

**Application of AOSD System as Energy Saving
and Advanced Wastewater Treatment
Technology to Vietnam and Spread to Asia**

**【省エネと高度処理技術としてAOSDシステムのベトナム汚水処理場
への応用とアジアへの展開】**

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Importance of conservation and recovery of water environment in the world 国際的水環境再生保全重要



Tahihu Lake, China



Dianchi, China



Lake Kasumigaura,
Japan



Lake Biwa,
Japan

Urgency of the energy saving and the advanced removal of nutrient salts against eutrophication and global warming

ベトナムの環境は経済成長で汚染が加速
環境再生保全のために富栄養化対策・
省エネ・地球温暖化対策が必須



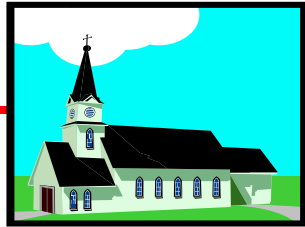
Rivers and lakes,
Vietnam

© 2014 Google
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Image Landsat
画像取得日 2014

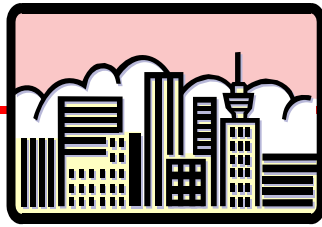
google earth
高度 6574.26 km

Present Water Environment and Global Warming Issues

水環境と温暖化の現状と課題



Domestic waste water
Point source 点源負荷

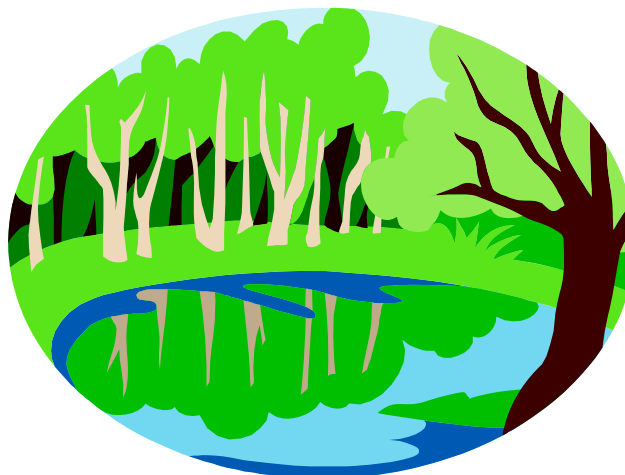


Industrial waste water
Point source 点源負荷



Farm wastewater
Nonpoint source 面源負荷

Water environment pollution has been accelerated by the point and nonpoint sources, and the **global warming**. In the closed water bodies, abnormal growth of **blue-green algae** has become big environment issues.

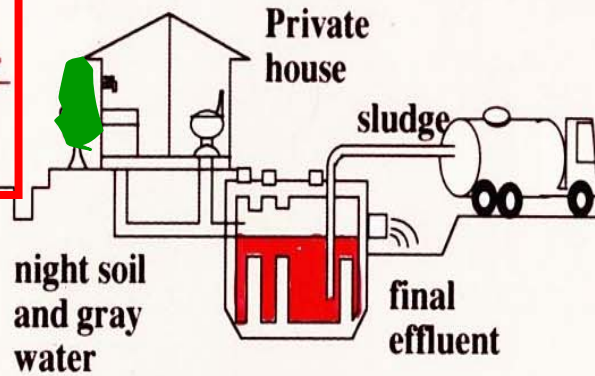


Closed water bodies 閉鎖性水域
Abnormal growth of blue-green algae
湖沼におけるアオコ藍藻類の異常増殖

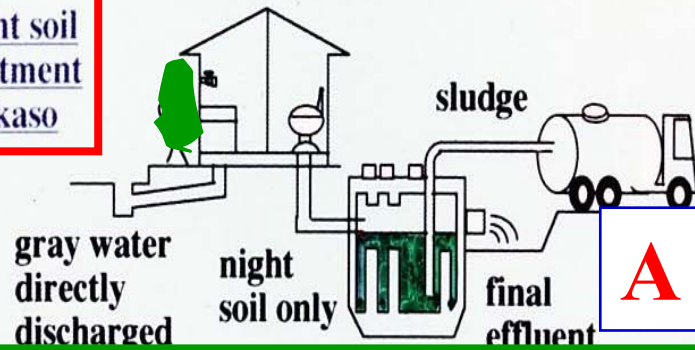


Blue-Green Algae

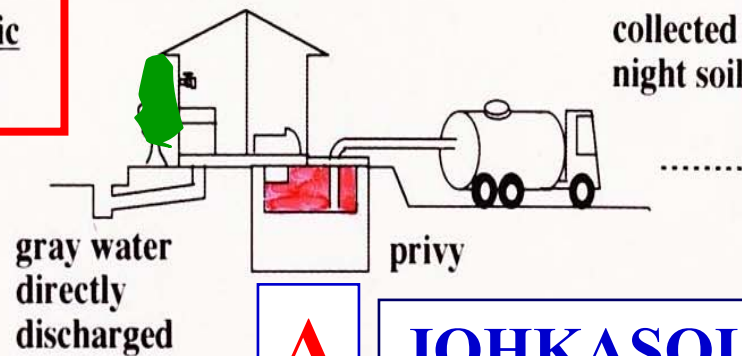
**Domestic wastewater treatment
Johkaso**



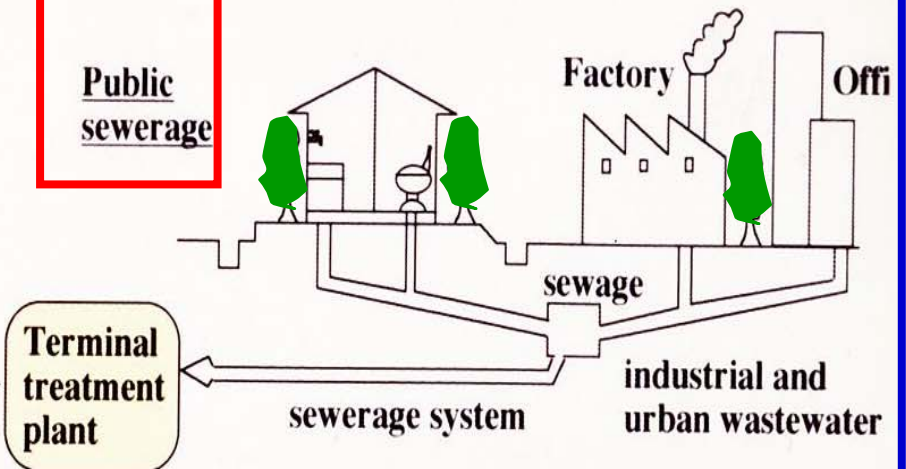
**Night soil treatment
Johkaso**



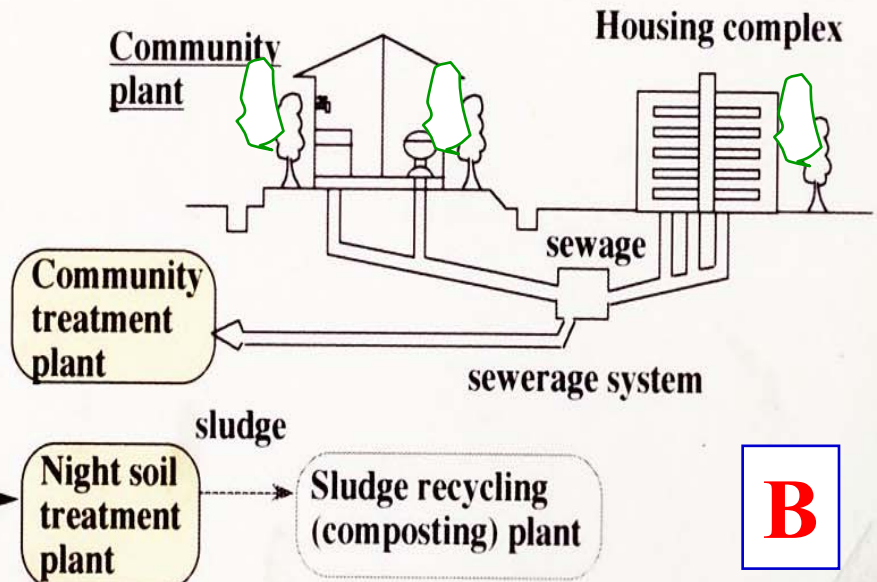
Septic tank



Public sewerage



Community plant



JOHKASOU AREA

SEWERAGE AREA

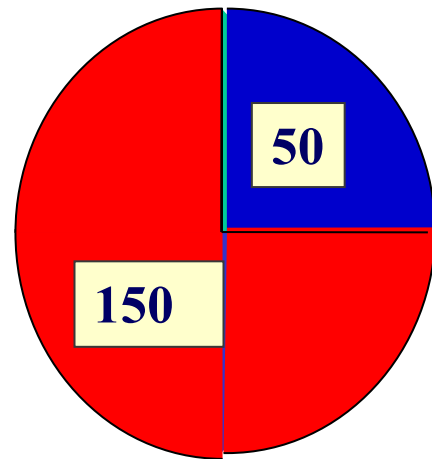
Schematic Flow of Domestic Wastewater Treatment System

Basic units of the ratios between black water(屎尿) & gray water(雑排水)

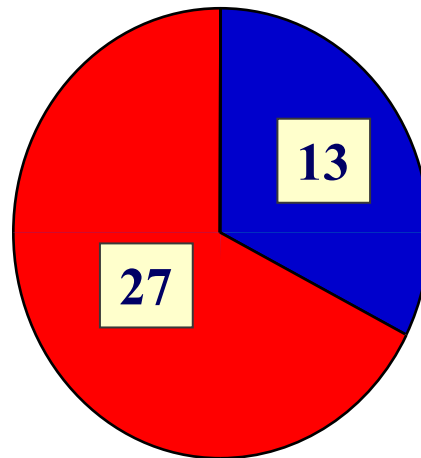
生活排水における屎尿と雑排水の原単位

Standards of BOD/T-N/T-P are 200, 45, 5mg/l

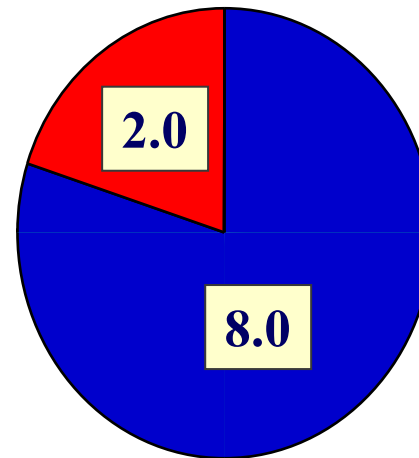
Volume of water



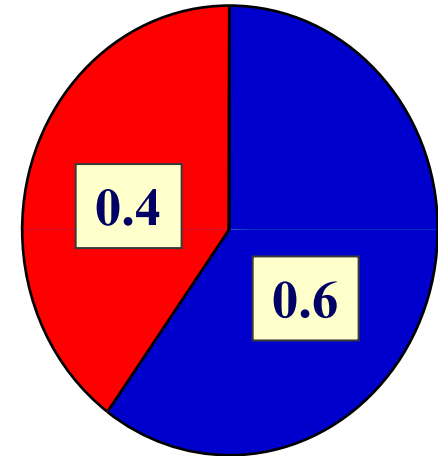
BOD



T-N



T-P



BOD 40 g/person/day

T-P 1 g/person/day

200 L/person/day

T-N 10 g/person/day

■ Black water

■ Gray water

【about 80% of N and 60% of P are from black water】

Dissemination Project of AOSD Control System as the Advanced and Cost-Saving Wastewater Treatment Technology for Restoration in Vietnam

Implementing Site

Ho Chi Minh City, Vietnam



Background

- Needs governmental response for water pollution following rapid economic growth.
- Imposing vast costs of operation/maintenance for sewerage.
- Aeration can be decrease.
- Requirement of the automatic control system as the advanced and aeration-saving.

