ULTRA-FLO®

膜生物反应器

Ultra-Flo Pte Ltd

452 Tagore Industrial Avenue
Singapore 787823
Tel: +65 6457 7733
Fax: +65 6457 7517
info@ultra-flo.com.sg
www.ultra-flo.com.sg

MEMBER Water Quality ASSOCIATION

Ultra-Flo

The 'Know-how' in Water Treatment

背景信息

- 从 20 世纪初期，活性污泥法作为生物处理开始应用于工业和城市废水处理和再循环工艺。
- 生物降解工艺被设计成积累氧化有机物和矿物污染物的微生物。它的处理效率与反应器内生物团的浓度和微生物具体的转化率有关。
- 100 年后，传统的活性污泥法没有突破性的进展。直到最近几年，膜生物反应器以其可靠、小巧和良好的出水品质成为一种更经济的方法。

膜生物反应器

定义：

- 膜生物反应器有生物降解和膜分离两部分组成，用于生物降解悬浮固体颗粒和微生物经膜组件与出水分离的工艺。

常规操作：

- 原水经生物反应池与生物团接触(厌氧池或曝气池)后在一定的压力下被泵打入过滤膜中过滤。滤水被排放使用而全部被截留的生物团被送回生物反应池。为了保持稳定的污泥龄，剩余污泥会定期排出。膜要定期清洁和反冲洗，或化学清洗，或两者兼用。全部的微生物被限制在反应系统内，以保证有效的停流时间和降解效率。
- 全部的微生物被限制在反应系统内，以保证有效地控制反应池微生物(污泥龄)停留时间和出水杀菌。

Ultra-Flo

The 'Know-how' in Water Treatment

膜生物反应器的长处

相对于其他生物处理法的优点：

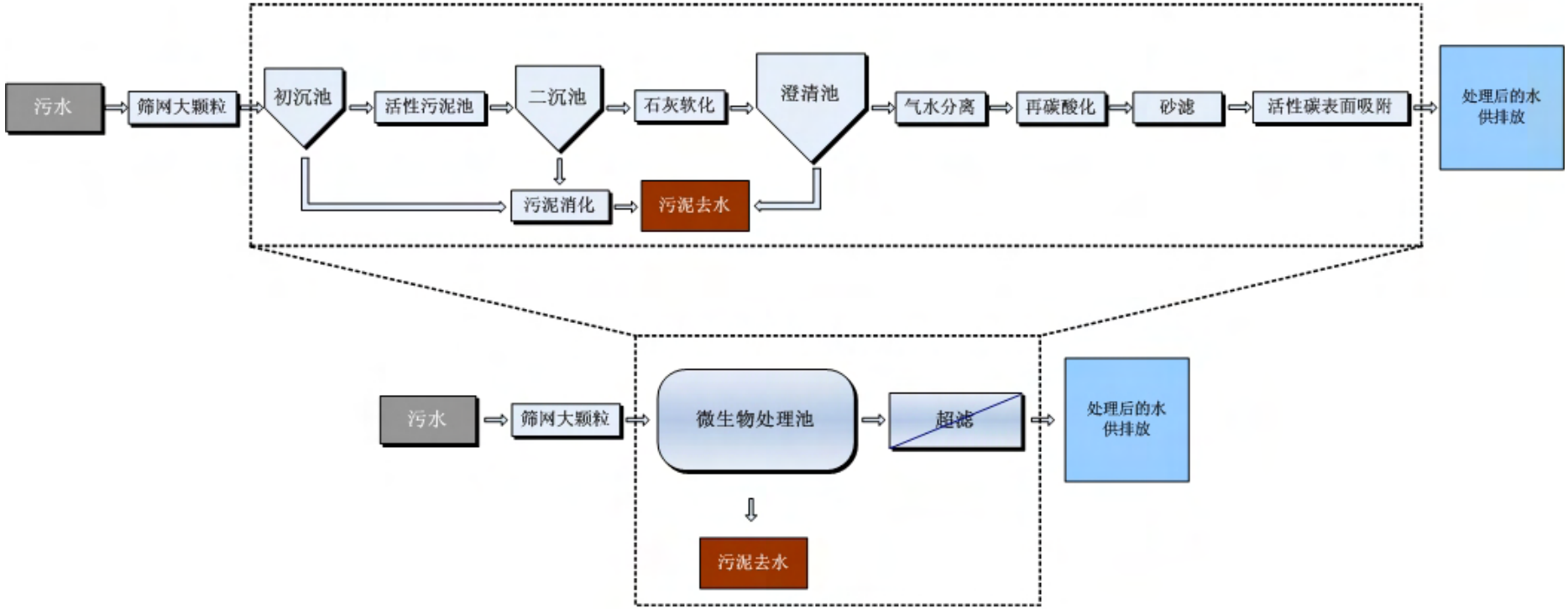
- 生物降解和出水杀菌合二为一
- 水力停留时间和污泥停留时间的完全分离，可提供生物反应最优化控制和更灵活更可靠的应用
- 具有缓解水力负荷和有机物负荷变化的特点
- 全面控制污泥龄对慢速生长的微生物(如硝化细菌)的发展是很重要的
- 工艺强化通过提高生物团的浓度
- 比其他生物处理法的污泥产量低
- 占用土地更少而处理高强度的废水

