

All-Process All-Container Integrated Water Treatment Plant

全流程全集装箱式饮用水厂

Comply with WHO drinking water standards 达到世界卫生组织饮用水标准



工厂生产、海上及陆地运输、安装调试
Manufacturing,shipping and installing

全部工期至多3~6月
All IN 3~6 MONTHS

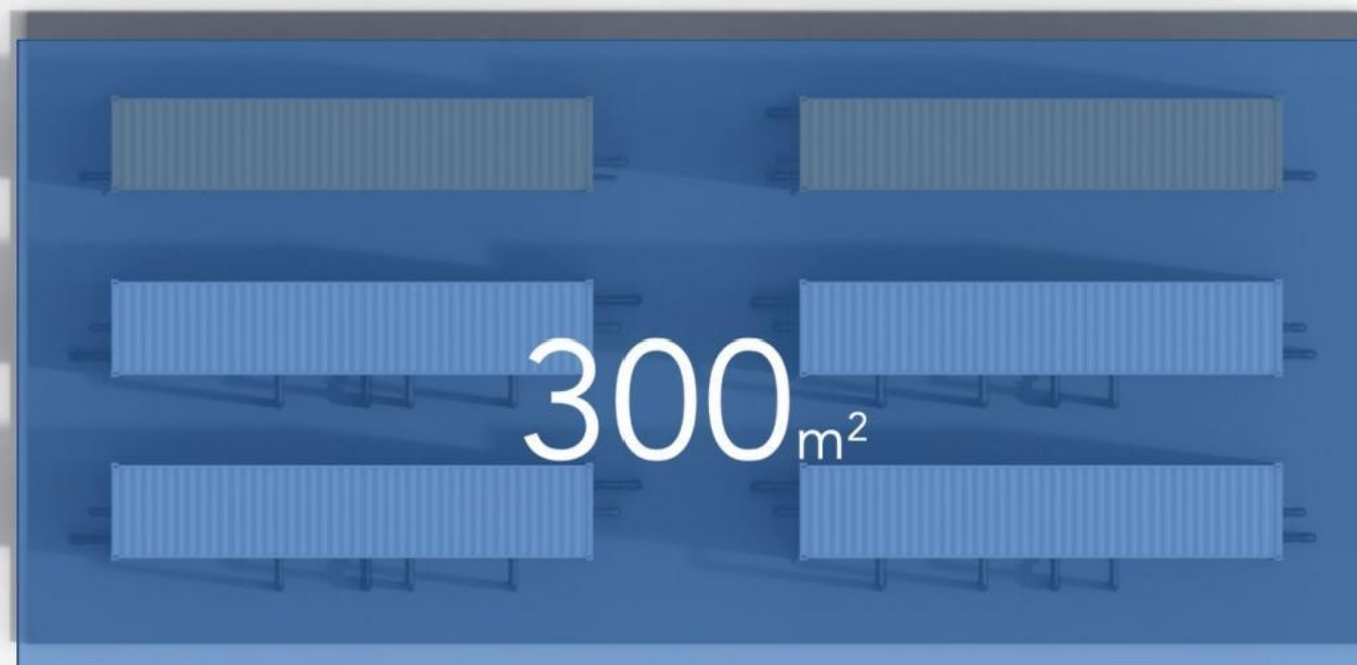


10,000吨/日处理系统仅需占地300平米

10MLD WTP only requires land of 300m²

仅为传统施工方式的1/5 至1/3

1/5 to 1/3 of traditional construction



1. 处理工艺 Treatment Processes

全流程全集装箱式饮用水厂(AAIWPT) 包含全部的水处理工艺，产水水质可以达到世界卫生组织要求的处理标准，整体上，处理工艺可以分为如下四个方面：

All-Process All-Container Integrated Water Treatment Plant(AAIWPT) contains all necessary water treatment units to meet WHO drinking water standards. Generally treatment processes fall into following four units:

● 预处理 Pre-treatment

此单元包括混凝、气浮、沉淀、氧化、自清洗过滤器等多种预处理工艺的组合。预处理单元能够有效地去除水中较大的颗粒物及有机物，减少后续膜系统污染，保障膜工艺的稳定运行。

This unit includes one or a combination of flocculation, air flotation, sedimentation, oxidation, self-cleaning filter etc. The pre-treatment unit is an important process to lower the concentration of larger particles and/or organic matter so that the water can be treated by following membrane systems without causing server membrane fouling.

