

**SWCM (E) 型**  
**SWCM (E) Type**  
**船用生活污水处理装置**  
**Marine Sewage Treatment Plant**

**用 户 手 册**  
**Manual**

执行IMO MEPC.227(64)决议的STP  
Implement of IMO MEPC.227 (64) Resolution

东台市东方船舶装配有限公司  
DONGTAI CITY DONGFANG MARINE FITTING CO., LTD.



1 本装置可用于处理船舶使用淡水或海水冲洗的厕所污水、厨房灰水、洗衣和洗浴灰水。

The device can be used to treat toilet sewage, kitchen grey water, laundry and bath grey water washed by ships using fresh or sea water.

2 本装置柜体的水压试验压力为0.021MPa。

The test pressure of the tank is 0.021MPa.

3 本装置排放水指标符合IMO.MEPC.227(64)排放标准和GB10833-2015《船用生活污水处理设备技术条件》。

The effluent quality of the device is in compliance with the standards of IMO. MEPC.227 (64) and GB10833-2015 Technical conditions of marine sewage treatment system.

 **警告 WARNING**

1 本装置不可安装在爆炸性大气中，即非防爆型。

The plant cannot be installed in explosive atmosphere.

2 本装置柜内壁涂环氧沥青漆，不得在柜上再焊接。

Paint tar epoxy as that coat on inside surface of the tank, welding should not be worked on the surface of the tank.

3 本装置所需的操作和维修空间：建议所有操作和维修面为600mm。

It needs clear space at front of device 600 mm to allow for operation and main-tenance of the device.

4 本装置在使用过程中不得使用任何杀菌剂。

Any disinfectants can't be used in the progress of device using.

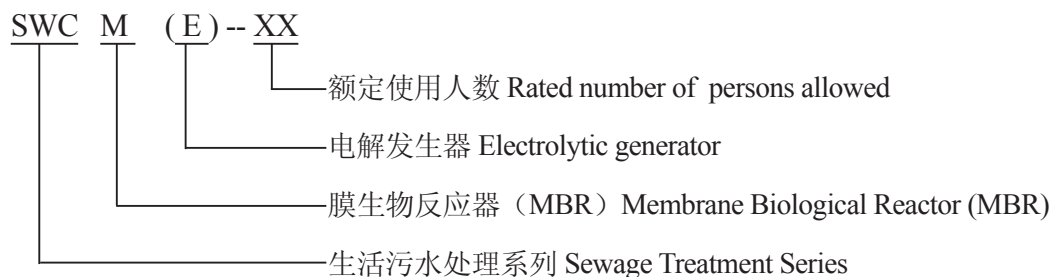
5 本装置在使用过程中不能有塑料制品、抹布、手套等掉入马桶从而进入装置。

During the use of the device, no plastic products, rags, gloves, etc. can fall into the toilet and enter the device.

6 本装置冲洗水尽量使用淡水、且温度为5~30℃（超温会造成细菌死亡）。

The flushing water of this device should use fresh water as far as possible, and the temperature is 5~30℃ (overtemperature will cause bacterial death).

型号说明 Type description





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## Chapter 1 前言 Preface

船用生活污水处理装置属IMO国际防止船舶造成海洋污染公约《MARPOL 73/78》附则IV的关键设备。本系列装置遵守2012年10月5日颁布的MEPC.227(64)决议和GB3552-2018标准的要求，用于处理船上来自厕所的粪便污水、厨房灰水、洗衣、洗浴灰水等。

Marine Sewage Treatment Plant belongs to the key devices for prevention of pollution from ships in seas and oceans according to the revised Annex IV of the International Convention of the Prevention of Pollution (MARPOL 73/78). This device is according to the MEPC.227(64) resolution enacted on October 5, 2012 and GB3552-2018, and used to dispose fecal sewage from lavatories and grey water generated from kitchens, laundries and bath on board.

本装置将适用于2016年1月1日或以后在下列船舶上安装的生活污水处理装置（符合2012年导则的所有要求，包括导则第4.2节关于总氮和总磷去除标准的要求）：

This device will apply to sewage treatment plants installed on or after 1 January 2016 on (conforming to all requirements in 2012 Guideline, including Section 4.2 — Total Nitrogen and Total Phosphorus Removal Criteria):

(1) 对于在MARPOL附则IV特殊区域内营运并拟排放生活污水入海的新客船，在2016年1月1日或以后安装上船；

For new passenger ships operating in a particular region and to discharge sewage into the ocean, the device will be installed on or after January 1, 2016 according to Supplemental Provision IV of MARPOL,

(2) 对于在MARPOL附则IV特殊区域内营运并拟将排放生活污水入海的现有客船，在2018年1月1日或以后安装上船。

For the existing passenger ships operating in a particular region and to discharge sewage into the ocean, the device will be installed on or after January 1, 2018 according to Supplemental Provision IV of MARPOL  
汇总各种规则和排放标准如下：

Summary all the rules and effluent standards as followings:

指标index	MEPC.227 ( 64 )	GB3552-2018
TSS (mg/l)	≧ 35Qi/Qe	≧ 20Qi/Qe
BOD5 (mg/l)	≧ 25Qi/Qe	≧ 20Qi/Qe
COD (mg/l)	≧ 125Qi/Qe	≧ 60Qi/Qe
大肠菌群coliform (个Per/100ml)	100	100
PH	6~8.5	6~8.5
余氯Residual chlorine (mg/l)	< 0.5	< 0.5
氨氮Ammonia nitrogen (mg/l)	--	≧ 15
总氮Nitrogen (mg/l)	≧ 20Qi/Qe (或至少70%减少率)	≧ 20Qi/Qe
总磷Phosphorus(mg/l)	≧ 1.0Qi/Qe (或至少80%减少率)	≧ 1.0Qi/Qe

SWCM(E)型船用生活污水处理装置利用物理分离、厌氧-好氧（A-O）、微电解技术和膜生物反应器（MBR）的原理消解有机污染物质。装置能高效、彻底和干净地处理污水，使排放水满足IMO新标准和其他更严厉的要求。

SWCM(E) Marine Sewage Treatment Plant is used to degrade organic contaminants by virtue of physical separation, anaerobic-aerobic (A-O), micro-electrolysis technique and membrane bioreactor (MBR). It

is able to effectively and completely purify sewage, making the discharged water satisfy the new IMO standards and other more stringent requirements.

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which can treat sewage effectively and reach at the IMO new effluent standard or other stricter requirements.

## 警告 WARNING

### 机械危害!

#### Mechanical Hazards

在维修装置中由电动机驱动的泵时必须将船舶供应设备电源开关断开,并挂上“正在维修,不准合闸”的醒目标签,只有主管本装置的船员或工人才可对运转部件进行维修。

When the pump driven by the motor in the maintenance device must be turned off the power switch of the ship's supply equipment, and hang up the "OUT OF SERVICE" Eye-catching label, only the crew or workers in charge of the unit may perform maintenance on the moving parts.

### 电气危害!

#### Electrical Hazards

本装置供应有高压电源,如不小心接触人体会引起危险,在任何情况下不要随意打开控制箱的门或电动机接线盒,在需要对控制箱、电动机进行维修时,必须将供应电源的船舶开关“断开”,在打开电气控制箱门时首先拉开电控箱内电源总开关,任何人都应非常小心操作,以免引起触电的危害。

This device is supplied with high voltage power supply, such as accidental contact with human will cause danger, in any case do not open the door of the control box or motor junction box at will, in the need of control box, motor maintenance, must supply the ship switch "off", when opening the electrical control box door, first turn off the main power switch in the control box. Anyone should be very careful to avoid the danger of electric shock.

### 疾病危害!

#### Disease Hazards

生活污水通常都含有很多寄生虫机体,诸如:细菌、真菌、病菌、原生物、轮生虫等。它们多数是致病菌,可以引起严重的交叉感染,大多数与生活污水有关的疾病是由人的手到嘴来传播这些致病细菌,保持个人的良好卫生习惯,少接触占有污水的设备可以避免疾病的发生。

Sewage is a common mode of transmission for parasite organisms such as bacteria, fungi, protozoa, viruses and worms; some of these may be pathogenic, meaning they have the capacity of causing serious communicable diseases. Most diseases associated with sewage result from hand to mouth transfer of the pathogenic organisms. Good personnel habits by those servicing or in any way coming in contact with the equipment are imperative.

如果万一接触到污水或者被污水污染的设备时,个人应立即用消毒肥皂或洗洁精很好地清洗自己。在吃饭、喝饮料、吸烟或者任何从手到嘴的动作前特别应该清洗,如果皮肤划破应立即进行适当的医疗保护。

After coming in contact with sewage on any contaminated equipment items, personnel should thoroughly clean themselves with a disinfectant soap solution. This precaution is an absolute requirement before eating, drinking, smoking or performing any hand to mouth functions. Skin abrasions, punctures, or any other wounds require immediate and proper medical attention.

## Chapter2 技术参数 Technical Performance

规格型号 Model		SWCM(E)-													
		20	25	30	40	50	60	80	100	120	150	200	250	300	400
处理负荷 LOAD	黑水负荷 (L/d) Black water load (L/d)	1540	1890	2310	3080	3780	4480	6020	7700	9100	11200	14700	18200	23100	30800
	灰水负荷 (L/d) Grey water load (L/d)	3520	4320	5280	7040	8640	10240	13760	17600	20800	25600	33600	41600	52800	70400
	总水力负荷 (L/d) Total water power load (L/d)	5060	6210	7590	10120	12420	14720	19780	25300	29900	36800	48300	59800	75900	101200
	黑水高峰负荷 (L/h) Black water peak load (L/h)	193	236	289	385	473	560	753	963	1138	1400	1838	2275	2888	3850
	灰水高峰负荷 (L/h) Grey water peak load (L/h)	264	324	396	528	648	768	1032	1320	1560	1920	2520	3120	3960	5280
	有机负荷 (kgBOD5/d) Organic load (kgBOD5/d)	1.298	1.593	1.947	2.596	2.836	3.73	5.074	6.49	7.67	9.44	12.39	15.34	19.47	25.96
	总氮 (kg/d) Total nitrogen (kg/d)	0.242	0.297	0.363	0.484	0.594	0.704	0.946	1.21	1.43	1.76	2.31	2.86	3.63	4.84
	总磷 (kg/d) Total phosphorous (kg/d)	0.0308	0.0378	0.0462	0.0616	0.0756	0.0896	0.1204	0.154	0.182	0.224	0.294	0.364	0.462	0.616
	额定使用人数 (人)	20	25	30	40	50	60	80	100	120	150	200	250	300	400
	最大使用人数 (人)	22	27	33	44	54	64	86	110	130	160	210	260	330	440
电制 Electricity AC220/380/415/440/460/690V, 50/60Hz, 3φ或其它电制															
重量 Weight	功率 (kW)	10.44	10.44	10.44	14.4	17.4	18.2	18.2	24.1	27.1	33.1	40	49.6	58.6	80.6
	外形尺寸 Outline dimension (mm) 长×宽×高	3050 × 1500 × 1300	3350 × 1680 × 1530	3600 × 1650 × 1780	3800 × 1850 × 1780	4100 × 1980 × 1850	4350 × 2000 × 2050	4670 × 2100 × 2050	4900 × 2300 × 2250	4900 × 2300 × 2250	4880 × 2450 × 2250	5130 × 2680 × 2270	6100 × 2680 × 2470	6800 × 2930 × 2470	8600 × 3000 × 2670
排放水质 Discharged water quality	干重 Dry weight (kg)	1798	2016	2276	2555	3310	3529	3805	5878	6065	6635	7395	9095	11208	13191
	湿重 Wet weight (kg)	5008	6524	7900	9486	11830	13978	15728	21063	23719	27056	34060	41577	56496	19673
总悬浮固体 TSS ≤ 200 Q <sub>ij</sub> mg/l、五日生化需氧量 BOD <sub>5</sub> ≤ 200 Q <sub>ij</sub> mg/l、化学需氧量 COD ≤ 600 Q <sub>ij</sub> mg/l、耐热大肠菌 ≤ 100 个/100ml、 PH 6 ~ 8.5、余氯 Cl <sub>2</sub> < 0.5 mg/l、总氮 TN ≤ 200 Q <sub>ij</sub> mg/l 且至少 70% 减少率、总磷 TP ≤ 1.00 Q <sub>ij</sub> mg/l 且至少 80% 减少率、氨氮 NH <sub>3</sub> -N ≤ 15mg/L Total suspended solid TSS ≤ 200 Q <sub>ij</sub> mg/l; five-day biochemical oxygen demand BOD <sub>5</sub> ≤ 200 Q <sub>ij</sub> mg/l; Chemical Oxygen Demand COD ≤ 600 Q <sub>ij</sub> mg/l; heat-resisting coliform ≤ 100 /100ml; PH values between 6 and 8.5; residual chlorine Cl <sub>2</sub> < 0.5 mg/l; total nitrogen TN ≤ 200 Q <sub>ij</sub> mg/l with a depletion no less than 70%; total phosphorous TP ≤ 1.00 Q <sub>ij</sub> mg/l with a depletion no less than 80%; and ammonia nitrogen NH <sub>3</sub> -N ≤ 15mg/L															
环境条件温度 Ambient conditions 原污水 (厕所冲洗水) Raw sewage (lavatory wash water) 排放压力 Discharge pressure															
温度 5℃ ~ 50℃, 湿度 ≤ 95% Temperature 5℃ ~ 50℃; humidity ≤ 95% 冲洗水温度 2℃ ~ 32℃, 淡水或海水 (35000ppm) Temperature of wash water between 2℃ and 32℃, being fresh water or seawater (35000ppm) 0.2MPa (注: 可根据用户不同要求选择泵的排放压力) 0.2MPa (note: the discharge pressure can be selected according to different user demands)															

