



Introduction to Membrane Solutions Division

Global Water Business by Three Main Membrane Technologies



■KUBOTA Submaged Membrane Unit

KUBOTA Submerged Membrane Unit (Kubota SMU)

KUBOTA Submerged Membrane Unit (Kubota SMU) is applied to various wastewater treatment system such as Johkaso, domestic/rural wastewater treatment, sewage treatment, and industrial wastewater treatment. The quality of treated water level is clean enough so as to be re-used in industrial water or for sprinkler. There are two stages in this treatment system. They are the biodegradation stage in which microbes biodegrades organic matter and the solid-liquid separation stage in which Kubota SMU is used for filtration.

As shown in Figure 1, adoption of cross-flow microfiltration system prevents membrane surface from fouling, and enables stable filtration. This system also has advantages in maintenance and operation process since the in-situ chemical cleaning process is available.

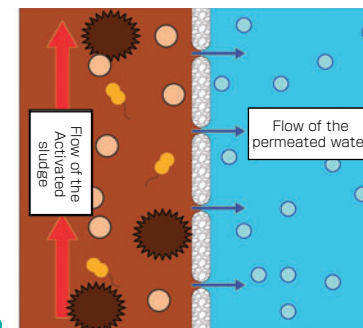
The other advantages compared to the conventional activated sludge process are listed below.

- ①It is capable of sustaining high concentration activated sludge as operating.
- ②No settling tank and sludge thickening tank are required, which makes the footprint remarkably small.
- ③Diversification of microbes enables biodegradation of refractory substance such as detergent and it provides removal of nutrients such as nitrogen easily, which leads to stable treatment performance.
- ④Adjustment of return sludge is not necessary which makes the MBR maintenance easier.

※ Kubota SMU have acquired the Japanese Minister of Land, Infrastructure, and Transportation approval based on the building code as shown in Table 1.

■Table 1 Approved number of Johkaso and standard value. (Within ( ) are the actual value)

Description	Advanced treatment type	BOD type	PC type
Population equivalent	51~20,000	51~10,000	51~1,000
Approved number in JAPAN	DW3N-0031	DW3N-8244	DW3N-8233
BOD (mg/L or less)	5(2)	5(2)	10(2)
COD (mg/L or less)	10(5)	10(5)	15(7)
SS (mg/L or less)	5(N.D)	5(N.D)	5(N.D)
T-N (mg/L or less)	10(7)	20(15)	-(25)
T-P (mg/L or less)	0.5(0.1)	-(2)	-(2)
n-Hex Extraction (mg/L or less)	3(N.D)	3(N.D)	3(N.D)
Coliform colony counts (No./L or less)	100(N.D)	100(N.D)	100(N.D)



■Figure 1 Cross-flow microfiltration process



■KUBOTA Submerged Type Ceramic Membrane

KUBOTA Anaerobic MBR Process

KUBOTA Anaerobic MBR process encourages recycle and reduction of food waste and effective utilization of biomass energy. The advantages of KUBOTA Anaerobic MBR compared to other similar technologies such as composting and carbonization are that the scope of application is wide and the generated energy is easy to be converted to electricity and heat.

Figure 1 shows how methane gas is generated, collected and utilized. Incoming raw solid waste is first put into Solubilization Tank, in which hydrolysis, acetogenesis and acid formation are occurred by anaerobic bacteria, and the solid wastes are hydrolyzed to alcohols and volatile fatty acids. After the acid forming phase, volatile fatty acids are decomposed to methane and carbon dioxide by thermophilic methanogens in High Temp & Speed Methane Fermentation Tank.

KUBOTA Anaerobic MBR process implements KUBOTA Submerged Membrane Unit (Kubota SMU) as solid-liquid separation, and the system has the following advantages compared to other conventional methane fermentation systems:

- 1. By using Kubota SMU, the system can sustain high concentration of methane bacteria, which leads to effective treat-ability and to reduce the fermentation tank volume requirement. (By our comparison, methane fermentation tank is reduced by 1/3 to 1/5 from a conventional system.)
- 2. Kubota system stabilizes treatment performance by controlling concentration of dissolved substances, such as ammonia, which would inhibit methane bacteria activities.
- 3. You can expect very reliable after-sale services since the whole system is Kubota's unique technology. (In addition, proper operation management is also done by Kubota IT Maintenance System.)

