

RO Membrane System Design Software

CSMPRO v4.0



A Guide to New Features

This guide outlines the new features of CSMPPro v4.0



Element Osmotic Pressure

CSMPRO v4.0 - [Result]

File Option Help Update

Print Close

Result Scan Diagram

System Data

FEED	266.67 m3/hr	5,000.00 mg/l	0.00 Bar
PRODUCT	261.99 m3/hr	25.27 mg/l	0.00 Bar
CONCENTRATE	4.68 m3/hr	283,745.32 mg/l	169.00 Bar
% RECOVERY	98.25	TEMPERATURE	25.00 C

1 Errors / 4 Warnings

Pass 1 Array 1 Array 2

Pass1 Data

RAW WATER	266.67 m3/hr	5,000.00 mg/l	0.00 Bar	Flux decline	5.00 %/yr
SIDE STREAM	m3/hr	mg/l	Bar	Salt Passage increase	8.00 %/yr
BY-PASS(BLENDING)	m3/hr	mg/l	Bar	MEMBRANE Age	0.00 yr
FEED	266.67 m3/hr	5,000.00 mg/l	284.75 Bar	Average Flux	449.48 lmh
PERMEATE	261.99 m3/hr	25.27 mg/l	0.00 Bar	Dose	0 mg/l
PRODUCT	261.99 m3/hr	25.27 mg/l	0.00 Bar	SOFTENER	No
CONCENTRATE	4.68 m3/hr	283,745.32 mg/l	169.00 Bar	Array Recycle	No
% RECOVERY	98.25	% REJECTION	99.49	TEMPERATURE	25.00 C

	UNIT	Element 1	Element 2	Element 3	Element 4	Element 5	Element 6	Total
Feed	m3/hr	266.67	196.05	138.85	89.57	44.99	4.68	266.67
Permeate	m3/hr	70.62	57.20	49.27	44.59	40.31	0.00	261.99
Conconcentrat	m3/hr	196.05	138.85	89.57	44.99	4.68	4.68	4.68
Recovery	%	26.48	29.18	35.49	49.78	89.61	0.00	98.25
Conc. Pol.	-	1.20	1.23	1.28	1.42	1.87	1.00	1.87
Feed Press.	Bar	284.75	228.77	195.99	178.60	171.35	169.96	284.75
Diff. Press.	Bar	55.98	32.78	17.40	7.24	1.39	0.09	114.88
Perm. Flux	lmh	1,900.33	1,539.21	1,325.82	1,199.88	1,084.71	0.00	1,175.00
Beta	-	1.22	1.24	1.30	1.45	1.96	1.00	1.96
Osm. Press.	Bar	4.50	5.53	7.76	11.94	23.47	215.15	

[Pass1] - [Array1]

mg/l	Na	K	NH4	Ca	Mg	Fe	Ba	Sr	Cl	NO3	SO4
Feed	1,965.81	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3,034.19	0.00	0.00
Perm.	9.93	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15.33	0.00	0.00
Conc.	11,557.97	0.00	0.00	0.00	0.00	0.00	0.00	0.00	72,187.30	0.00	0.00

	F	HCO3	CO3	CO2	B	BOH3	SiO2	Total Alk	TDS	pH	E-Cond
Feed	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5000.00	6.81	9220.22
Perm.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.89	25.27	4.83	53.81
Conc.	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.89	283745.32	8.40	367848.32

Concentrate Saturation	
LSI	-5.290
S & DSI	79.630
CaSO4 (% st.)	0.000
SiO2 (% st.)	0.000
CaF2 (% st.)	0.000
BaSO4 (% st.)	0.000
SrSO4 (% st.)	0.000
Ionic Strength	4.850

Element osmotic pressure is now included in the result scan tab.