Ultra-Flo

The 'Know-how' in Water Treatment

水处理工艺流程图

传统活性污泥工艺



膜生物反应器工艺

Ultra-Flo Pte Ltd

452 Tagore Industrial Avenue
Singapore 787823
Tel: +65 6457 7733
Fax: +65 6457 7517
info@ultra-flo.com.sg
www.ultra-flo.com.sg

Ultra-Flo

The 'Know-how' in Water Treatment

**上面替代的工艺适应于处理工业和城市污水*

ULTRA-FLO® 膜生物反应器

- 高效低压超滤减少膜表面污染
- 设计紧凑，体积小
- 低造价和低运行成本
- 无异味
- 无需化学药剂
- 高负荷处理能力
- 低或没有污泥产生
- 完全去除固体颗粒
- 在一个膜组件内能同时去除 COD 、固体颗粒和微生物营养物质等组成的混合物更多的处理能力
- 无污泥膨胀问题
- 低氧操作
- 启动系统快
- 更容易改进模式

Ultra-Flo

The 'Know-how' in Water Treatment

ULTRA-FLO® 膜生物反应器

侧流系统相对于浸没式生物膜的优点

- 没有小气泡扩散维护
- 更轻易地用化学药剂清洗膜，而不需干扰生物反应
- 没有多余的移动，如此中空纤维在过滤过程中受到承载更少
- 没有多余的移动，因此中空纤维在过滤过程中受到承载更少
- 能更轻易有效地控制膜装置的周围环境
- 在较小的占地面积，较少的膜表面积上产生更多的透水量

Ultra-Flo

The 'Know-how' in Water Treatment

Ultra-Flo® 膜生物反应器侧流系统对比一览表

表1膜生物反应器设计描述：沉浸式和侧流式系统 (数据来源：Stephenson [1]和Judd[2])					Ultra-Flo
	单位	板框式	中空纤维	平板	平板
膜组件类型		平板	成捆	管状	中空纤维
透水量	$L/h.m^2$	15-15	20-30	70-100	20-30
建议**MLSS**污泥浓度	gMLSS/L	10-15	10-15	15-30	8-15
氧气占膜体积百分比	%	30-100	10-40	External set-up	External set-up Dead End
能量消耗 （只包括膜系统）	kWh/m^3	0.3-0.6	0.3-0.6	2-10	0.3-0.6
费用	$-/m^2$	High	Medium	Very High	Low
pH 范围	-	1-12	2-11	1-13	2-11
耐温能力	°C	<60°C	<40°C	<100°C	<40°C

Ultra-Flo

The 'Know-how' in Water Treatment

ULTRA-FLO® 膜生物反应器市场目标

适用于废水日产量 100 - 1000m^3 的处理和再循环：

- 高 BOD 和 COD 的工业污水：
  - 皮革厂
  - 屠宰厂
  - 食品厂
  - 药厂
- 垃圾填埋场
- 再浓缩的城市废水
- 小型工业用地
- 酒店及旅游胜地
- 公寓
- 偏僻的居民地区