Abstract

Contribution to the reclamation of wastewater treatment (Domestic, Industrial) with high advanced and saving-energy simultaneously.

Introduced technology

AOSD (Automatic Oxygen Supply Device) **Optimized control system** for biological wastewater treatment using **automatic operation of blower with ON-OFF switching.**

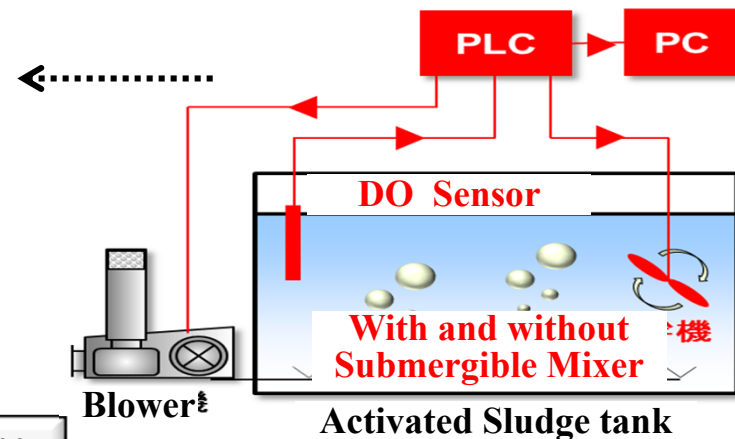
AOSD
Original
Artificial
Intelligence
program

Expected outcome

- **Low loading** of BOD,N,P water environment restoration
- **High stability** to treat fluctuated wastewater by **AOSD**
- **Saving electricity cost** by optimized required oxygen
- **GHG reduction** by saving electricity and optimized operation

Business model

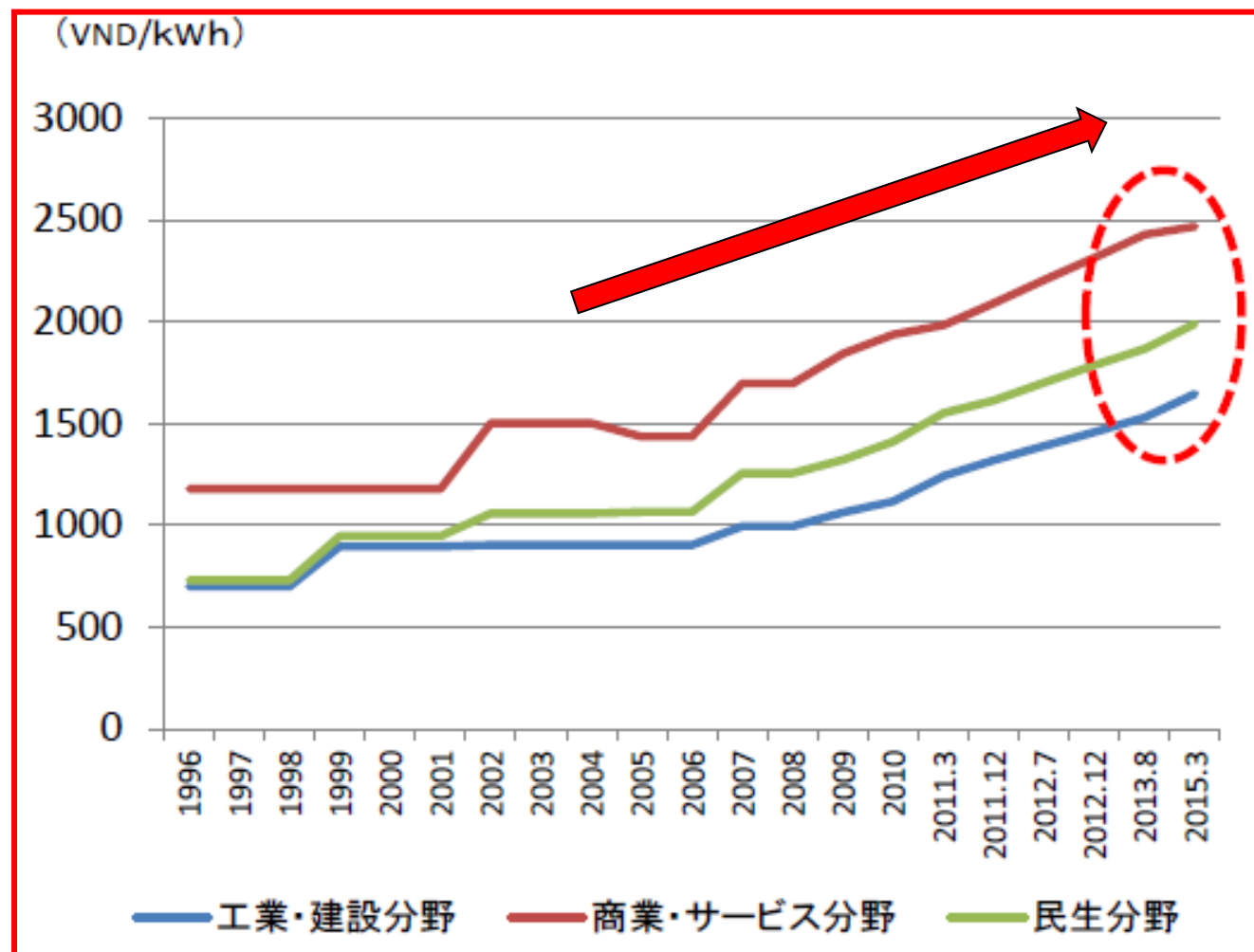
- ① Upgrade of existing WWTP
- ② Rental with saving initial investment
- ③ Newly built WWTP with technology



Business growth with best- balance combination of three business models for Asia:

Current status of important electricity charges in water environment projects in Asia

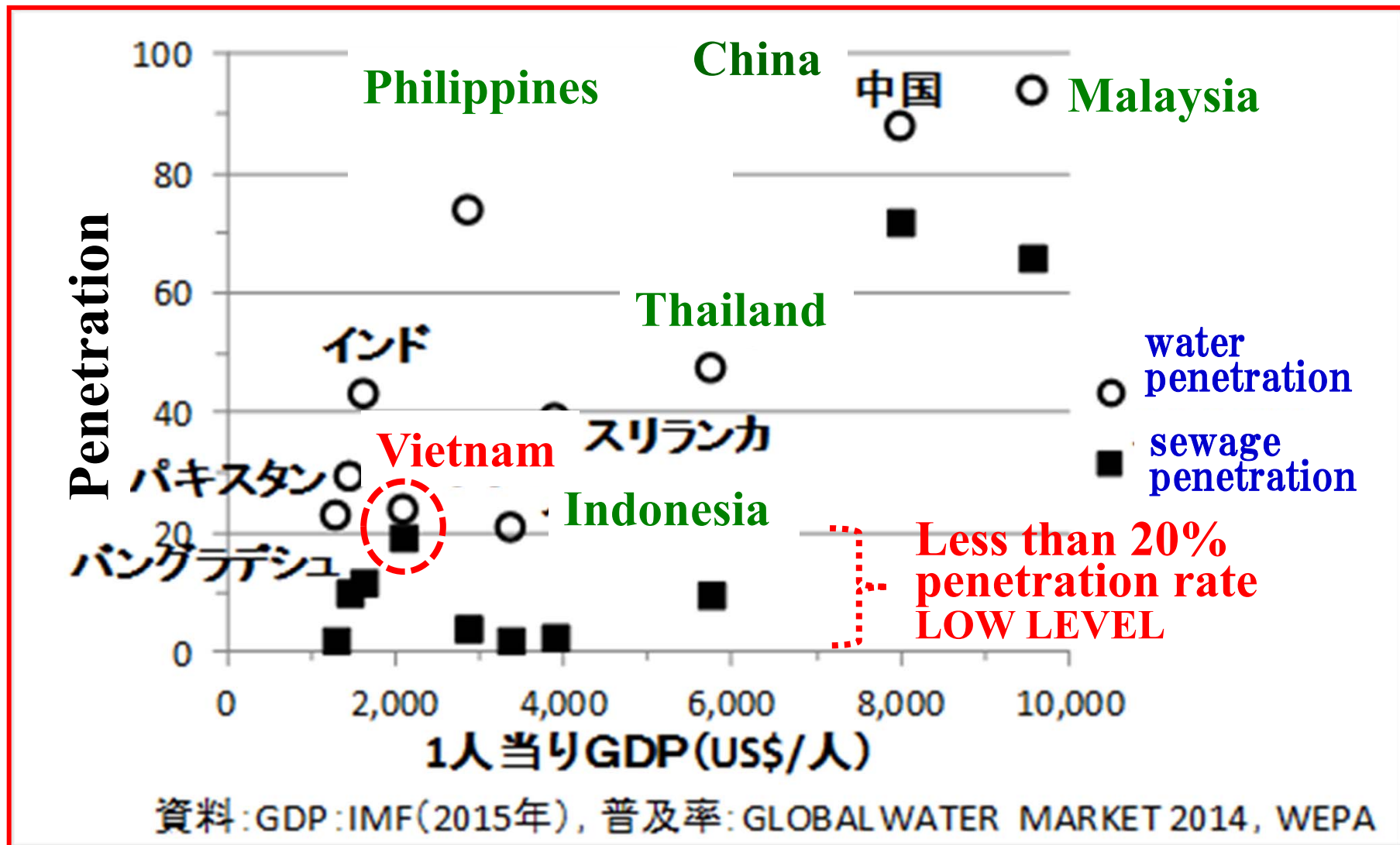
アジア地域の水環境事業における重要な電力料金の現状



資料:「ベトナム電力調査2015」、ジェトロ・ハノイ事務所、2015.8

Trends in electricity charges in Vietnamベトナムにおける電力料金の推移

Current status of GDP and water and sewage penetration in Asia アジア地域のGDPと上下水道普及率現状



GDP per capita and water and sewage penetration rate
1人当りGDPと上下水道普及率

Epochal controlling system for WWTP to fulfill conflict requests

AOSD

Automatic Oxygen Supply Device

*Want to improve
the ability of WWTP*



*Want to cut down
the cost for WWTP*



AOSD can satisfy both
requests at the same time



Technology

Treatment of Nitrogen

AOSD can improve the treatment ability for nitrogen and organic pollutants such as BOD and COD.

No empirical knowledge

AOSD can control the WWTP without any empirical knowledge even if the quality of WW changes.

Developed in Japan

AOSD was developed and researched in Japan over 20 years ago and became widely used.

Economy

Saving the electric cost

AOSD can save the electric cost for aeration because optimum amount of oxygen is provided.

Long life for equipment

AOSD can operate WWTP in the minimum time. So the life of the related equipment will be long.

Installed to existing WWTP

AOSD can be installed to existing WWTP and utilize it. So it need not to construct new facility.

Contact info.: 0 906 906 122 or sakura.ecotech@gmail.com

Components of AOSD

PLC

Calculation of best operating time for blower by DO data using original program developed by Genetic Programming.