KUBOTA Anaerobic MBR Process is applied not only by municipality but also private sectors, such as confectionary manufacturer and distilled spirit manufacturer.

※ KUBOTA Anaerobic MBR Process received the new energy award in FY 2003 (prize of Minister of Economy, Trade and Industry, which is a gold medal) from New Energy Foundation, an extra-departmental body of Japanese Ministry of Economy, Trade and Industry.

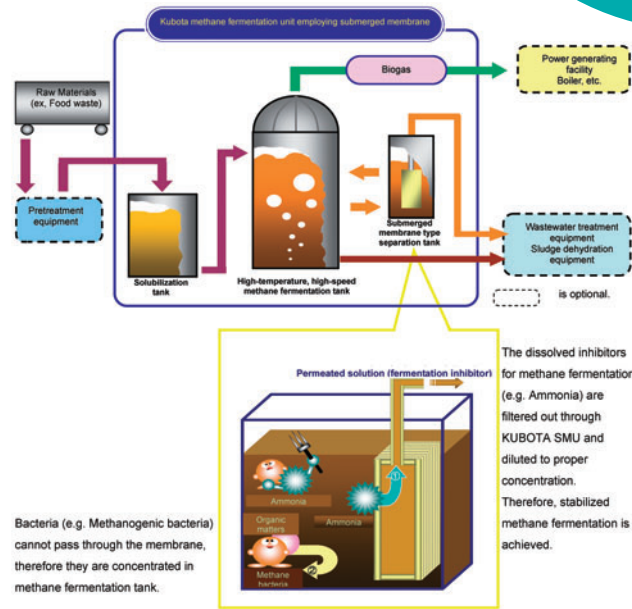
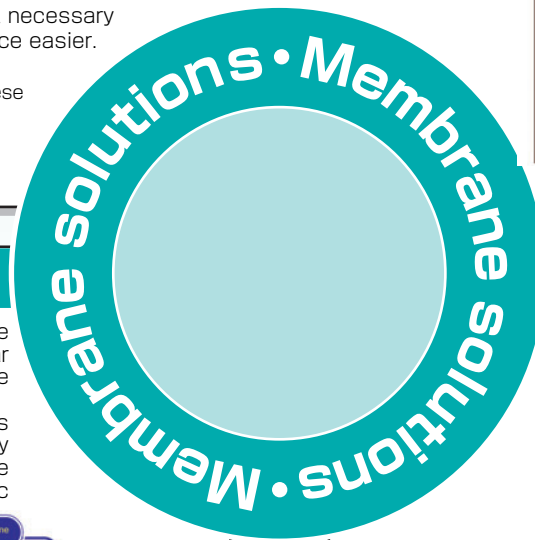


Fig 1. KUBOTA Anaerobic MBR Process Flow Diagram



KUBOTA Submerged Type Ceramic Membrane Filtration System, KUBOTA FILCERA

KUBOTA FILCERA (FILCERA) provides you with ground water and industrial water without turbidity, bacteria, color, Iron, Manganese, and Arsenic, which meets drinking water quality standard.

Figure 1 shows process flow diagram of FILCERA. The system can substitute a conventional treatment process that is a mixture of coagulation and sand filtration processes, and, in FILCERA, ceramic membrane filters and removes particles, which follows oxidation and coagulation processes. FILCERA can treat by chemical, filter, and remove, all done in one tank without a requirement of separate pre-treatment equipment in order to meet water quality standard. By utilizing FILCERA, following advantages are provided by it compared to by the conventional treatment process:

①Process flow diagram is simple.

②Stable performance, which does not depend on settle-ability of suspended particles and easy maintenance are promised.

③Turbidity and pathogenic bacteria, such as Cryptosporidium are completely removed.