Changes in Values According Feed Water Source



Feed Water Source	Flux decline (%/yr)	SP increase (%/yr)	Membrane Type
Well water SDI<3	7	10	RE8040-BE
Surface water SDI <3	7	10	RE8040-BE
Surface water SDI <5	12	10	RE8040-BE
Tertiary Effluent SDI <3	12	10	RE8040-FEn
Tertiary Effluent SDI <5	15	10	RE8040-FEn
Sea water SDI <3	7	10	RE8040-SHN
Sea water SDI <5	7	10	RE8040-SHN
RO/UF permeate SDI <1	5	5	RE8040-HUE

CSMPro v4.0 calculates various flux decline and salt passage increase values for each membrane model and feed water source.

Concentrate Recycle from 2nd Pass

CSMPRO v4.0 - [DESIGN]

File Option Help Update

Project Name: _____ Case: 1 Version: 1.0 Date: 2010-01-11

Projected By: _____ Company: _____

E-Mail: _____ Homepage: _____

Project(Case)Note: _____

Unit: Flow: m3/hr Pressure: Bar Flux: l/mh Temp: C

OPEN SAVE

Result

Feed Scale Calculation System

Number of Pass: 2 Temp.: 25.00 C

	Pass 1	Pass 2	Unit
Permeate	156.00	117.00	m3/hr
Recovery	52.00	75.00	%
Feed	300.00	156.00	m3/hr
Flux Decline %/yr	5.00	5.00	%
Salt Passage Incr. %/yr	8.00	5.00	%
Membrane Age(yr)	0.00	0.00	yr
Average Permeate Flux	37.91	35.19	l/mh
Permeate Blending	0.00	0.00	m3/hr
Number of Array	1	2	
Split	0.00	0.00	m3/hr

	Array Recycle	Unit
From Array	2	2 Stage
To Array	1	1 Stage
Quantity	0.00	0.00 m3/hr

Option:

☐ Auto Array Design ☐ Permeate Blending

☐ Same Back pressure ☐ Split

☐ No H/Pump in 2nd Pass ☒ Concentrate Recycle

☐ Hybrid

☒ Same Element type within Pass

☒ Same Vessel length within Pass

2nd Pass pH Adjustment

Chemical: _____

Concentration: 0 %

Adjusted pH: 7

Post Treatment

Chemical: _____

Concentration: 0 %

Adjusted pH: 7

Model select

Array 1

Model Name: RE8040-SHN

No. of Press. Vessel: 20

Elements per PV: 6

Boost Pump Press.: 0.00

Perm. Back Press.: 0.00

Hybrid: 1

Array 1 Array 2

Model Name: RE8040-BLR RE8040-BLR

No. of Press. Vessel: 10 5

Elements per PV: 6 6

Boost Pump Press.: 0.00 0.00

Perm. Back Press.: 0.00 0.00

Hybrid: 1 1

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CSMPro v4.0 can control the concentrate recycle from the 2nd pass.

Split Option

CSMPRO v4.0 - [DESIGN]

File Option Help Update

Project Name: Test
 Projected By: Kendrick Wilson
 E-Mail: kwil@wjscm.com
 Project(Case)Note: Split Option

Company: Woongjin Chemical
 Homepage: www.csmfilter.com

Case: 1
 Version: 1.0
 Date: 2010-01-11

Unit:
 Flow: m3/hr
 Pressure: Bar
 Flux: gfd
 Temp: C

OPEN SAVE

Result

Feed Scale Calculation System

Number of Pass: 2 Temp.: 30.00 C

	Pass 1	Pass 2	Unit
Permeate	195.81	222.39	m3/hr
Recovery	45.00	85.00	%
Feed	559.48	195.81	m3/hr
Flux Decline %/yr	7.00	5.00	%
Salt Passage Incr. %/yr	10.00	5.00	%
Membrane Age(yr)	1.00	0.00	yr
Average Permeate Flux	9.30	22.00	gfd
Permeate Blending	0.00	0.00	m3/hr
Number of Array	1	2	
Split	55.95	0.00	m3/hr

