



# High Efficiency Water Treatment 高效脫鹽CCD-RO機組

[www.desalitech.com](http://www.desalitech.com)

國家水專業有限公司  
廖家延

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## 介紹影片 75項專利的CCD-RO

### CCD-RO技術概要介紹

網址:<https://www.youtube.com/watch?v=Kw8AtZczcJA>

### CCD-RO完整介紹影片(YOUTUBE, in English)

網址:<https://www.youtube.com/watch?v=DtpbxaWl0xc>

### CCD-RO維護安裝介紹

網址:<http://desalitech.com/operations-and-maintenance/>

### CCD-RO原廠網址

(<http://www.desalitech.com/>)



## 優點與特色

- a) 最大回收率 一般可達 90 – 98% (單段RO)
- b) 濃水排放量降低50 – 75%
- c) 更大的操作彈性(回收率可設定)
- d) 更好的穩定性(進水水質變化耐受性)
- e) 耗電節省 20% – 35%
- f) 節省RO膜數量
- g) 使用一般標準RO元件組合而成

# 關鍵技術:CCD

- ▶ 密閉迴路脫鹽技術:CCD(Closed Circuit Desalination)
- ▶ 安裝循環泵浦→大幅提升RO膜元件內之橫向流速(**cross flow velocity**)(約**二倍**)→操作平均壓力降低，並提升膜間水力分配均勻度→**降低結垢率及堵塞率，降低清洗頻率。**
- ▶ 濃水間歇性排放，提升**回收率(最高可達98%**，視進水水質而定)
- ▶ **降低產水能耗20 - 35%**(因為操作平均壓力較低)
- ▶ **此技術超過75項專利授權!**

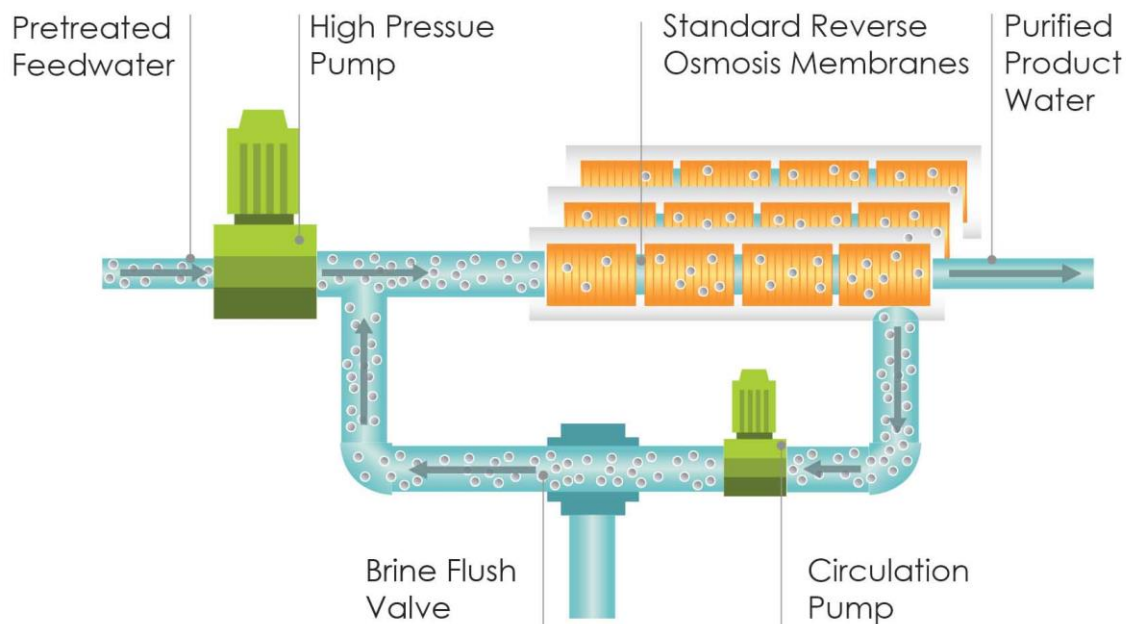


# RO膜上的橫向流速(Cross flow velocity)

- ▶ RO膜元件上的橫向流速(Cross flow velocity )是以系統內的循環變頻泵浦(internal circulation pump)設定控制，使RO膜受到(進水)頻繁與完全的沖洗，可防止(或減緩)垢沉積並破壞RO膜表面的生物性膜堵塞，使高回收率變為可能，即使進水是含高鹽分或汙染的水。
- ▶ 一樣條件下，RO膜濃水端流量越大，滲透壓越低，透過水量(通量)越大，脫鹽率越高。
- ▶ 產水出流率(permeate)、橫向流速、及回收率等重要操作參數皆由控制系統獨立設定/控制。

# Differentiated Technology

## 脫鹽除礦 CCD-RO 機組(單段)的構造示意圖



- 依據進水水質而定，單段RO最高回收率可達 98%
- 回收率可在控制盤上設定
- 循環泵浦大幅提升Cross flow velocity(橫向流速)
- 堵塞與結垢因流速提升及鹽度循環而降低

