007021395872617
0.0000000000000001	0.0000000	0.000000031480152
0.00000000000000001	0.0000000	0.000000006978539
0.0000000000000000000000000000000	0.0000000	0.000000000000000
0.00000000001	0.0000032	0.000005594640292
#DIV/0!	#DIV/0!	#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!
0.0000100000000000000000000000000	0.0031623	0.005603570290449
#DIV/0!	#DIV/0!	#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!

Solubility Constant in mole/ ltrs	Molecular Weight	Solubility in ppm after multiplying gm/ltr by 1000
	78	0
0.000001	100	5.7965506985
0.00000001	78	0.4581462649
0.00000000000000000000000000001	310	0.0000000000141
0.01	170	952.6069493763
0.01	136	954.9098386759
0.0000000000001	280	0.0088144427
0.00000000000001	90	0.0006280685
0.00000000000000000000000000000	107	0.0000000000000057
0.00000001	116	0.6489782739
0		0
#DIV/0!	58	#DIV/0!
#DIV/0!		#DIV/0!
#DIV/0!		#DIV/0!
#DIV/0!		#DIV/0!
#DIV/0!		#DIV/0!
0.01	170	952.6069493763
#DIV/0!		#DIV/0!
#DIV/0!		#DIV/0!
#DIV/0!		#DIV/0!
#DIV/0!		#DIV/0!
#DIV/0!		#DIV/0!
#DIV/0!		#DIV/0!

LARSON & SKOLDS INDEX CALCULATIONS

					COC	1
ppm P (P)	=	0		fill data		
ppm M (Tc	=	190		fill data		
					Eq.Wt	
ppm Chlor	**A-**	54		fill data	Cl	35.5
ppm Sulph	**B-**	63		fill data	So4	48
ppm Bicarl	**C-**	190		click here	HCo3	61
ppm Carbo	**D-**	380		click here	Co3	30
L & S IND	=	A/eq wt Cl	+	B/eq wt So4		
		C/eq wt H	+	D/eq wt Co3		
	=					
		1.52	+	1.31		
		3.11	+	12.67		
	=	2.83				
		15.78				
L & S IND	=	0.18		result		

LARSON & SKOLDS INDEX CALCULATIONS

					COC	3
ppm P (P)	=	60		fill data		
ppm M (Tc	=	570		fill data		
					Eq.Wt	
ppm Chlor	**A-**	162		fill data	Cl	35.5

	ppm Sulph	**B-**	189		fill data		So4	48		
	ppm Bicart	**C-**	**450**		click here		HCo3	61		
	ppm Carbo	**D-**	1020		click here		Co3	30		
	L & S IND	=	A/eq wt Cl	+	B/eq wt So4					
			C/eq wt H	+	D/eq wt Co3					
		=								
			4.56	+	3.94					
			7.38	+	34.00					
		=	8.50							
			41.38							
	L & S IND	=	0.21		result					

LARSON & SKOLDS INDEX CALCULATIONS

							COC	**5**		
	ppm P (P)	=	0		fill data					
	ppm M (Tc	=	950		fill data					
							Eq.Wt			
	ppm Chlor	**A-**	270		fill data		Cl	35.5		
	ppm Sulph	**B-**	315		fill data		So4	48		
	ppm Bicart	**C-**	**950**		click here		HCo3	61		
	ppm Carbo	**D-**	1900		click here		Co3	30		

	L & S IND	=	A/eq wt Cl	+	B/eq wt So4					
			C/eq wt H	+	D/eq wt Co3					
		=								
			7.61	+	6.56					
			15.57	+	63.33					
		=	14.17							
			78.91							
	L & S IND	=	0.18		result					
	LARSON & SKOLDS INDEX CALCULATIONS									
							COC	**7**		
	ppm P (P	=	0		fill data					
	ppm M (Tc	=	1330		fill data					
							Eq.Wt			
	ppm Chlor	**A-**	378		fill data		Cl	35.5		
	ppm Sulph	**B-**	441		fill data		So4	48		
	ppm Bicarl	**C-**	1330		click here		HCo3	61		
	ppm Carbo	**D-**	2660		click here		Co3	30		
	L & S IND	=	A/eq wt Cl	+	B/eq wt So4					
			C/eq wt H	+	D/eq wt Co3					
		=								
			10.65	+	9.19					
			21.80	+	88.67					
		=	19.84							
			110.47							

