

### 🙀 Hydranautics RO Projection Program - [Analysis]

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File Analysis RODesign UF Treatment Calculation Graphs Help

Project			C	ode		Feed W	ell Water		-	Date 28	/11/25
- nH	7.00		wb	-		Econd		uS /om	<u></u>		0 000
рп	7.00			.0		E Conu	U	u370m	LUZ		.0 PPm
Temp	25.0	с 🗕 9	DI	.0	15min 💌	H2S	.0	ppm	Fe		.O ppm
Ca	.0	ppm 💌	.00	meq	1	CO3	0.	ppm	•	.00	meq
Mg	.0	ppm 🔻	.00	meq	i i	HCO3	.1	ppm	-	.00	meq
Na	.0	ppm 🔻	.00	meq		SO4	.0	ppm	•	.00	meq
ĸ	.0	ppm 💌	.00	meq		CI	.0	ppm	-	.00	meq
NH4	.0	ppm 💌	.00	meq		F	.0	ppm	-	.00	meq
Ba	.000	ppm 💌	.00	meq		NO3	.0	ppm	-	.00	meq
Sr	.000	ppm 💌	.00	meq		SiO2	.0	ppm	-	.00	meq
	Total	Positive	.00	meq	Autoba	alance	Total	Negativ	e	.00	meq
Cacicula	ted TDS	0	ppm			lonic str	ength	.0	00	P	rint
CaSO4 s	aturation	.0	%	Not a	a complete	data set	ituration		.0 %	clip	board
Silica saturation			%			SrSO4 saturation			.0 %	s Sa	ave
Saturation Index 0.0			Langelier	•		Osmotic	pressure		.0 p	si 🔻	

กรณีแหล่งน้ำดิบ 1 แหล่ง

## 1. ใส่ project name

### 🙀 Hydranautics RO Projection Program - [Analysis]

File Analysis RODesign UF Treatment Calculation Graphs Help

Project	MWA		C	ode	MWA	Feed	Well Water		-	Date	28	/11/254
рH	7.00	т	urb	.0		E co	Well Water Surface Wate	۲				0 ppm
Temp	25.0	C 🔻 S	DI	.0	15min 💌	H2S	RO Permeate					.O ppm
Ca	.0	ppm 🔻	.00	meq		CO3	Seawater - op Seawater - we	en intak ell	e		.00	meq
Mg	.0	ppm 💌	.00	meq		HCOL	Wastewater				.00	meq
Na	.0	ppm 💌	.00	meq		SO4	.0	ppm	-		.00	meq
ĸ	.0	ppm 💌	.00	meq		CI	.0	ppm	•		.00	meq
NH4	.0	ppm 💌	.00	meq		F	.0	ppm	•		.00	meq
Ba	.000	ppm 💌	.00	meq		NO3	.0	ppm	•		.00	meq
Sr	.000	ppm 💌	.00	meq		SiO2	.0	ppm	-		.00	meq
	Total	Positive	.00	meq	Autoba	lance	Total	Negative			.00	meq
Cacicula	ted TDS	lo	ns out of Ba	alanc	e by over 1	0%, ad	just concentra	ations	)0		P	int
CaSO4 s	aturation	.0	%	Not a	a complete	data se	t ituration		.0	%	Clipt	board
Silica sa	turation	.0	%			SrSO4	saturation		.0	%	Sa	ive
Saturatio	on Index	0.0	Langelier	-		Osmo	tic pressure		.0	psi	-	

# 2. ใส่ประเภทของแหล่งน้ำ





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File Edit	Bookmai	rk Optior	ns Help			
Contents	Index	<u>B</u> ack	<u>Print</u>	<u>&lt;</u> <	≥>	
Satur	ation In	dex				~

Saturation indices are exceeded. A red message will appear that tells the user when saturation limits are exceeded. Recommended limits for various indices and salts are given in the Limits section of Help. System recovery can be reduced when saturation limits are exceeded. Another alternative is to decrease the pH of the feed stream so that the concentration of bicarbonate ion is reduced; this reduces the risk of precipitating of sparingly soluble carbonate salts from the concentrate stream. Where high concentrations of sulfate salts in the concentrate stream presents a risk of sulfate salts precipitation, use of hydrochloric acid instead of sulfuric acid when acidifying feed may be an acceptable alternative.

LSI (Langlier Saturation Index): LSI is a method of reporting the scaling or corrosive potential of low TDS brackish water based on the level of saturation of calcium carbonate. LSI is important to boiler water and municipal plant chemists in determining whether a water is corrosive (has a negative LSI) or will tend to scale calcium carbonate (has a positive LSI). LSI is important to RO chemists as a measurement of the scaling potential for calcium carbonate. The LSI value is calculated by subtracting the calculated pH of saturation of calcium carbonate from the actual feed pH. Calcium carbonate solubility decreases with increasing temperature (as evidenced by the liming of a teakettle), higher pH, higher calcium concentration, and higher alkalinity levels. The LSI value can be lowered by reducing pH by the injection of an acid (typically sulfuric or hydrochloric) into the RO feed water. A recommended target LSI in the RO concentrate is negative 0.2 (which indicates that the concentrate is 0.2 pH units below the point of calcium carbonate saturation). A negative 0.2 LSI allows for pH excursions in actual plant operation. A polymer-based antiscalant can also be used to inhibit the precipitation of calcium carbonate. Some antiscalant suppliers have claimed the efficacy of their product up to a positive LSI value of 2.5 in the RO concentrate (though a more conservative design LSI level is +1.8). Sodium hexametaphosphate, an inorganic antiscalant, was used in the early days of RO but the maximum concentrate LSI was + 0.5 and it had to be made in short-lived batches as the air easily oxidized it.

According to Reverse Osmosis, A Practical Guide for Industrial Users (Byrne), LSI is estimated as the difference between the current pH of the water ( pH ) and the pH at which calcium carbonate reaches saturation ( pHLSI ) :

LSI = pH - pHLSI

Where : pHLSI = (9.3 + A + B) - (C + D)

where : A = (log(TDS) - 1)/10 B = -13.12 \* log(Temp(0C) + 273) + 34.55 C = log[Ca as CaCO3] - 0.4D = log[Alk as CaCO3]

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Concentrations in brackets are moles/L and TDS is in mg/L.

S ROD	ESIGN					
File Edil	: Bookmar	k Optior	ns Help			
Contents	Index	Back	<u>Print</u>	<u></u>	≥≻	
Con	tents		20			
Welcon	me to the	RODES	IGN Hel	p module elines el	. The He lement s	elp module is organized into several sections to help you better understand the ROdesign Program, principles of membrane
Sectio	n I - ROE	ESIGN	Operati	on.	serie in s	Section II - Overview of RO
Use of	RODESI	<u> SN</u>	-		l	ntroduction, Terms, and Equations
Progra	m Logic				<u>c</u>	Commercial RO Technology
Conver	sion and	Design E	Errors		N	Membrane Module Configurations
					E	Parameters of the RO Process
					1	A/ater Chemistry

#### Section III Design Process

Pretreatment Flow Configuration RO Sizing Design Parameters Affecting Performance DESIGN LIMITS Cleaning

### Section V – HYDRAcap Ultra-Filtration Introduction to Technology Introduction to Operation

Hydracap Technical Information

Section IV – RO Element Information HYDRANAUTICS' Offering of Elements Element Performance/ Testing Conditions Element Specification Sheets



For Help on Help, Press F1

#### 📲 Hydranautics RO Projection Program - [Analysis]

File Analysis RO Design UF Treatment Calculation Graphs Help

-									_			
Project	MWA		C	ode	MWA	Feed Su	irface Wate	er 👘	•	Date		
рН	6.71	T	urb	1.7		E cond	3457	uS/cm	CO2	2 1	06.9 P	pm
Temp	25.0	C 🗕 S	DI	.0	15min 💌	H2S	.0	ppm	Fe		.O P	pm
Ca	.0	ppm 💌	.00	meq		CO3	.2	ppm	-		)1 me	q
Mg	.0	ppm 💌	.00	meq		HCO3	374.5	ppm	•	6.1	4 me	q
Na	483.3	ppm 💌	21.01	meq		SO4	369.4	ppm	-	7.7	70 me	q
К	220.0	ppm 💌	5.64	meq		CI	583.2	ppm	•	16.4	15 me	q
NH4	66.0	ppm 💌	3.67	meq		F	.4	ppm	•		)2 me	q
Ba	.000	ppm 💌	.00	meq		NO3	.6	ppm	•		)1 me	q
Sr	.000	ppm 💌	.00	meq		SiO2	19.8	ppm	-		)0 me	q
	Total	Positive	30.32	meq	Autoba	alance	Total	Negativ	e	30.3	32 me	q
Caclcula	ted TDS	2117	ppm			lonic str	rength		)34		Print	
CaSO4 s	aturation	.0	%			BaSO4 :	saturation		.0	% CI	ipboar	rd
Silica saturation 14.1		%		SrSO4 saturation			.0	~ _	Save			
Saturation Index 0.0		Langelier 🔻			Osmotic	1	9.6 J	osi	•			

## 3. ลงผลวิเคราะห์น้ำในช่องผลวิเคราะห์น้ำ

### 4. ทำ Autobalance

5. Click Toolbar ปุ่ม RO Design



File Analysis RO Design UF Treatment Calculation Graphs Help



- 6. เข้าสู่หน้าจอ RO Design
- 7. ใส่ตัวเลข product recovery, permeate flow ที่ต้องการ

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File Analysis RODesign UF Treatment Calculation Graphs Help

