Introduction of Kubota Corporation and its capability in Water Market

6th October, 2016

KUBOTA Corporation
http://www.kubota-global.net/
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Corporate Profile (As of Mar. 2015)

- KUBOTA Corporation
- Established: 1890
- Number of Employees: 35,487
- Capital: ¥84B ($840M)
- Revenue: ¥1,587B ($15.9B)
- Listing Market: Tokyo SE, Osaka SE
- Business Summary:
  - Farm & Industrial Machinery Business
  - Water & Environment Business

* Exchange rate of JPY100 / USD is applied in this presentation.
Farm & Industrial Machinery Business

Kubota has contributed to mechanization of agriculture in Japan and other countries mainly through the supply of rice farming machinery.

- Power Crawler Tractor
- Head-feeding Combine
- Mini Excavator
- Mid-scale Tractor
- Riding Transplanter
- Small-scale Combine Harvester
- Diesel Engine
Kubota has more than a century of experience in **WATER-RELATED** business operation. With our quality materials and equipment for water works and sophisticated water treatment technologies, we contribute to the solution of various water problems in many parts of the world.

**Water & Environment Business**

- Ductile Iron Pipe
- Butterfly Valves
- Pumps
- Diffuser
- Mixer
- Johkasou
- Submerged Membrane Unit
- Sludge incineration plant
- Sludge collector
Kubota’s Water Related Products

Kubota’s products and technologies can cover the entire “WATER CYCLE”.

Water Treatment Plant

Water Reclamation Plant

Kubota’s Water Related Products

- Drainage Pump
- Johkasou
- Treatment Water Pump
- Ductile Iron Pipe
- Resilient Seated Gate Valve
- Diffuser
- Submerged Membrane Unit
- Sewage Sludge Thickener
- Sewage Sludge Incinerator
- High Pressure RO Feed Pump

Raw Water Intake Pump
Underdrain System
Butterfly Valve
Sewerage Pump
Plastic Pipes
Agitator For Reactors
EPC For Plant
Dewatering Machine
Global Network  (As of June, 2016)

Kubota has 34 main overseas affiliates, 18 overseas production sites and 5 overseas offices for its global business operation.
Business Operation in Malaysia

Kubota has 1 branch and 1 affiliate in Malaysia.

- **Kubota Malaysia Branch**
  (In Petaling Jaya, Selangor)
  Sales of WATER and WASTEWATER related products.

- **Sime Kubota Sdn. Bhd.**
  (In Puchong, Selangor)
  Sales of tractors and engines.
History of Kubota MBR Business

**Operations**

- **1986**: Start of KUBOTA MBR
- **1991**: Developed SMU, Submerged Membrane Unit
- **1994**: Kubota Membrane Co., Ltd. for maintenance
- **2001**: Kubota Membrane USA for NA market
- **2002**: Stainless frame, EK Double deck
- **2005**: Kubota Membrane Europe for European market
- **2009**: Economic & environment-friendly
- **2011**: Large scale municipal MBR
- **2016**: Kubota Environment Engineering Shanghai for Chinese market

**Developments**

- **1986**: A100
- **1991**: ES200, EK400
- **2002**: ES/EK series
- **2005**: RW400
- **2009**: Economic & environment-friendly RM/RW series
- **2011**: SPC series
- **2016**: SPC600

**Water and Environment R&D Center USA** for research and development activity for NA market
Key technologies for MBR System

**Submerged Membrane Unit (SMU)**
Designed to maximize the performance of Membrane Cartridges.

- Permeated clean water is collected through "Tubes" and "Manifold".
- The up flow of the sludge driven by the air supplied from the "Diffuser" scours the membrane surface to prevent fouling.
Key technologies for MBR System

Membrane Cartridge
- Membrane Material: Chlorinated Polyethylene
- Average Pore Size: 0.2µm (0.4µm in maximum)
- Filtration Area: 0.80m²/plate (ES/EK type), 1.45m²/plate (RM/RW type)

- Treated water filtrated by the Membrane Sheet flows up on the surface of the Plate and comes out through the Nozzle.

*Microscopic view of the Membrane surface
Advantages of Kubota MBR System

Kubota MBR System is an advanced technology, a combination of Conventional Activated Sludge process and Kubota Submerged Membrane Unit.

- Small Tank, NO Clarifier = Space Saving
- Membrane Separation = Cleaner Permeate
- Simple Configuration = Easy Upgrade, O&M

1. Small footprint
   - CAPEX & Space saving
   - Effective use of land

2. High effluent quality
   - Complies with strict regulations

3. Easy retrofit / upgrade
   - Increase of WWTP capacity

4. Easy O&M
   - CAPEX & OPEX saving due to simplified system

*WWTP: Waste Water Treatment Plant
*O&M: Operation and Maintenance
Advantages of Kubota MBR System

Due to the high MLSS up to 20,000mg/L, the footprint would be reduced that saves your CAPEX and precious land.