	L & S IND	=	0.18		result					
	LARSON & SKOLDS INDEX CALCULATIONS									
							COC	**9**		
	ppm P (P	=	0		fill data					
	ppm M (Tc	=	1710		fill data					
							Eq.Wt			
	ppm Chlor	**A-**	486		fill data		Cl	35.5		
	ppm Sulph	**B-**	567		fill data		So4	48		
	ppm Bicarl	**C-**	1710		click here		HCo3	61		
	ppm Carbo	**D-**	3420		click here		Co3	30		
	L & S IND	=	A/eq wt Cl	+	B/eq wt So4					
			C/eq wt H	+	D/eq wt Co3					
		=								
			13.69	+	11.81					
			28.03	+	114.00					
		=	25.50							
			142.03							
	L & S IND	=	0.18		result					

LARSON & SKOLDS INDEX CALCULATIONS

COC	2						COC	2
	ppm P (P	=	30		fill data			
	ppm M (Tc	=	380		fill data			
							Eq.Wt	
	ppm Chlor	A-	108		fill data		Cl	35.5
	ppm Sulph	B-	126		fill data		So4	48
	ppm Bicart	C-	320		click here		HCo3	61
	ppm Carbo	D-	700		click here		Co3	30
	L & S IND	=	A/eq wt Cl	+	B/eq wt So4			
			C/eq wt H	+	D/eq wt Co3			
		=						
			3.04	+	2.63			
			5.25	+	23.33			
		=	5.67					
			28.58					
	L & S IND	=	0.1982997		result			

LARSON & SKOLDS INDEX CALCULATIONS

COC	4						COC	4
	ppm P (P	=	90		fill data			
	ppm M (Tc	=	760		fill data			
							Eq.Wt	
	ppm Chlor	A-	216		fill data		Cl	35.5

	ppm Sulph	**B-**	252		fill data		So4	48		
	ppm Bicart	**C-**	**580**		click here		HCo3	61		
	ppm Carbo	**D-**	1340		click here		Co3	30		
	L & S IND	=	A/eq wt Cl	+	B/eq wt So4					
			C/eq wt H	+	D/eq wt Co3					
		=								
			6.08	+	5.25					
			9.51	+	44.67					
		=	11.33							
			54.17							
	L & S IND	=	0.2092208		**result**					

LARSON & SKOLDS INDEX CALCULATIONS

COC	**6**						**COC**	**6**		
	ppm P (P	=	0		fill data					
	ppm M (Tc	=	1140		fill data					
							Eq.Wt			
	ppm Chlor	**A-**	324		fill data		Cl	35.5		
	ppm Sulph	**B-**	378		fill data		So4	48		
	ppm Bicart	**C-**	**1140**		click here		HCo3	61		
	ppm Carbo	**D-**	2280		click here		Co3	30		

	L & S IND	=	A/eq wt Cl	+	B/eq wt So4					
			C/eq wt H	+	D/eq wt Co3					
		=								
			9.13	+	7.88					
			18.69	+	76.00					
		=	17.00							
			94.69							
	L & S IND	=	0.1795546		**result**					

LARSON & SKOLDS INDEX CALCULATIONS

COC	**8**						**COC**	**8**		
	ppm P (P	=	0		fill data					
	ppm M (Tc	=	1520		fill data					
							Eq.Wt			
	ppm Chlor	**A-**	432		fill data		Cl	35.5		
	ppm Sulph	**B-**	504		fill data		So4	48		
	ppm Bicarb	**C-**	**1520**		click here		HCo3	61		
	ppm Carbo	**D-**	3040		click here		Co3	30		
	L & S IND	=	A/eq wt Cl	+	B/eq wt So4					
			C/eq wt H	+	D/eq wt Co3					
		=								
			12.17	+	10.50					
			24.92	+	101.33					
		=	22.67							
			126.25							