● 超滤 Ultrafiltration

超滤膜是去除水中浊度悬浮物及微生物的重要工艺，通常超滤膜产水的浊度可以达到0.2NTU 甚至0.1NTU 以下。在后续需要像纳滤或反渗透膜等更高精度膜系统的应用中，超滤膜是保障水质可以达到后续膜系统进水水质要的重要预处理工艺。

Ultrafiltration (UF) membrane filtration process is the key unit to remove virtually all turbidity and microorganisms in raw water. Usually UF membrane yields water with turbidity of lower than 0.2 or even 0.1 NTU. In applications where following treatment process includes more precise membrane system like nanofiltration or reverse osmosis, UF membrane is the necessary process to guarantee the water quality meets inflow requirements of those systems.

● 反渗透(应用苦咸水或海水) Reverse Osmosis(for brackish water or seawater)

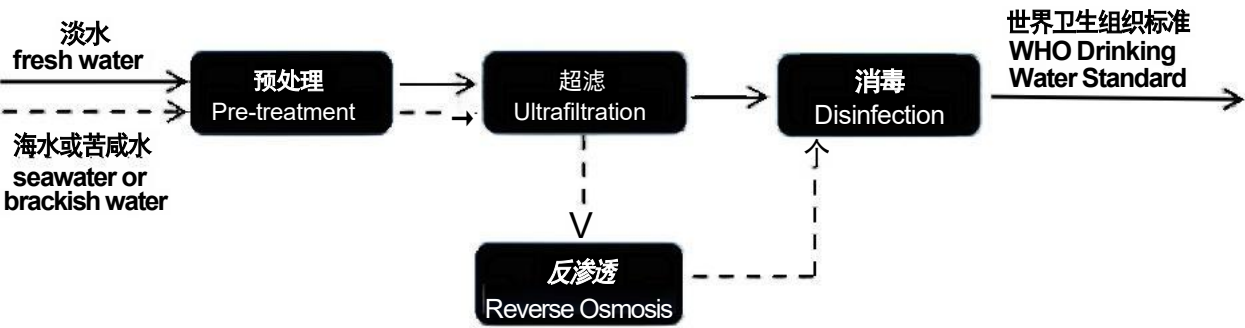
在苦咸水或海水淡化项目中，需要应用到反渗透膜系统。反渗透膜是除盐系统中最常用的处理工艺，对水中盐份的去除率可以高达99%。另外使用多级反渗透系统便可以实现更高的脱盐率要求。

In applications when raw water is brackish water or seawater, reverse osmosis(RO) membrane process will be used. RO membrane is the most commonly used desalination process in the industry being capable of removing up to 99% of dissolved salts in the water. Even higher salt removal rate can be achieved by simply adding more stages of RO system.

● 消毒 Disinfection

饮用水处理的最后一道处理工艺是消毒，通过投加消毒剂，可以使产水中不包含任何可致病微生物的存在，同时消毒剂还可以保证细菌病毒不再后续管网输送中再次生长。

The final treatment step for drinking water is disinfection.This process,by adding disinfectant, is to guarantee that no pathogenic microorganisms exist in the treated water and no re-growth in the distribution system.



