New Technologies Meeting Your Needs 2022

Japan Sewage Works Agency

Two Pillars of JS' R&D Strategy

JS New Tech Implementation Program

JS New Tech implementation Program, started in 2011, aims to encourage the introduction of new technologies in the contract projects based on the application by developers.

As of June 2022, the program has registered **45** new technologies and has introduced **20** technologies from the program to **120** contract projects.

B-DASH Project

JS has been engaged in B-DASH (Breakthrough by Dynamic Approach in Sewage High Technology) Project collaborating with private enterprises and municipalities.
Joining in B-DASH Project promotes the adoption of demonstrated technologies by utilizing published guidelines.

As of June 2022, the Project has adopted **25** projects JS joins, and **23** have been completed.

New Tech Implementation Program 1/3

As of June 2022

Name of technology	Registered developer	Page
Wastewater treatment		
Feedforward aeration control by ammonia sensor	*Nissin Electric Co., Ltd.*	9
Aeration control device consisting of ammonia meter and control panel	*Kobelco Eco-Solutions Co., Ltd.*	10
Dual DO control for oxidation ditch (OD) process	*Kochi University,* *Maezawa Industries, Inc.*	11
Energy-saving MBR system using ceramic flat membranes	*MEIDENSHA CORPORATION*	12
Energy-saving MBR system using thin PVDF hollow fiber membranes	*Mitsubishi Chemical Aqua Solutions Co., Ltd.,* *Swing Engineering Corporation,* *Mitsubishi Kakoki Kaisha, Ltd.*	13
High-speed filtration system: an alternative to primary sedimentation tank system	*METAWATER Co., Ltd.*	14
Carrier-added activated sludge process (LINPOR process)	*NISHIHARA Environment Co., Ltd.*	15
Inclined plate sedimentation and separation device for a final settling tank	*Sekisui Aqua Systems Co., Ltd.*	16
Temporary wastewater treatment unit using single tank MBR and high-rate coagulation settling system	*Hitachi Plant Services Co., Ltd.*	17
Vertical screw screen with crushing/ dewatering functions	*Sumitomo Heavy Industries Environment Co., Ltd.*	18
Rapid up-flow moving bed filtration	*TAKUMA CO., LTD.*	19
Disk-type multi-filament filter fabric filtration equipment	*METAWATER Co., Ltd.* *Maezawa Industries, Inc.*	20
Stormwater Control		
Flow rate and water level fluctuation-adaptive horizontal submersible pump	*ISHIGAKI COMPANY, LTD.*	21

New Tech Implementation Program 2/3

As of June 2022

Name of Technology	Registered developer	Page
Dewatering		
Type 4 screw press (SP) dewatering device with enhanced internal thickener	*ISHIGAKI COMPANY, LTD.*	22
Type 4 rotary pressure dewatering device	*Tomoe Engineering Co., Ltd.*	23
Down-sized belt press dewatering device	*Tsukishima Kikai Co., Ltd.*	24
Type 2 screw press dewatering device with multiple disks	*AMCON INC.*	25
Enhanced belt-press dewatering device with two-stage coagulant addition	*METAWATER Co., Ltd.*	26
Enhanced hard-to-dewater sludge-adaptive SP dewatering device	*Hokuryo Co., Ltd.* *Kobelco Eco-Solutions Co., Ltd.*	27
Type 3 screw press dewatering device	*ISHIGAKI COMPANY, LTD.*	28
Type 3 rotary pressure dewatering device	*Tomoe Engineering Co., Ltd.*	29
Sewage-derived fiber utilization system	*ISHIGAKI COMPANY, LTD.*	30
Digestion		
Carrier-filled high-speed methane fermentation	*METAWATER Co., Ltd.*	31
Enhanced thickening with filtration and mesophilic digestion system	*Tsukishima Kikai Co., Ltd.*	32
Cone-bottom steel plate digestion tank	*Tsukishima Kikai Co., Ltd.*	33
Steel plate digestion tank with four divided pit structures	*ISHIGAKI COMPANY, LTD.*	34

New Tech Implementation Program 3/3

As of June 2022

Name of Technology	Registered developer	Page
Steel digestion tank using injection nozzles	*JFE Engineering, FUSO Corporation*	35
Packaged steel plate digestion tank	*Kobelco Eco-Solutions Co., Ltd.*	36
High-performance anaerobic digestion system with thermal hydrolysis unit	*Mitsubishi Kakoki Kaisha, Ltd.*	37
Anammox		
Nitrogen removal using ANAMMOX	*TAKUMA CO., LTD., METAWATER Co., Ltd.*	38
Power generation		
Power generation system using step grate stoker furnace	*TAKUMA CO., LTD.*	39
Incineration, fuelization		
Multi-layer fluidized incinerator	*Bureau of Sewerage, Tokyo Metropolitan Government, METAWATER Co., Ltd.*	40
Advanced two-stage incinerator (Circulating fluidized bed)	*Kobelco Eco-Solutions Co., Ltd.*	41
Bubble generation two-stage fluidized incinerator	*Kobelco Eco-Solutions Co., Ltd.*	42
Multi-stage bubbling fluidized bed incineration system with optimized combustion control	*Mitsubishi Heavy Industries Environmental & Chemical Engineering Co., Ltd.*	43
Two-stage combustion type swirling fluidized bed furnace	*Swing Engineering Corporation*	44
Flow turbine: energy-saving supercharged blowing system for fluid bed furnace	*METAWATER Co., Ltd. KUBOTA Corporation.*	45
Sludge fuelization using a carbonization furnace with an electric heating screw	*Kobelco Eco-Solutions Co., Ltd.*	46
Sludge property fluctuation-adaptive steam drying system	*Swing Engineering Corporation*	47

B-DASH Project 1/3

As of June 2022

FY	Name of the Project / Implementer	Page
2011-12 Guideline published	Demonstration study of energy management system using intensive solid-liquid separation technology *METAWATER Co., Ltd., and JS*	50
2012-13 Guideline published	Demonstration of highly efficient nitrogen removal through the fixed-bed anammox process *Kumamoto City, JS, and TAKUMA CO., LTD.*	51
2013-14 Guideline published	Demonstration of electricity generation system from sewage biomass source *Wakayama City, JS, Kyoto University, NISHIHARA Environment Co., Ltd., and TAKUMA CO., LTD.*	52
2013 Guideline published	Demonstration of the efficient sewer management system using advanced image-recognition technology *Funabashi City, JS, and NEC Corporation*	53
2014-15 Guideline published	Demonstration of new sewage treatment technology using circulation and no-aeration *Kochi City, Kochi University, JS, and METAWATER Co., Ltd.*	54
2014-15 Guideline published	Demonstration of an energy-saving sewage treatment system using high-efficient solid-liquid separation technology and dual dissolved oxygen control technology *Maezawa Industries, Inc., ISHIGAKI COMPANY, LTD., JS, and Saitama Prefecture*	55
2014-15 Guideline published	Demonstration of efficient sewage treatment control using process control and remote diagnosis with ICT *Toshiba Corporation, JS, Fukuoka Prefecture, and Center for Sewage Management of Fukuoka*	56
2015-16 Guideline published	Demonstration of a microalgae cultivation system with carbon dioxide captured from digestion gas in the sewage treatment plant *Toshiba Corporation, euglena Co.,Ltd., Nikkan Tokushu Co., Ltd., Nihon Suido Consultants Co., Ltd., JS, and Saga City*	57
2016-17 Guideline published	Demonstration on sewage sludge conversion to fertilizer/fuel with dehydration and drying system *Tsukishima Kikai Co., Ltd., Sun Eco Thermal Co., Ltd., JS, Kanuma City, and Kanuma City Agriculture Public Corporation*	58

B-DASH Project 2/3

As of June 2022

FY	Name of the Project / Implementer	Page
2016-17 Guideline published	Demonstration of flow fluctuation-adaptive wastewater treatment technology using DHS system	59
	SANKI ENGINEERING CO., LTD., Tohoku University, National Institute of Technology, Kagawa College, National Institute of Technology, Kochi College, JS, and Susaki City	
2016-17 Guideline published	Demonstration of wastewater treatment technology using special fiber carriers for excess sludge reduction	60
	IHI Plant Services Corporation, TEIJIN FRONTIER CO., LTD., JS, and Tatsuno Town	
2016-17 Completed	Feasibility study on the practical application of hydrogen production system by salinity difference between treated wastewater and seawater	61
	Yamaguchi University, SEIKO ELECTRIC CO., LTD., and JS	
2017-18 Guideline published	Demonstration of treatment performance improvement technology for final settling tanks	62
	METAWATER Co., Ltd., JS, and Matsumoto City	
2017-18 Completed	Demonstration project for the practical use of local energy production and local consumption technology with a high-efficiency anaerobic digestion system	63
	Mitsubishi Kakoki Kaisha, Ltd., Kyushu University, JS, and Karatsu City	
2017-18 Completed	Demonstration of the practical application of power generation type Sewage Sludge Incineration Technology for Greenhouse Gas Reduction	64
	JFE Engineering Corporation, JS, and Kawasaki City	
2015-19 Completed	Demonstration of diagnosis technologies applied for conditions of deteriorated sewage treatment utilities using vibration data sensing and big data analysis	65
	Water Agency Inc., NEC Corporation, Asahi Kasei Engineering Corporation, JS, Moriya City, and Hidaka City	
2018-19 Completed	Demonstration on comprehensive gradual sewer diagnosis system using ICT	66
	Clearwater OSAKA Corporation, JS, and Osaka City	
2018-20 FS completed	Feasibility study on the AI-based operation management support technology for wastewater treatment	67
	YASKAWA Electric Corporation, Maezawa Industries, Inc., and JS	

B-DASH Project 3/3

As of June 2022

FY	Name of the Project / Implementer	Page
2018-19 Guideline published	Demonstration project on the efficient energy utilization technology using high-solids anaerobic digestion and energy-saving biogas purification *Kobelco Eco-Solutions, Co., Ltd, JS, and Fuji City*	68
2015-17 Completed	Demonstration of the practical application of underground cavities detection with a towing vehicle *Kawasaki Geological Engineering Co., Ltd., JS, and Funabashi City*	69
2019-20 Completed	Demonstration project for advanced wastewater treatment technology in single tank nitrification denitrification process using ICT and AI control *METAWATER Co., Ltd., JS, and Machida city*	70
2020 FS Completed	Feasibility study on the practical application of AI-based sewer diagnosis system *OKUMURA CORPORATION, JS, Saitama City, Funabashi City, Fukui City, Fujisawa City, and JUST Ltd.*	71
2020-21 FS Completed	Feasibility study on the practical application of screening technologies of underground radar survey vehicle system and AI-based cavity detection system *KAWASAKI GEOLOGICAL ENGINEERING CO., LTD., and JS*	72

*Guideline: National Institute for Land and Infrastructure Management (NILM) has published Technology Introduction Guidelines for B-DASH Project. The Guidelines describing the summary of B-DASH technology facilitates their adoption.

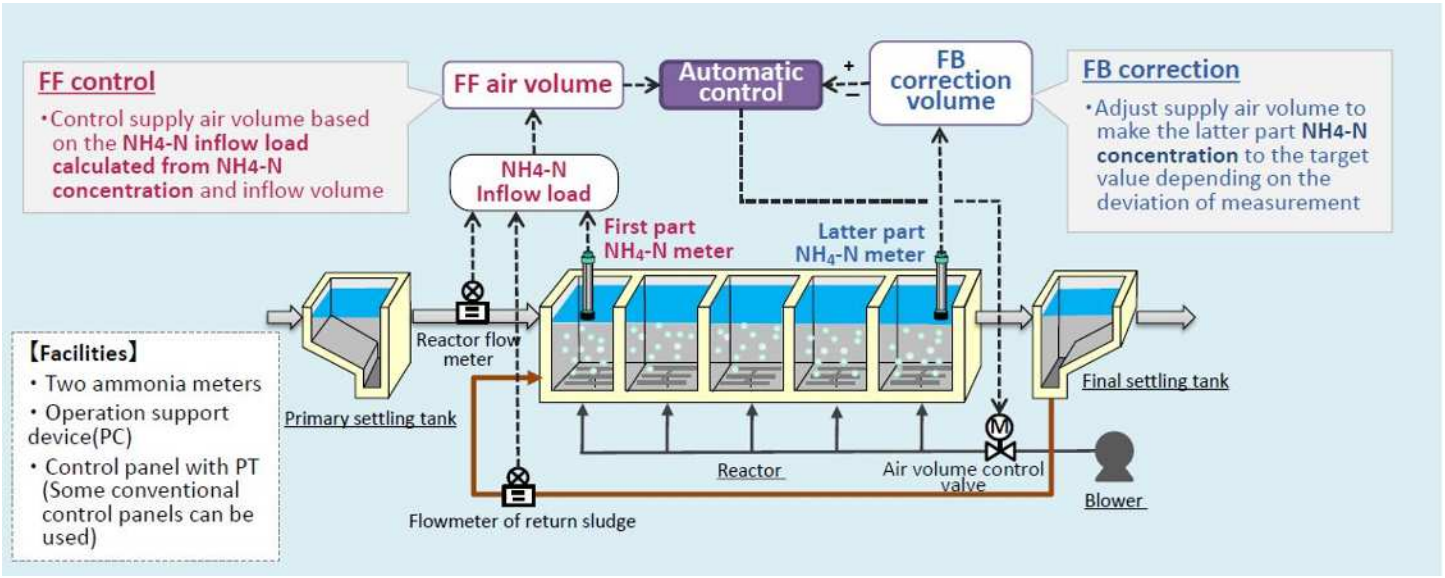
New Tech Implementation Program

Feedforward Aeration Control by Ammonia Sensor

Developers: Nissin Electric Co., Ltd.