Cross flow velocity(橫向流速)越大，膜表面擾流及剪切力越大，越不會堵塞(fouling)；水力分配越均勻，越不會結垢，操作壓力越低，越省電。

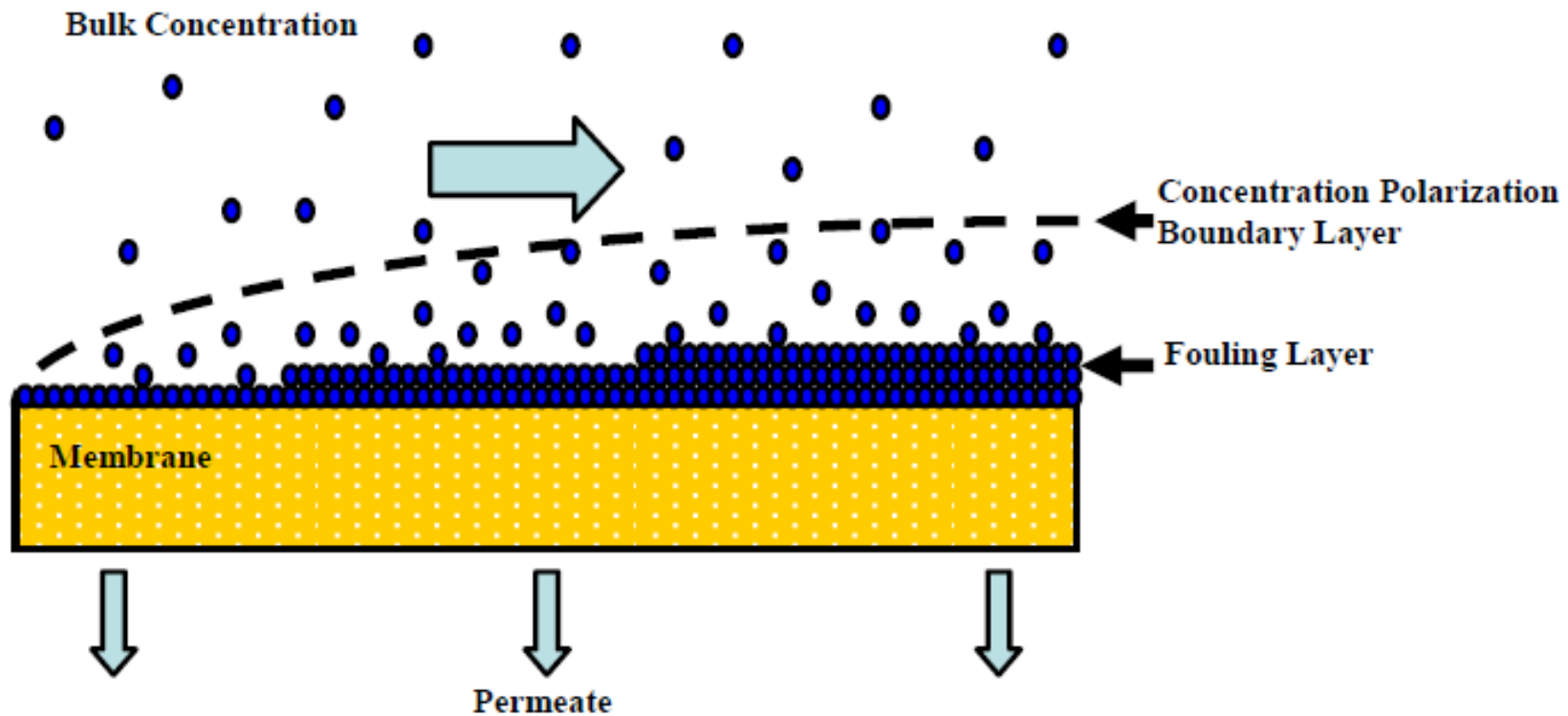


FIGURE 1. Schematic representing the development of a concentration polarization boundary layer (CPBL) and subsequent fouling of a membrane during a cross-flow filtration.