	Array Recycle	Unit
From Array	1 2	Stage
To Array	1 1	Stage
Quantity	0.00 0.00	m3/hr

Option

☐ Auto Array Design
☐ Same Back pressure
☐ No H/Pump in 2nd Pass
☐ Hybrid

☒ Permeate Blending
☒ Split
☒ Concentrate Recycle

☒ Same Element type within Pass
☒ Same Vessel length within Pass

☒ 2nd Pass pH Adjustment
 Chemical:
 Concentration: 0 %
 Adjusted pH: 7

☐ Post Treatment
 Chemical:
 Concentration: 0 %
 Adjusted pH: 7

☒ Model select

Array 1

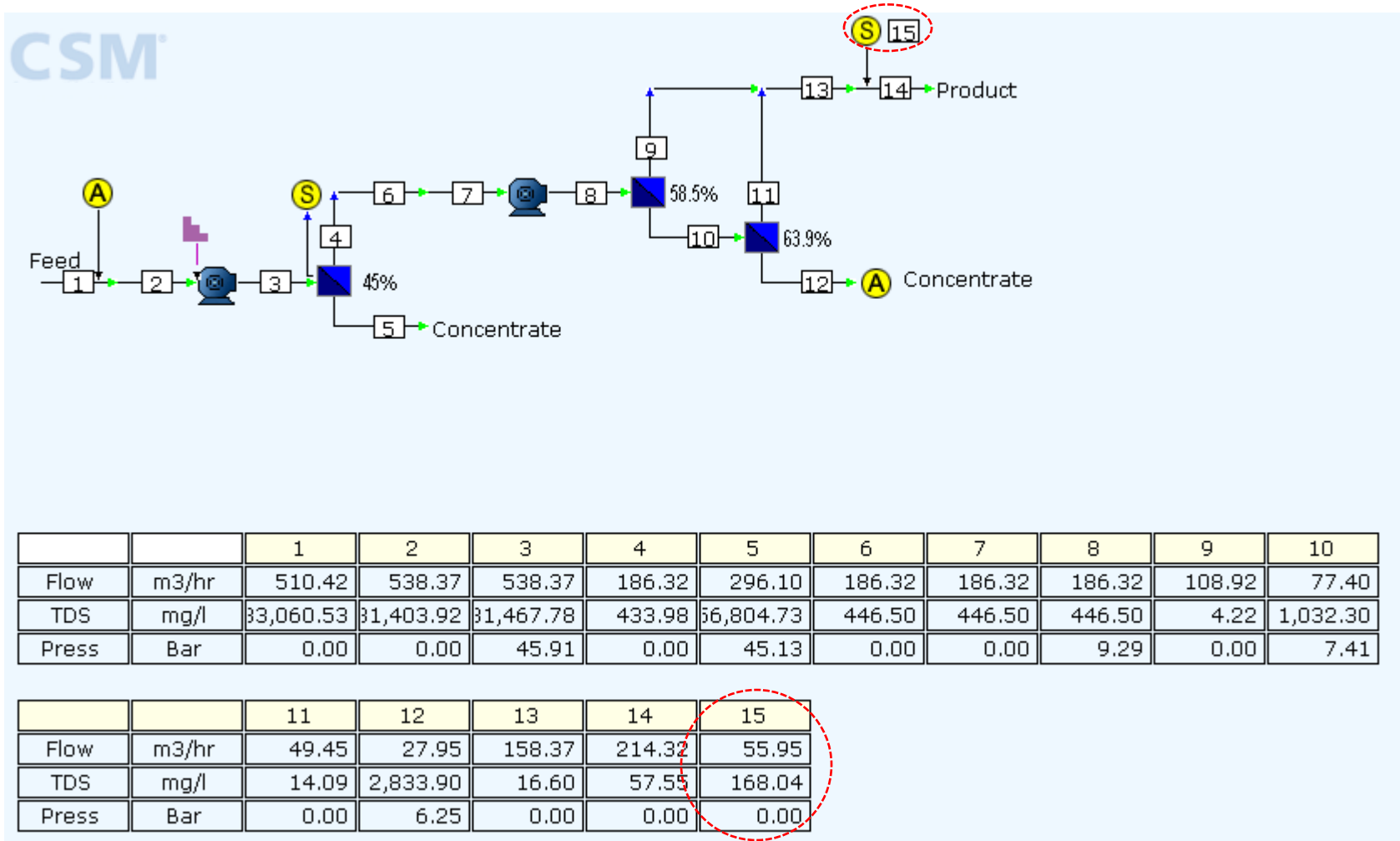
Model Name: RE16040-SHF
 No. of Press. Vessel: 18
 Elements per PV: 6
 Boost Pump Press.: 0.00
 Perm. Back Press.: 0.00
 Hybrid: 1