Ultra-Flo

The 'Know-how' in Water Treatment

ULTRA-FLO® 实验项目

地点	：	勿洛废水处理厂
验收期	：	2004 年 5 月开始
实验项目	：	废水回收项目
		超滤膜系统 $8m^3/hr$，98% 回收率
		纳滤膜系统 $4m^3/hr$，75% 回收率
进水	：	初级生活污水出水
目的	：	降低 BOD 和 COD 以达到排放标准再循环污水用于非饮用公共用水

Ultra-Flo

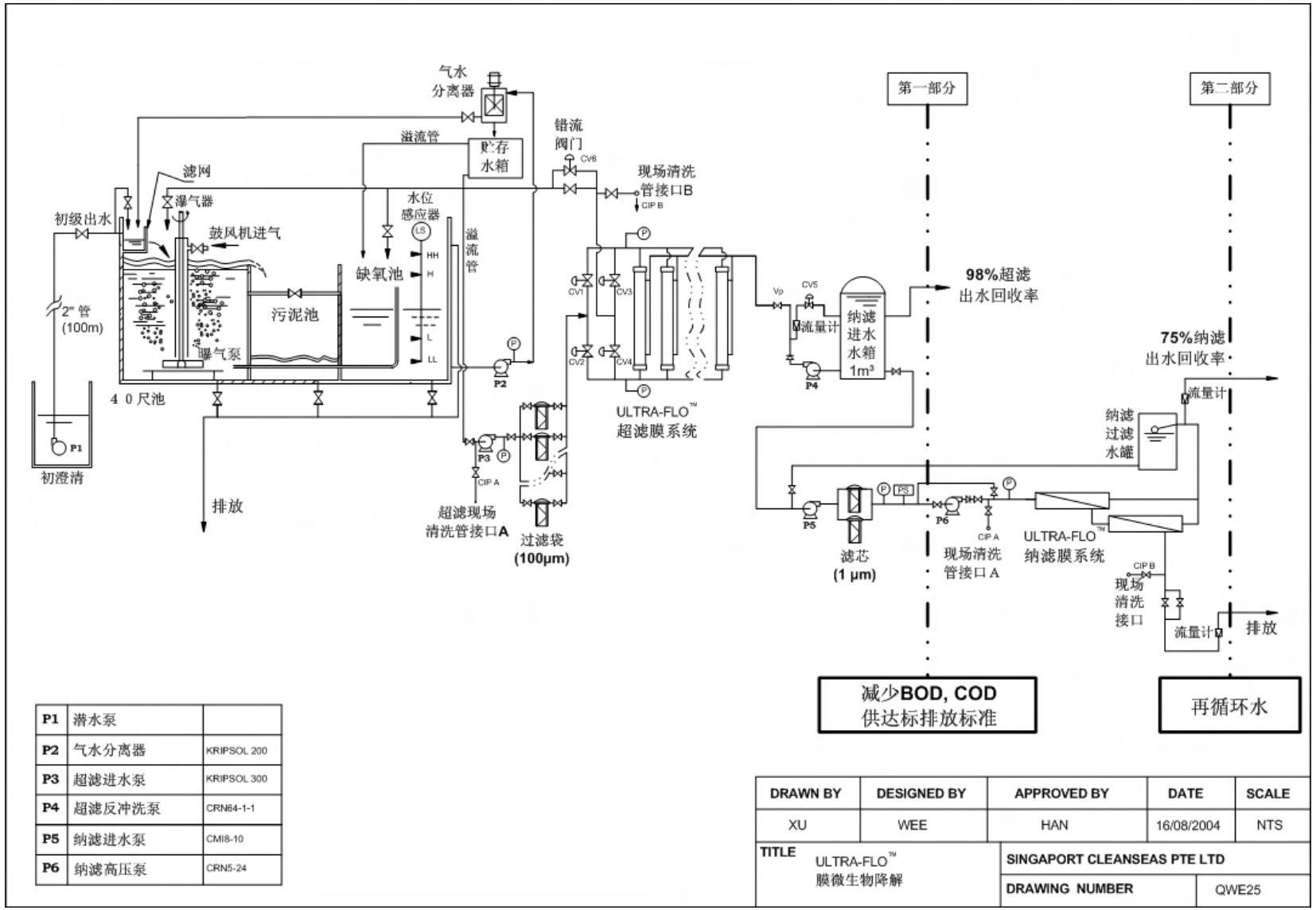
The 'Know-how' in Water Treatment

ULTRA-FLO® 勿洛膜生物反应器实验项目的全景

较小的占地面积

Ultra-Flo

The 'Know-how' in Water Treatment



P1	潜水泵	
P2	气水分离器	KRIPSOL 200
P3	超滤进水泵	KRIPSOL 300
P4	超滤反冲洗泵	CRN64-1-1
P5	纳滤进水泵	CMI8-10
P6	纳滤高压泵	CRN5-24

DRAWN BY	DESIGNED BY	APPROVED BY	DATE	SCALE
XU	WEE	HAN	16/08/2004	NTS

TITLE ULTRA-FLO™ 膜微生物降解	SINGAPORT CLEANSEAS PTE LTD	
	DRAWING NUMBER	QWE25

Ultra-Flo

The 'Know-how' in Water Treatment

ULTRA-FLO® 膜生物反应工艺

第一部分污水进入筛网池

第二部分生物降解曝气池

第三部分浮渣溢流进污泥池

第四部分厌氧

第五部分滴定与平衡池

4小时停留时间内的检测结果:

平均能量消耗	: 0.8 kWh/m^3
平均产水量	: 8 m^3/hr
压差	: 0.5 bar
进水 COD	: <1,000ppm
出水 COD	: <20ppm

第六
部分超滤以达到标准排放标准和应用

第七
部分纳滤可生产比工业用水水质更好的出水

Ultra-Flo

The 'Know-how' in Water Treatment

ULTRA-FLO® M-14 超滤膜系统

操作参数

配置	:	毛细管型(内压)
材料	:	亲水化改性聚丙烯腈
操作	:	死端与错流和反冲洗
流水量	:	560l/hr (每只)
表面积	:	17m2 (185ft2) (每只)
透水量	:	33l/m2/hr (19GFD) (每只)
回收率	:	>95%
出水浊度	:	<0.2NTU

进水　过滤水　冲水

操作压力只需 0.5 bar

Ultra-Flo

The 'Know-how' in Water Treatment

ULTRA-FLO® N-05 纳滤膜系统

操作参数

配置	：	螺旋缠绕式(内压)
材料	：	聚酰胺尼龙
操作	：	错流
流水量	：	>800l/hr (每只)
表面积	：	37m^2 (400ft^2) (每只)
透水量	：	22l/m^2/hr (13GFD) (每只)
回收率	：	>75%
出水TDS	：	<100ppm

实际压力只需 **0.5 Bar**

反冲洗水　过滤水

Ultra-Flo

The 'Know-how' in Water Treatment

PUB's R&D Efforts

PUB's Technology Groups

Biological Quality Technology Group
- Builds expertise in biological quality technology in source management, water treatment and water distribution.
- Looks into quality assessment and monitoring as well as treatment process and techniques.

Chemical Quality Technology Group
- Develops in-house chemical quality technology expertise.
- Looks into emerging health related water quality issues, source water assessment, monitoring and treatment, regulatory issues and watershed management.

Construction and Pipeline Technology Group
- Complements PUB's drive towards water-related technologies and foster innovations in the field of C&P.

Desalting Technology Group
- Equips PUB with expertise in desalting technologies to lead implementation of seawater desalination as one of the viable sources of water supply in Singapore.

Hydraulics and Hydrology Technology Group
- Develops expertise in hydraulics & hydrology to further enhance our water resources and flood control capabilities .

Instrumentation and Control Technology Group
- To lead in instrumentation and control technologies in the areas of potable water, wastewater and NEWater.
- To be a leading player in application of membrane and UV technologies in water reclamation and wastewater treatment.

