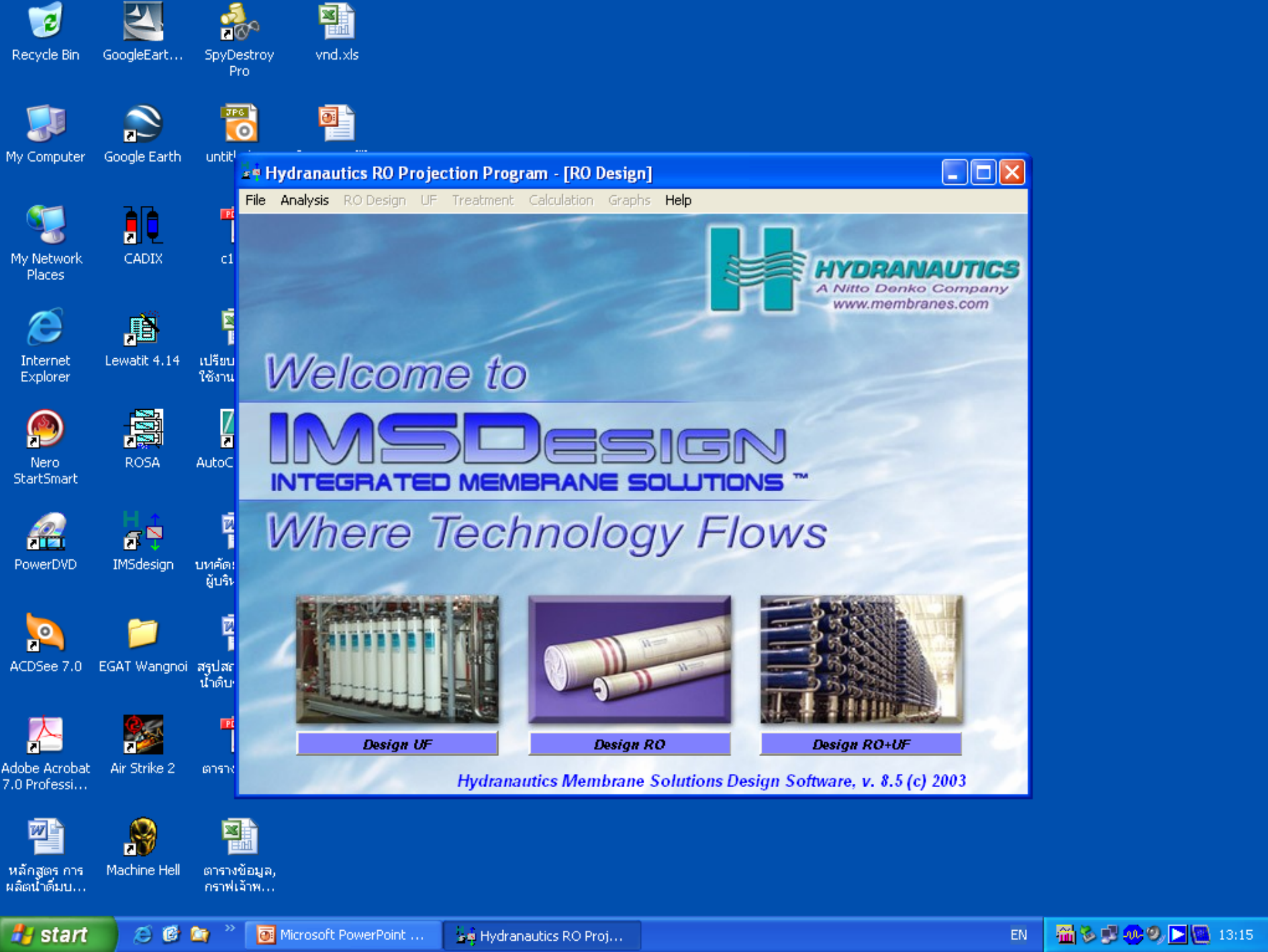
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SpyDestroy Pro
vnd.xls
My Computer
Google Earth
My Network Places
CADIX
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Nero StartSmart
ROSA
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ACDSee 7.0
EGAT Wangnoi
Adobe Acrobat 7.0 Professi...
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HYDRANAUTICS
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www.membranes.com
Welcome to
IMSDESIGN
INTEGRATED MEMBRANE SOLUTIONS ™
Where Technology Flows
Design UF
Design RO
Design RO+UF
Hydranautics Membrane Solutions Design Software, v. 8.5 (c) 2003
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Hydranautics RO Proj...
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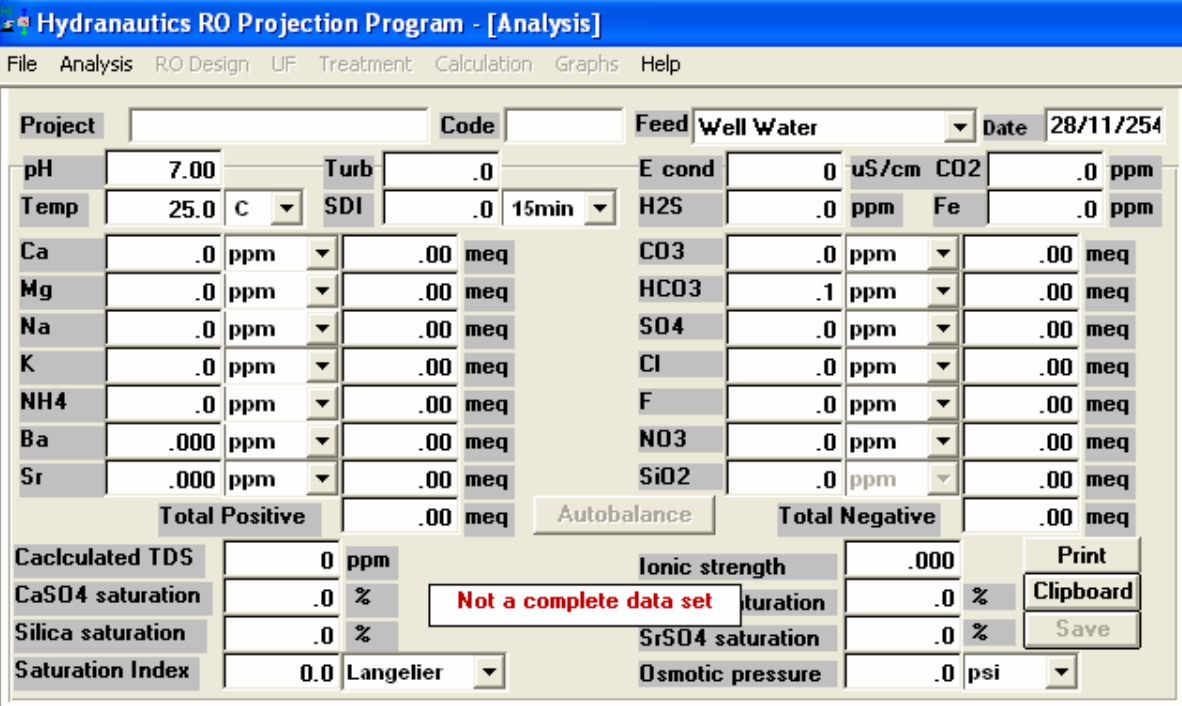
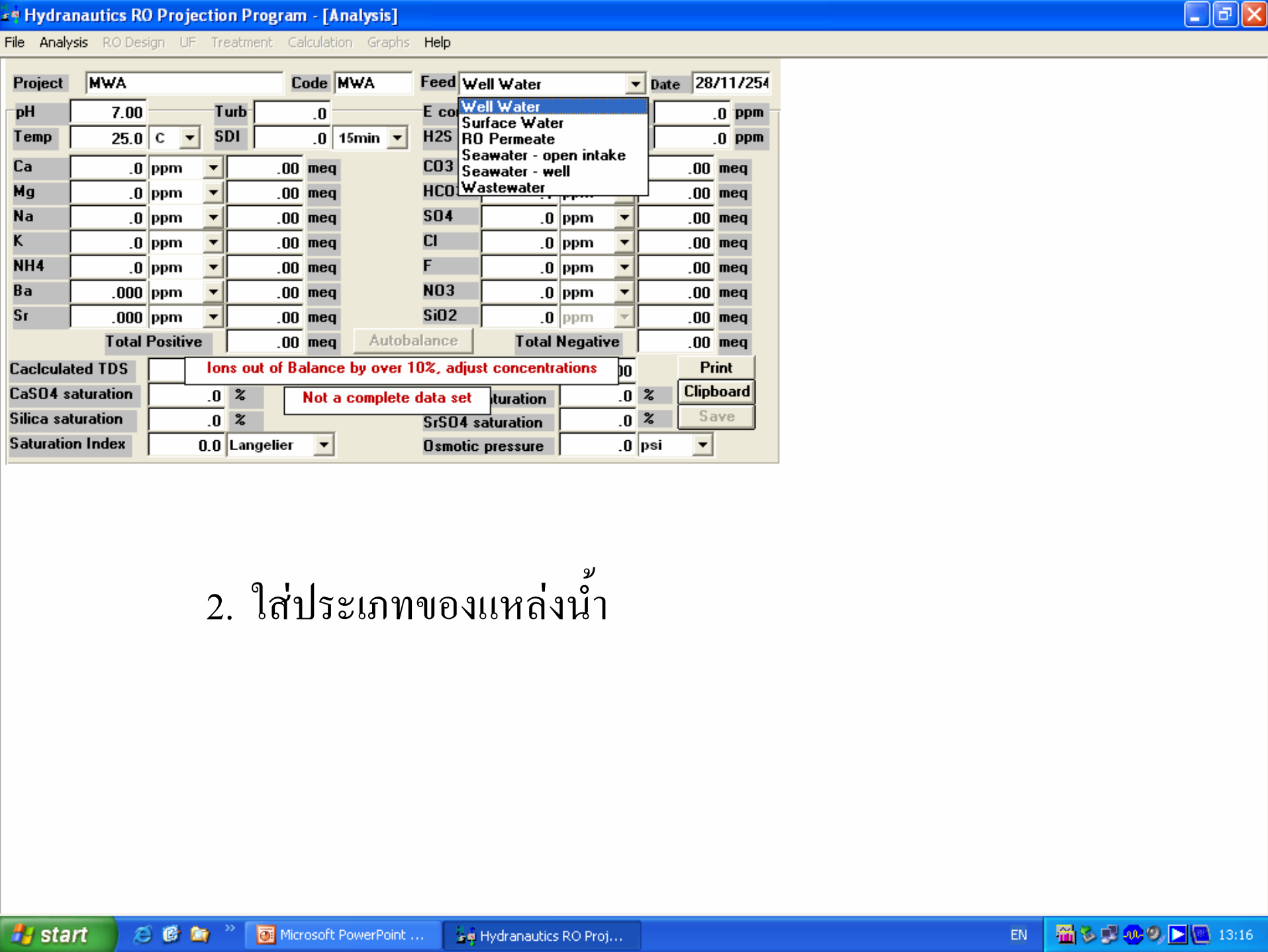


กรณีแหล่งน้ำดิบ 1 แหล่ง

1. ใส่ project name



2. ใส่ประเภทของแหล่งน้ำ

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]

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

RODESIGN

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Contents

Welcome to the RODESIGN Help module. The Help module is organized into several sections to help you better understand the RODesign Program, principles of membrane filtration, RO and UF design guidelines, element specifications, and other information on operating and maintaining a reverse osmosis system.

Section I - RODESIGN Operation.

Use of RODESIGN
Program Logic
Conversion and Design Errors

Section II - Overview of RO

Introduction, Terms, and Equations
Commercial RO Technology
Membrane Module Configurations
Parameters_of_the_RO_Process
Water Chemistry

Section III Design Process

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

Section IV – RO Element Information

HYDRANAUTICS' Offering of Elements
Element Performance/ Testing Conditions
Element Specification Sheets

Section V – HYDRAcap Ultra-Filtration

Introduction to Technology
Introduction to Operation
Hydracap Technical Information
Input Parameters

HYDRANAUTICS
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www.membranes.com

For Help on Help, Press F1

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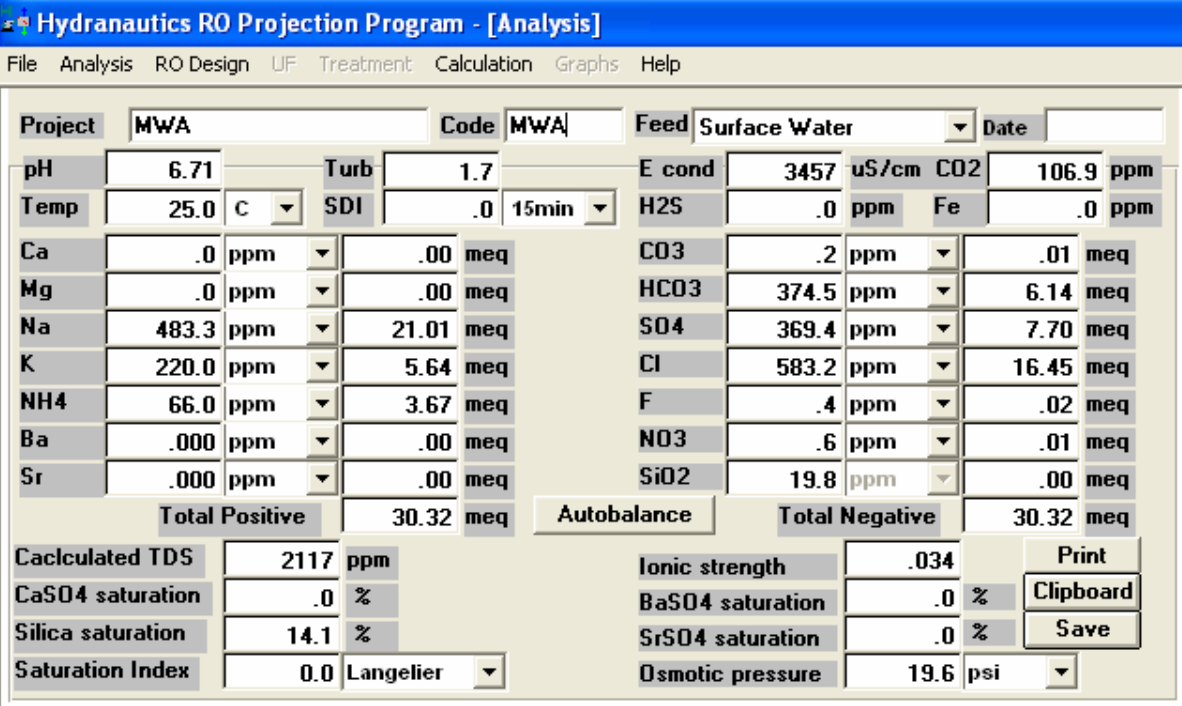
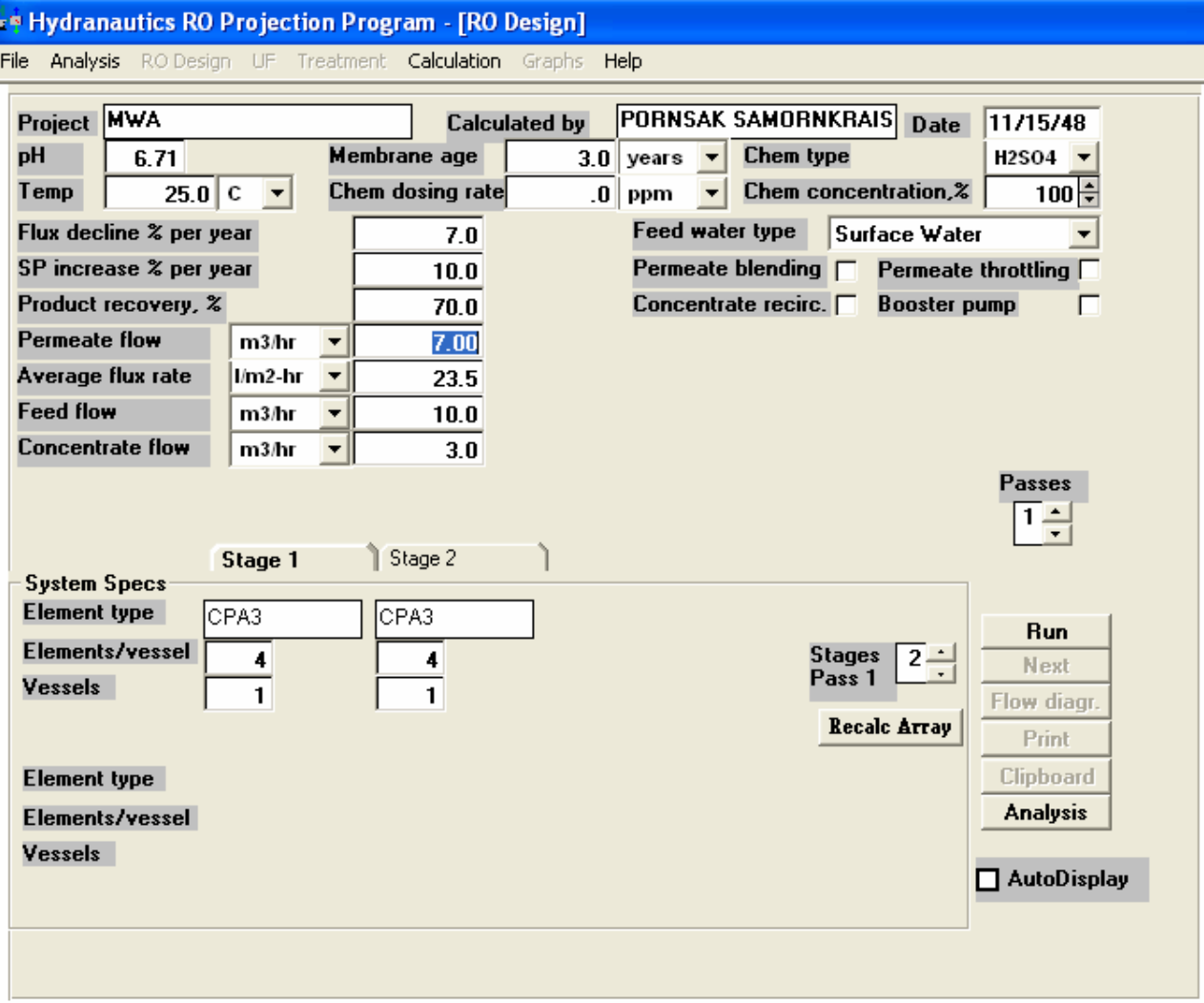