產品

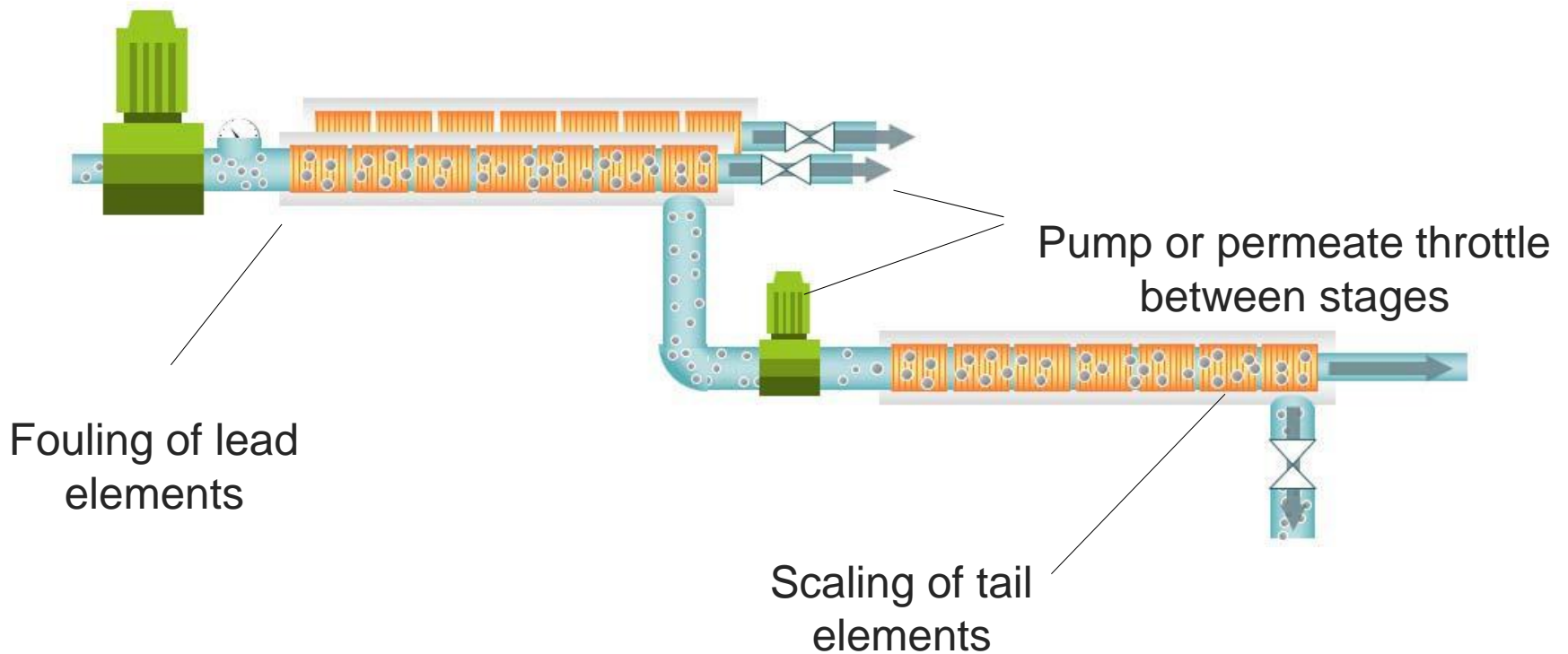
回收率高、省電、操作彈性大、  
抗堵塞、抗結垢

↓ 脫鹽除礦 CCD-RO機組外觀





# 傳統RO高能耗

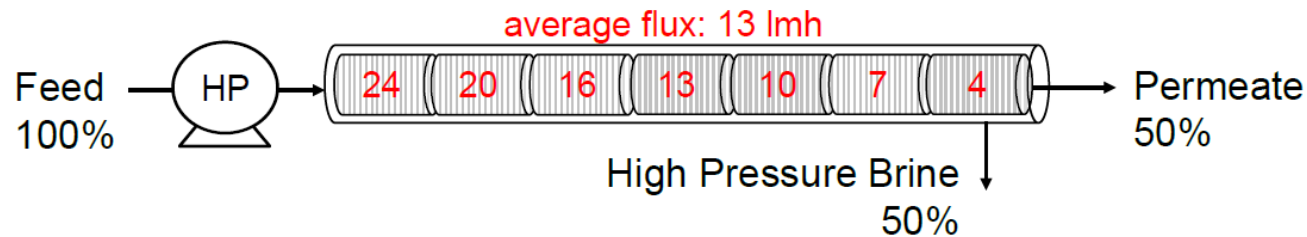


1. 回收率低，若須 $>50\%$ ，須採用多段RO

2. 多段RO初設成本高，複雜，沒有彈性

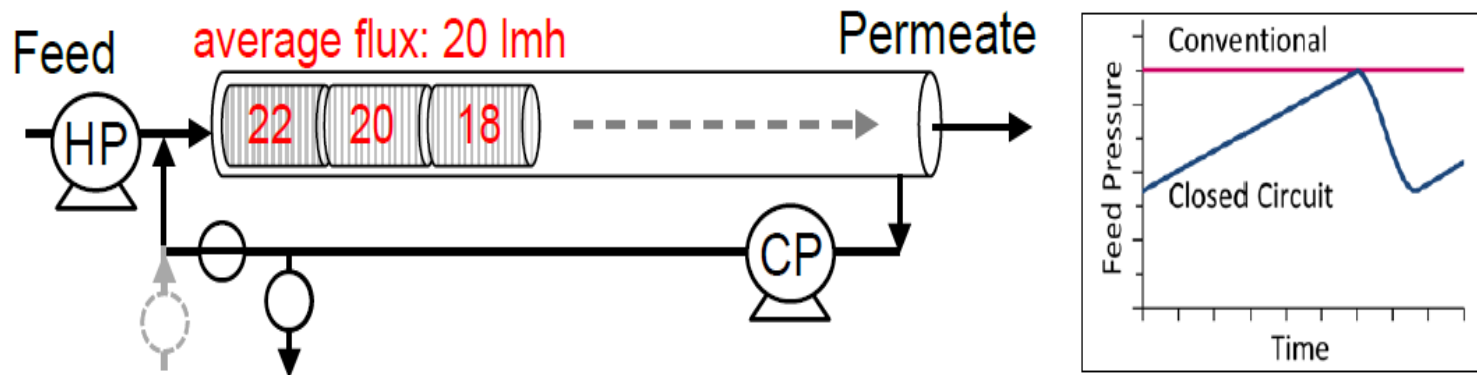
3. 水力分布無法達到平衡，造成堵塞(前端RO膜)、結垢(後端RO膜)、回收率低

# 傳統-RO



- Most experts agree that RO is the future of desalination.
- Excess pump pressure needed to overcome brine osmotic barrier.
- ▶ 操作壓力更高
- High flux head elements foul, low flux tail elements scale.
- ▶ 前端膜易堵塞及後端膜易結垢(因水力分配不均)
- Recovery per stage is limited - complex expensive multi-staging necessary for high recovery.
- ▶ 回收率受限；一般需要3或4段RO，回收率才能>85%
- Energy recovery devices needed in high pressure brine stream
- ▶ 海淡機組需安裝高價的ERD/ERI
- No significant advances in RO process design since the 1960s
- ▶ 數十年來RO沒有顯著進步

# CCD-RO



- 半批次操作；沖洗膜元件不需停止進水泵浦及產水
- 較低的平均進水/產水壓力(較省電)
- RO膜的效率更高，因可調的高橫向流速(high cross flow velocity)
- 每支膜殼只安裝4支膜元件
- 高平均通量，但前端膜的通量卻不會太高
- 高橫向流速及鹽度循環，降低堵塞率及結垢率
- 無高壓排放管路
- 以改變循環時間加以控制，回收率不受限

# CCD RO機組 vs. 傳統RO機組的差異

	CCD-RO	傳統-RO
操作模式	半批次式連續操作	連續式
操作程序	100%密閉循環滲透產水(沒有排出濃水)→排出濃水，同時補充進水及繼續滲透產水→恢復100%密閉循環滲透產水	在穩定狀態下操作，連續進水、連續滲透產水、連續排出濃水
RO段數	一段	多段
回收率	高，可調，可設定	低，不可調整? 不可設定?
通量	可調，可設定	不可調整?不可設定?

# CCD RO機組 vs. 傳統RO機組的差異

	CCD-RO	傳統-RO
橫向流速	高，可調可設定	低，不可設定
進水水質變化，自動調整操作	YES	NO
進水量/處理費 濃水排放量/處理費	低 低	高 高
膜元件與膜管	使用較少	較多
耗電	省20 – 35%；進水TDS越高，省電越多	100%
初設成本	與多段RO類似	多段RO與CCD-RO類似

# CCD-RO機組特色整理1

- ▶ RO膜上的橫向流速(Cross flow velocity )是以系統內的循環變頻泵浦(internal circulation pump)設定控制，使RO膜受到頻繁與完全的沖洗，可防止(或減緩)垢沉積並破壞RO膜表面的生物性膜堵塞，使高回收率變為可能，即使進水是含高鹽分或汙染的水。
- ▶ 產水出流率、橫向流速、及回收率等重要操作參數皆由控制系統獨立設定/控制。
- ▶ 較短的RO膜陣列(4支膜芯)及較高的橫向流(cross flow)，使平均通量高於傳統的RO，但又不會超過膜製造商所訂的最高通量與回收率。
- ▶ Desalitech公司專利的ReFlex RO-CCD機組是結合標準RO膜系統元件與專利CCD系統，大幅提升RO性能，以一段RO取代傳統的多段RO；回收率(%)可由操作控制盤設定；實機操作顯示本系統一段RO的回收率可達98%，並大幅降地濃水排放量達50-75%。
- ▶ Desalitech公司專利的ReFlex RO-CCD機組用於苦鹹水(brackish water)及工業用水處理，可節能達35%；用於海淡水處理，可節能達20 - 35%

# CCD-RO機組特色整理2

- ▶ 進水壓力比較低，回收率比較高，提升膜的效能及操作彈性，只須採用標準通用之RO膜，不需使用能源回收裝置(ERD, Energy Recovery Device)
- ▶ 單段RO即可達最高回收率，符合工業回收水及苦鹹水(brackish water)之水質純化處理需求
- ▶ 高回收率搭配高操作彈性，即可大幅降低操作費用(進水處理量、動力、濃水排放與處理)
- ▶ 系統自動調整適應進水水質變化(例如 進水的TDS升高)

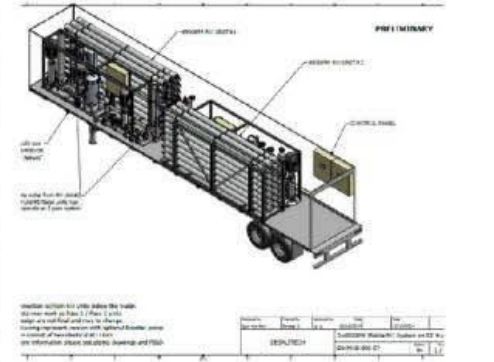


# 安裝案例與數據

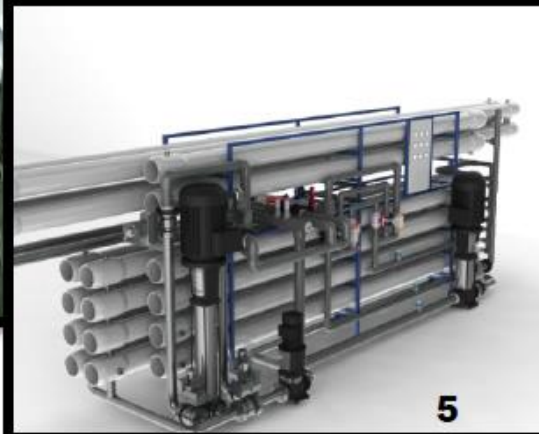




# Installation Examples



# Desalitech RO Units



# Case Studies



**Coca Cola, brackish well water to ingredient water**



- Startup mid 2014
- 93% recovery and 95% recovery guaranteed and met
- “The Desalitech systems performance demonstrated that it can run at very high recovery rates under very high TDS water, with little or no fouling over time.”