AAIWTP treatment process diagram /AAIWPT 处理工艺示意图

2.AAIWPT 型号参数 Models ofAAIWTP

AAIWPT 由标准40尺集装箱作为设备载体而组成，每个集装箱尺寸约为12.0米*2.4米*2.4米，各个工艺集装箱数量以及功能如下表所示。对于每个型号的 AAIWPT，整体上各个功能集装箱的数量是根据原水是地表淡水抑或是海水而定，但是可能根据如下情况进行调整：

AAIWTP consists of multiple 40-feet standard shipping containers.The dimensions of each container is 12.0m*2.4m*2.4m.The number of containers and the function of each container is listed below. In each model,the number of containers and the function of each container are designed based on typical fresh water or seawater quality and may vary according to following factor:

- 需要额外的原水供应系统或调节水池；
- Additional raw water pump station and/or buffer tank
- 需要提供的额外的集装箱作为净水池使用；
- Requirement of using more containers as final clean water storage tank
- 存在非常规性污染物因此需要额外的处理工艺。
- Existence of uncommon contaminants that requires additional treatment process

表 1 淡水处理用AAIWTP 各功能集装箱数量表

Table#1 list of containers in AAIWTP for fresh water treatment/

Model No. 型号参数	Pretreatment/ 预处理	Ultrafiltration/ 超滤	Dosing/加药系 统	Accessory/附属 系统	Total/合计
GAAIWTPF-2500	1	1	1	1	4
GAAIWTPF-5000	2	2	1	1	6
GAAIWTPF-7500	3	3	1	3	10
GAAIWTPF-10000	4	4	1	3	12
GAAIWTPF-15000	6	6	1	3	16
GAAIWTPF-20000	8	8	1	3	20
GAAIWTPF-25000	10	10	1	3	24
GAAIWTPF-30000	12	12	1	5	30

表2海水处理用AAIWTP各功能集装箱数量表

Table#2 list of containers in AAIWTP for seawater treatment/

Model No. 型号参数	Pretreatment /预处理	Ultrafiltration /超滤	RO system/ 反渗透系统	Dosing/加药 系统	Accessory/附 属系统	Total/合计
GAAIWTPS-2500	1	1	1	1	1	5
GAAIWTPS-5000	2	2	2	1	1	8
GAAIWTPS-7500	3	3	3	1	1	10
GAAIWTPS-10000	4	4	4	1	2	15
GAAIWTPS-15000	6	6	6	1	3	22
GAAIWTPS-20000	8	8	8	1	4	29
GAAIWTPS-25000	10	10	10	1	4	35
GAAIWTPS-30000	12	12	12	2	5	43

3.AAIWPT 的运行Operation of AAIWTP

- 100%全自动运行100% Fully Automatic

全部型号的AAIWPT 都是全自动运行，几乎不需要日常人工维护，仅在药剂不足需补充药剂或设备故障时需要人工进行干预。

All AAIWTPmodels are 100%automatic operational that requires virtually no daily maintenance. Labor requirements limit to chemical refill and trouble shooting.

● 远程监控及数据采集系统 Supervisory Control and Data Acquisition System

全部型号的 AAIWTP 均配备远程监控及数据采集系统，全部运行参数均可在远程 PC 或智能手机端获取，所有的运行参数均可远程调节，客户可以定制需要的数据，系统会自动发送数据给用户并存储在使用当地服务器的云端系统中。

All AAIWTP comes with built-in SCADA system.All operational data is accessible remotely on PC or smartphone.All operational parameters can be adjusted remotely.Customized daily data will be send to user and stored on cloud with local server.

● 运行费用 Operational cost

运行费用如下表所示，运行费用的估算包含了电费及药剂费用，未包含人工费用。电费的估算基于电费为0.1 美元/千瓦时。

Operational costs of an AAIWTP in the table below only includes power consumption and necessary chemical usage.The cost of electricity is estimated based on the price of 0.1US\$/kwh. Labor cost is not included.

表 3 各AAIWTP 型号水厂运费费用估算

Table#3 Estimated operational cost of each AAIWTP models(US\$/m³)

型号系列 Model Series/	运行费用 Operational cost	型号系列 Model Series/	运行费用 Operational cost
淡水处理 Freshwater treatment F系列 F Series	~0.1 元 / 吨 水 ~\$0.015/m³	海水处理 Seawater treatment S 系 列 S Series	4 ~ 6 元 / 吨 水 \$0.5~0.8/m³