3. ลงผลวิเคราะห์น้ำในช่องผลวิเคราะห์น้ำ

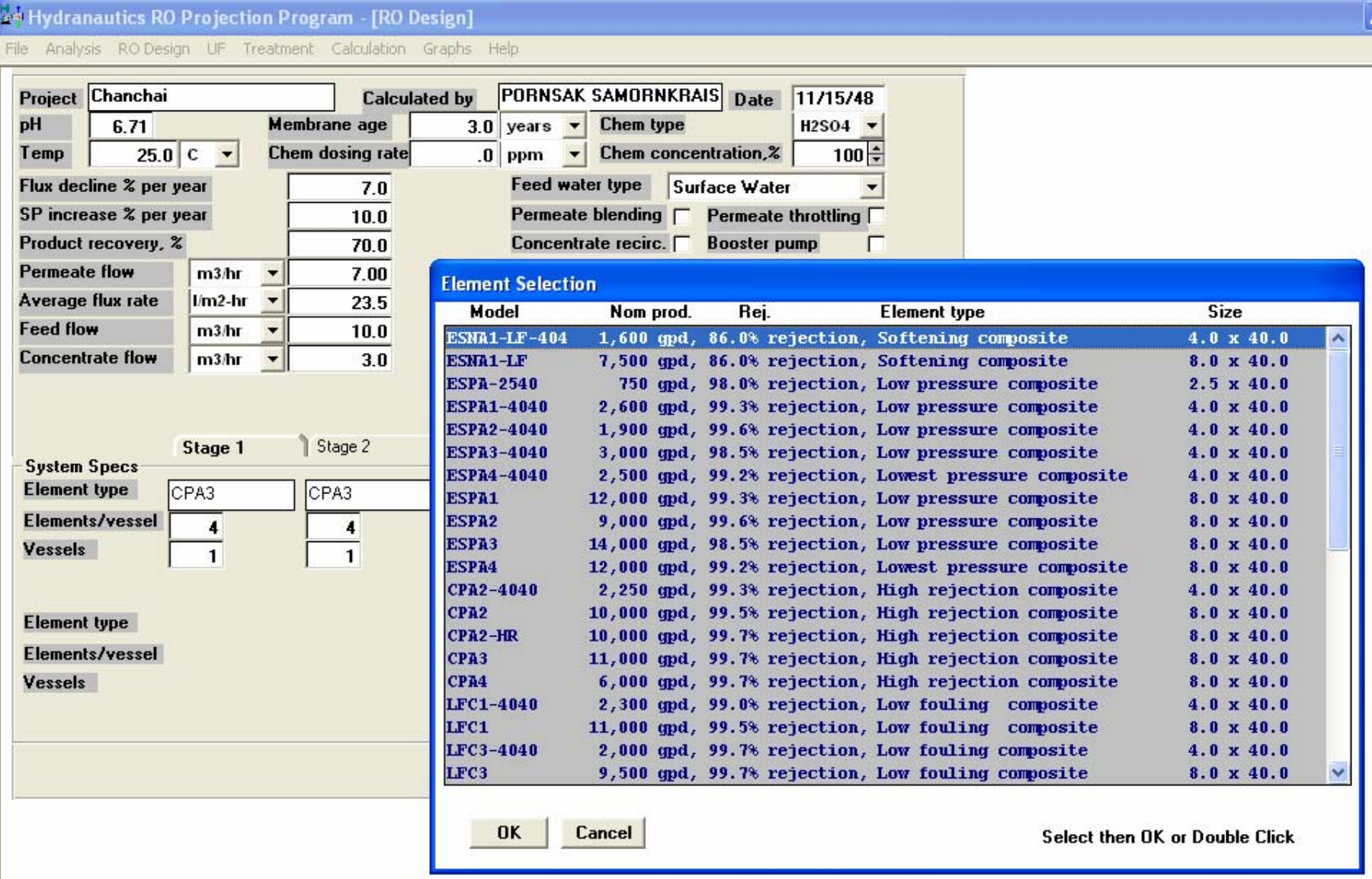
4. ทำ Autobalance

5. Click Toolbar ปุ่ม RO Design

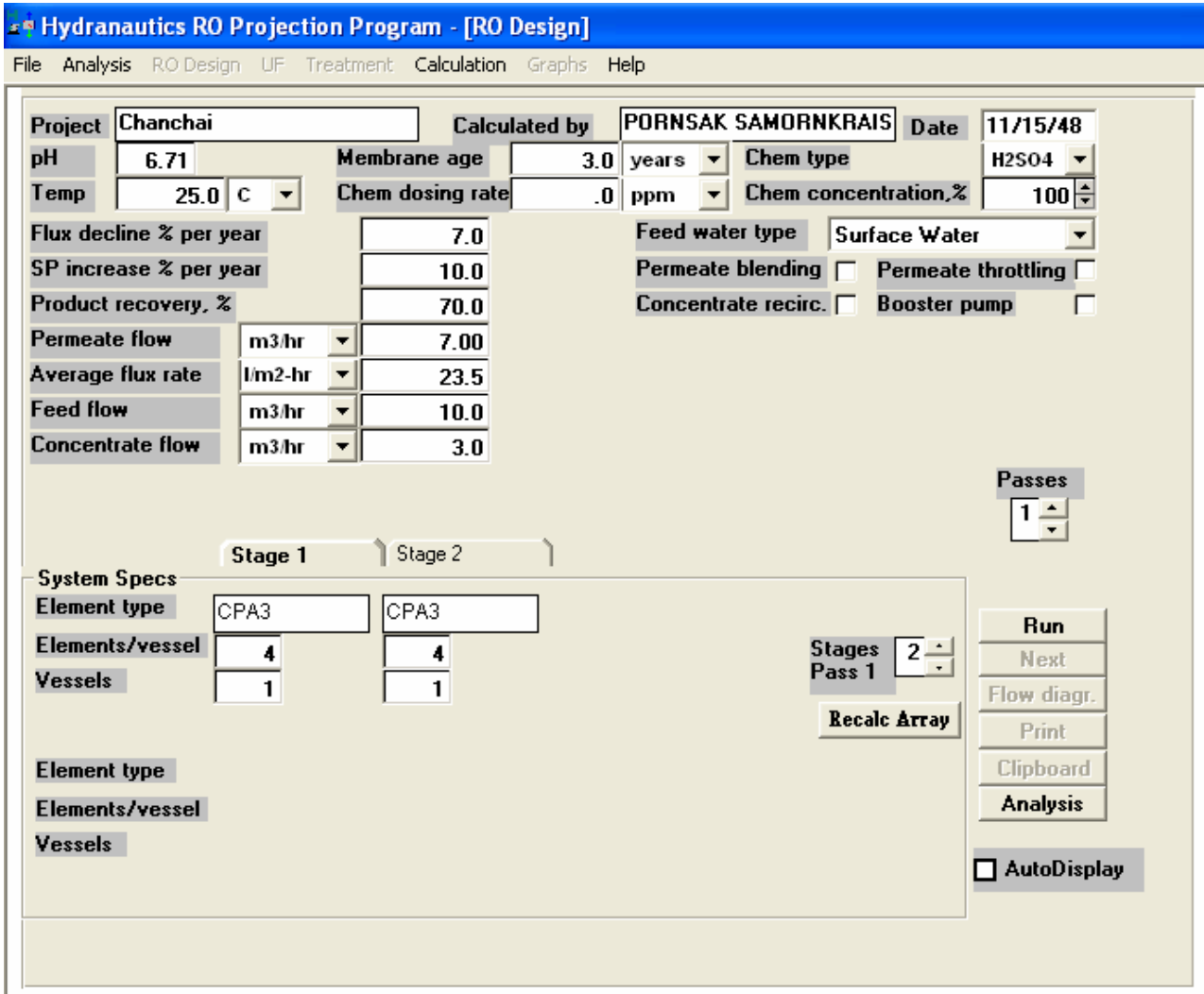


6. เข้าสู่หน้าจอ RO Design

7. ใส่ตัวเลข product recovery, permeate flow ที่ต้องการ



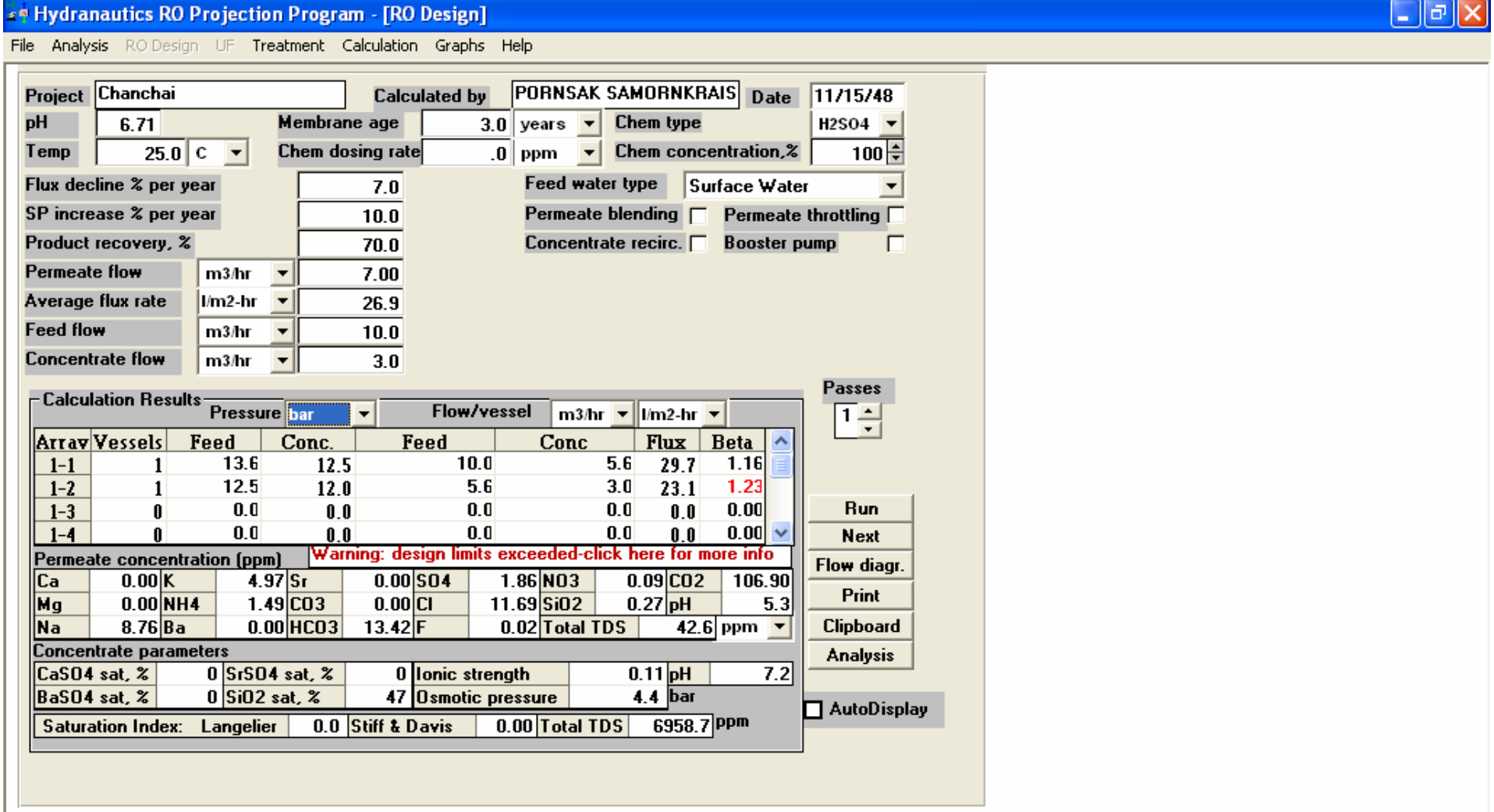
8. เลือก RO Element ที่เหมาะสมกับแหล่งน้ำ



10. Click ปุ่ม Run

9. ใส่ตัวเลข Elements/vessel และจำนวน vessels

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



11.กรณีขึ้นตัวเลขสีแดงแสดงว่าเกิดความผิดปรกติ เราสามารถดูวิธีการแก้ไขโดยนำ mouse ไปdouble click ตรง Warning : โปรแกรมจะบอกรายละเอียดวิธีการแก้ไขให้

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 polarization are as follows:

1. Greater osmotic pressure at the membrane surface than in the bulk feed solution, delPosm, and reduced Net Driving Pressure differential across the membrane (delP - delPosm).
2. Reduced water flow across membrane (Qw).
3. Increased salt flow 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).

$$CPF = Cs/Cb \quad (10)$$

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).

$$CPF = Kp * \exp(Qp/ Qfavg) \quad (11)$$

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 element (Ri).

$$CPF = Kp * \exp(2Ri/(2-Ri)) \quad (12)$$

RODESIGN

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Beta Factor Exceeded

Flow Limits Exceeded

Flow is too high or too low/ beta factor is exceeded. A red message will appear when the recommended values for flow are not met or are exceeded, or when the beta value is exceeded. Ways to correct this are to alter the system configuration, alter the recovery, or to adjust the flow distribution through the individual passes of the system.

RODESIGN

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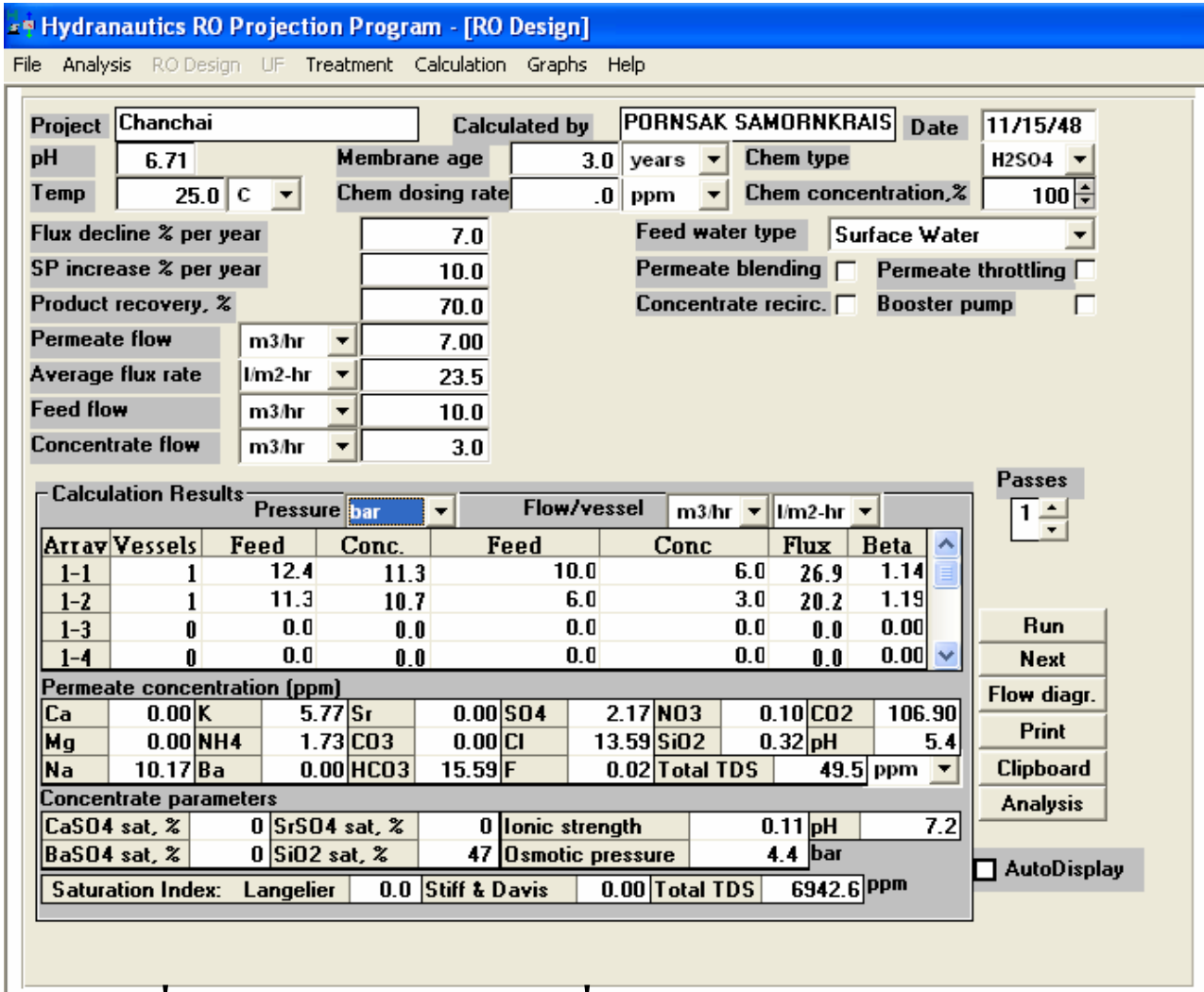
Max/Min Flow per Vessel:

	Feed Flow		Concentrate Flow	
Membrane Diameter (in)	Max (GPM)	Max (m3/hr)	Min (GPM)	Min (m3/hr)
4	16	3.6	3	0.7
6	30	8.8	7	1.6
8	75	17.0	12	2.7
8.5	85	19.3	14	3.2



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

Rodesign Quick Results Screen

File Close

Hydranautics Membrane Solutions Design Software, v. 8.5 (c) 2003 15/11/2548
BASIC DESIGN

RO program licensed to:
Calculation created by: PORNSAK SAMORNKRAISORAKIT
Project name: Chanchai

Permeate flow:	7.00 m3/hr		
HP Pump flow:	10.0 m3/hr	Raw water flow:	10.0 m3/hr
Recommended pump press.:	13.6 bar		
Feed pressure:	12.4 bar	Permeate recovery ratio:	70.0 %
Feedwater Temperature:	25.0 C(77F)		
Feed water pH: 6.71	(0.00)	Element age:	3.0 years
Acid dosage, ppm (100%):	0.0 H2SO4	Flux decline % per year:	7.0
Acidified feed CO2:	106.9	Salt passage increase, %/yr:	10.0
Average flux rate:	23.5 l/m2-hr	Feed type:	Surface Water

Stage	Perm. Flow m3/hr	Flow/Vessel Feed m3/hr	Conc m3/hr	Flux l/m2-hr	Beta	Conc.&Throt. Pressures bar	bar	Element Type	Elem. No.	Array
1-1	4.0	10.0	6.0	26.9	1.14	11.3	0.0	CPA3	4	1x4
1-2	3.0	6.0	3.0	20.2	1.19	10.7	0.0	CPA3	4	1x4

Ion	Raw water mg/l	Raw water meq/l	Feed water mg/l	Feed water meq/l	Permeate mg/l	Permeate meq/l	Concentrate mg/l	Concentrate meq/l
Ca	0.0	0.0	0.0	0.0	0.00	0.0	0.0	0.0
Mg	0.0	0.0	0.0	0.0	0.00	0.0	0.0	0.0
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
NH4	66.0	3.7	66.0	3.7	1.73	0.1	216.0	12.0
Ba	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0
Sr	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0
CO3	0.2	0.0	0.2	0.0	0.00	0.0	0.7	0.0
HCO3	374.5	6.1	374.5	6.1	15.59	0.3	1212.0	19.9
SO4	369.4	7.7	369.4	7.7	2.17	0.0	1226.3	25.5
Cl	583.2	16.5	583.2	16.5	13.59	0.4	1912.3	53.9
F	0.4	0.0	0.4	0.0	0.02	0.0	1.3	0.1
NO3	0.6	0.0	0.6	0.0	0.10	0.0	1.8	0.0
SiO2	19.8		19.8		0.32		65.3	
TDS	2117.4		2117.4		49.5		6942.6	
pH	6.7		6.7		5.4		7.2	

	Raw water	Feed water	Concentrate
CaSO4 / Ksp * 100:	0%	0%	0%
SrSO4 / Ksp * 100:	0%	0%	0%
BaSO4 / Ksp * 100:	0%	0%	0%
SiO2 saturation:	14%	14%	47%
Langelier Saturation Index	0.00	0.00	0.00
Stiff & Davis Saturation Index	0.00	0.00	0.00
Ionic strength	0.03	0.03	0.11
Osmotic pressure	1.4 bar	1.4 bar	4.4 bar

These calculations are based on nominal element performance when operated

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Hydranautics RO Projection Program - [RO Design]

File Analysis RO Design UF Treatment Calculation Graphs Help

Project Chanchai | Calculated by PORNSAK SAMORNKRAIS | Date 11/15/48

pH 6.71 | Membrane age 3.0 years | Chem type H2SO4

Temp 25.0 C | Chem dosing rate .0 ppm | Chem concentration,% 100

Flux decline % per year

SP increase % per year

Product recovery, %

Permeate flow m3/hr

Average flux rate l/m2-hr

Feed flow m3/hr

Concentrate flow m3/hr

Feed water type Surface Water

Calculation Results

Array	Vessels	Feed	Pressure
1-1	1	12.4	
1-2	1	11.3	
1-3	0	0.0	
1-4	0	0.0	

Permeate concentration (ppm)

Ca	0.00	K	5.7
Mg	0.00	NH4	1.7
Na	10.17	Ba	0.0

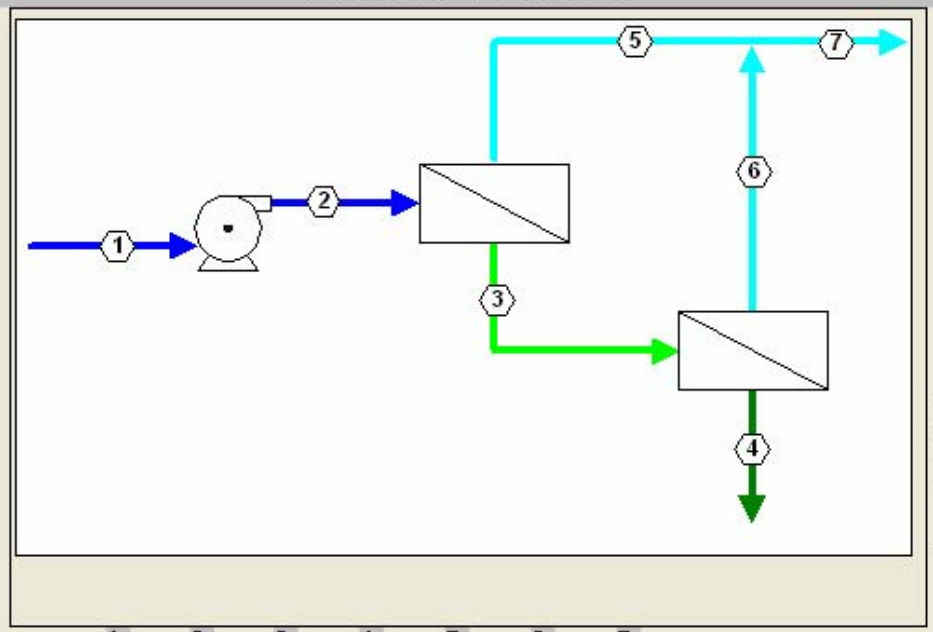
Concentrate parameters

CaSO4 sat, %	0	SrSO4	
BaSO4 sat, %	0	SiO2	

Saturation Index: Langelier

Flow Diagram

TWO STAGE SYSTEM



		1	2	3	4	5	6	7
Flow	m3/hr	10.0	10.0	6.0	3.0	4.0	3.0	7.0
Pressure	bar	.0	12.4	11.3	10.7	.0	.0	.0
TDS (ppm)		2117.4	2117.4	3511.3	6942.6	24.6	82.6	49.5

Close

Clipboard

Print

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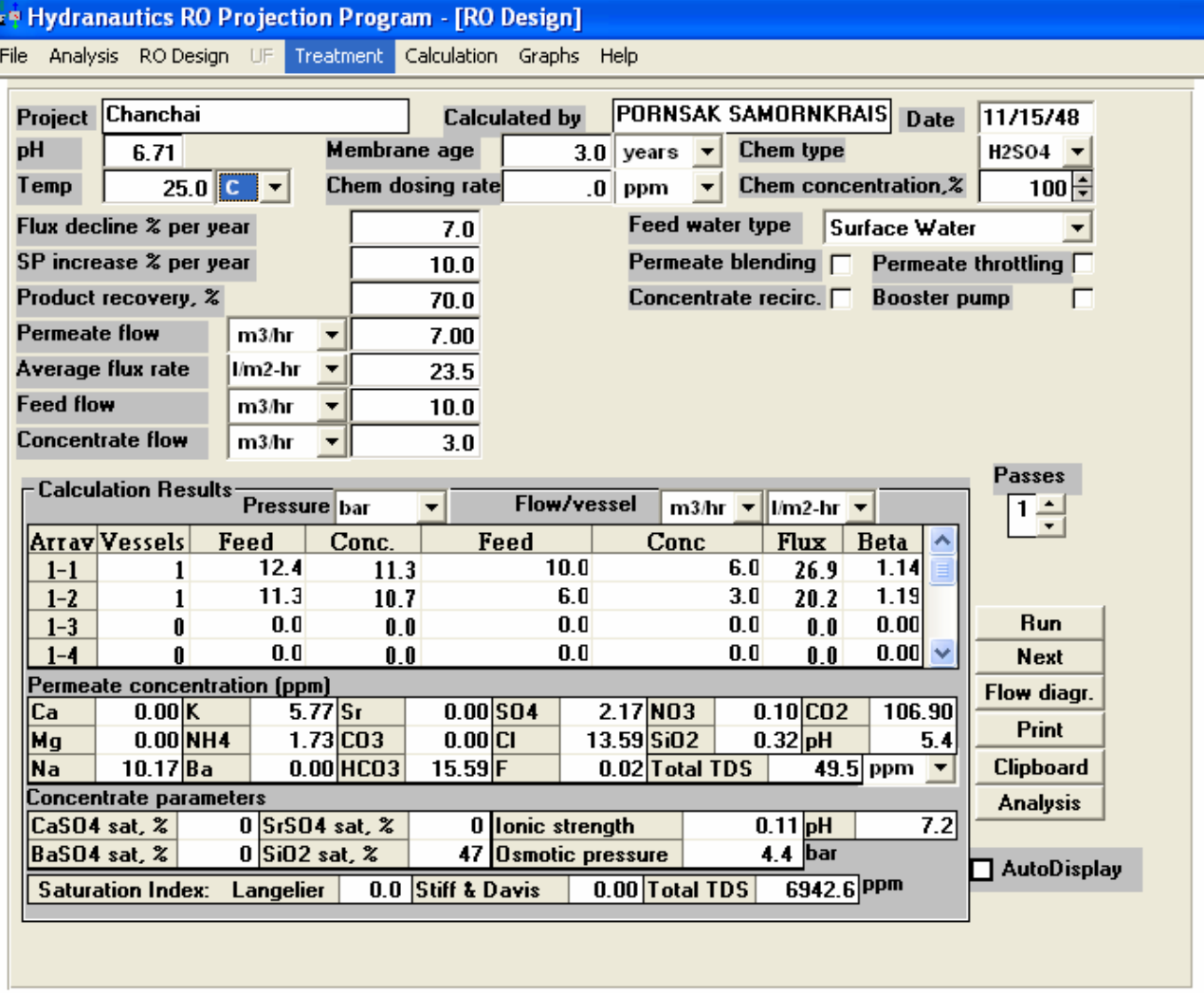