Two ammonia meters in a reactor **automatically control the aeration according to the inflow nitrogen load and nitrification status** to **save energy** by reducing the air volume and **stabilize the treated water quality** (ex. NH4-N concentration) at the same time.

✓ Feed-forward (FF) control by NH4-N inflow loads
⇒ Real-time tracking of inflow nitrogen load variations
✓ Feedback (FB) correction based on the deviation from the target NH4-N concentration in the rear part of the reactor
⇒ Stabilize the NH4-N concentration in the treated water



Needs

- Energy-saving blowers
- Stable NH4-N concentration for treated wastewater

Benefits

- Reduce blowing air volume by 10% for constant DO control
- Stabilize NH4-N concentration at low levels

*Assuming that the system is an activated sludge process facility that promotes nitrification. However, the OD process is excluded.

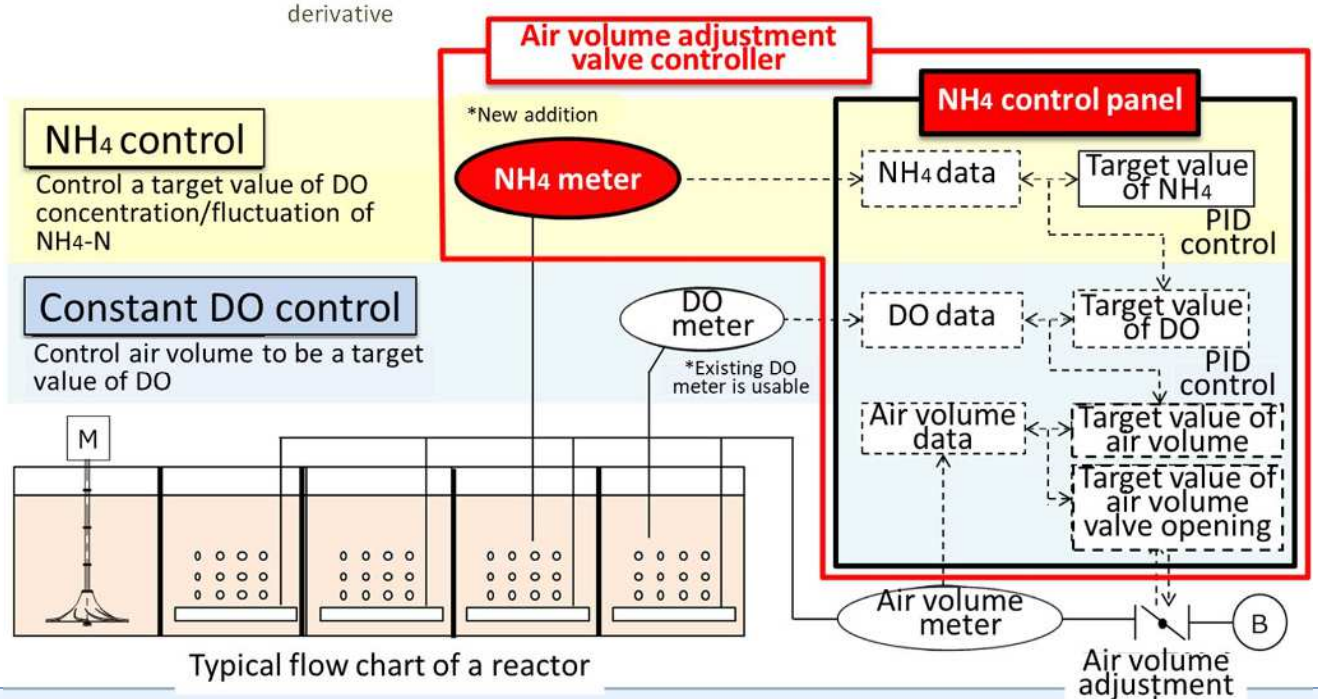
Aeration Control Device Consisting of Ammonia Meter and Control Panel

Developers: Kobelco Eco-Solutions Co.,Ltd.

An ammonia meter and a DO meter installed in the reaction tank **control airflow** to automatically adjust the target DO concentration according to the nitrification status, to achieve both **energy saving** by reducing airflow and **stabilization of treated water quality** (such as NH4-N concentration).

✓ Feedback Control of Air volume based on NH4-N concentration measurements at later stages of the reactor⇒Variable OD control with two stage PID control*

*PID control: a basic, general-purpose feedback control in which the input value is controlled by three elements: the deviation of the output value from the target value and its integration and derivative



Typical flow chart of a reactor

Needs

- Energy saving of blower
- Stable NH_4-N concentration for treated wastewater

*Assuming that the system is an activated sludge process facility that promotes nitrification. However, the OD process is excluded.

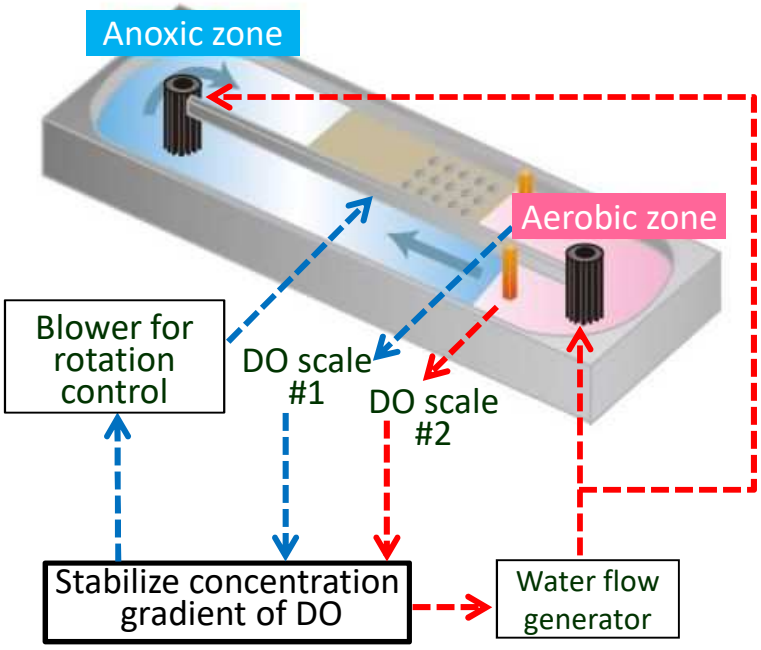
Benefits

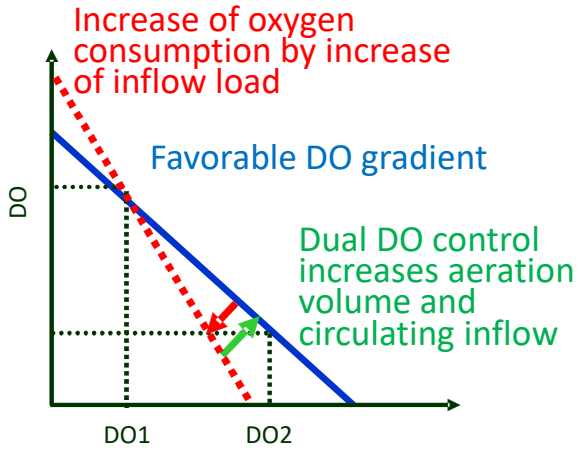
- Energy saving by reducing air flow rate
  ⇒ 10% or more against constant DO control
- Stabilize NH_4-N concentration of treated effluent
  ⇒ low concentration of 0.5-1.0mg/L

Dual DO Control System for OD Process

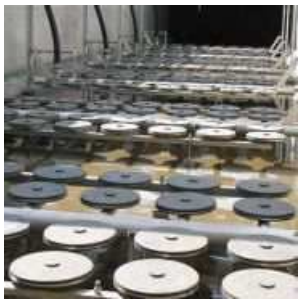
Developers: Kochi University, Maezawa Industries, Inc.

The automatic control system **individually controls aeration volume and circulation flow rate** to stabilize the gradient of DO concentration. This mechanism solidly creating aerobic and anoxic zones **makes treatment stable and reduces electric power consumption.**





Water flow generator (vertical)



Air diffuser

Needs

- Accelerate energy saving at retrofit of the existing OD process
- Avoid facilities' expansion according to the increase of the inflow load

Benefits

- Generate stable quality treated effluent adaptable to nutrients removal
- Reduce power consumption by 30% against vertical OD process
- Reduce LCC by the enhanced treatment performance*

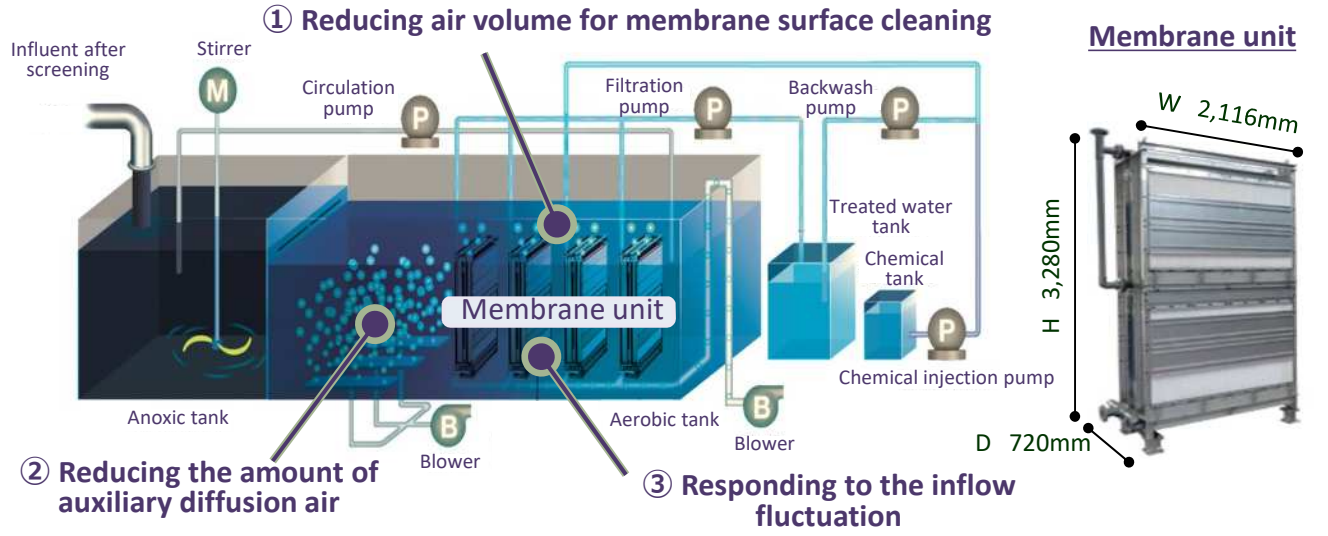
*Depending on the specific inflow conditions

Energy-saving MBR System Using Ceramic Flat Membrane

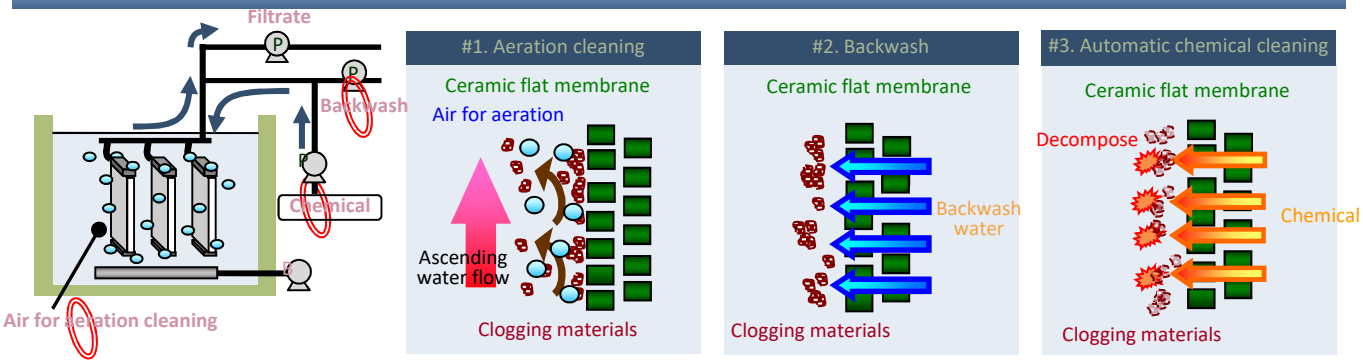
Developers: MEIDENSHA CORPORATION

Membrane cleaning with **alumina-based inorganic membranes, ceramic flat membranes**, and optimization of operations to achieve **energy savings** by reducing aeration volume and **dealing with inflow fluctuations**

Flow diagram of energy-saving MBR



Various cleaning techniques



Needs

- Energy saving
- Responding to temporary inflow increases due to rainfall, etc.