Display

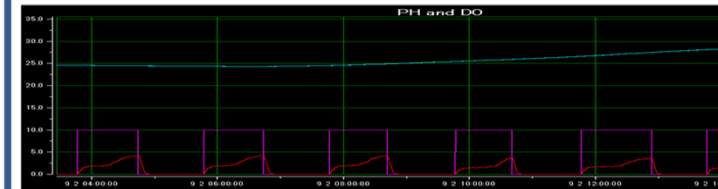
PLC (Programmable Logic Controller)

Display

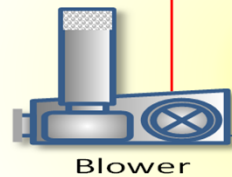
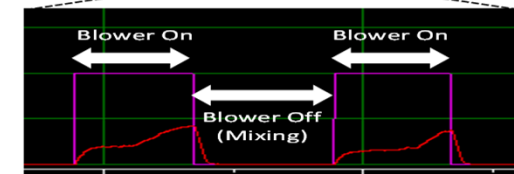
Confirmation of current situation and alarm

Data logging and drawing graph

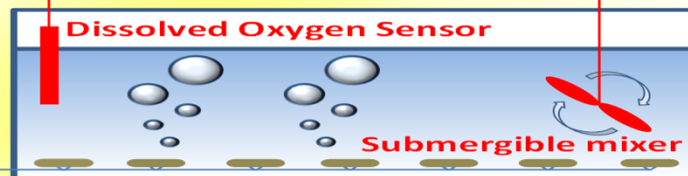
*Optional functions with PC



Zoom up!



Blower



Activated sludge tank

Existing WWTP

Dissolved Oxygen Sensor

Measure of Dissolved Oxygen with newest method (Fluorescent type).



Submersible mixer

Mixing of sludge when blower is stopping

Background of AOSD

AOSD was developed by ALS over 20 years ago and became widely used for advanced treatment of nitrogen around closed water body and inner sea in Japan. The number of projects was over 100. AOSD has been started installing in Vietnam as well.



Supervisor: Prof. INAMORI Yuhei

Japanese famous professor of Wastewater treatment using bio-eco engineering. He developed AOSD, researched it and made it raise the performance drastically and be expanding over the world.



Advanced AOSD Sewage Treatment System

AOSDシステムはBOD, T-N, T-Pが各々 200, 50, 5mg/L程度の下水処理などで省エネ・温暖化対策可能な電力削減高度処理システムである。

Organic wastewater consists of human wastes and miscellaneous wastewater and has a **typical BOD, T-N, and T-P level of 200, 50, and 5mg/L**, respectively. Daily and yearly changes in the amount of drainage should be considered.

Aeration time is controlled in the activated sludge method depending on microorganisms' oxygen consumption.

**Automatic Oxygen Supply
Device(AOSD) Installation**



**Beautiful
water**

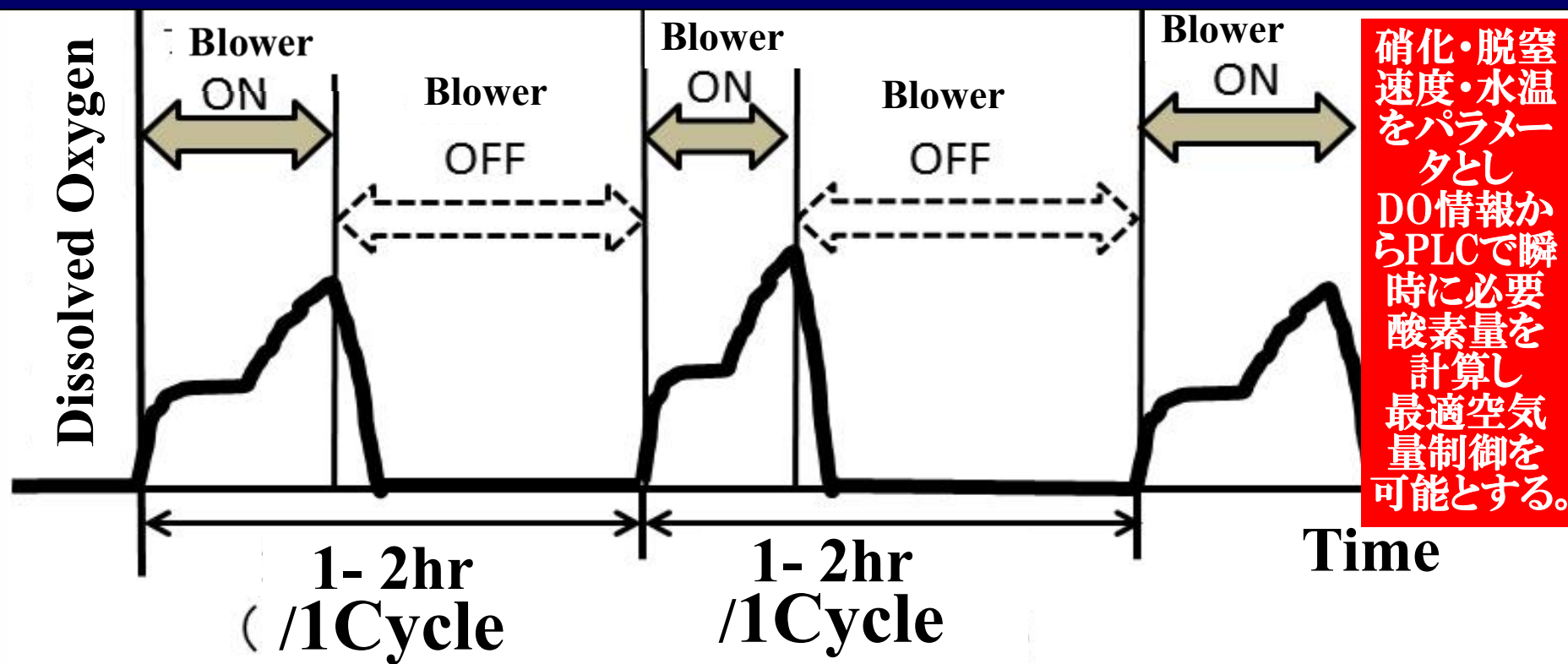
**AOSD is an innovative system for a low-carbon society creation.
It is capable of conducting advanced treatment on sewage
with a lower power consumption.**

DO Pattern change in AOSD System of Blower

Air Control AOSDシステムにおける曝気用送風機ブロワーのON-OFF 制御下のDO(溶存酸素)パターン:1サイクル2時間の場合ブロワーONでのDO上昇パターン・ブロワーOFFでのDO減少パターンのDO値をPLCに取り込み高速計算して最適な曝気時間を自動決定

AOSD (自動酸素供給装置; Automatic Oxygen Supply Device) System

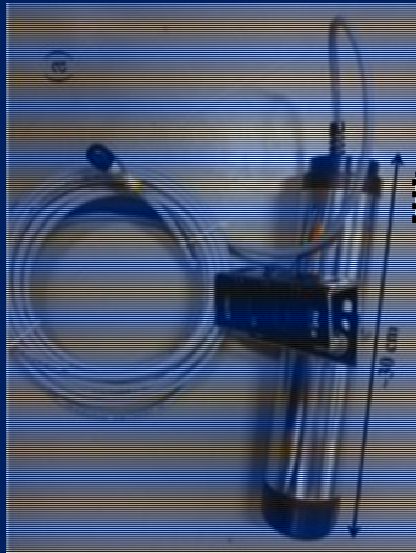
From slope of DO increase and decrease, oxygen supply coefficient value has been determined with high accuracy automatically under the base of nitrification/denitrification/water temperature in PLC



Component of Equipment in AOSD System

LDO Sensor (蛍光式DO計) Installation in Reactor

LDO controller

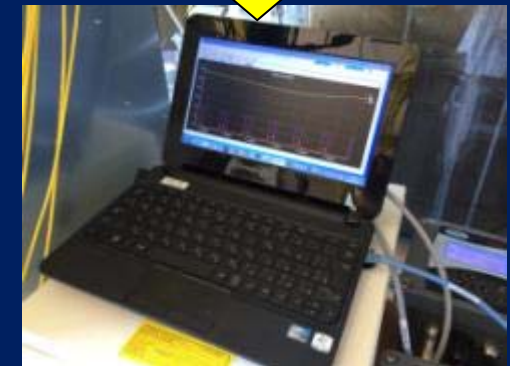
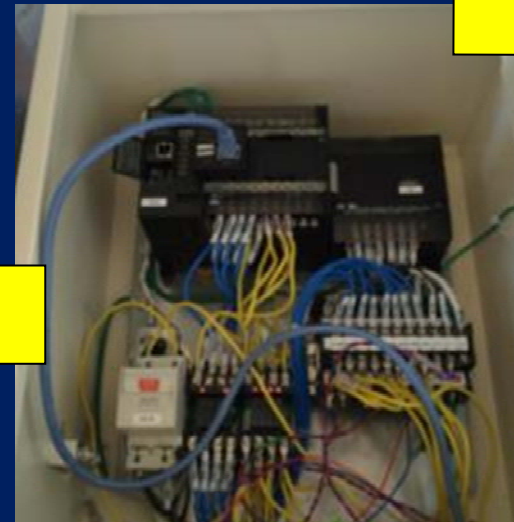


DO • Water Temperature
Continuous Monitoring

PLC

PC

Blower



Supply of Theoretical Oxygen

Blower: ON/OFF control

制御状態
Monitoring

Estimation in Binh Hung Sewage Treatment Plant(連続HRT3hr活性汚泥法) (Ho Chi Minh City) 140,000 m³/Day ビンファン ホーチミン



10 series 10系列

J I H G F  E D C B A


First sedimentation pond HRT : 39 minutes Water area
load : 108m³ / m² / day



Activated sludge tank 28m long Width 10.5m Depth 5.5m 10
series, 4 divisions HRT : 2.76 hours

Activated sludge tank 1 series 4 tanks 活性汚泥槽1系列4槽

Confirmation of effectiveness of AOSD system
AOSDシステムの効果確認



Final sedimentation pond 10 series HRT : 1.63 hours
Water area load: 52m³ / m² / day