	L & S IND	=	0.1795546		result					

LARSON & SKOLDS INDEX CALCULATIONS

COC	10						COC	10		
	ppm P (P	=	0		fill data					
	ppm M (Tc	=	1900		fill data					
							Eq.Wt			
	ppm Chlor	A-	540		fill data		Cl	35.5		
	ppm Sulph	B-	630		fill data		So4	48		
	ppm Bicart	C-	1900		click here		HCo3	61		
	ppm Carbo	D-	3800		click here		Co3	30		
	L & S IND	=	A/eq wt Cl	+	B/eq wt So4					
			C/eq wt H	+	D/eq wt Co3					
		=								
			15.21	+	13.13					
			31.15	+	126.67					
		=	28.34							
			157.81							

	L & S IND	=	0.1795546		result					

			COC	1					COC	2
	PUCKORIUS SOLUBILITY INDEX CALCULATIONS							PUCKORIUS SOLUBILITY IND		
	RI	A	=	Err:502	fill data			RI	A	=
	pH	B	=	7.2	fill data			pH	B	=
	2pHs	C	=	Err:502	click here			2pHs	C	=
	M Alkalini	D	=	190	fill data			M Alkalini	D	=
	Log 10(M)	E	=	2.2787536	click here			Log 10(M)	E	=
	pH eq		=	7.878374				pH eq		=
	Puckorius Index		=	2pHs-pH eq				Puckorius Index		=
	PSI		=	Err:502	result			PSI		=
	FORMULE:							FORMULE:		
	PSI	=	2pHs-pH eq					PSI	=	2pHs-pH e
	pH eq	=	1.465*log10(M)+4.54					pH eq	=	1.465*log1
	NOTE :							NOTE :		
	THE RESULTS OF PSI ARE TOBE SEEN ON THE TABLE OF RSI							THE RESULTS OF PSI ARE TO		
	PUCKORIUS SOLUBILITY INDEX CALCULATIONS								PUCKORIUS SOLUE	
		COC	5							COC
	RI	A	=	#N/A	fill data				RI	A
	pH	B	=	9.4	fill data				pH	B

	2pHs	C	=	#N/A	click here				2pHs	C
	M Alkalini	D	=	950	fill data				M Alkalini	D
	Log 10(M)	E	=	2.9777236	click here				Log 10(M)	E
	pH eq		=	8.9023651					pH eq	
	Puckorius Index		=	2pHs-pH eq					Puckorius Index	
	PSI		=	#N/A	result				PSI	
	PUCKORIUS SOLUBILITY INDEX CALCULATIONS								PUCKORIUS SOLUE	
			COC	**8**						**COC**
	RI	A	=	Err:502	fill data				RI	A
	pH	B	=	9.8	fill data				pH	B
	2pHs	C	=	Err:502	click here				2pHs	C
	M Alkalini	D	=	1520	fill data				M Alkalini	D
	Log 10(M)	E	=	3.1818436	click here				Log 10(M)	E
	pH eq		=	9.2014009					pH eq	
	Puckorius Index		=	2pHs-pH eq					Puckorius Index	
	PSI		=	Err:502	result				PSI	

				COC	**3**				
)EX CALCULATIONS				PUCKORIUS SOLUBILITY INDEX CALCULATIONS					
Err:502	fill data			RI	A	=	Err:502	fill data	
8.6	fill data			pH	B	=	9	fill data	
Err:502	click here			2pHs	C	=	Err:502	click here	
380	fill data			M Alkalini	D	=	570	fill data	
2.5797836	click here			Log 10(M)	E	=	2.7558749	click here	
8.319383				pH eq		=	8.5773567		
2pHs-pH eq				Puckorius Index		=	2pHs-pH eq		
Err:502	result			PSI		=	Err:502	result	
				COC	**4**				
				RI	A	=	#N/A	fill data	
				pH	B	=	9.2	fill data	
q									
				2pHs	C	=	#N/A	click here	
0(M)+4.54				M Alkalini	D	=	760	fill data	
				Log 10(M)	E	=	2.8808136	click here	
BE SEEN ON THE TABLE OF RSI				pH eq		=	8.7603919		
				PSI		=	#N/A	result	
ILITY INDEX CALCULATIONS				PUCKORIUS SOLUBILITY INDEX CALCULATIONS					
6						**COC**	**7**		
=	Err:502	fill data			RI	A	=	Err:502	fill data
=	9.5	fill data			pH	B	=	9.6	fill data