Benefits

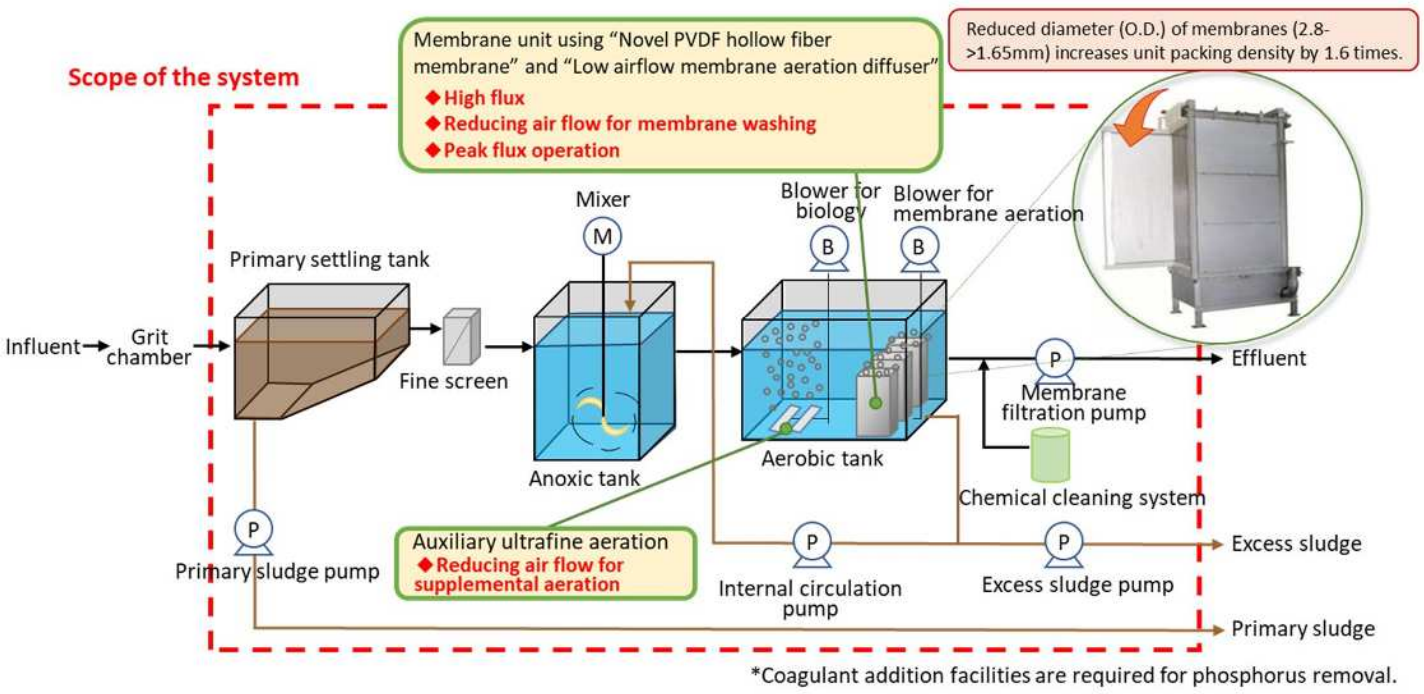
- Combining various cleaning techniques reduces aeration rate for cleaning
- Optimized operating conditions of MLSS and DO control reduce auxiliary diffused air rate
- Temporary raising of the flux can respond to inflow fluctuations

Energy Saving MBR Using Novel PVDF Hollow Fiber Membranes

Developers: Mitsubishi Chemical Aqua Solutions Co., Ltd., Swing Engineering Corporation, Mitsubishi Kakoki Kaisha, Ltd.

The system adopts (i)PVDF* hollow fiber membranes with small diameter (high packing density), (ii)a low air-flow membrane aeration system, and (iii)an auxiliary aeration system with superfine air bubble diffusers. This new MBR system enables energy-saving, cost-reduction, and adaptability to inflow fluctuation.

*PVDF : Polyvinylidene Difluoride



Needs

- MBR with energy and cost savings
- MBR responding to the temporary inflow fluctuation

Benefits

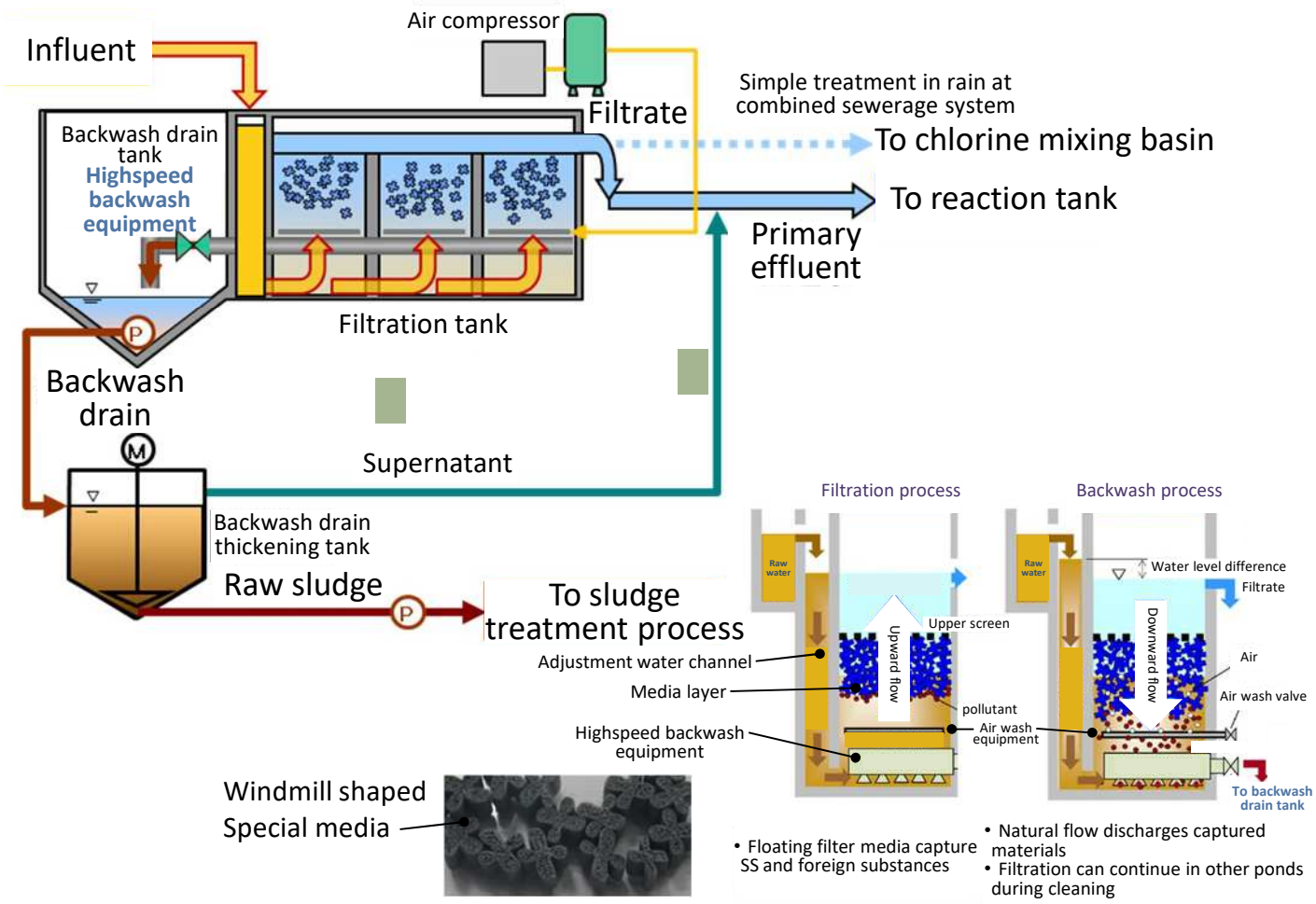
- Energy-saving by air-flow rate reduction (0.4kWh/m^3 or less)
- Fewer numbers of membrane units reduce initial cost and membrane replacement cost
- High adaptability to inflow fluctuation by peak flux operation

High-speed Filtration System: Alternative to Primary Sedimentation Tank System

Developers: METAWATER Co., Ltd.

A high-speed filtration system using special filter carriers is an alternative to a first sedimentation tank. It can increase treatment capacity, improve removability of SS and floating BOD, save space, reduce cost reduction, and adapt to inflow increase at rain*.

*In the combined or separated sewerage system, if the designed wastewater inflow rate in the rain is set up.



Needs

- Enhance treatment performance at retrofit of a first settling tank
- Energy utilization of sewage sludge by digestion gas power generation
- Response to inflow water increase at rain

Benefits

- Space-saving, construction cost reduction by increasing treatment capacity
- Improve energy recycle efficiency by more raw sludge with rich digestion gas
- High removability of impurities compared to simple sedimentation treatment

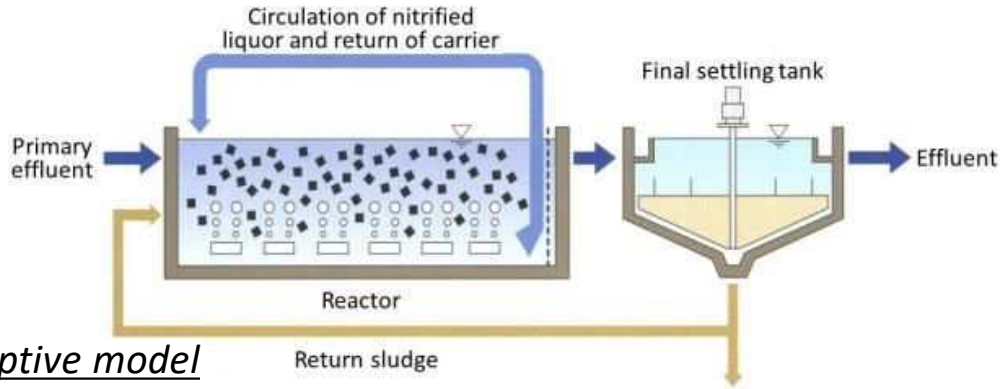
Carrier Added Activated Sludge Process (LINPOR Process)

Developers: NISHIHARA Environment Co., Ltd.