▼ Chen	1 dosing rate 7.0 10.0 70.0 7.00 23.5 10.0	.0 ppm Feed wa Permeal Concent Element Selecti Model	Chem conce ater type Sur te blending ( trate recirc. ( on Nom prod.	ntration,% 100 face Water Permeate throttling Booster pump			
13/hr ▼ n2-hr ▼ 13/hr ▼ 13/hr ▼	7.0 10.0 70.0 7.00 23.5 10.0	Feed wa Permeat Concent Element Selecti Model	ater type Sur te blending ( trate recirc. ( on Nom prod.	face Water Permeate throttling Booster pump			
13/hr ▼ n2-hr ▼ 13/hr ▼ 13/hr ▼	10.0 70.0 7.00 23.5 10.0	Permeal Concent Element Selecti Model	te blending trate recirc. on Nom prod.	Permeate throttling Booster pump			
13/hr ▼ n2-hr ▼ 13/hr ▼ 13/hr ▼	70.0 7.00 23.5 10.0	Concent Element Selecti Model	trate recirc. on Nom prod.	Booster pump			
13/hr 💌 n2-hr 💌 13/hr 💌	7.00 23.5 10.0	Element Selecti Model	on Nom prod.				
13/hr	7.00 23.5 10.0	Element Selecti Model	on Nom prod.				
n2-hr 💌 13/hr 💌 13/hr 💌	23.5 10.0	Model	Nom prod.	hereit the second			
13/hr 💌	10.0	-		Rei.	Element type	Size	
n3/hr ▼		10512 F/0 = 102 = 4104	1.600 and.	86.0% rejection.	Softening composite	4.0 x 40.0	~
	3.0	ESNA1-LF	7,500 gpd,	86.0% rejection,	Softening composite	8.0 x 40.0	
		ESPA-2540	750 gpd,	98.0% rejection,	Low pressure composite	2.5 x 40.0	
		ESPA1-4040	2,600 gpd,	99.3% rejection,	Low pressure composite	4.0 x 40.0	
		ESPA2-4040	1,900 gpd,	99.6% rejection,	Low pressure composite	4.0 x 40.0	
ge 1 🛛 🐧	Stage 2	ESPA3-4040	3,000 gpd,	98.5% rejection,	Low pressure composite	4.0 x 40.0	
		ESPA4-4040	2,500 gpd,	99.2% rejection,	Lowest pressure composite	4.0 x 40.0	
3	CPA3	ESPA1	12,000 gpd,	99.3% rejection,	Low pressure composite	8.0 x 40.0	
7	4	ESPA2	9,000 gpd,	99.6% rejection,	Low pressure composite	8.0 x 40.0	
-		ESPA3	14,000 gpd,	98.5% rejection,	Low pressure composite	8.0 x 40.0	
<u>1</u>	1	ESPA4	12,000 gpd,	99.2% rejection,	Lowest pressure composite	8.0 x 40.0	
		CPA2-4040	2,250 gpd,	99.3% rejection,	High rejection composite	4.0 x 40.0	
		CPA2	10,000 gpd,	99.5% rejection,	High rejection composite	8.0 x 40.0	
		CPA2-HR	10,000 gpd,	99.7% rejection,	High rejection composite	8.0 x 40.0	
		СРАЗ	11,000 gpd,	99.7% rejection,	High rejection composite	8.0 x 40.0	
		CPA4	6,000 gpd,	99.7% rejection,	High rejection composite	8.0 x 40.0	
		LFC1-4040	2,300 gpd,	99.0% rejection,	Low fouling composite	4.0 x 40.0	
		LFC1	11,000 gpd,	99.5% rejection,	Low fouling composite	8.0 x 40.0	
		LFC3-4040	2.000 md.	99.7% rejection.	Low fouling composite	4.0 x 40.0	
		LFC3	9,500 gpd,	99.7% rejection,	Low fouling composite	8.0 x 40.0	~
	3 4 1	3 CPA3 4 4 1 1	3       CPA3       ESPA4-4040         3       CPA3       ESPA1         4       4       ESPA2         1       1       ESPA4         CPA2       CPA2-4040         CPA2       CPA2-HR         CPA3       CPA4         LFC1-4040       LFC1         LFC3-4040       LFC3	3       CPA3         4       4         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1 <t< td=""><td>3       CPA3         4       4         1       1         ESPA4-4040       2,500 gpd, 99.2% rejection, ESPA1         ESPA2       9,000 gpd, 99.3% rejection, ESPA3         ESPA4       12,000 gpd, 99.2% rejection, ESPA3         ESPA4       12,000 gpd, 99.2% rejection, CPA2-4040         CPA2       9,000 gpd, 99.2% rejection, CPA2-4040         CPA2       10,000 gpd, 99.2% rejection, CPA2-4040         CPA3       11,000 gpd, 99.3% rejection, CPA3         CPA4       6,000 gpd, 99.7% rejection, CPA4         CPA4       6,000 gpd, 99.7% rejection, LFC1-4040         LFC1       11,000 gpd, 99.7% rejection, LFC3         LFC3       9,500 gpd, 99.7% rejection,         LFC3       9,500 gpd, 99.7% rejection,</td><td>3       CPA3         4       4         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         <t< td=""><td>CPA3ESPA40,000 gpd, 99.2% rejection, Low pressure composite4.0 x 40.044112,000 gpd, 99.3% rejection, Low pressure composite8.0 x 40.05ESPA112,000 gpd, 99.3% rejection, Low pressure composite8.0 x 40.06ESPA29,000 gpd, 99.2% rejection, Low pressure composite8.0 x 40.06ESPA412,000 gpd, 99.2% rejection, Low pressure composite8.0 x 40.06ESPA412,000 gpd, 99.2% rejection, Low pressure composite8.0 x 40.06CPA2-40402,250 gpd, 99.3% rejection, High rejection composite8.0 x 40.06CPA2-40402,250 gpd, 99.3% rejection, High rejection composite8.0 x 40.07CPA210,000 gpd, 99.5% rejection, High rejection composite8.0 x 40.07CPA2-HR10,000 gpd, 99.7% rejection, High rejection composite8.0 x 40.07CPA311,000 gpd, 99.7% rejection, High rejection composite8.0 x 40.07CPA46,000 gpd, 99.7% rejection, Low fouling composite8.0 x 40.01LFC1-40402,300 gpd, 99.5% rejection, Low fouling composite8.0 x 40.01LFC39,500 gpd, 99.7% rejection, Low fouling composite8.0 x 40.01&lt;</td></t<></td></t<>	3       CPA3         4       4         1       1         ESPA4-4040       2,500 gpd, 99.2% rejection, ESPA1         ESPA2       9,000 gpd, 99.3% rejection, ESPA3         ESPA4       12,000 gpd, 99.2% rejection, ESPA3         ESPA4       12,000 gpd, 99.2% rejection, CPA2-4040         CPA2       9,000 gpd, 99.2% rejection, CPA2-4040         CPA2       10,000 gpd, 99.2% rejection, CPA2-4040         CPA3       11,000 gpd, 99.3% rejection, CPA3         CPA4       6,000 gpd, 99.7% rejection, CPA4         CPA4       6,000 gpd, 99.7% rejection, LFC1-4040         LFC1       11,000 gpd, 99.7% rejection, LFC3         LFC3       9,500 gpd, 99.7% rejection,         LFC3       9,500 gpd, 99.7% rejection,	3       CPA3         4       4         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1         1       1 <t< td=""><td>CPA3ESPA40,000 gpd, 99.2% rejection, Low pressure composite4.0 x 40.044112,000 gpd, 99.3% rejection, Low pressure composite8.0 x 40.05ESPA112,000 gpd, 99.3% rejection, Low pressure composite8.0 x 40.06ESPA29,000 gpd, 99.2% rejection, Low 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40.06ESPA412,000 gpd, 99.2% rejection, Low pressure composite8.0 x 40.06ESPA412,000 gpd, 99.2% rejection, Low pressure composite8.0 x 40.06CPA2-40402,250 gpd, 99.3% rejection, High rejection composite8.0 x 40.06CPA2-40402,250 gpd, 99.3% rejection, High rejection composite8.0 x 40.07CPA210,000 gpd, 99.5% rejection, High rejection composite8.0 x 40.07CPA2-HR10,000 gpd, 99.7% rejection, High rejection composite8.0 x 40.07CPA311,000 gpd, 99.7% rejection, High rejection composite8.0 x 40.07CPA46,000 gpd, 99.7% rejection, Low fouling composite8.0 x 40.01LFC1-40402,300 gpd, 99.5% rejection, Low fouling composite8.0 x 40.01LFC39,500 gpd, 99.7% rejection, Low fouling composite8.0 x 40.01<

8. เลือก RO Element ที่เหมาะสมกับแหล่งน้ำ



File Analysis RO Design UF Treatment Calculation Graphs Help



## 9. ใส่ตัวเลข Elements/vessel และจำนวน vessels

โดยปรกติการออกแบบ RO นั้นจะกำหนด rule of Thumb ไว้ที่น้ำ permeate 1 ลบ.ม/RO element 1 ท่อน (ขนาดเส้นผ่าศูนย์กลาง 8 นิ้ว)

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File Analysis RO Design UF Treatment Calculation Graphs Help

Project	Chanch	ai			Calc	ulated	by PC	RNSA	( SAM	IORNKR	AIS Dat	e 11/15/48
pН	6.71			Membr	ane age		3.0 y	ears 🔻	Che	em type		H2SO4 🔻
Temp	25	5.0 C	•	Chem (	losing rat	e	.0 p	pm 🔽	Ch	em conc	entration	× 100‡
Flux dec	line % p	er yea	r		7.0		F	eed wa	ter ty	pe Su	irface Wa	ater 💌
SP incre	ease % p	er yea	r		10.0		F	ermeat	e blen	ding 🕅	Permea	ate throttling
Product	recovery	y, %			70.0		C	oncent	rate re	ecirc. 🗆	Booste	r pump 🔽
Permeat	e flow	1	n3/hr	-	7.00							
Average	flux rate	e I/	m2-hr	-	26.9							
Feed flo	w	1	n3/hr	•	10.0							
Concent	trate flow	•	n3/hr	•	3.0							
- Calcul	lation Re	sults-	Pressu	re bar		Flow	/vessel	m3/h	ır 🔽	l/m2-hr	<b>▼</b>	
Arrav	Vessels	Fe	ed	Conc.	F	eed	_	Conc		Flux	Beta	
1-1	1		13.6	12	.5	1	0.0		5.6	29.7	1.16	
1-2	]		12.5	12	.0		5.6		3.0	23.1	1.23	Bun
1-3	U 0	1	0.0	(	.U		0.U 0.0		0.0	0.0	0.00	- Nout
Permea	u te conci	entrati	on (nnr	ո 🛛	arning: de	sign lin	nits exce	eded-c	lick h	ere for n	nore info	
Ca	0.00	K	4.9	97 Sr	0.00	SO4	1.86	NO3	0.	09 CO2	106.9	
Mg	0.00	NH4	1.4	49 CO3	0.00	CI	11.69	SiO2	0.	27 pH	5.	3 Print
Na	8.76	Ba	0.0	DO HCO3	13.42	F	0.02	Total	<b>FDS</b>	42.0	6 ppm 💽	Clipboard
Concer	ntrate pa	ramete	ers									Analysis
CaSO4	sat, X	(	D SrSO	4 sat, %	0	lonic s	strength		0.	.11 <mark>pH</mark>	7.	2
BaSO4	sat, %		D  SiO2	sat, %	47	Osmot	ic press	lite	4	.4 bar	_	AutoDisplay
Satura	ation Ind	ex: L	angelie	er O.(	Stiff & I	Davis	0.00	Total 1	DS	6958.7	ppm	

11.กรณีขึ้นตัวเลขสีแดงแสดงว่าเกิดความผิดปรกติ เราสามารถดูวิธีการแก้ไขโดย นำ mouse ไปdouble click ตรง Warning : โปรแกรมจะบอกรายละเอียด วิธีการแก้ไขให้



🖉 RODESIGN
File Edit Bookmark Options Help
<u>Contents</u> <u>Index</u> <u>Back</u> <u>Print</u> <u>&lt;</u> < <u>&gt;</u>
CONCENTRATION POLARIZATION (Beta factor)
The value of the Concentration Polarization Factor of 1.2, which is the recommended Hydranautics limit, corresponds to 18% permeate recovery for a 40" long membrane element.
As water flows through the membrane and salts are rejected by the membrane, a boundary layer is formed near the membrane surface in which the salt concentration exceed the salt concentration in the bulk solution. This increase of salt concentration is called concentration polarization. The effect of concentration polarization is to reduce actual product water flow rate and salt rejection versus theoretical estimates. The effects of concentration are as follows:
<ol> <li>Greater <u>osmotic pressure</u> at the membrane surface than in the bulk feed solution, delPosm, and reduced Net Driving Pressure differential across the membrane (delP - delPosm).</li> </ol>
2. Reduced <u>water flow</u> across membrane (Qw).
3. Increased <u>salt flow</u> across membrane (Qs).
4. Increased probability of exceeding solubility of sparingly soluble salts at the membrane surface, and the distinct possibility of precipitation causing membrane scaling.
The Concentration Polarization Factor (CPF) or Beta can be defined as a ratio of salt concentration at the membrane surface (Cs) to bulk concentration (Cb).
CPF = Cs/Cb (10)
An increase in permeate flux will increase the delivery rate of ions to the membrane surface and increase Cs. An increase of feed flow increases turbulence and reduces the thickness of the high concentration layer near the membrane surface. Therefore, the Beta is directly proportional to permeate flow (Qp), and inversely proportional to average feed flow (Qfavg).
CPF = Kp * exp(Qp/ Qfavg) (11)
Where Kp is a proportionality constant depending on system geometry.
Using the arithmetic average of feed and concentrate flow as average feed flow, the CPF can be expressed as a function of the permeate recovery rate a of membrane elemen (Ri).
CPF = Kp * exp(2Ri/(2-Ri)) (12)