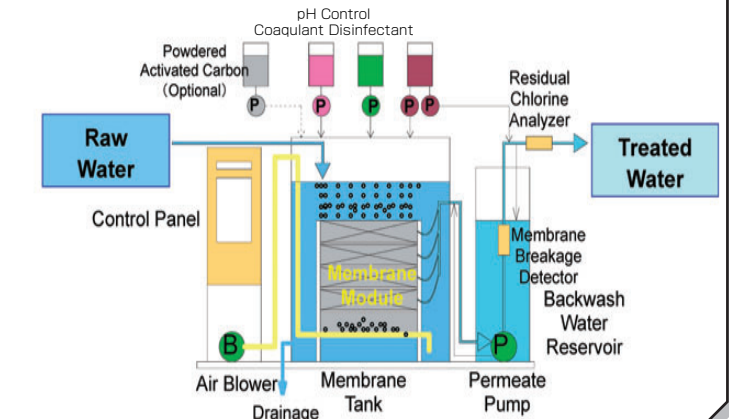
④Standardized package plants are prepared depending on required capacity (3.3 to 10m<sup>3</sup>/h), thus it shortens construction period on site.

Membrane Module and membrane device are approved for drinking water treatment by Japan Water Research Center (JWRC) and the Association of Membrane Separation Technology of Japan (AMST) respectively, and FILCERA are implemented in many water purification plants in Japan. In addition, private companies have selected FILCERA since May 2005 in order to purify ground water for drinking/tap water in an attempt to reduce water consumption.

Table 1 shows the water quality of FILCERA.

■Table 1. Water Quality

Parameter	Unit	Raw Water	Treated Water	Drinking Water Standard
pH	-	7.8	6.8	5.8 to 8.6
Turbidity	Deg.	<0.1	<0.1	<2
Color	Deg.	6	1	<5
Iron	mg/L	0.24	<0.03	<0.3
Manganese	mg/L	0.021	0.006	<0.06



■Fig 1. KUBOTA FILCERA Process Flow Diagram

## Introduction of Industrial Wastewater Treatment Using Membrane Bioreactor System ~Medium and small scale business establishment~

### 1. Introduction

In the preceding report, I have introduced the case of MBR application to wastewater treatment at the large scale business establishment. In this report, I would like to introduce the case of MBR application to wastewater treatment at the small scale business establishment along with "New Applied Technology Promotion Agenda to Small Scale Business Establishment" done by Japanese Ministry of the Environment.

### 2. "New Applied Technology Promotion Agenda to Small Scale Business Establishment" Done by Japanese Ministry of the Environment.

Advanced environmental technologies, even though they are commercial-ready and seem to be useful, have not necessarily been spread widely since the users such as local governments, companies and citizens, cannot make selection of those technologies because of the lack in objective assessments, concerning the performance in environmental conservation. The Ministry of the Environment, therefore, launched the "Pilot Project of the Environmental Technology Verification" in fiscal year 2003. This project provides environmental conservation and economic revitalization of environmental business field by verifying the advantageous effect of the advanced environmental technologies by third parties, which promotes the venture companies to develop advanced environmental technologies.

The flow sheet of this project are shown in Figure 1. Verification management organization and verification organization are selected by public offering, which is mainly managed by the Ministry of the Environment. For the verification organization, the local public organization are selected quite often. When the result of the verification test is approved by the Ministry of the Environment or the verification organization, this advanced technology would be verified as a safe and reliable technology which an end-user can adopt easily.

The target verification technology fields are ① Organic wastewater treatment technologies for small scale establishments(kitchens/restaurants, and food manufacturing plants), ②Treatment technologies for human wastes in mountain district, ③Technologies for mitigation of the urban heat-island effect, ④ Wastewater treatment technologies for nonmetallic elements(e.g., boron), ⑤Technologies for improving the quality of lakes and reservoirs, and ⑥Volatile Organic Compounds(VOC) treatment technologies. As for the organic wastewater treatment technologies for small scale establishments(such as kitchens/restaurants, and food manufacturing plants) with a daily wastewater flow rate of less than 50m<sup>3</sup>, the wastewater is often discharged directly to the environment without any treatment because of the loose water quality regulations. This situation, therefore, led the Ministry of the Environment to specify this category(organic wastewater treatment technologies for small scale establishments) as the target verification technology field.