# Case Studies



	Mid America Steel	Unilever
Partner	Water Street	Veolia. Approved by CH2MHill & Jacobs
Application	Wastewater Reuse Near Zero Liquid Discharge	Process / Boiler Water Makeup Mission Critical Application for the plant
Industry	Steel processing	Food & Beverage
Customer Challenge	Steel mill was hauling 60,000 gallons of rod mill and melt shop wastewater per day at a cost of about \$12,000/day or \$3M/year	\$152M margarine plant expansion required reliable makeup water. Competing RO would have wasted \$850K/year in water costs
Solution	ReFlex 50 + pre treatment, recycling wastewater at 90-93% recovery	2 X ReFlex 300, purifying tap water at 90-95% recovery & <20 ppm TDS permeate
Impact	Waste generation reduced by 90%, saving more than \$10,000/d while serving as a new water source	Saving up to \$470-650K/year. Reduced environmental footprint & achievement of corporate sustainability goals
ROI	ROI < 2 year	ROI < 2 year

Site pictures



# 美國Desalitech的RO-CCD機組操作案例一覽表 1

(摘錄自原廠網站[www.desalitech.com](http://www.desalitech.com) 的case studies)

處理量	安裝地點	進水水質	產水水質及回收率%	效益	應用/備註
500 m <sup>3</sup> /day, 2013完成	印度United Phosphorous Ltd.(生產農藥)	6000 ppm TDS ,250 ppm COD ,1000 ppm hardness	TDS<300ppm Min. 90%		廢水回收； 零排放
2180m <sup>3</sup> /day, 2014完成	美國 U.S. Pulp and Paper Manufacturer	井水	90%(傳統RO為75%)	節省25%	RO濃水處理成本最高
820m <sup>3</sup> /day, 2012完成， 2013再度擴建	以色列 Sedom	苦鹹水 TDS: >4000 ppm	TDS: 250 ppm 80%(舊有RO <50%)		藥廠用水/ 飲用水
180m <sup>3</sup> /day, 2013完成，	CHS/YWT - Israel		91%(原為82%), TDS: 5-20 ppm	省電280kw;總成本降低93%(省電、省水、廢水量較低、樹脂再生成本降低) *原水處理及濃水排放成本 > USD 2.64/m <sup>3</sup> )	鍋爐/冷卻水塔用水
336 m <sup>3</sup> /d	Layne Christensen - Phoenix, AZ	井水 TDS 1,055 ppm	93%	0.6 kWh/m <sup>3</sup> , 省電35%	既有RO機組改裝成CCD系統

# 美國Desalitech的RO-CCD機組操作案例一覽表 2

(摘錄自原廠網站[www.desalitech.com](http://www.desalitech.com) 的case studies)

2,180 m3/d	Industrial Site – Arizona	地下水	70-95%之間任意調整		
3,360 m3/d	Consumer Products Manufacturer – Kansas	地下水(苦鹹水)		與舊有RO比較，節省200,000加侖原水/天	
273 m3/d, 2014完成	Mid American Steel and Wire		93%	廢水量降低93%，廢水運棄費用每天節省USD10,000	廢水回收再利用(零排放)
3270m3/day, 2014完成	食品/飲料廠		90%, TDS: 6ppm	90%(舊有RO回收率為80%)，節省原水378m3/day，電費節省35%，每年節費USD500,000	耗電0.37kw/m3

# 下表資料為Desalitech的 SWRO-CCD機組與傳統的RO機組實廠操作數據及能耗比較:

(由表中可發現，傳統RO機組需要使用三段RO(3 stage))

**Table 2 – Field and Model Data for SWRO-CCD and Conventional RO Processes**

	SWRO-CCD Measured Performance	SWRO-CCD Model	Conventional RO Model, <b>3-Stage</b> , Permeate Throttled	Conventional RO Model, <b>3 Stage</b> , Inter-stage Boost
Membrane Type	ESPA2 MAX	ESPA2 MAX	ESPA2 MAX	ESPA2 MAX
Permeate Flow, m <sup>3</sup> /h	35.0	35.0	35.0	35.0
Recovery	88%	88%	88%	88%
Overall Average Flux, l/mh	26.8	26.8	26.8	26.8
Supply Pressure, bar	2.0	2.0	2.0	2.0
1st Stage Fresh Feed Flow, m <sup>3</sup> /h	35.0	35.0	39.8	39.8
1st Stage Membrane Feed, m <sup>3</sup> /h	70.8	70.8	39.8	39.8
1st Stage Module Recovery	49%	49%	51%	51%
1st Stage Permeate Flow, m <sup>3</sup> /h	35.0	35.0	20.2	20.2
1st Stage Brine Flow, m <sup>3</sup> /h	35.8	35.8	19.6	19.6
1st Stage Brine Pressure, bar	11.1	9.9	20.7	14.5
1st Cycle Feed Pressure, bar	12.0	11.3	–	–
Last Cycle Feed Pressure, bar	20.0	19.4	–	–
Average Feed Pressure, bar	16.0	15.4	22.8	16.6
Differential Pressure, bar	0.92	1.4	1.1	2.1
1st Stage Average Flux, l/mh	26.8	26.8	27.4	27.4
2nd Stage Boost Pressure, bar	–	–	–	0.0
2nd Stage Feed Pressure, bar	–	–	20.5	14.5
2nd Stage Brine Flow, m <sup>3</sup> /h	–	–	8.8	8.8
2nd Stage Average Flux, l/mh	–	–	26.3	26.4
2nd Stage Recovery	–	–	55%	55%
3rd Stage Boost Pressure, bar	–	–	–	6.2
3rd Stage Feed Pressure, bar	–	–	19.2	19.1
3rd Stage Average Flux, l/mh	–	–	24.8	24.7
3rd Stage Recovery	–	–	47%	45%
HP Pump Efficiency	55%	55%	55%	55%
CP Pump Efficiency	45%	45%	–	45%
Specific Energy, kWh/m <sup>3</sup>	<b>0.77</b>	<b>0.76</b>	<b>1.19</b>	<b>0.93</b>

## 與傳統二段、三段 RO 機組比較表：

### Process Comparison Matrix

Per 1,000 Gallons of Permeate	Two Stage	Three Stage	ReFlex RO
Maximum Recovery	75%	85%	<b>Up to 98%</b>
Brine Waste Flow (gallons)	333	176	<b>75</b>
Excess Feed Flow (gallons)	333	176	<b>75</b>
5 Year Cost of Ownership	\$3.81	\$2.53	<b>\$1.61</b>
Annual Savings with ReFlex RO	\$337,392	\$141,091	<b>X</b>
Standard, Off Shelf Components	Yes	Yes	<b>Yes</b>
Recovery Guarantee	No	No	<b>Yes</b>

\*Based on U.S. average power, water supply and sewage costs for a 300 gpm system with a feedwater TDS of 1,500 ppm.