Membrane Technology Group
- To be a leading player in application of membrane and UV technologies in water reclamation and wastewater treatment.

System Development Technology Group
- Develops in-house expertise to provide IT solutions to enhance PUB's business processes.

Wastewater and Sludge Treatment Technology Group
- Builds the expertise of PUB in wastewater and sludge treatment technologies to achieve higher efficiency and cost effectiveness.

Water Treatment and Disinfection Technology Group
- Builds the expertise of PUB in water treatment technologies to enhance potable water treatment capabilities to achieve higher efficiency and cost effectiveness.

PUB's Research & Development Efforts

Innovation and technology are key drivers in PUB's mission to secure an adequate supply of water at an affordable cost. In recent years, breakthrough innovations such as NEWater and the Deep Tunnel Sewerage Scheme have contributed significantly to Singapore's water resources strategy.

PUB continues to invest in technology and has formed 10 technology groups with some 150 persons headed by Chief Specialists in ten strategic fields of technology to undertake studies and projects that could increase water resources, better manage water quality and lower costs.

The technology groups welcome expertise from the water industry players, academia and research institutes to partner in such research & development projects.

Test-Bedding Projects

PulverDryerTM Technologies (PDT)

- Technology to pulverize and dry solid / sludge like materials.
- Potential of achieving significant volume / moisture reduction in a modularized and compact system.
- Test-bed plant treating dewatered sludge currently set up at Bedok Water Reclamation Plant (Bedok WRP).
- The PulverDryer (PD) Stage-3 plant has the potential of achieving sludge of total solids content of 65-75%.

Membrane Bioreactors

- Improved way to reclaim used water for indirect water reuse.
- Combines the effectiveness and efficiency of biological treatment with the benefits of membrane separation processes for producing better feed water quality for the production of NEWater.
- Toyoplas and Cleanseas test-bedding their membrane bio-reactors at Bedok Water Reclamation Plant.

16-inch Reverse Osmosis Membranes

- Traditional Reverse Osmosis (RO) membrane elements are 8-inch diameter.
- GrahamTek, a Singapore owned Technology Company, designed and developed a large size 16-inch diameter RO membrane element.
- Currently being test-bedded in parallel against existing 8-inch membranes at Bedok Water Reclamation Plant.
- GrahamTek's 16-inch RO consists of two unique patented designs that are capable of
  - moderate flow dynamic of the feedwater
  - retard fouling & scaling
  - produce flux rates double that of traditional 8-inch membranes

R&D Projects

Ultrasonic Disintegration of Sewage Sludge

- Looks into using ultrasonic disintegration to pre-treat the sludge so that they can be better digested resulting in more methane gas and therefore, more electricity and less sludge to be disposed.

Partners: NTU, CAWT

Integrated Anaerobic and Aerobic Treatment of Wastewater

- Looks at using anaerobic process in combination with the aerobic process to treat wastewater to reduce energy requirements and produce less sludge, while maintaining the high quality of treated effluent.

Partners: NTU, NUS, CAWT

Membrane Bioreactors

- Looks at the application of MBR technology in Singapore to treat municipal wastewater.
- Pilot trial results have been very encouraging.
- Project has been scaled up to a 5 mgd demonstration plant to establish the feasibility of plant-scale operation for wastewater treatment in relation to future development of water reclamation and NEWater plants.

Partners: CAWT, Mitubishi, Zenon, Kubota

Pilot Trial To Verify The Use Of Ferric Chloride As An Alternative To Alum As Coagulant In Water Treatment

- Looks into using alternative coagulants such as ferric chloride, poly-aluminium-chloride (PAC) as a coagulant in water treatment.
- Cost effectiveness and impact on water quality of the alternative coagulants used would be studied.

On-Site Wireless And Off-Site Mobile Telephone On-Line Monitoring Of The Critical NEWater Parameters

- Looks into using wireless technology for on-site and mobile telephone technology for off-site of key operating parameters and historical trends of pre-identified key operating parameters on a Personal Digital Assistant (PDA).
- 14 key NEWater parameters of Bedok & Kranji NEWater plants would be monitored under this project.