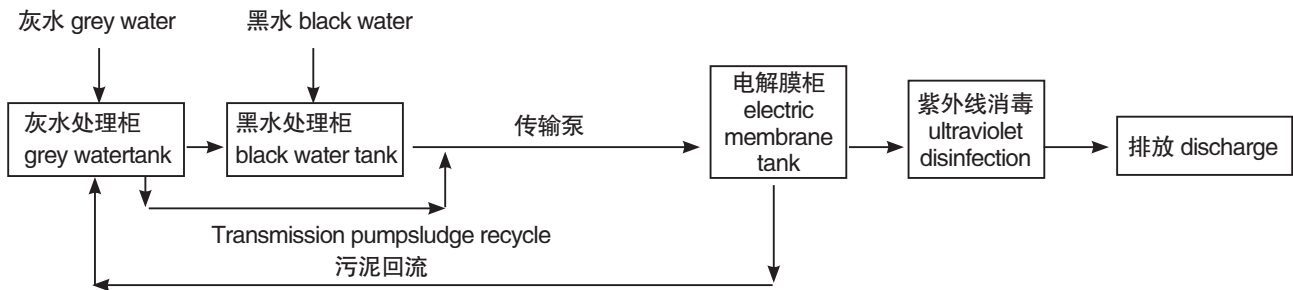
## Chapter 3 基本工作原理 System Principles

### 3.1 系统处理流程（请参照系统原理图）(please refer to the system schematic diagram)

#### System processes

本装置采用厌氧、好氧、接触氧化、微电解技术（又称电絮凝技术）和膜生物反应器（MBR）的处理原理来消解污水中的有机污染物质。MBR 能达到高效、彻底和干净地处理污水，使排放水满足IMO 新标准和其他更严厉的要求。其处理流程为：

The device uses anaerobic, aerobic, contact oxidation, micro-electrolysis technology (also known as electroflocculation technology) and membrane bioreactor (MBR) treatment principle to dissolve organic pollutants in sewage. The MBR enables the efficient, thorough and clean treatment of wastewater, enabling discharge water to meet new IMO standards and other more stringent requirements. Relevant flow of treatment is as follows.



厨房灰水、洗衣、洗浴灰水等船舶灰水从灰水入口进入灰水处理柜，灰水柜装置有微电解发生器，用来脱氮除磷，并带加热器，当油加热上浮后，利用油不导电而水导电的原理，由排油界面计控制实行自动排油功能。装置内含油由厨房水含油而定。正常厨房水含油被洗涤剂同化，从而装置内基本无油。

Ship grey water generated from kitchens, laundries and bath, etc. flows into the ash water treatment tank from a grey water inlet. The tank is equipped with a micro-electrolytic generator for nitrogen and phosphorus removal and a heater. After the oil rises due to heating, an oil discharge interface detector plays a role in controlling to realize the function of automatic oil discharge based on a principle that the oil is non-conducting while the water is conductive. The oil content of the device depends on the oil content of the kitchen water. Normal kitchen water contains oil and is assimilated by detergent, so that there is basically no oil in the device.

黑水通过黑水入口进入黑水处理柜，在黑水处理柜内悬挂有软性生物膜填料，具有吸附消解有机物功能的生物膜在水中自由飘动，大部分原生物寄居于纤维生物膜内，同样由于充氧的作用，有机物质进一步与生物膜接触氧化分解。如果停机一段时间再起动的話，由于生物膜中尚有细菌的孢子存活，因此比常规曝气法起动时间要快得多。同时软性填料像棉桃一样，营养过剩时会涨开，吸附过剩的污泥；营养差时会慢慢消化自己，又称“内源呼吸”，“棉桃”萎缩，等待食物。

The black water flows into a black water treatment tank via a black water inlet. Inside this tank, soft bio-membrane fillers are suspended. Bio-membranes functioning to adsorb and degrade organic matters float freely in water. A great majority of protobionts dwell in the fiber bio-membranes. Likewise, under the action of oxygenation, organic matters contact the bio-membrane giving rise to further oxygenolysis. If it is re-started after a period of shutdown, the start-up time is much shorter than that required by a conventional aeration method as spores of cells still survive in the bio-membrane. In addition, soft fillers can roll out like cotton bolls in a case

of overnutrition, to adsorb excessive sludge, while digesting themselves in a condition of poor nutrition, which is referred to as "endogenous respiration". As the "cotton boll" shrinks, it waits for food.

本装置采用序批次处理法，即所有泵和阀门动作受时间和液位控制。装置每个处理循环，黑灰水处理柜气泵A1 开68 分钟20秒后停转，在真空泵和传输泵都停止运行时，气泵A1再开启68 分钟20 秒……，进入下一个处理循环。电解膜柜气泵A2 开50 分钟，停38 分钟连续启动，待真空泵排水和传输泵补水结束后，重新计时，再开启50 分钟，停38 分钟……，进入下一个循环。污泥定期被粉碎提升泵返送到灰水处理柜内作为生化处理的菌种；传输泵P2在真空泵P3排水完毕后，自动将灰水处理柜和黑水处理柜内上清液驳入电解膜柜进行深度处理。

This device adopts sequential batch processing method, that is, all pump and valve actions are controlled by time and level. In each treatment cycle of the device, the black-gray water treatment tank A1 stops after running for 68 minutes and 20 seconds; when both the vacuum pump and the transmission pump both stop running, the air pump A1 restarts and keeps running for 68 minutes and 20 seconds ..., and thus the next treatment cycle begins. After the membrane air pump A2 has been initiated for 50 minutes and then shut down for 38 minutes, it begins to run continuously. Since the end of water discharge by the vacuum pump and water replenishing by the transmission pump, the timer is restarted to ensure that the membrane air pump runs for another 50 minutes and stops for another 38 minutes. Thus, the next cycle begins. The sludge is sent into the grey water treatment tank through a cutting pump and then serves as a microbial strain of biochemical treatment. After the water has been completely discharged by the vacuum pump, the transmission pump automatically sends supernatants in grey water and black water treatment tanks into the electrolysis membrane tank for in-depth treatment.

污泥排放周期视污水水质和负荷而定，一般6~9个月左右排放一次多余污泥是适当的。在正常运行状态下，从取样口用1000ml量筒取出含有悬浮物的液体，静止半小时后。如沉淀物界面超过50%时，此时应将污泥排入船厂提供的贮存柜或在公海时排放至舷外。

Inside the electrolysis membrane tank, not only is an electrolytic generator installed to further remove nitrogen and phosphorus and eliminate BOD and COD, but a submerged membrane module is provided. Meanwhile, as it participates in biochemical reactions through aeration, it is also referred to as membrane bioreactor (MBR). The membrane is made from hollow fiber ultra-filtration materials. Clean water penetrating through the membrane is pumped by the vacuum pump and then subjected to ultraviolet disinfection. In this way, it can meet emission standards and be permitted to be discharged overboard or into a clear water tank on board.

污泥排放周期视污水水质和负荷而定，一般6~9个月左右排放一次多余污泥是适当的。在正常运行状态下，从取样口用1000ml量筒取出含有悬浮物的液体，静止半小时后。如沉淀物界面超过50%时，此时应将污泥排入船厂提供的贮存柜或在公海时排放至舷外。

The sludge discharge cycle depends on the sewage quality and load, it is appropriate to discharge the residual sludge once 6 to 9 months. In normal operation, take out the liquid including suspended matters with the measuring cylinder of 1000ml from sampling outlet. Still for half an hour. If the sediment interface is over 50%, sludge should then be discharged into storage tanks provided by shipyards or discharged overboard in high seas.

### 3.2 主要配套件和功能 Main spare parts and functions

#### (1) 气泵 Air pump

气泵用于向装置供送压缩空气，提供菌种生化过程需要的溶解氧，本装置气泵配有两台泵，两者结构一样，功能类似。气泵A1主要是用来向黑灰水处理柜曝气，气泵A2主要是用来向电解膜柜曝



气。

An air pump is used to deliver compressed air to the device, and provide dissolved oxygen required by microbial strain dependent biochemical process. The air pump of this device is equipped with two pumps with the same structures and similar functions. Air pump A1 mainly functions to fulfill aeration for the black-gray water treatment tank, while air pump A2 plays a major role of aeration for the electrolysis membrane tank.

### (2) 粉碎排放泵和粉碎提升泵 Cutting discharge pump and cutting lift pump

粉碎排放泵P1和粉碎提升泵P4为带刀离心泵，在手动时可用于污水的粉碎，使打浆后的污水容易被分解；在气泵A2停曝期间，将污泥从电解膜柜返送灰水处理柜；在应急情况下，也可直接将污水排放至舷外。

The cutting discharge pump P1 and the cutting lift pump P4 are centrifugal pumps with knives, which can be used for the cutting of sewage when manually, so that the sewage after beating is easy to be decomposed; During the aeration shutdown of air pump A2, the sludge is returned from the electrolytic membrane tank to the ash water treatment tank; In case of emergency, sewage can also be discharged directly overboard.

### (3) 传输泵 Transmission pump

传输泵P2用来将黑水处理柜和灰水处理柜内的上清液转驳到电解膜柜内，进一步进行深度处理。

A transmission pump P2 is used to send supernatants in grey water and black water treatment tanks into the electrolysis membrane tank for further in-depth treatment.

### (4) 真空泵 Vacuum pump

真空泵P3具有较强的自吸能力，但正常运行时真空泵吸入管内最好不能脱水，以免下次启动困难。真空泵能在膜丝内外形成一定的压差，使水渗透过膜后排出。如果膜因污染堵塞，抽吸不畅，则排水量下降，最终造成装置高水位报警。

Vacuum pump P3 is a centrifugal pump with stronger ability of self-suction, but it is better to keep some water in the pipes to avoid the problem for restarting. It can create a certain difference pressure and make the water permeate the membrane. If the membrane is blocked for pollution and not suction smoothly, the discharge capacity will come down, and cause the equipment to alarm at high level.