最初沈澱池

HRT: 39分 水面
積負荷:
108m³/m²/day

活性汚泥槽

長さ28m 幅
10.5m 深さ
5.5m 10系列・
4分割 HRT:
2.76時間

最終沈澱池

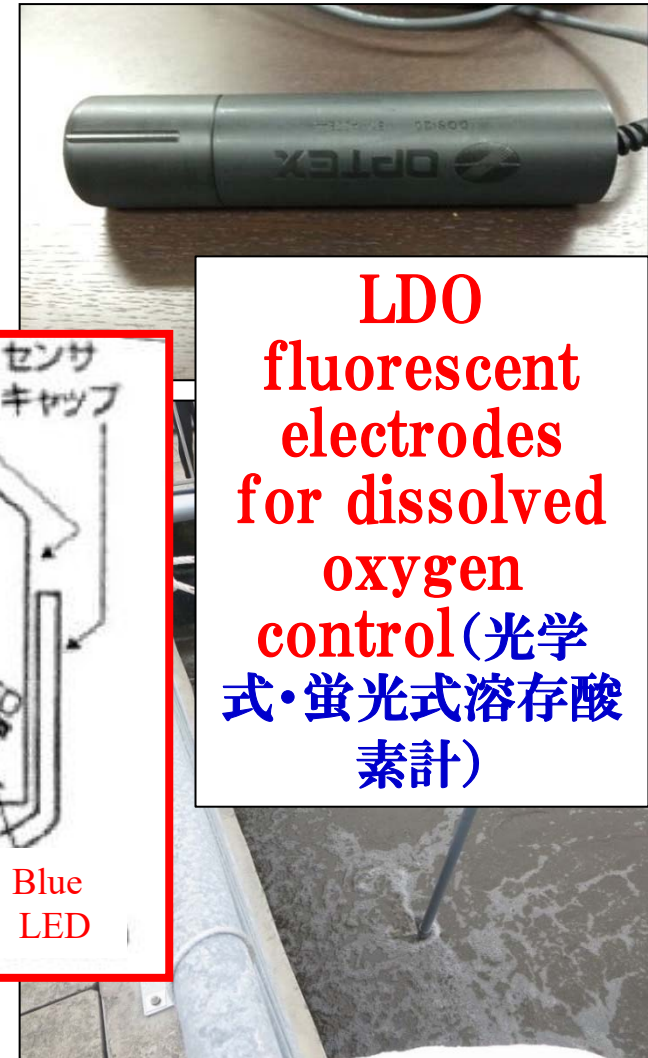
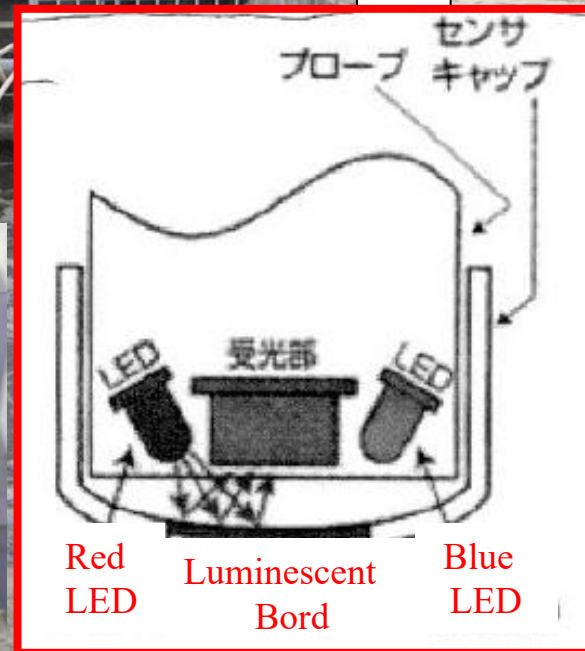
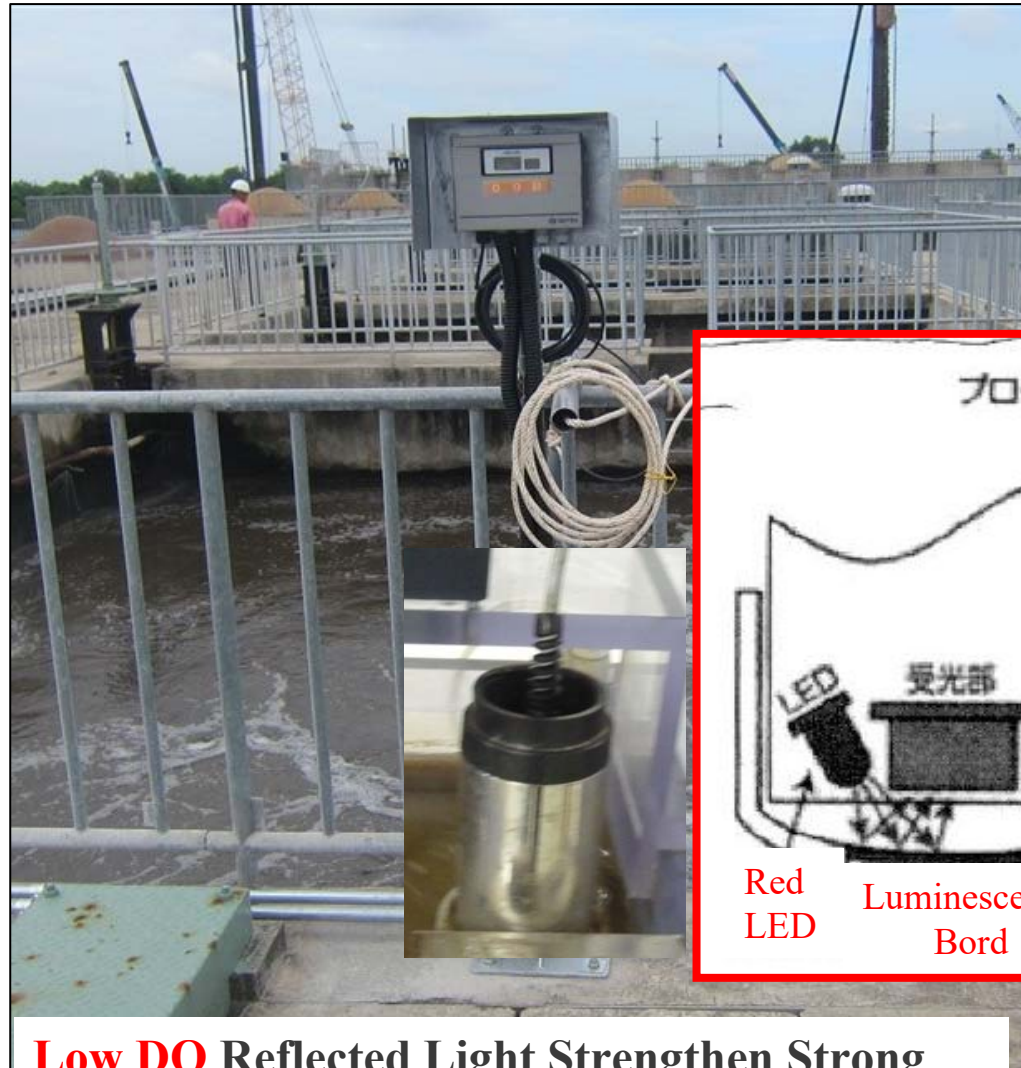
10系列
HRT: 1.63時間
水面積負荷:
52m³/m²/day

AOSD control (with automatic control system for oxygen supply) in activated sludge system



Application of Fluorescent Dissolved Oxygen (LDO) Meter which is the core of AOSD system

AOSDシステムの中核となる蛍光式溶存酸素(LDO)計の適用

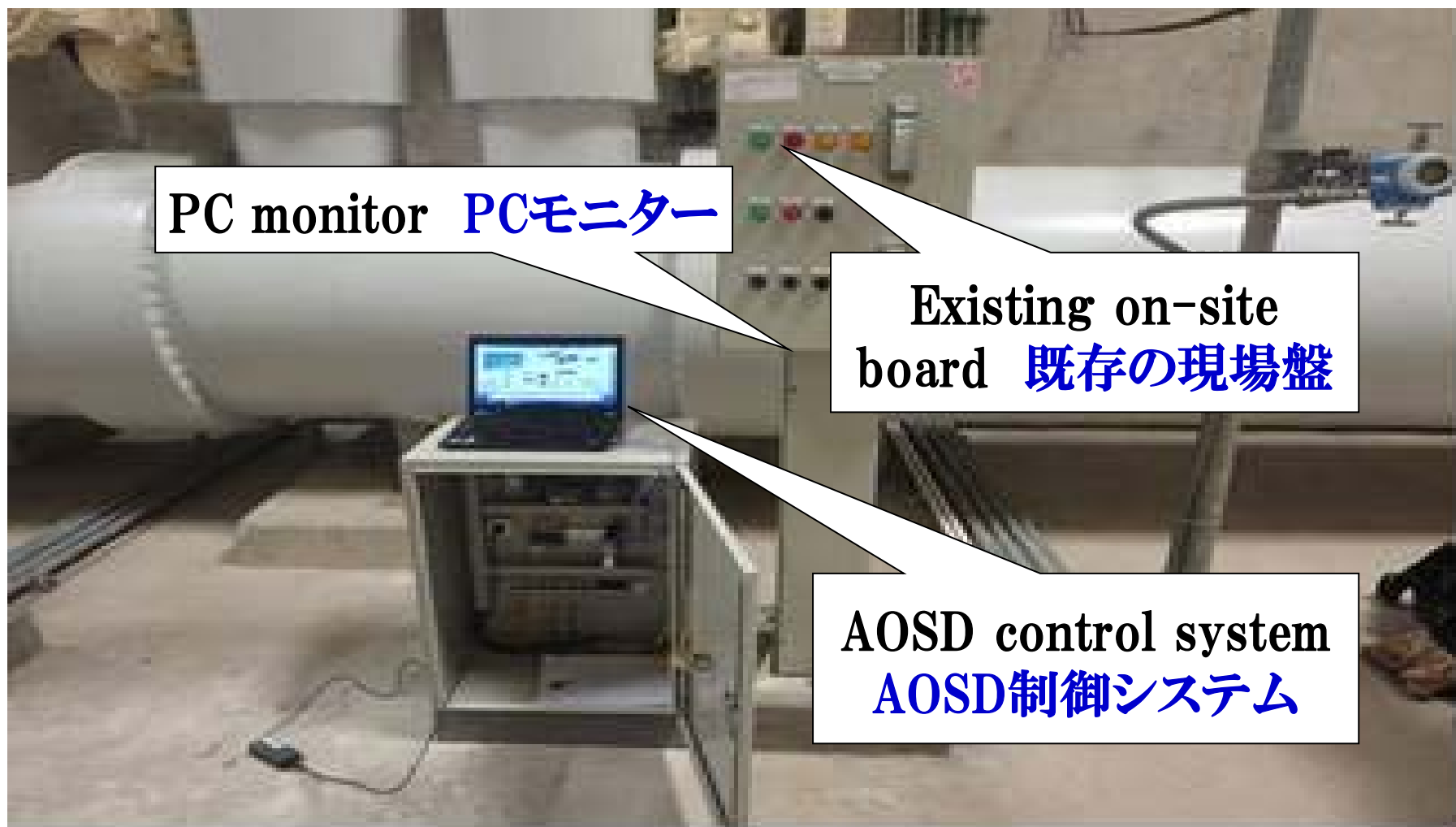


LDO
fluorescent
electrodes
for dissolved
oxygen
control(光学
式・蛍光式溶存酸
素計)