4. 系统布置 Typical Layout

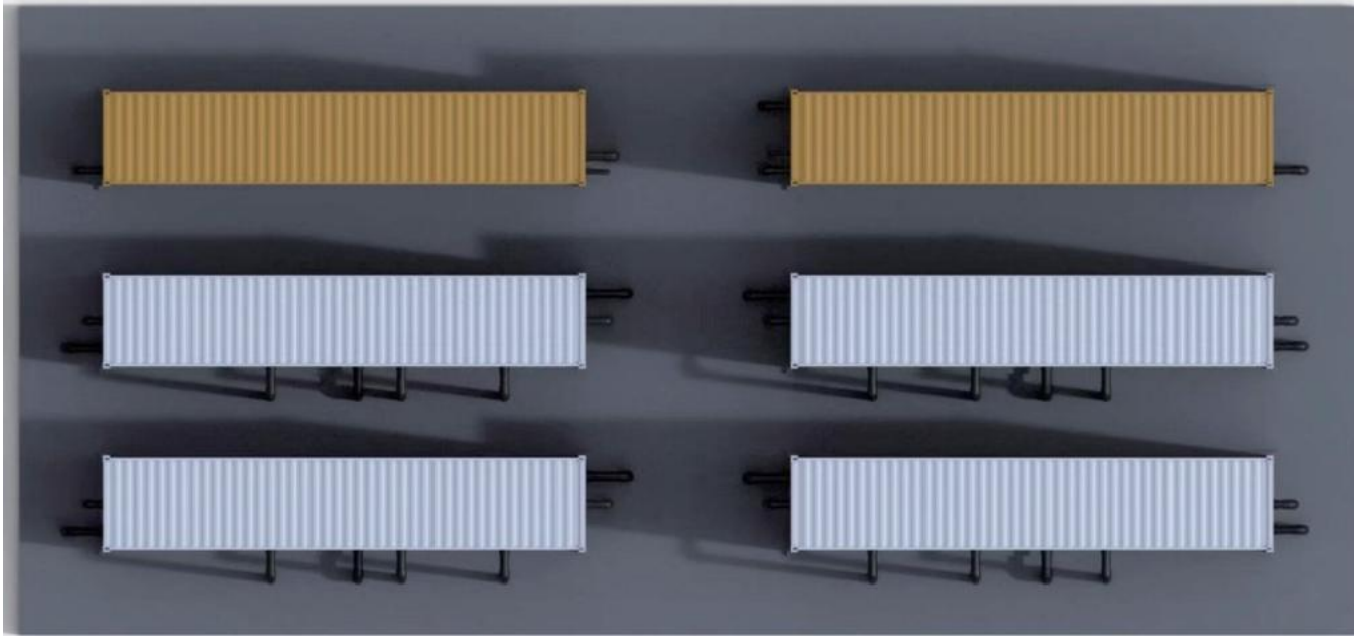
AAIWTP 的占地面积远远小于传统施工方式，这是由于采用了更为紧凑的系统设计，而且集装箱系统可以进行上下双层布置，每个型号预估的占地面积如下表所示。

Footprint of AAIWTP is significantly smaller than traditional construction as the containers of most all of AAIWTP are **double-layered** and designed in a more compact manner.Estimated footprint of each model is in the table listed below.

表 4 各 个AAIWTP 预估占地面积 (m²)

Table#4 Estimated land usage of AAIWTP models(m²)

型 号 Model No.	集装箱数量 #of containers	占地面积 Footprint	型 号 Model No.	集装箱数量 #of containers	占地面积 Footprint
GAAIWTPF-2500	3	80m²	GAAIWTPS-2500	5	100 m²
GAAIWTPF-5000	5	100 m²	GAAIWTPS-5000	8	240m²
GAAIWTPF-7500	7	210m²	GAAIWTPS-7500	12	300 m²
GAAIWTPF-10000	12	300 m²	GAAIWTPS-10000	15	400 m²
GAAIWTPF-15000	15	400 m²	GAAIWTPS-15000	22	550 m²
GAAIWTPF-20000	20	500 m²	GAAIWTPS-20000	29	700 m²
GAAIWTPF-25000	24	600m²	GAAIWTPS-25000	35	800 m²
GAAIWTPF-30000	29	700m²	GAAIWTPS-30000	43	1100m²