Water Quality Monitoring, Modelling And Management Of A Reservoir/Catchment System

- To develop an integrated model for simulation and prediction of water quality in a tropical reservoir and catchment system.
- Model can be used to assist management to enhance water quality in existing reservoirs and in planning of water resources by predicting the impacts of future land use changes or environmental perturbations.
- Model will also form the basis of a nationalIn-house capability to assess the quality aspects of Singapore's reservoirs.

Partners: NTU

Develop A Cheaper And More Corrosion Resistant Concrete Pipe

- Looks into the using of calcium aluminate cement (CAC) as lining material for small diameter concrete pipes.
- Extensive tests to establish the suitability of CAC for use in sewage atmosphere in tropical climate, as well as to use CAC in concrete pipes over two phases with a study period of 2 years.

Partners: NUS, Bilcon Industries

膜生物反应器检测报告

SETSCO SERVICES PTE LTD
18 Teban Gardens Crescent
Singapore 608925
Tel : (65) 6566 7777
Fax: (65) 6566 7718
Website: www.setsco.com
Business Reg. No. 196900269D

Your Ref : -

Our Ref : EN287/WPH

Date : 02/08/2004

TEST REPORT

(This Report is issued subject to the terms & conditions set out below)

Page 1 of 1

Subject : Analysis of water sample submitted by **Singaport Cleanseas Pte Ltd** on **27/07/2004** and testing commenced on **27/07/2004**.

Tested For : **Singaport Cleanseas Pte Ltd**
452 Tagore Industrial Avenue
Singapore 787823
Attn : Jonathan Cray

Sample Reference : Two (02) water samples were received on 27/07/2004 and labelled as follows :

Sample 1 : UF Permeate (27/07/04)
Sample 2 : MBR Raw Water (27/07/04)

Results :

Determination	Test Method	Sample 1	Sample 2	* Watercourse
Biochemical Oxygen Demand (mg/L)	APHA : Pt 5210 B	<2†	156	50
Chemical Oxygen Demand (mgO_2/L)	APHA : Pt 5220 B	19	450	100
Total Organic Carbon (mg/L)	APHA : Pt 5310 B	8.67	63.1	-

Remarks:
1. APHA is a Standard Method for the Determination of Water and Waste Water (APHA 20th Edition : 1998)
2. † = Not Detectable (The reported values are less than (<) the detection limits of the test methods)
3. * = Trade Effluent regulations for Watercourse.

KYI TAR NWE
EXECUTIVE CHEMIST

WONG PIK HUNG
ASSISTANT MANAGER

BIOLOGICAL & CHEMICAL TECHNOLOGY DIVISION

ENVS\'poreCleanseas/Jess

Terms & conditions:
(1) The Report is prepared for the sole use of the Client and is prepared based upon the item submitted, the services required by the Client and the conditions under which the Services are performed by SETSCO. The Report is not intended to be representative of similar or equivalent Services on similar or equivalent items. The Report does not constitute an endorsement by SETSCO of the item.
(2) SETSCO agrees to use reasonable diligence in the performance of the Services but no warranties are given and none may be implied directly or indirectly relating to the Services, the Report or the facilities of SETSCO.
(3) The Report may not be used in any publicity material without the written consent of SETSCO.
(4) The Report may not be reproduced in part or in full unless approval in writing has been given by SETSCO.
(5) SETSCO shall under no circumstances be liable to the Client or its agents, servants or representatives, in contract, tort (including negligence or breach of statutory duty) or otherwise for any direct or indirect loss or damage suffered by the Client, its agents, servants or representative howsoever arising or whether connected with the Services provided by SETSCO herein.

Ultra-Flo

The 'Know-how' in Water Treatment

BIOREACTOR

ULTRAFILTRATION


NANOFILTRATION

2005 年 5 月 30 日新加坡环保局 YAACOB IBRAHIM 博士产惯了勿洛实验基地

ULTRA-FLO® 膜生物反应池的新生水

Ultra-Flo

The 'Know-how' in Water Treatment