=	Err:502	click here			2pHs	C	=	Err:502	click here
=	1140	fill data			M Alkalini	D	=	1330	fill data
=	3.05690485	click here			Log 10(M)	E	=	3.123851641	click here
=	9.01836561				pH eq		=	9.116442654	
=	2pHs-pH eq				Puckorius Index		=	2pHs-pH eq	
=	Err:502	result			PSI		=	Err:502	result
ILITY INDEX CALCULATIONS					PUCKORIUS SOLUBILITY INDEX CALCULATIONS				
9						**COC**	**10**		
=	1.0	fill data			RI	A	=	6455.4	fill data
=	9.9	fill data			pH	B	=	10	fill data
=	10.9391986	click here			2pHs	C	=	6465.412814	click here
=	1710	fill data			M Alkalini	D	=	1900	fill data
=	3.23299611	click here			Log 10(M)	E	=	3.278753601	click here
=	9.2763393				pH eq		=	9.343374025	
=	2pHs-pH eq				Puckorius Index		=	2pHs-pH eq	
=	1.66285934	result			PSI		=	6456.06944	result

			SKILL MAN INDEX			
	TABLE-1	1				
		U-IONIC STRNGTH			MG/LIT(as analysed)	
		IONIC FORM		AS ANALYSED FORM as CaCO3		
		pH	8.1		8.1	
		Sp.Cond.	#VALUE!		#VALUE!	
		TDS	#VALUE!		997	as caco3
		P	0		0	as caco3
		M	94		94	as caco3
		TH	0		0	as caco3
		Ca++	4040	2	2020	as caco3
		$SO4^{--}$	4259	2.1	2028	as SO4
		$SO4^{--}$	2.1	2.1	1	as SO4
		Cl -	2835	1.4	2025	as C l
		SiO2--	#VALUE!	1	A-	asSiO2
		Mg++	8134	8.2	992	as caco3
		Na+	2765	2.2	1257	as caco3

	(M-2P)	HCO3⁻	356	0.49	726	as caco3
	2(M-P)	CO3--		3.3		as caco3
	(2P-M)	OH-		5.88		as caco3
		Solubility Product Constant of CaSO4 (Ksp).				
		from graph at 35 deg.C			4101561	
				ksp=	#VALUE!	
	X=	EXCESS COMMON ION CONC. OF Ca++&SO4--ION CONC.				
	X=	SO4	2110	*1/100000 MOLES PER LITER AS CaCO3		
		Ca	5050	*1/100000 MOLES PER LITER AS CaCO3		
				TO FILL		
			X=	0.211020	FILL the value of "X "manuall	
					the Lower Value oamong SO4 o	
		LANGELIAR RYZNER POCKURIOUS INDEXES ……..OPERATIN				
		STEP(1)ENTER MAKE UP WATER COMPLETE ANALYSIS DATAS				
		(2) ENTER COC VALUE AS 1 IN CELL-N-6 AND DESIRED HIGHER COC				
		(3)FOR ACID ADDITION CONDITION, MAY CHOOSE & FILL REDUCEI				
		(4)FIND INDEX RESULTS DEVELOPED IN CELL Q-17,Q19,Q21..IN				
		(5) CHANGE OF LANGELIER AND RYZNER INDEX ES CAN BE IN				
		POINT OUT RISE OF CORROSIVE TENDENCY ON AVAILABLE S				