🛗 🏷 🗾 🐠 🧶 📐 🛄 15:54

🤣 RODESIGI	iN												
File Edit Bo	ookmark	Options	Help										
Contents Ind	idex	Back	Print	<u> &lt;</u> <	<u>&gt;</u> >								
Beta Fact	tor Ex	ceeded											
Flow Lim	nits Ex	ceeded											
<u>Flow is too</u> is exce system	<u>) high c</u> eeded. n.	i <u>r too low</u> Ways ti	<u>// beta</u> o corre	<u>factoris</u> ct this ar	<u>exceede</u> e to altei	<u>d</u> . A <mark>red</mark> messa the system co	age will appear wi nfiguration, alter	hen the <u>recommer</u> the recovery, or to	<u>ded values</u> for adjust the flow	flow are not mo distribution th	et or are excee rough the indiv	ded, or when th idual passes o	ne <u>beta value</u> f the
🤣 RODESIGI	iN												
File Edit Bo	ookmark	Options	Help		1								
Contents Ind	ndex	Back	Print	<	<u>≥&gt;</u>								
Max/Min Fl	low per	Vessel:											
<u>Membrane</u>	<u>Diame</u> 4 6 8 8.5	<u>ter (in)</u>	P	Fe <u>Max (GPI</u> 16 30 75 85	ed Flov	W <u>Max (m3/hr)</u> 3.6 8.8 17.0 19.3	Concentrate <u>Min (GPM)</u> 3 7 12 14	Flow <u>Min (m3/hr)</u> 1.6 2.7 3.2					

File Analysis RODesign UF Treatment Calculation Graphs Help

Project	Chanch	ai				Calco	ulated	by	PO	RNSA	K SAM	IORN	KRA	AIS	Date	11/15/48
pН	6.71			Men	nbrar	ne age		3.0	ye:	ars 🔻	Ch	em ty	ре			H2SO4 🔻
Temp	25	5.0 C	-	Che	m do	sing rate	e	.0	l pp	m 🔽	Ch	em co	once	ntral	tion,%	100 ≑
Flux dec	cline % p	er yea	ar	Г		7.0			Fe	eed wa	ter ty	pe	Sur	face	Wate	r 🔻
SP incre	ease % p	er yea	ar	Ĺ		10.0			Pe	ermeat	e bler	nding		Per	meate	throttling
Product	recovery	y, %				70.0			Co	oncent	rate r	ecirc.		Boo	oster p	ump 🗌
Permeat	te flow		m3/hr	-		7.00										
Average	e flux rate	e I	l/m2-hr	-		23.5										
Feed flo	W		m3/hr	-		10.0										
Concen	trate flo <del>v</del>	•	m3/hr	-		3.0										
Calculation Results Pressure bar V Flow/vessel m3/hr V/m2-hr V 1 1																
Arrav	Vessels	E F	eed	Cor	nc.	F	eed			Conc		Flux	(   I	Beta		
1-1	1		12.4		11.3	}	1	0.0			6.U 2.0	26	.9 ว	1.1	4	
1-2	1		0.0		10.7 0 0	1		0.0			0.0	20	. <u>2</u> 0	0.0		Run
1-4		I	0.0		0.0	, j		0.0			0.0	Ő	.0	0.0	IO 🔽	Next
Permea	ate conc	entral	tion (pp	m)												Flow diagr.
Ca	0.00	ĸ	5.	77 Sr		0.00	S04	2	2.17	NO3	0	.10 C	02	10	6.90	Print
Mg	0.00	NH4	1.	73 CO	)3	0.00		13	3.59	Si02	0	.32 p	H		5.4	
Na	10.17	Ba	0.	00 HC	:03	15.59	F	1	0.02	Total	TDS		19.5	ppn	י י	Clipboard
Concer	ntrate pa	ramet			0.	- 0	<b>.</b> .			_					7.0	Analysis
LaSU4	sat, %		0 5150	4 sat	, %	U	Ionic	stren	gth		U		H	_	7.2	
BasU4	sat, %		0 5102	sat, i	/0	4/	USMO	ac pr	essu	re	4	1.4 D				AutoDisplay
Satura	ation Ind	ex:	Langelie	er 🛛	0.0	Stiff & D	avis	0	0.00	Total 1	DS	694	2.6	hhiy		

 เมื่อทำการแก้ไขตามที่โปรแกรมแนะนำแล้วจะเห็นว่าไม่พบตัวเลขสีแดง แสดงว่า OK ใช้ mouse click ปุ่ม Check box Auto display แล้ว Click ปุ่ม Run เพื่อให้โปรแกรมทำงานต่อไป



	<b>1</b>			- I- D			_
- I - I	COC	esie	n uu	СКК	esui	is scre	en
_							

File Close

Hydrai	nautics Nem	brane Sc	olutions Des BA	sign Sof SIC DES	itware, v. 8 SIGN	.5 (c)	2003 15	/11/2548
RO pro	ogram licen	sed to:						
Projec	lation crea	ted by:	FURNSAK SAR	DENKRA	ISUKAKII		7	00 = 3/b=
	n flow	анснат	10 0 •3/6	ir Pai	water flow.		10	0 m3/hr
Recom	ended numn	nress '	13 6 har			-	10	
Feed	ressure:	pr033.	12 4 har	Per	rmeate recov	erv rai	tio: 70	0 %
Feedva	iter Temper	ature:	25.0 C(77	F)	20000 10000	.,		
Feed v	ater pH:	6.71	(0.00)	– Éle	ement age:		3	.0 years
Acid o	losage, pp <b>n</b>	(100%):	0.0 Ĥ2SC	)4 Flu	1x decline 🎗	per ye	ear: 7	.0
Acidi	fied feed C	02 :	106.9	Sal	lt passage i	ncrease	e, %/yr: 10	. 0
Averag	ge flux rat	e:	23.5 1/m2	2-hr Fee	ed type:	9	Surface Vat	er
Stage	Pern. Fl	ov∕Vesse	el Flux Be	eta Co	onc.&Throt.	Eleme	ent Ele:	n. Array
_	Flov Fee	d Cor	1C		Pressures	Tyı	pe N	<b>o</b> .
	m3/hr m3/h	r m3/h1	r 1∕∎2-hr		bar bar			
1-1	4.0 10.	0 6.0	26.91.	14 1	L1.3 0.0	CI	243	4 1x4
1-2	3.06.	0 3.0	0 20.21.	19 1	LO.7 O.O	CI	PA3	4 1x4
+	⊦Ra <b>v v</b>	ater	Feed wat	er	Permeat	e	Concent:	rate+
Ion	∎g∕l	∎eq⁄l	∎g∕l	∎eq⁄l	∎g∕l	∎eq∕l	∎g∕l	∎eq∕l
ICa	0.0	0.0	0.0	0.0	0.00	0.0	0.0	0.0
j∦g	0.0	0.0	0.0	0.0	0.00	0.0	0.0	0.0 j
Na	483.3	21.0	483.3	21.0	10.17	0.4	1587.3	69.0
K	220.0	5.6	220.0	5.6	5.77	0.1	719.9	18.5
INH4	66.0	3.7	66.0	3.7	1.73	0.1	216.0	12.0
Ba		0.0	0.000	U.U		U.U	0.000	0.0
			0.000	U.U 0 0		0.0		
	274 5	6 1	0.Z 274 E	U.U 6 1	U.UU 15 59	0.0	0.7	10.0 1
ISO4	369 4	7 7	369 4	7 7	2 17	0.5	1226 3	25 5
lici	583 2	16 5	583 2	16 5	13 59	0 4	1912 3	53 9
İF	0.4	0.0	0.4	0.0	0.02	Ŏ.Ô	1.3	0.1
I NO3	0.6	0.0	0.6	0.0	0.10	0.0	1.8	0.0 j
Si02	19.8		19.8		0.32		65.3	ļ
	2117.4		2117.4		49.5		6942.6	+
₽Ę	6.7		6.7		5.4		7.2	ļ
4								+
		_		Rav vat	ter Fee	d water	Conce	ntrate
CaS04	/ Ksp # 10	0:		0%		0%		0%
SrS04	/ Ksp ≢ 10	U :		0%		0%		0%
Ba504	/ Ksp # 10	U:		144		14*		0%
5102 s	saturation:	tion Ind	lo <del></del>	14%	10	14%	4	/4
Ctiff	Lier Satura & Davie Ca	turation	Tadee	0.0	10	0.00		0.00
Ionic	strength	curation	THUCK	0.0	13	0.00		0.00
Osmoti	ic pressure			1	bar	1.4	bar	4.4 bar
	p	_	_		 			
AL eta	rt 🗠 🙋	🍋 » 📷	DO Software Decia		O preceptation (w	H.L. H.	dranautics P.O. Pr	Est Dadasier
20 Sta		-	rice bortware besig.		to presentation (M	a a fille	aranautics KO Pr	, Rouesign

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File Analysis RODesign UF Treatment Calculation Graphs Help



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File Analysis RODesign UF Treatment Calculation Graphs Help

Project	Chanch	ai			Calco	ulated I	by PO	RNSAK	SAN	ORNKF	AIS Da	te	11/15/48	
Н	6.71		L L	Membrar	ne age		3.0 ye	ars 🔻	Ch	em type			H2SO4 🔻	
emp	2!	5.0 C	-	Chem da	sing rate		.0 pr	m 🔻	Ch	em conc	entration	1 <i>,</i> %	100 🗘	
lux dec	; line % p	er yea	r		7.0		F	eed wa	ter ty	pe S	urface W	'ater	•	
SP incre	ease % p	er yea	ır		10.0		Р	ermeate	e bler	nding 🔽	Perme	ate I	throttling 🗌	
Product	recover	y, %	-		70.0		C	oncenti	rate r	ecirc. 🗆	Booste	er pu	IMP 🗌	
Permeat	e flow		m3/hr 📑	•	7.00									
verage	flux rate	e l	m2-hr	-	23.5									
eed flo	₩		m3/hr 🔄	-	10.0									
Concent	rate flov	•	m3/hr 🔄	-	3.0									
-Calcul	lation Re	esults-	Pressure	bar	•	Flow	/vessel	m3/h	r 🔻	l/m2-hr	•		Passes	
Arrav	Vessels	i Fe	ed	Conc.	F	eed		Conc		Flux	Beta	^	<b>_</b>	
1-1	1	1	12.4	11.3	3	10	D.O		6.0	26.9	1.14			
1-2	]	1	11.3	10.7	/ 1	1	5.U D A		3.U 0.0	20.2	0.00		Bun	
1-3		i	0.0	0.0	, 1	Ì	D. O		0.0	0.0	0.00	<b>~</b>   '	Next	
Permea	te conc	entrati	ion (ppm)										Flow diagr	
Ca	0.00	K	5.77	Sr	0.00	SO4	2.17	NO3	0	.10 CO2	106.9	90   ·	Tion diagi.	
Mg	0.00	NH4	1.73	CO3	0.00	CI	13.59	SiO2	0	.32 pH	5	.4	Print	
Na	10.17	Ba	0.00	HCO3	15.59	F	0.02	Total 1	<b>FDS</b>	49.	5 ppm	•	Clipboard	
Concer	trate pa	ramete	ers										Analysis	
CaSO4	sat, X		0 SrSO4	sat, %	0	lonic s	trength		0	.11 pH	7	.2 1		
BaSO4	sat, %		O SiO2 s	at, %	47	Osmoti	c pressu	ire	4	4.4 bar				
Satura	ation Ind	ex: L	.angelier	0.0	Stiff & D	avis	0.00	Total T	DS	6942.0	6 ppm		. iatob iopia	,