### (5) 紫外线消毒器 (UV)

紫外线消毒器的消毒原理是利用其内部安装的紫外线灯发射的适当波长的紫外线破坏微生物机体细胞中的DNA(脱氧核糖核酸)或RNA(核糖核酸)的分子结构，造成生长性细胞死亡和(或)再生性细胞死亡，使大肠菌群符合排放标准。主要元件为紫外线灯管，如需维修时，请参阅《JX-UV型紫外线杀菌消毒器使用说明书》。定期检查您的杀菌器，以确保紫外线灯的正常运作。连续使用9000~10000小时后，应及时更换紫外线灯管，以确保高杀菌率。

The disinfection principle of the ultraviolet sterilizer is to destroy the molecular structure of DNA(deoxyribonucleic acid) or RNA(ribonucleic acid) in the cells of the microbial body by using the appropriate wavelength of ultraviolet light emitted by the ultraviolet lamp installed inside the device, resulting in growth cell death and/or regenerative cell death, so that coliform bacteria meet the emission standards. The main component is the ultraviolet lamp, if you need to repair, please refer to the "JX-UV type ultraviolet sterilization sterilizer manual". Check your sterilizer regularly to ensure that the UV lamp is working properly. After 9000~10000 hours of continuous use, the ultraviolet lamp should be replaced in time to ensure a high bactericidal rate.

### (6) 电解发生器 Electrolytic generator

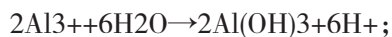
电解发生器(电絮凝装置)：通过其内部可消耗的极板及电流发生器来对流入装置的水体附加

电流,从而达到将水中的颗粒物凝结成絮状物沉淀的目的。在使用时电絮凝系统的极板浸没在电解膜柜的污水中,通过外部电源使电流通过极板导入水体,污水在电流的作用下将会发生一系列的电化学反应,不仅能去除BOD和COD,对氮和磷更有特殊的去除效果。电絮凝与传统的化学絮凝法相比,无需投加药品,运行维护费用低,处理效果稳定,不会造成水质和沉淀物的二次污染,是一项高效、环保的水处理技术。

Electrolytic generator (electric flocculation device): Water bodies flowing into the device are electrified by a dissolvable polar plate and a current generator inside it, to congeal particulates inside the water into floccules precipitated. In use, polar plate of the flocculation system is submerged into the sewage inside the electrolytic membrane tank and the current is led in water bodies by an external power source. As a result, the sewage suffers a series of electrochemical processes under the action of electric currents to remove BOD and COD as well as nitrogen and phosphorus removal. Comparing with conventional chemical flocculation methods, electric flocculation requires no dosage of chemicals, low operating maintenance cost and stable treatment effect. As no secondary pollution is incurred to water quality or sediments, it can be regarded as a high-efficient and environmental-friendly treatment technique.

①除磷:通常水中的磷以无机态的形式存在为主,当采用电絮凝技术除磷时,其原理是利用阳极材料在电解时生成的金属阳离子或其水合物与水中的磷酸盐形成沉淀而去除污水中的磷,在电絮凝过程中其原理如下:

Phosphorus removal: Usually, phosphorus in water exists mainly in the form of inorganic state. When phosphorus removal is adopted by electroflocculation technology, the principle is to use metal cation or its hydrate generated by anode material during electrolysis to precipitate with phosphate in water to remove phosphorus in sewage. Such a principle of electric flocculation can be expressed as follows.



根据长期的理论和实验证明,在水力停留时间为5~20 min的条件下,铝电极对磷质量浓度10~200 mg·L<sup>-1</sup>的污水的净化效果,结果表明去除率几乎可以全部达到80%以上。

As proven by relevant theories and experiments, phosphorus removal rate nearly reaches 80% and above in all cases under circumstances that hydraulic retention time lasts for 5–20 minutes and the mass concentration of aluminum electrode to phosphorus is 10–200 mg·L<sup>-1</sup>.

②脱氮:污水中的氮以有机氮和无机氮的形式存在于水溶液中,有机氮可以分为以溶解形式存在的有机氮(如尿素、氨基酸等)和非溶解形式存在的有机氮(污水中的含有机氮悬浮颗粒物等);无机氮又可以分为铵离子、硝酸盐、亚硝酸盐、溶于水的氨气和氮氧化合物等,且上述各种形态的氮在一定条件下,可以在水溶液中相互转化。实践证明,电絮凝技术对有机氮可以通过电极表面的吸附作用得到去除,另外还可以利用电絮凝氧化去除污水中的氨氮(铵离子、氨水、溶于水的氨气)和电絮凝还原去除污水中的硝酸盐、亚硝酸盐等无机氮。

Nitrogen removal: Nitrogen in sewage exists in aqueous solutions in forms of organic and inorganic nitrogen. While the former can be divided into organic nitrogen existing in a dissolved form and that in an insoluble form (suspended particulates containing organic nitrogen in sewage), the latter can be further classified into ammonium ions, nitrates, nitrites, water-soluble ammonia gas and oxynitrides, etc.. Moreover, above-mentioned nitrogen in various forms can be transitioned mutually in aqueous solutions in certain conditions. It has been found that electric flocculation technology can make use of absorption on the electrode surface to remove organic

nitrogen; besides, ammonia nitrogen (ammonium ions, ammonium water and water-soluble ammonia gas) is removed from sewage by electric flocculation oxidation. As for inorganic nitrogen such as nitrate and nitrite, it can be eliminated from sewage by electric flocculation reduction.

#### (7)电气控制箱

电气控制箱用以实现装置的自动控制、保护和程序控制的功能。

The electric box is provided with the function of electric operation, protection and procedure control for the equipment.

## Chapter 4 安装要求 Installation

### 4.1管系Pipes:

#### (1)污水入口管系Sewage inlet pipe:

从厕所来的黑水和洗衣、洗澡、厨房等处所的灰水各分成两路，一路至舷外，另一路进入本装置，其间用截止阀隔开，两个阀应尽量相近。

Black water generated from lavatories and grey water from laundries, bathing and kitchens, etc. can be divided into two flows. One is discharged overboard, while the other flow passes into the device. Moreover, they can be stopped with stop valves that are close to each other to the greatest extent.

#### (2)排放水管系Discharging water pipe:

粉碎排放泵吸入口同时与灰水处理柜、黑水处理柜，其间分别用球阀相隔。一般情况下，球阀V2、V3常开，V1、V4常闭。应急排空时，打开应急排放阀V1、V2、V4，关闭阀V3，可将经粉碎后的污水直接从排放泵出口排至舷外或国际通岸接头；合格水排放由真空泵排出。

The suction inlet of the crushing discharge pump is simultaneously separated from the gray water treatment tank and the black water treatment tank by ball valves. Under normal circumstances, ball valve V2, V3 normally open, V1, V4 normally closed. During emergency discharge, open the emergency discharge valve V1, V2, V4, and close the valve V3, and the crushed sewage can be discharged directly from the discharge pump outlet to the outboard or the international shore connection; Qualified water discharge from the vacuum pump.

**注意：安装合格排放水管时由排放水口接至舷外，舷壁应加装防浪止回阀，排放口管路往装置下走，排放水管应做成防倒虹管，防止污水从装置自流至舷外，排放口管路往装置上方，则不需要做防倒虹管。**

**Note:When a qualified discharge pipe is installed, it should be connected to the outboard by the discharge water outlet, the gunwale should be equipped with a wave check valve, the discharge pipe should go down the device, and the discharge pipe should be made into an anti-siphon to prevent the sewage from flowing from the device to the outboard, and the discharge pipe should go up the device, and the anti-siphon is not necessary.**

**(3)通气管系：**在装置顶部有一通气口，安装时用管道从装置通气口引出，通至上甲板高出甲板3米，并带有鹅颈弯管，管口加防火星网（船厂自配），经好氧分解的废气虽然不像一般贮存柜那样有恶臭和甲烷气体，但也应远离生活区或居室窗口。防火星网可根据装置通气口的大小选择相应的规格（具体请查询《船用管系附件》或征询本公司）。

**Transport pockets:** There is a ventage at the top of the paint. During installation, the transport pockets are extended to the upper deck 3 meters above the deck from its ventage by virtue of pipelines; it is equipped with a swan neck benttube the orifice of which is provided with a spark-proof mesh (provided by the shipyard). Al-

though the exhaust gas suffering aerobic decomposition is not as stink or contains methane gas as ordinary storage tanks, it should be discharged far away from living quarters or windows of living rooms. Specifications of the spark-proof mesh can be selected according to the size of the ventage (for details, please refer to Piping Accessories for Ship Use or consult us.

**注意：通气管应保持其畅通，不得有“盛水弯”，防止“盛水弯”积水堵塞管路。**

**Note: Transport pockets should not exist in pipe lines to prevent transport pockets blocking up pipe lines, In addition vent pipe should be smooth, can't be added any addendum.**

**(4)空气管系Air pipe:** 气泵A1的压缩空气通过V10、V12进入黑水处理柜曝气，通过V10、V11进入灰水处理柜曝气，气泵A2的压缩空气通过V14、V15、V16向电解膜柜内曝气。

The compressed air of air pump A1 enters the blackwater treatment tank for aeration through V10 and V12, enters the grey water treatment tank for aeration through V10 and V11, and the compressed air of air pump A2 enters the electrolytic membrane cabinet for aeration through V14, V15 and V16.

如某个气泵出现故障，需要维修时，可打开阀V13，然后关闭阀V10或V14，保持装置内部得到供气，防止装置长期缺氧出现危险。

If an air pump breaks down and requires repair, please open valve V13 and then close valves V10 or V14, keep air supply inside the device to prevent hazards from happening due to long-term oxygen deficit.

**(5)溢流管系Emergency overflow pipe:** 当装置出现故障（自动控制或高位报警失控等），不能将污水正常排出时，可通过电解膜柜上部的应急溢流口溢流至污水舱。电解膜柜上部的应急溢流口应用船厂提供的溢流管连接至舱底。

Water will overflow from the emergency outlet on the top of the settling tank when automatic control and high level warning are out of order and the troubles have not been resolved. The emergency outlet on the top of settling tank is connected to the bilge of the ship by overflow pipe. The emergency overflow pipe should be provided by ship.

**注意：溢流口应时刻保持畅通，不得外加任何附加物。**

**Note: Keep the overflow outlet unblocked. There couldn't be any accessories.**

**(6)冲洗水管Flushing water pipe:** 船上消防水系统应引一路至本装置冲洗水入口处供清洗柜子时使用，船厂应装截止阀，冲洗水压力不得大于0.3Mpa（建议压力为0.1Mpa），冲洗水尽量使用淡水。

One pipe of the fire fighting system on board should be connected to the flushing water inlet of the device for using when cleaning tank. The shipyard should install a check valve. The flushing water pressure can't be more than 0.3Mpa (usually is 0.1Mpa). Try to use fresh water as flushing water.

**(7)污泥排放管系Emergency discharging pipe**

应急排放管直接从粉碎排放泵出口接至舷外。

The emergency discharging pipe is connected to overboard through the outlet of cutting discharge pump.

## 4.2 安装Installations

(1) 本系列装置备有公共底座，用不同规格槽钢焊接而成，船厂自制的船舶基座与公共底座应相配，采用焊接或螺栓连接。若焊接，公共底座和船舶底座都应在四周连续满焊，保证足够强度；若

螺栓连接，连接螺栓数量应符合各型号装置底座螺栓孔实际数量。

The plant base is welded by channel steel, the connection between the ship base which is supplied by shipyard and the plant base should be welded or bolted. The weld length should be all around the ship base continuously with ship plate form. The bolt number has to meet the base drawing of each model of device.

(2) 装置安装处四周加围框，高约80毫米用以收集可能从泵轴处漏出的污水。船上自备潜水泵，可将漏出的污水泵入船上贮存柜。

The installation is surrounded by a frame, about 80 mm high, to collect sewage that may leak from the pump shaft. The submersible pump is provided on board to pump the leaking sewage into the storage tank on board.

(3) 电气控制箱外部接线完毕以后，应将机架接地。

Device should have electrical grounding connection after finishing connection of external wires of the electric control box;

(4) 装置附近应设有清洗用自来水龙头和洗手盆，还应有空间存贮化学药品，此外应保持干燥和远离可能发生爆炸的地方。

A running water tap and a washbasin for cleaning and a space for chlorine storage room should be provided. The space should be kept dry and far away from the place where an explosion may occur.