	Array 1	Array 2
Model Name	RE16040-BLR	RE16040-BLR
No. of Press. Vessel	3	2
Elements per PV	6	6
Boost Pump Press.	0.00	0.00
Perm. Back Press.	0.00	0.00
Hybrid	1	1

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A Split option is available in CSMPro v4.0 where a portion of the lead-end permeate of the 1st pass can be blended with the permeate from the 2nd pass.

Split Option



The above diagram indicates how split information about flow-rate and concentrate are displayed.

1. Go to the system tab
2. Input system information (e.g. permeate flow rate, recovery)
3. Input the number of array and pressure vessels
4. Input the number of membrane type in each stage
(2 or 3 types of membranes can be selected in each stage)
5. Choose the “Hybrid” in option
6. Choose the membrane type and number of membranes
(“Same Element type within Pass” should be unchecked)

How to Use the Hybrid Function

Feed		Scale Calculation	
Number of Pass	2	Temp.	30.00 C
	Pass 1	Pass 2	Unit
Permeate	186.32	214.32	m3/hr
Recovery	45.00	85.00	%
Feed	538.37	186.32	m3/hr
Flux Decline %/yr	7.00	5.00	%
Salt Passage Incr. %/yr	10.00	5.00	%
Membrane Age(yr)	1.00	1.00	yr
Average Permeate Flux	8.90	21.00	gfd
Permeate Blending	0.00	10.00	m3/hr
Number of Array	1	2	
Split	55.95	0.00	m3/hr

Model select	Array 1
Model Name	RE16040-SHF
No. of Press. Vessel	18
Elements per PV	6
Boost Pump Press.	0.00
Perm. Back Press.	0.00
Hybrid	2

	Array 1	Array 2
Model Name	RE16040-BLR	RE16040-BLR
No. of Press. Vessel	3	2
Elements per PV	6	6
Boost Pump Press.	0.00	0.00
Perm. Back Press.	0.00	0.00
Hybrid	2	1

Number of Pass		Temp.	
2	30.00 C		

	Pass 1	Pass 2	Unit
Permeate	186.32	214.32	m3/hr
Recovery	45.00	85.00	%
Feed	538.37	186.32	m3/hr
Flux Decline %/yr	7.00	5.00	%
Salt Passage Incr. %/yr	10.00	5.00	%
Membrane Age(yr)	1.00	1.00	yr
Average Permeate Flux	8.90	21.00	gfd
Permeate Blending	0.00	10.00	m3/hr
Number of Array	1	2	
Split	55.95	0.00	m3/hr

Hybrid	Array 1	Array 1
Model Name	RE16040-SHN	RE16040-SHF
No. of Press. Vessel	18	18
Elements per PV	3	3

	Array 1	Array 1	Array 2
Model Name	RE16040-BE	RE16040-BLR	RE16040-BLR
No. of Press. Vessel	3	3	2
Elements per PV	3	3	6