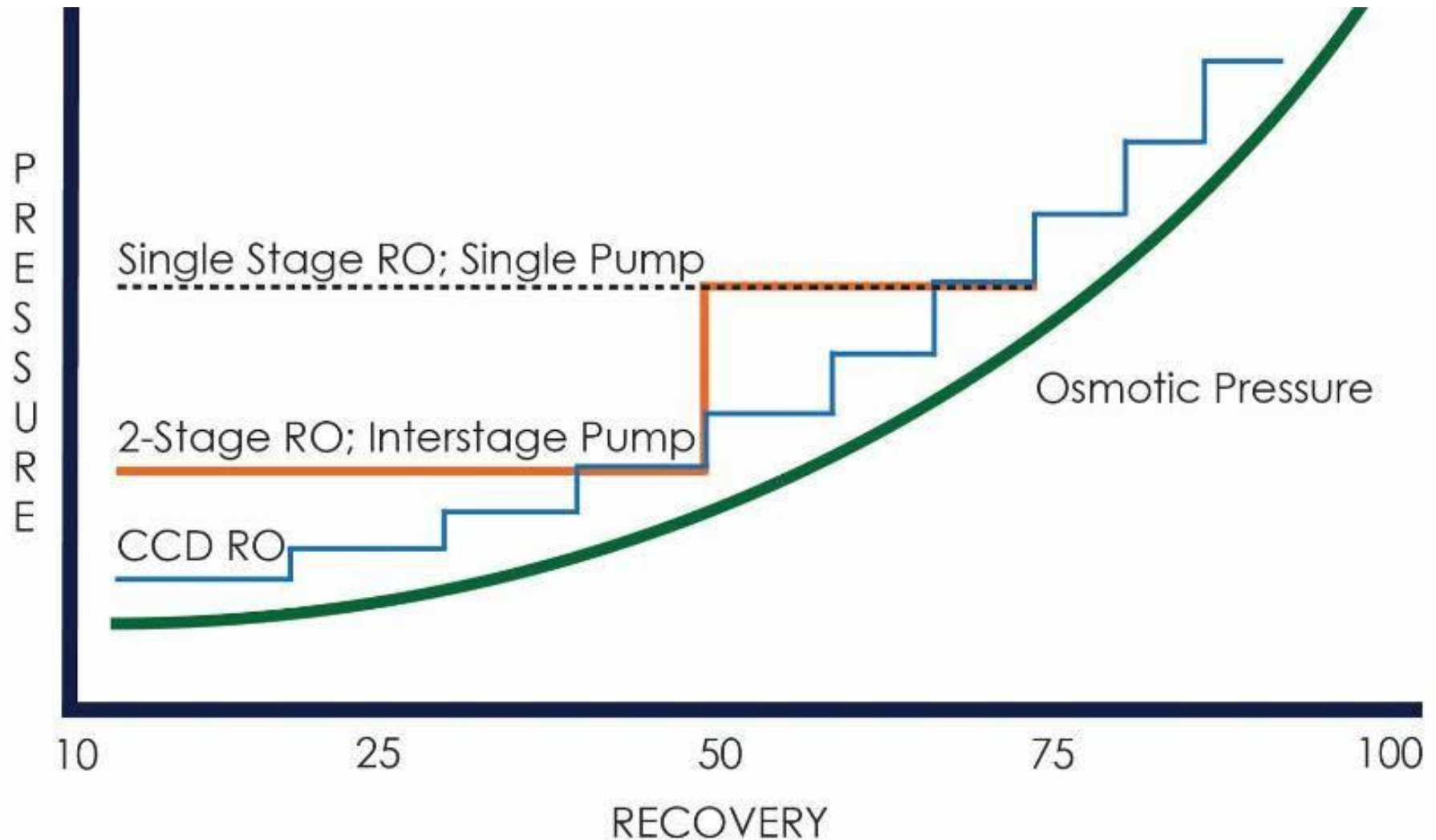
\*ReFlex projections based on typical reported recovery rates of 93%.





# Applied and Osmotic Pressures

CCD-RO機組 以濃水循環提升回收率，而非利用多段RO



約10% 的時間排出濃水(排水時以PFD模式操作, plug flow desalination) ,  
 90%的時間密閉循環(以CCD模式操作, closed circuit desalination)

Table 1

Energy consumption of 8ME4 REIM-I Unit with feed conductivity of 6800  $\mu$ S/cm and system recovery of 80%

Pump	m <sup>3</sup> /h	bar	% Eff	kW	% -hour	Effective Data	
						kW	kWh/m <sup>3</sup>
HP <sup>1</sup>	24.4	15.57	60	17.59	100	17.59	0.72
CP	24.9	0.72	45	1.11	100	1.11	0.05
BRP <sup>2</sup>	60.0	0.70	40	2.92	12	0.35	0.01
Air compressor <sup>3</sup>				2.00	15	0.30	0.01
Miscellaneous <sup>4</sup>				1.00	100	1.00	0.04
						20.35	0.83

<sup>1</sup>The listed pressure is the difference between inlet and outlet of pump.

<sup>2</sup>The pump was operated 6.7 times per hour, each time for 1.1 min.

<sup>3</sup>The compressor operated 15% of the time with power supply of 2.0 kW.

<sup>4</sup>Anti-Scalant pump, Control board, Lights, with AC unit turned off.

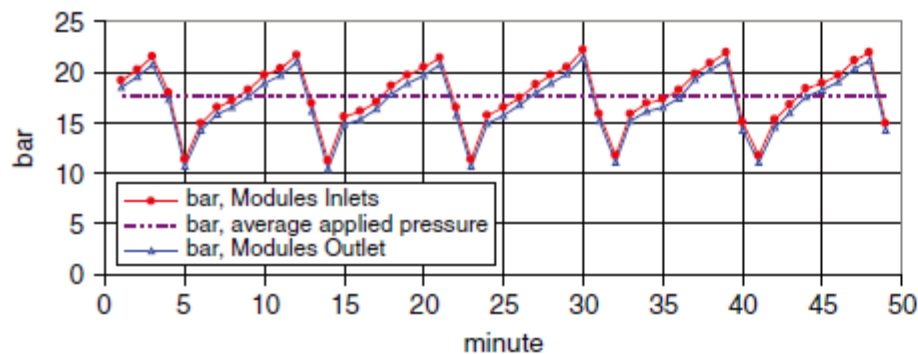


Fig. 3. Pressure variations on time.