13. เมื่อต้องการปรับค่า pH ของน้ำ permeate ให้เลือก toolbar treatment

Hydranautics RO Projection Program - [Analysis]

File Analysis RO Design UF Treatment Calculation Graphs Help

Project		Code	ROPERM	Feed	RO Permeate	Date	28/11/254				
pH	5.39	Turb	.0	E cond	86	uS/cm	CO2	106.9	ppm		
Temp	25.0 C	SDI	.0 15min	H2S	.0	ppm	Fe	.0	ppm		
Ca	.0 ppm	.00 meq		CO3	.0 ppm	.00 meq					
Mg	.0 ppm	.00 meq		HCO3	15.6 ppm	.26 meq					
Na	10.2 ppm	.44 meq		SO4	2.2 ppm	.05 meq					
K	5.8 ppm	.15 meq		Cl	13.6 ppm	.38 meq					
NH4	1.7 ppm	.10 meq		F	.0 ppm	.00 meq					
Ba	.000 ppm	.00 meq		NO3	.1 ppm	.00 meq					
Sr	.000 ppm	.00 meq		SiO2	.3 ppm	.00 meq					
	Total Positive	.69 meq	Autobalance		Total Negative	.69 meq					
Caclculated TDS	49 ppm			Ionic strength	.001						
CaSO4 saturation	.0 %			BaSO4 saturation	.0 %						
Silica saturation	.2 %			SrSO4 saturation	.0 %						
Saturation Index	0.0 Langelier			Osmotic pressure	.5 psi						

Print

Clipboard

Save

Dosing rate of chemicals, ppm (100% concentration)

NaOH	NaHCO3	Na2CO3	Ca(OH)2	H2SO4	HCl	CO2
.0	.0	.0	.0	.0	.0	106.9

Restore

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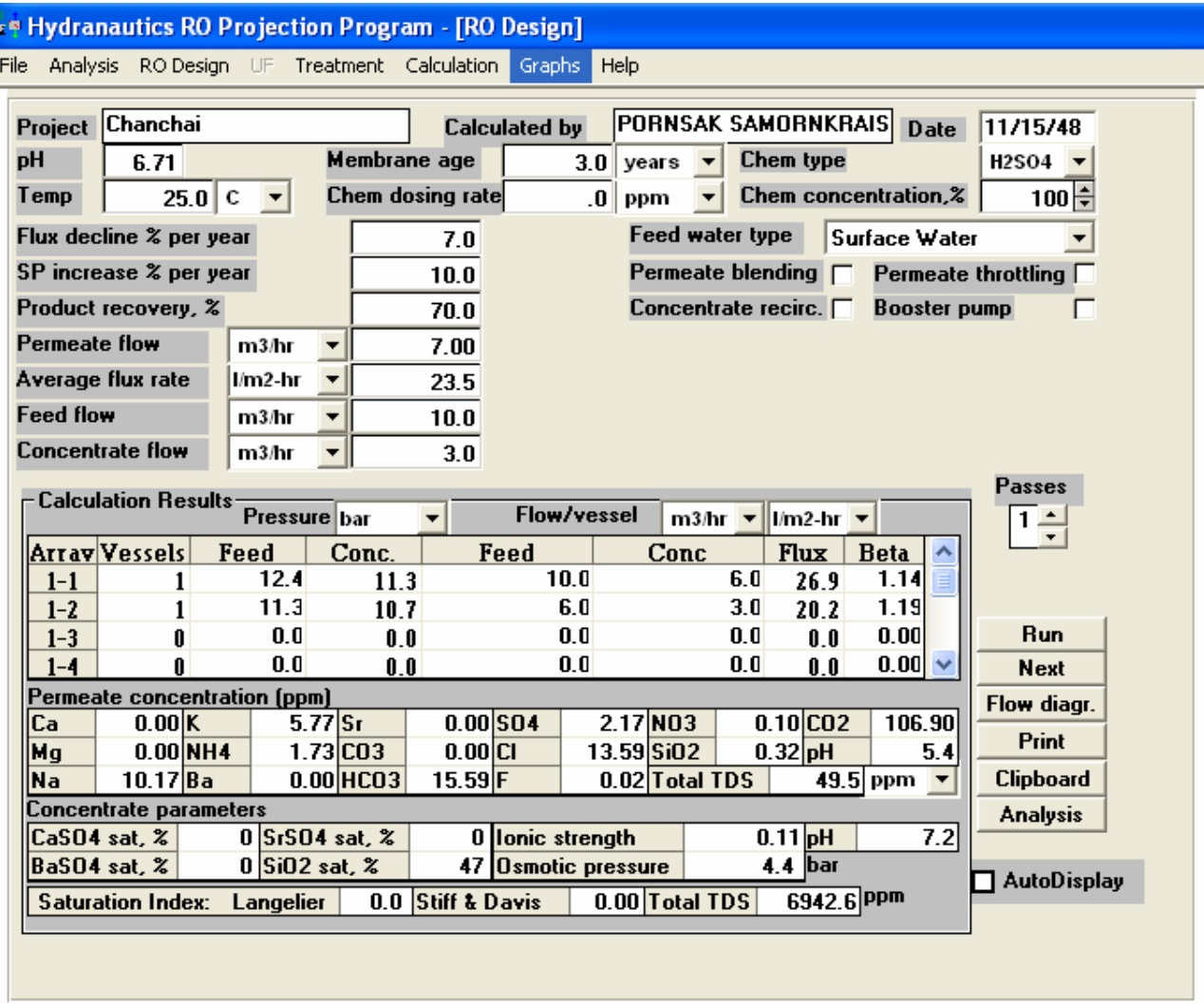
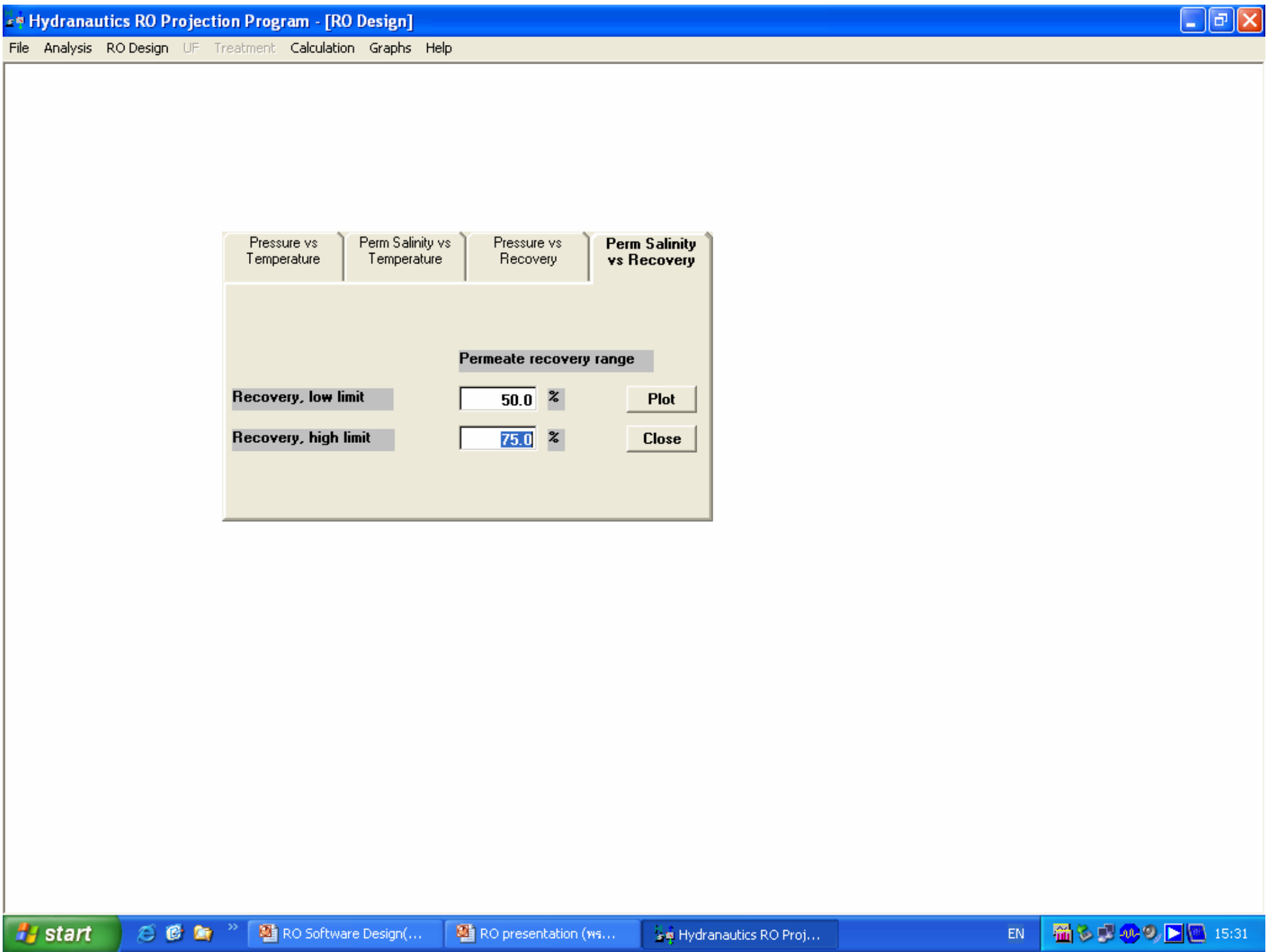


14. Mouse Click ปุ่ม Toolbar Graphs เพื่อดูกราฟความสัมพันธ์ต่างๆ


Hydranautics RO Projection Program - [RO Design]
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Pressure vs Temperature
Perm Salinity vs Temperature
Pressure vs Recovery
Perm Salinity vs Recovery
Permeate recovery range
Recovery, low limit
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%
Plot
Recovery, high limit
75.0
%
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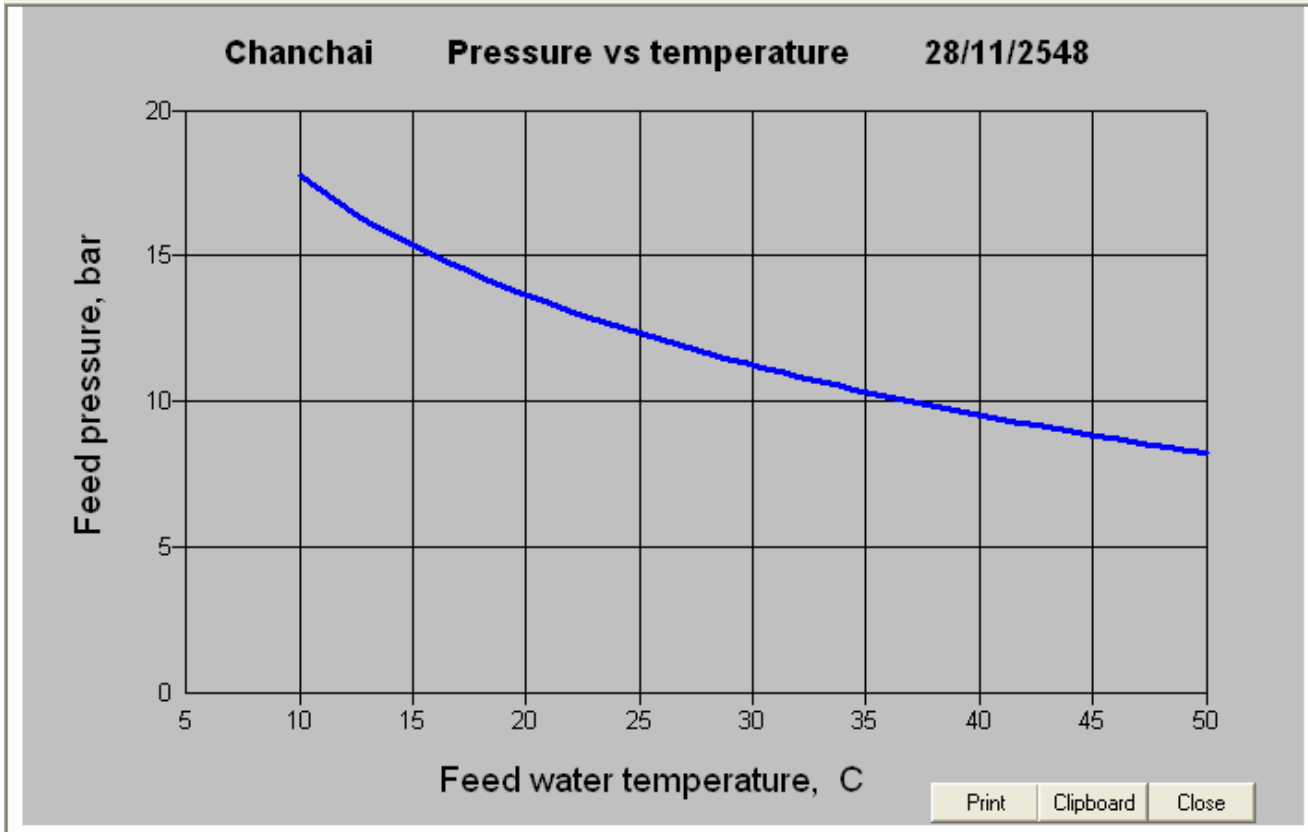
Hydranautics RO Projection Program - [RO Design]

File Analysis RO Design UF Treatment Calculation Graphs Help



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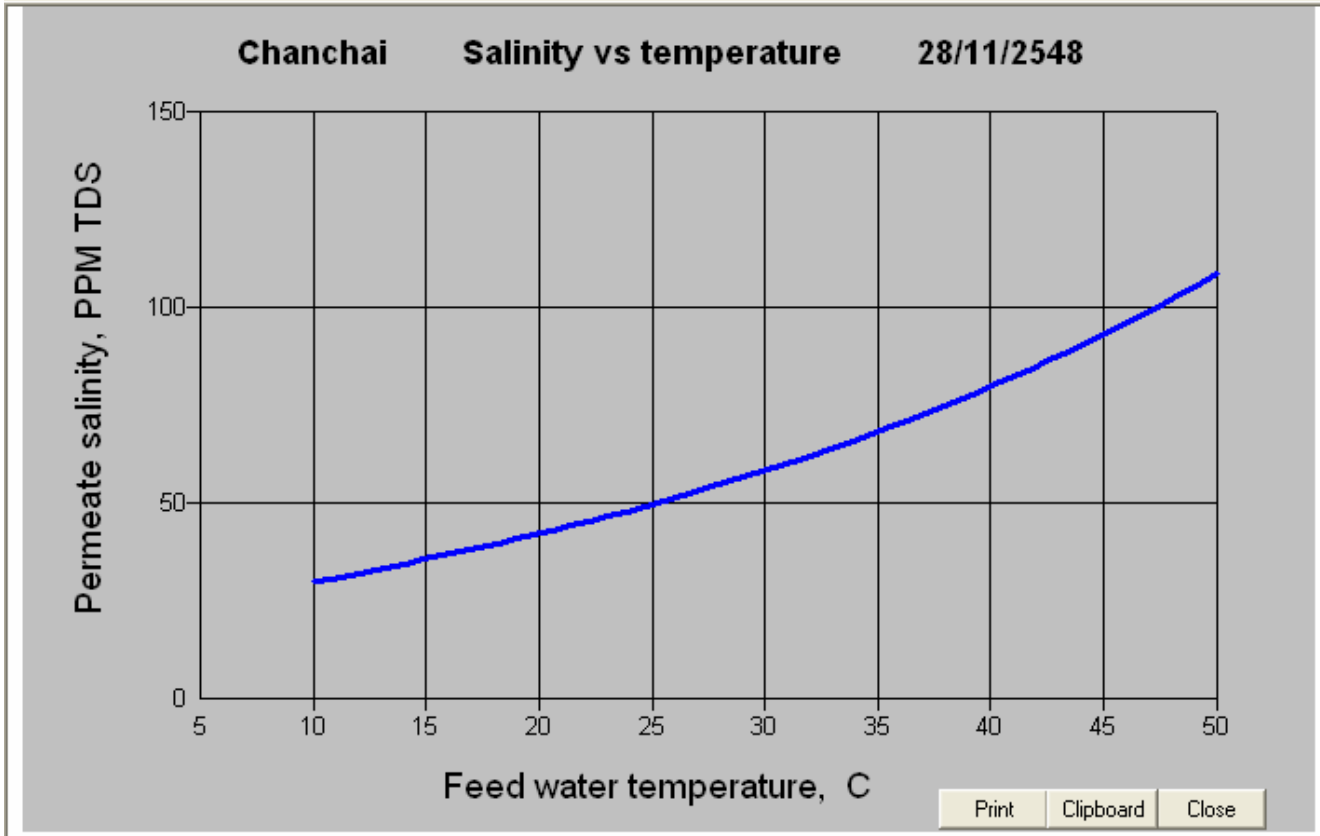
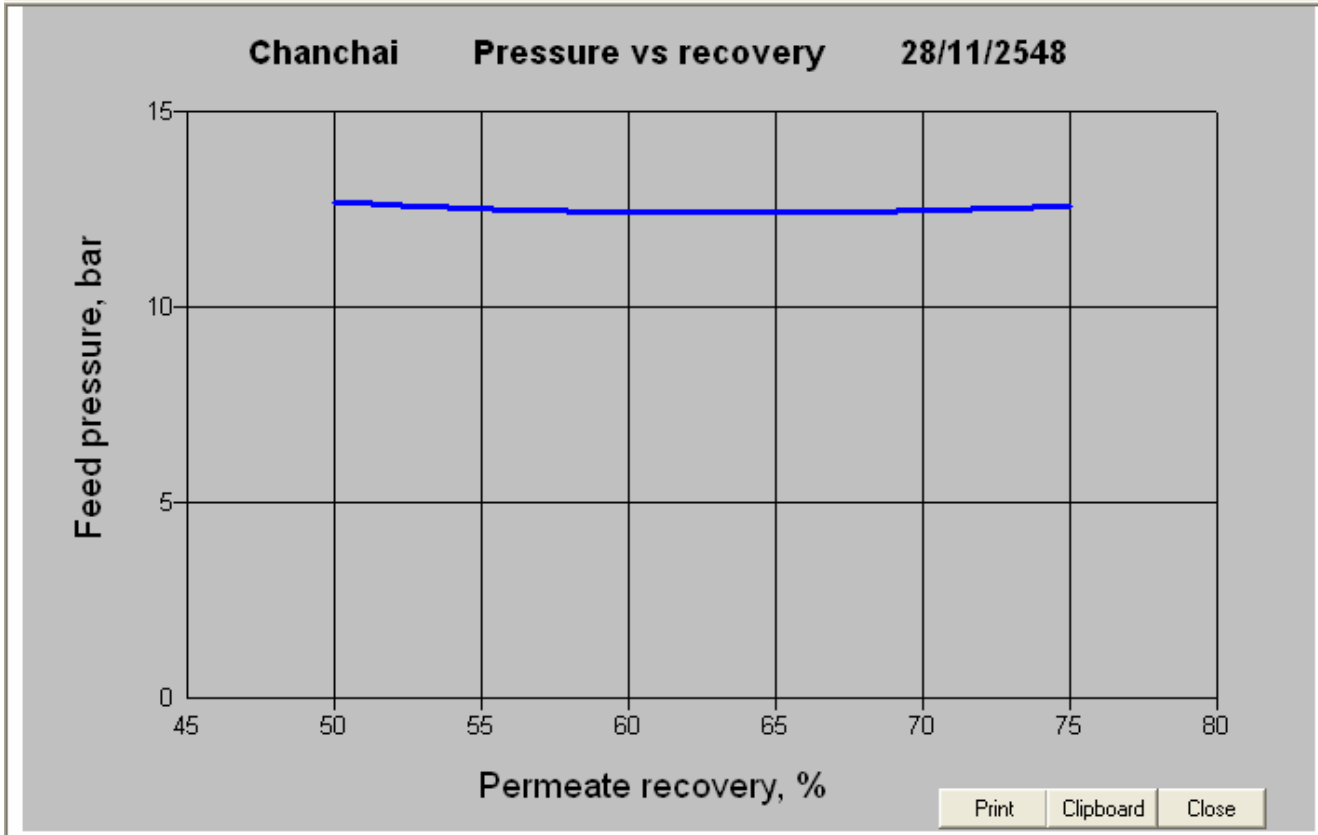
Hydranautics RO Projection Program - [RO Design]

File Analysis RO Design UF Treatment Calculation Graphs Help



Hydranautics RO Projection Program - [RO Design]