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13. เมื่อต้องการปรับค่า pH ของน้ำ permeate ให้เลือก toolbar treatment

### Hydranautics RO Projection Program - [Analysis]

File Analysis RODesign UF Treatment Calculation Graphs Help

Project					Code	ROPERM	Feed R	D Permeate		-	Date	28/	11/254
pН	5.39		Tu	up 🗌	.0		E cond	86	uS/cm	CO2	2 1	06.9	) ppm
Temp	25.0	C 🔻	SD		.0	15min 💌	H2S	.0	ppm	Fe			) ppm
Ca	.0	ppm	-	.0	) mec	1	CO3	.0	ppm	-	-	00	neq
Mg	0.	ppm	-	.0	) mec	1	HCO3	15.6	ppm	-	-	26	neq
Na	10.2	ppm	-	.4	4 mec	1	SO4	2.2	ppm	-	-	05 I	neq
К	5.8	ppm	-	.1	5 mec	1	CI	13.6	ppm	-	-	38 1	neq
NH4	1.7	ppm	-	.1	) mea	1	F	.0	ppm	-	-	00 1	neq
Ba	.000	ppm	-	.0	) mea	1	NO3	.1	ppm	$\mathbf{T}$	-	00	neq
Sr	.000	ppm	-	.0	) mea	1	SiO2	.3	ppm	-	-	00 1	neq
	Total	Positive		.6	9 mec	Auto	balance	Total	Negativ	e	-	69 I	neq
Cacicula	ted TDS		49	ppm			lonic st	renath		01		Prir	nt
CaSO4 s	aturation		.0	%			BaSO4	saturation		.0	% C	lipbo	bard
Silica sa	turation		.2	%			SrSO4 s	aturation		.0	%	Sav	/e
Saturatio	on Index	0	).O	Langelier	-		Osmotic	pressure		.5 J	osi	-	
		D:			_L		/1000/						
		Dosi	ng	rate of	cnem	licals, pp	om (100%	concent	ationj				_
Na	OH	NaHCO3	1	Na2CO	)3	Ca(OH)	2 H2	SO4	HCI		C	02	
	.0 🗘 🗌	.0	ŧ.		D 🖨	.0	÷ –	.0 🕈	.0	1	10	)6.9	1
			_			Poster					,		
						neston	-						



Analysis RODesign UF Treatment Calculation Graphs Help File

Incident	Chanch	ai				Calar	ulated b	PO	BNSA	K SAI	MORN	KBA			11/15/40	
noject					4	Laici		<b>y</b> 10	IIIIJA				Dat	te	11/13/40	
н	6.71			_ [	embrai	ne age		3.U ye	ars		iem (y	ре			H2SO4 -	
emp	2	5.0 0	c _	- C	Chem do	osing rate	e	.O PI	m _	r Cł	nem co	oncei	ntration	1,%	100 🖨	
lux dec	cline % p	er ye	ar			7.0		F	eed wa	ater ty	ре	Surf	iace Wa	ater	r 💌	
P incre	ease % p	er ye	ar			10.0		Р	ermea	te ble	nding		Permea	ate	throttling 🗌	
roduct	recover	y, %				70.0		C	oncen	trate	recirc.		Booste	er pu	ump 🗌	
ermea	te flow		<b>m</b> 3	/hr 💽	·	7.00										
verage	e flux rat	e	l/m2	?-hr 🗖	·	23.5										
eed fla	w		m3	/hr 🗖	•	10.0										
oncen	trate flow	v	m3.	/hr 🗖	·	3.0										
C-I	I-E D.			_										_	Passes	
Laicu	lation Re	esuits	Pre	essure	bar	-	Flow/	vessel	m3/	hr 🔻	l/m2-	hr 🔻			1	
Arrav	Vessel	s F	eed	1	Conc.	F	eed		Conc		Fluz	c E	Beta 🛃	~		
1-1	1	l	1	2.4	11.3	3	10	.0		6.0	26	.9	1.14			
1-2	1	l	1	1.3	10.1	7	6	.0		3.0	20	.2	1.19			
1-3	(	)		0.0	0.0	D	0	.0		0.0	0	.0	0.00		Run	
1-4	(	)		0.0	0.0	0	0	.0		0.0	0.	.0	0.00	<b>~</b>	Next	
Permea	ate conc	entra	tion	(ppm)											Flow diagr.	
Ca	0.00	к		5.77	Sr	0.00	SO4	2.17	NO3	0	).10 <mark>C</mark>	02	106.9	0	Print	
Mg	0.00	NH4		1.73	CO3	0.00	CI	13.59	SiO2	(	). 32 pl	H	5.	4	FIIR	
Na	10.17	Ba		0.00	HC03	15.59	F	0.02	Total	TDS	4	19.5	ppm 📘		Clipboard	
Concer	ntrate pa	rame	ters												Analysis	
CaSO4	sat, %		0 9	GrSO4	sat, %	0	lonic st	rength		. (	).11 pl	H	7.	2		
BaSO4	sat, %		0 9	6iO2 sa	at, %	47	Osmotic	c pressu	Ire		4.4 b	ar			AutoDisola	au
Satur	ation Ind	ex:	Lan	gelier	0.0	Stiff & D	) avis	0.00	Total	TDS	694	2.6	opm		- Automapic	•3

14. Mouse Click ปุ่ม Toolbar Graphs เพื่อดูกราฟความสัมพันธ์ต่างๆ

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File Analysis RODesign UF Treatment Calculation Graphs Help



Perm Salinity vs Pressure vs Pressure vs Perm Salinity Temperature Temperature Recovery vs Recovery Permeate recovery range Recovery, low limit % 50.0 Plot Recovery, high limit 75.0 % Close



File Analysis RODesign UF Treatment Calculation Graphs Help



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File Analysis RO Design UF Treatment Calculation Graphs Help





File Analysis RODesign UF Treatment Calculation Graphs Help



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File Analysis RODesign UF Treatment Calculation Graphs Help





กรณีแหล่งน้ำดิบมากกว่า 2 แหล่งต้องมีการทำ Blending หมายถึง การผสมแหล่งน้ำดิบมากกว่า 2 แหล่งขึ้นไปเพื่อนำเข้าระบบ RO ขั้นตอนการทำ Blending มีดังนี้

1. ลงผลวิเคราะห์น้ำแหล่งน้ำแหลง่ที่ 1 ลงในช่องผลวิเคราะห์น้ำ

2. ทำ Autobalance

Save ข้อมูลผลวิเคราะห์น้ำ โดยไปที่ Toolbar Analysis\Save\analysis
 ลงผลวิเคราะห์น้ำแหล่งน้ำแหลง่ที่ 2 ลงในช่องผลวิเคราะห์น้ำ

5. ทำ Autobalance

6. Save ข้อมูลผลวิเคราะห์น้ำ โดยไปที่ Toolbar Analysis\Save\analysis

### 📲 Hydranautics RO Projection Program - [Analysis]

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File Analysis RODesign UF Treatment Calculation Graphs Help

Project			C	ode		Feed W	ell Water		•	Date	28	/11/254
pН	7.00	T	urb	.0		E cond	0	uS/cm	CO	2		.0 ppm
Temp	25.0	C 🗕 S	DI	.0	15min 💌	H2S	.0	ppm	Fe			.0 ppm
Ca	.0	ppm 🔻	.00	meq		CO3	0.	ppm	-		.00	meq
Mg	.0	ppm 💌	.00	meq	i i	HCO3	.1	ppm	-		.00	meq
Na	.0	ppm 🔻	.00	meq	(	SO4	.0	ppm	-		.00	meq
ĸ	.0	ppm 💌	.00	meq		CI	.0	ppm	-		.00	meq
NH4	.0	ppm 💌	.00	meq		F	.0	ppm	-		.00	meq
Ba	.000	ppm 💌	.00	meq	1	NO3	.0	ppm	-		.00	meq
Sr	.000	ppm 💌	.00	meq		SiO2	.0	ppm	-		.00	meq
	Total	Positive	.00	meq	Autoba	alance	Total	Negativ	e		.00	meq
Caclcula	ted TDS	0	ppm			lonic str	ength	(	000		Р	int
CaSO4 s	aturation	.0	%	Not a	a complete	data set	ituration		.0	%	Clipt	breoc
Silica saturation0			%				SrSO4 saturation		.0	%	Save	
Saturation Index 0.0			Langelier	-		Osmotic		.0	psi	-		

# 1. ลงผลวิเคราะห์น้ำแหล่งน้ำแหลง่ที่ 1 ลงในช่องผลวิเคราะห์น้ำ

## 2. ทำ Autobalance

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### 📲 Hydranautics RO Projection Program - [Analysis]

File Analysis RODesign UF Treatment Calculation Graphs Help

_	Op	pen												-	_		
Pro	Ne	ew				C	ode	CHAN	CH	Feed Su	urface Wate	er 👘	1	r Dat	e		
рH	Ne	ew TDS/Cond	۱ -		urb 🛛		1.7			E cond	3457	uS/cm	CC	12	106.	9 ppm	ŀ
Te	Sa	ive	•	Ana	ysis		.0	15min	-	H2S	.0	ppm	Fe			0 ppm	
Ca	Ble	end Jaka		Pern	neate		mea		_	CO3	2	ppm	-		01	mea	1
Mg	De	siece I .U	ppn	n 🔻	lentrat	.00	meq			HCO3	374.5	ppm	•	<u> </u>	6.14	meq	
Na		483.3	ppn	n 🔻	i –	21.01	meq			S04	369.4	ppm	•	ĺ –	7.70	meq	
К	220.0 p			n 🔻	i –	5.64	meq			CI	583.2	ppm	-	<u> </u>	16.45	meq	
NH	H4 66.0 p			n 🔽		3.67	meq			F	.4	ppm	-		.02	meq	
Ba		.000	ppn	n 🔻		.00	meq	i		NO3	.6	ppm	-		.01	meq	
Sr		.000	ppn	n 🔽		.00	meq	1	S		19.8	ppm	$\mathbf{v}$		.00 mea		
		Total	Posi	tive		30.32	meq	Autoba		alance Tota		Total Negativ			30.32		
Cac	Caclculated TDS			2117	2117 ppm					lonic str	Ionic strength		)34	Print		int	
CaSO4 saturation				.0	.0 %					BaSO4 :	saturation		.0	% Clipboa		board	
Silica saturation				14.1	%			SrSO4 :		SrSO4 s	aturation	.0		%	% Save		
Saturation Index			0.0	0.0 Langelier		-			Osmotic pressure		1	9.6	psi	-			

## 3. Save ข้อมูลผลวิเคราะห์น้ำ โดยไปที่ Toolbar Analysis\Save\analysis

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File Analys	sis – RO Desi(	IF Treatment	Calculation Graphs Help	_
Project	Chancha	Save As	? 2	3
pН	6.71	Save in	n: 🗁 Project Design(Hydranautics RO) 🗾 🔶 🗈 📸 🎹 🕇	
Temp	25.0	c 💦	analysis	1
Ca	.0	pp 🛄 Mu Becent	🖬 analysis2	
Mg	.0	P Documents	argunanchai2.des	
Na	483.3	까 🔼	understandigerse statistics stat	
ĸ	220.0	an hair an	∰∯Chanchai5(soft+20%).des	
NH4	66.0	pp Desktop	and Chanchai6(ปาบัด+20%).des	
Ba	.000	an 🔨 🗤	ອີພຸ່Chanchai6(ປານັກ+20%+)7m3-h.des	
Sr	.000	ab 💋 🛛	글렉Chanchaib1(sort+20%).des	
	Total F	O My Documents	🗟 setup.dat	
Caclculat	ed TDS	-		
CaSO4 sa	aturation			
Silica sat	uration	My Computer		
Saturation	n Index			
			File name: analysis 🔹 Save	
		My Network	Save as type: All files (*.*)  Cancel	
		Places		