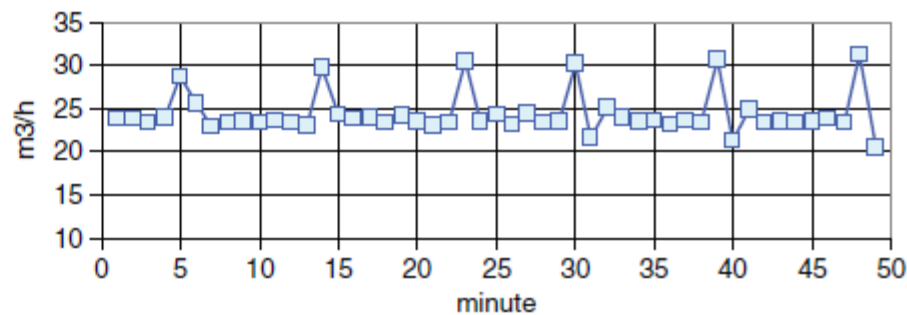


Fig. 6. Permeate flow on time.

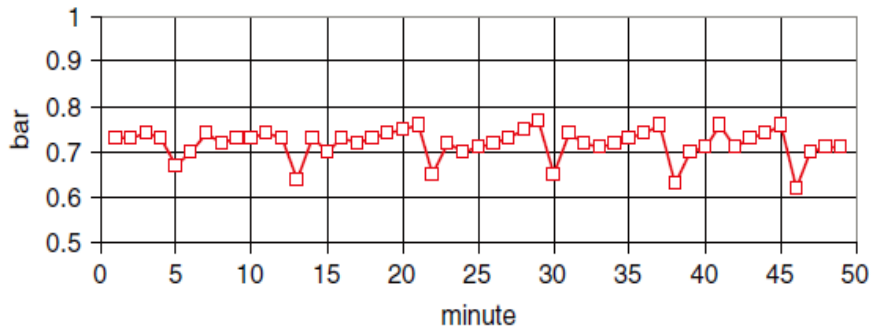


Fig. 4. Modules pressure difference on time.

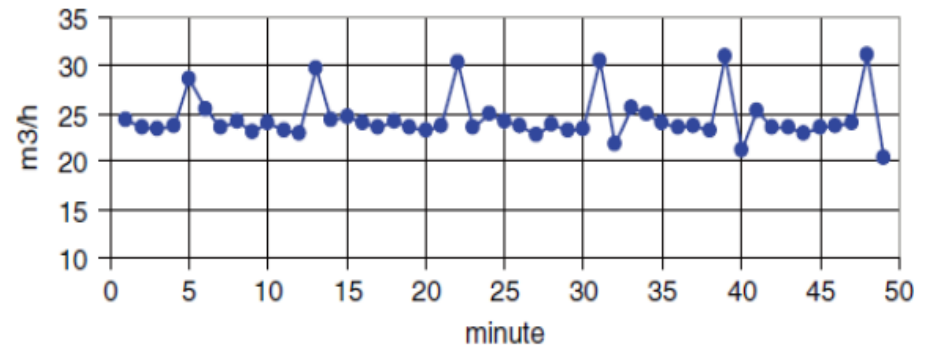


Fig. 5. Pressurized feed flow on time.

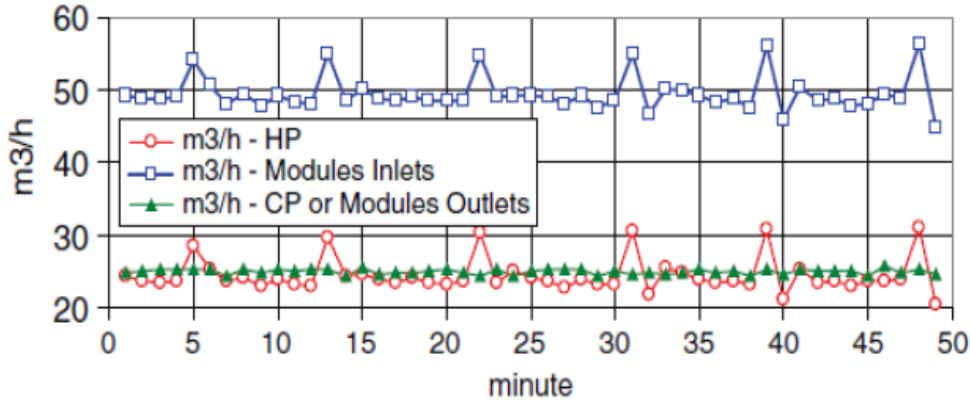


Fig. 7. Modules inlet and outlet flow rates on time.

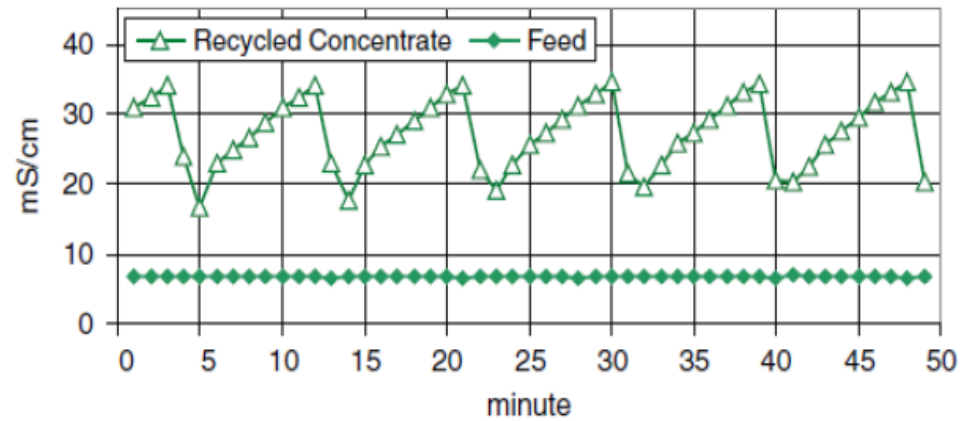


Fig. 9. Recycled concentrate and feed conductivity on time.



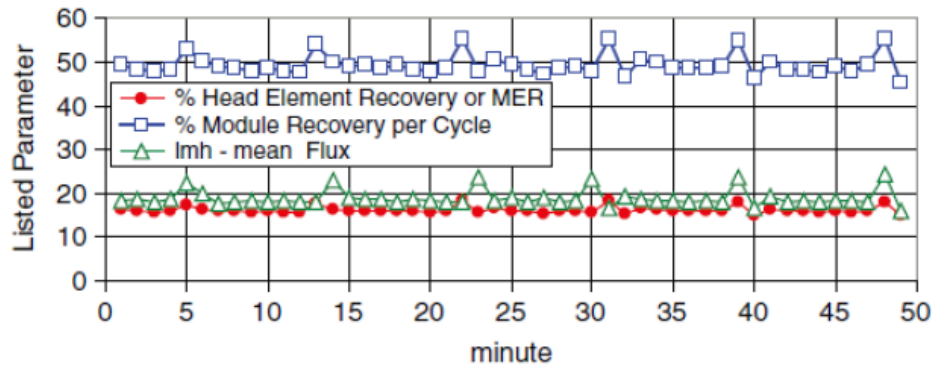


Fig. 8. Modules and membranes performance on time.