Supplied immobilized carrier (LINPOR cube) enables **highly concentration of activated sludge** and **reduction of SS loadings to a final settling tank**. Applicable to the inflow increase of the conventional activated sludge (CAS) process, and nutrients removal without expansion

Inflow increase-adaptive model

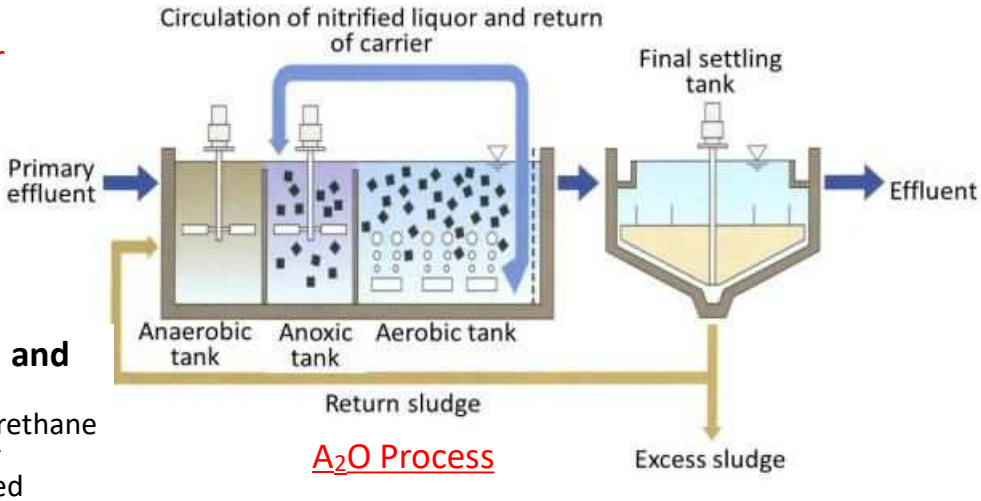
Scope of application:
CAS process



Nutrients removal-adaptive model

Scope of application:
Modified Ludzack-Ettinger process, A_2O Process

15 year old' LINPOR cube and carrier separation device
12mm*12mm*15mm, polyurethane requires no fine-mesh carrier separator that is easily clogged



A_2O Process

Needs

- Dealing with temporary inflow increase with no additional wastewater treatment facilities

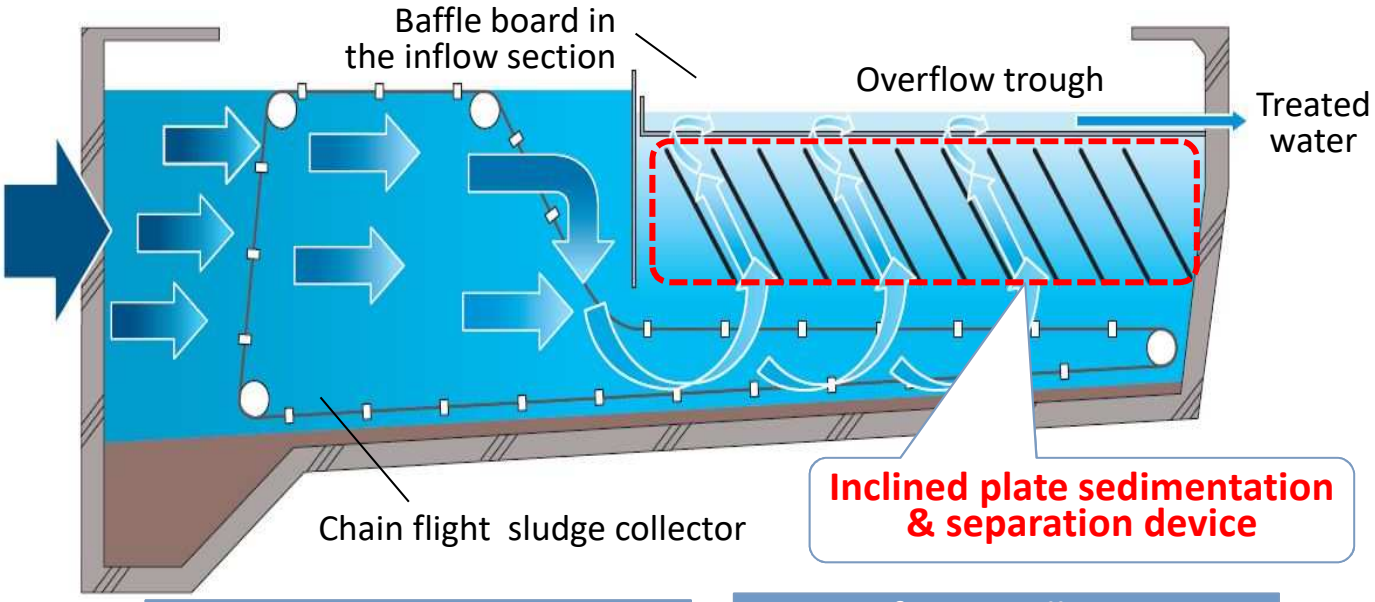
Benefits

- Inflow increase-adaptive model handles 150% increase in treated water at CAS process without additional reactor and final settling tank
- Nutrients removal-adaptive model works with no additional facilities. For new construction, its compact reaction tank enables space-saving

Inclined Plate Sedimentation and Separation Device for Final Settling Tank

Developers: Sekisui Aqua Systems Co., Ltd.

Multiple inclined plates enlarge the settling area and improve the treatment performance of the existing final settling tanks with low costs



Before installation

After installation
(SS removability improved)

Needs

- Utilize the existing facilities to deal with the inflow increase
- Sufficient performance for final settling tanks

Benefits

- Improve SS removal performance with a simple mechanism
- Enable cost reduction for retrofit, remodel to nutrients removal, inflow fluctuation-adaptive, etc.

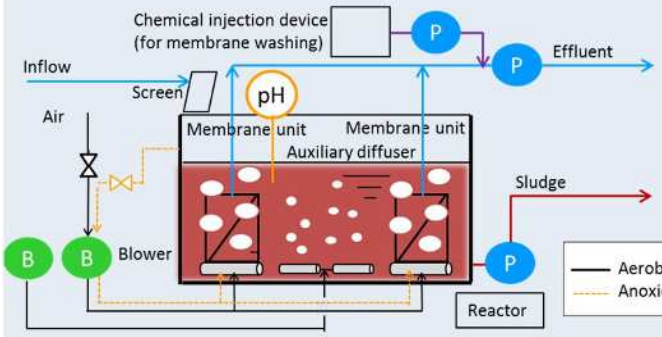
Temporary Wastewater Treatment Unit Using Single Tank MBR and High-rate Coagulation Settling System

Developers: Hitachi Plant Services Co., Ltd.

Portable wastewater treatment unit for **temporary treatment** using single tank MBR and/or high-rate coagulation settling (HS) unit with steel plate. Enable **stable, low-cost** wastewater treatment during the construction period of small-scale WWTP

Single tank MBR unit

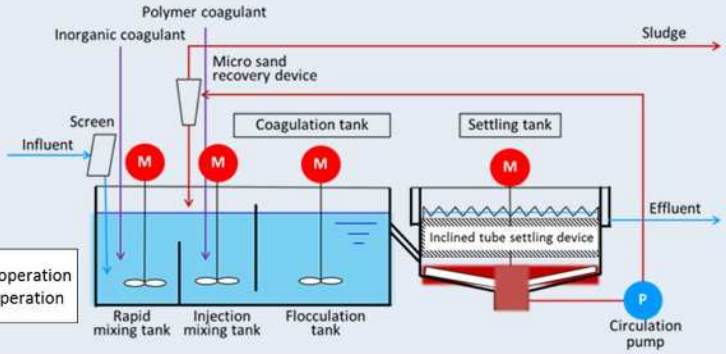
with daily maximum capacity of 300m^3



Immersion type single tank MBR can switch aerobic/anoxic operation depending on pH inside a tank and recover alkalinity with no pH conditioner.

High-rate coagulation settling unit

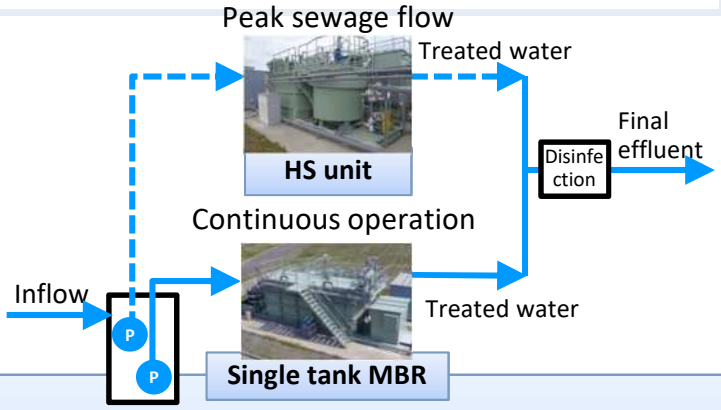
with hourly maximum capacity of 500m^3/day



High-rate coagulation settling unit using micro sand simplifies O&M by coagulant (inorganic + polymer) addition with fixed quantity and adoption of inclined tube settling device.

Treatment flowchart

- ☆ Continuously operate single tank MBR unit with excellent quality of effluent
- ☆ Concurrently use HS unit to apply to hourly fluctuation of sewage inflow



Needs

- Need retrofit while having only one tank of a wastewater treatment facility
- Need continuous wastewater treatment performance during retrofitting works, and temporary wastewater treatment at the time of disasters

Benefits

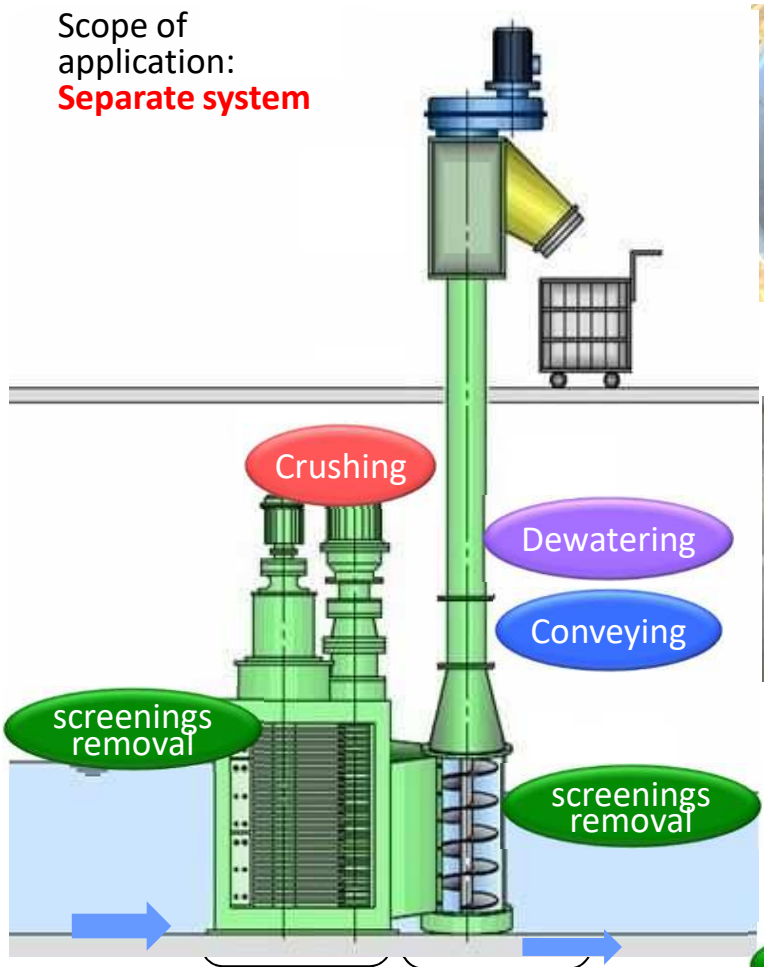
- Secure wastewater treatment performance and treated water quality with no additional trains or tanks
- Can reduce in construction period, footprint, and costs for temporary treatment facilities

Vertical Screw Screen with Crushing/Dewatering Functions

Developers: *Sumitomo Heavy Industries Environment Co., Ltd.*

Integrate removing, washing and dewatering functions of screen residues to a compact unit, Crushing function massively reduces the generation of screen residues

Scope of application:
Separate system



Conventional crusher with screen

Newly adopted fragment capturing/conveying device

screen residues per **day** (Conventional collector)

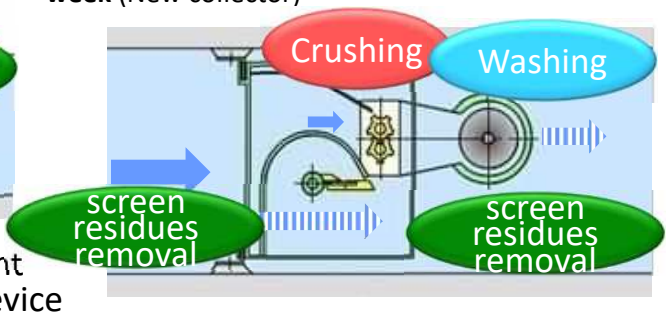
screen residues per **week** (New collector)

A conventional screen unit remains **50kg** screen residues per day

1/20 or less!

Including dewatering effects

The new screen units remains **1.5kg** screen residues per day



Needs

- Space saving and efficient removal of screen residues at the same time

Benefits

- Significant screen residues reduction system requires no subsequent facilities like a hopper and reduces costs for construction and screen residues disposal
- Compact facilities improve maintainability

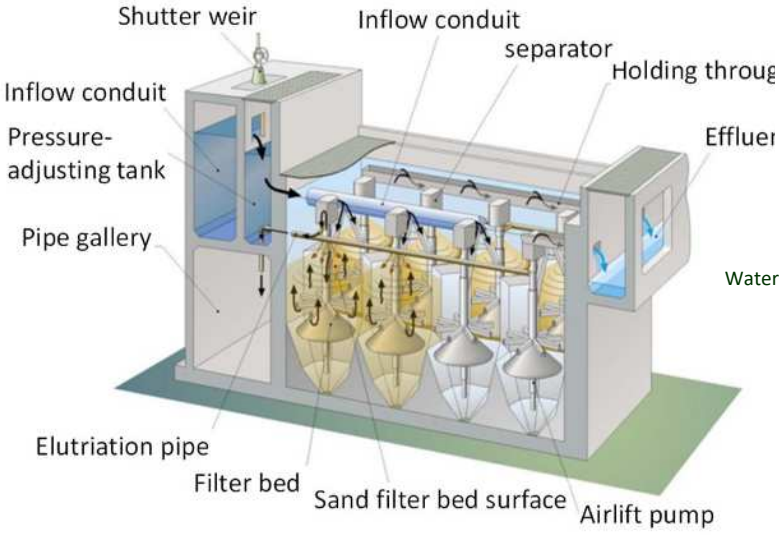
Rapid Up-flow Moving Bed Filtration

Developer: TAKUMA CO., LTD.