GAAIWTPF-10,000 （处理能力10,000吨/天，占地面积300m²;Treatment capacity~10MLD, Footprint~270m²)

5. 核心处理工艺 Core Processes

5.1预处理系统 Pretreatment system

预处理系统设计采用标准高柜集装箱，其中包括混凝单元、沉淀单元及调节水池(如图所示，从右至左), 混凝区、沉淀区和调节水池的水力停留时间分别为10分钟、20分钟及15分钟。

The pretreatment module is designed into an high cube shipping container.It includes coagulation chamber,sedimentation chamber and buffer tank(as shown in the figure blow,from right to left). The hydraulic retention time(HRT)are 10mins,20mins and 15 mins for coagulation chamber, sedimentation chamber and buffer tank respectively.

表5.1 预处理单元设计(上层) Table#5.1 Pre-treatment unit design (upper layer)

No.	项目Indicators	描述Description
1	单元尺寸Unit dimensions (L*W*H)	12000*2300*2900
2	混凝区Coagulation chamber	2600*2300*2900
3	沉淀区Sedimentation chamber	5200*2300*2900
4	调节池Buffering tank	4200*2300*2900
5	处理能力Treatment capacity per container	2500m³ /d
6	内外涂层Coating inside/outside	Anti-corrosion costing

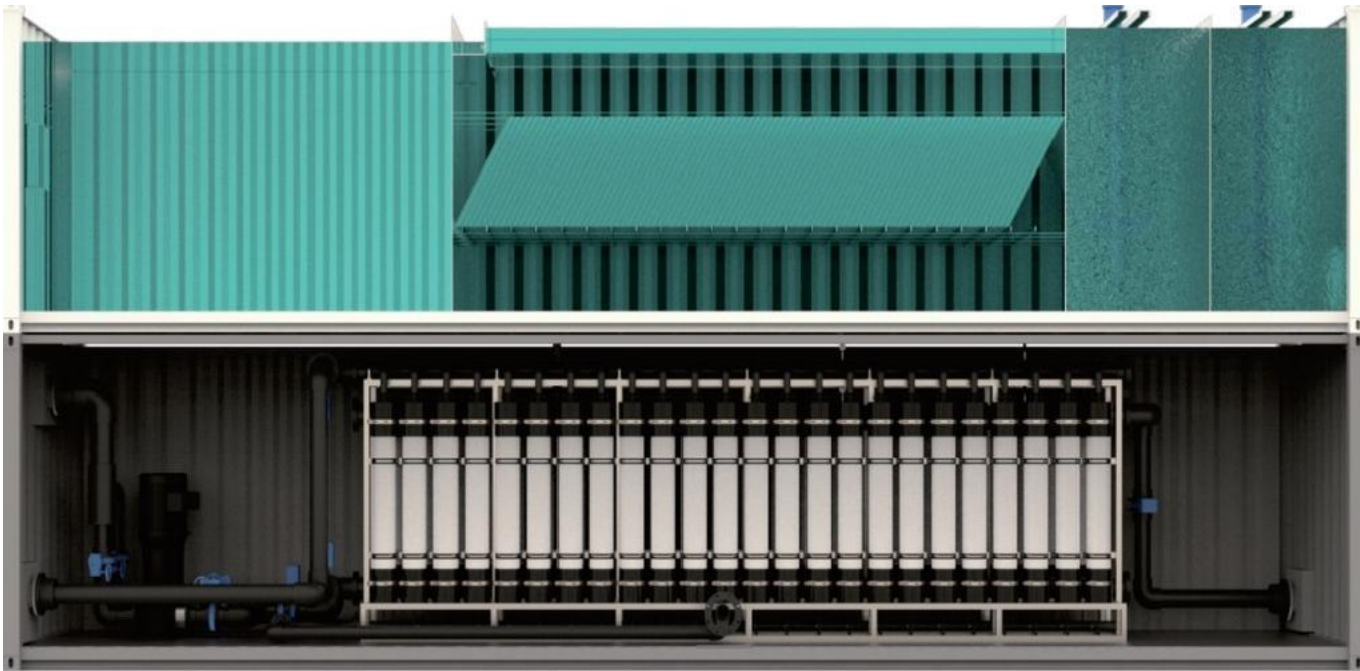


图5.1 预处理单元(上层) Figure #5.1 Pre-treatment unit (upper layer)