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File Analysis RODesign UF Treatment Calculation Graphs Help

_				<u> </u>	_				_								-
Pro	Op	ben				C	ode			Feed W	ell Water			Date	28	/11/25	j4
-	ive	ew.			_	_		,				e		_ Dates			
pН	Ne	w TDS/Cond	1		-T	urb	.0			E cond	0	uS/cm	CO	2		Оррп	1
Te	Sa	ive	•	-	S	DI	.0	15min	•	H2S	.0	ppm	Fe			O ppn	n
Ca	Ble	end elete		ı	-	.00	meq			CO3	0.	ppm	-		.00	meq	
Mg		.U.	ppr	n	•	.00	meq	i		HCO3	.1	ppm	-		.00	meq	
Na		.0	ppr	n	•	.00	meq	i		SO4	0.	ppm	-		.00	meq	
ĸ		.0	ppr	n	•	.00	meq			CI	.0	ppm	-		.00	meq	
NH	4	.0	ppr	n	•	.00	meq			F	.0	ppm	-		.00	meq	
Ba		.000	ppr	n	-	.00	meq			NO3	.0	ppm	-		.00	meq	
Sr		.000	ppr	n	•	.00	meq	L		SiO2	0.	ppm	-		.00	meq	
		Total	Posi	itive		.00	meq	A	itoba	alance	Total	Negativ	e		.00	meq	
Cac	lcula	ted TDS			0	ppm				lonic str	ength		00	_	Pr	int	
CaS	04 s	aturation			.0	%	Not	a comp	lete	data set	ituration		.0	%	Clipt	board	
Silic	a sal	turation			.0	%		,		SrSO4 s	aturation		.0	%	Sa	ve	
Sati	uratio	on Index		C	).0	Langelier	-			Osmotic	pressure		.0	psi	-		

## 6. เปิดหน้า toolbar Analysis\Blend

Open				? 🔀		💶 🗗 🔀
Look in: My Recent Documents Desktop My Documents	Project Design analysis analysis2 d Chanchai2.des d Chanchai3.des d Chanchai3.des d Chanchai5(soft d Chanchai5(soft d Chanchai6(ปาป d Chanchai6(ปาป d Chanchai51(sol d Chanchai.des	(Hydranautics RD) +20%).des α+20%).d α+20%+): Date Modified: 18/10/3 t+20%).d Size: 821 bytes	← È ᡤ ⊞.		28/11/254 .0 ppm .0 ppm 0 meq 0 meq 0 meq 0 meq 0 meq 0 meq 0 meq 0 meq 0 meq 0 meq	
My Network Places	File name: Files of type:	analysis All files (*.*) T Open as read-only	•	Open Cancel	Print ipboard Save	

## 7. เลือก file analysis ที่ save ไว้แล้วออกมาเป็น file แรก

File Analysis RO Design UF Treatment Calculation Graphs Help

Chanchai	(1 of 1)	
chanchai	(1011)	
Analysis Name	Code Date	
Chanchai	CHANCH	1
		OK
		Lancel

### 8. Click OK

### 🙀 Hydranautics RO Projection Program - [Analysis]

File Analysis RODesign UF Treatment Calculation Graphs Help

Feed Wa	eed Water Blending														
No. 1 🗧	Analysis o	ode CH.	ANC	H Fla	W		.0	m3/hr	٠	0 Tot	al Flow			.0	0K
								m3/hr	^	1				_	
Project	BLEND1				Code	e	CHANC	m3/d apm		face Wate	er -	-	Date	287	17254
pН	6.71		Tu	up		D		gpd		3482	uS/cm	CO	2 1	06.5	ppm
Temp	25.0	C 🔽	SC	ы		D	15min	m3/hr m3/d		.0	ppm	Fe		.(	ppm
Ca	66.3	ppm	-	3.	.31 m	eq		gpm		.2	ppm	-	ا.	11	neq
Mg	1.7	ppm	-		.14 m	eq		gpd	-	374.5	ppm	-	6.1	4	neq
Na	403.0	ppm	-	17.	.52 m	eq		SO4		369.4	ppm	-	7.	70 I	neq
ĸ	220.0	ppm	-	5.	.64 m	eq		CI		583.2	ppm	-	16.4	15 1	neq
NH4	66.0	ppm	-	3.	.67 m	eq		F		.4	ppm	-	ا.	12	neq
Ba	2.800	ppm	-		.04 m	eq		NO3		.6	ppm	<u> </u>		11	neq
Sr	.000	ppm	-		.00 m	eq		SiO2	Ļ	19.8	ppm	-		)O I	neq
	Total	Positive		30.	.32 m	eq	Au	tobalance		Total	Negativ	e	30.3	32 I	neq
Caclculated TDS 210				ppm				lonic	str	ength	.036		Print		it
CaSO4 s	CaSO4 saturation 4.3			%				BaSO	<b>4</b> s	aturation	1556	5.9	% <u></u> C	ipbo	ard
Silica sal	Silica saturation 14.1			%				SrSO4 saturation				.0	%	Sav	e
Saturatio	aturation Index			Langeli	lier 🔻			Osmo	Osmotic pressure		19	<b>3.0</b>	psi 💌		

## 9. ใส่จำนวนตัวเลข flow ที่ต้องการและหน่วย

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### 🙀 Hydranautics RO Projection Program - [Analysis]

File Analysis RO Design UF Treatment Calculation Graphs Help

Feed Wa No. 1≑	ter Blendir Analysis c	ng :ode CH/	ANCI	H Flow		5.0 n	n3/hr 💌	100 Tot	al Flow		5.0	OK
Project	BLEND1			C	ode	CHANCH	Feed St	urface ₩ate	;r	•	Date 28.	/11/254
рН	6.71		Tu	rb-	.0		E cond	3482	uS/cm	C02	106.	5 ppm
Temp	25.0	C 🔻	SD	1	.0	15min 💌	H2S	.0	ppm	Fe		.0 ppm
Ca	66.3	ppm	-	3.31	meq		CO3	.2	ppm	-	.01	meq
Mg	1.7	ppm	-	.14	meq	1	HCO3	374.5	ppm	-	6.14	meq
Na	a 403.0 ppm			17.52	meq	1	S04	369.4	ppm	-	7.70	meq
ĸ	220.0	ppm	-	5.64	meq	1	CI	583.2	ppm	-	16.45	meq
NH4	66.0	ppm	-	3.67	meq		F	.4	ppm	-	.02	meq
Ba	2.800	ppm	-	.04	meq		NO3	.6	ppm	-	.01	meq
Sr	.000	ppm	-	.00	meq		SiO2	19.8	ppm	-	.00	meq
	Total Positiv			30.32	meq	Auto	balance	Total	Negativ	e	30.32	meq
Caclcula	opm			lonic str	rength	.0	36	Print				
CaSO4 s	aturation		4.3	%			BaSO4 :	saturation	1556	5.9 %	; Clipt	board
Silica sal	Silica saturation 14.1 %						SrSO4 s	.0		; <u>S</u> a	ive	
Saturatio	n Index	-(	).5 L	angelier	elier 🔻 Osmotic pressure 19.0 psi				si 🔻			

Mouse Click ช่อง Feed Water Blending NO.เพื่อ
 เปลี่ยนเป็นแหล่งน้ำที่ 2



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Open					? 🛛			_ 8
Look in: My Recent Documents Desktop My Documents	Project Desig analysis analysis chanchai2.des chanchai3.des chanchai4.des chanchai6(unu chanchai6(unu chanchai6(unu chanchai6(unu chanchai51(so chanchai.des chanchai.des	n(Hydranautics RO) ; ; t+20%).des ĭø+20%).des ĭø+20%).des iø+20%).des	★ €	<b>* •</b>		.0 OK 28/11/254 D6.5 ppm .0 ppm D1 meq 14 meq 70 meq 15 meq 12 meq D1 meq 12 meq 11 meq 2 meq 2 meq 2 meq 2 meq		
My Network Places	File name: Files of type:	analysis2 All files (*.*) Open as read-only		•	Open Cancel	Print ipboard Save		

# 11. เลือกผลวิเคราะห์น้ำแหล่งที่ 2 Click Open

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File Analysis RO Design UF Treatment Calculation Graphs Help

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		(1 of 1)	Chanchai
		Code Date	Analysis Name
	1	CHANCH	Chanchai

## 12. Double Click เพื่อเปิด file

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#### 📲 Hydranautics RO Projection Program - [Analysis]

File Analysis RO Design UF Treatment Calculation Graphs Help

Feed Wa	ater Blendir Analysis c	ng :ode CH/	ANC	H Flow		3.0	m3	/hr 💌	0 Tot	al Flo <del>w</del>	Γ	5.0	OK
Project	BLEND1			C	ode	CHANC	H	Feed Su	irface Wate	;r	-	Date 28	/11/254
рН	6.71		Tu	ırb-	.0			E cond	3482	uS/cm	CO2	2 106	.5 ppm
Temp	25.0	C 🔻	SD	II .	.0	15min	•	H2S	.0	ppm	Fe		.0 ppm
Ca	66.3	ppm	-	3.31	meq	1		CO3	.2	ppm	-	.01	meq
Mg	1.7	ppm		.14	meq	1		HCO3	374.5	ppm	-	6.14	meq
Na	403.0	ppm	-	17.52	meq			SO4	369.4	ppm	-	7.70	meq
К	220.0	ppm	-	5.64	meq	1		CI	583.2	ppm	-	16.45	meq
NH4	66.0	ppm	-	3.67	meq	1		F	.4	ppm	-	.02	meq
Ba	2.800	ppm	-	.04	meq			NO3	.6	ppm	-	.01	meq
Sr	.000	ppm	-	.00	meq			SiO2	19.8	ppm	-	.00	meq
	Total	Positive		30.32	meq	Aut	toba	alance	Total	Negativ	e	30.32	meq
Caclcula	ted TDS	21	08 I	ppm				lonic str	ength		36	Pi	rint
CaSO4 s	aturation		4.3	%				BaSO4 :	saturation	1556	5.9	% Clip	board
Silica sa	turation	14	<b>1</b> .1	%				SrSO4 s	aturation		.0	% <u>S</u> a	ave
Saturatio	on Index	-(	).5 I	Langelier	•			Osmotic	pressure	1	9.0	osi 💌	