Rapid Up-flow Moving Bed Filtration **removes suspended solids (SS)** from treated wastewater **stably and speedy**

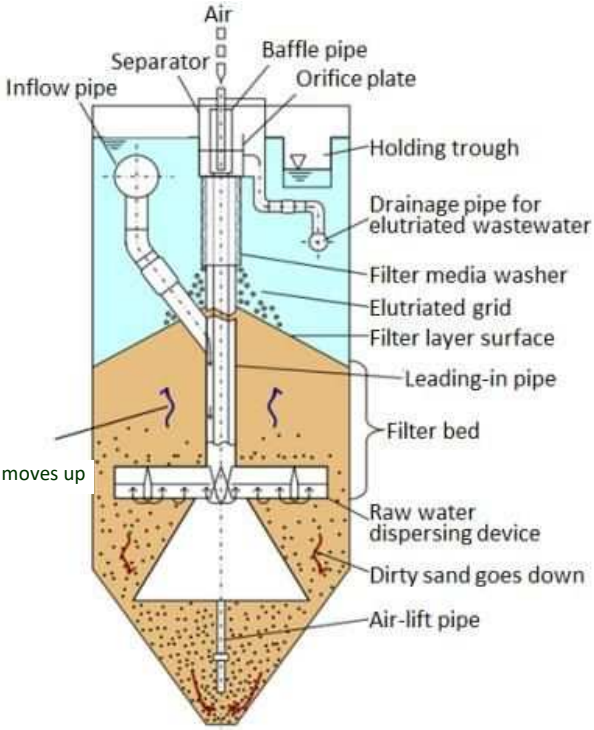
Design filtration rate and SS concentration

	Conventional sand filtration	High-speed sand filtration	
		A Design specification	B Design specification
Daily maximum	300 m/day or less	450 m/per day or less	650 m/per day or less
Maximum per hour	450 m/day or less	700 m/per day or less	1000m/per day or less
Raw water SS concentration	20mg/L		10mg/L
Filtrate SS concentration	5mg/L		



Configuration of multi-module reinforced concrete structure (for large-scale WWTP)

Optimized configuration of filtration sand enables high-speed/stable treatment, Applicable to retrofit using existing facilities



Configuration of high-speed sand filtration unit

Needs

- Space saving and existing facilities' utilization at retrofit or update

Benefits

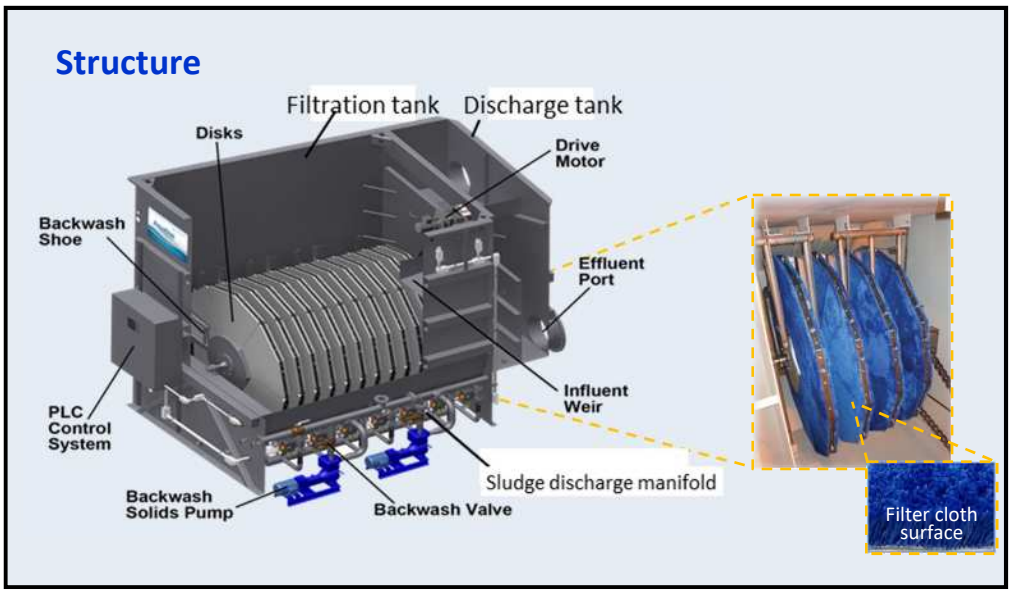
- High speed system reduces required filtration area and compacts facilities
- Compact facilities saves space, energy, and construction costs

Disk-type Multi-filament Filter Fabric Filtration Equipment

Developer: METAWATER Co., Ltd., Maezawa Industries, Inc.

Disk shaped filament filter cloth filtration system removes suspended solids (SS) from secondary effluent.

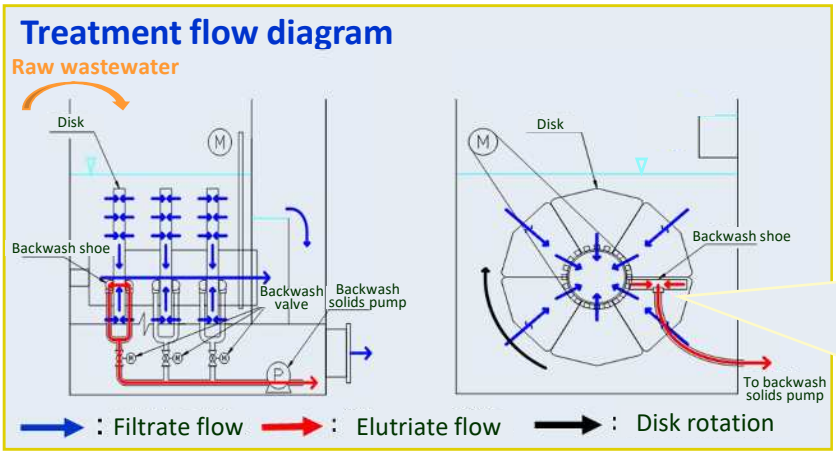
Structure



Design filtration rate and SS

Parameter	This system
Maximum daily	300m/day or less
Hourly maximum	400m/day or less
Raw water SS	30mg/L or less
Filtrate SS	5mg/L or less

Treatment flow diagram



Backwash shoe and backwash pump suck SS accumulating at filter cloth.

Needs

- Space-saving in the time of reconstruction of the existing rapid filtration facilities
- Cost-saving utilizing existing facilities

Benefits

- A larger filtration area per footprint than the conventional system achieves space saving.
- Gravity filtration functioned with the efficient intermittent washing function enables energy saving

Flow Rate And Water Level Fluctuation-adaptive Horizontal Submersible Pump

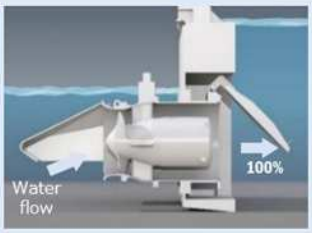
Developers: Ishigaki Company Ltd.

Horizontal submergible pump that enables full speed operation not depending on the water level
Provide stable operation for the various driving situation including low water level and water level fluctuation

Smooth transition between each operation mode. Rapid discharge at emergency.

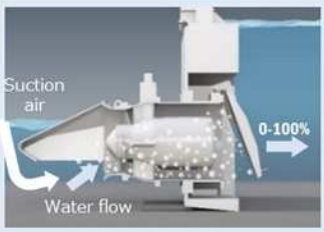
Idling operation

Wait for inflowing. Preceding standby condition.



Max-discharge operation

Same discharging operation as the conventional pumps.



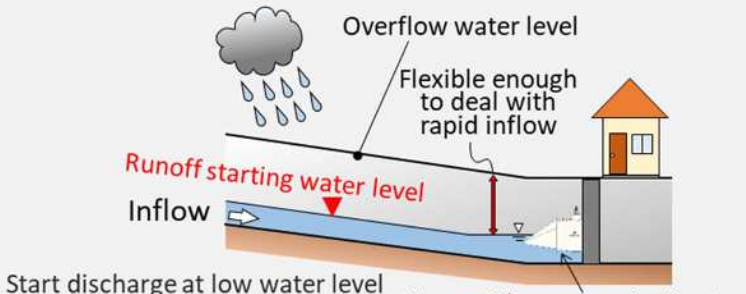
Air/water operation

Discharge the mixture of air and water. Discharge volume varies depending on the water level of the suction side.

Standby operation

No discharge operation. A timer stops a pump after a set time elapses.

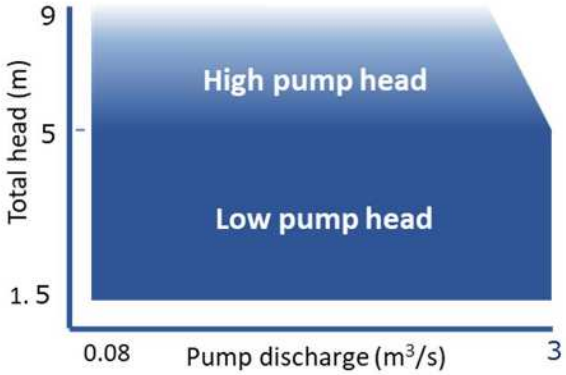
Ready for localized downpour



Start discharge at low water level and hold down water level
→Flexible to rapid inflow

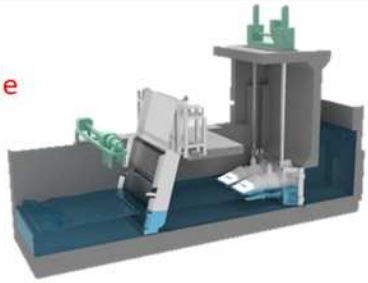
All speed/water level-adaptive horizontal submersible pump

Extend total head from 5m to 9m
➡Expand application



Pump gate style (with gate)

Setting example



Fixed style (no gate)