5.2超滤膜 Ultrafiltration membrane

Grapheilm2 超滤膜组件具有如下特点:

The Grapheilm2 Ultrafiltration(UF)modules have the following features:

- 2 过滤精度为0.02 μm, 能够去除几乎全部的颗粒物、胶体、细菌及病毒。
- 20.02 μm nominal pore diameter for removal of all particulates colloids, bacteria and viruses.
- 2 用于地下水或地表水的处理或海水淡化预处理。
- 2 Use for treatment of ground and surface water or pretreatment for seawater desalination.
- 2 PVDF 膜材质以及专利的石墨烯亲水改性技术
- 2 PVDF material as well as patented graphene hydrophilic additive.
- 2 由外向内过滤方式，承受高远水悬浮物浓度。
- 2 Outside-in flow type for super high inflow SS tolerance.

Model P	超滤膜堆技术参数	MODEL P	RACK	SPECIFICATIONS
外观Appearance	如图所示 As shown			
膜面积 Membrane surface area	51m²/module			
组件直径 Diameter of each module	225mm			
组件高度Height of each module	1860mm			
组件数量# of modules in one rack	50~64			
模架高度 Height of membrane rack	2,150mm			
模架长度 Length of membrane rack	9.0~10.5m			
单支组件流量Flow rate for one module	2.5m³/h (freshwater)			
单支组件流量Flow rate for one module	2m³/h (seawater)			
单个膜堆流量 Flow rate for one rack	125m³/h			

表4每个型号中预估安装的超滤膜组件数量

Table#4 Estimated number of UF membrane modules in each model

Model No.	#of modules	Model No.	#of modules
GAAIWTPF-2500	50	GAAIWTPS-2500	64
GAAIWTPF-5000	100	GAAIWTPS-5000	128
GAAIWTPF-7500	150	GAAIWTPS-7500	192
GAAIWTPF-10000	200	GAAIWTPS-10000	256
GAAIWTPF-15000	300	GAAIWTPS-15000	384
GAAIWTPF-20000	400	GAAIWTPS-20000	512

GAAIWTPF-25000	500	GAAIWTPS-25000	640
GAAIWTPF-30000	600	GAAIWTPS-30000	768

膜堆如何安装于集装箱内 How UF membrane racks fit into shipping containers

膜堆高度约为2.15米(包含连接管道以及不锈钢基础), 整个集装箱内净高为2.3米。膜堆的宽度为1.0米左右, 而集装箱内部宽度为2.3米, 因此留有足够的维护操作空间。

The height of membrane racks is 2,150mm(connecting pipes and stainless steel structure included) while the height of container is around 2,300mm.The width of a membrane rack is 1,000mm while the width of container is around 2,300mm.Enough room is left for maintenance work.



表4各个型号系统中包含超滤集装箱数量

Table#4 Estimated number of 40 feet UF membrane containers in each model

Model No.	#of modules	Model No.	#of modules
GAAIWTPF-2500	1	GAAIWTPS-2500	1
GAAIWTPF-5000	2	GAAIWTPS-5000	2
GAAIWTPF-7500	3	GAAIWTPS-7500	3
GAAIWTPF-10000	4	GAAIWTPS-10000	4

苦咸水或海水淡化反渗透系统包括原水泵、保安过滤器、高压泵、海水淡化膜壳、海水淡化膜元件、阻垢剂投加系统、还原剂投加系统、杀菌剂投加系统、工艺管路及阀门。主要设备构件集成在 SUS316L 材质膜架上, 高压段管道为2205双相钢材质, 低压段管路为UPVC 材质。

The Brackish or Seawater RO unit consists of RO feed pump,RO pre-filter,high-pressure pump, seawater RO membrane vessels,seawater RO membrane modules,scale inhibitor dosing system, reducing agent dosing system,microbicide dosing system,process valves and pipes.Main components are integrated into an SUS316L membrane rack.High pressure pipeline material is duplex 2205 stainless steel.Low pressure pipeline material is UPVC.