CAS
Conventional Activated Sludge
MLSS: 2,000~5,000mg/L

MBR
Hollow Fiber
MLSS: 5,000~10,000mg/L

MBR
Kubota Flat Sheet
MLSS: 5,000~20,000mg/L

Tank Volume Comparison
100%
63%
32%

1. Small footprint
   + CAPEX & Space saving
   + Effective use of land

NO CLARIFIER !! SMALLER TANK !!
Advantages of Kubota MBR System

Sambou 60,000m³/d STP had applied Kubota MBR system due to its small foot print, 40% against the conventional system. The generated land was used in the highway construction.

Details of biological part

Conventional (10,200 m²)  
Kubota MBR (4,040 m²)

1. Small footprint
   - CAPEX & Space saving
   - Effective use of land
Advantages of Kubota MBR System

The effluent quality easily complies with strict regulations without a post-treatment.

- Effluent quality comparison in the actual REFINERY plant which has fluctuation with NON-biodegradable COD.

### Parameter [mg/L] | Influent | Existing CAS (AO Process) | Effluent CAS
--- | --- | --- | ---
SS | 61.5 | | 49.4
BOD₅ | 181.0 | | 10.0
CODCr | 400.8 | | 51.2
T-N | 31.2 | | 16.0
O & G | 15.8 | | 0.8

### Parameter [mg/L] | Influent | Kubota MBR system | Effluent MBR
--- | --- | --- | ---
SS | 61.5 | | < 1.0
BOD₅ | 181.0 | | 4.6
CODCr | 400.8 | | 39.2
T-N | 31.2 | | 12.0
O & G | 15.8 | | 0.6

2. High effluent quality
Complies with strict regulations
Advantages of Kubota MBR System

At Moriyama STP in Japan, both the MBR and the RO effluent have been achieving an excellent quality.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>MBR Effluent</th>
<th>RO Effluent</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOD</td>
<td>0.86</td>
<td>&lt;0.1</td>
</tr>
<tr>
<td>SS</td>
<td>N/D</td>
<td>N/D</td>
</tr>
<tr>
<td>T-N</td>
<td>6.3</td>
<td>0.7</td>
</tr>
<tr>
<td>T-P</td>
<td>0.85</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Turbidity</td>
<td>0.2</td>
<td>&lt;0.1</td>
</tr>
<tr>
<td>E-Coli</td>
<td>N/D</td>
<td>N/D</td>
</tr>
<tr>
<td>Color</td>
<td>15</td>
<td>&lt;0.5</td>
</tr>
<tr>
<td>pH</td>
<td>7.0</td>
<td>6.0</td>
</tr>
<tr>
<td>SDI_{15}</td>
<td>Ave 1.2</td>
<td>-</td>
</tr>
</tbody>
</table>
Advantages of Kubota MBR System

The capacity of the WWTP can be increased up to 400% with cleaner permeate by using the existing aeration tank.

CAS
Conventional
Activated Sludge

MLSS: 2,000~5,000mg/L
SRT: ~10 days

Kubota MBR
Flat Sheet

MLSS: 5,000~20,000mg/L
SRT: ~30 days

Capacity Comparison

100%

~400% with cleaner permeate

3. Easy retrofit / upgrade
   Increase of WWTP capacity
Advantages of Kubota MBR System

Canton Water Reclamation Facility 159,000 m³/d, located in Ohio US, needed to retrofit and upgrade its performance.

[BEFORE - CAS -]
Existing needed to:
1. Enhance Nutrient Removal
2. Increase Peak Flow Capacity
3. Remove/Upgrade Existing Infrastructure

3. Easy retrofit / upgrade
   Increase of WWTP capacity
Advantages of Kubota MBR System

The Canton WRF is under renovation from the CAS to the MBR System by using only 1/3 of the existing Aeration Tank for 159,000 m³/d.

[AFTER - MBR] Kubota MBR System would be:
1. 159,000 m³/d by using only 1/3 of the existing Aeration tank.
2. P < 1.0 mg/L, N < 8.0 mg/L, even eliminating “Primary & Secondary Clarifier”, “Tertiary Filter” and “Disinfection”.
3. Reduce monitoring items (TMP, Flow rate)
4. Apply Gravity Filtration for energy saving.
Advantages of Kubota MBR System

The clients CAPEX & OPEX can be saved by simplified O&M system such as GRAVITY and/or SIPHON filtration, IN-SITU cleaning and Less Monitoring items.

- The Gravity and/or Siphon filtration can be applied to Kubota MBR System which ease O&M and reduce CAPEX & OPEX.

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**Hollow Fiber MBR**

Suction Pump

**Kubota MBR**

NO SUCTION PUMP !!

NO ENERGY CONSUMPTION!!

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Suction Filtration

Gravity Filtration

Siphon Filtration
Advantages of Kubota MBR System

Membrane can be cleaned *IN-SITU* by simple backflow of chemical solution. Diffuser beneath the membrane also can be cleaned *IN-SITU* by simple valve operation.

- **Quarterly Maintenance**
  - *IN-SITU* Chemical Cleaning
  - (3 to 4 hours/3 months)

- **Daily Maintenance (Automated)**
  - *IN-SITU* Diffuser Cleaning
  - (5 min/day)

At Kubota, we understand the importance of easy O & M for your MBR system, leading to CAPEX & OPEX saving through simplified O&M system. DEBRIS with Sludge can be removed while the diffuser is being cleaned.
Advantages of Kubota MBR System

Centralized remote monitoring system when constructed eases clients’ operation management. Each site’s signals to be sent to the central system through internet.