File Analysis RO Design UF Treatment Calculation Graphs Help



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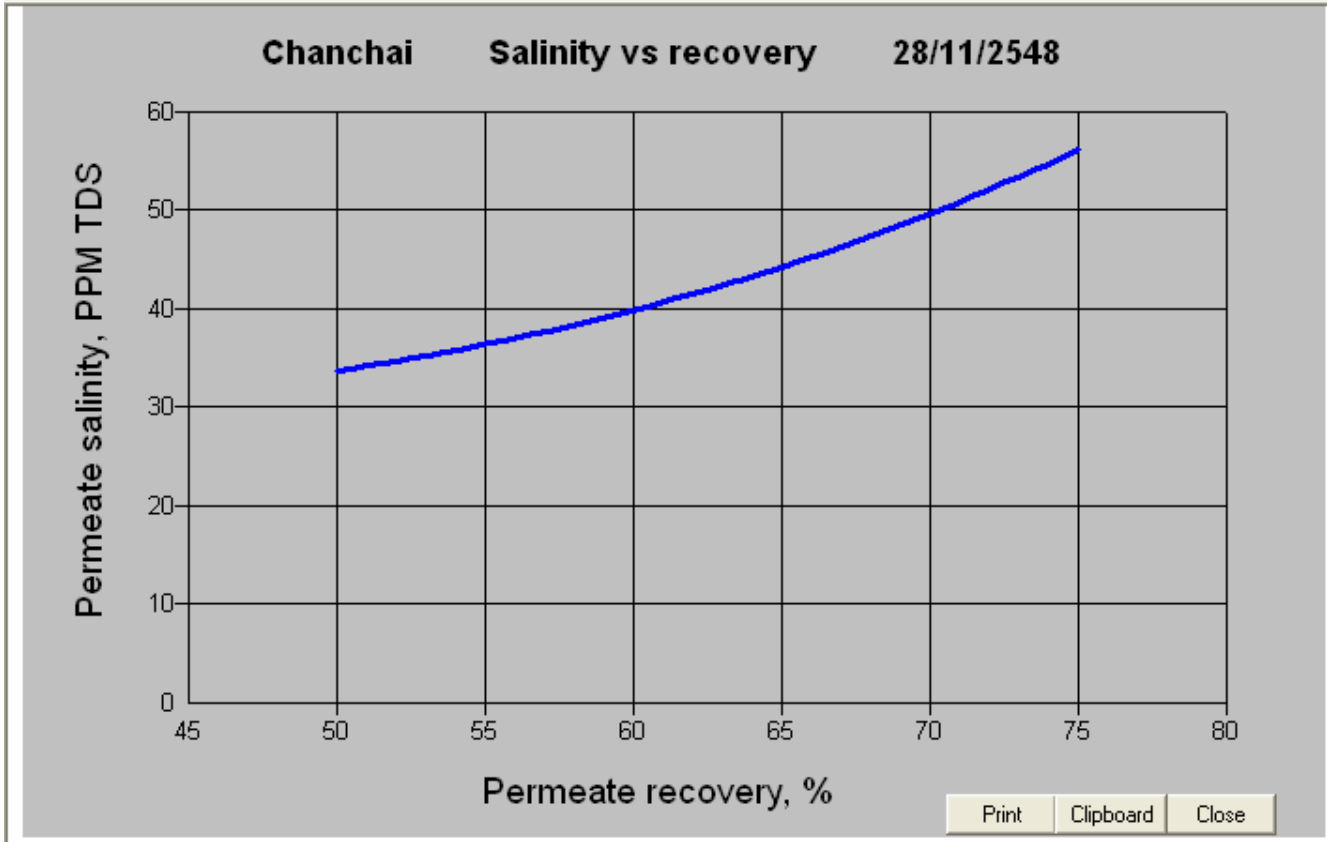
Hydranautics RO Projection Program - [RO Design]

File Analysis RO Design UF Treatment Calculation Graphs Help



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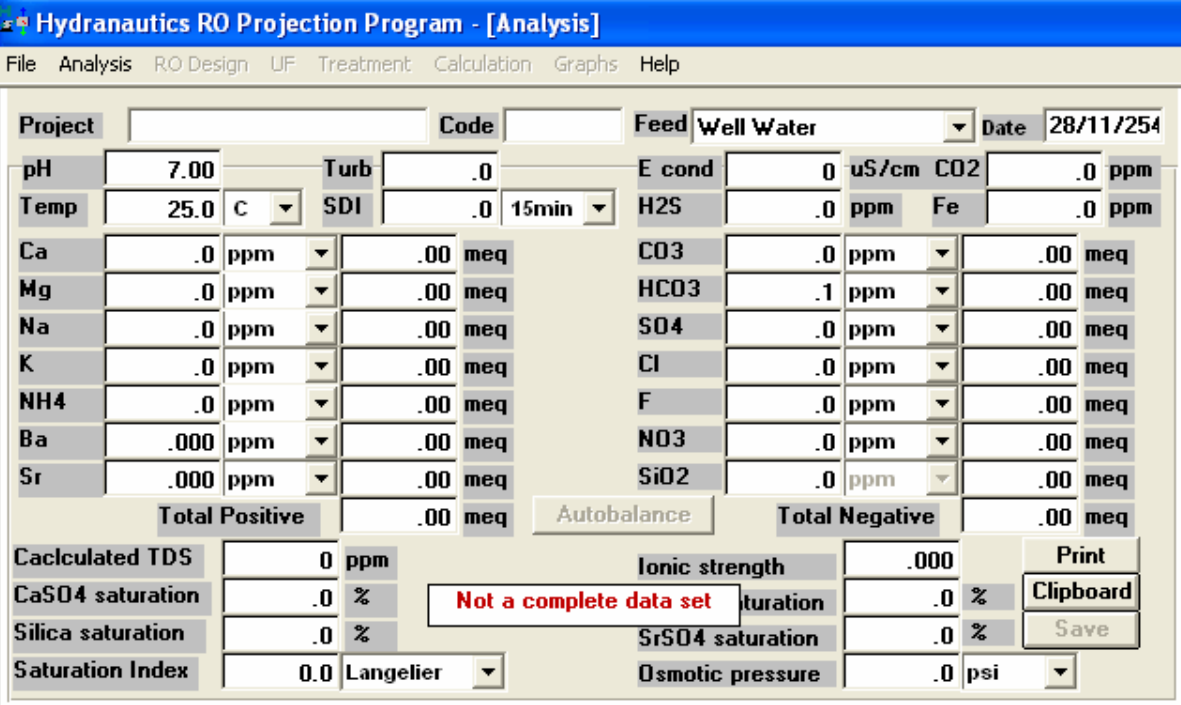
กรณีแหล่งน้ำดิบมากกว่า 2 แหล่งต้องมีการทำ Blending

หมายถึง การผสมแหล่งน้ำดิบมากกว่า 2 แหล่งขึ้นไปเพื่อนำเข้าระบบ RO

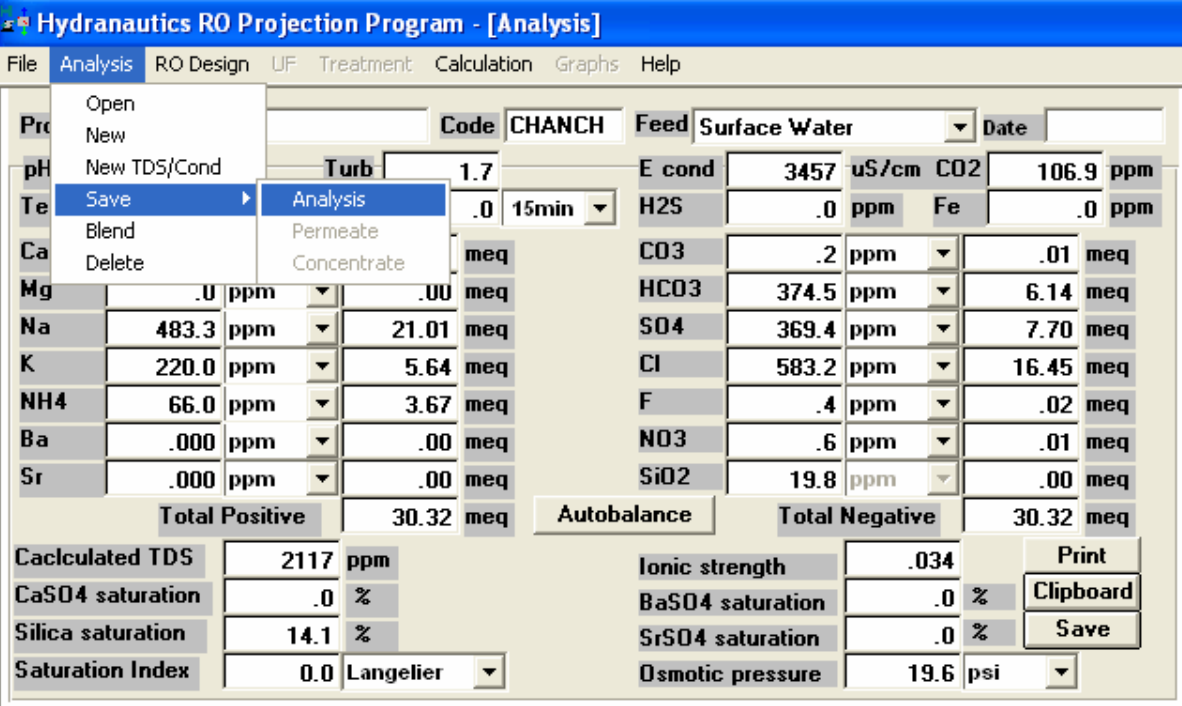
ขั้นตอนการทำ Blending มีดังนี้

1. ลงผลวิเคราะห์น้ำแหล่งน้ำแหลง่ที่ 1 ลงในช่องผลวิเคราะห์น้ำ
2. ทำ Autobalance
3. Save ข้อมูลผลวิเคราะห์น้ำ โดยไปที่ Toolbar Analysis\Save\analysis
4. ลงผลวิเคราะห์น้ำแหล่งน้ำแหลง่ที่ 2 ลงในช่องผลวิเคราะห์น้ำ
5. ทำ Autobalance
6. Save ข้อมูลผลวิเคราะห์น้ำ โดยไปที่ Toolbar Analysis\Save\analysis

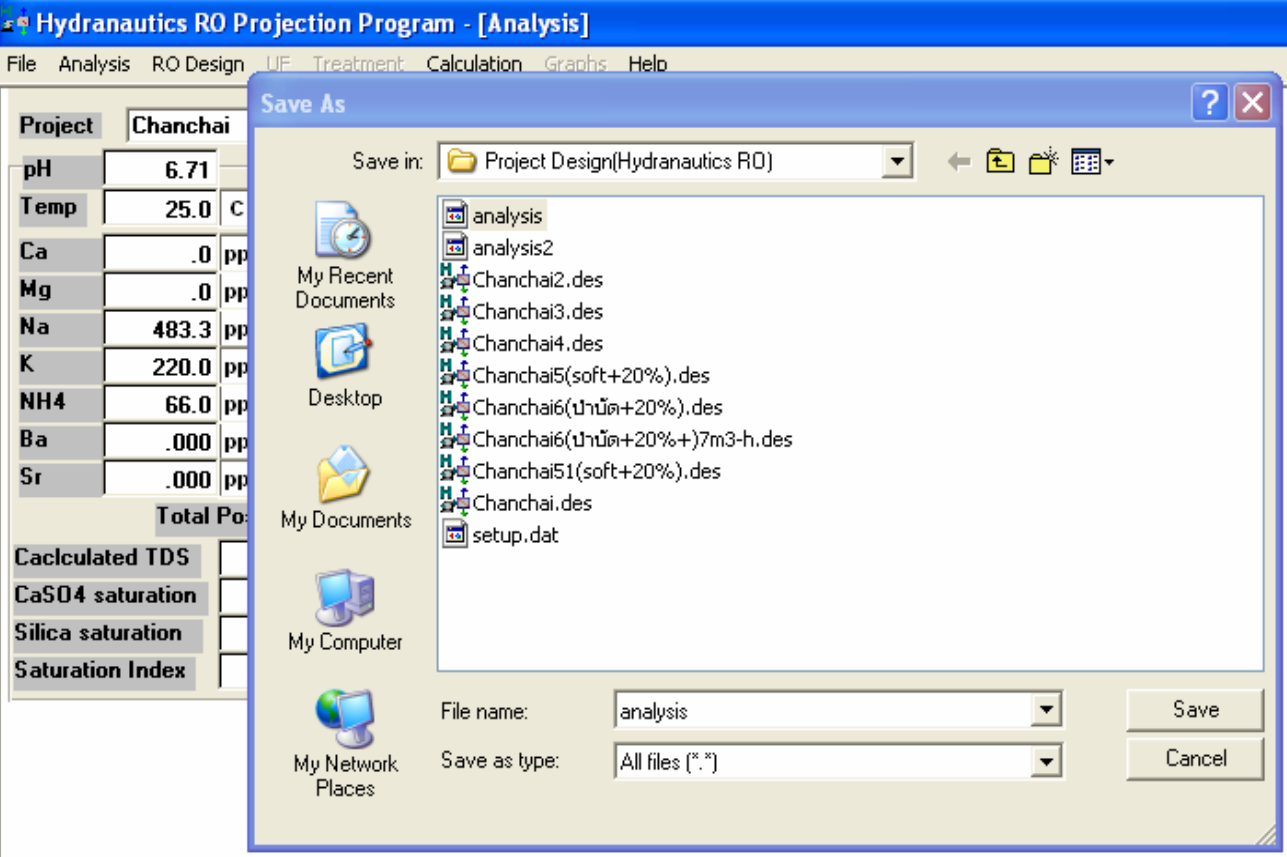


1. ลงผลวิเคราะห์น้ำแหล่งน้ำแหล่งที่ 1 ลงในช่องผลวิเคราะห์น้ำ

2. ทำ Autobalance

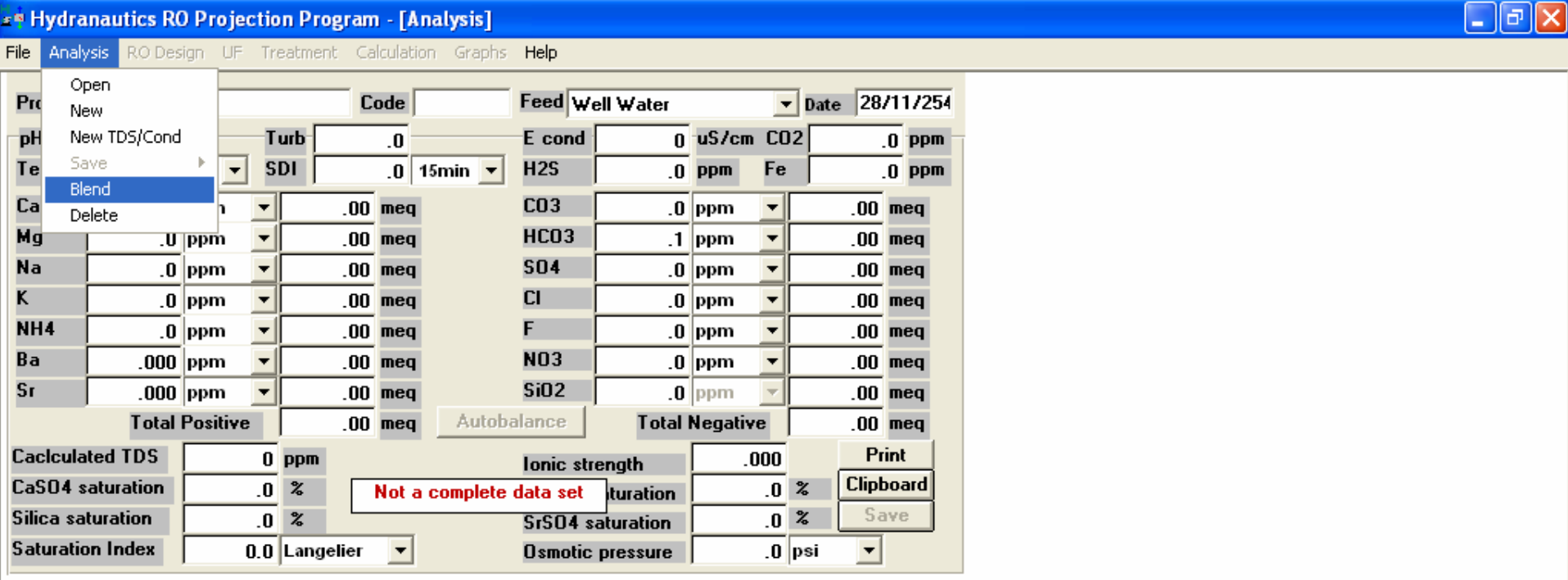


3. Save ข้อมูลผลวิเคราะห์น้ำ โดยไปที่ Toolbar Analysis\Save\analysis

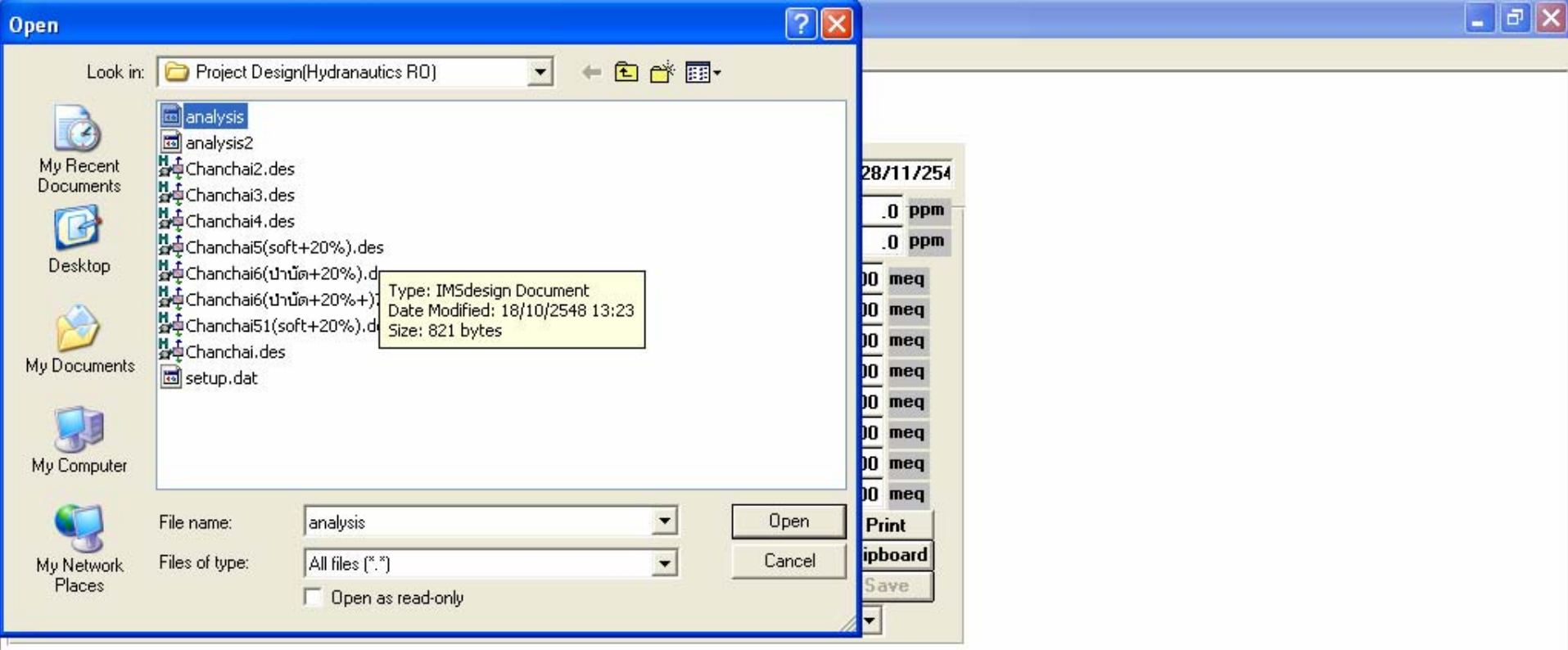


4. ตั้งชื่อ file ที่ต้องการ

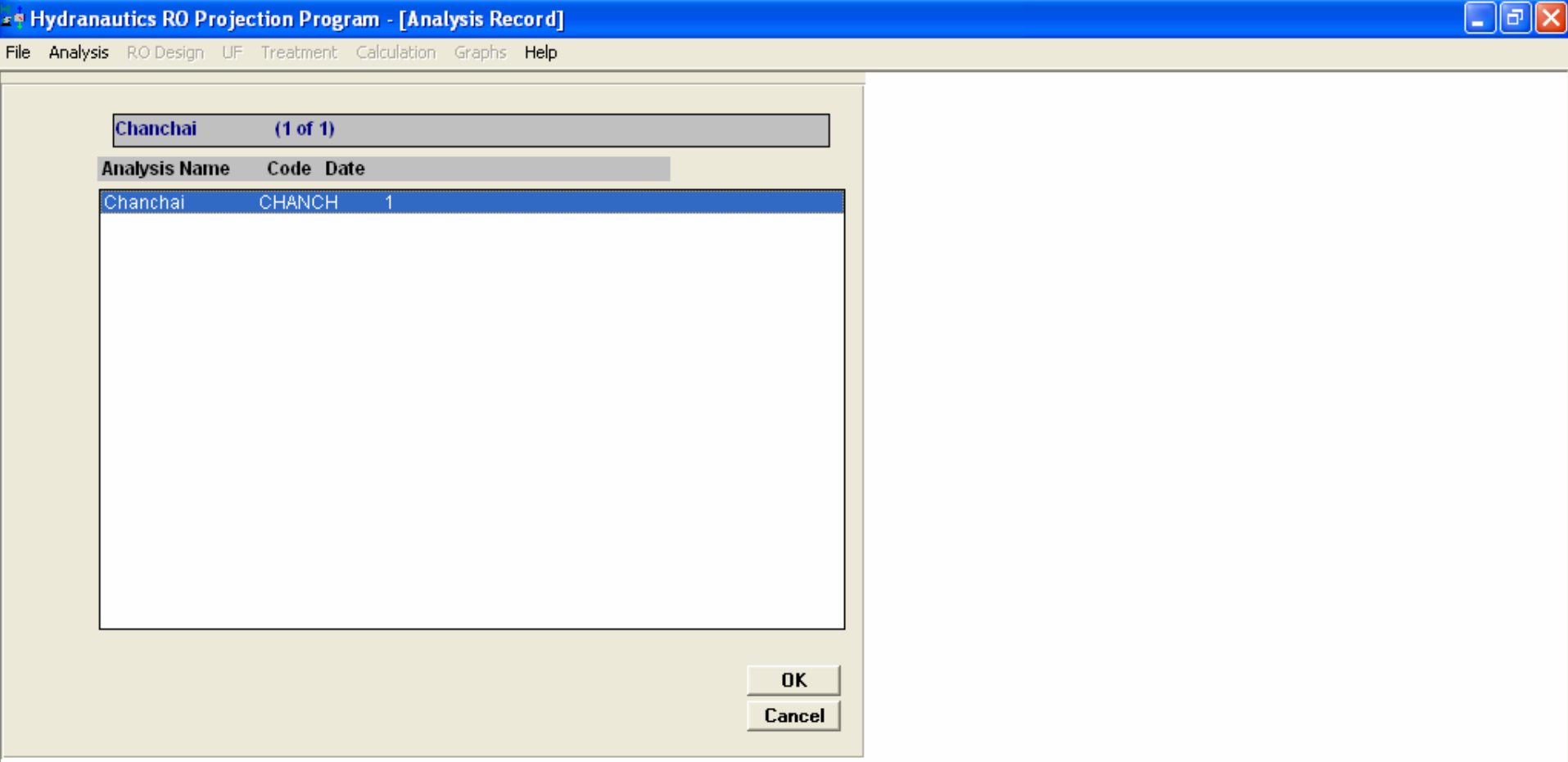
5. ลงข้อมูลแหล่งน้ำที่ 2 แล้วทำตั้งแต่ข้อ 1 — 4 ข้างต้น