Low DO Reflected Light Strengthen Strong
High DO Reflected Light Strengthen Weak

Improvement of introduction of AOSD system to existing control panel

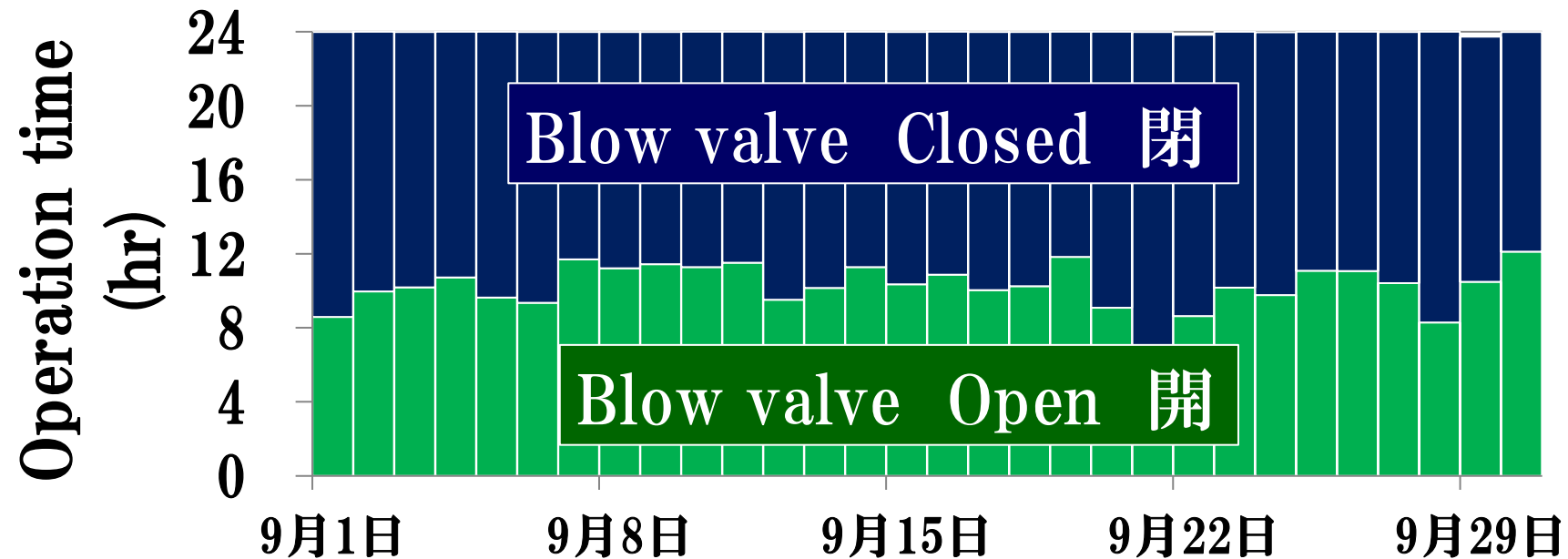
AOSDシステムの既存制御盤への導入改善



Installation status in Vietnam ベトナムにおける設置状況(制御盤)

Evaluation of power reduction effect from opening and closing time of blower valve at Bin Hung sewage treatment plant

ビンフン下水処理場における送風バルブの開閉時間からの電力削減効果の評価



In the Old system, the blower is operated continuously for 24 hours. But in the AOSD system, when a simulation was performed by opening and closing the blow valve, it automatically followed the change in the raw water quality and when the valve was opened, it decreased by about 60%. It was confirmed that the control was performed under the optimum conditions.既存システムではブロワ24時間連続運転であるが、AOSDシステムでは、送風バルブの開閉シミュレーションから、原水水質の変化に自動追従して、バルブ開時間は、約60%減に制御できた。

Electricity consumption at Bin Hung sewage treatment plant Estimated reduction effect and business modeling

ビンフン下水処理場：電力使用量削減効果の試算とビジネスモデル化

Amount of treated water (m3 / day) 処理水量 (m3/日)	Aeration power amount (Thousand kWh / year) 曝気電力量 (千kWh/年)	Annual electricity cost (Thousand yen / year)年間電力費用 (千円/年)	Reduced power cost (thousand yen / year) 削減電力費用(千円/年)
141,000	4,205	35,657	21,394

Estimated condition : “ **Power reduction rate is 60%**” by adding the amount of power used during micro-aeration agitation currently being analyzed. And setting. It is set that the result of the verification test of 1 series out of all 10 series is applied to the entire facility.

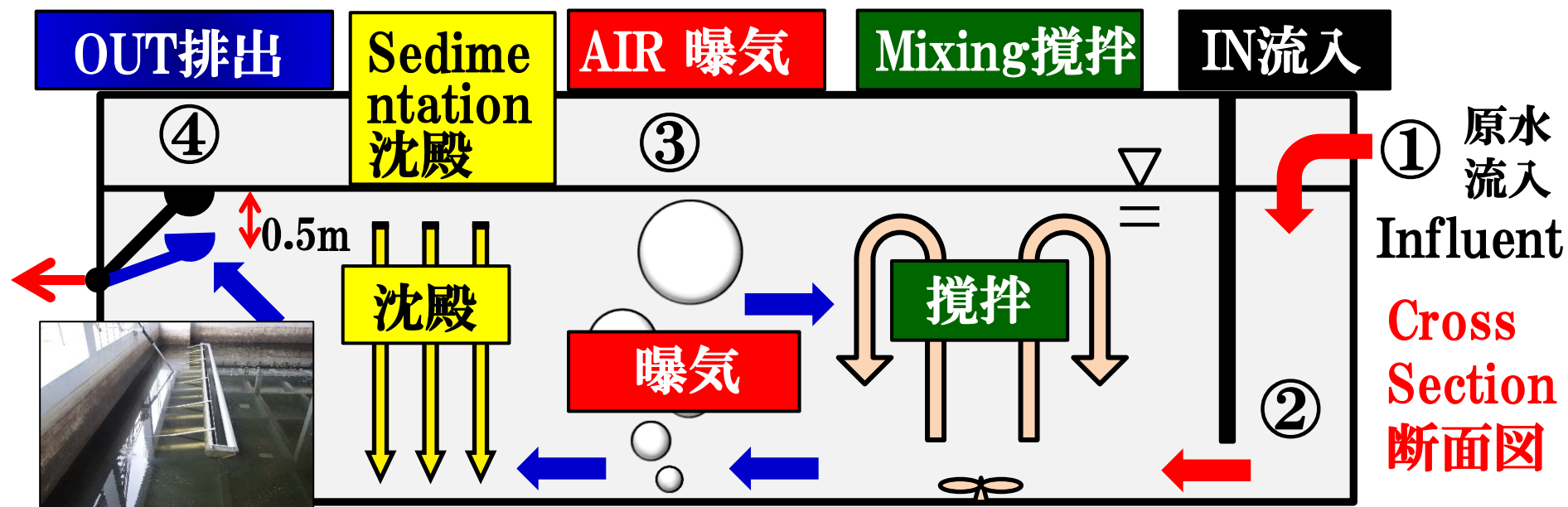
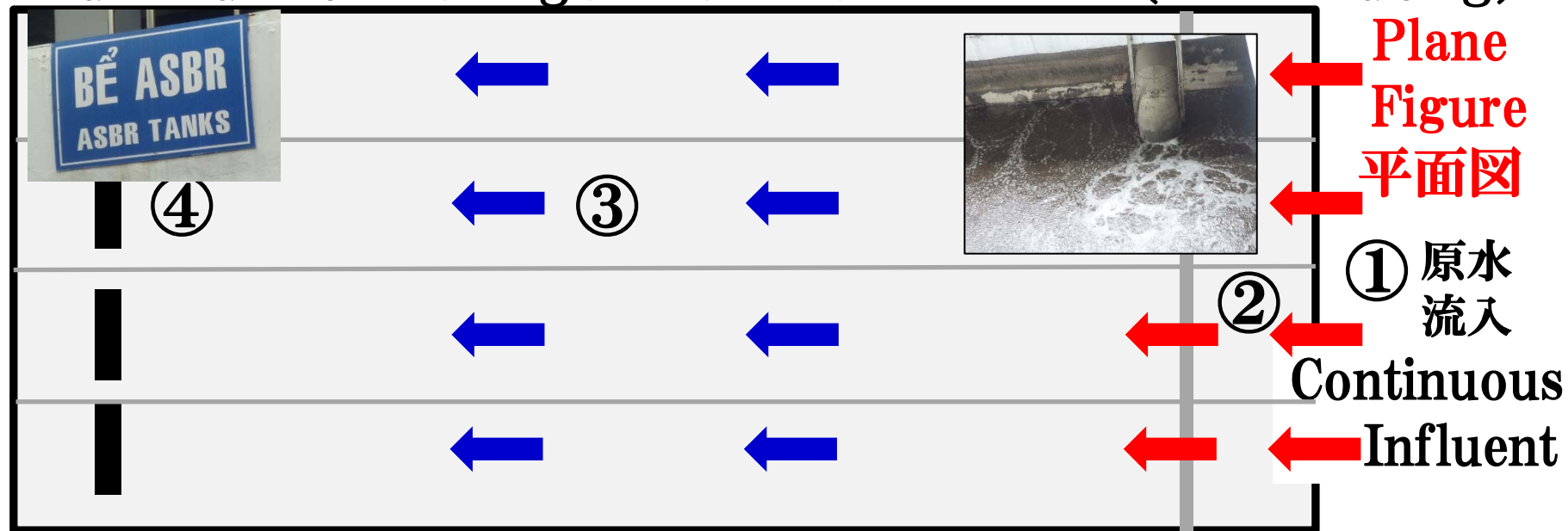
試算条件：現在解析中の微曝気攪拌時の電力使用量を加え「**電力削減率を60%**」と設定。全10系列中1系列の実証試験の結果を、施設全体に適応したと設定。

◎ **Stable water quality can be maintained. Big cost merit** was calculated. It's a phenomenal achievement.◎ **Assuming remodeling cost is 68 million yen, the investment amount can be recovered in about 3 years.** ◎ **安定した水質を維持できると共に大きなコストメリットが試算された。驚異的成果である。** ◎ 既設改造費用を 6,800万円とすると、**約3年で投資金額の回収**可能である。

Estimation in Thu Dau Mot Sewage Treatment Plant (修正回分式活性汚泥法) (Binh Duong) 17,000 m³/Day トゥーザウモット ビンズン

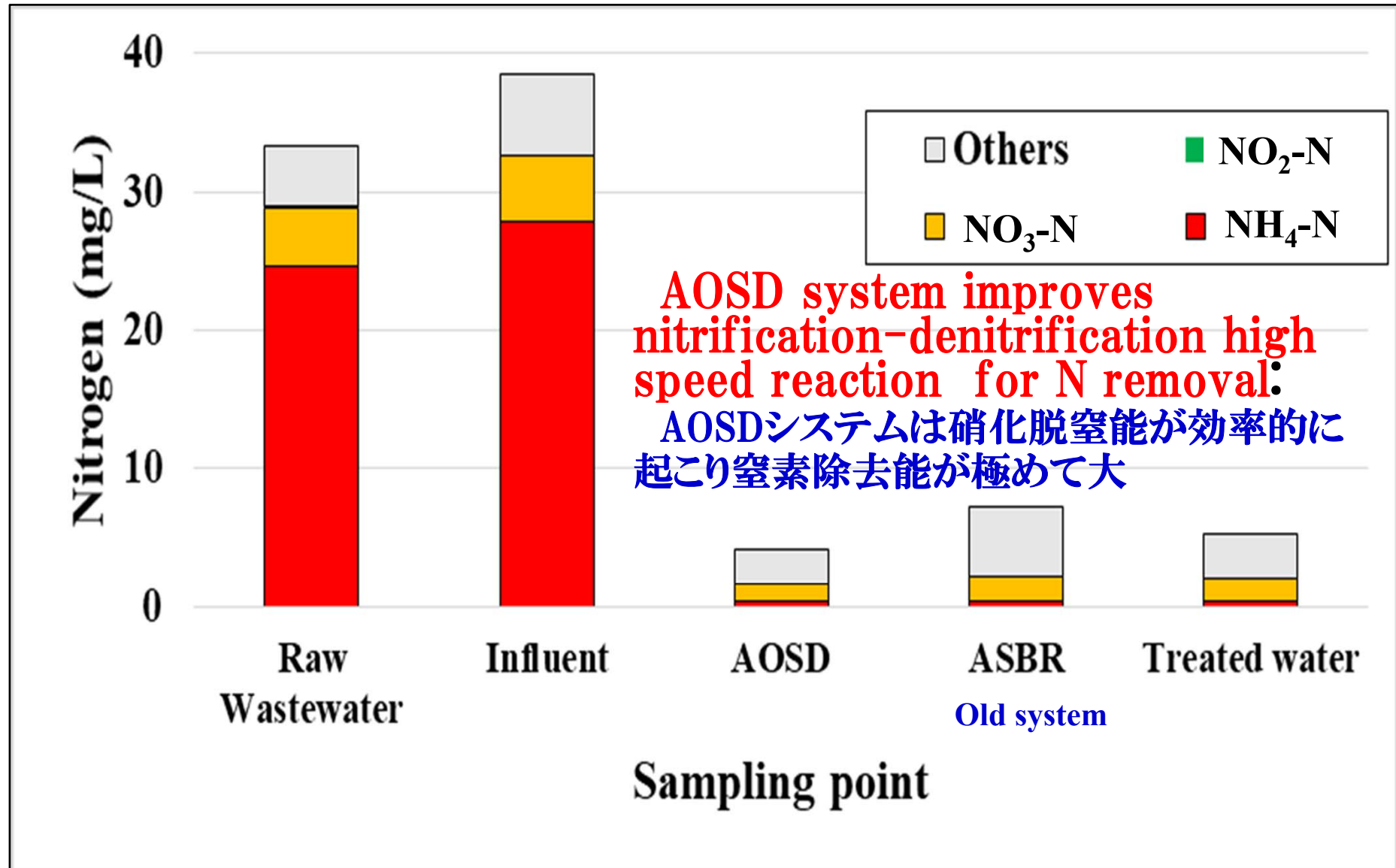


Thu Dau Mot Sewage Treatment Plant (Binh Duong)