### aturation 15565.9 % Clipboard aturation .0 % Save pressure 19.0 psi •

# 13. ใส่จำนวน flow แหล่งน้ำที่ 2 ที่ต้องการป้อนเข้าระบบ RO

\_ 7 🛛

🛓 Hydrar	nautics RC	) Projec	ctior	ı Progran	n - [A	nalysis]											_ 7 🛛
File Analys	sis RODes	ign UF	Trea	atment Ca	lculati	ion Graphs	Help										
Feed Wat No. 2 🗧	ter Blendir Analysis c	ng :ode CH/	ANC	H Flow		3.0 m3	3/hr 💌	38 Tot	al Flow	ſ	8.		ж	เปอร์เซ็นต์นั้	้าเข้า <b>R(</b>	C	
Project	BLEND1			C	ode	CHANCH	Feed Su	rface Wate	er	•	Date 2	8/11/2	254	< จำนวน Flo	w ทั้งหา	เด	
рН	6.71		Tu	rb	.0		E cond	3482	uS/cm	CO2	2 10	16.5 PPI	pm			<b>V</b> 11	
Temp	25.0	C 🔽	SD	1	.0	15min 💌	H2S	.0	ppm	Fe		.0 PPI	pm				
Ca	66.3	ppm	-	3.31	meq		CO3	.2	ppm	-	.0	1 meq					
Mg	1.7	ppm	-	.14	meq	i	HCO3	374.5	ppm	-	6.1	4 meq					
Na	403.0	ppm	-	17.52	meq		SO4	369.4	ppm	-	7.7	0 meq					
ĸ	220.0	ppm	-	5.64	meq		CI	583.2	ppm	-	16.4	5 meq					
NH4	66.0	ppm	-	3.67	meq		F	.4	ppm	<b>-</b>	.0	2 meq					
Ba	2.800	ppm	<b>x</b>	.04	meq		NO3	.6	ppm	-	.0	1 meq					
Sr	.000	ppm	-	.00	meq		SiO2	19.8	ppm	-	.0	0 meq					
	Total	Positive		30.32	meq	Autob	alance	Total	Negativ	e	30.3	2 meq					
Caciculat	ed TDS	21	08 F	opm			lonic str	ength	.0	)36	_	Print					
CaSO4 sa	aturation		4.3	%			BaSO4 :	saturation	1556	5.9	% Cli	pboard	<u>1</u>				
Silica satu	uration	14	4.1	%			SrSO4 s	aturation		.0	%	Save					
Saturation	n Index	-(	D.5 L	angelier	-		Osmotic	pressure	1	9.0 J	psi 🔹	-					

14. Click OK

### 📲 Hydranautics RO Projection Program - [Analysis]

File Analysis RO Design UF Treatment Calculation Graphs Help

Feed Wa No. 2 ≑	ater Blendir Analysis c	ig :ode CH/	ANC	H Flow		3.0	m	8/hr 💌	38 Tot	al Flow		8.0	OK
Project	BLEND1				Code	BLEND	)1	Feed Su	ırface Wate	;r	-	Date 28	/11/254
рH	6.71		Tu	up 🗌	.0			E cond	3482	uS/cm	C02	106	.5 ppm
Temp	25.0	C 🔽	SC	ы	.0	15min	-	H2S	.0	ppm	Fe		.0 ppm
Ca	66.3	ppm		3.31	mea	1		CO3	.2	ppm	-	.01	meq
Mg	1.7	ppm		.14	mea	1		HCO3	374.5	ppm	-	6.14	meq
Na	403.0	ppm	-	17.52	mea	1		SO4	369.4	ppm	-	7.70	meq
ĸ	220.0	ppm	-	5.64	mea	1		CI	583.2	ppm	<u> </u>	16.45	meq
NH4	66.0	ppm	-	3.67	mea	1		F	.4	ppm	<b>-</b>	.02	meq
Ba	2.800	ppm	-	.04	mea	1		NO3	.6	ppm	<u> </u>	.01	meq
Sr	.000	ppm	-	.00	mea	1		SiO2	19.8	ppm	-	.00	meq
	Total	Positive		30.32	mea	A	itob	alance	Total	Negativo	e	30.32	meq
Caclcula	ted TDS	21	08	ppm				lonic str	ength	.0	36	Pi	int
CaSO4 s	aturation		4.3	%				BaSO4 :	saturation	1556	5.9 %	; Clipl	board
Silica sa	turation	14	<b>f.</b> 1	%				SrSO4 s	aturation		.0 %	; Sa	ive
Saturatio	on Index	-(	0.5	Langelier	•			Osmotic	pressure	19	9.0 p	si 🔻	

### 15. Click RO Design



File Analysis RODesign UF Treatment Calculation Graphs Help





18. ใส่ตัวเลข Permeate Flow

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### - [RO Design]

File Analysis RODesign UF Treatment Calculation Graphs Help

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Project BLEND1	Calcu	lated by		Date 11/28	B/48		
pH 6.71	Membrane age	.0 years	- Chem type	H2SO	94 🔽		
Temp 25.0 C 💌	Chem dosing rate	.0 ppm	- Chem con	centration,%	100 ≑		
Flux decline % per year	7.0	Feed	water type S	urface Water	•		
SP increase % per year	10.0	Perm	eate blending	Permeate throttli	ing 🗌		
Product recovery, %	60.0	Conc	entrate recirc.	Booster pump			
Permeate flow m3/hr	▼ 5.00	Element Selecti	0.0				
Average flux rate I/m2-hr	- 22.4	Model	Nom prod	Bei	Flement tune	Size	
Feed flow m3/hr	▼ 8.3	ESNA1-LE-404	1.600 cmd.	86.0% rejection	Softening composite	4.0 x 40.0	~
Concentrate flow m3/br	× 33	ESNA1-LF	7.500 and.	86.0% rejection	. Softening composite	8.0 x 40.0	
		ESPA-2540	750 gpd,	98.0% rejection	, Low pressure composite	2.5 x 40.0	
		ESPA1-4040	2,600 gpd,	99.3% rejection	, Low pressure composite	4.0 x 40.0	
		ESPA2-4040	1,900 gpd,	99.6% rejection	, Low pressure composite	4.0 x 40.0	
Stage 1	Stage 2	ESPA3-4040	3,000 gpd,	98.5% rejection	, Low pressure composite	4.0 x 40.0	
System Specs		ESPA4-4040	2,500 gpd,	99.2% rejection	, Lowest pressure composite	4.0 x 40.0	
Element type CPA3	CPA3	ESPA1	12,000 gpd,	99.3% rejection	, Low pressure composite	8.0 x 40.0	
Elements/vessel		ESPA2	9,000 gpd,	99.6% rejection	, Low pressure composite	8.0 x 40.0	
Massala 3	3	ESPA3	14,000 gpd,	98.5% rejection.	, Low pressure composite	8.0 x 40.0	
vessels 1	1	ESPA4	12,000 gpd,	99.2% rejection	, Lowest pressure composite	8.0 x 40.0	
		CPR2-4040	2,250 gpd,	99.3% rejection	, High rejection composite	4.0 x 40.0	
		CPA2	10,000 gpd,	99.5% rejection	, High rejection composite	8.0 x 40.0	
Element type		CPA2-HR	10,000 gpd,	99.7% rejection	, High rejection composite	8.0 x 40.0	
Elements/vessel		СРАЗ	11,000 gpd,	99.7% rejection	, High rejection composite	8.0 x 40.0	
Vessels		CPR4	6,000 gpd,	99.7% rejection	, High rejection composite	8.0 x 40.0	
1 000010		LFC1-4040	2,300 gpd,	99.0% rejection	, Low fouling composite	4.0 x 40.0	
		LFC1	11,000 gpd,	99.5% rejection	, Low fouling composite	8.0 x 40.0	
		LFC3-4040	2,000 gpd,	99.7% rejection	, Low fouling composite	4.0 x 40.0	
		LFC3	9,500 gpd,	99.7% rejection	, Low fouling composite	8.0 x 40.0	-
		ОК	Cancel		Select the	n OK or Double Click	
	10		mont	 ที่และเวชร	າ ສາເດັນແຈະລ່າງໃວ		

🛃 start

File Analysis RO Design UF Treatment Calculation Graphs Help



20. ใส่ตัวเลข Elements/vessel และจำนวน vessels

โดยปรกติการออกแบบ RO นั้นจะกำหนด rule of Thumb ไว้ที่น้ำ permeate 1 ลบ.ม/RO element 1 ท่อน (ขนาดเส้นผ่าศูนย์กลาง 8 นิ้ว)

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File Analysis RODesign UF Treatment Calculation Graphs Help



## 21. Click ปุ่ม Run

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File Analysis RO Design UF Treatment Calculation Graphs Help

Project	BLEND	1			Calc	ulated by	, PO	RNSAK			Date	
pН	6.71		I	Membra	ne age		3.0 ye	ars 🔻	Che	em type		H2SO4 🔻
Temp	2!	5.0 C	•	Chem do	osing rat	e	.0 pp	m 🔻	Che	em conce	ntration,%	100 🗘
Flux dec	line % p	er year			7.0		Fe	ed wat	er typ	e Sur	face Wate	• <b>•</b>
SP incre	ease % p	er year			10.0		Pe	ermeate	blen	ding 🔽	Permeate	throttling
Product	recover	y, %			70.0		Co	oncentr	ate re	ecirc. 🗖	Booster p	oump 🗌
Permeat	e flow	m	3/hr 🖪	-	7.00							
Average	flux rat	e I/n	n2-hr	-	23.5							
Feed flo	w	m	3/hr 💌	•	10.0							
Concent	trate flow	v m	3/hr 🔹	-	3.0							
- Calcul	lation Re	esults –	ressure	bar	<b>F</b>	Flow/	vessel	m3/h	r 💌	l/m2-hr 🔻		Passes
Arrav	Vessel	s Fee	ed 👘	Conc.	F	eed		Conc		Flux I	Beta 🔺	
1-1	1	1	12.3	11.	3	10. c	U n		6.U 2.0	26.8	1.14	
1-2	נ ו	1	0.0	10.	0 N	0.	0		0.0	20.5	0.00	Run
1-4	Ì	, )	0.0	0.	0	0.	0		0.0	0.0	0.00 🔻	Next
Permea	ate conc	entratio	n (ppm)									Flow diagr.
Ca	0.30	K	5.98	Sr	0.00	SO4	2.06	NO3	0.	09 CO2	106.54	Print
Mg Na	8.79	NH4 Ba	0.01	HCO3	14 78	F	12.89	SIUZ Total T	DS	32 pH 47 0	0.4 DDM <b>V</b>	Clipboard
Concer	ntrate pa	rameter	\$	Warnin	ig: satura	ation limi	ts exce	eded-cl	lick h	ere for m	ore info	Analusis
CaSO4	sat, %	19	SrSO4	sat, %	0	lonic str	ength		0.	12 <mark>pH</mark>	7.2	
BaSO4	sat, %	67042	SiO2 sa	at, %	47	Osmotic	pressu	re	4	.3 bar		AutoDisplay
Satura	ation Ind	ex: La	ngelier	1.0	Stiff & D	) avis	0.70	Total T	DS	6916.6	ppm	
									_			

22.กรณีขึ้นตัวเลขสีแดงแสดงว่าเกิดความผิดปรกติ เราสามารถดูวิธีการแก้ไขโดย นำ mouse ไปdouble click ตรง Warning : โปรแกรมจะบอกรายละเอียด วิธีการแก้ไขให้

😂 🕑 🦾



🥏 RODE	SIGN					×
File Edit	Bookma	irk Optior	ns Help			
Contents	Index	<u>B</u> ack	<u>P</u> rint	<u>&lt;</u> <	<u>&gt;</u> >	
Cat	the second	0.00000	22.71			

Saturation Index

Saturation indices are exceeded. A red message will appear that tells the user when saturation limits are exceeded. Recommended limits for various indices and salts are given in the Limits section of Help. System recovery can be reduced when saturation limits are exceeded. Another alternative is to decrease the pH of the feed stream so that the concentration of bicarbonate ion is reduced; this reduces the risk of precipitating of sparingly soluble carbonate salts from the concentrate stream. Where high concentrations of sulfate salts in the concentrate stream presents a risk of sulfate salts precipitation, use of hydrochloric acid instead of sulfuric acid when acidifying feed may be an acceptable alternative.