6. เปิดหน้า toolbar Analysis\Blend

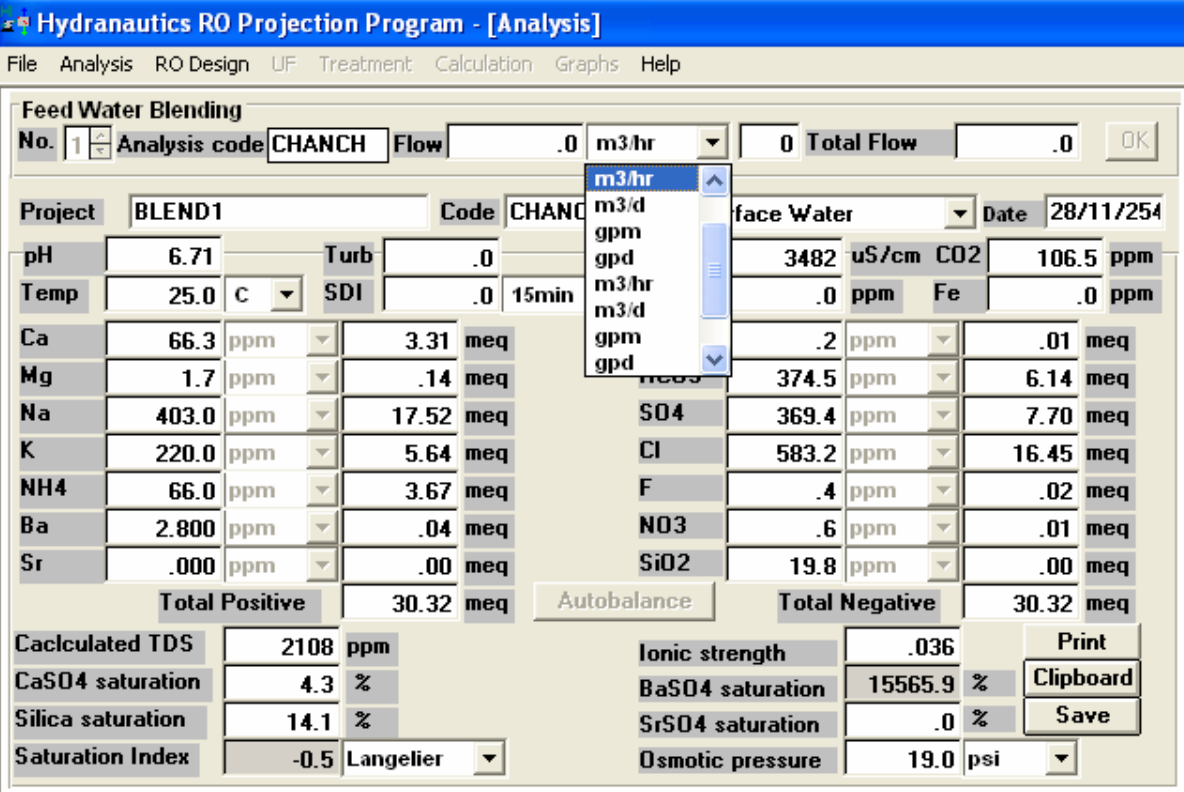


7. เลือก file analysis ที่ save ไว้แล้วออกมาเป็น file แรก

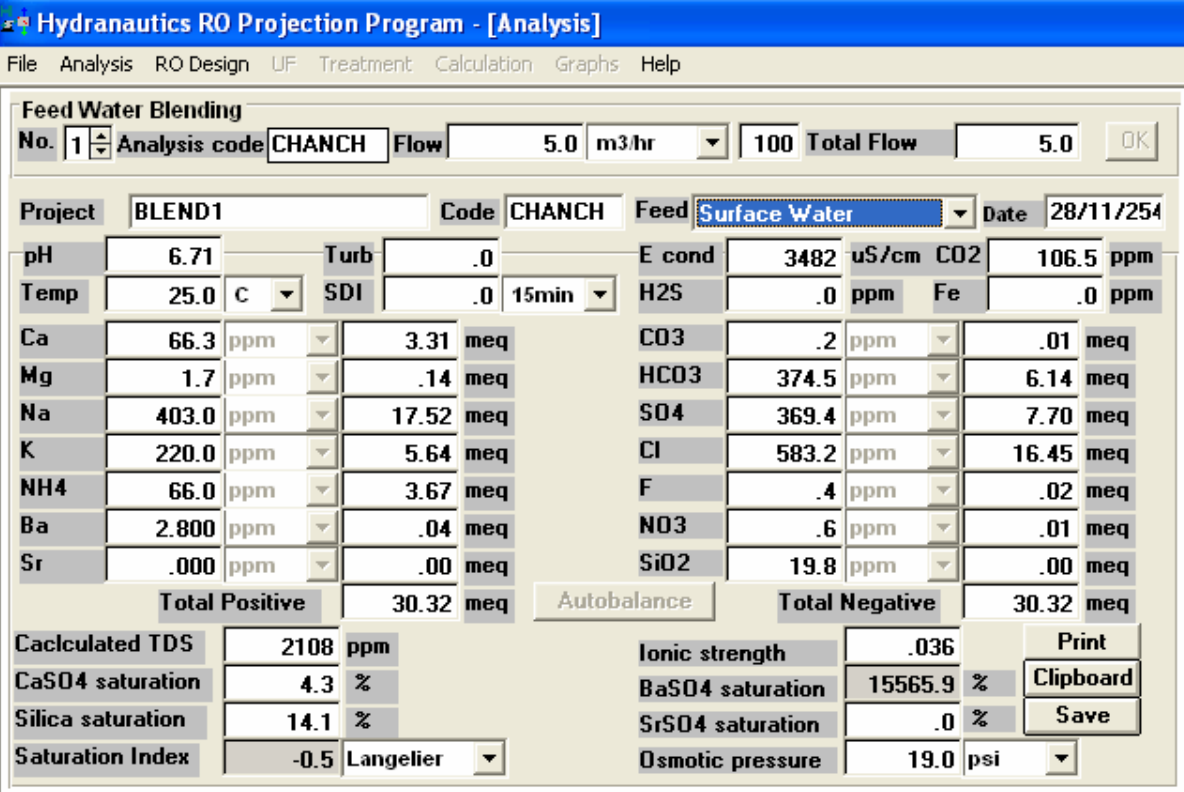

Hydranautics RO Projection Program - [Analysis Record]
File
Analysis
RO Design
UF
Treatment
Calculation
Graphs
Help
Chanchai (1 of 1)
Analysis Name
Code
Date
Chanchai
CHANCH
1
OK
Cancel

8. Click OK

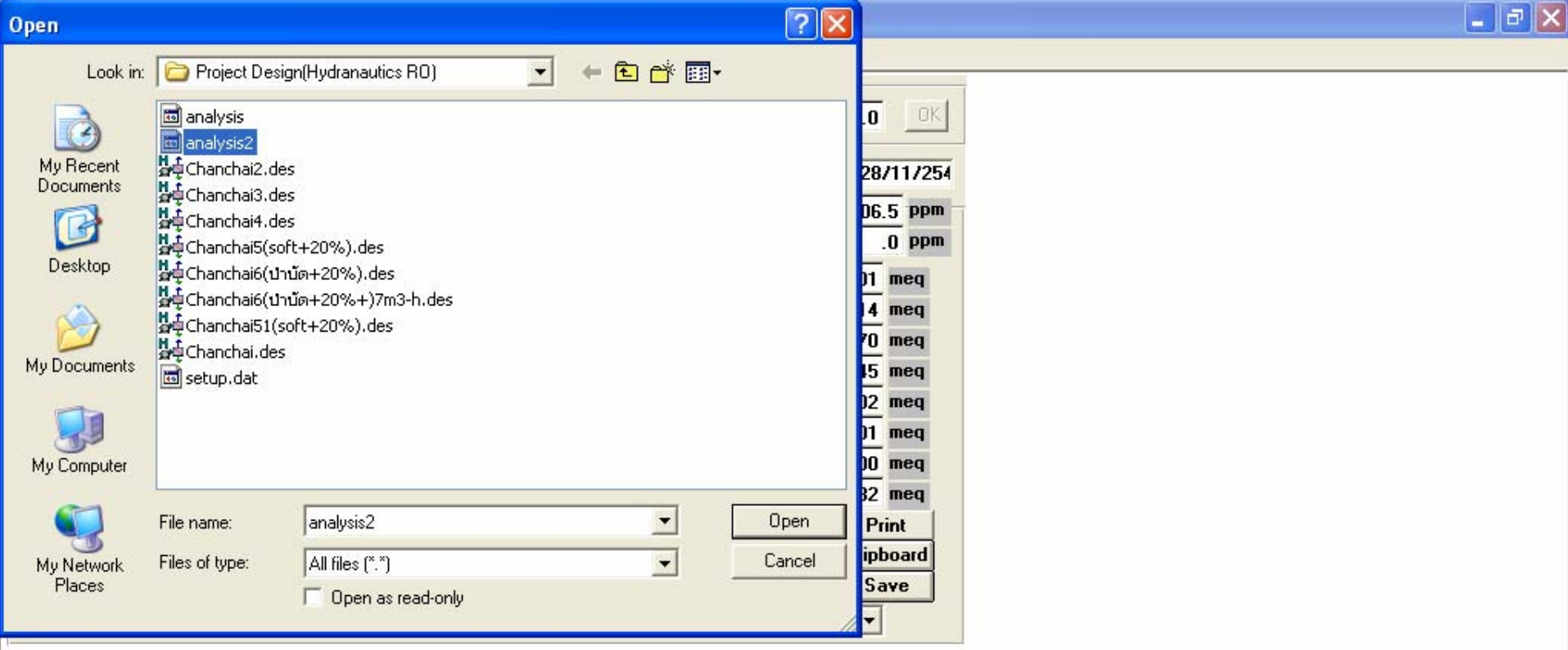
start
RO Software Design(...
RO presentation (ws...
Hydranautics RO Proj...
EN
14:20



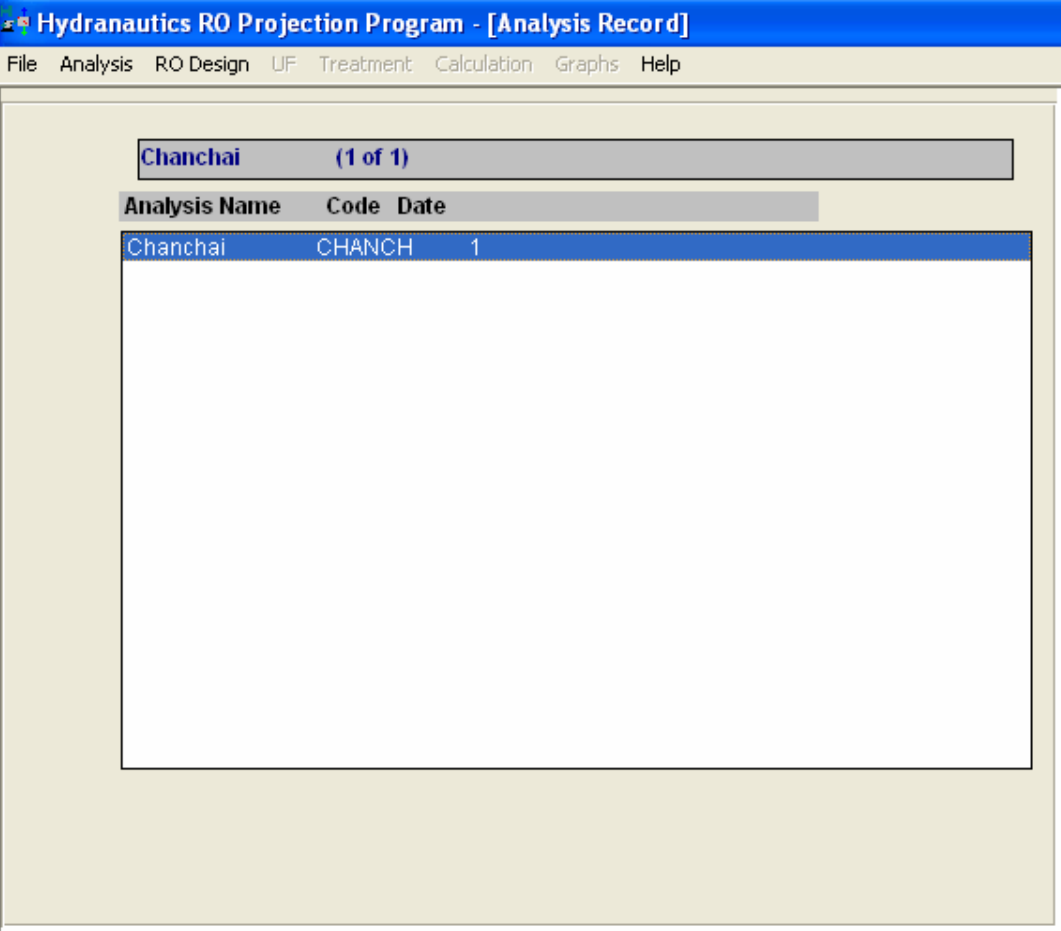
9. ใส่จำนวนตัวเลข flow ที่ต้องการและหน่วย



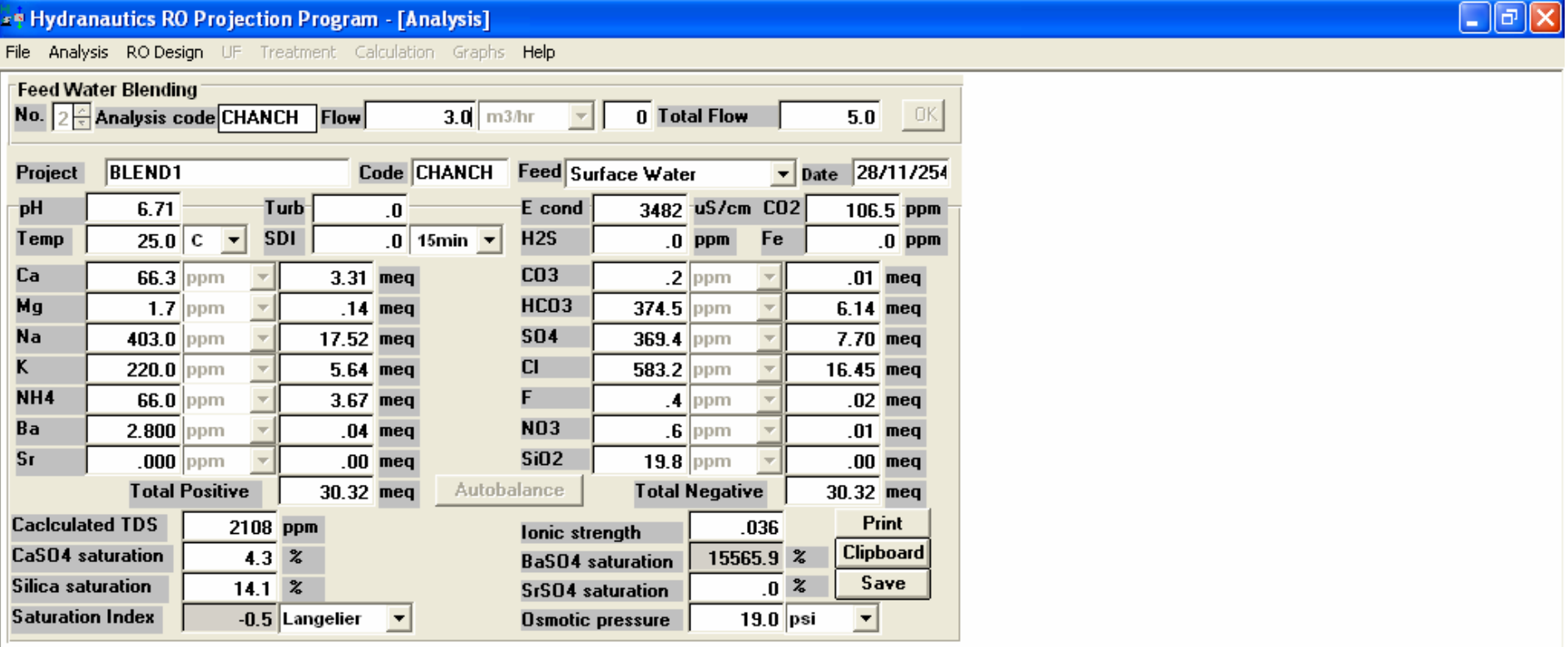
10. Mouse Click ช่อง Feed Water Blending NO.เพื่อเปลี่ยนเป็นแหล่งน้ำที่ 2



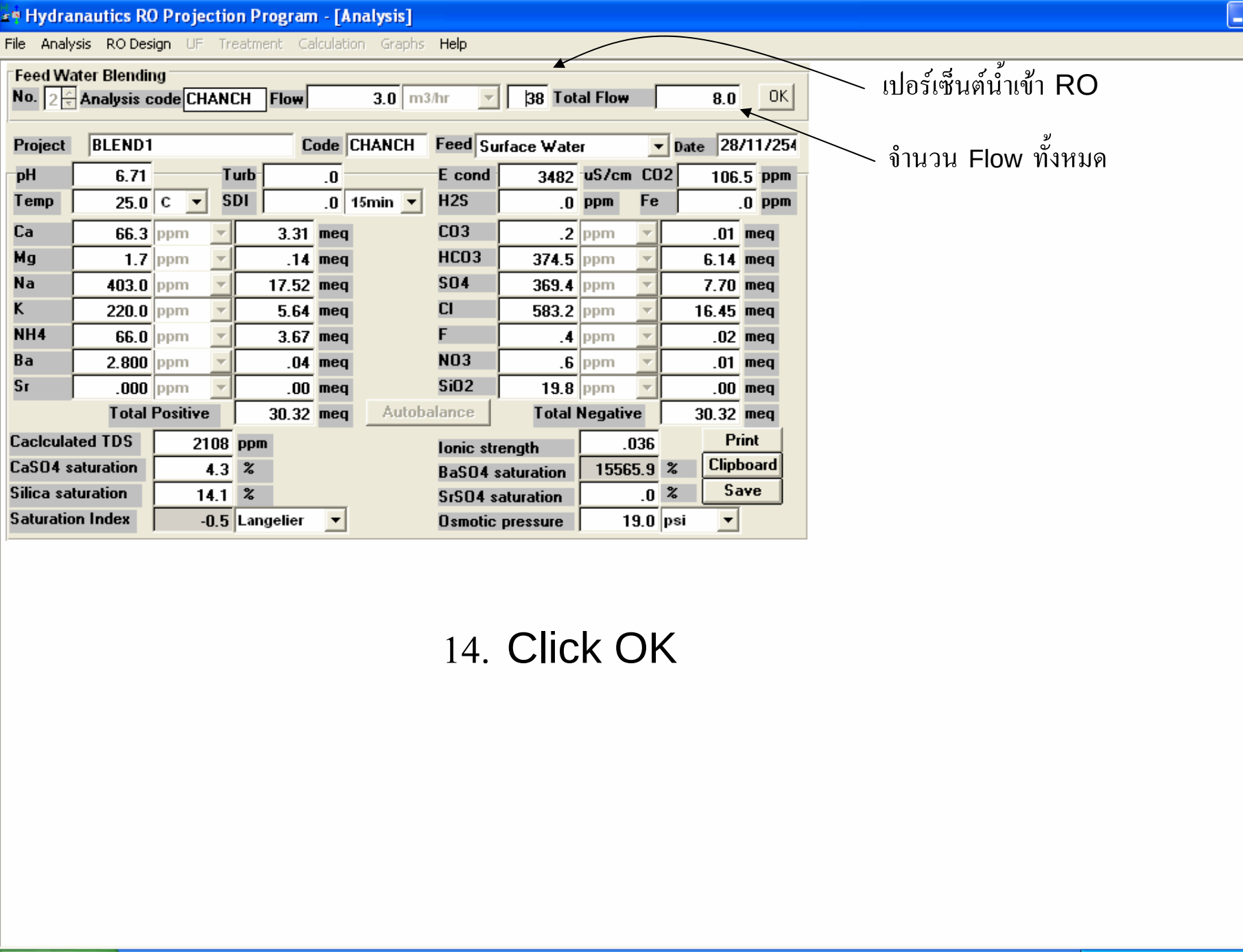
11. เลือกผลวิเคราะห์น้ำแหล่งที่ 2 Click Open