	Array Recyc
From Array	1
To Array	1
Quantity	0.00

Option

☐ Auto Array Design

☐ Same Back pressure

☐ No H/Pump in 2nd Pass

☒ Hybrid

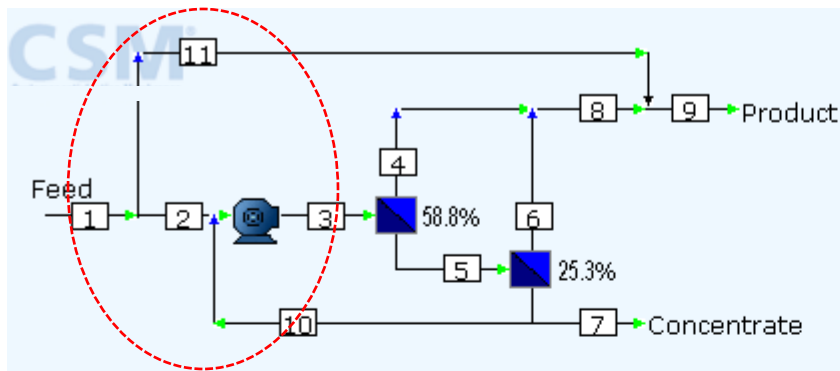
☐ Same Element type wit

☐ Same Vessel length wit

System information

- 2nd pass (1st pass / 1 array, 2nd pass / 3-2 array, 6 elements per pressure vessel)
- 1st pass has 3 number of 16040-SHN & 3 number of 16040-SHF in each vessel
- 1st array of 2nd pass has 3 number of 16040-BE & 3 number of 16040-BLR in each vessel

Permeate Blending Before the Array Recycle



		1	2	3	4	5	6	7	8	9	10
Flow	m3/hr	130.00	120.00	130.00	76.47	53.53	13.53	30.00	90.00	100.00	10.00
TDS	mg/l	2,000.00	2,000.00	2,456.02	29.41	5,922.81	137.71	7,879.38	45.69	241.12	7,879.38
Press	Bar	0.00	0.00	9.01	0.00	8.42	0.00	7.48	0.00	0.00	7.48

		11
Flow	m3/hr	10.00
TDS	mg/l	2,000.00
Press	Bar	0.00

In CSMPro v4.0, the feed water is blended with the permeate water before the concentrate is recycled with the feed water.

Permeate TDS Bug



Pass 1

Array 1

Pass 2

Array 1

Array 2

Pass1 Data

RAW WATER	538.37 m3/hr	33,060.53 mg/l	0.00 Bar	Flux decline	7.00 %/yr
SIDE STREAM	41.34 m3/hr	2,372.35 mg/l	7.36 Bar	Salt Passage increase	10.00 %/yr
BY-PASS(BLENDING)	m3/hr	mg/l	Bar	MEMBRANE Age	1.00 yr
FEED	579.71 m3/hr	31,398.94 mg/l	45.29 Bar	Average Flux	8.90 gfd
PERMEATE	242.27 m3/hr	366.76 mg/l	0.00 Bar	NaOH(100) Dose	31.93 mg/l
PRODUCT	242.27 m3/hr	366.76 mg/l	0.00 Bar	SOFTENER	No
CONCENTRATE	337.44 m3/hr	53,678.62 mg/l	44.36 Bar	Array Recycle	1 >> 1, 5.00 m3/hr
% RECOVERY	45.00	% REJECTION	98.89	TEMPERATURE	30.00 C

	Element/Vessel Data			Flow Rate (m3/hr)				Last Beta	Press. (Bar)			Avg Flux (gfd)	TDS			
	Vessel#	Element#	Element Type	Feed	Concentrat	Permeate	% Rec.		Feed	Conc.	DP		Feed	Perm.	Conc.	% Rej.
1	18	108/6	RE16040-SHF	579.71	337.44	242.27	41.79	1.040	45.29	44.36	0.93	8.89	31,376.94	353.78	53,641.86	98.87
Tot	18	108/6	RE16040-SHF	579.71	337.44	242.27	41.79	1.040	45.29	44.36	0.93	8.90	31,376.94	366.76	53,641.86	98.83