#### 4.3 电气Electricity

(1) 应连接AC380V、3 $\phi$ 、50Hz或船东特殊说明的电源，应保证接线填料函的密封。

An electric wire power supply of 3 phase, 380V, 50Hz should be connected into the electric control panel. The waterproof seal of wiring and connectors to the control box should be ensured. If the water pump rotates in the wrong direction, the two incoming wiring terminals should be exchanged with each other. Into the line should pay attention to the power supply phase sequence.

(2) 控制箱留有足够的维修空间，建议大约600毫米。

A place for installation with a minimum of 600mm free clearance in front of the control box to allow for maintenance should be provided.

## Chapter 5 操作说明 Operation Instructions

### 5.1 电控箱控制面板功能 The functions of electric control box control panel

#### (1) 粉碎排放泵P1转换开关S1

##### (1) Change-over switch S1 of cutting-emptying pump P1

粉碎排放泵P1转换开关S1有三个位置：自动、手动和停止。

Change-over switch S1 of cutting-emptying pump P1 has three positions for automatic operation, manual operation and stop.

①当S1转向“手动”位置时，粉碎排放泵P1连续运转，可以循环粉碎污水；

If S1 turns to the position of "manual" operation, the cutting-emptying pump P1 runs continuously to smash sewage in a cyclic manner;

②当S1转向“自动”位置时，粉碎排放泵P1在每个处理循环开始时，运行2分钟后停止，当黑水柜液位低液位或者高液位时，粉碎排放泵P1不运行。

If S1 turns to the position of "automatic" operation, the cutting-emptying pump P1 runs for 2 minutes and then stops when each treatment cycle begins; in the case that liquid level in the black water tank is at the lowest or highest position, the cutting-emptying pump P1 stops running.

③当S1转向“停止”位置时，粉碎排放泵P1停止运行。

If S1 turns to the position of "stop", the cutting-emptying pump P1 stops running.

#### (2) 传输泵P2转换开关S2

##### (2) Change-over switch S2 of transmission pump P2

传输泵P2转换开关S2有三个位置：自动、手动和停止。

Change-over switch S2 of transmission pump P2 has three positions for automatic operation, manual operation and stop.

①当S2转向“手动”位置时，传输泵P2连续运转；

If S2 turns to the position of "manual" operation, the transmission pump P2 runs continuously;

②当S2转向“自动”位置，传输泵P2在电解膜柜液位到达低位L3（真空泵P2停止运行）时，自动启动向电解膜柜补水，直到电解膜柜液位到达高位H3或黑水处理柜低于低位L2、灰水处理柜低于低位L1时停止；

If S2 turns to the "automatic" position, when the liquid level of the electrolytic membrane cabinet reaches the low level L3 (vacuum pump P2 stops running), the transmission pump P2 will automatically start to refill water to the electrolytic membrane cabinet until the liquid level of the electrolytic membrane cabinet reaches the high level H3 or the blackwater treatment cabinet is lower than the low level L2 and the gray water treatment cabinet is lower than the low level L1;

③当S2转向“停止”位置时，传输泵P2停止运行。

If S2 turns to the position of "stop", the transmission pump P2 stops running.

#### (3) 真空泵P3转换开关S3

##### (3) Change-over switch S3 of vacuum pump P3

真空泵P3转换开关S3有三个位置：自动、手动和停止。

Change-over switch S3 of vacuum pump P3 has three positions for automatic operation, manual operation and stop.

①当S3转向“手动”时，真空泵P3连续运行；

If S3 turns to the position of "manual" operation, the vacuum pump P3 runs continuously;

②当S3转向“自动”时，真空泵P3在处理循环的第75分钟时启动，到电解膜柜低位L3时停止；

If S3 turns to the position of "automatic" operation, the vacuum pump P3 starts at the 75th minute of the treatment cycle and stops at the low level L3 of the electrolytic film cabinet;

③当S3转向“停止”位置时，真空泵P3停止运行。

If S3 turns to the position of "stop", the vacuum pump P3 stops running.

#### **(4)粉碎提升泵P4转换开关S11**

##### **(4) Change-over switch S11 of cutting-lift pump P4**

粉碎提升泵P4转换开关S11有三个位置：自动、手动和停止。

Change-over switch S11 of cutting-lift pump P4 has three positions for automatic operation, manual operation and stop.

①当S11转向“手动”位置时，粉碎提升泵P4连续运转，可以提升电解膜柜内沉淀的污泥。

If S11 turns to the position of "manual" operation, the cutting-lift pump P4 runs continuously to lift the sediment sludge in the electrolytic membrane cabinet.

②当S11转向“自动”位置时，粉碎提升泵P4在第68分钟时，自动返送污泥20秒到灰水处理柜。

If S4 turns to the position of "automatic" operation, the cutting-lift pump P4 automatically delivers the sludge back to the grey water treatment tank for 20 seconds at the 68th minute of its running.

③当S11转向“停止”位置时，粉碎提升泵P4停止运行。

If S11 turns to the position of "stop", the cutting-lift pump P4 stops running.

#### **(5)黑灰水柜气泵A1转换开关S4**

##### **(5) Change-over switch S4 of black-gray water tank air pump A1**

黑灰水柜气泵A1转换开关S4有三个位置：自动、手动和停止。

Change-over switch S4 of black-gray water tank air pump A1 has three positions for automatic operation, manual operation and stop.

①当S4转向“手动”位置时，黑灰水柜气泵A1连续运行；

If S4 turns to the position of "manual" operation, the black-gray water tank air pump A1 runs continuously;

②当S4转向“自动”位置时，黑灰水柜气泵A1开68分钟20秒，在传输泵提升污水至电解膜柜停止运行时，黑灰水柜气泵再开启68分钟20秒……，进入下一个处理循环；

If S4 turns to the position of "automatic" operation, the black-gray water tank air pump A1 is started for 68 minutes and 20 seconds and then stops; when the transmission pump lifts sewage to electrolytic film cabinet, the black-gray water tank air pump A1 is restarted for 68 minutes and 20 seconds, where the next treatment cycle begins.

③当S4转向“停止”位置时，污水柜气泵A1停止运行。

If S4 turns to the position of "stop", the sewage tank air pump A1 stops running.

#### **(6)电解膜柜气泵A2转换开关S5**

##### **(6) Change-over switch S5 of Electrolytic film cabinet air pump A2**

①当S5转向“手动”位置时，电解膜柜气泵A2连续运行；

If S5 turns to the position of "manual" operation, the electrolytic film cabinet air pump A2 runs continuously;

②当S5转向“自动”位置，电解膜柜气泵A2开50分钟，停38分钟后一直开启，待真空泵排水和传输泵补水结束或等第二次计时，重新计时，再开启50分钟，停38分钟……，进入下一个循环；

If S5 turns to the position of "automatic" operation, the air pump A2 of the electrolytic membrane cabinet starts for 50 minutes, stops for 38 minutes, and then starts all the time. After the vacuum pump drains and the transmission pump replenates water, or the second time is timed, start again for 50 minutes, stop for 38 minutes....., enter the next cycle;

③当S5转向“停止”位置，电解膜柜气泵A2停止运行。

If S5 turns to the position of "stop", the electrolytic film cabinet air pump A2 stops running.

#### (7) 电加热器转换开关S6

##### (7) Change-over switch S6 of electric heater

①当S6转向“手动”位置时，电加热器连续运行加温；

If S6 turns to the position of "manual" operation, the electric heater runs continuously for heating;

②当S6转向“自动”位置，电加热器受液位控制和温度计控制。当柜内液位低于低液位L1、L2，电加热器停止工作。当柜内液位高于低液位L1、L2，电加热器受温度控制器控制，低温15℃启动，高温25℃停止；

If S6 is turned to the "automatic" position, the electric heater is controlled by the level control and the thermometer. When the liquid level in the cabinet is lower than the low level L1 or L2, the electric heater stops working. When the liquid level in the cabinet is higher than the low level L1, L2, the electric heater is controlled by the temperature controller, low temperature 15℃ start, high temperature 25℃ stop;

③当S6转向“停止”位置，电加热器停止运行。

If S6 turns to the position of "stop", the electric heater stops running.

#### (8) 电动阀DV2、DV3、DV4转换开关S7、S8、S9；DV1无开关控制受油水界面控制；

**(8) Change-over switches S7, S8 and S9 of solenoid valves DV2, DV3 and DV4; DV1 switchless control is controlled by oil-water interface;**

三个电动阀DV2、DV3、DV4分别由转换开关S7、S8、S9控制，都具有自动、手动、停止功能，正常状态都处于“自动”，当测试或需要手动时，可分别转向“手动”。

Change-over switches S7, S8 and S9 are controlled by solenoid valves DV2, DV3 and DV4 respectively; and each of them is provided with functions of automatic operation, manual operation and stop. In normal cases, they are all automatic. When testing or manual is required, you can turn to "manual" respectively.

电动阀DV1自动：到达灰水处理柜液位触点时自动开启排油（因水导电而油不导电）；

DV1 automatic: It automatically opens to discharge oil (as water is electrically conductive, while oil is non-conducting) when the liquid level reaches a liquid level contact in the gray water treatment tank;

电动阀DV2、DV3自动：电解膜柜液位低于L3时两个阀自动打开，传输泵P2延迟1分钟开启，向电解膜柜补水，当电解膜柜液位到达高位H3时，两个阀自动关闭或者灰水处理柜液位先低于低位L1时，DV2关闭，黑水处理柜低于低位L2时，DV3关闭；

DV2 and DV3 automatic: When the liquid level of the electrolytic membrane cabinet is lower than L3, the two valves will automatically open, and the transmission pump P2 will be delayed for 1 minute to open, and the



water will be supplied to the electrolytic membrane cabinet. When the liquid level of the electrolytic membrane cabinet reaches the high H3, the two valves will automatically close, or when the liquid level of the gray water treatment tank is lower than the low L1 first, DV2 will close, and when the blackwater treatment tank is lower than the low L2, DV3 will close.

电动阀DV4自动：电解膜柜液位到达H3时，自动开启向灰水处理柜回流浮沫5分钟后关闭，进行再处理。

DV4 automatic: When the liquid level of the electrolytic membrane tank reaches H3, it will automatically open the reflux floating foam to the ash water treatment tank and close it after 5 minutes for reprocessing.

### (9) 紫外线灯转换开关S10

#### (9) Change-over switch S10 of ultraviolet lamp

①当S10转向“手动”位置时，紫外线连续运行；

If S10 turns to the position of "manual" operation, the ultraviolet lamp turns on continuously;

②当S10转向“自动”位置，紫外线在一个处理循环的第71分钟时启动，到电解膜柜低于低位L3时，延迟20秒停止；

If S10 turns to the position of "automatic" operation, the UV started at the 71st minute of a treatment cycle, and stopped 20 seconds later when the electrolytic membrane cabinet was lower than the low L3.

③泵和紫外线指示灯：当黑灰水柜气泵A1、膜柜气泵A2、粉碎排放泵P1、粉碎提升泵P4、传输泵P2、真空泵P3、紫外线灯正常工作时，指示灯分别亮。

Bump and ultraviolet indicator light: When the black-gray water tank air pump A1, membrane tank air pump A2, crushing discharge pump P1, crushing lift pump P4, transmission pump P2, vacuum pump P3, and ultraviolet lamp work normally, the indicator light is on respectively.

#### (10) 指示灯Indicator light

①控制电源和综合报警指示灯：装置接上电源和装置发生故障综合报警时，指示分别灯亮。

Control power and comprehensive alarm indicator light: When the device is plugged in and the device is alarming for the fault, the indicator will be bright.

②电动阀指示灯：当DV1、DV2、DV3、DV4四个电动阀正常工作时，电动阀指示分别灯亮。

Indicator light of solenoid valve: When the four solenoid valves DV1, DV2, DV3 and DV4 are all in normal working status, the indicator light of solenoid valve will be bright.

③泵和紫外线指示灯：当黑灰水柜气泵A1、膜柜气泵A2、粉碎排放泵P1、粉碎提升泵P4、传输泵P2、真空泵P3、紫外线灯正常工作时，指示灯分别亮。

Bump and ultraviolet indicator light: When the black-gray water tank air pump A1, membrane tank air pump A2, crushing discharge pump P1, crushing lift pump P4, transmission pump P2, vacuum pump P3, and ultraviolet lamp work normally, the indicator light is on respectively.