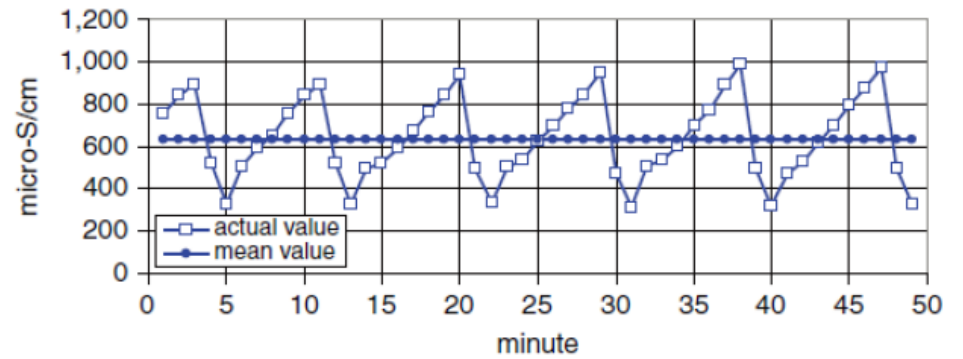


Fig. 10. Permeate conductivity variations on time.

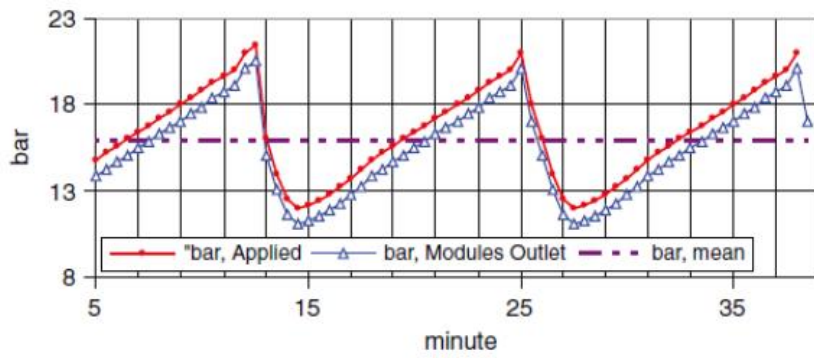


Fig. 11. Pressure variations on time.

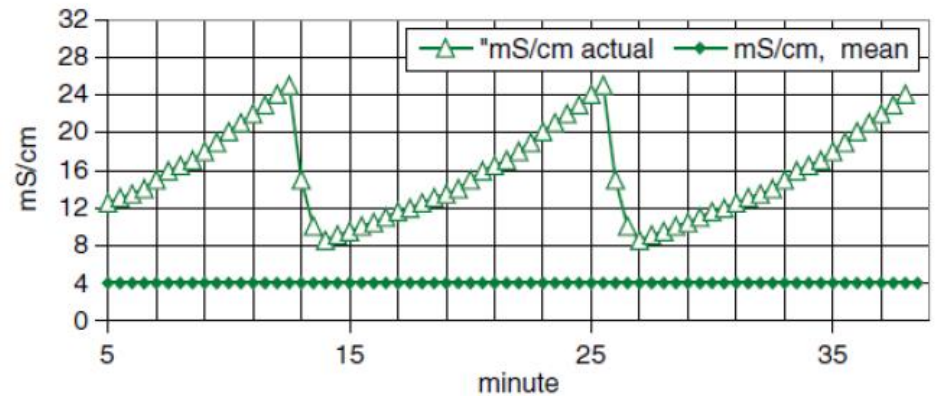


Fig. 12. Recycled concentrate and feed conductivity on time.

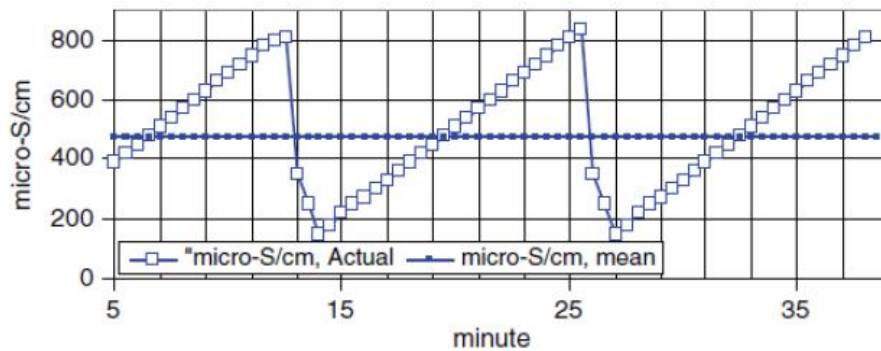


Fig. 13. Permeate conductivity variations on time.

## 上述案例摘要: (reference: CCD-RO-具體說明-Desalitech)

1. 原水:進水為苦鹹水(brackish water)，兩道進水導電度分別為a)6,800us/cm, 及 b)4,000 us/cm
2. RO模組:單段8支8”RO模組(每支4 x ESPA2+膜件)，進水口/出水口為平行連接，RO模組採用CCD系統(closed circuit desalination)，且具有循環濃水可以與加壓新鮮進水混合的管路
3. 回收率:分別為a)80%及b)88%。
4. 本案設備名稱為REIM-I，連續產水，無能量損失。
5. 當進水為6,800 us/cm時，回收率為80%，通量為19LMH，產水為24.4m<sup>3</sup>/hr，產水平均導電度為625 us/cm，RO進水壓力範圍11-22 bar(平均17.7bar)，進水高壓泵浦效能約為55%，總比能耗(overall specific energy consumption)為0.83 kw-h/m<sup>3</sup>產水
6. 當進水為4,000 us/cm時，回收率為88%，通量為27LMH，產水為35m<sup>3</sup>/hr，產水平均導電度為482 us/cm，RO進水壓力範圍12-21 bar(平均16.2bar)，進水高壓泵浦效能約為60%，總比能耗(overall specific energy consumption)為0.81kw-h/m<sup>3</sup>產水
7. 系統添加適當適量抗垢劑(anti-scaling agents)
8. 本系統已經連續商轉超過二年(至2011年本paper發表為止)，產水超過400,000m<sup>3</sup>，產水導電度皆低於1,300us/cm，供應以色列Negev 地區灌溉用水。
9. 另案摘要:地中海海水淡化，鹽分4.1%，能耗1.85 kW-h /m<sup>3</sup>產水，通量13LMH，進水高壓泵浦(high pressure positive displacement pump)效能約為85%，節能約30%(與安裝有節能裝置的傳統RO機組比較)

## 上列案例操作數據整理

	6800 us/cm	4000 us/cm
平均操作壓力 bar	17.7	16.2
回收率%	80	88
通量 LMH	19	27
產水率 m3/hr	24.4	35
耗電 kw-h/m3	0.83	0.81
高壓泵浦效能	55%	60%

## CCD-RO機組 型號

產水量: 11 - 255 m<sup>3</sup>/hr(視選購型號而定)