- Only 2 items, “Trans Membrane Pressure” and “Flow Rate”, to be monitored for a stable operation.
References

EPC / EPS MBR References

1991
First Installation in Japan

1995
First Installation for industrial plant in Japan

1998
Porlock WWTP 1,900m³/d, Sewage (UK)
EPC by Kubota

2001
Daldowie 12,900m³/d, Liquor (UK)

2005
1st municipal MBR STP of Japan

2008
Al Ansab 54,000m³/d, Sewage (Oman)
Palm Jumeirah 18,000m³/d, Sewage (UAE)

2009
Ohda STP 2,150m³/d (Japan) EPC by KBT

2010
Moriyama STP 5,000m³/d EPC by Kubota group
Shingu STP 6,060m³/d EPC by Kubota

2011
Petrobras 9,600m³/d, Refinery (Brazil)
MRPL 14,760m³/d, Refinery (India)

2013
Palm Jumeirah 18,000m³/d, Sewage (UAE)

2014
Canton 159,000m³/d, Sewage (US)

2015
Al Ansab 2nd 125,000m³/d, Sewage (Oman)

Now, we have more than 5,500 references all over the world!!

Selected Membrane Supplies
Porlock WWTP, UK

- Capacity: 1,900 m³/d
- Influent: Sewage
- Commissioned: 1998

- First Municipal MBR plant installed in Europe.
- Near Exmoor national park and swimming beach.
- Proven Kubota’s high durability / long life.

At Porlock WWTP, the longest operated municipal MBR in the world, the replacement rate was only 6% after a 10 year operation.
(Only 300 membrane cartridges out of 3,600 needed to be replaced.)

Membrane bioreactors: Ten years after

The municipal sewage treatment plant at Porlock in the South West of the UK is the oldest continuously operating full scale submerged MBR plant in Europe. Operated by Wessex Water, it now celebrates its 10th anniversary serving a population of 3,800 people. Kubota Membranes, responsible for the technology behind the success, take a look at how the plant is coping ten years on.

Being located in the wilderness in Exmoor National Park, Porlock WWTP represents the success of the Kubota MBR concept in a remote area, with many advantages including low infrastructure costs and the ability to be completely hidden.

Initially, 1,300 membrane bioreactor (MBR) cartridges were installed in Porlock WWTP in 1998. The system provides excellent effluent quality, achieving a BOD < 5 mg/L. The treated effluent is used for irrigation in the area to combat drought conditions. The treatment system is based on the use of submerged membrane bioreactors with the membranes being cleaned using the innovative Kubota Cleaning System. The system is designed to remove particulate matter and organic material from the wastewater. The membranes are cleaned using a combination of backwashing and chemical cleaning.

The following is a list of the main advantages of the system:

- High removal efficiency of solids and organic material.
- Low sludge production.
- Energy efficiency.
- Low maintenance costs.

Membranes are expected to be replaced every 10 years. However, in Porlock WWTP, the replacement rate was only 6% after a 10 year operation. (Only 300 membrane cartridges out of 3,600 needed to be replaced.)
Al Ansab, Oman

- Capacity: 54,000 m³/d (Ph. 1)
- 125,000 m³/d (Ph. 2: Expansion)
- Influent: Sewage
- Installation: 2006 (Phase 1), 2016 (Phase 2)
- Why MBR?: High effluent quality, especially Helminth Ova removal, to recycle the permeate for irrigation.

- Largest MBR plant in Middle East.
- Gravity filtration applied.
- Recycle for irrigation.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Influent Design [mg/L]</th>
<th>Influent Actual</th>
<th>Effluent Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSS</td>
<td>220</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>BOD₅</td>
<td>310</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>CODCr</td>
<td>N/A</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>NH₃-N</td>
<td>29</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>TKN</td>
<td>48</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Viable Helminth Ova [n/L]</td>
<td>N/A</td>
<td></td>
<td>&lt;1</td>
</tr>
</tbody>
</table>

*Average data during 5 months
References - Fish Processing -

**Salmon Factory Gyouba, Japan**

- Capacity: 200 m³/d
- Influent: Fish Processing Water
- Installation: 2010
- Why MBR?: Ease Operation and Maintenance. (Previously using SBR). Stable permeate quality even fluctuated to comply with the discharge limit.
Even the actual influent quality fluctuates far from the design, the MBR permeate has been achieving an excellent quality.
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Conclusion

Kubota is always ready to support your infrastructure development by our reliable products and technologies.

1. Kubota has more than a century of experience in WATER-RELATED businesses and our products can cover the entire “Water Cycle”.

2. Kubota has more than 5,500 MBR references all over the world due to our reliable product “Submerged Membrane Unit” and related engineering capabilities and experiences.

3. Kubota MBR System contributes to “Environment Load Reduction” and would also save your CAPEX & OPEX due to its simplified configuration and accumulated KNOW-HOW for 30 years.
Thank you for your attention!!