Needs

- Rapid improvement of space-saving rainwater pumping stations

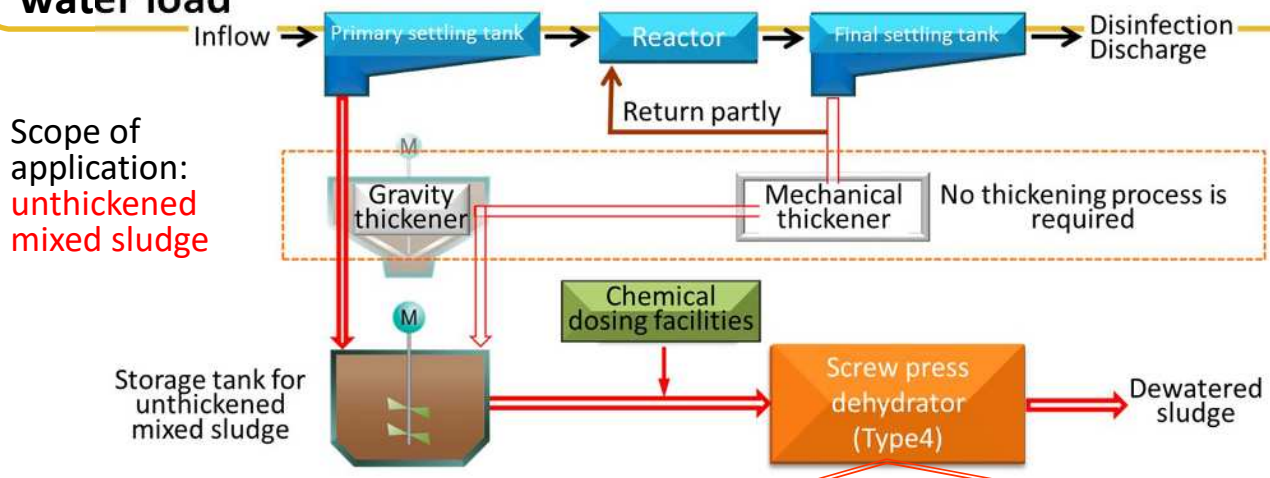
Benefits

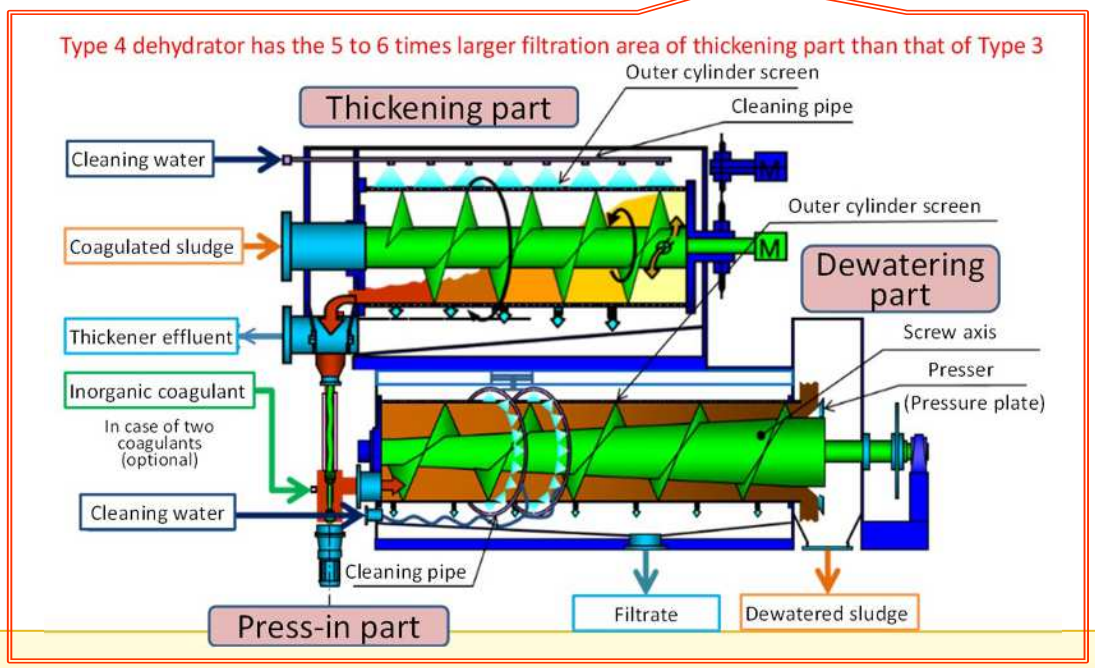
- Reduce flooding damage against a rapid increase in inflows
- Easy operation setting
- Require no inverter to reduce construction cost and LCC

Type 4 SP Dewatering Device with Enhanced Internal Thickener

Developer: ISHIGAKI COMPANY, LTD.

Enhanced thickening section of the conventional press-in SP dewatering device requires no separate thickening device and achieves **direct dewatering system** which **reduces LCC** and **return water load**





Needs

- Avoid retrofitting thickening device
- Reduce return water load (phosphorus and SS) from sludge treatment

Benefits

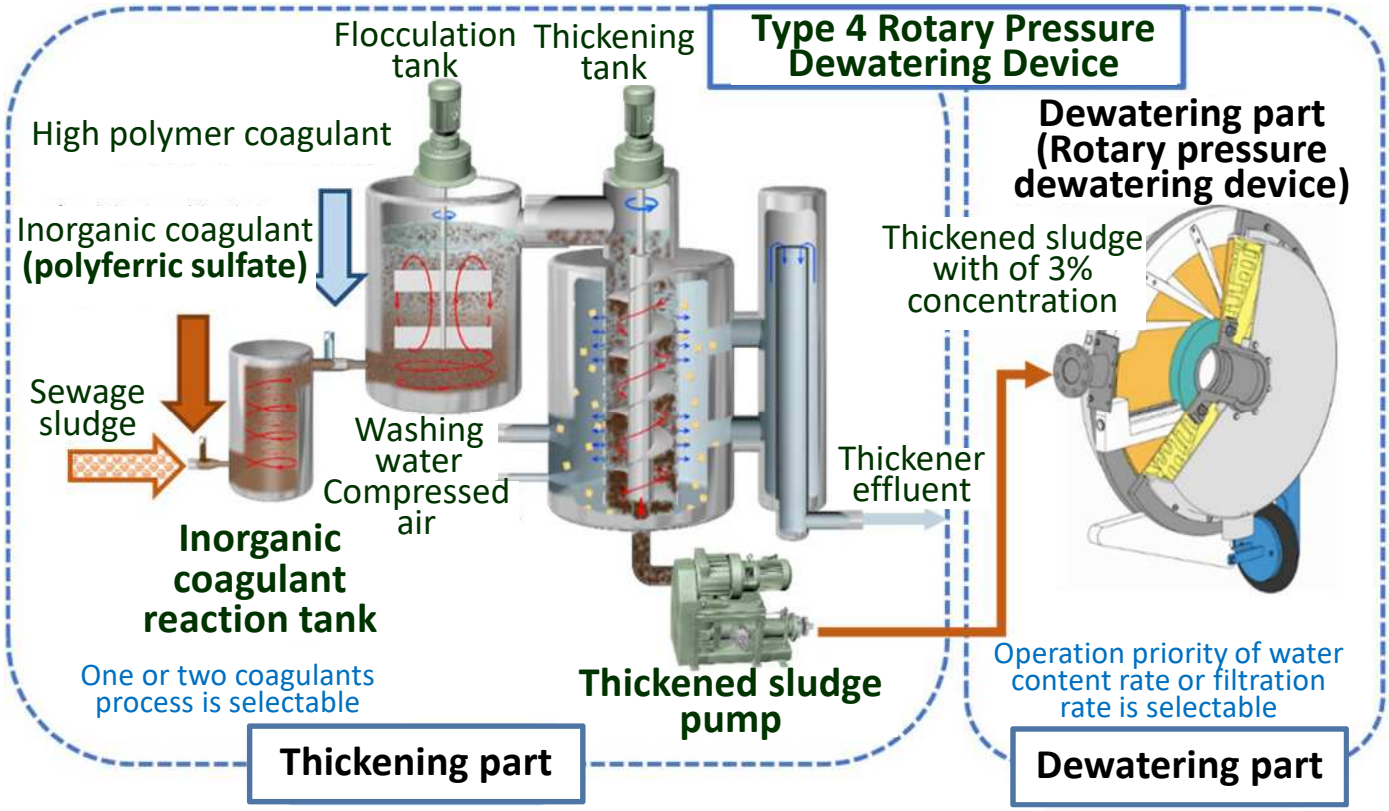
- Simple system with no thickening facilities reduces LCC
- Improved SS recovery rate
- Short retention time inhibits a putrefaction and release of phosphorus, and reduces return water load.

Type 4 Rotary Pressure Dewatering Device

Developer: Tomoe Engineering Co., Ltd.

Thickening and dewatering parts enable unified coagulation, thickening, and dewatering processes. The device achieves low water content of sludge by efficient thickening and dewatering of unthickened or low concentrated* mixed raw sludge.

*TS: 0.5-1.5%



Scope of application: Mixed raw sludge (CAS process)

- Thicken and dewater low-concentrated sludge of 1.5% or below with a low chemical injection rate and power
- A maximum of six points lower water content rate*1 than the conventional technology*2

*1: Two coagulants and water content rate-first operation *2: Granulation refining facility + belt press dewatering device

*Dewatering performance varies depending on sludge properties. Ask JS for details

Needs

- Efficient dewatering of low-concentrated sludge
- Retrofitting the dewatering system combined granulation/refining facilities and a dewatering device

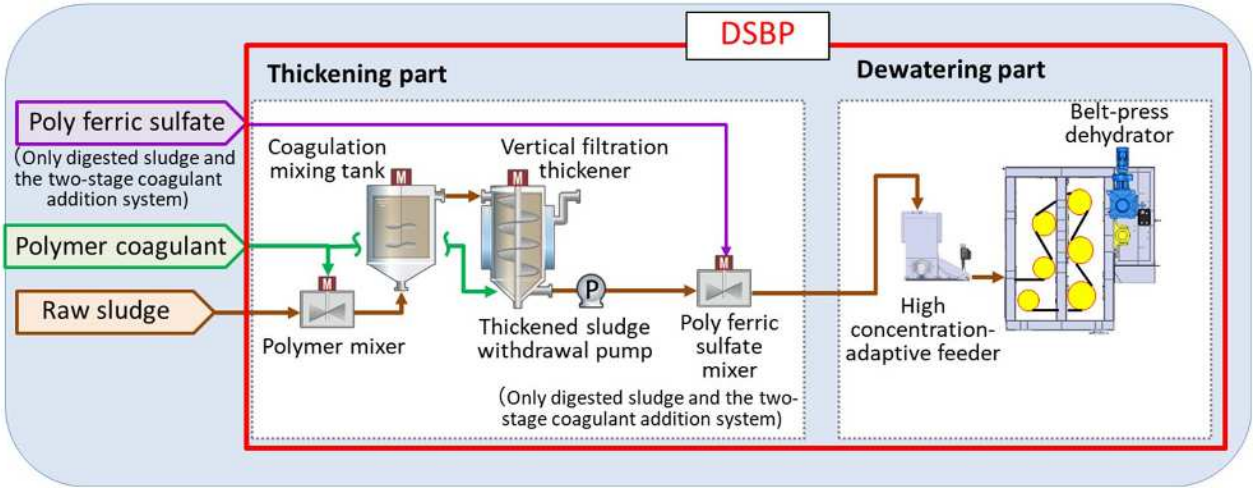
Benefits

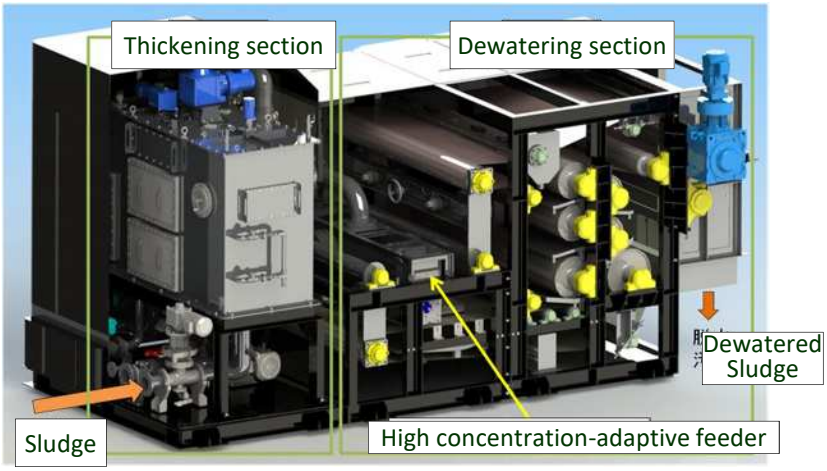
- Low chemical injection and low water content of sludge reduce running costs
- Reducing consumption of coagulant, supplemental fuel for combustion, and electric power to reduce CO2 emissions

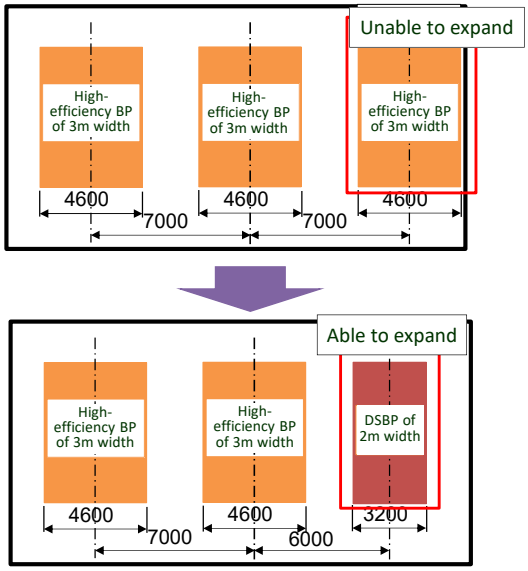
Down-sized Belt Press Dewatering Device

Developer: Tsukishima Kikai Co., Ltd.