④液位控制指示灯：当装置液位分别达到灰水处理柜的低液位L1、中液位M1、高液位H1；黑水处理柜的低液位L2、中液位M2、高液位H2；电解膜柜的低液位L3、中液位M3、高液位H3时，指示灯分别亮。

Liquid level control indicator light: When liquid level of the device reaches low position L1, middle position M1 and high position H1 inside the gray water treatment tank, or low position L2, middle position M2 and high position H2 of the black water treatment tank, or low position L3, middle position M3 and high position H3

of the electrolytic membrane tank, the indicator light turns on.

### 5.2 正常运行前的准备 The preparation before normal work

(1)检查电气控制箱电源是否符合设计要求，合上电源开关和各分开关，检查泵转向是否正确，如不对，应进行调整。

Check the power of electric box to see whether it complies with the design requirements; Check the rotation direction of all pumps, which should be adjusted as incorrect. Engage or turn on the power switch and all sub-switches.

(2)装置启动前，打开灰水处理柜和黑水处理柜冲洗水口外接冲洗水球阀向装置内灌清水至中水位M1、M2，检查柜体、阀门和管系附件是否有渗漏。检查无渗漏后，把V1、V2、V4阀打开，将粉碎排放泵开关打到“手动”排放黑水和灰水柜液位到L1、L2灯灭。

Before the device is started, open the rinse water nozzles of the gray water and black water treatment tanks, and connect them to the rinse water ball valve externally to fill the device with clean water up to middle positions M1 and M2; in this way, the tanks, valves and piping accessories can be checked to define leakage or not. After checking that there is no leakage, open the V1, V2 and V4 valves, and turn the switch of the cutting discharge pump to the "manual" discharge black water and ash water tank level until the L1 and L2 lights are off.

### 5.3 “培菌”操作 Breeding bacteria

新装置必须在进行“培菌”后，方可处理原污水。（培菌温度在20℃~25℃为最佳）低于5℃需加温。

The new plant should have the "breeding bacteria" procedure before raw sewage treatment. (Incubation temperature of 20℃~25℃ is the best) below 5℃ need to be warmed.

粉碎排放泵P1转换开关S1、粉碎提升泵P4转换开关S11、传输泵P2转换开关S2、真空泵P3转换开关S3、污水柜风机A1转换开关S4、膜柜风机A2转换开关S5、电动阀DV2、DV3、DV4转换开关S7、S8、S9、紫外线灯转换开关S10转向“停止”位置，电加热器转换开关S6转向“自动”位置，手动关闭阀V1、V2、V3、V4、V7、V8、V9、V13、V17、V18，打开黑水柜灰水柜连通阀V5、V6、打开气源阀V10、V11、V12、V14、V15、V16。此时，装置完全由人工控制，需要仔细监视。

Change-over switch S1 of cutting-emptying pump P1, change-over switch S11 of cutting-lift pump P4, change-over switch S2 of transmission pump P2, change-over switch S3 of vacuum pump P3, change-over switch S4 of sewage tank air pump A1, Change-over switch S5 of membrane tank air pump A2, change-over switches S7, S8 and S9 of solenoid valves DV2, DV3 and DV4, and change-over switch S10 of ultraviolet lamp turn to the position of stop, while change-over switch S6 of electric heater turns to the position of "automatic" operation, valves V1, V2, V3, V4, V7, V8, V9, V13, V17 and V18 are closed manually; intercommunicating valves V5 and V6 of the black water treatment tank, and its air supply valves V10, V11, V12, V14, V15 and V16 are open. In this case, the device is manually controlled entirely, requiring meticulous monitoring.

打开黑水入口阀，让黑水缓慢流入，当装置内液位到达M2时关闭。然后打开V2、V3，将粉碎排放泵P1转换开关S1转向“手动”，将污水在曝气柜内循环粉碎10分钟后关闭。将黑灰水柜气泵A1转换开关S4转向“手动”，A1气泵连续运行，对污水进行“闷曝”培菌3-4天。根据污水浓度，可向装置内适当添加营养物质，如化肥、面粉、葡萄糖等。4天后，将黑灰水柜气泵A1转换开关S4转向“停

止”，关闭阀V3、打开阀V4，将粉碎排放泵P1转换开关S1转向“手动”，向舷外排放少量的污水（开启5~10秒），直至液位低于L2时停止，关闭阀V4，打开阀V3，将粉碎排放泵P1转换开关S1转向“停止”。如上所述，再次进入原污水，如此反复操作，对菌种进行培养。原污水培菌需要根据原污水有机物含量、含盐度、新鲜度来决定培菌时间长短，一般淡水30天~40天，海水60天~80天，如能加入“种泥”菌种可缩短培养时间。

Open the black water inlet valve, let the black water slowly flow in, and close when the liquid level in the device reaches M2. Then turn on V2 and V3, turn the conversion switch S1 of the crushing discharge pump P1 to "manual", and shut down the sewage after circulating and crushing in the aeration cabinet for 10 minutes. Turn the A1 transfer switch S4 of the black ash water tank air pump to "manual", and the A1 air pump will run continuously, and the sewage will be "smothered" for bacteria cultivation for 3-4 days. According to the concentration of sewage, nutrients can be added to the device, such as fertilizer, flour, glucose, etc. 4 days later, turn the black ash water tank air pump A1 transfer switch S4 to "stop", close the valve V3, open the valve V4, turn the pulverized discharge pump P1 transfer switch S1 to "manual", discharge a small amount of sewage overboard (open for 5-10 seconds), and stop until the liquid level is below L2, close the valve V4, open the valve V3. Turn the pulverized discharge pump P1 changeover switch S1 to "Stop". As mentioned above, the original sewage is re-entered, and so repeated operations are performed to culture the bacteria. Raw sewage bacteria cultivation needs to be based on the raw sewage organic content, salinity, freshness to determine the length of culture time, generally fresh water 30 days to 40 days, seawater 60 days to 80 days, if you can add "seed mud" bacteria can shorten the culture time.

可以用1000ml量筒从曝气柜取样口取出1000ml污水，观察活性污泥的培养状态如何。静止沉淀20~30分钟后，污泥沉降体积如能达到1/3即30%，污泥的形态正常了，培菌过程就完成了，污泥的形态为棉絮状，沉淀后的水为透明色。

1000ml sewage can be taken out from the sampling port of the aerator with 1000ml measuring cylinder to observe the culture state of activated sludge. After 20 to 30 minutes of static precipitation, if the sludge settling volume can reach 1/3 (30%), the shape of the sludge is normal, the cultivation process is completed, the shape of the sludge is wadding, and the water after precipitation is transparent.

#### 5.4正常运行Normal operations

(1)手动打开阀V2、V3、V5、V6、V7、V8、V9、V10、V11、V12、V14、V15、V16、V17,关闭V1、V4、V13、V18,将粉碎排放泵P1转换开关S1转向“自动”位置。

Open valves V2, V3, V5, V6, V7, V8, V9, V10, V11, V12, V14, V15, V16 and V17 manually; close valves V1, V4, V13 and V18; and turn change-over switch S1 of cutting-emptying pump P1 to the position of "automatic" operation.

(2)将粉碎提升泵P4转换开关S11转向“自动”位置。

Turn change-over switch S11 of cutting-lift pump P4 to the position of "automatic" operation.

(3)将传输泵转换开关S2转向“自动”位置。

Turn change-over switch S2 of transmission pump to the position of "automatic" operation.

(4)将气泵A1转换开关S4转向“自动”位置，气泵A1向黑灰水处理柜供气。

Turn the air pump A1 changeover switch S4 to the "automatic" position, and the air pump A1 supplies gas

to the black-gray water treatment tank.

(5)将气泵A2转换开关S5转向“自动”位置，气泵A2向电解膜柜供气。

Turn change-over switch S5 of air pump A2 to the position of "automatic" operation, so that the air pump A2 can supply air to the electrolytic membrane tank.

(6)将紫外线UV开关、各电动阀(DV1~DV4)转换开关转向“自动”位置。

Turn UV switch and change-over switches of solenoid valves DV1-DV4 to the position of "automatic" operation.

(7)将真空泵P3转换开关S3转向“自动”位置，真空泵按时间运行，第75分钟自动定期排放电解膜柜内污水，液位低于底水位L3时停止。

Turn change-over switch S3 of vacuum pump P3 to the position of "automatic" operation, so that the vacuum pump can run by time, discharge sewage inside the electrolytic membrane tank at the 75th minute automatically and regularly, and stop when the liquid level is below the bottom water level L3.

(8)常开黑水和灰水入口阀，让污水缓慢流入装置。

Black water and gray water inlet valves should be normally on, so that the sewage can flow into the device slowly.

(9)手动调节真空泵的进出口阀V17的开度，按本说明书第2部分各型号装置标定的平均负荷（见7.4(4)表格中装置各型号正常使用时的流量计读数）控制排放流量，如太高会引起跨膜压差太大；太小会引起水位超高。

Manually adjust opening of terminal valve V17 of the vacuum pump; and control the discharge flow according to the average load marked on devices of various models as specified in Part 2 of this Instruction Book (see flow meter readings for devices of various models during normal running presented in Table 7.4(4)); while excessive flow gives rise to over-large transmembrane pressure, too small flow causes super-high liquid level.

**注意：**

**Notes:**

①V4阀除了应急排放时打开，正常情况下必须关闭，平常不得误操作打开此阀！

Except for emergencies, valve V4 must be closed in normal conditions; in usual times, please do not open it by misoperation!

②真空泵P3在运转时，电解膜柜必须供气。水位低于L3时，不得启动P3！

The electrolytic membrane tank must have air supply when the vacuum pump P3 is running; in case that the liquid level is below L3, please do not initiate P3!

③膜不能在原污水内工作！！！！

The membrane cannot be put into service in raw sewage!!!

④如果装置长时间运行后，积累的食物残渣太多，可以打开阀V1、V4，使用粉碎排放泵P1手动模式循环粉碎灰水处理柜中食物残渣；同理可利用阀V2、V3和粉碎排放泵P1手动循环粉碎黑水处理柜内粪便。（此方法在装置使用6个月后，每1个月开启1次）

If the device runs for a long time, too much food debris can be accumulated inside; in this case, please open valves V1 and V4 to smash food debris in the gray water treatment tank cyclically in a manual mode by virtue of the cutting-emptying pump P1; likewise, valves V2 and V3 together with the cutting-emptying pump P1 can be used to smash faeces inside the black water treatment tank manually and cyclically. (This method is turned on

once every 1 month after the device has been used for 6 months)

⑤黑灰水柜气泵A1和电解膜柜气泵A2，转换开关必须转向“自动”。任一开关关闭程序就会乱。

Black grey water tank air pump A1 and electrolytic film tank air pump A2, the transfer switch must be turned to "automatic". Any one of those switches turns the program off.

### 5.5综合报警Comprehensive alarm

当装置内液位到达高位H1、H2任意一个位置时，装置将发出高位报警，并将报警信号远传至集控台，提醒船员暂停冲洗厕所，如长期高位，操作人员应至现场检查。当出现泵过载，PLC故障，电絮凝断电影响装置运行的情况下，装置停止运行，并远传报警信号至集控台，操作人员应至现场检查。

When the liquid level in the device reaches any position of high H1 and H2, the device will issue a high alarm, and the alarm signal will be transmitted to the centralized control console to remind the crew to suspend flushing the toilet, such as long-term high, the operator should go to the scene for inspection. When the pump overload, PLC failure, electric flocculation power failure affects the operation of the device, the device stops running, and remote alarm signal to the centralized control console, the operator should go to the site inspection.