MODEL	ReFlex 50	ReFlex 100	ReFlex 150	ReFlex 200
Average Permeate Flow	72,000 gpd 50 gpm 11 m <sup>3</sup> /h	144,400 gpd 100 gpm 23 m <sup>3</sup> /h	216,000 gpd 150 gpm 34 m <sup>3</sup> /h	288,000 gpd 200 gpm 45 m <sup>3</sup> /h
Maximum Permeate Flow	108,000 gpd 75 gpm 17 m <sup>3</sup> /h)	201,600 gpd 140 gpm 32 m <sup>3</sup> /h)	273,600 gpd 190 gpm 43 m <sup>3</sup> /h)	403,200 gpd 280 gpm 64 m <sup>3</sup> /h)

### Pumps and Motors

<u>High Pressure Pump</u>				
Motor Power and Type	20 HP (15 kW) TEFC	40 HP (30 kW) TEFC	60 HP (45 kW) TEFC	60 HP (45 kW) TEFC
Design Flow Rate	68 gpm (16 m <sup>3</sup> /h)	132 gpm (30 m <sup>3</sup> /h)	182 gpm (41 m <sup>3</sup> /h)	227 gpm (52 m <sup>3</sup> /h)
Design Boost Pressure	297 psi (21 bar)	377 psi (26 bar)	348 psi (25 bar)	235 psi (16 bar)
<u>Circulation Pump</u>				
Motor Power and Type	4 HP (3 kW) TEFC	10 HP (7.5 kW) TEFC	20 HP (15 kW) TEFC	25 HP (18.6 kW) TEFC
Design Flow Rate	101 gpm (23 m <sup>3</sup> /h)	194 gpm (44 m <sup>3</sup> /h)	308 gpm (70 m <sup>3</sup> /h)	396 gpm (90 m <sup>3</sup> /h)
Design Boost Pressure	30 psi (2 bar)	30 psi (2 bar)	30 psi (2 bar)	30 psi (2 bar)

MODEL	ReFlex 300	ReFlex 450	ReFlex 600	ReFlex 900
Average Permeate Flow	432,000 gpd 300 gpm 68 m <sup>3</sup> /h	648,000 gpd 450 gpm 102 m <sup>3</sup> /h	863,000 gpd 600 gpm 136 m <sup>3</sup> /h	1,294,474 gpd 900 gpm 204 m <sup>3</sup> /h
Maximum Permeate Flow	504,000 gpd 350 gpm 79 m <sup>3</sup> /h)	807,000 gpd 560 gpm 127 m <sup>3</sup> /h)	1,008,000 gpd 700 gpm 159 m <sup>3</sup> /h)	1,614,000 gpd 1,120 gpm 255 m <sup>3</sup> /h)

### Pumps and Motors

<u>High Pressure Pump</u>				
Motor Power and Type	100 HP (75 kW) TEFC	150 HP (110 kW) TEFC	200 HP (150 kW) TEFC	300 HP (220 kW) TEFC
Design Flow Rate	341 gpm (78 m <sup>3</sup> /h)	487 gpm (110 m <sup>3</sup> /h)	650 gpm (150 m <sup>3</sup> /h)	974 gpm (221 m <sup>3</sup> /h)
Design Boost Pressure	271 psi (19 bar)	200 psi (14 bar)	210 psi (15 bar)	200 psi (14 bar)
<u>Circulation Pump</u>				
Motor Power and Type	25 HP (18.6 kW) TEFC	37.5 HP (27 kW) TEFC	50 HP (37 kW) TEFC	75 HP (55 kW) TEFC
Design Flow Rate	528 gpm (120 m <sup>3</sup> /h)	595 gpm (135 m <sup>3</sup> /h)	794 gpm (180 m <sup>3</sup> /h)	1190 gpm (270 m <sup>3</sup> /h)
Design Boost Pressure	30 psi (2 bar)	30 psi (2 bar)	30 psi (2 bar)	30 psi (2 bar)



# CCD-RO機組 組合-案例

## One (1) ReFlex 100 RO systems

1. Cartridge Filter housing w/ 1  $\mu$  nominal rated PPL wound cartridges
  2. Pressure Vessels - Fiber Reinforced Polymer (FRP), 8" diameter
  3. High Pressure pump - vertical multistage centrifugal w/ VFD
  4. Circulation pump - vertical multistage centrifugal w/ VFD
  5. All manifolds, piping, valves, and instrumentation
  6. PLC/HMI control panel
  7. Factory skid mounting on a structural steel frame
  8. Engineering support detailed design phase, construction, and startup
- 
1. System warranty 系統保固
  2. Performance guarantee 性能保證
  3. Lifetime technology license



# CCD-RO機組 配備與選擇

- ▶ 人機介面:Siemens S7-1200, Unitronics (or equal), AB optional
- ▶ RO膜:客戶可任選採用品牌
- ▶ 膜殼: FRP or 316SS
- ▶ 高壓泵浦:Grundfos, Goulds, or equal
- ▶ 監測儀器:ABB (or equal)



# 選購項目-案例

1. Membrane elements RO膜元件
2. Feed Tank 進水槽
3. Booster (feed) Pump 進水泵浦
4. Automatic Permeate Flush 自動產水沖洗
5. Permeate pH/ORP 產水PH/ORP監測儀
6. Clean in Place (CIP) System
7. Anti-scalant injection system 抗垢劑加藥
8. SMBS injection system (Sodium MetaBiSulfite 除氯劑加藥)
9. Acid injection system 加酸
10. Caustic (post) injection system 加鹼
11. RealiteQ™ Remote Monitoring / Control 遠端監控
12. Control Panel UL certification 控制盤UL認證
13. AB MicroLogix 1400 PLC & PV6+ 1000 10” HMI 人機介面
14. Factory skid mounting on a 304L SS structural steel frame 不鏽鋼架
15. Lot Stainless Steel leveling feet 可調水平架腳
16. Conductivity (TDS) Analyzer (high pressure circ.) 導電度儀(高壓端)



# CCD-RO機組 Value Proposition



## 75%

Reduction in water waste



## 35%

Reduction in energy



New level of flexibility



Increased reliability and uptime

- ▶ 單段RO的回收率80~90%，使產生的濃水量更低，大幅降低濃水處理費用(例如:零排放案例)
- ▶ 工業用水處理，最高節能可達35%；用於海淡水處理，最高節能可達20 - 35%
- ▶ 使RO脫鹽的回收率變成可調式(操作控制盤上調整即可)
- ▶ 可降低阻垢劑及清洗藥劑的用量
- ▶ 所需的RO膜較少
- ▶ 原水需求量更低，降低輸送及前處理費用



\*\*本系統尤其適用於位於內陸(不靠海邊)的水廠(牽涉濃水處理與排放成本)的脫鹽、廢水處理、回收、濃縮。

- ▶ 過去的RO技術回收率太低，太耗電，已然沒有競爭力
- ▶ RO設備選擇，至關競爭力、操作成本、得標與否！！



# Thanks!

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