The belt press dewatering device, which is improved filtration speed by combining a thickening section with a high concentration adaptive feeder, achieves **downsizing** and **a small footprint**







Down sized dewatering device works for limited space

Work with: mixed sludge and digested sludge generated from CAS process with two-coagulants injection

*Dewatering performance varies depending on sludge properties. Ask JS for details

Needs

Adding or retrofitting dewatering device at a limited space

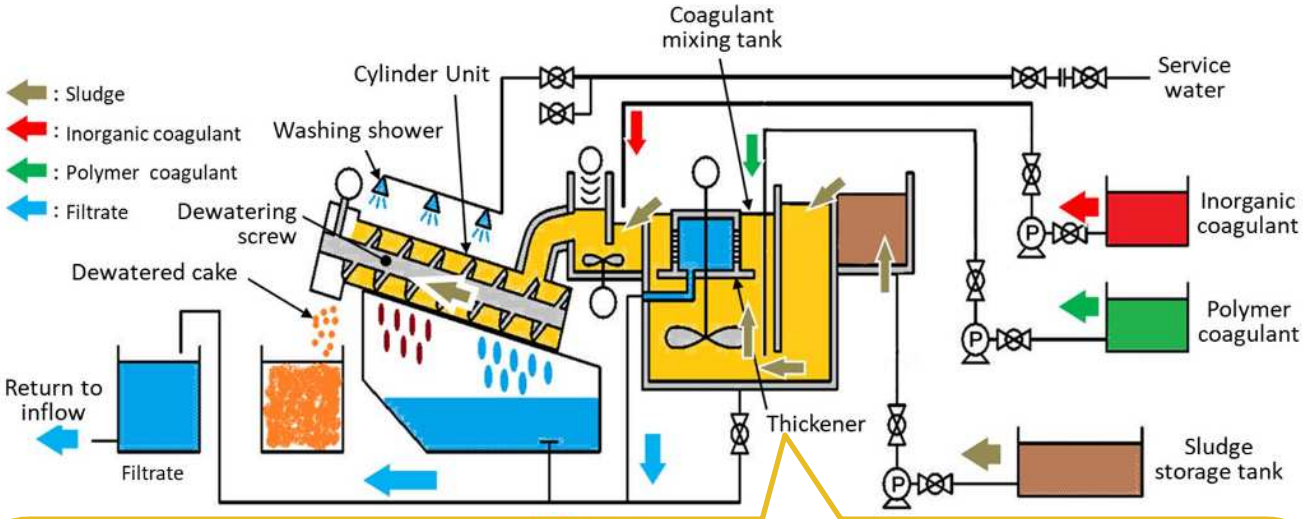
Benefits

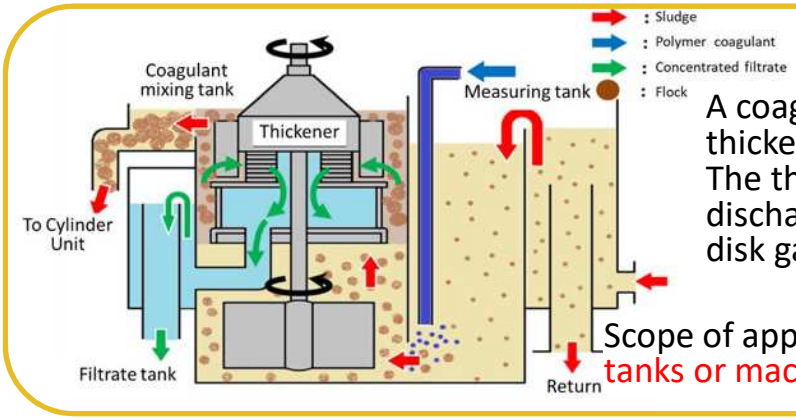
Down sizing of dewatering device and space saving

Type 2 Screw Press Dewatering Device with Multiple Disks

Developers: AMCON INC.

The new dewatering device having additional functions to the conventional machine dewatering sludge directly withdrawn from OD tanks **improves dewatering performance** and **works with CAS sludge**





New "thickener"

A coagulant mixing tank has a simple thickener having disks with small gaps. The thickener dewaters flocked sludge by discharging its water content from the disk gaps to thicken it.

Scope of application: withdrawn sludge from OD tanks or machine thickening mixed sludge

Other new features: 1. **Automatic control**: constant rate of treatment, prevent damages caused by abnormal pressures, 2. **New dewatering screw**: improved shape and an enhanced dewatering performance. 3. **New fixed ring**: sludge discharge without taking out dewatering screw at sludge clogging.

Needs

- Enhance treatment performance than the conventional multiple disk type SP1 dewatering device
- Use multiple disk type SP dewatering device for CAS sludge, which already has good achievements for OD sludge

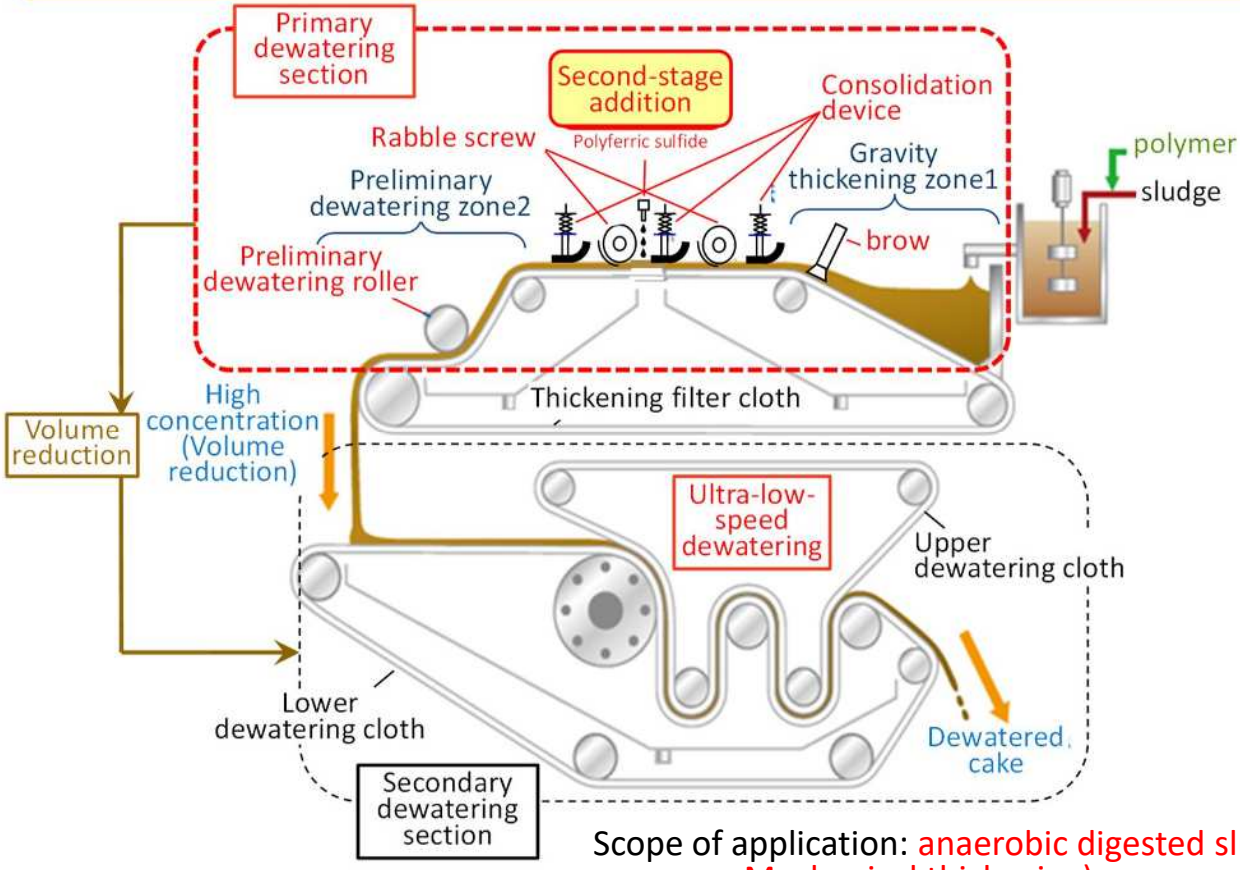
Benefits

- Reduce footprint and LCC by the treatment performance improvement
- Stable dewatering performance against fluctuation of sludge concentration

Enhanced Belt-press Dewatering Device with Two-stage Coagulant Addition

Developers: METAWATER Co., Ltd.

Newly developed functions added to primary dewatering section of the conventional high efficiency belt press dewatering device **improve dewatering performance for hard-to-dewater sludge** and **reduces the dose of inorganic coagulant**



Scope of application: anaerobic digested sludge (CAS process + Mechanical thickening)

◆**Primary dewatering section**:
Gravity thickening→Inject/mix inorganic coagulant→Preliminary dewatering
➔**Achieve high concentration of sludge (volume reduction)**

◆**Secondary dewatering section**:
Volume reduction(high concentration) super low speed (long-term) dewatering
➔**Achieve lowering water content of sludge**

Needs

- Need better dewatering performance of hard-to-dewater sludge while reducing inorganic agents dosing

Benefits

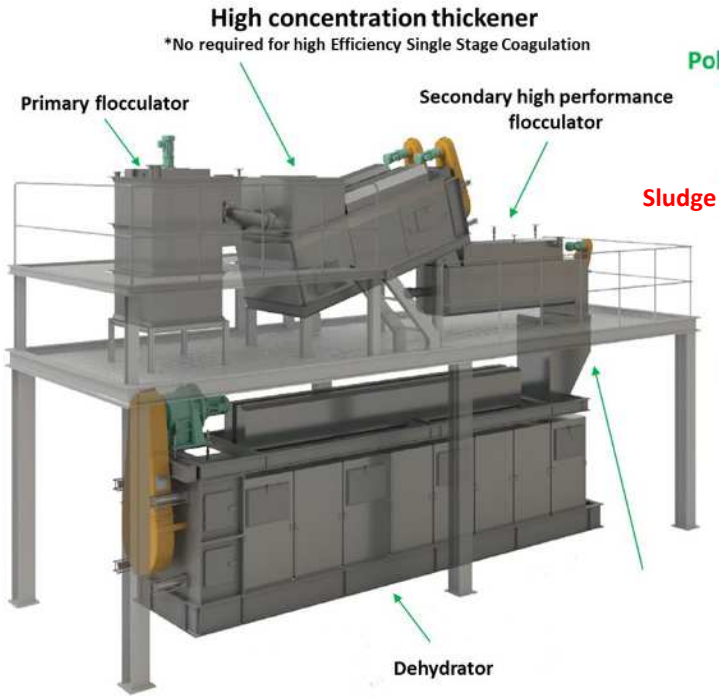
- Reduce water content rate of dewatered cake to reduce sludge generation and their disposal costs
- Reduce inorganic agents (polyferric sulfate) dosing

Enhanced Screw Press Dewatering Device for Hard-to-dehydrate Sludge

Developers: Hokuryo Co.,Ltd., Kobelco Eco-Solutions Co., Ltd.

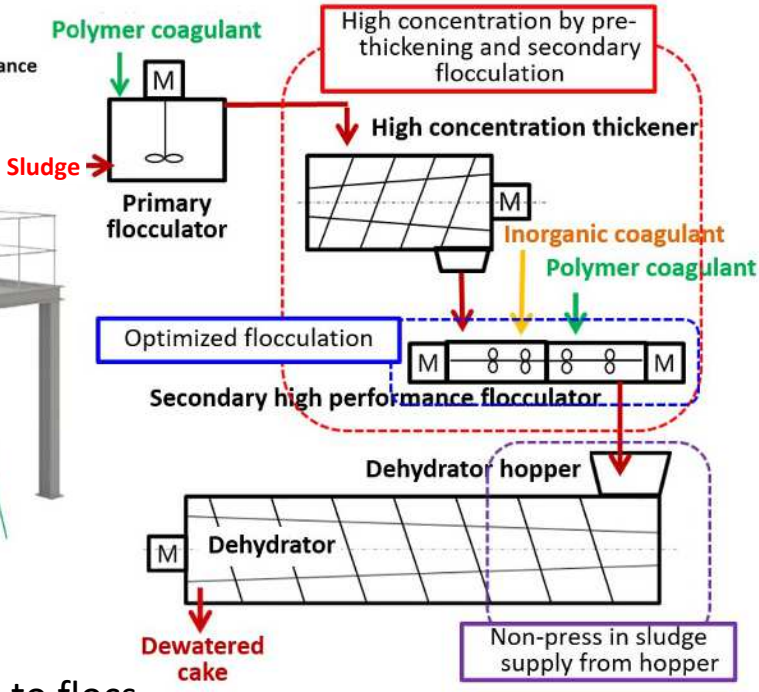
Achieve proper coagulation and dewatering performance required for a good floc formation. Improve the dewatering performance against hard-to-dewater sludge with low power. Reduce greenhouse gas emissions

Proper flocculation



Dehydration providing proper power to flocs

1.Highly efficient two-stage flocculation



2. Highly efficient single-stage flocculation

No high concentration thickener is required
High dewatering performance for mixed sludge, which is relatively easily dewatered, with no high concentration thickener

Scope of application: mixed sludge and anaerobic digested sludge generated from CAS process + mechanical thickening

*Dewatering performance varies depending on sludge properties. Ask JS for details