SKILL MAN INDEX

STEP(1)ENTER MAKE UP WATER COMPLETE ANALYSIS (as CaC

STEP(2) PICK UP VALUE OF" X " FROM CELLI-31 OR I-32 (WHIC

STEP (3) SIMILAR EXERCISE CAN BE DONE BY CHOOSING AND

CLICK OUT SIDE.ENTER VALUE OF 'X' INE35 CELL.F

STEP(4) THE INDEX VALUE OF MORE THAN ONE FOR CALCI

STEP (5)SIMILARLY WHEN H2SO4 ACID ADDITION IS TARGETT

"X" VALUE ENTERED IN CELL E35 MANUALLY FROM CEI

RYZNAR	ig Sat Ind	pH	Alk	Ca	TCa
###	###	9.4	940	1140	456
					COC

WITHOUT ACID ADDITION

LARSON & SKOLDS INDEX CALCULA

ppm P (P Alkal=	150
ppm M (Total A=	940

ppm Chloride	A-	230
ppm Sulphate	B-	350
ppm Bicarbonat	C-	640
ppm Carbonate	D-	1580
L & S INDEX	=	A/eq wt Cl
		C/eq wt HCo3
	=	
		6.48
		10.49
	=	13.77
		63.16
L & S INDEX	=	0.22

INITIALLY WHEN P ALKALINITY IS ABOVE

RYZNARig Sat Ind		pH	Alk	Ca	TCa
###	###	8.8	440	1140	456
					COC

WITH ACID ADDITION

S theoretical = 1000 $\sqrt{}$ (x*0.5 + 4 Ksp) - x

S THEORETICAL=1000		Ksp	#VALUE!

				x	0.021102	
				X*X	0.0422032	
				+		
	ksp=	#VALUE!	*4=	4 Ksp	#VALUE!	
	X*2+4ksp			=	#VALUE!	
				SQRT()		
				√(....)	#VALUE!	
				- x	0.021102	
			AS CaCO3	mg/lit	#VALUE!	
				/eq.wt.	#VALUE!	#VALUE!
	S THEORETICAL=			*1000	**#VALUE!**	**#VALUE!**
				as individual ion	**SO4**	**Ca**
						on coc basis
						1010
	S actual=	D59/20	for Ca		101.00	=
	S theoretical=				#VALUE!	
		REASULT				
	S actual=	D61/48	for SO4		42.3	=
	S theoretical=				#VALUE!	
						422.7083333333
		x=		0.0000000		

SOLUBILITY PRODUCT Vs IONI

Solubility Product Constant (Ksp)

Y-AXIS
0.0040
0.0035
0.0030
0.0025
0.0020
0.0015
0.0010
0.0005
0.0000

AUTO

#VALUE!

1	2	3

Ionic Strengt

Solubility product Constant (Ksp) *1000

0 1 2 3

					Ionic Strength (U)	

	TABLE-3					
	ON COC BASIS			TABLE	4	
	VALUES OF TABLE-1					COC
	PICKED UP	IONIC				1
	COC-	10	←	P	as caco3	0
	pH	8.9		M	as caco3	94
	Sp.Cond.	#VALUE!		Ca CaCO3		114
	TDS	9970		Cl as Cl ppm		23
	P	94			pH	8.05
	M	939		SO4 as SO4ppm		35
	TH			SP.COND		#VALUE!
TOTAL	Ca++	40400		TDS		997
2029	$SO4^{--}$	42609		TEMP	DEG C	25
				Larson & Skold		0.00
	+	28350		Larson & Skold		
	SiO2--	#VALUE!				
	Mg++	81344		Langeliar index		
2765.4	Na+	27650				

	$HCO3^-$	3557.4		Ryzner	Index	
	CO3--	0			`	
	OH-	0				
	A	#VALUE!				
A/100000=U	U=	#VALUE!				
	IONIC STRENGTH					
TABLE-2						
	TWO		moles/lit.			
	0.021102	=	0.022090	SO4	RESULT	#VALUE!
	0.050500					consider the r
			-0.022090	Ca	NA	#VALUE!
						consider the r

y in Cell No-E35 , by selecting

r Ca result as appeared in Cell I-31 or I-32.