[Pass1]

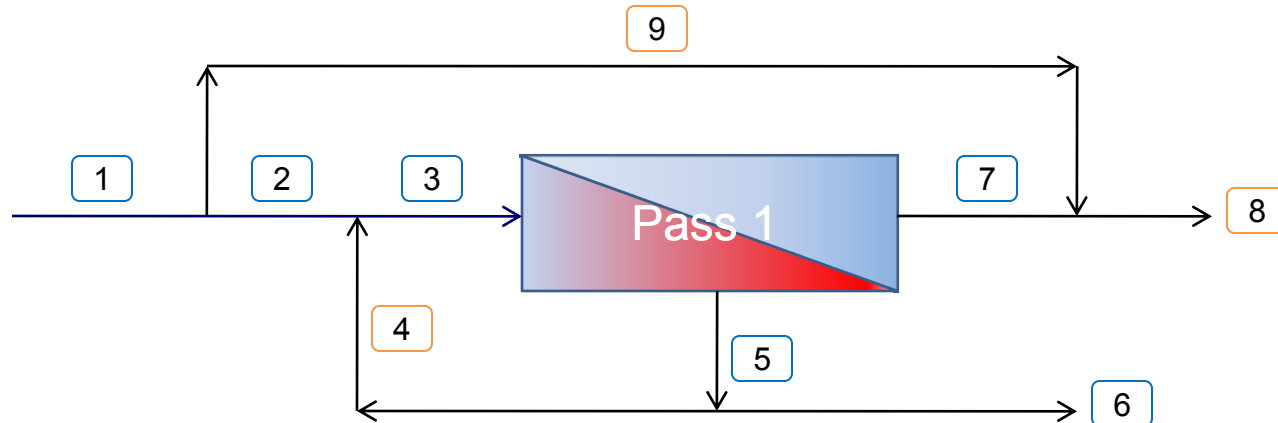
mg/l	Na	K	NH4	Ca	Mg	Fe	Ba	Sr	Cl	NO3	SO4
Feed	9,231.46	401.46	0.10	421.27	1,329.44	0.00	0.02	8.41	17,089.84	0.76	2,702.08
Perm.	130.18	6.13	0.00	3.97	4.70	0.00	0.00	0.05	190.98	0.02	11.15
Conc.	15,765.77	685.30	0.16	720.88	2,280.54	0.00	0.03	14.42	29,222.44	1.30	4,634.04

	F	HCO3	CO3	CO2	B	BOH3	SiO2	Total Alk	TDS	pH	E-Cond
Feed	0.60	178.88	1.00	9.21	4.89	4.83	1.90	164.31	31398.94	7.28	50695.61
Perm.	0.09	4.19	0.00	9.21	2.28	2.28	0.03	3.71	366.76	5.80	752.48
Conc.	0.97	304.30	1.71	9.21	6.77	6.66	3.24	353.98	53678.62	7.49	82636.88

Concentrate Saturation	
LSI	1.040
S & DSI	0.288
CaSO4 (% st.)	46.898
SiO2 (% st.)	2.400
CaF2 (% st.)	0.388
BaSO4 (% st.)	136.621
SrSO4 (% st.)	34.805
Ionic Strength	1.087