### 5.6公海排放

#### 5.6 High sea procedure

在公海或非规则海区，按国际公约规定离陆地12海里，可以排放未经处理的污水。用以下操作方法：

Untreated sewage may be discharged on the high seas or in irregular sea areas, 12 nautical miles from land in accordance with international conventions. Use the following methods:

打开阀V1、V4、V7、V8、V9，关闭V3、V5、V6。将粉碎排放泵P1转换开关S1转向“手动”，粉碎提升泵P4转换开关S11转向“手动”，向舷外排放经过生化处理的污水，当电解膜柜液位低于低位时，把粉碎提升泵P4转换开关S11转向“停止”，当黑水处理柜和灰水处理柜液位低于低位时，把粉碎排放泵P1转换开关S1转向“停止”，此法可延长膜组的使用。

Open the valve V1, V4, V7, V8, V9 and close the valve V3, V5, V6. Turn the crushing discharge pump P1 transfer switch S1 to "manual" and the crushing lift pump P4 transfer switch S11 to "manual" to discharge the biochemical treated sewage overboard. When the level of the electrolytic membrane tank is lower than the low level, turn the crushing lift pump P4 transfer switch S11 to "stop". When the level of the black water treatment tank and gray water treatment tank is lower than the low level, By turning the conversion switch S1 of the crushing discharge pump P1 to "stop", this method can extend the use of the membrane group.

此方法只能手动操作。（每天需操作3~4次）

This method can only be done manually. (3~4 times a day)

### 5.7 污泥排放

(1)在正常运行状态下，从黑水柜取样口用1000ml量筒取出含有悬浮物的液体，静止30min后，如沉淀物界面超过50%时，此时应将黑水柜多余污泥排放至舷外（离岸12海里）或排入船厂提供的贮存柜。检查污泥浓度需要每星期进行一次。

Under normal operation, the liquid containing suspended matter should be removed from the sampling port

of the black water tank with a 1000ml measuring cylinder. After standing still for 30min, if the sediment interface exceeds 50%, the excess sludge of the black water tank should be discharged overboard (12 nautical miles offshore) or into the storage tank provided by the shipyard. Check the sludge concentration once a week.

(2)排放污泥时，先关闭阀V3、V5，打开阀V2、V4，粉碎排放泵P1转换开关S1转向“手动”位置，将黑水处理柜内污泥排去，待液位低于L2时，粉碎排放泵P1转换开关S1转向“停止”位置；接着关闭阀V2，打开阀V1，粉碎排放泵P1转换开关S1转向“自动”位置，将灰水处理柜内污泥排去，待液位低于L1时，粉碎排放泵P1转换开关S1转向“停止”位置。

When discharging sludge, first close the valve V3 and V5, open the valve V2 and V4, and turn the conversion switch S1 of the crushing discharge pump P1 to the "manual" position to discharge the sludge in the black-water treatment cabinet. When the liquid level is lower than L2, the conversion switch S1 of the crushing discharge pump P1 to the "stop" position; Then close the valve V2, open the valve V1, crushing discharge pump P1 transfer switch S1 turn to the "automatic" position, the sludge in the gray water treatment cabinet is discharged, when the level is lower than L1, crushing discharge pump P1 transfer switch S1 turn to the "stop" position.

(3)污泥排放周期一般为6~9个月左右，且一定要在公海内排放，所以当船舶航行于公海时，测定污泥沉淀物超过30%时，可以将污泥排去一些，排至黑水柜低位L2灯灭。（使用公海模式）

The sludge discharge cycle is generally about 6 to 9 months, and must be discharged in the high seas, so when the ship is sailing on the high seas, when the sludge sediment is more than 30%, the sludge can be discharged to the low level of the black water tank L2 light off. (Using open sea mode).

(4)《MARPOL73/78公约》允许在距陆地3海里外排放经消毒处理过的污水，在距陆地12海里外排放原污水。在码头上或有污水接收船时，可通过通岸接头排放污泥。

The MARPOL73/78 allows to discharge the macerated and disinfected sewage outside 3 nautical miles from land and the raw sewage outside 12 nautical miles from land. When in a harbor, or where has recycle vessel, the sludge can be discharged by shore connection.

### 5.8停机

如打算长期不使用装置（>3个月），应关闭黑水和灰水进口阀，将柜内污水排空，打开冲洗水进口阀，使用清水对柜体进行冲洗2次，通过打开V1、V2、V4及泵将水排空，或直接打开放泄螺栓将水排空。最后切断电源。再使用时需要重新培菌。

If you do not intend to use the device for a long time (> 3 months), you should close the black water and gray water inlet valve, drain the sewage in the cabinet, open the flushing water inlet valve, flush the cabinet with clean water twice, and empty the water by opening V1, V2, V4 and the pump, or directly open the drain bolt to drain the water. Finally cut off the power. Re-culture is required for reuse.

**Chapter 6 常见故障及排除 Common failures and trouble shooting**

序号 No.	故障 Trouble	可能原因 Possible cause	排除方法 Suggestion
1	黑水处理柜H2高位报警 灰水处理柜H1高位报警 Full level alarm for black water treatment tank at H2 Full level alarm for gray water treatment tank at H1	检查厕所用厕情况，可能瞬即用厕高峰。 Check conditions of lavatories since there may exist an instantaneous lavatory need peak	暂时停用厕所 Temporarily using the toilet
		传输泵排放管路不畅 Discharge pipe blockage of the transmission pump	检查传输泵管路和传输泵 Check the transmission pump and its piping
2	电解膜柜H3高位报警 Full level alarm for electrolytic membrane tank at H3	看流量计，如在额定流量以上，可能瞬即用厕高峰。 Read the flow meter, if below rated flow capacity, may caused by block of discharge pipe	暂时停用厕所 Temporarily using the toilet
		看流量计，如在额定流量以下，可能排放管路不畅 Read the flow meter, if below rated flow capacity, may caused by membrane pollution	检查出口管路和真空泵 Check outlet piping and the vacuum pump
		看流量计，如在额定流量以下，则可能膜污染。 Read the flow meter, if below rated flow capacity, may caused by membrane pollution	清洗膜 Cleaning membrane
3	气泵声音异常 (如用CYBW型) (e.g., CYBW type) Voice of air pump is abnormal	出口阀未开。 The outlet valve is not opened	打开出口阀 Open the outlet valve
		气泵滑片磨损。 Slide vane is damaged	换滑片或换泵 Replace the slide vane or replace the air pump
4	真空泵声音异常 Voice of vacuum pump is abnormal	吸入不畅。 Suction is not smooth	检查管路 Check the control circuit
		无水，可能膜污染。 Anhydrous, may caused by membrane fouling	清洗膜 Clean the membrane
5	紫外线灯不亮 UV-lamp is not lighting	灯管损坏。 UV-lamp is broken	换灯管 Replace the lamp
6	装置运行不正确 Wrong operation of device	各开关位置与泵和阀的开关情况不符合 The procedure switch position is not comply with the condition of valve switch	仔细阅读说明书 Read the procedures carefully in manual book
7	出水水质不佳 Water quality is not qualified	活性污泥不好 Activated sludge is not enough or qualified	培菌 Breeding bacteria
		膜寿命到了 The membrane is out of order	换膜 Replace membrane

## Chapter 7 维护保养 Maintenance

### 7.1 粉碎排放泵和粉碎提升泵 Cutting discharge pump and cutting lift pump

#### (1) 用途 Purpose:

粉碎泵安装在装置前方，用于循环粉碎黑水柜内的污水，也可排放本体各腔污泥，此泵具有粉碎的功能，在公海排放和应急排放时可使用粉碎排放泵。

The cutting pump is installed in front of the device, which is used for circulating and cutting the sewage in the blackwater cabinet, and can also discharge the sludge in each chamber of the body. The pump has the function of cutting, and the cutting discharge pump can be used in the discharge of the high seas and emergency discharge.

#### (2) 运行和保养 Operation and maintenance

①如果发现泵有泄漏，应及时停机检查，关闭阀门，以免烧坏电机，必要时更换密封圈。泵正常运转时密封圈泄漏量应小于10ml/h。

If the pump is found leaked, it is needed to stop and check, close valves in order to avoid causing electrical burn. Replace a new seal ring when necessary. When the pump is working normally, the leakage of sealing ring should be less than 10ml/h.

②应定期（1个月）通过泵体上的加油杯注入钙钠基润滑脂至泵的轴封之间，以便润滑油封及轴衬。

It needs to put calcium-sodium base grease into the place between shaft seals of pump through the oil cup on the pump so as to lubricate oil seal and bushing.

③泵长时间不用，应拆下清洗干净，并注意拆装时机械密封圈两密封面不得碰损。装回时应涂上适量润滑油，妥善保存。

When the long period of time without using, it is needed to remove it to clean. When removing, please don't damage the two sealing faces of mechanical seal ring. Please coat a right amount of lube oil when reassembling and keep it somewhere safe.

④泵不得空运转，以免烧坏密封圈。

The pump can't idle run in order to avoid burning out the seal ring.

### 7.2 气泵 Air pump

黑灰水柜气泵A1，电解膜柜气泵A2

Black-gray water tank air pump A1, electrolytic film cabinet air pump A2

CYBW型气泵，则结构、功能和运行维护如下：

CYBW type air pump, the structure, function and operation maintenance are as follows:

#### (1) 结构 Structure :

气泵本体及其驱动电机安装在一公共底座上，其间由联轴节相连，气泵转子采用两端支撑结构，电动机风扇起到良好冷却作用。

The air pump body and its motor are fixed on a common base, a coupling connects them. The rotor of the air pump has a supporting connection at both ends. The fan of the motor cools the device.

#### (2) 运行和维护 Operation and maintenance:



①气泵应布置在清洁、通风和室温环境。

The air pump should be installed in a stable location in a clear well ventilated and room temperature environment.

②滑片材料为自润滑材料，所以泵内禁止水或油等液体吸入。

The sliding vane is made of self-lubricating material and no oil is required for the pump.

③应经常保持空气吸入滤器及滤网的清洁，每二个月应清洗一次。

The air pump filter and the filter element should be kept clean, clean them once every two months.

④每半年应拆洗气泵一次，清洗滚珠轴承后应用N0.2或N0.3 钙基油脂或膨润土油脂注入,如转子运转故障,则应清洗或更换之,滑片如有损坏则应更换,保持其性能良好,在更换滑片时应注意以下几点:

Clean and reassemble the air pump once every 6 months. Inject No.2 or No.3 calcium grease or bentonite grease into the rolling bearing after cleaning. If the rotor operates ineffectively, replace it or clear it. Replace the sliding vane if it is damaged. Pay attention to the following notes when replacing the sliding vane.

1) 小心碰断滑片,新更换的滑片边缘应倒角,滑片的斜角应安置在转子槽的外侧,其方向应与转子外径圆弧一致。

Take care not to break the sliding vane. The edge of new sliding vane needs to be chamfered. The bevel edge of the sliding vane needs to be arranged outside the rotor groove and its direction need to be same as the circular of outside diameter of the rotor.

2) 不要损伤或磨擦机械表面,不要让灰尘进入气泵。

Do not touch the machined surface and do not allow dirt or debris to enter into the air pump.

3) 气泵内表面应用干净的布清洁。

Clear inside surface of the air pump with a clean dry cloth.

4) 贮存仓库期间应采取防锈和防潮处理。

When the plant is stored, the pump shall be kept from rust and moisture.

### 7.3电气控制箱Electric control box

注意: 维护保养时, 要保证外部船舶供应装置电源开关处于“断开”位置,控制箱内主电源断路器处于“断开”位置。

Warning: During maintenance, ensure that the power switch of the external ship supply device is in the "off" position and the main power circuit breaker in the control box is in the "off" position.

#### (1)拆卸Removal

在拆卸某几个电气元件时不必将整个电气控制板拆下来。

检查某个电气元件时应该先拆去接线,注意电线上的标记和代号,在必须拆下电气元件时才取下该电气元件。

Replacement of control box components does not require removal of entire panel.

When checking the components and removing wires, pay attention to the mark and code of wire for reassembly.

#### (2)再装配Reassembly

当必须更换某个损坏的电气元件时,应参照电气原理图及原来的接线编号连接电线,只有当确认接线无误后才可以合闸通电试验。

When it is necessary to replace damaged parts or reassemble components, refer to the electrical principle diagram. Ensure that the wiring is correct before turning the circuit breaker to ON.