G STEPS.

S (as CaCO3) IN CELL NO-N-7 TO N-15 OF TABLE-4. FOR HIGHER COC RUN PUT CO

VALUE IN CELL-P-6. CLICK OUT SIDE AND RESULTS OF DIFFERENT INDEXES SHALL APP

P ALK.FIGURE(SAY TO 10 TO 15) IN CELL -Q7, M VALUE FIGURE (200 TO 300) IN CELL -

ADDITION TO THAT H2SO4 ACID REQUIRED IN PPM SHALL BE REFLECTED IN CE

TERPRETED IN TERMS OF DROP IN SCALING TENDENCY SIDE BY SIDE RISE IN L

SYSTEM COMMON METALLURGIES.

OPERATING STEPS						
CO3)IN CELL F8 TO F23(EXCEPT IN F16). FILL COC NUMBER AS 1 IN CELL-J7.CLIC						
CH EVER IS LOWER) AND MANUALLY ENTER IN CELL E35.CLICK OUT SIDE. READ						
) ENTERING DESIRED COC NUMBER MANUALLY IN CELL J 7.						
READ THE RESULT OF SKILL AN INDEX FROM .					**CELL N31 ORN33.**	
UM INDICATES TENDENCY OF CaSO4 DEPOSITION WHERE AS VALUE OF MORE T						
TED THEN EXCESS SO4 VALUES IN ppm as CaCO3 SHALL BE ENTERED IN CELL F16						
LL E31/E32 (WHICHEVER IS LOWER).CLICK OUTSIE TO GET THE RESULT OF						
°C	Cond	TDS	pHs			
25	#VALUE!	9970	#VALUE!			
10						
TIONS						
			COC	**10**		
as CaCO3	fill data					
as CaCO3	fill data					

			Eq.Wt			
	fill data		Cl	35.5		
	fill data		So4	48		
	click here		HCo3	61		
	click here		Co3	30		
+	B/eq wt So4					
+	D/eq wt Co3					
+	7.29					
+	52.67					
	NOTE-		OR	WHEN	P ALK.	ZERO
Cl	&	SO4	13.77	Cl	&	SO4
HCO3	&	CO3	10.49	HCO3		
	result		1.31			
ZERO OR ZERO			WITHOUT ACID ADDITION			
°C	Cond	TDS	pHs			
25	#VALUE!	9970	#VALUE!			
10						
	S actual = for Ca(D59/20) FOR SO4(F61/48)					
	AS ANALYSED	BASIS	AS CaCO3		1010	
			mol.wt/eq.wt.		ON COC BASIS	

	S actual concentration FOR Ca=				101.00	1010
			808/20=			
	S actual concentration FOR SO4 =				42.27	422.7083333333
	THEORETICAL	BASIS	2428/48=			
	Ca	2020	5050			0.050500
		X=	MOLES/ LITER			0.02110
	SO4	2029	2110		0.02110	0.0211016
					x=	-0.029398
	S THEO={2.5(Ca)-1.04(Mg)}/100000					
	2940		/100000=		###	as caco3
						21.1016
#VALUE!						
#VALUE!		consider the result when Ca ion concentration is lower than SO4 ion concentration				
#VALUE!		consider the result when SO4 ion concentration is lower than Ca ion concentration				
#VALUE!						
	by S.C. Bharadwaj 28/07/10					

C STRENGHT for CaSO4 Chart.