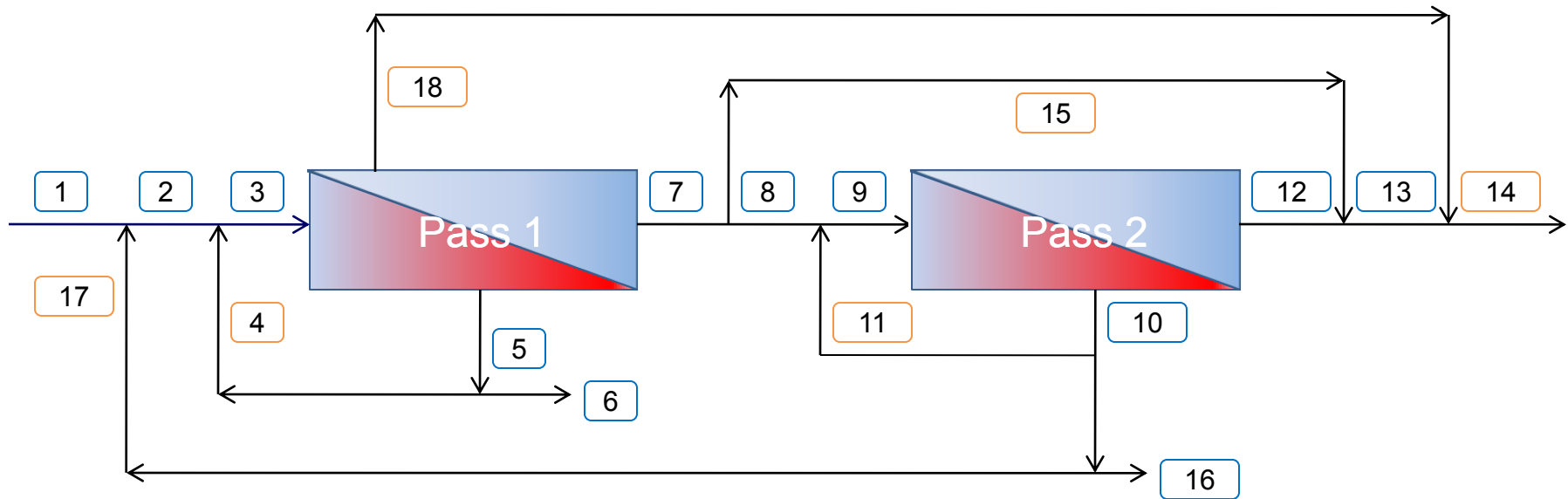
CSMPro v3.15 had a bug where the RO permeate yielded different TDS values, and this has been fixed in CSMPro v4.0

Definition of Recovery in a Single Pass System



Case		Pass Recovery	System Recovery
case 1	No blending, No array recycle (no 4, no 9)	$=7/2=8/1$	$=8/1$
case 2	Blending (9, no 4)	$=7/2=(8-9)/(1-9)$	$=8/1$
case 3	Array recycle (4, no 9)	$=7/2=8/1$	$=8/1$
case 4	Blending, array recycle (4, 9)	$=7/2=(8-9)/(1-9)$	$=8/1$

Definition of Recovery in a Double Pass System



Case		1 st Pass Recovery	2 nd Pass Recovery	System Recovery
case 5	No recycle, No blending, No split (No 4, 11, 15, 17, 18)	$=7/2 = 7/1$	$=12/8 = 14/8$	$=14/1$
case 6	blending (15, no 4, 11, 17, 18)	$=7/2 = 7/1$	$=12/8 = (14-15)/(7-15)$	$=14/1$
case 7	concentrate recycle (17, no 4, 11, 15, 18)	$=7/2 = 7/(1+17)$	$=12/8$	$=14/1$
case 8	blending, concentrate recycle (15, 17, no 4, 11, 18)	$=7/2 = 7/(1+17)$	$=12/8 = (14-15)/(7-15)$	$=14/1$
case 9	blending, concentrate & array recycle (4, 11, 15, 17, 18)	$=7/2 = 7/(1+17)$	$=12/8 = (14-15)/(7-15)$	$=14/1$
case 10	Blending, concentrate & array recycle, Split (4, 11, 15, 17, 18)	$=(7+18)/2 = (7+18)/(1+17)$	$=12/8 = (14-15-18)/(7-15)$	$=14/1$

Thank you!

For further assistance or inquiries, please contact us at csm@wjchemical.co.kr or visit our website at www.csmfilter.com