## 7.4 膜组 Membrane module

### (1) 膜的存放 The storage of membrane

如果船舶长期停留寒冷地区，装置所处温度在 $0^{\circ}\text{C}$ 以下时，应对膜采取如下防冻措施：配20~60%（体积百分比）的乙二醇作为防冻剂，其冰点为 $-49^{\circ}\text{C}$ ，灌进电解膜柜，此防冻剂对膜和塑料没有损伤，浓度愈大，结冰点愈低。

If the vessel should stay in a cold area for a long time and the device is in a place where is lower than  $0^{\circ}\text{C}$ , please do the following anti-freezing measures: Mix ethylene glycol of 20~60% as antifreeze solution whose freezing point is  $-49^{\circ}\text{C}$ . Pour it into membrane tank. The antifreeze solution has no damages for membrane and plastic. The higher the concentration is, the lower the freezing point becomes.

注意：本装置电解膜柜内存有水，不能在 $0^{\circ}\text{C}$ 以下运行、运输和存储，若在 $0^{\circ}\text{C}$ 以下要有防冻措施。膜分开保存例外！

Warning: The membrane modules can't function in subzero water. And they also can't be placed in an environment of subzero temperature except being stored separately when transiting or storing the plant.

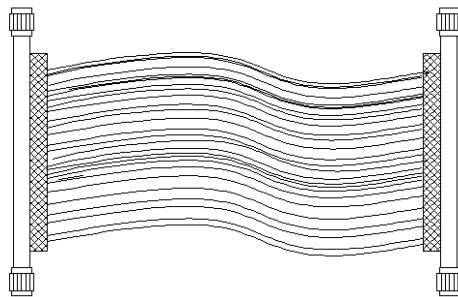
### (2) 膜组件的结构、安装 The structure and installation of membrane module

#### ① 膜组件（以下称膜片）结构：

Membrane module (hereinafter called MBR-module) structure:

本系列装置采用KH-MBR-16、32型膜片，其结构示意图如下：

There is KH-MBR-16.32 type piece in SWCM type STP. It's diagram of structure size as follows:



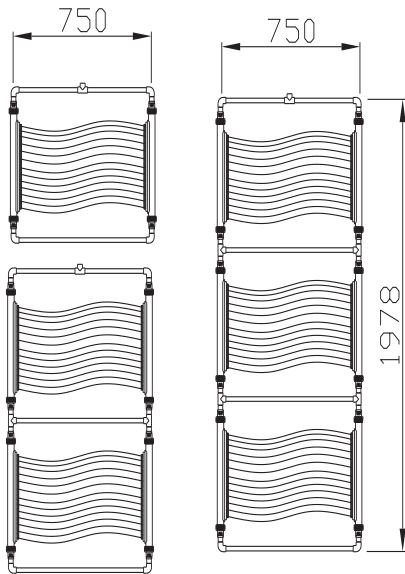
膜片外形图

#### ② KH-MBR型膜片的连接方式

KH-MBR type MBR-module connection manner

在实际使用过程中，KH-MBR型膜片可以根据需要以单片、多片为一组，作为一个单元，固定在电解膜柜内的膜架上。在本系列装置中，采用了1片、或2片、或3片连接为一组，它们的连接方式和尺寸见附图。在使用过程中，膜丝与生化池内的液面呈平行状态。

In normal use, KH-MBR type MBR-module can be combined one group with single piece, two pieces or three pieces as required, and fixed on membrane shelves in the biochemical treatment tank. This system is designed to use a single or a two piece connection for a group. Please see the attached diagram for the connections



and dimensions. In the process of usage, membrane threads should be paralleled with the level of biochemical treatment tank.

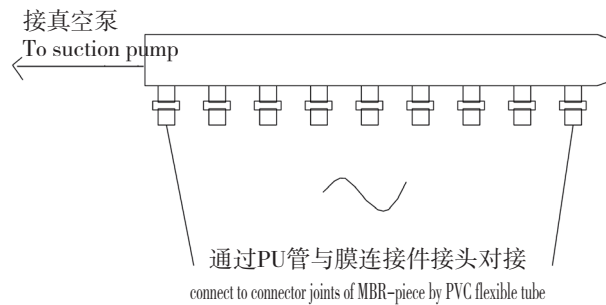
### ③膜片集水管 Water collection pipe of MBR-module

膜片安装在电膜柜内固定的膜架上，所有膜片的出水口并联接到一根出水管上，称为集水管。集水管上根据膜组的数量，安装了相应的接口。集水管和真空抽吸泵连接，膜片出水通过真空抽吸泵抽吸出水。

All outlets of MBR groups are connected in parallel to an outflow pipe, which is called “water collection pipe”. The number of joints on water collection pipe is decided by the number of MBR groups. Connect the water collection pipe to the vacuum pump; the effluent from MBR-module is discharged through the pump.

膜片连接件的气密接头和收集管的气密接头之间用PU软管连接。

The seal connector joints of membrane module and water collection pipe are connected by PU flexible tube.



### ④膜片的安装步骤和注意事项 Installation steps of MBR-module and related items

1) 在更换新膜片时，须在电膜柜中固定好膜片机架，防止振动，摇晃。

Fix the bracket of MBR-module in membrane tank first, when replacing the membrane, to prevent vibration and shaking

2) 向黑水处理柜中注入待处理的污水，按照活性污泥生化处理方法，驯化和接种污泥。

Inject sewage to be treated into the black water treatment tank; perform sludge acclimation and seeding based on biochemical treatment method for activated sludge.

3) 待污泥培养活性比较好，沉降比为20~30%时，污水才可以进电膜柜。(培菌)

When sludge breeding activity is rather satisfactory and has a settling ratio of 20-30%, the sewage can flow into the electrolytic membrane tank.(culture)

4) 膜片的安装按照前述组装方式，接好各膜片之间的活接和连接件。在安装时，注意放置密封垫圈，并把活接旋紧。

Connect the loose joints between MBR-plates after the installation of MBR-plates according to the assembly methods as above-mentioned. Please pay attention to place sealing gaskets and seal up the loose joints.

5) 膜组连接好了后, 顺着膜片机架的插槽, 将膜组插入膜插槽内, 最后将膜组出水口和集水管的接口连接上。

After the MBR module groups are connected well and slid into the channels of membrane module bracket, connect the effluent outlet of MBR module groups to the connector joint of the water collection pipe.

6) 为了防止膜片在电解膜柜曝气时浮起来, 膜片应安装牢固。

In order to prevent the diaphragm from floating during aeration of the electrolytic membrane cabinet, the diaphragm should be firmly installed.

7) 在膜片调试出水时, 先通过集水管的预留孔注入水, 直到真空泵内注满水, 即可启动真空泵抽吸出水。

In case that water is discharged from the membrane during debugging, please inject water through a pre-formed hole in the collector pipe until the vacuum pump is full of water inside, where the vacuum pump can be initiated to pump effluent.

8) 膜片安装完成后必须确保所有膜丝浸没水中, 防止膜片失水。

The membrane threads should be submerged in the water, to prevent the MBR-module from losing water.

9) 在安装膜片之前检查一下包装箱, 看看密封袋是否破裂, 如果膜片的保护液留失干了后, 需要按下述方法重新处理, 或请咨询有关技术人员。

Please check the packing container of the modules before installation, to see whether the airproof bag is broken. If seal is broken or the protective solution is missing, the MBR-module will require re-treatment or consult the relevant technician.

### (3)膜使用注意事项Matters needed attention when using membrane

①本公司提供给客户的产品是已经经过亲水化处理的产品, 装在MBR反应器内后可以直接使用。

The products provided to our clients have been pretreated, and can be used directly after being installed in the MBR reactor.

②为了节约膜的使用寿命, 操作使用得当可有较大裨益。在公海和非规则海区, 污水还是海洋生物的营养物质, 大海有一定的自净的能力, 可使用本装置的“公海排放”操作对污水进行处理, 这样可延长膜的使用寿命。

In order to save the service life of the film, proper operation and use can be of great benefit. In the high seas and irregular sea areas, the sewage is still the nutrients of Marine life, the sea has a certain self-purification ability, can use the device's "high seas discharge" operation to treat the sewage, so as to extend the service life of the membrane.

③在正常运行时, 电解膜柜的污水来自黑水处理柜和灰水处理柜上层污水, 一般不会有大的固体颗粒, 对膜的损伤较小, 在使用冲洗水对电解膜柜进行清洗时, **冲洗水尽量使用淡水, 海水清洗会对膜渗透增加负担。**

In normal running, sewage in the electrolytic membrane tank is derived from the upper sewage inside the black water and gray water treatment tanks and contains no large solid particulates generally. Therefore, it causes minor damages the membrane. When rinse water is used to clean the electrolytic membrane tank, **please try fresh water to the greatest extent as cleaning with sea water may make it more difficult for membrane permeation.**

### (4)膜的清洗Membrane cleaning

本装置对膜通量的设计有足够的余量，而且装置采用了电絮凝技术，预计膜的寿命在5-10年左右，因此我们不建议用户进行化学清洗，如果几年后当装置膜通量显著下降时只需要用户购买电解配件来替换装置损耗的电极即可。但是如果用户不想更换电极，需要自行清洗，仅在排放流量下降至70%并且调整真空泵进口调节阀V17开度后，流量计读数无明显变化时，对膜组进行化学清洗。

The device has sufficient margin for the design of membrane flux, and the device adopts electric flocculation technology, which is expected to have a membrane life of about 5-10 years, so we do not recommend users to carry out chemical cleaning, if a few years later when the membrane flux of the device significantly decreases, only the user needs to buy electrolytic accessories to replace the electrode loss of the device. However, if the user does not want to replace the electrode, it is necessary to clean it by itself, and only when the discharge flow rate drops to 70% and the opening of the vacuum pump inlet regulator V17 is adjusted, the flow meter reading does not change significantly, the chemical cleaning of the membrane group is performed.

流量计读数Flow meter reading (数据供参考, 非绝对值Data for reference, not absolute value) :

项目Items 型号Type	正常使用时流量计读 (LPM) Flow meter reading (LPM)	膜需清洗时流量计读数 (LPM) ≤ When the membrane need to clean reading of the flow meter (LPM) ≤
SWCM(E)-20	3.5	2.5
SWCM(E)-25	4.3	3
SWCM(E)-30	5.3	3.7
SWCM(E)-40	7	4.9
SWCM(E)-50	8.6	6
SWCM(E)-60	10	7.2
SWCM(E)-80	14	9.6
SWCM(E)-100	18	12
SWCM(E)-120	21	15
SWCM(E)-150	26	18
SWCM(E)-200	34	23
SWCM(E)-250	42	29
SWCM(E)-300	53	37
SWCM(E)-400	70	49

同上，本装置采用电絮凝技术，对膜有保护作用，膜通量不易下降，如长期使用后船东需要自行清洗，则清洗时仅需要用2-3%左右的NaOH溶液将膜片浸泡2小时，除去附着在膜片表面的有机物和胶体物质，再用清水对膜片进行冲洗，膜片通量即可恢复。如果膜片使用的当地水质硬度高的话，也可以结合酸洗的方法对膜片进行浸泡清洗。配置1-2%的盐酸溶液，浸泡2小时后，取出，用清水冲洗干净。

As described above, electric flocculation technology selected for the device plays a role in protecting the membrane and makes it less likely for membrane flux to drop. If it needs to be cleaned after long-time service by the ship owner itself, please immerse the membrane in NaOH solution with a concentration of about 2-3% for 2 hours, eliminating organic and colloidal matters on the membrane surface; then, the membrane can be cleaned with water to restore its membrane flux. If water hardness is high locally, please immerse and clean the membrane in combination with acid cleaning methods. Prepare 1-2% hydrochloric acid solution, immerse for 2 hours

and take out to be washed out with clean water.

此项工作要求操作人员在清洗过程中要十分小心，以免弄断膜丝。

The operators should very be careful in the cleaning process, to prevent the membrane thread from being broken.