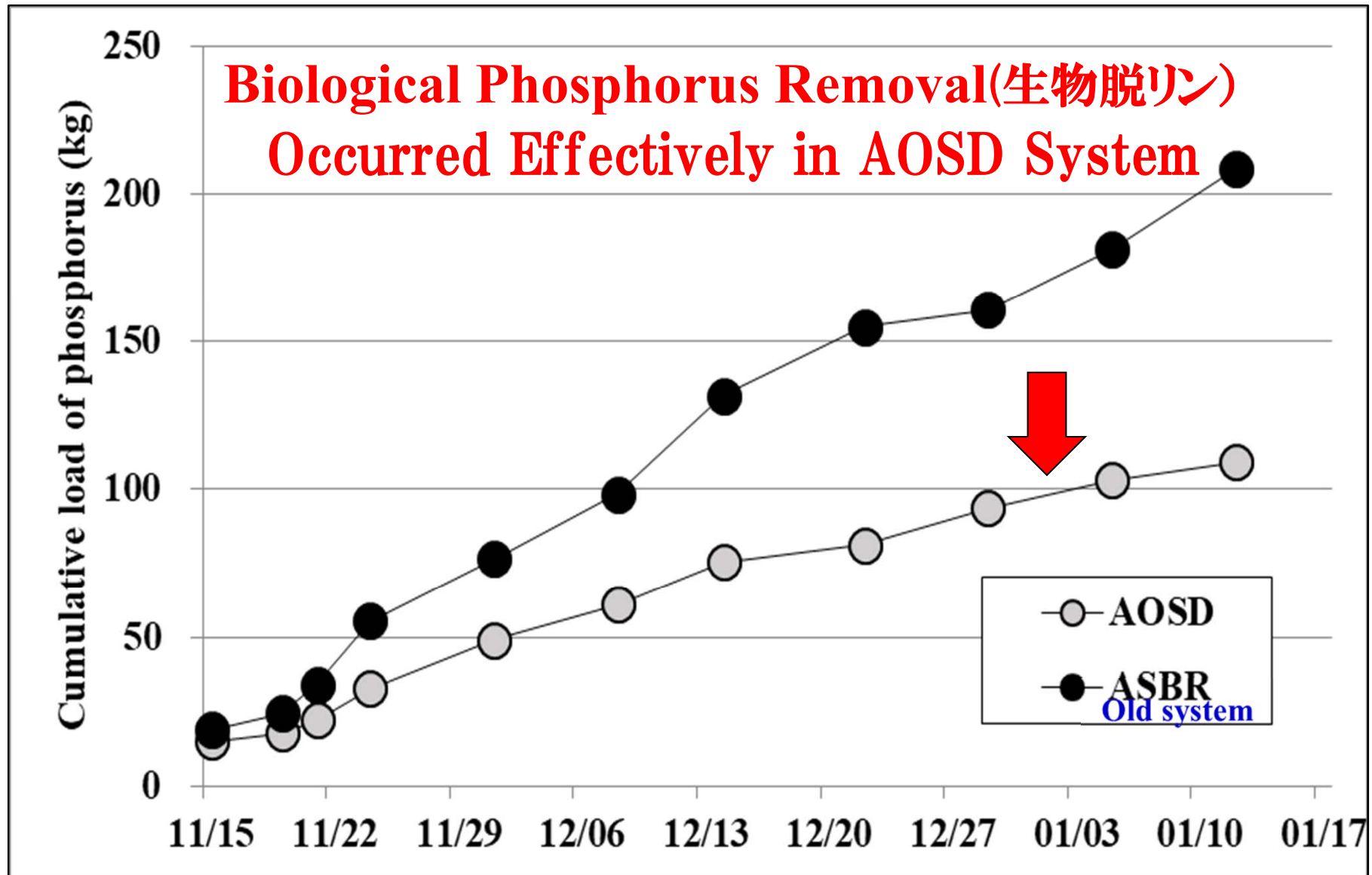


Aeration 120Min. Mixing 48Min. Sedimentation/OUT 120Min. = 288Min.
 (4.8hr) 5 Cycle/Day : Original Operation Method

Average integrated value of each nitrogen form



Reduction effect of phosphorus load by AOSD



Maximum Power Consumption Reduction is about 40-70%

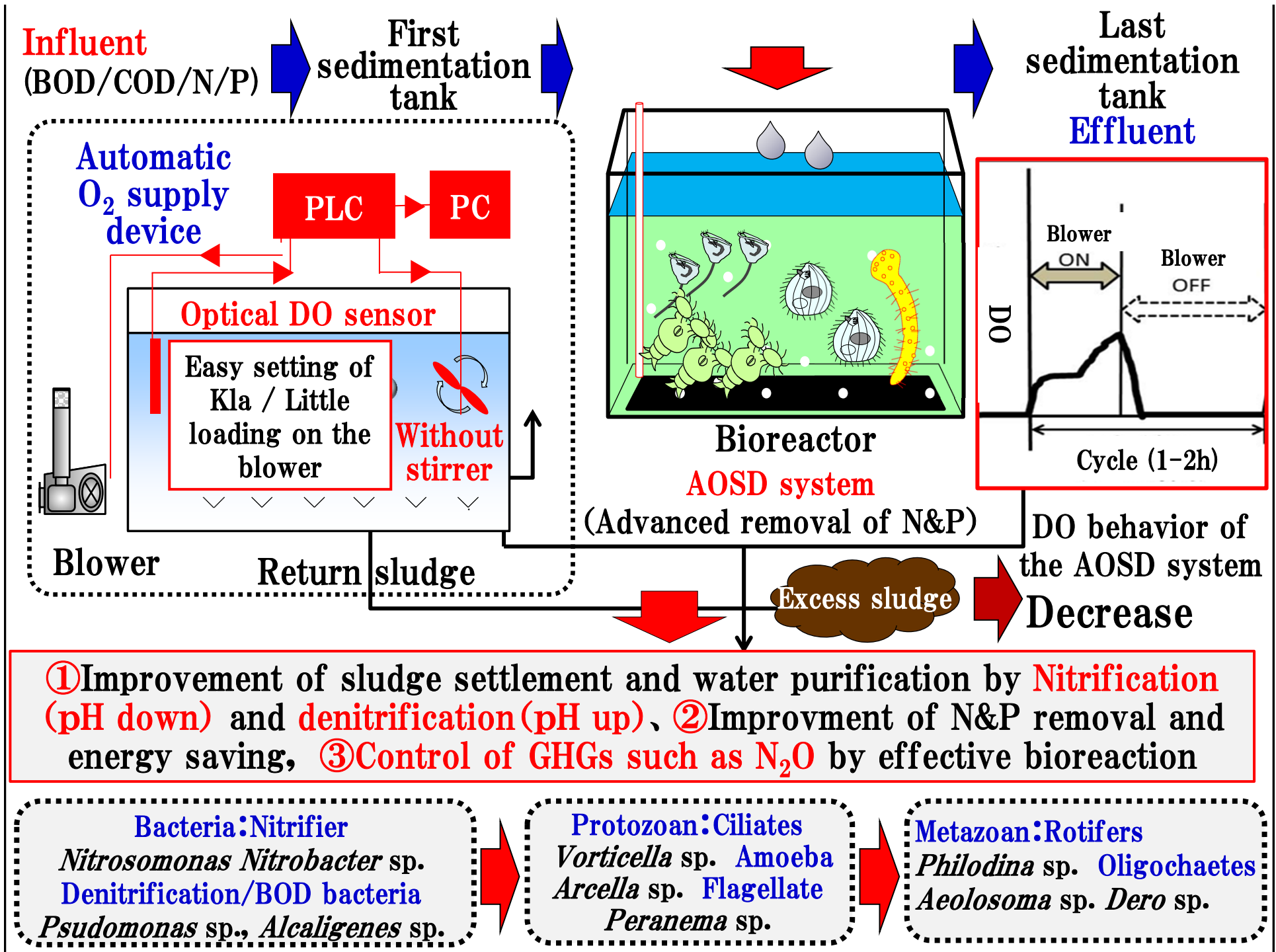
* Japanese Yen

Blower capacity Power consumption Ordinary use fee Yen/year

2.2 KW	$2.2 \text{ KW} \times 24 \text{ hr} \times 30 \text{ days} \times 12 \text{ months} \times 10 \text{ yen/KW}$	¥190,080
3.7 KW	$3.7 \text{ KW} \times 24 \text{ hr} \times 30 \text{ days} \times 12 \text{ months} \times 10 \text{ yen/KW}$	¥319,680
5.5 KW	$5.5 \text{ KW} \times 24 \text{ hr} \times 30 \text{ days} \times 12 \text{ months} \times 10 \text{ yen/KW}$	¥475,200
7.5 KW	$7.5 \text{ KW} \times 24 \text{ hr} \times 30 \text{ days} \times 12 \text{ months} \times 10 \text{ yen/KW}$	¥648,000
11 KW	$11 \text{ KW} \times 24 \text{ hr} \times 30 \text{ days} \times 12 \text{ months} \times 10 \text{ yen/KW}$	¥950,400
15 KW	$15 \text{ KW} \times 24 \text{ hr} \times 30 \text{ days} \times 12 \text{ months} \times 10 \text{ yen/KW}$	¥1,296,000

AOSD System high performance for Electric power reduction, about 30% in conventional anoxic-oxic process, More than 60% in conventional oxic process.