LSI (Langlier Saturation Index): LSI is a method of reporting the scaling or corrosive potential of low TDS brackish water based on the level of saturation of calcium carbonate. LSI is important to boiler water and municipal plant chemists in determining whether a water is corrosive (has a negative LSI) or will tend to scale calcium carbonate (has a positive LSI). LSI is important to RO chemists as a measurement of the scaling potential for calcium carbonate. The LSI value is calculated by subtracting the calculated pH of saturation of calcium carbonate from the actual feed pH. Calcium carbonate solubility decreases with increasing temperature (as evidenced by the liming of a teakettle), higher pH, higher calcium concentration, and higher alkalinity levels. The LSI value can be lowered by reducing pH by the injection of an acid (typically sulfuric or hydrochloric) into the RO feed water. A recommended target LSI in the RO concentrate is negative 0.2 (which indicates that the concentrate is 0.2 pH units below the point of calcium carbonate saturation). A negative 0.2 LSI allows for pH excursions in actual plant operation. A polymer-based antiscalant can also be used to inhibit the precipitation of calcium carbonate. Some antiscalant suppliers have claimed the efficacy of their product up to a positive LSI value of 2.5 in the RO concentrate (though a more conservative design LSI level is +1.8). Sodium hexametaphosphate, an inorganic antiscalant, was used in the early days of RO but the maximum concentrate LSI was +0.5 and it had to be made in short-lived batches as the air easily oxidized it.

According to Reverse Osmosis, A Practical Guide for Industrial Users (Byrne), LSI is estimated as the difference between the current pH of the water ( pH ) and the pH at which calcium carbonate reaches saturation ( pHLSI ) :

LSI = pH - pHLSI

Where :

pHLSI = (9.3 + A + B) - (C + D)

where :

A = (log(TDS) - 1)/10 B = -13.12 \* log(Temp(0C) + 273) + 34.55 C = log[Ca as CaCO3] - 0.4 D = log[Alk as CaCO3]

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Concentrations in brackets are moles/L and TDS is in mg/L.

🥏 RODE	SIGN									
File Edit	Bookma	'k Optior	ns Help							
Contents	Index	<u>B</u> ack	<u>Print</u>	<u>&lt;</u> <	<u>&gt;</u> >					Minimize
Satura	tion Limi	ts								
Satur	ation L	imits fo	r Spari	ngly So	luble S	alts in the Cor	icentrate			
Salt		<u>S</u>	aturatio	on %						
CaSO	4	1	230							
SrSO4	1	8	300							
BaSO	4	60	000							
SiO2			100							
Limits	of Sati	iration	Indices	3.1						
Condit	tion*						LSI \	<u>alue</u>		
LSI an	d SDS	l withou	t scale	inhibito	r		≤ -1	.2		
LSI & 3	SDSIW	ith SHN	NP (sod	ium hexa	metapho	sphate)	<u> </u>	.5		
LSI & 3	SDSIW	ith orga	anic sca	ale inhib	bitor		<u> </u>	.8		
*La	angelie	r and St	tiff & Da	avis Sat	turatior	Indices				

File Analysis RO Design UF Treatment Calculation Graphs Help

Project	BLEND1	l					Calc	ulated	by								Da	te	11/28/	48
рH	6.71				Me	mbra	ne age		.0	ye	ars	-	Che	m tyj	pe				H2SO4	-
Гетр	25	.0	с	•	Ch	em da	osing rate	e	.0	pp	m	•	Che	m ca	nce	entra	atior	1,%	10	10 ≑
Flux dec	line % pe	er ye	ar				7.0			Fe	eed w	ate	r typ	e	Su	rfac	e₩	ater	r	-
SP incre	ase % pe	er ye	ar		[		10.0			P	ermea	te I	blend	ling	Γ	Pe	erme	ate	throttlin	g 🗌
Product	recovery	, %					60.0			C	oncen	tra	te re	circ.	Γ	Bo	oste	er pu	ump	
Permeato	e flow		m3	/hr	-		5.00													
verage	flux rate	:	l/m2	2-hr	•		22.4													
eed flo	w		m3	hr	-		8.3													
Concent	rate flow		m3	/hr	-		3.3													
-Calcul	ation Re	sults	Pr	essu	ıre 🕞	ar	•	Flow	w/ves	sel	m3/	hr	<b>-</b> I	/m2-l	hr	•			Passe	:s
Arrav	Vessels	F	eed	1	Co	onc.	F	eed			Conc	;		Flux	:	Bet	a	^		
1-1	1			9.6		9.	0		8.3				5.5	25.	3	1.	14			
1-2	1			9.0		8.	4		5.5				3.3	19.	6	1.	17	1	<b>D</b>	_ 1
1-3	U			0.0		U.	0		0.0			- 1	J.U 2.0	U.	U	U. 0	UU ool (		- Ru	n
1-4	<u> </u>			U.U		<u>U.</u>	0		U.U	_			J.U	<u>U.</u>	U	U.	UU	<u> </u>	Ne	et 🔤
Permea		entra r	tion		mj 7c c	-	0.00	CO.4	-	1.20	NO2		0.4		0.2	1	00 7	76	Flow d	iagr.
Ma	0.07			3. 1	130	י חפ	0.00	504 CI	6	2.56	NU3 Si02	-	0.0	20 년	4	-	00.7 5	2	Prir	nt
Na	6.21	Ba		0.	00 H	C03	9.85	F		).01	Total	TD	IS S	-oppr 3	1.2	ppi	m	Ţ	Clipbe	bard
Concen	trate par	ame	ters	2.				-					-						Analı	sis
CaSO4	sat, %		5	SrSO	)4 sa	it, %	0	lonic	stren	gth			0.0	09 pł	1		7.	.1		010
BaSO4	sat, %		0	5i02	! sat,	%	35	Osmo	tic pr	essu	re		3.	3 ba	ar					Diapla
Satura	tion Inde	ex:	Lan	geli	er	0.2	Stiff & D	) avis	0	.01	Total	TD	S	523	5.2	]ррп	n			pishiał

 เมื่อทำการแก้ไขตามที่โปรแกรมแนะนำแล้วจะเห็นว่าไม่พบตัวเลขสีแดง แสดงว่า OK ใช้ mouse click ปุ่ม Check box Auto display แล้ว Click ปุ่ม Run เพื่อให้โปรแกรมทำงานต่อไป

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Hydrar	nautics	Menbr	rane Sc	lutions ]	Design BASIC	Sof DE9	tvare, SIGN	<b>v</b> . 8.5	(c)	2003	28/11	L⁄2548
RO pro	ogram l:	icense	d to:									
Calcul	lation	create	ed bv:									
Projec	t name	BLEN	ID1			Per	meate f	low			5 00	■3/hr
	b flow			0 2 -	2742	Dat	. motor	flow			0 0	= 2 /h =
	The second se			0.3 L.	<u>зин</u>	Ka	vater	IIU¥.			0.3	<b>1</b> 2/ III
Recon	ienaea j	pump p	oress.:	10.5 D	ar	-				-		•.
reed i	pressur	e:		9.6 Da	ar	Per	rmeate I	ecover	y rat	10:	<b>Б</b> Ū.U	7.
Feed <b>v</b> a	ater Te	<b>n</b> perat	ure:	25.0 C	(77F)							
Feed v	vater pl	<b>H</b> :	6.71	(0.00)		Elε	e <b>nent</b> ag	je:			0.0	years
Acid d	losage,	DD <b>n</b> (	(100%):	0.0 H	2504	Flu	ıx decli	ne % p	er ve	ar:	7.0	
Acidif	fied fe	ed CO2	).	106 8		Sal	t nassa	ore inc	rease	%/yr	· 10 0	
Avera	re fluv	rate		22 4 1	/=2-hr	Fee	d type:	- <b>-</b>	G	urface	Water	
ATCIUS	JC 1144	1400.		LL.4 1.		1.00	d type.			411466	*ucor	
Ctore	Dana	Flor		1 51	Dete	<b>C</b> -	(Th-		Flore	-+	Flor	1
Stage	rer∎.	- F 104	/ vesse	I FIUX	Deta	C	JUC . & LUI		LICEC	nı	LICE.	Array
	F TOA	reed	Lor				Pressur	es	IYP	e	NO.	
	∎3/hr :	∎3∕hr	∎3∕hr	: 1∕∎2-hr			bar	bar				
1-1	2.8	8.3	5.5	25.3	1.14		9.0	0.0	CP	<b>A</b> 3	3	1x3
1-2	2.2	5.5	3.3	19.6	1.17		8.4	0.0	CP	<b>A</b> 3	3	1x3
<b></b>	LR	av vat	er+	Feed	ater		Per	meate_	+	<u>Con</u>	central	e+
liton						21 İ			i			
LITON	<b></b> 9/		сецут ј	Eg/ I	Ted.		Eg/1		°4′ ± 1	Eg/ .	T <b>T</b>	54/ I I
+									+		•	+
lla	24.	9	1.2	24.9	1	. <u>z</u> j	0.07		U.U I	62	1	3.1
Mag	0.	6	0.0	0.6	0.	.0	0.00	)	0.0	1.	5	0.1
Na	453.3	2	19.7	453.2	19	.7	6.21	_	0.3	1123.	74	18.9
IK I	220.	0	5.6 İ	220.0	5.	.6 İ	3.76		0.1 İ	544.4	4 1	L4.0 İ
INH4	66	ñ	37	66 0	3	7	1 13		n i i	163	3	9 1 İ
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	0.	000		0.00						0.	000	
	U.	000	0.0	0.00	U U.		0.0	100	0.0	U.	000	0.0
103	U.,	2	0.0	U.2	U.	. U	0.00		<u>u.u</u> i	U.:	5	0.0
HCO3	374.	5	6.1	374.5	6.	.1	9.85	,	0.2	921.	5 1	L5.1
SO4	369.	4	7.7	369.4	7.	.7	1.36		0.0	921.	5 1	19.2
llci l	583.3	2	16.5 İ	583.2	16	.5 İ	8.56		0.2 1	1445.3	2 4	10.8 İ
İF	0	4	0 0 İ	0.4	0	o i	0 01		0.0 İ	1	0	0 1 İ
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16.02	10	ŏ	0.0	10.0			0.00		0.0	40		0.0
12102	1.7.	0		19.0			0.20	,		47.	2	!
	2112			2112 0					+			+
line	2112.	8		2112.8			31.2			5235.	2	
pH	6.	7		6.7			5.2	2		7.3	1	I 1
44	F											+
					Rav	vat	er	Feed	vater	- Ce	oncenti	rate
CaSO4	/ Ksp +	<b>₽</b> 100 ·				2%			2%		5%	
STSOA	/ Ven	<b>=</b> 100				02			02		07	
D-C04	/ Vor	- 100. - 100.				0*			0*		0%	
Da304	v vsb	- IOO:				04			44		204	
5102 5	saturat	10n:			]	144	-	1	44		35%	
[Lange]	lier Sa	turati	on Ind	lex	-	-0.9	15	-	0.95		0.1	18
Stiff	& Davi:	s Satu	ration	Index	-	-0.9	96	-	0.96		0.0	)1
Ionic	streng	th				0.0	)3		0.03		0.0	)9
Osnoti	ic pres	sure				1	} har		13h	ат	3	3 har
	to pros					÷.,			D		9.1	
TL	1_1	- • ÷	L			1				_1		

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File Analysis RO Design UF Treatment Calculation Graphs Help



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File Analysis RODesign UF Treatment Calculation Graphs Help