加药用量Please use chemicals according to instruction book (数据供参考，非绝对值Data for reference, not absolute value) :

项目Items 型号Type	电解膜柜有效容积(L) Volume of membrane tank(L)	2%NaOH (kg)	备注
SWCM(E)-15	1177	2.35	
SWCM(E)-20	1540.8	3.08	
SWCM(E)-25	2059.2	4.12	
SWCM(E)-30	2587.2	5.17	
SWCM(E)-40	3195	6.39	
SWCM(E)-50	3888	7.78	
SWCM(E)-60	4406.4	8.81	
SWCM(E)-80	5896.8	11.8	
SWCM(E)-100	6552	13.1	
SWCM(E)-120	7607.6	15.2	
SWCM(E)-150	10221.2	20.4	
SWCM(E)-200	12604.8	25.2	
SWCM(E)-250	18648	37.3	
SWCM(E)-300	26136	52.3	
SWCM(E)-400	1177	2.35	

以上方法清洗完毕后，如产水量还是严重不足时，就必须更换膜片。

After several kinds of cleaning above mentioned, if the water discharging quantity isn't enough, please replace the membrane.

**注意Warning:**

1, 不要将下列物品与次氯酸钠中溶液混合以及接触：润滑油脂、柴油、机油、溶剂、酸、碱、肥皂制品、油漆制品、厨房用化学品醋；泔脚；饮料；松节油；脏油加丝等。如与这类化学品混合或接触，含氯消毒剂将会引起剧烈为燃烧。Do not mix up bleaching powder near other substances such as grease, oil, lubricating oil, solvent, acid, alkali, soap, paint, home products, garbage, beverage, pine oil, dirty rags etc. If the powder is mixed up with these materials, it may cause fire that might be severe.

2, 防止任何热的或燃烧物质与次氯酸钠接触，如点燃的香烟。Prevent any hot or burning substance such as lit cigarette from falling into the vessel of the bleaching powder.

3, 如果发生火灾，必须用大量水浇灭和冷却周围环境。If the powder catches, pour the water into it and spray the surrounding area with water.

4, 不要让次氯酸钠接触人眼、皮肤或衣服，否则可能引起化学燃烧，吃入口中会发生很大的危险。

Do not touch eyes, skin, mucus membranes or clothes with bleaching powder otherwise it could cause severe chemical burns. If bleaching powder is swallowed, it may have deadly consequences.

5, 小心地安放容器，不要跌落、滚动或拖滑，保持朝上安放位置。

Be careful to place the vessel containing bleaching powder. Don't drop it, roll it or spill it. Keep it vertical.

6, 在添加次氯酸钠粉时必须保持手的干燥, 清洁, 戴橡皮手套用金属器皿, 如果散落, 可能引起火灾。Use the bleaching powder only with clean dry rubber gloves or metal ware. Any contamination can cause a fire.

7, 万一发生次氯酸钠粉散落, 必须用大量水冲洗干净。

Use large quantity of water to deal with the spilling bleaching powder. If the leftover bleaching powder in the vessel needs scouring, large quantity of water is needed to wash them into appropriate treatment system.

解毒方法Antidote:

外部: 用大量水冲洗皮肤或眼睛15分钟, 如果皮肤灼烧, 应立即医疗处理, 如果眼睛灼烧应立即请外科医生处置。

External: If exposed use large quantitative of clean water to rinse skin or eyes for 15 min. If pain persists, consult a doctor. If you get the chemical in your eyes, consult an ophthalmologist immediately.

内部: 饮大量水或牛奶, 然后吃镁盐泻药, 蔬菜油或鸡蛋, 对于眼睛立即请外科医生。

Internal: drink large quantities of water or milk, milk of magnesia, vegetable oil or egg and go to the internal medical department for emergency.

## 7.5 电极的更换

### 7.5 Electrode replacement

SWCM (E) 型装置灰水处理柜和电解膜柜内的电极原重量如下表所示。

装置每运行半年, 拆下各柜体内的电极称重, 如重量消耗至原重量的20%时, 需进行更换。

Original weights of electrodes inside gray water treatment tank and the electrolytic membrane tank of SWCM(E) type devices have been shown in the table below.

After the device has been put into operation for half a year, please disassemble electrodes inside various tanks to weight them; if the weight declines to 20% of its original value, please replace the electrode.

(数据供参考, 非绝对值Data for reference, not absolute value)

型号 Models	灰水处理柜 Gray water treatment tank		电解膜柜 Electrolytic membrane tank	
	电极重量 (kg) Electrode weight (kg)	需要更换时电极重量 (kg) ≤ Weight of electrodes to be replaced ≤	电极重量 (kg) Electrode weight (kg)	需要更换时电极重量 (kg) ≤ Weight of electrodes to be replaced ≤
SWCM(E)-20	21.49	4.3	26.86	5.37
SWCM(E)-25	21.49	4.3	32.97	6.59
SWCM(E)-30	32.24	6.45	40.3	8.06
SWCM(E)-40	32.24	6.45	53.73	10.7
SWCM(E)-50	48.36	9.67	65.94	13.2
SWCM(E)-60	48.36	9.67	78.15	15.6
SWCM(E)-80	64.48	12.9	105	21
SWCM(E)-100	85.97	17.2	134.3	26.9
SWCM(E)-120	107.5	21.5	158.7	31.7
SWCM(E)-150	129	25.8	195.4	39.1
SWCM(E)-200	171.9	34.4	256.4	51.3
SWCM(E)-250	214.9	43	317.5	63.5
SWCM(E)-300	268.6	53.7	403	80.6
SWCM(E)-400	322.4	64.5	537.3	107

## 7.6 柜体、膜组冲洗

### 7.6 Tank and membrane module cleaning

装置首次清水动作试验，长期不运行，以及对膜组进行清洗时，都需通过装置冲洗水口向柜体内注入冲洗水，冲洗水来自船上压力水柜，压力不超过0.5MPa，在注入冲洗水时，必须有操作人员观察装置内液位，当液位超过任一柜体的高液位时，必须立即停止向柜体内注入冲洗水。

Regarding first clean water operation test, long-term idling or membrane module cleaning, rinse water should be injected into the tank through a rinse water nozzle in the device. The rinse water is taken from a pressure tank onboard with the pressure no more than 0.5MPa. During rinse water injection, an operator must be appointed to observe liquid level in the device. As soon as the liquid level exceeds a high liquid level of a tank, rinse water injection should be stopped immediately.

## 7.7 灰水柜排油和毛发过滤器

### 7.7 Grey water tank drain and hair filter

#### (1) 工作原理

#### (1) Operating principle

本装置利用油与水的密度的不同，通过电加热器，在停留时间适当的情况下，使油上浮，水沉淀，从而达到撇油的目的。当液位到达排油液位时，因为油和水的导电率不同，排油阀自动打开排油。

Based on the difference in densities of water and oil, the device is used to make oil floating and water settling by an electric heater under the circumstance of a proper retention time, so as to realize the purpose of oil removal. When the liquid level reaches that for oil removal, the oil draining valve opens automatically to remove oil as water and oil have different electric conductivity values.

#### (2) 毛发过滤器

#### (2) Hair filter

##### ① 结构 Structure

见本体图，毛发过滤器由不锈钢滤网、精密过滤器等组成。

See the diagram.

##### ② 工作原理 Operating principle

本装置利用不锈钢滤网、精密过滤器过滤毛发，防止毛发缠绕在膜上，影响膜通量。

The device makes use of stainless steel filter screen and precision filter to filter the hair, prevent the hair from winding around the membrane which may affect the membrane flux.

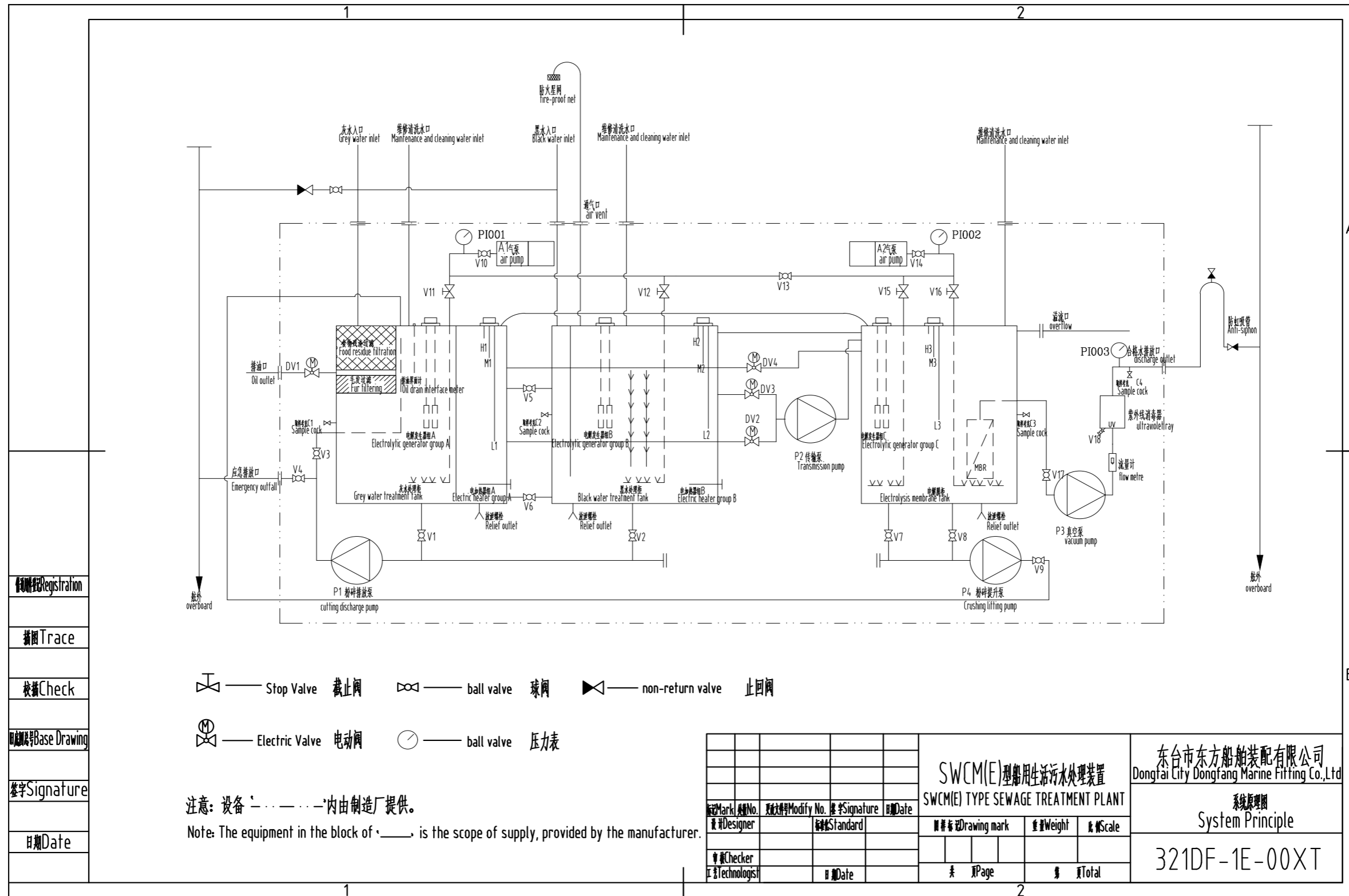
##### ③ 操作须知 Operating instruction

用户必须每个月清洗一次毛发过滤器，防止毛发过滤器堵塞。

The hair filter must be cleaned once every month to prevent blockage.



系统原理图 System Principle



注册 Registration
绘图 Trace
校核 Check
审核 Base Drawing
签字 Signature
日期 Date

- Stop Valve 截止阀
- ball valve 球阀
- non-return valve 止回阀
- Electric Valve 电动阀
- ball valve 压力表

注意: 设备 '-----' 内由制造厂提供。  
 Note: The equipment in the block of '-----' is the scope of supply, provided by the manufacturer.

SWCM(E) 型船用生活污水处理装置				东台市东方船舶装配有限公司	
SWCM(E) TYPE SEWAGE TREATMENT PLANT				Dongtai City Dongfang Marine Fitting Co., Ltd	
图号 Mark No.	更改次 Modify No.	签字 Signature	日期 Date	系统原理图	
设计 Designer	标准 Standard	图样号 Drawing mark	重量 Weight	System Principle	
审核 Checker	日期 Date	表 页 Page	第 页 Total	321DF-1E-00XT	