AOSDシステムは通常の嫌気好気硝化脱窒システムに比べて約30%、通常の標準活性汚泥法に比べて60%以上の電力削減が可能となる。

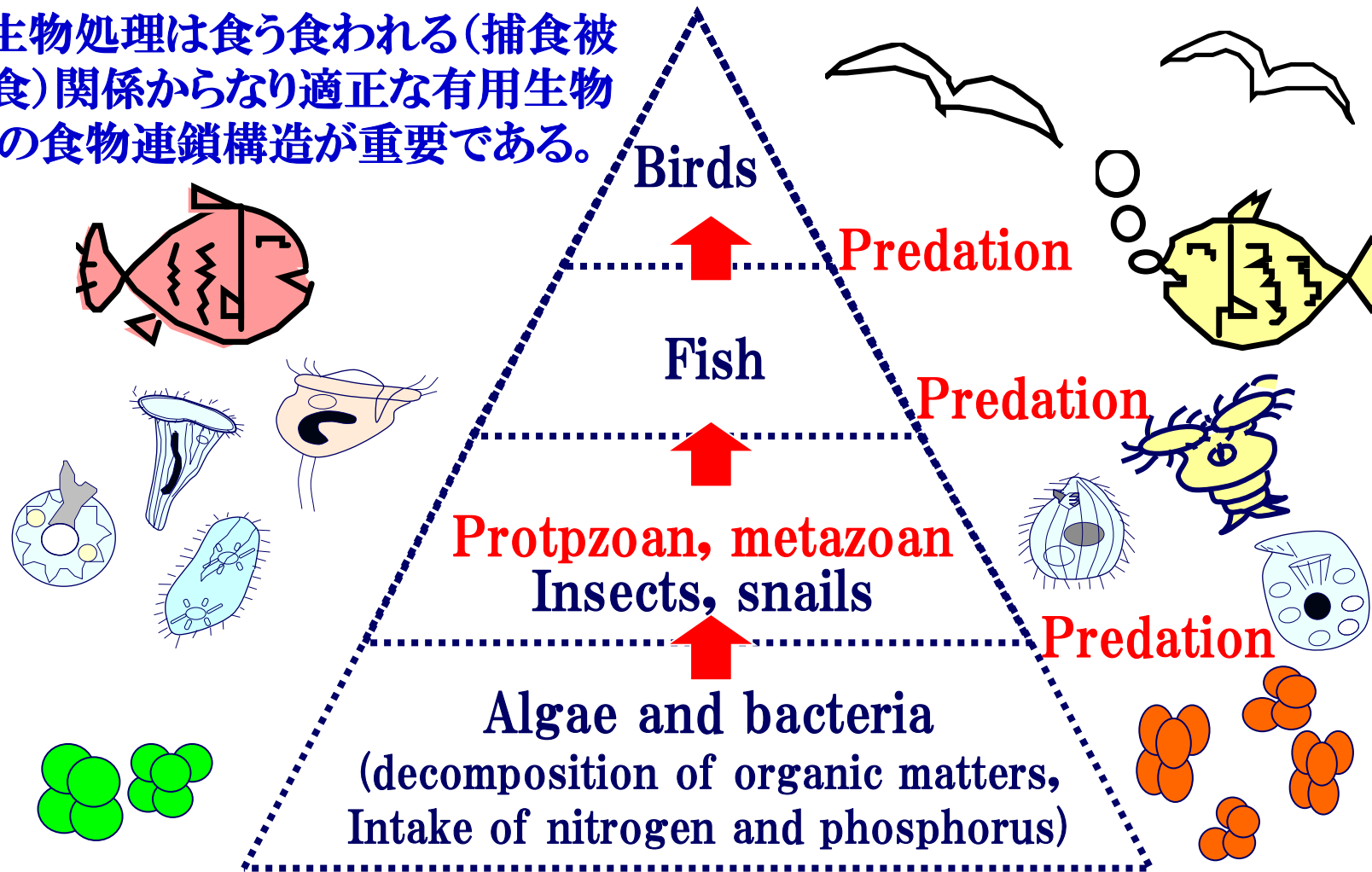


Effectiveness of AOSD system

- ◎ AOSD (Automatic Oxygen Supply Device) system is the latest environment newly renovation system which supplies only the necessary quantity of oxygen of the microorganism in the advanced sewage treatment under the electric power reduction.
- ◎ It also contributes to COP21 including a basin of lakes and marshes. In the sewage treatment process, optimal oxygen amounts required for organic matter removal, nitrogen removal by nitrification-denitrification etc. are controlled by using some parameters such as water temperature and dissolved oxygen (DO) and so on, efficiency of blowers and stirrers can be operated via PLC (Programmable Logic Controller) automatically.
- ◎ As the Model Project of Asia Water Environment Improvement by Ministry of the Environment of Japan, "Vietnam's wastewater treatment and cost saving dissemination project" was carried out.
- ◎ By this project advanced BOD, nitrogen and phosphorus removals have been accomplished and verified with more than 50% electric power reduction with AOSD system, simultaneously.

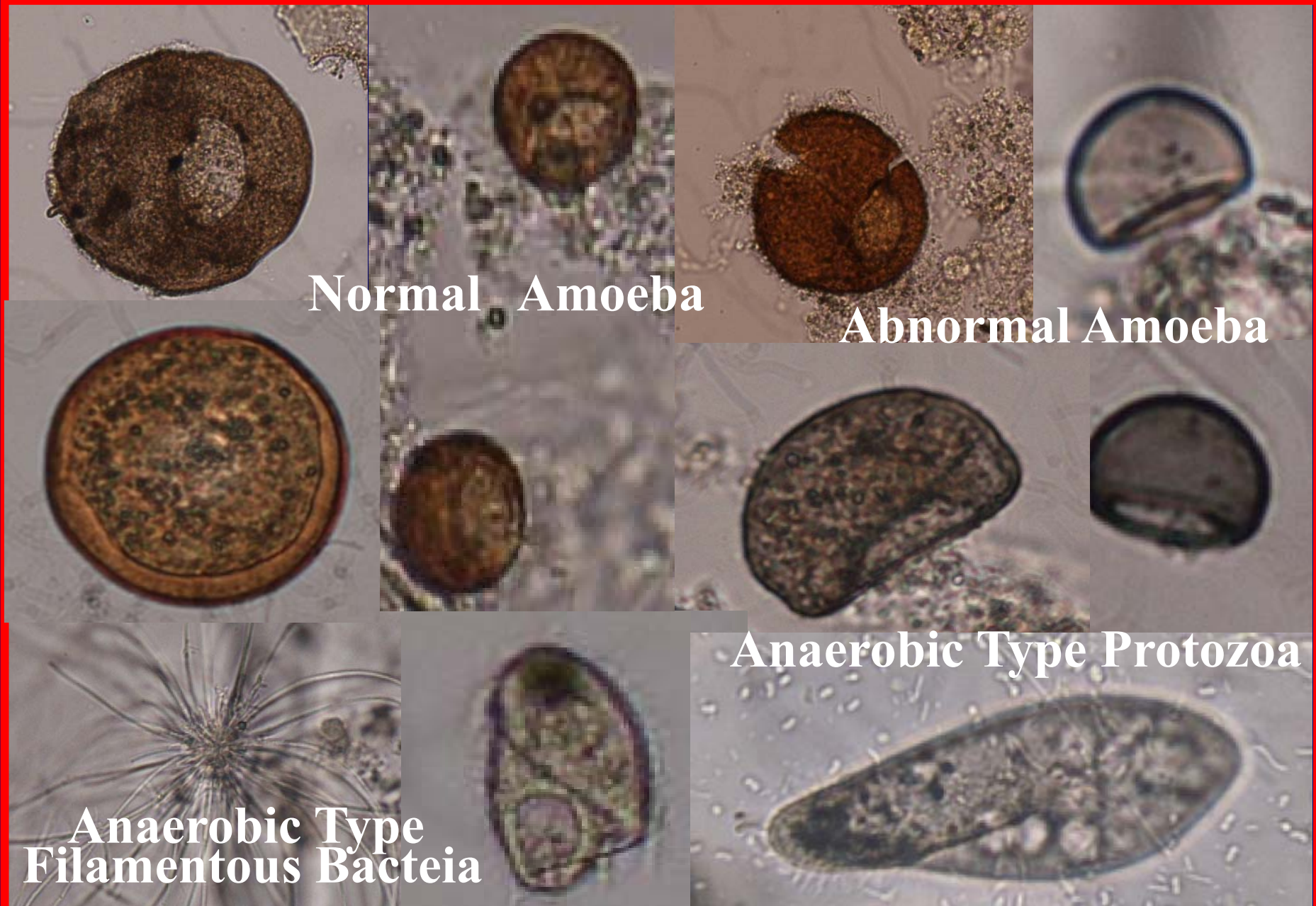
Creatures contributed to improving water environment

生物処理は食う食われる(捕食被食)関係からなり適正な有用生物の食物連鎖構造が重要である。



Food-chain and water purification in natural and artificial ecosystem

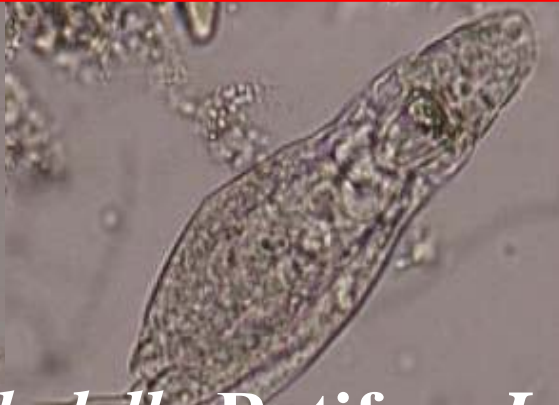
Micro-animals in reactors



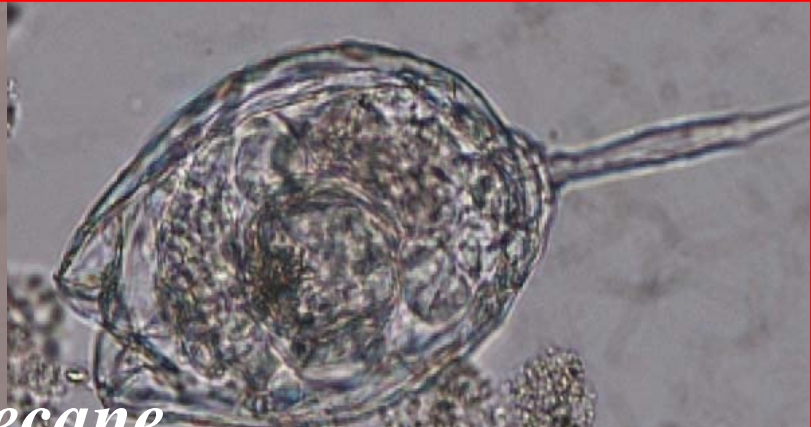
Micro-animals in Reactor



Rotifera *Cephalodella*



Rotifera *Lecane*



Rotifera *Monostylla*



Ciliate

Rotifera *Philodina*



Egg of Rotifera



Movement of *Philodina*

Micro-animals in Reactors



Protozoa *Epistylis*



Protozoa Sarcodina



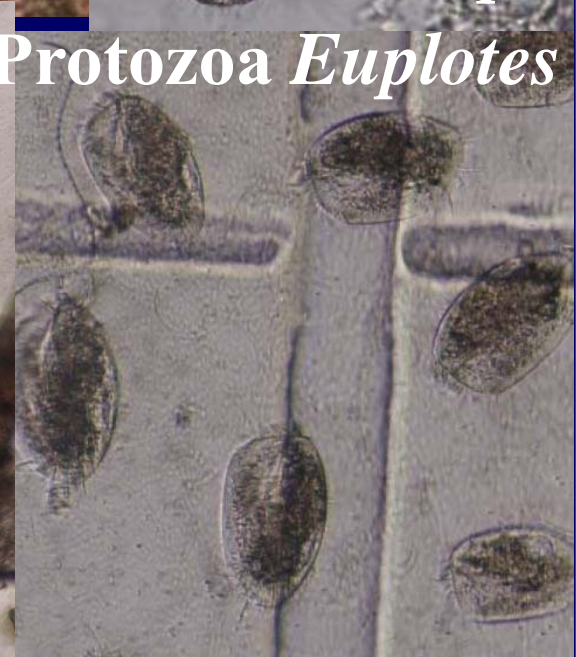
Protozoa *Coleps*



Micro metazoa
Aeolosma



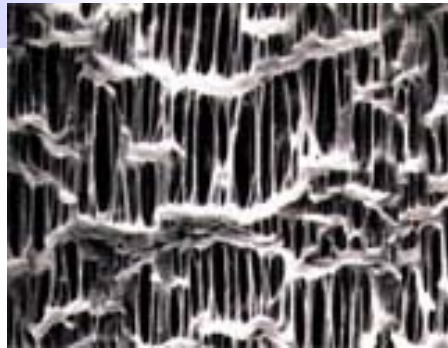
Micro metazoa
Dero



Protozoa *Euplotes*

Membrane unit installed in Advanced Wastewater Treatment System: Important of Clean Water Recirculation