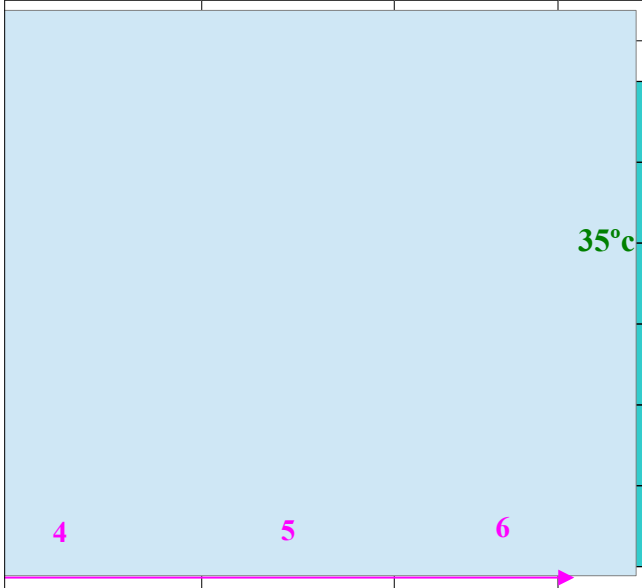
CHART

X-AXIS

4	5	6

h (U)

35°c



	Ksp RESULT	
6	0.000000	FIX
5	0.000000	FIX
4	0.000000	FIX
3	0.000000	FIX
2	0.000000	FIX
1	#VALUE!	FINAL RESULT

RESULT SHEET					
		ACID			
	COC	**COC**			
	10	**10**			
P	**150**	**50**	**P value with acid addition**		
M	**940**	**440**	**M value with acid addition**		
Ca	**1140**	**1140**			
CL	**230**	**230**			
pH	**9.4**	**8.8**	**pH value with acid addition**		
SO4	**350**	**350**			
	#VALUE!	**500**	**PPM SO4 RISE IN CIR**		
	9970	**850**	**TOTAL SULPHATE**		
H2SO4	**SO4 PPM ADDED**	**50**	**55**	**ppm**	**H2SO4**
L&S	**0.22**		**without acid addition**		
L1&S1		**0.77**	**with acid addition**		
LSI	**#VALUE!**	**###**			

RSI	**#VALUE!**	**###**			
			S actual=	**D61/48**	**for SO4**
SKILL MAN INDEX			**S theoretical=**		
				REASULT	
			S actual=	**D59/20**	**for Ca**
			S theoretical=		
result when SO4 ion concentration is lower than Ca ion concentration					
result when Ca ion concentration is lower than SO4 ion concentration					
C VALUE IN CELL P6 AND RELATED P ALK.AND pH VALUE IN CELL-P7 AND P11					
EAR IN CELL P16,P-19 & P-21. SIMILARLY FOR HIGHER COC RESULTS EXIBITED IN CI					
Q8 AND pH REDUCED VALUE (8.3 to 8.5) IN CELL Q11 RESPECTIVELY.cLICK OUT SIDE					
LL-Q15.					
ARSON AND SKOLD INDEX SHALL BETTER					

K OUTSIDE .

THE SKILLMAN INDEX DEVELOPED IN CELL N31(FOR Ca) OR N33 (FOR SO4).

THAN ONE FOR SO4 INDICATES SULPHATE SATURATION VALUE

AND COC NUMBER ENTERED INCELL-J2 CLICK OUT SIDE.

SKILL MAN INDEX.

LARSON & SKOLDS INDEX CALCULATIONS

ppm P (P Alkalinity)	=	50	as CaCO3	fill data
ppm M (Total Alkilinity)	=	440	as CaCO3	fill data

	ppm Chloride	**A-**	230		fill data
	ppm Sulphate	**B-**	850		fill data
	ppm Bicarbonate	**C-**	**340**		click here
	ppm Carbonate	**D-**	780		click here
	L & S INDEX	**=**	A/eq wt Cl	+	B/eq wt So4
			C/eq wt H(	+	D/eq wt Co
		=			
			6.48	+	17.71
			5.57	+	26.00
					NOTE-
		=	24.19	Cl	&
			31.57	HCO3	&
	L1 & S1 INDEX	=	0.77		result
	AFTER ACID ADDITION AND MAINTAINING SOME + P ALKALINITY				
		WITH ACID ADDITION			

TABLE-11

M INDICATING P&pH

pH	P	M
7.0		35
7.5		50
7.8		100
8.0		150
8.3	5	200
8.4	10	250
8.5	20	300
8.6	30	350
8.7	40	400
8.8	50	450
9.0	60	500
9.0	70	550
9.1	80	600
9.1	90	650
9.2	100	700
9.2	110	750
9.3	120	800

CULATION WATER

IN CIRCULATION

ON ON MAKE UP BASIS

		9.3	130	850		
		9.4	140	900		
		9.4	150	940		
42.3		9.5	160	1000		
#VALUE!						
101.00		.				
#VALUE!						