There are following four points required for the verification.

1. Environmental conservation effect under utilization in actual site within technical specification which is specified by the implementer.
2. Required energy, material, and cost for the operation
3. Required operation environment for appropriate management
4. Required effort for maintenance and operation

Considering the wastewater treatment of medium and small scale business establishments in the urban area, small footprint of the treatment system and extremely high quality treated water (can be used as reclamation water) are essential. To respond this requirement, Kubota decided to implement the test verification of waste water treatment applying MBR system. The verification organization was Kagawa prefecture. The result of the test verification was approved, and the report is disclosed by the Ministry of the Environment in fiscal year 2004. The outline of the test verification are described in the next section. Please refer to the HP of Japanese Ministry of the Environment for more details.

HP of Japanese Ministry of the Environment (<http://www.env.go.jp/policy/etv/en/index.html>)

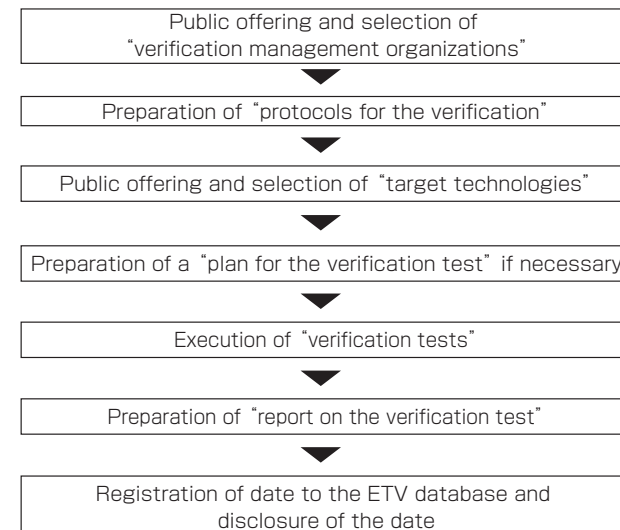


Figure 1 Flow sheet of the "Pilot Project of the Environmental Technology Verification"

### 3. Wastewater Treatment Test Utilizing MBR System with KUBOTA Submerged Membrane Unit(Kubota SMU) (in Kagawa Prefecture)

KUBOTA MBR system is utilized to Kagawa prefecture Soy Sauce Brewage Cooperative Association wastewater treatment under the condition of influent flow with 35m<sup>3</sup>/d. The report of test verification shows all the experimental data taken from Sep.2004 to Feb.2005. Flow sheet of the treatment, basic condition, and the result of the treatment performance are shown in Figure 1, Table1 and 2.

The data showed that the removal ratios of BOD and SS were over 99.9%, and the removal ratios of COD, n-Hex, T-N,T-P were over 97%. Other factors required to be verified as Environmental Impact Assessment and Used Resources Assessment are listed in Table3 and 4.

The pilot showed that the sludge amount generated as operating was 8.9kg/d as dry weight, and the sludge yield was 20%. The noise and odor evaluations were in the safe range.

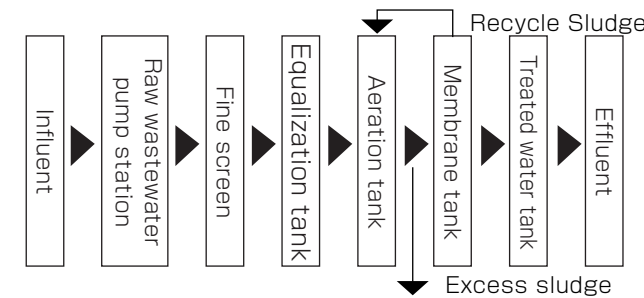


Figure.2 Flow sheet of Kagawa prefecture Soy Sauce Brewage Cooperative Association wastewater treatment