表5.3 苦咸水或海水反渗透膜系统设计

Table#5.3 Brackish or Seawater RO membrane unit design

No.	项目Indicators	描述Description
1	单元尺寸Unit dimensions (L*W*H)	12,000mm*2,300mm*2,900mm
2	处理能力Treatment capacity per container (inlet water flow rate)	2,500 m³ /d
3	净产水能力Net desalinated water capacity per container	1,250~2,000 m³ /d
4	反渗透膜壳RO membrane vessel	300~1000PSI
5	反渗透膜壳数量RO membrane vessel number	30
6	单支膜壳中反渗透膜元件数量Number of RO membrane modules in one vessel	6
7	单个集装箱中反渗透膜元件总数量Number of RO membrane modules in one container	180

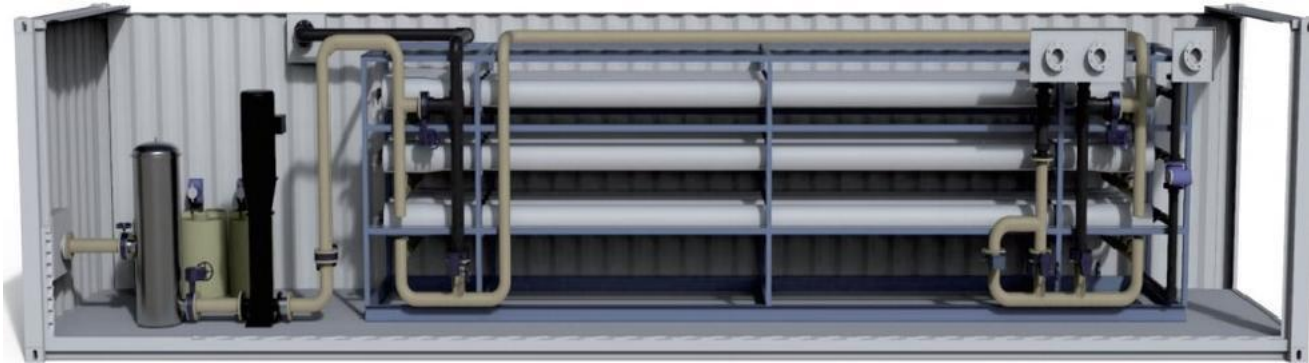


表5常用海水淡化反渗透膜元件参数

Table#5 Commonly used seawater desalination RO membrane specification

Model	产水流量Pemeate flow		截流率Rejection rate	膜面积Membrane area	
	GPD	m³ /d	%	ft²	m²
SW8040XHR-440	6600	25.0	99.85	440	40.9
SW8040FR-400	8200	31.0	99.8	400	37.2
SW8040HR-440	9000	34.0	99.8	440	40.9
SW8040LE-440	9500	35.9	99.8	440	40.9
测试条件 Testing conditions	运行压力Operating pressure 800 psi(5.52 MPa); 使用32000mg/L NaCl溶液测试; Tested in 32000 mg/L NaCl solution; 25摄氏度, pH=8, 回收率为8%;Temperature at 25 degree C, pH=8, Recovery rate at 8%				
Operational limits	最大运行压力Maximum Operating pressure		1200 psi (8.28MPa)		
	最大原水流量Maximum feedwater flow		75 GMP (17m³ /h)		
	最高温度Maximum temperature		45 degree C		
	最大原水SDI;Maximum feedwater flow SDI ₁₅		5		
	最高自由氯浓度; Maximum concentration of free chlorine		<0.1mg/L		
	单支膜元件最大压降; Maximum pressure drop per element		15psi (0.1MPa)		
	化学清洗时pH范围; pH range for chemical cleaning		1~13		
	原水pH范围; pH range for feedwater in operation		2~11		