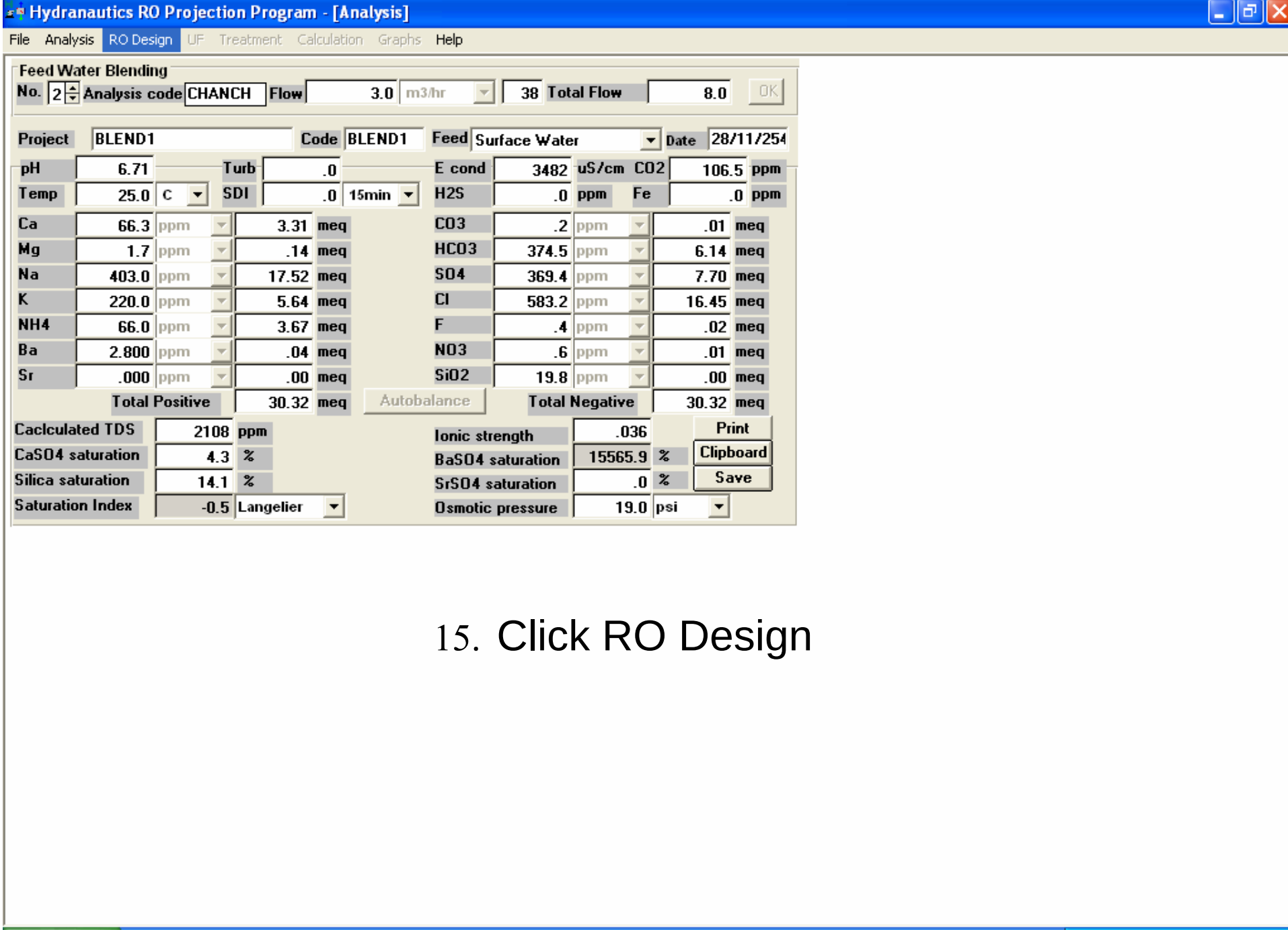
12. Double Click เพื่อเปิด file



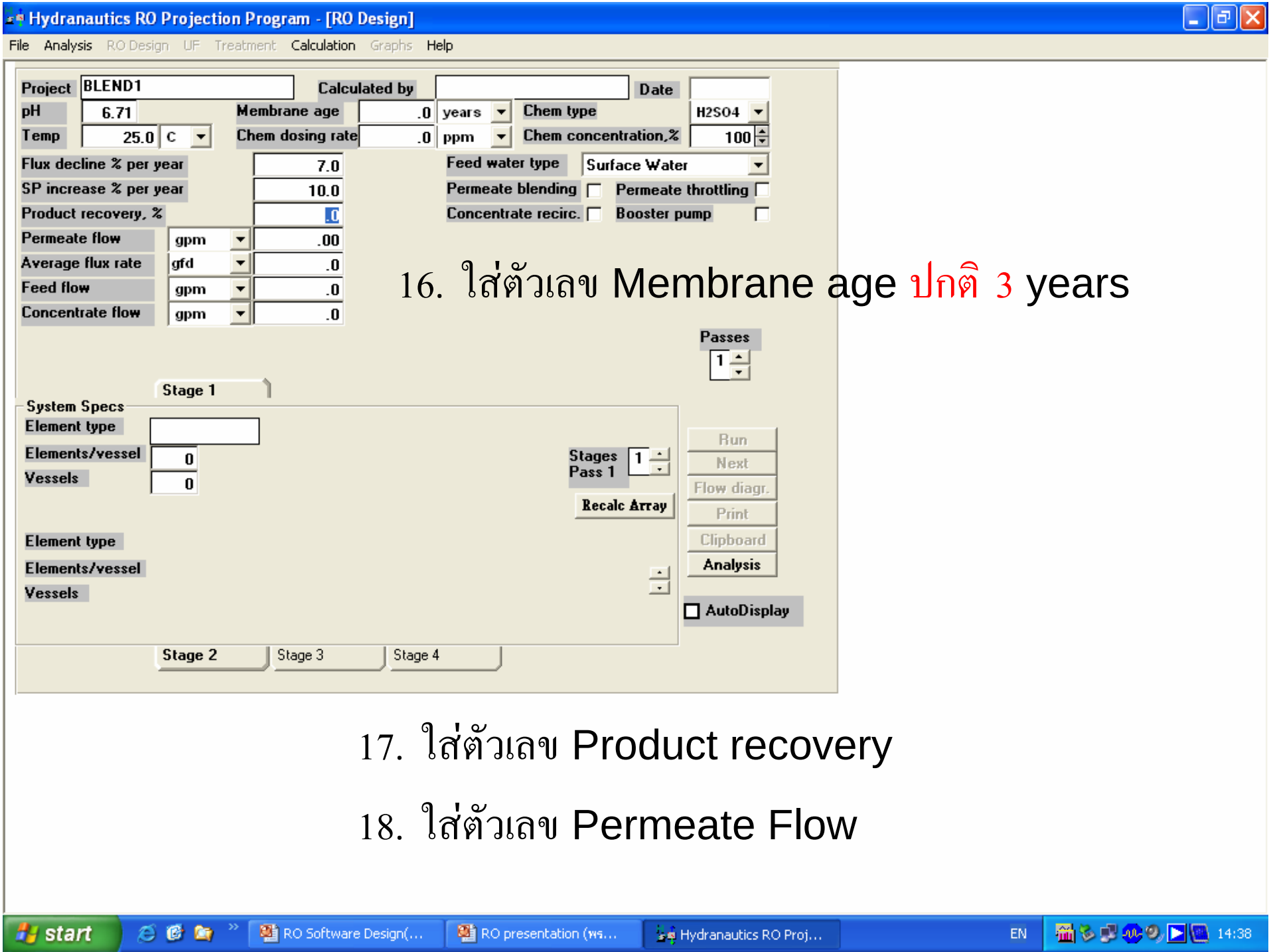
13. ใส่จำนวน flow แหล่งน้ำที่ 2 ที่ต้องการป้อนเข้าระบบ RO


Hydranautics RO Projection Program - [Analysis]
File Analysis RO Design UF Treatment Calculation Graphs Help
Feed Water Blending
No. 2 Analysis code CHANCH Flow 3.0 m3/hr 38 Total Flow 8.0 OK
Project BLEND1 Code CHANCH Feed Surface Water Date 28/11/254
pH 6.71 Turb .0 E cond 3482 uS/cm CO2 106.5 ppm
Temp 25.0 C SDI .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 HCO3 374.5 ppm 6.14 meq
Na 403.0 ppm 17.52 meq SO4 369.4 ppm 7.70 meq
K 220.0 ppm 5.64 meq Cl 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 Positive 30.32 meq Autobalance Total Negative 30.32 meq
Caclculated TDS 2108 ppm Ionic strength .036 Print
CaSO4 saturation 4.3 % BaSO4 saturation 15565.9 % Clipboard
Silica saturation 14.1 % SrSO4 saturation .0 % Save
Saturation Index -0.5 Langelier Osmotic pressure 19.0 psi
เปอร์เซ็นต์น้ำเข้า RO
จำนวน Flow ทั้งหมด

14. Click OK



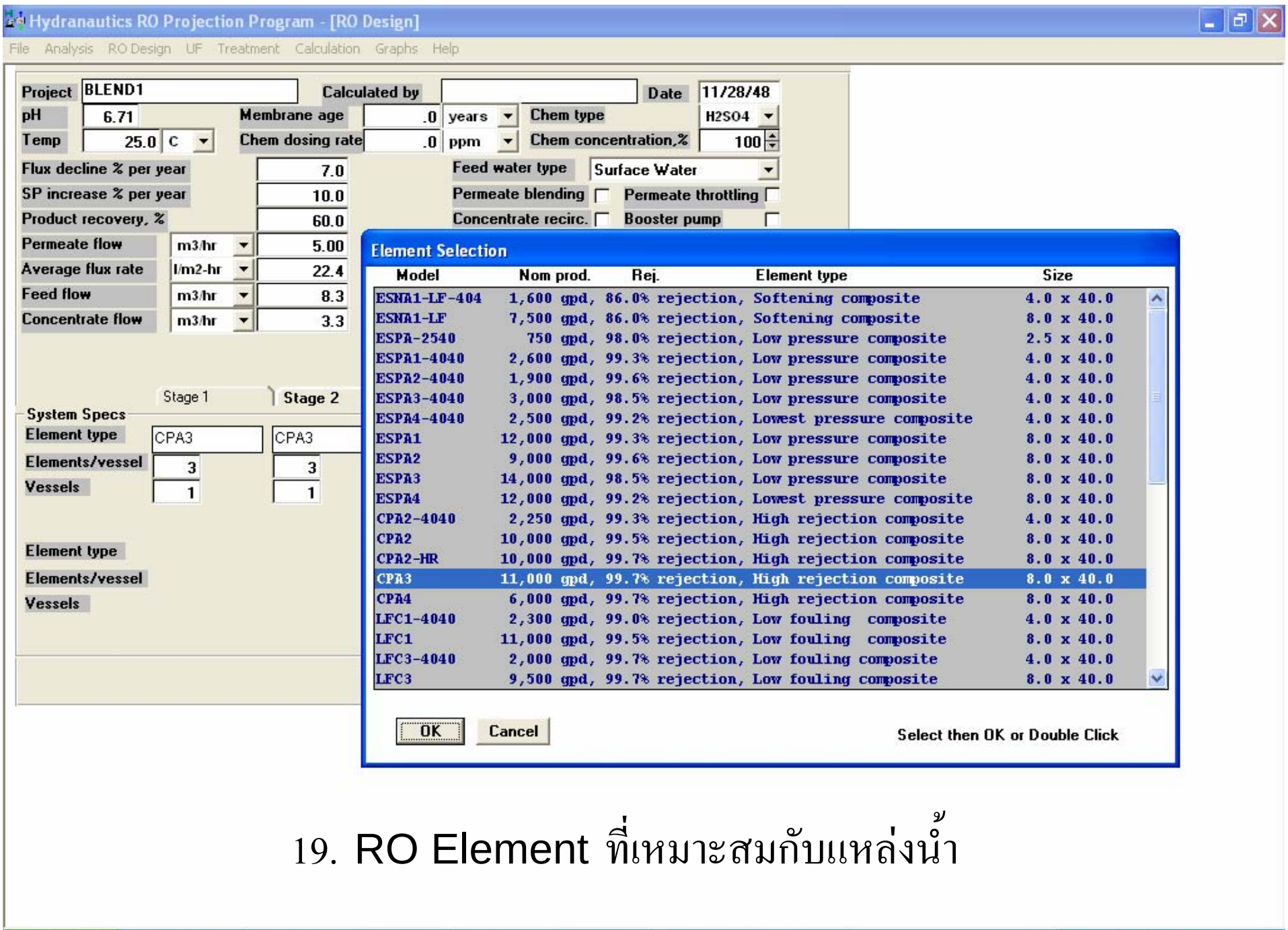
15. Click RO Design



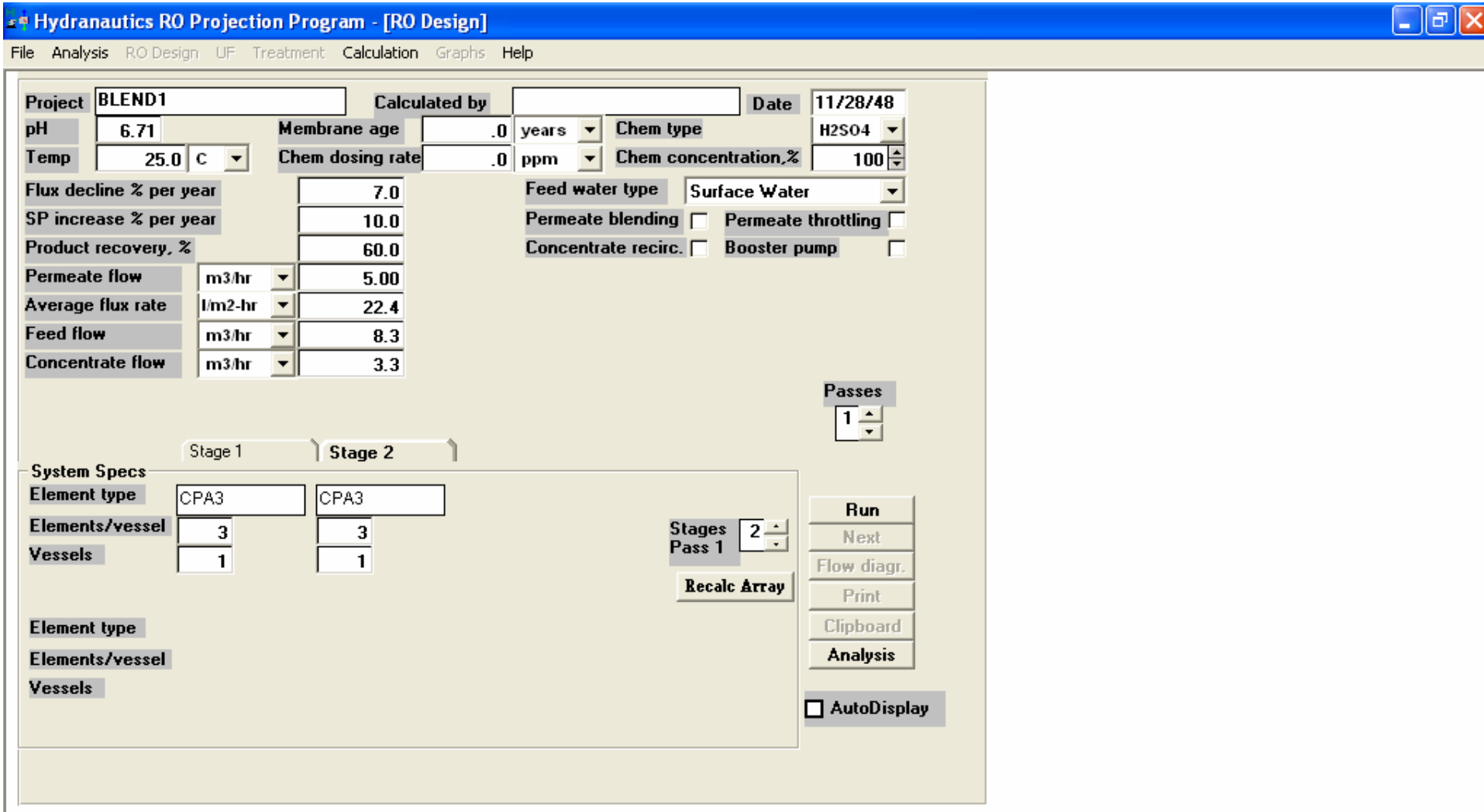
16. ใส่ตัวเลข Membrane age ปกติ 3 years

17. ใส่ตัวเลข Product recovery

18. ใส่ตัวเลข Permeate Flow

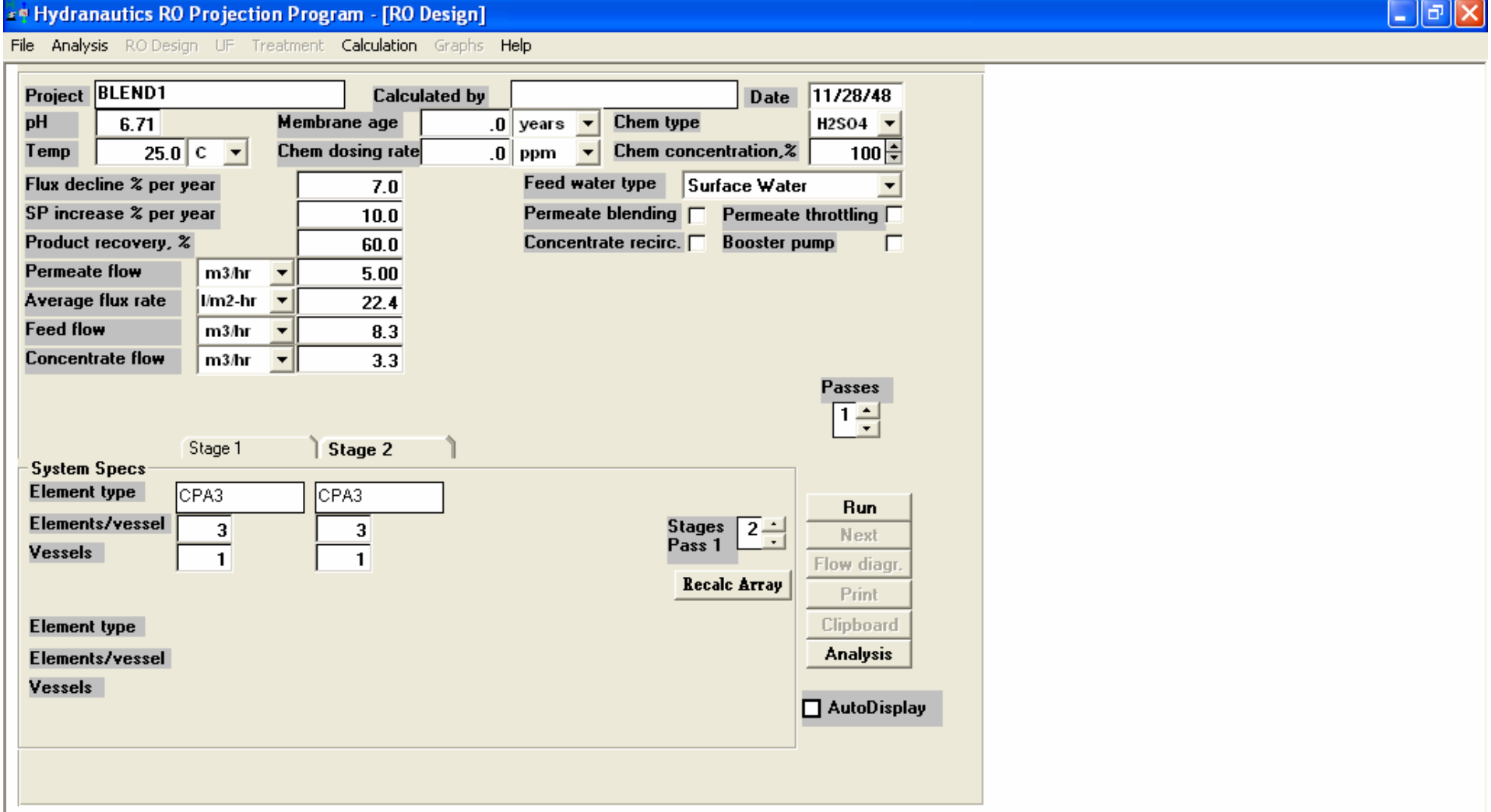


19. RO Element ที่เหมาะสมกับแหล่งน้ำ

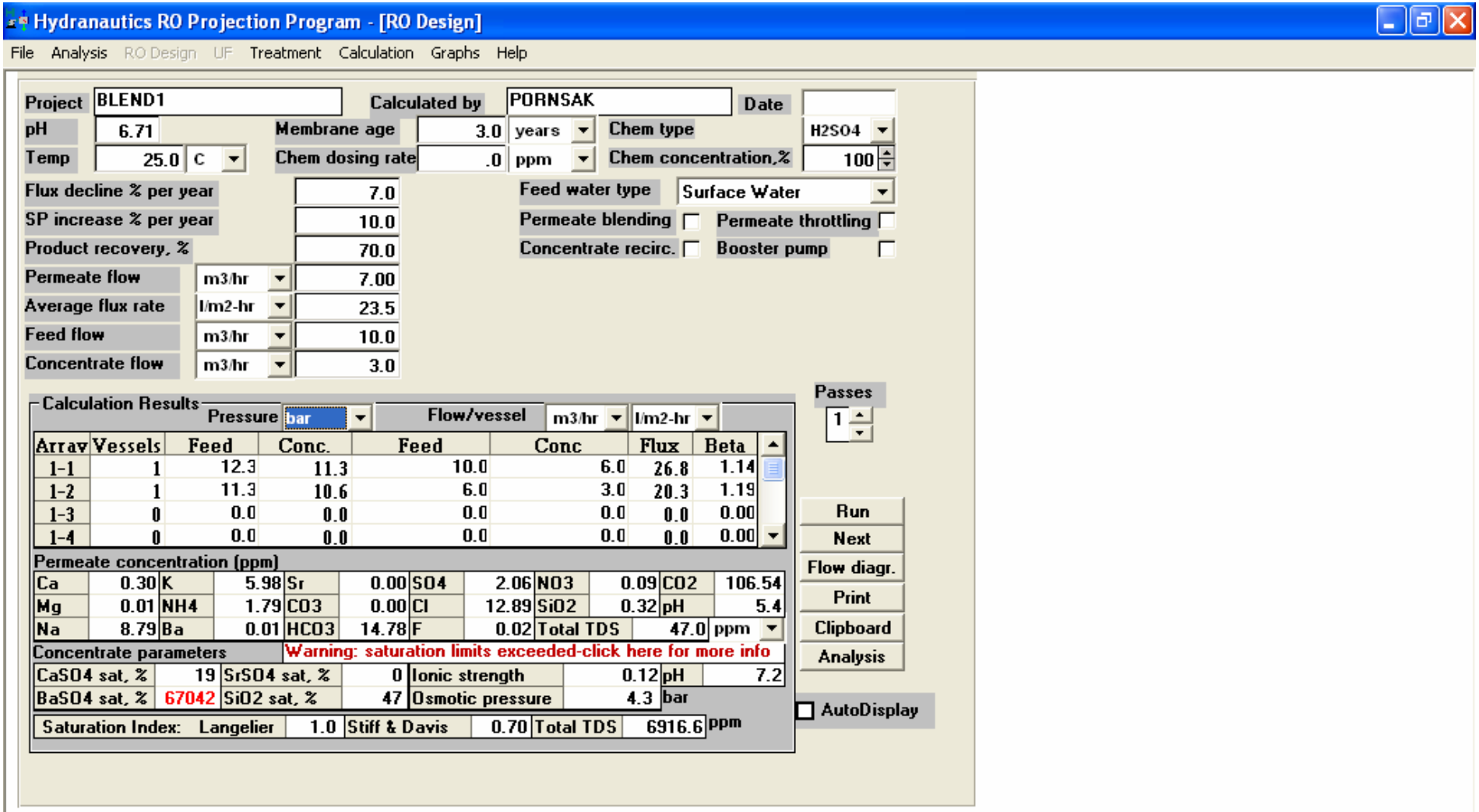


20. ใส่ตัวเลข Elements/vessel และจำนวน vessels

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



21. Click ปุ่ม Run



22.กรณีขึ้นตัวเลขสีแดงแสดงว่าเกิดความผิดปรกติ เราสามารถดูวิธีการแก้ไขโดยนำ mouse ไปdouble click ตรง Warning : โปรแกรมจะบอกรายละเอียดวิธีการแก้ไขให้