Table.1 Outline of the verification test equipment

Facility Outline	Specifications and Treatment Capacity	
	Type	Activated sludge process (Package Plant Model : MT60)
Size, Weight	12,700mm W × 12,400mm D × 2,854mm H, 15,000kg	
Design Condition	Removed substances	BOD, SS
	Flow	35 m <sup>3</sup> /d
	Influent quality	(BOD) 400mg/L, (SS) 950mg/L, (pH) 5.8~8.6
	Effluent Quality	(BOD) 10mg/L, (SS) 5mg/L, (pH) 5.8~8.6

Table.2 Conclusion of the verification test (treated water quality)

Description	Unit(pH : none, others : mg/L)			
	Conclusion of Verification Test (range, medium value)			
	Influent		Effluent	
pH ※	5.4 to 7.9	6.6	7.4 to 8.0	7.6
BOD	430 to 1400	1100	0.5 to 1.5	1
COD ※	350 to 1200	570	10 to 23	13
SS	210 to 770	420	<0.5	<0.5
n-Hex ※	18 to 620	200	<1.0	<1.0
T-N ※	35 to 78	56	0.8 to 3.1	1.6
T-P ※	6.2 to 17	10	0.01 to 0.17	0.03

(Note 1) Items with ※ mark are not subject to be removed.

(Note 2) Values are from 23 datas.

Table.3 Conclusion of the verification test (Environment Impact Assessment)

Description	Conclusion from verification test
Generated sludge	8.9kg/d(dry), 60.6kg/d(Water content85.3%)
Generated debris	Debris from screen 0.3kg/d(dry), 2.0kg/d(Water content84.0%)
Noise	65.3dB (Includes the environmental noise outside the facility)
Odor	Odor index:14, Odor concentration:23, Odor intensity:3 (6step odor intensity) Odor offensiveness:0(9step odor offensiveness)

Table.4 Conclusion of the verification test (Used Resources Assessment)

Description	Conclusion from verification test
Electricity consumption	128kWh/d
Coagulant consumption	Ferric Chloride solution 3.5kg/d
Other consumables	Chemicals for membrane cleaning Oxalic acid 4.7kg/year
	Membrane cartridges 12% Sodium Hypochlorite 38kg/year
	Membrane cartridges replacement (however, no replacement was needed during the test)

### 4. Conclusion

In this report, MBR system applied to the wastewater treatment at the small-scale business establishment have been introduced. As one of the project involved in the "New Applied Technology Promotion Agenda to Small Scale Business Establishment" done by the Ministry of the Environment, Kubota MBR process obtained the approval of Japanese Ministry of the Environment and Kagawa Prefecture, concluding that this system is an effective and reliable technology available to wastewater treatment of the small scale business establishments.

In the next report, I would like to introduce the case of permeate reuse of Kubota MBR system. (Kiyoshi Izumi)

## Europe's Regional Technical Meeting

Kubota Corporation and their two subsidiaries; Kubota Membrane Europe Limited (hereafter KME) and Kubota Membrane USA (hereafter KMU), corporate with 'Kubota Partners' (distributors of KUBOTA Submerged Membrane Unit). Combining Partners' wastewater treatment knowledge and past experiences in each market with Kubota's membrane technology, Kubota is expanding membrane business worldwide.

In order to make the business collaborations work smoothly, Kubota and Partners hold periodical meeting occasions, Technical Partners Meeting, to exchange technical information and discussions. This time, however, KME held European Regional Technical Meeting for European Partners, in which the main theme was 'Flux'.

Flux is one of the important design parameters in water treatment employing membrane technology. It demonstrates the performance of membranes. Partners reported their experiences and discussed the difference between design flux and 'real' flux as well as controlled operation to keep the designed flux. Design flux values by other membrane suppliers were also reported for comparison.

Past experiences play an important part to set the design flux value for industrial wastewater treatment because it is difficult to apply the same flux to different activated sludge of different kind of wastewater. If there were no reference, a pilot study or adding 'safety rate' would be required to choose the design flux. Therefore, other Partners' experiences are very useful information for Partners to share. There were presentations on both real and pilot case studies: trialed design flux examples, operational conditions and performances were reported.