RESPECTIVELY BY TAKING REFERENCE FROM M VALUE .(MAY SELECT FRO

ELL P16,P-19 & P-21.

..

	COC	10					

	Eq.Wt						
	Cl						
		35.5					
	So4						
		48					
	HCo3						
		61					
	Co3						
		30					
3							
	24.19	P	ALK	ZERO			
SO4	31.57	CL	+	SO4			
CO3	0.8						
		24.19					
		5.57		4.339469			

Spreadsheet for the calculation of Ryznar & Langellier I								5.8 to 6.2		
Input the data below:										
Parameter		**Value**	FILL IN							
Total Solids:		300	ppm as total solids							
Temperature:		45	oC							
Calcium Hardness		20	ppm as CaCO3							
Methyl Alkalinity:		6	ppm as CaCO3							
pH		6.5								
CLICK BELOW										
Calculed Data:										
pHs	Saturation pH:			#N/A						
L	Langellier Index:			#N/A	Positive = scaling, Negative = corrosive					
R	Ryznar Index:			#N/A	Less than 6 = scaling, Greater than 6 = corrosive					
Calculation Details:										
Langelier Index (L) = pH - pHs										
where:										
pHs = 9.3 + A + B - C - D										
						Value	Function			
A	Function of TOTAL SOLIDS					300	#N/A			
B	Function of TEMPERATURE					45	1.6			
C	Function of CALCIUM HARDNESS					20	0.9			
D	Function of ALKALINITY TO METHYL OR					6	#N/A			
	pH					6.5				
	Saturati	**pHs**					**#N/A**		**Negative = corrosive**	
L	**Langelli**	**L**					**#N/A**		**Positive = scaling**	
R	**Ryznar Index:**						**#N/A**			
TDS Total Solids ppm	Factor A		Water Temperature °C	Factor B		Calcium Hardness ppm CaCO3	Factor C		Methyl Orange Alkalinity ppm CaCO3	Factor D
500	0.1		0	2.6		10	0.6		10	1.0
4000	0.2		2	2.5		12	0.7		12	1.1
			7	2.4		14	0.8		14	1.2
			10	2.3		18	0.9		18	1.3
			14	2.2		23	1		22	1.4
			18	2.1		29	1.1		29	1.5
			22	2.0		35	1.2		36	1.6
			28	1.9		44	1.3		45	1.8

			32	1.8		56	1.4		56	1.8
			38	1.7		70	1.5		70	1.9
			44	1.6		88	1.6		88	2.0
			51	1.5		111	1.7		111	2.1
			57	1.4		139	1.8		140	2.2
			64	1.3		175	1.9		177	2.3
			72	1.2		230	2.0		230	2.4
						280	2.1		280	2.5
						350	2.2		360	2.6
						440	2.3		450	2.7
						560	2.4		560	2.8
						700	2.5		700	2.9
						880	2.6		880	3.0
				END						

Enter System Parameters Here									
				as					R
				CaCO3					
RYZNAR	Lang Sat Ind	pH	Alk	Ca	TCa	°C	Cond	TDS	pHs
6.7	0.6	8	180	96	38.4	45	1410	918	7.3676941

equired pH and alk	tion, and should not be changed!							
to give Zero LSI								
ReqpH	Req ALK	I	sqrt I	A	E	T	pKw	pK2
7.683847058	86.5305054138	0.02256	0.1501999	0.5309584	71.445312	318.2	13.391903	10.195596

pKs	pfm	gmolCa	pCa	gmolALK	pALK	New pHs	Req pALK	
8.6199894	0.0657421	0.00096	3.0177288	0.0036	2.4456478	0.0035953	2.761800764	1.0031868