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 :

$$A = (\log(TDS) - 1)/10$$

$$B = -13.12 * \log(\text{Temp}(^0C) + 273) + 34.55$$

$$C = \log[\text{Ca as } CaCO_3] - 0.4$$

$$D = \log[\text{Alk as } CaCO_3]$$

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

Saturation Limits

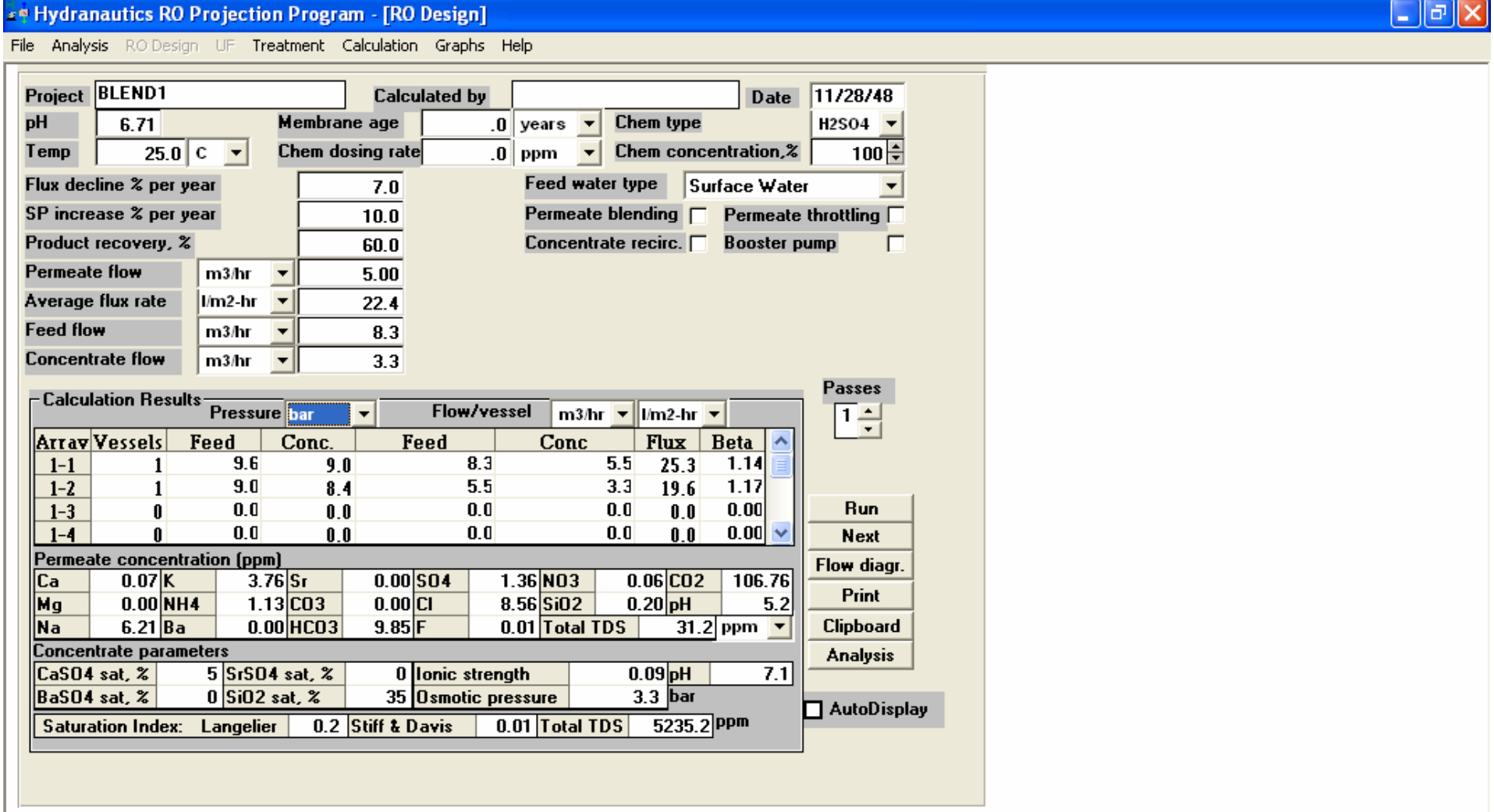
Saturation Limits for Sparingly Soluble Salts in the Concentrate:

Salt	Saturation %
CaSO4	230
SrSO4	800
BaSO4	6000
SiO2	100

Limits of Saturation Indices:

Condition*	LSI Value
LSI and SDSI without scale inhibitor	≤ -0.2
LSI & SDSI with SHMP (sodium hexametaphosphate)	≤ 0.5
LSI & SDSI with organic scale inhibitor	≤ 1.8

*Langelier and Stiff & Davis Saturation Indices



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

Rodesign Quick Results Screen

File Close

Hydranautics Membrane Solutions Design Software, v. 8.5 (c) 2003 28/11/2548
BASIC DESIGN

RO program licensed to:
Calculation created by:
Project name: BLEND1

HP Pump flow:	8.3 m3/hr	Permeate flow:	5.00 m3/hr
Recommended pump press.:	10.5 bar	Raw water flow:	8.3 m3/hr
Feed pressure:	9.6 bar	Permeate recovery ratio:	60.0 %
Feedwater Temperature:	25.0 C(77F)		
Feed water pH: 6.71	(0.00)	Element age:	0.0 years
Acid dosage, ppm (100%):	0.0 H2SO4	Flux decline % per year:	7.0
Acidified feed CO2:	106.8	Salt passage increase, %/yr:	10.0
Average flux rate:	22.4 l/m2-hr	Feed type:	Surface Water

Stage	Perm. Flow m3/hr	Flow/Vessel Feed m3/hr	Conc m3/hr	Flux l/m2-hr	Beta	Conc.&Throt. Pressures bar	bar	Element Type	Elem. No.	Array
1-1	2.8	8.3	5.5	25.3	1.14	9.0	0.0	CPA3	3	1x3
1-2	2.2	5.5	3.3	19.6	1.17	8.4	0.0	CPA3	3	1x3

Ion	Raw water mg/l	Raw water meq/l	Feed water mg/l	Feed water meq/l	Permeate mg/l	Permeate meq/l	Concentrate mg/l	Concentrate meq/l
Ca	24.9	1.2	24.9	1.2	0.07	0.0	62.1	3.1
Mg	0.6	0.0	0.6	0.0	0.00	0.0	1.5	0.1
Na	453.2	19.7	453.2	19.7	6.21	0.3	1123.7	48.9
K	220.0	5.6	220.0	5.6	3.76	0.1	544.4	14.0
NH4	66.0	3.7	66.0	3.7	1.13	0.1	163.3	9.1
Ba	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0
Sr	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0
CO3	0.2	0.0	0.2	0.0	0.00	0.0	0.5	0.0
HCO3	374.5	6.1	374.5	6.1	9.85	0.2	921.5	15.1
SO4	369.4	7.7	369.4	7.7	1.36	0.0	921.5	19.2
Cl	583.2	16.5	583.2	16.5	8.56	0.2	1445.2	40.8
F	0.4	0.0	0.4	0.0	0.01	0.0	1.0	0.1
NO3	0.6	0.0	0.6	0.0	0.06	0.0	1.4	0.0
SiO2	19.8		19.8		0.20		49.2	
TDS	2112.8		2112.8		31.2		5235.2	
pH	6.7		6.7		5.2		7.1	

	Raw water	Feed water	Concentrate
CaSO4 / Ksp * 100:	2%	2%	5%
SrSO4 / Ksp * 100:	0%	0%	0%
BaSO4 / Ksp * 100:	0%	0%	0%
SiO2 saturation:	14%	14%	35%
Langelier Saturation Index	-0.95	-0.95	0.18
Stiff & Davis Saturation Index	-0.96	-0.96	0.01
Ionic strength	0.03	0.03	0.09
Osmotic pressure	1.3 bar	1.3 bar	3.3 bar

These calculations are based on nominal element performance when operated

start | RO Software Desig... | RO presentation (M... | Hydranautics RO Pr... | Rodesign Quick Res... | EN | 15:11

Hydranautics RO Projection Program - [RO Design]

File Analysis RO Design UF Treatment Calculation Graphs Help

Project BLEND1 Calculated by Date 11/28/48

pH 6.71 Membrane age .0 years Chem type H2SO4

Temp 25.0 C Chem dosing rate .0 ppm Chem concentration,% 100

Flux decline % per year 7.0 Feed water type Surface Water

SP increase % per year

Product recovery, %

Permeate flow m3/hr

Average flux rate l/m2-hr

Feed flow m3/hr

Concentrate flow m3/hr

Calculation Results Pressur

Arrav	Vessels	Feed
1-1	1	9.6
1-2	1	9.0
1-3	0	0.0
1-4	0	0.0

Permeate concentration (ppm

Ca	0.07	K	3.7
Mg	0.00	NH4	1.1
Na	6.21	Ba	0.0

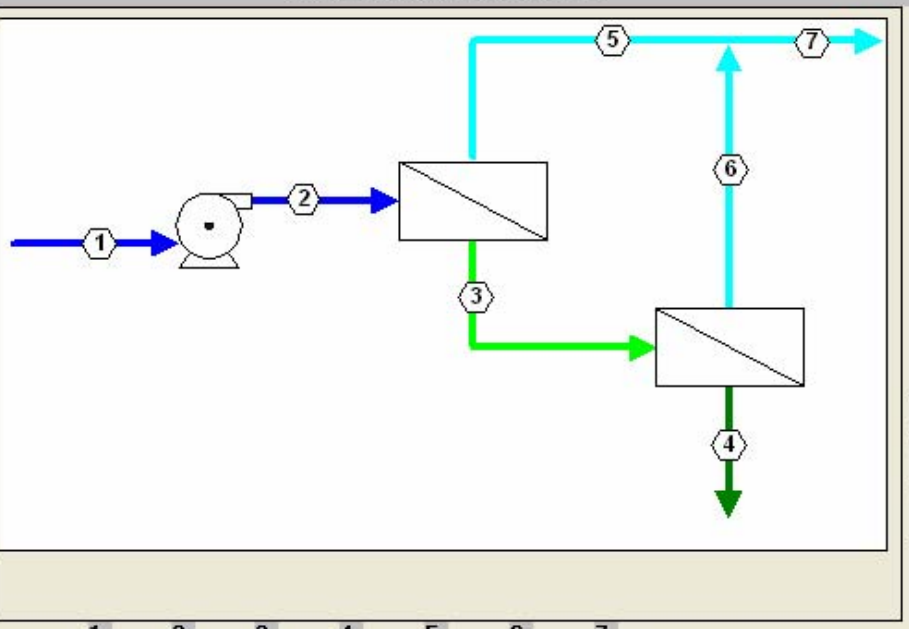
Concentrate parameters

CaSO4 sat, %	5	SrSO4	
BaSO4 sat, %	0	SiO2	

Saturation Index: Langelier

Flow Diagram

TWO STAGE SYSTEM



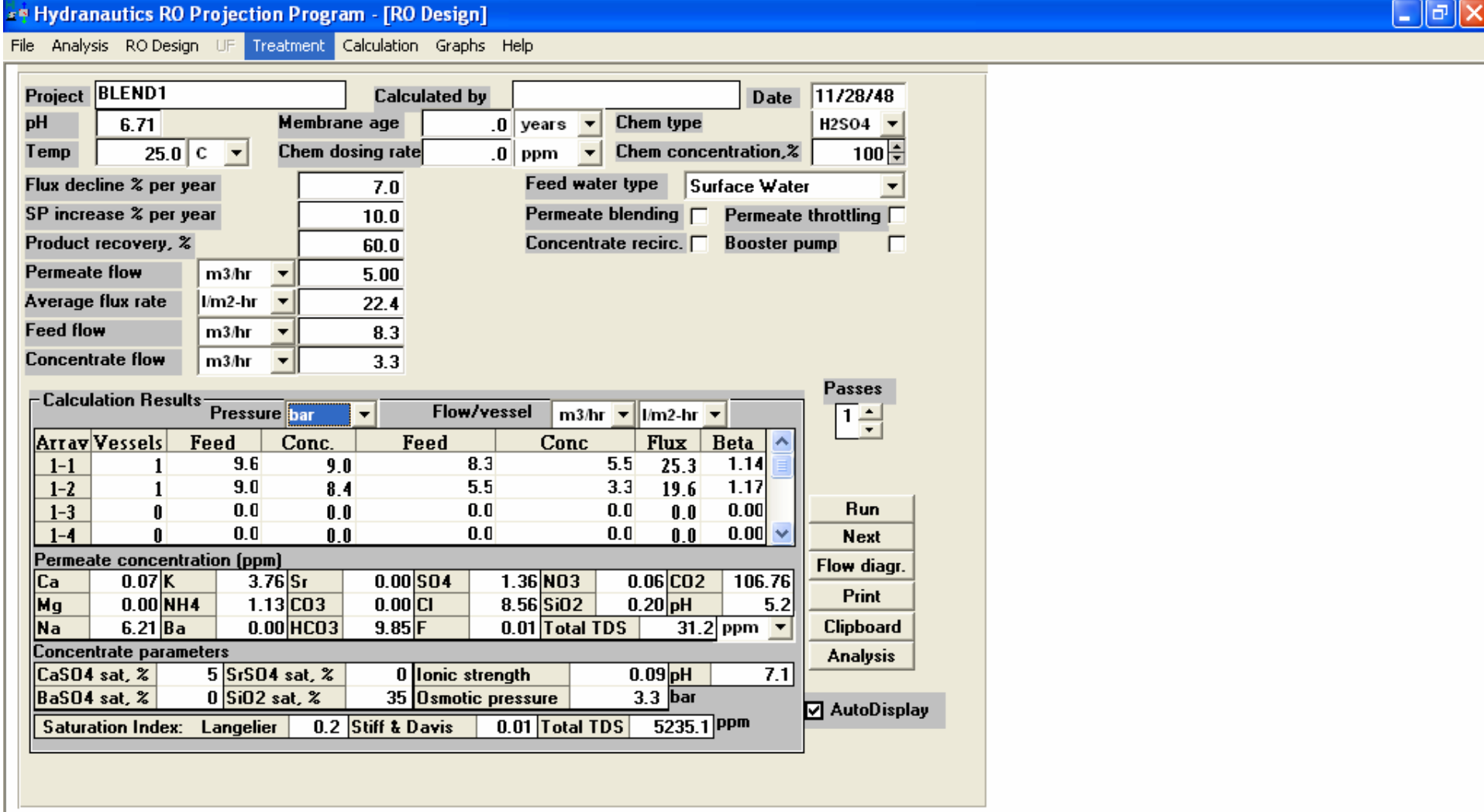
Close

Clipboard

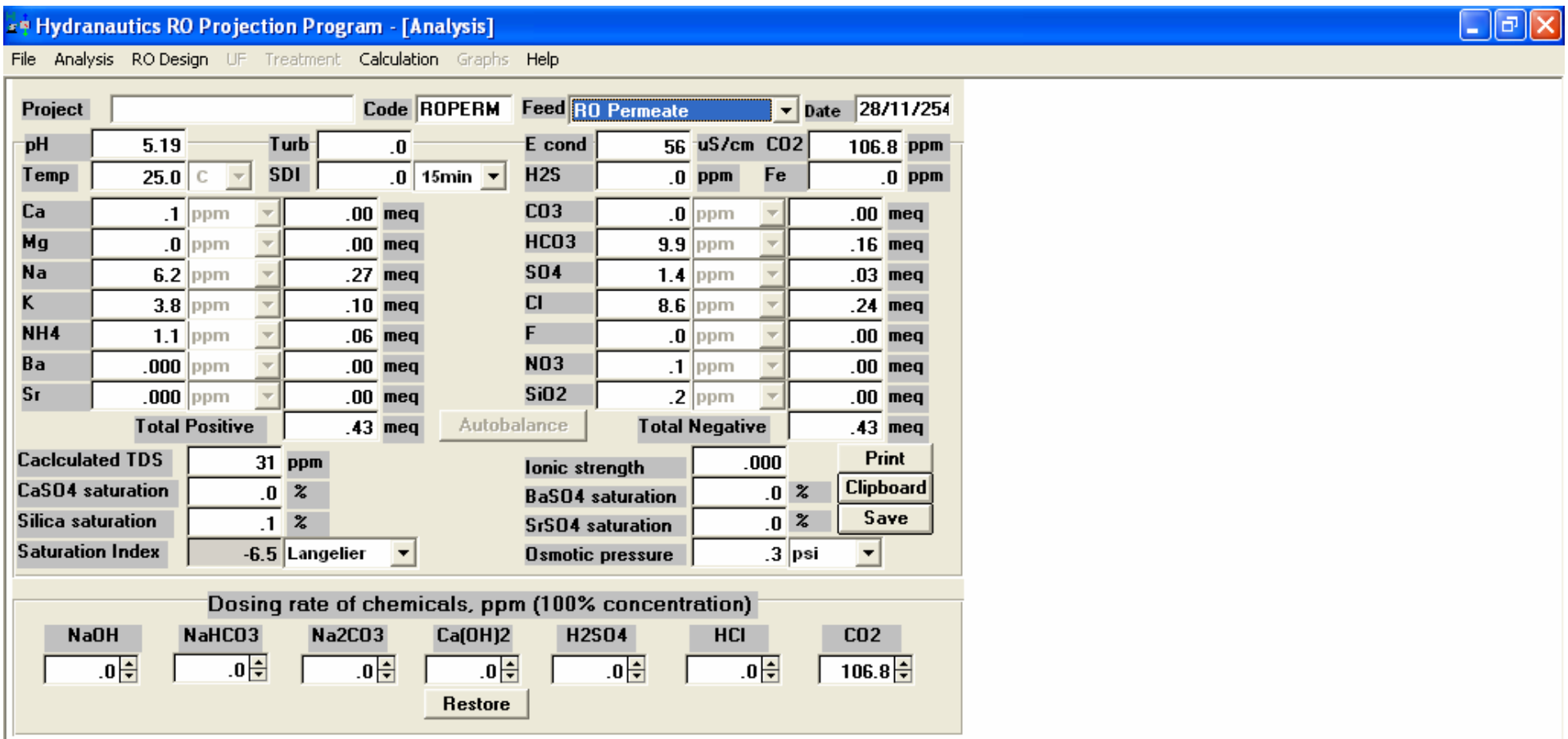
Print

		1	2	3	4	5	6	7
Flow	m3/hr	8.3	8.3	5.5	3.3	2.8	2.2	5.0
Pressure	bar	.0	9.6	9.0	8.4	.0	.0	.0
TDS (ppm)		2112.8	2112.8	3183.0	5235.2	18.3	47.9	31.2