In a relaxed atmosphere, enthusiastic questions flew between presenters and delegates; the two-days meeting provided a good opportunity for Kubota and Partners to exchange technical information and opinions. The delegates summed up the meeting topics and confirmed Kubota's and Partners' tanks which are necessary for further development of membrane business at the end of the meeting.

We hope to keep holding such Technical Meetings around the world in order to strengthen relationship between Kubota and Partners as well as among worldwide Partners so that we will have significant leap forward to expand membrane business together.

(Mito Kanai)



First Row from Left: ●Mr. Ryosuke Maekawa (KME), ●Ms. Laure Bachelier (Streau, France), ●Mr. Kazuhiro Yamazaki (Kubota), ●Ms. Haruka Shino (Kubota), ●Mr. Kiyoshi Izumi (Kubota), ●Ms. Mito Kanai (KME), ●Ms. Angels Lopez (Hera-Amasa, Spain), ●Ms. Ivonne Pelster (Solis, The Netherlands), ●Mr. Vincent Chastagnol (Streau, France).  
Second Row from Left: ●Mr. Nigel Rogers (Eimco, UK), ●Mr. Thomas Wozniak (Aggerwasser, Germany), ●Mr. Andrea Trepin (Ladurner, Italy), ●Mr. Alberto Daloli (Ladurner, Italy), ●Mr. Benjamin Egerland (Aggerwasser, Germany), ●Mr. Hidehiko Sakai (KME), ●Mr. Stephen Kennedy (Copa-Eimco, UK/Ireland), ●Mr. Yves Coquet (Saur, France).  
Third Row from Left: ●Mr. Sergi Lluch (Hera-Amasa, Spain), ●Mr. Timo Metsanen (EVAC, Finland), ●Mr. David Sisselaar (Solis, The Netherlands), ●Mr. Steve Churchouse (SciEng), ●Mr. Sami Nieminen (EVAC, Finland), ●Mr. Victor Ferre (KME), ●Mr. Jouko Jukkola (EVAC, Finland).

Extra

## A Message from Production

### ~Manufacturing Group of KUBOTA Membrane Co. Ltd.~

KUBOTA Membrane Co. Ltd. (Tacsui Co. Ltd at the time) has begun its business since December 1994 with a slogan "Explore the Future of Wastewater Treatment." By the year of 2001, we have changed the company name to the current one in order to help penetrating the market and enhancing the brand name of KUBOTA Submerged Membrane Unit (Kubota SMU), and have been engaged in the internal production since 2002. Manufacturing Group of KUBOTA Membrane Co. Ltd. has been the sole manufacturer of Kubota SMU since then.

The manufactory is located in the east center of Osaka Plain, called Yao-City, where it is wedged between Ikoma mountain range in East and Osaka port in West. The location is convenient and is approximately 1 km from Yao Interchange of Kinki Highway.

There are young staff members who are engaged in manufacturing Kubota SMU. The average age of the staff is 31 years old, and the factory is full of youth and enthusiasm, which gives full play in the factory for the mobility and efficiency.

Recently, we have been actively embracing productivity improvement by shortening the cycle time and better staff training for shift workers in order to meet the increasing demand of Kubota SMU productions.

For the environmental and quality management, we have acquired ISO-14001 in June 2003, and currently have been working on ISO-9001 acquisition. As for Membrane Cartridge manufacture and Kubota SMU assembly, we are implementing "3R promotions for reducing industrial waste generation and environmentally friendly delivery" in order to pursuit energy conservation and quality management.

At first, the production has been started only for Japanese market, however recently 70% of the production is dominated in overseas market. We are encouraged by filling out our world map one by one with the Kubota SMU we manufacture here and deliver worldwide.

Manufacturing group at KUBOTA Membrane Co. Ltd will keep exploring the future of wastewater treatment in order to contribute water environment conservation; we will keep providing reliable quality and performance as expert in Kubota SMU manufacture. At last, we keep manufacturing KUBOTA Submerged Membrane Unit hoping we can meet our products wherever we go on the globe.

(Masayuki Umeda)



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