Project	BLEND.	1			Calc	ulated b	y					Date	11/28/48
pН	6.71		M	lembrai	ne age		.0 ye	ars	- Che	em typ	e	-	H2SO4 🔻
Гетр	25	j.O C	- C	hem do	osing rat	e	.O pp	m	- Che	em co	ncent	ration,%	100 🜩
Flux dec	line % p	er year			7.0		Fe	ed wa	ater typ	pe	Surfa	ce Wate	er 💌
5P incre	ease % p	er year			10.0		Pe	ermea	te blen	ding	E P	ermeate	throttling 🗌
Product	recovery	1, %			60.0		Ce	oncen	trate re	ecirc.	E B	ooster p	ump 🔽
Permeat	e flow	m	3/hr 🔻	1	5.00								
Average	flux rate	e l/n	n2-hr 🔽	·	22.4								
Feed flo	w	m	3/hr 🔻	·	8.3								
Concent	rate flow	/ m	3/hr 🔻		3.3								
- Calcul	lation Re	sults P	ressure	bar	•	Flow/	vessel	m3/	hr 💌	l/m2-h	r 💌		Passes
Arrav	Vessels	Fee	ed (	Conc.	F	eed		Conc		Flux	Be	ta 🔼	
1-1	1		9.6	9.1	0	8	6.3		5.5	25.	3 1	.14 🔳	
			0.0	•	4					10.			
1-2	1		9.0 0.0	8.4	4 n	5	.5 10		3.3	19.0	6 1 N C	17	Bun
1-2 1-3 1-4	1 0 0		9.0 0.0 0.0	8.4 0.0 0.1	4 D N	5 0 0	5 0 0		3.3 0.0 0.0	19.0 0.0 0.1	6 1 D C D C	0.00 0.00	Run
1-2 1-3 1-4 Permea	1 0 0 1te conce	entratio	9.0 0.0 0.0 n (ppm)	8.4 0.0 0.0	4 D D	5 0 0	.5 .0 .0		3.3 0.0 0.0	19.0 0.0 0.0	6 1 0 C 0 C	).00 ).00 💌	Run Next Elow diagr
1-2 1-3 1-4 Permea Ca	1 0 0 1 <u>te conc</u> 0.07	entratio K	9.0 0.0 0.0 n (ppm) 3.76	8.4 0.0 0.0	4 D D 0.00	5 0 504	.5 .0 .0 1.36	NO3	3.3 0.0 0.0	19.1 0.1 0.1	6 1 0 C 0 C	1.17 ).00 ).00 💌	Run Next Flow diagr.
1-2 1-3 1-4 Permea Ca Mg	1 0 0 0.07 0.07	entratio K NH4	9.0 0.0 0.0 n (ppm) 3.76 1.13	8.4 0.1 0.1 0.1	4 0 0 0.00 0.00	5 0 504 Cl	.5 .0 .0 1.36 8.56	N03 Si02	3.3 0.0 0.0 0.0	19.0 0.0 0.0 06 CC 20 pH		1.17 1.00 1.00 106.76 5.2	Run Next Flow diagr. Print
1-2 1-3 1-4 Permea Ca Mg Na	1 0 0.07 0.07 0.00 6.21	entratio K NH4 Ba	9.0 0.0 0.0 n (ppm) 3.76 1.13 0.00	8.4 0.1 0.1 Sr CO3 HCO3	4 D D 0.00 0.00 9.85	5 0 0 504 CI F	.5 .0 .0 1.36 8.56 0.01	NO3 SiO2 Total	3.3 0.0 0.0 0.0 0.0 0. 0. TDS	19.0 0.0 0.0 06 CC 20 pH 3	6 1 0 0 12 0 1.2 P	1.17 0.00 0.00 ▼ 106.76 5.2 pm ▼	Run Next Flow diagr. Print Clipboard
1-2 1-3 1-4 Permea Ca Mg Na Concen	1 0 0.07 0.07 0.00 6.21 0.00	entratio K NH4 Ba rameter	9.0 0.0 0.0 n (ppm) 3.76 1.13 0.00 \$	8.4 0.1 0.1 0.1 5r CO3 HCO3	4 D 0.00 0.00 9.85	5 0 0 504 Cl F	1.36 1.36 8.56 0.01	NO3 SiO2 Total	3.3 0.0 0.0 0.0 0. 0. TDS	19.1 0.1 0.1 0.1 0.1 0.1 20 pH 3	6 1 0 0 12 1.2 pi	1.17 0.00 0.00 V 106.76 5.2 pm V	Run Next Flow diagr. Print Clipboard Analysis
1-2 1-3 1-4 Permea Ca Mg Na Concen CaSO4	1 0 0.07 0.07 0.00 6.21 0.00 5.21 0.00 0.21	entratio K NH4 Ba rameter 5	9.0 0.0 0.0 n (ppm) 3.76 1.13 0.00 s SrSO4 :	8.4 0.1 0.1 0.1 Sr CO3 HCO3 sat, %	4 0 0 0.00 0.00 9.85 0	SO4 Cl F Ionic st	.5 .0 .0 1.36 8.56 0.01 rength	NO3 SiO2 Total	3.3 0.0 0.0 0.0 TDS 0.	19.0 0.0 06 CC 20 pH 3 .09 pH	6 1 0 0 12 0 1.2 pi	1.17 0.00 0.00 ▼ 106.76 5.2 pm ▼ 7.1	Run Next Flow diagr. Print Clipboard Analysis
1-2 1-3 1-4 Permea Ca Mg Na Concen CaSO4 BaSO4	1 0 0 0.07 0.00 6.21 1trate parts sat, % sat, %	entratio K NH4 Ba rameter 5 0	9.0 0.0 0.0 n (ppm) 3.76 1.13 0.00 \$ \$r\$04 \$i02 \$a	8,4 0,1 0,1 Sr CO3 HCO3 sat, %	4 0 0 0.00 0.00 9.85 0 35	SO4 CI F Ionic st Osmotic	.5 .0 .0 1.36 8.56 0.01 rength	NO3 SiO2 Total	3.3 0.0 0.0 0.0 TDS 0. 3	19.1 0.1 0.1 06 CC 20 pH 3 .09 pH 3 ba	6 1 0 0 12 1.2 pi	1.17 0.00 0.00 ▼ 106.76 5.2 pm ▼ 7.1	Run Next Flow diagr. Print Clipboard Analysis
1-2 1-3 1-4 Permea Ca Mg Na Concen CaSO4 BaSO4 Satura	1 0 0 0.07 0.00 6.21 0 0 0 0 0.00 6.21 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	entratio K NH4 Ba rameter 5 0 ex: La	9.0 0.0 0.0 n (ppm) 3.76 1.13 0.00 s SrSO4 SiO2 sa siO2 sa	8.4 0.1 0.1 CO3 HCO3 sat, % at, %	4 0 0 0.00 9.85 0 35 Stiff & C	SO4 Cl F Ionic st Osmotic	.5 .0 .0 8.56 0.01 rength pressu 0.01	NO3 SiO2 Total re Total	3.3 0.0 0.0 0.0 TDS 0. 3 TDS	19.1 0.1 0.1 20 pH 3 .3 ba 5235	6 1 0 0 12 0 1.2 p 1.2 p 5.1 PP	1.17 ).00 ).00 ▼ 106.76 5.2 pm ▼ 7.1	Run Next Flow diagr. Print Clipboard Analysis

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# 24. เมื่อต้องการปรับค่า pH ของน้ำ permeate ให้เลือก toolbar treatment

### 🗚 Hydranautics RO Projection Program - [Analysis]

Analysis RO Design UF Treatment Calculation Graphs

Help

Project				C	ode	ROPERM	Feed R	) Permeate		•	Date 28.	/11/254
pН	5.19		Turb		.0		E cond	56	uS/cm	CO	2 106.	8 ppm
Temp	25.0	C 🔻	SDI		.0	15min 💌	H2S	.0	ppm	Fe		0 ppm
Ca	.1	ppm	-	.00	meq		CO3	.0	ppm	-	.00	meq
Mg	.0	ppm	-	.00	meq		HCO3	9.9	ppm	-	.16	meq
Na	6.2	ppm	-	.27	meq		SO4	1.4	ppm	-	.03	meq
κ	3.8	ppm	-	.10	meq		CI	8.6	ppm	-	.24	meq
NH4	1.1	ppm	-	.06	meq		F	.0	ppm	-	.00	meq
Ba	.000	ppm	-	.00	meq		NO3	.1	ppm	-	.00	meq
Sr	.000	ppm	-	.00	meq		SiO2	.2	ppm	-	.00	meq
	Total	Positive		.43	meq	Autoba	alance	T otal	Negative	•	.43	meq
Caclcula	ated TDS	3	1 ppm	ı			lonic str	renath	.0	00	Pr	int
CaSO4 s	saturation		.0 %	i .			BaSO4 :	saturation		.0	% Clipt	oard
Silica sa	turation		.1 %				SrSO4 s	aturation		.0	% Sa	ve
Saturation Index -6.5 L			5 Lan	Langelier 🔻			Osmotic		.3	psi 🔻		
N.	.011	DUSI	ig rau		nem v	c-rowa	∿ טטו) ח וכוו	CONCENT	auonj		C0.2	
Na		Nancus		Naztu:	5	La(UH)Z		504	HLI		LUZ	
	.0 🗧 📔	.0		.0	<b>-</b>	<b>.</b> 0€		.01	.0	Ŧ	106.8	31
						Restore						

25. หลังจากนั้นจะมีช่องให้ใส่ตัวเลขและชนิดของสารเคมีเพื่อปรับค่า pH ของ น้ำ permeate เมื่อใส่ตัวเลขลงไปในช่องค่า pH จะเปลี่ยนไปตามตัวเลขที่ใส่



File Analysis RODesign UF Treatment Calculation Graphs Help

Project oH	BLEND	1		Membra	Calc	ulated I	by O	vears		Che	em tvoe	D	ate	11/28/48 H2SO4
ſemp	2	5.0 C	-	Chem d	losing rat	e	.0	ppm	-	Che	em conc	entratio	on,%	100 🜩
lux dec	line % p	er yea	Ir		7.0			Feed	l wate	er typ	be Si	urface \	₩ate	r 🔻
SP incre	ase % p	er yea	ir		10.0			Perm	ieate	blen	ding 🔽	Perm	eate	throttling 🗌
Product	recover	y, %			60.0			Conc	entra:	ate re	ecirc. 🗆	Boos	ter p	ump 🗌
<sup>o</sup> ermeat	e flow		m3/hr	-	5.00									
\verage	flux rat	e I	/m2-hr	<b>•</b>	22.4									
Feed flo	w		m3/hr	-	8.3									
Concent	rate flow	۲ ۲	m3/hr	•	3.3									
-Calcul	ation Re	esults-	Pressu	re bar	•	Flow	/vess	el 1	m3/hr	-	l/m2-hr	•	_	Passes
Arrav	Vessel	s Fe	ed	Conc.	F	'eed		Co	nc		Flux	Beta	^	
1-1	1	l	9.6	9	.0		8.3			5.5	25.3	1.14		
1-2	]	1	9.U 0.0	8	.4	;	5.5 D A			3.3 0.0	19.6	1.17		Bun
1-3	1	, 1	0.0	0 0	.u N		D. O			0.0	0.0	0.00	~	Next
Permea	te conc	entrati	ion (pp	m)							0.0			Flow diagr
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26. Mouse Click ปุ่ม Toolbar Graphs เพื่อดูกราฟความสัมพันธ์ต่างๆ

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Pressure vs Temperature	Perm Salinity vs Temperature	Pressu Reco	re vs Pe very	erm Salinity vs Recovery
		Feed temp	erature rang	e
Temperature, low	¥ limit	10.0	C	Plot
Temperature, hig	yh limit	50.0	С	Close



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