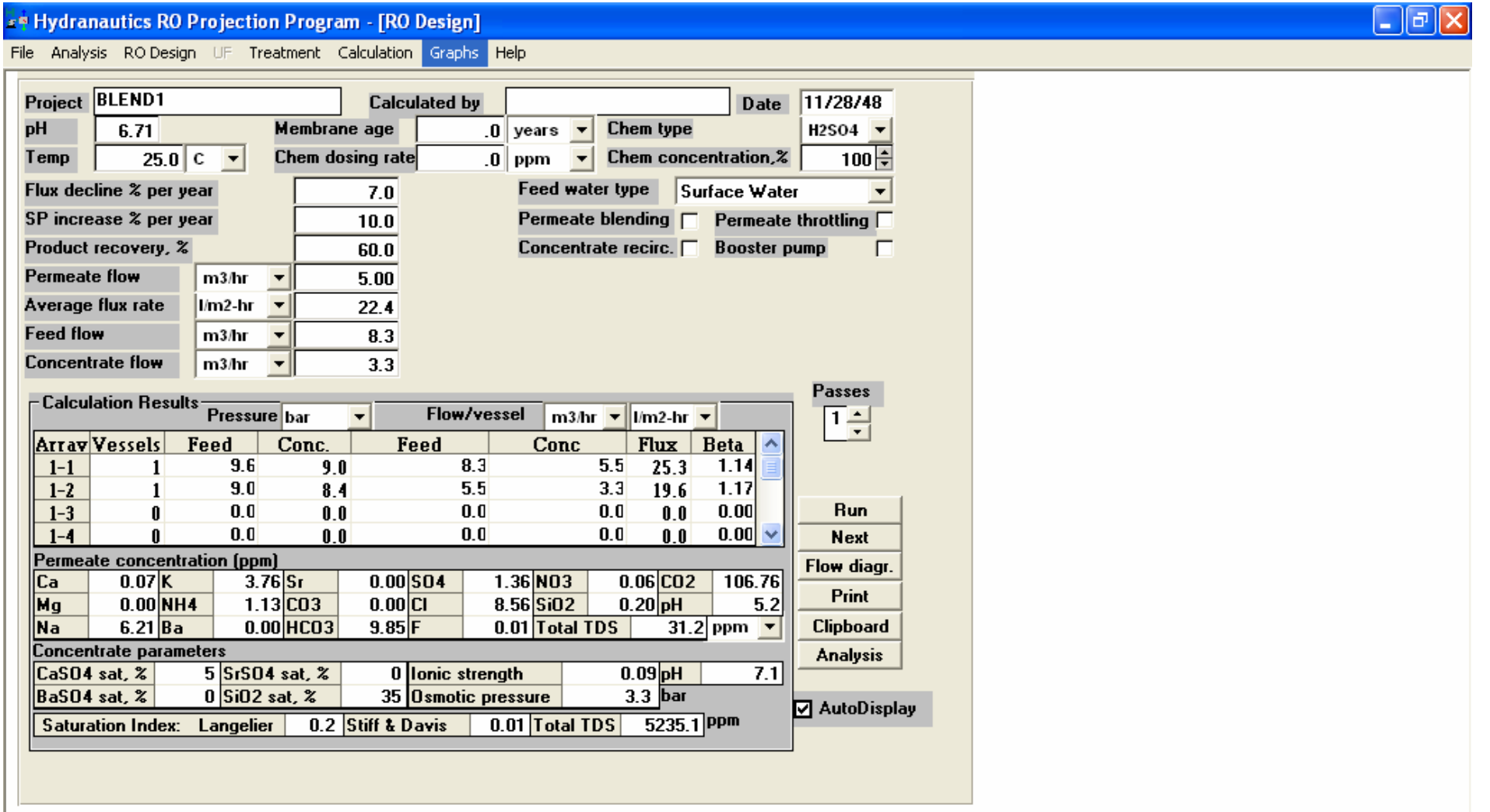
start RO Software Desig... RO presentation (w... Hydranautics RO Pr... Flow Diagram EN 15:12



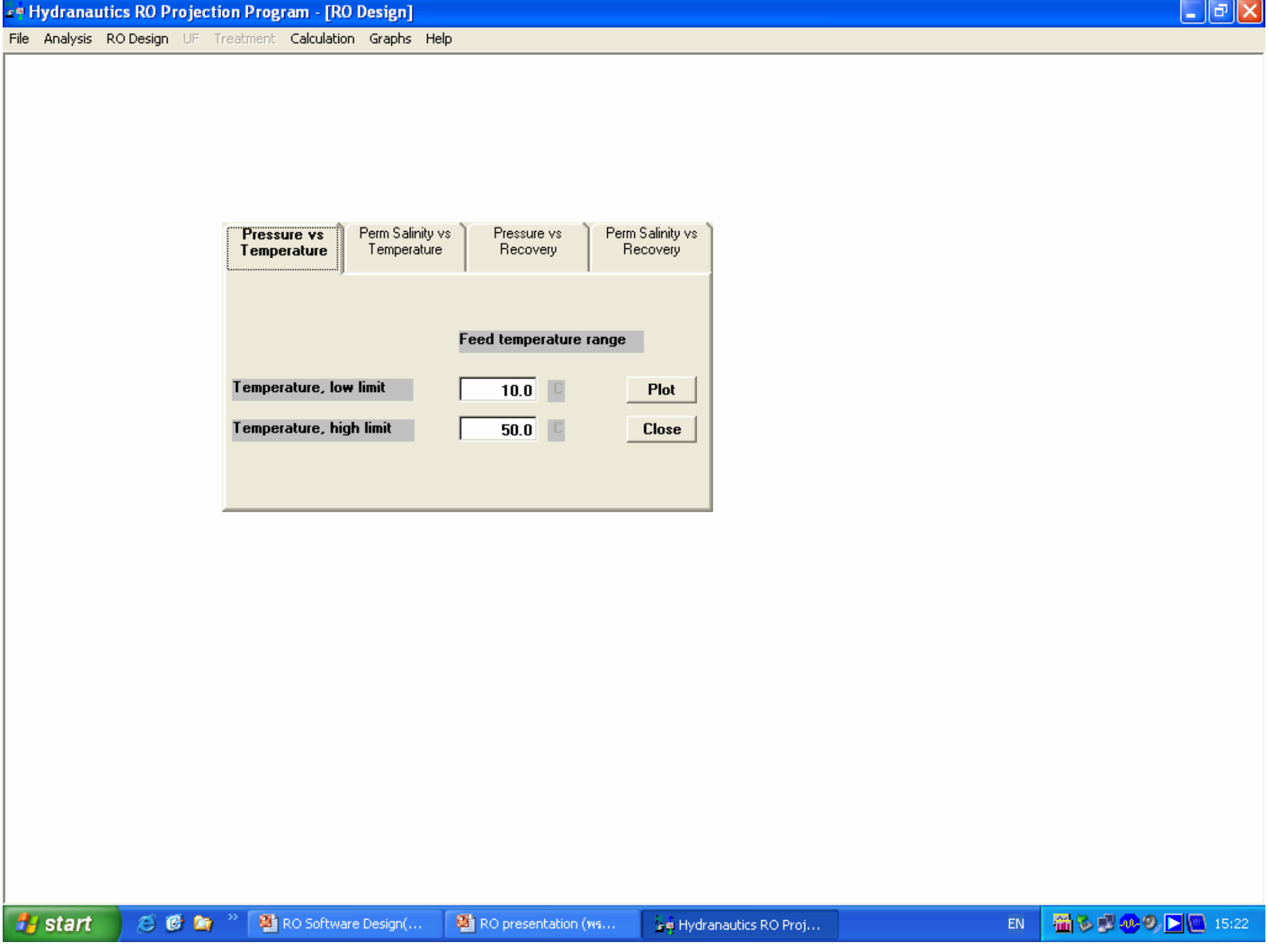
24. เมื่อต้องการปรับค่า pH ของน้ำ permeate ให้เลือก toolbar treatment



25. หลังจากนั้นจะมีช่องให้ใส่ตัวเลขและชนิดของสารเคมีเพื่อปรับค่า pH ของน้ำ permeate เมื่อใส่ตัวเลขลงไปในช่องค่า pH จะเปลี่ยนไปตามตัวเลขที่ใส่



26. Mouse Click ปุ่ม Toolbar Graphs เพื่อดูกราฟความสัมพันธ์ต่างๆ


Hydranautics RO Projection Program - [RO Design]
File
Analysis
RO Design
UF
Treatment
Calculation
Graphs
Help
Pressure vs Temperature
Perm Salinity vs Temperature
Pressure vs Recovery
Perm Salinity vs Recovery
Feed temperature range
Temperature, low limit
10.0
C
Plot
Temperature, high limit
50.0
C
Close
start
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RO presentation (ws...
Hydranautics RO Proj...
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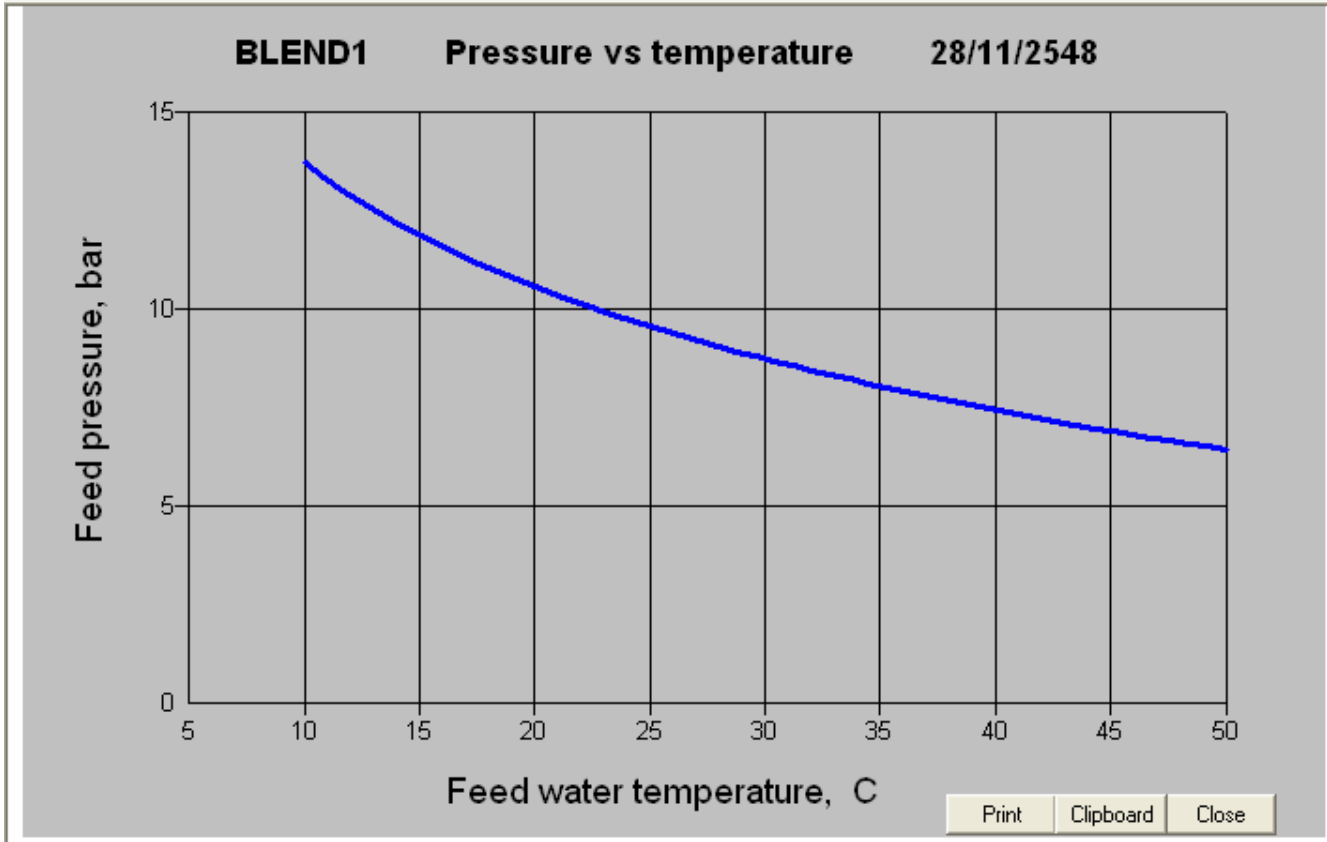
15:22

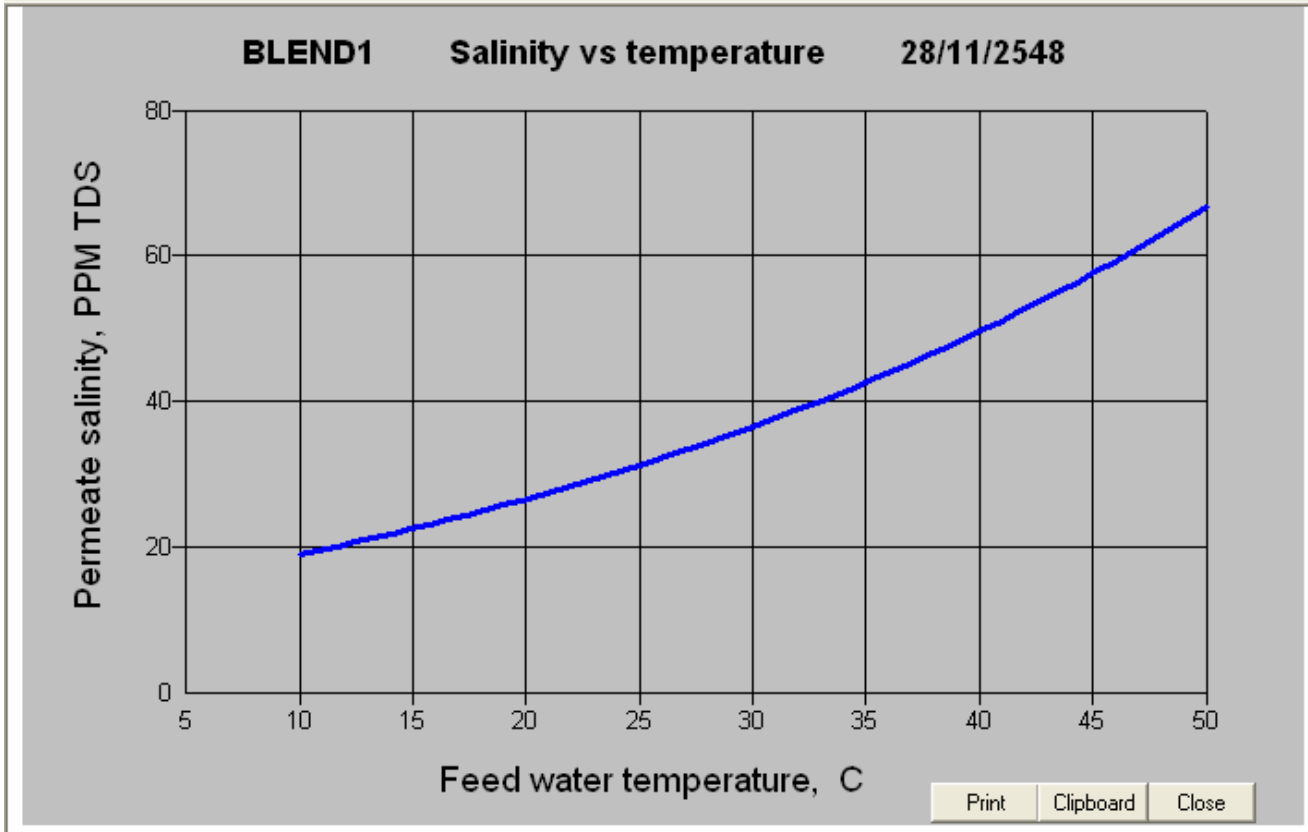
Hydranautics RO Projection Program - [RO Design]

File Analysis RO Design UF Treatment Calculation Graphs Help



Hydranautics RO Projection Program - [RO Design]

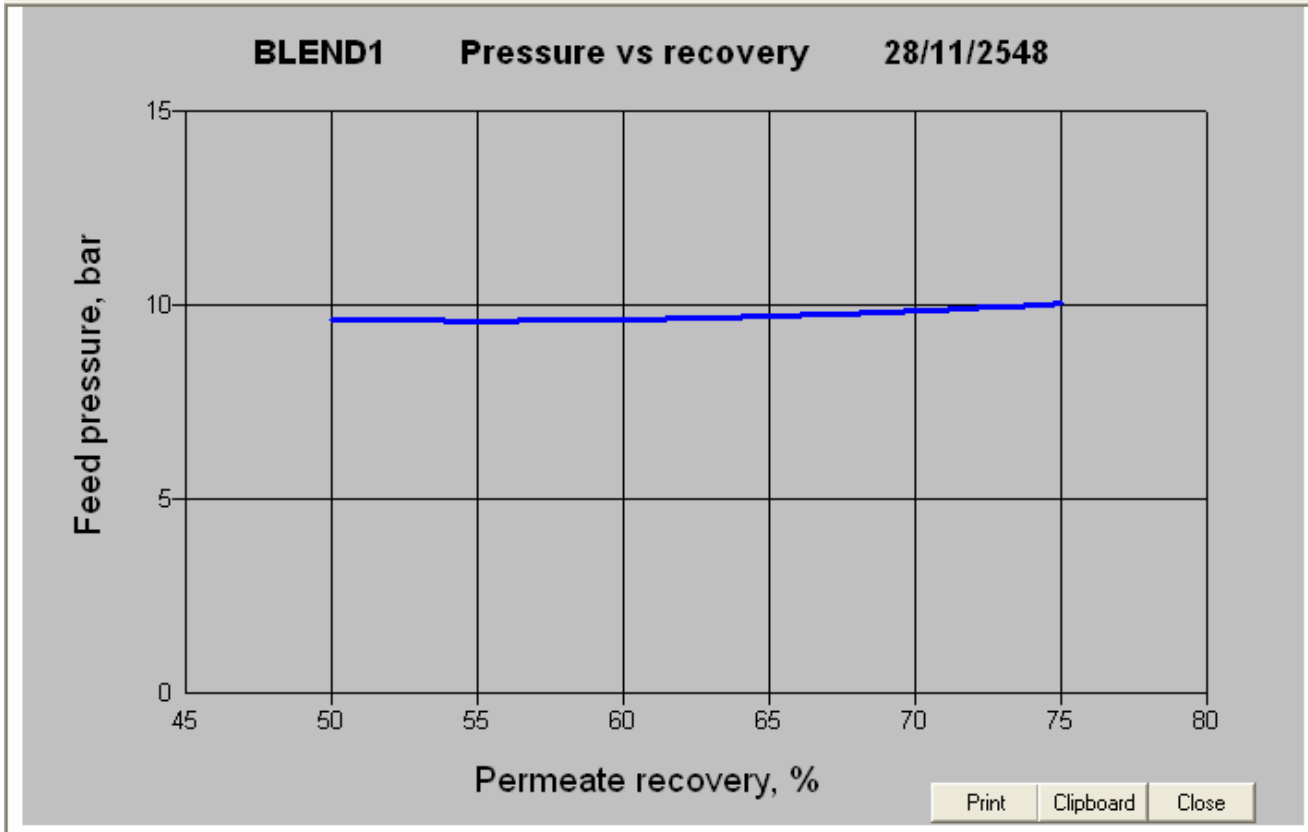
File Analysis RO Design UF Treatment Calculation Graphs Help



start RO Software Design(... RO presentation (ws... Hydranautics RO Proj... EN 15:23

Hydranautics RO Projection Program - [RO Design]

File Analysis RO Design UF Treatment Calculation Graphs Help



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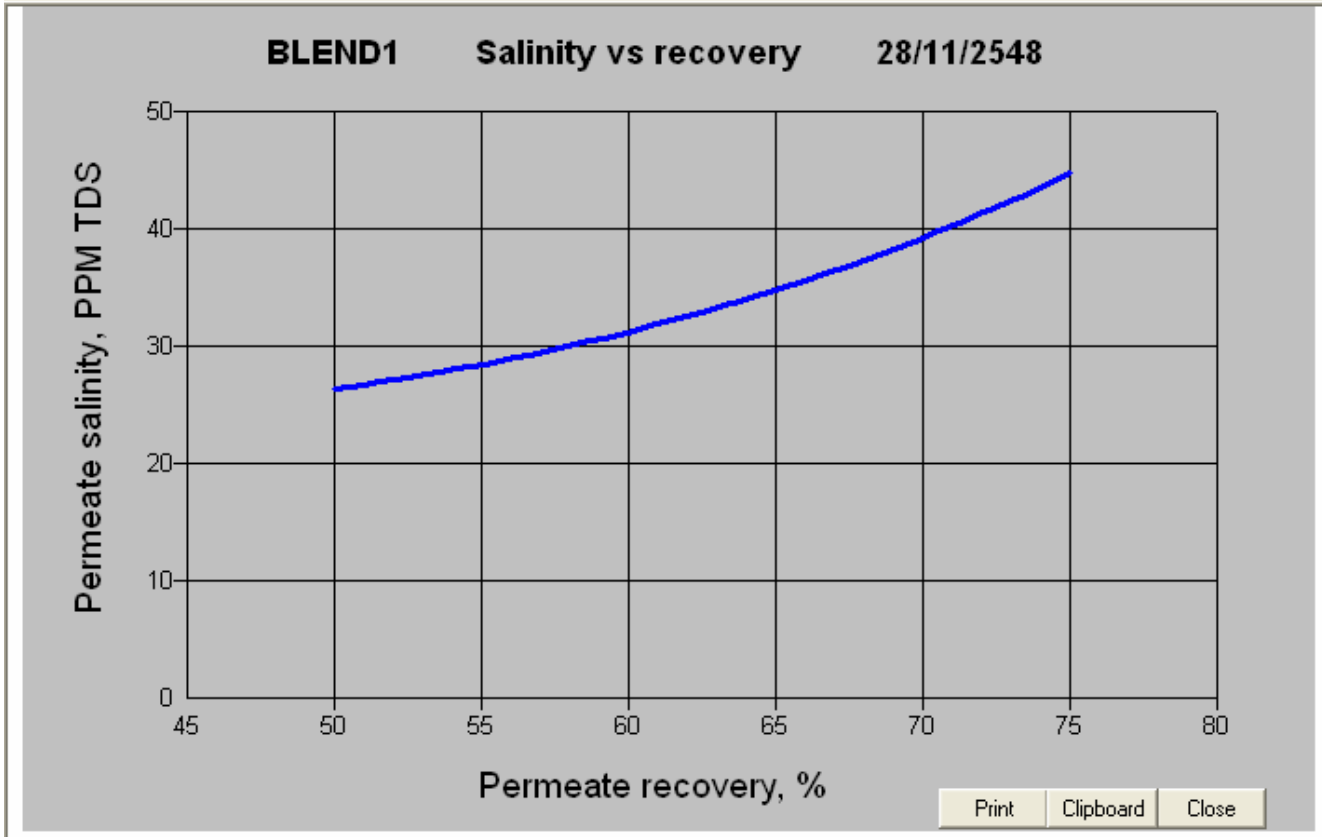
Hydranautics RO Projection Program - [RO Design]

File Analysis RO Design UF Treatment Calculation Graphs Help



start RO Software Design(... RO presentation (ws... Hydranautics RO Proj... EN 15:23