AOSDシステム-膜分離活性汚泥法に於ける膜洗浄曝気エネルギー活用で70%電量削減可能



Submerged membrane[®] set



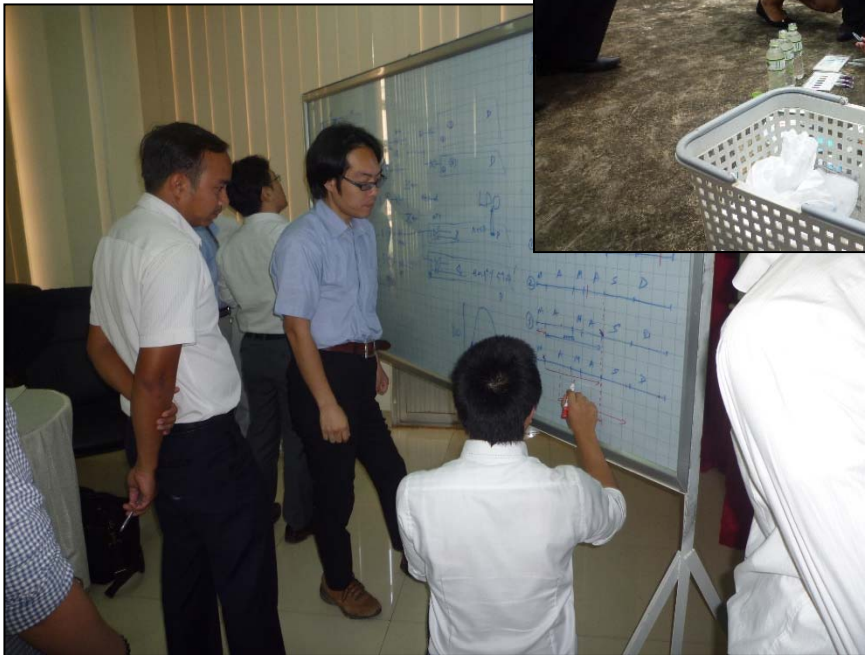
Membrane

Filter plate

Upflow stream

Treated water
Membrane

It's possible to reduce 70% electric amounts by Membrane washing aeration energy utilization in a AOSD system-Membrane separate activated-sludge process.



Education on AOSD System Introduction



Instruction on AOSD System using LDO: Face to Face

Outcome and Prospective on AOSD System

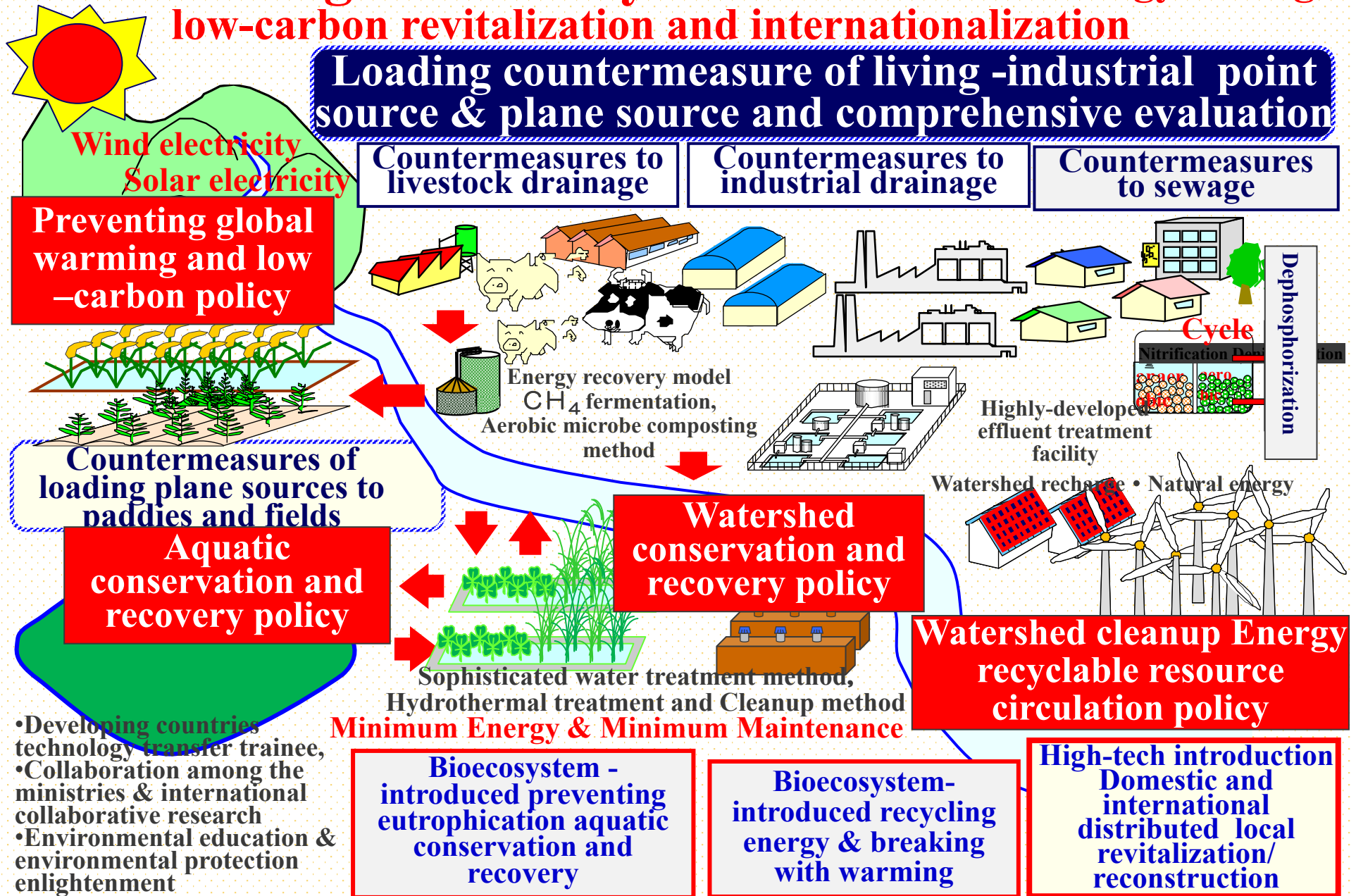
Based on the results of this study, following conclusions were drawn:

- ◎AOSD system was proved to be an energy saving technology.
- ◎AOSD system can be used to restore the accelerated pollution environment areas not only in developing countries like Vietnam but also in Japan such as Lake Kasumigaura catchments.
- ◎ We strongly suggest to promote the business model for installation of AOSD system and the spread to necessary regions.
- ◎ It is necessary for government to shift the enforcement policy for conventional wastewater treatment system to advanced affordable type (high treatment performance and energy saving) system for wastewater treatment and global warming measures.

AOSDシステムは電力削減50%以上の省エネ可能なCOP21に資する高度処理法で、アジア地域への展開による環境再生保全が可能な独創的な汎用的な技法である。

Regeneration of Environmental Protection by Introducing Bio-Eco System-An outline of energy-saving low-carbon revitalization and internationalization

Loading countermeasure of living -industrial point source & plane source and comprehensive evaluation



International Spreading on Advanced Energy Saving AOSD System using Results of Vietnam Project (ETV)

Speed up Spreading of Advanced Energy Saving AOSD
System using ETV (Environmental Technology
Verification): Certification of international Estimation.
Under Cooperation with the Friendly Relationship of
Vietnam Counterpart Government, Company and so on.
Investment can be recovered in short time: Efficient System.

Ministry of Environment
JAPAN

環境技術
実証事業

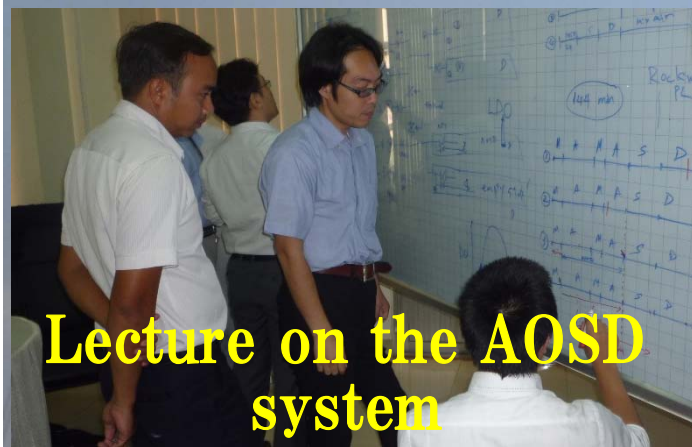


<http://www.env.go.jp/policy/etv/>

Electric reduction and advanced treatment
using AOSD(Automatic Oxygen Supply
Device) System

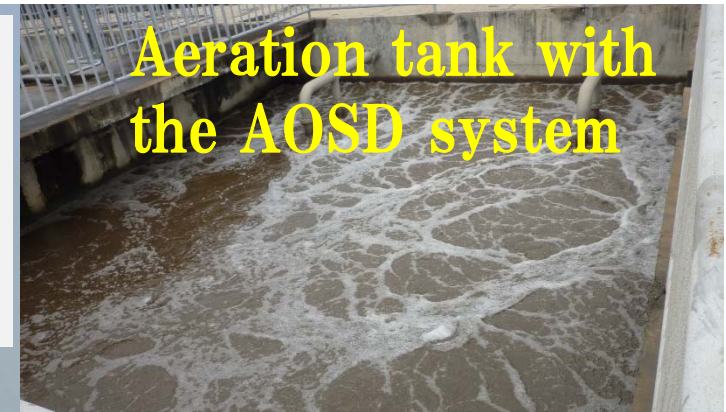
AOSD—YRINAS2018

Foundation for Advancement of
International Science :Bio-Eco Technology
Development Research Center, NPO: Bio-
ECO Technology Research Center,
Cooperation: ALS Co.Ltd, SAKURA ECO
TECH Co. Ltd, Rtec Co.Ltd and so on.



Lecture on the AOSD system

Friendship
At the sewage
plant with the
AOSD system



Aeration tank with
the AOSD system



Explanation of the AOSD system to the officials



Check of the LDO sensor



**Agreement on AOSD system enhancement
in sewage treatment plant, Vietnam
between Vietnam side and Japan side**

Sustainable Development

Technological Assistance

**Asian and
Pacific
Countries
and Other
World**



JAPAN
Vietnam

Feedback of Technical Development

**Importance of technological assistance and
feedback of technical development for
establishment of eco-sound water environment.**