Needs

Achieve low water content rate even for hard-to-dewater sludge

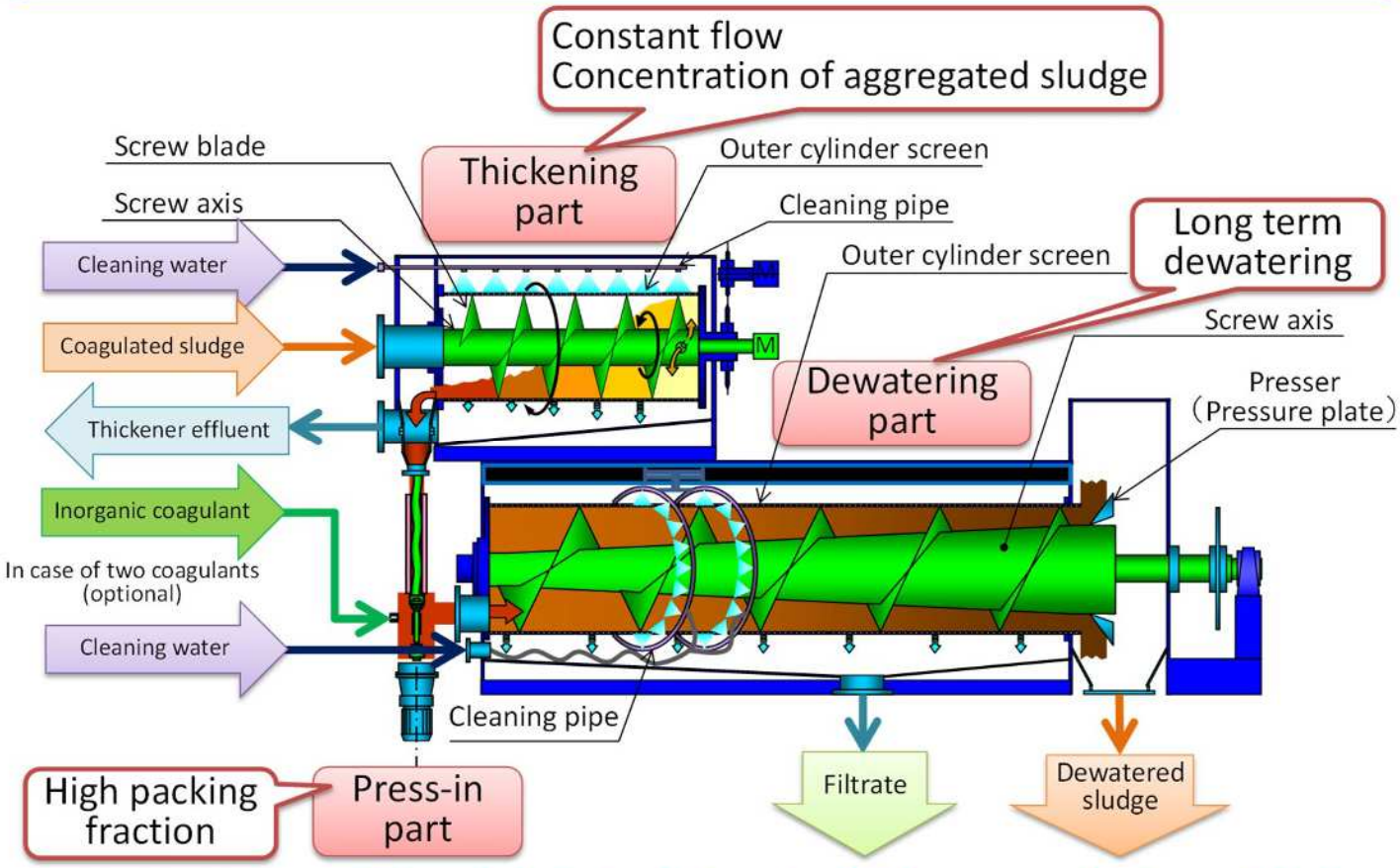
Benefits

The dehydration of hard-to-dewater sludge and mixed sludge with low power reduces power consumption and sludge generation

Type 3 Screw Press (SP) Dewatering Device

Developers: ISHIGAKI COMPANY, LTD.

The conventional screw press (SP) dewatering device has built-in thicken and dewatering device inside its body. Type 3 SP dewatering device has independent thickening and dewatering parts. This configuration improves dewatering performance of hard-to-dewater sludge and reduces sludge generation



Scope of application: **thickened sludge including mixed sludge, anaerobic digested sludge, excess sludge**, etc.

Needs

- Further dewatering performance than the conventional SP2 dewatering device
- Adopt a dewatering device with many achievements and know-how

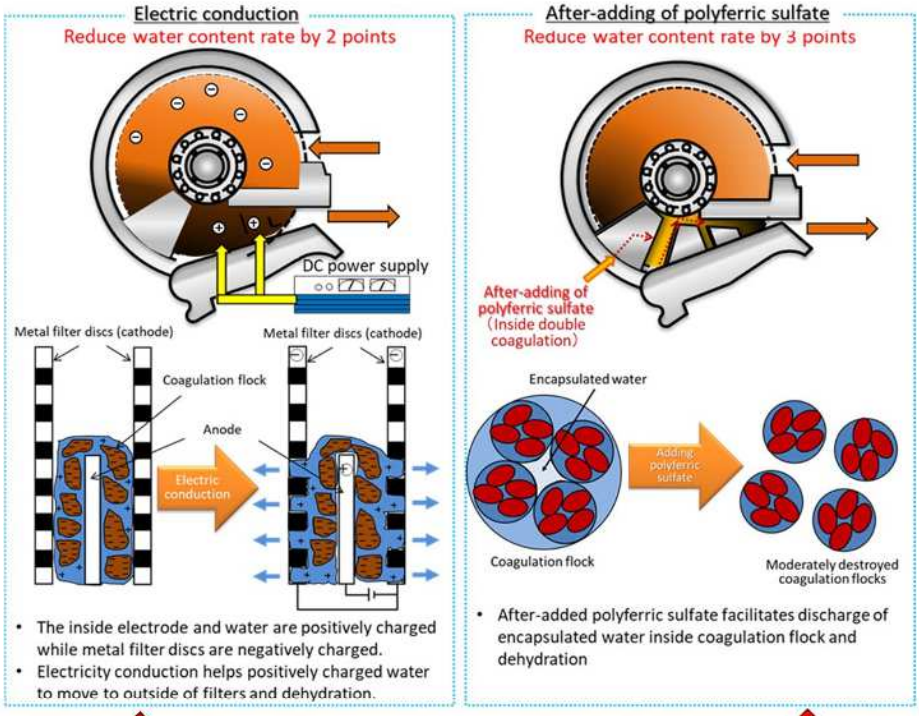
Benefits

- Enable water content reduction of hard-to-dewater sludge. Reduce sludge generation and disposal costs
- The independent thickening section improves treatment stability against the fluctuation of sludge property

Type 3 Rotary Press Dewatering Device

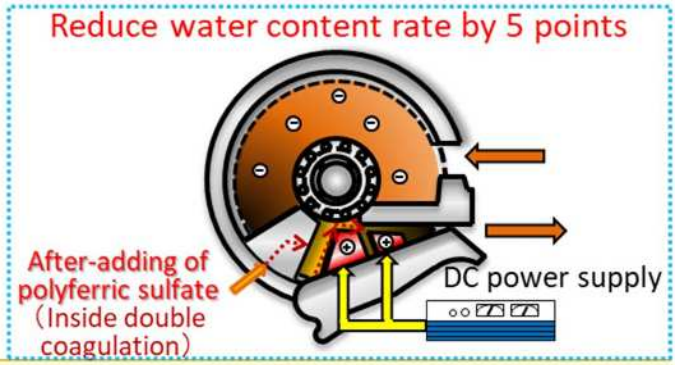
Developers: Tomoe Engineering Co., Ltd.

Type 3 maintaining Type 2' functions of simple structure, light-weight, space-saving, closed structure, and water-saving has additional features of **electric osmosis** and **after-adding of polyferric sulfate** achieve **a low water content**



Combination of electric conduction and after-adding of polyferric sulfate

※ Reductions of water content rate are compared values with type 2 dewatering device



Scope of application: mixed sludge from CAS process by mechanical thickening

Needs

While having favorable features of a rotary press dewatering device, achieve further low water content rate

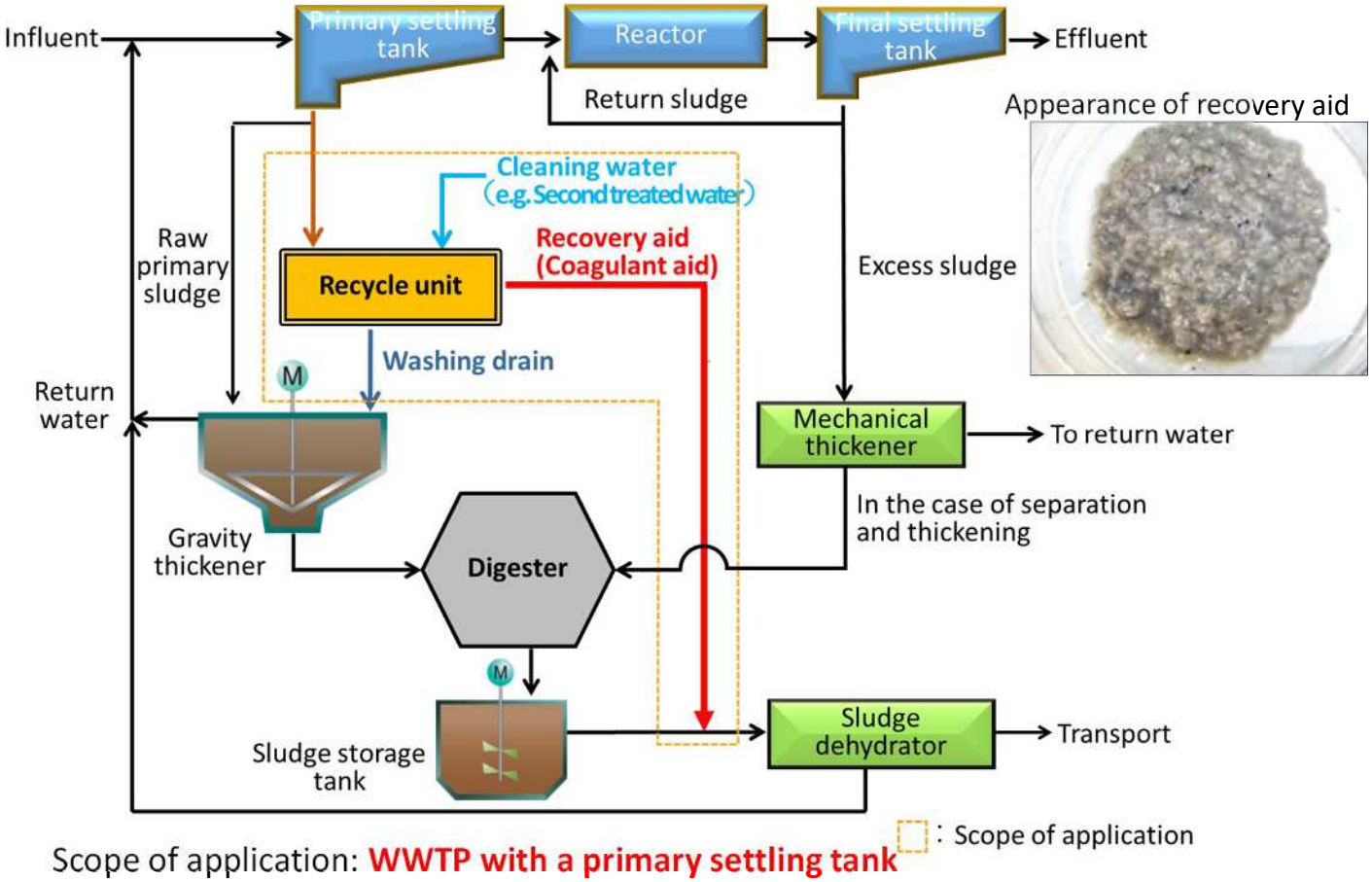
Benefits

Reduce sludge disposal costs and LCC by lower water content

Sewage-derived Fiber Utilization System

Developers: ISHIGAKI COMPANY, LTD.

Captured/added sewage-derived fiber that primary sludge includes improves dewatering performance. The system reduces the water content of sludge, chemical injection rate, load to the subsequent process facilities, and costs.



Scope of application: **WWTP with a primary settling tank**

Especially, benefit WWTPs that need to reduce disposal costs for hard-to-dewater anaerobic digested sludge or mixed sludge with significant property changes

Needs

- Improve dewatering performance even for hard-to-dewater sludge
- Achieve dewatering treatment with no expensive coagulants

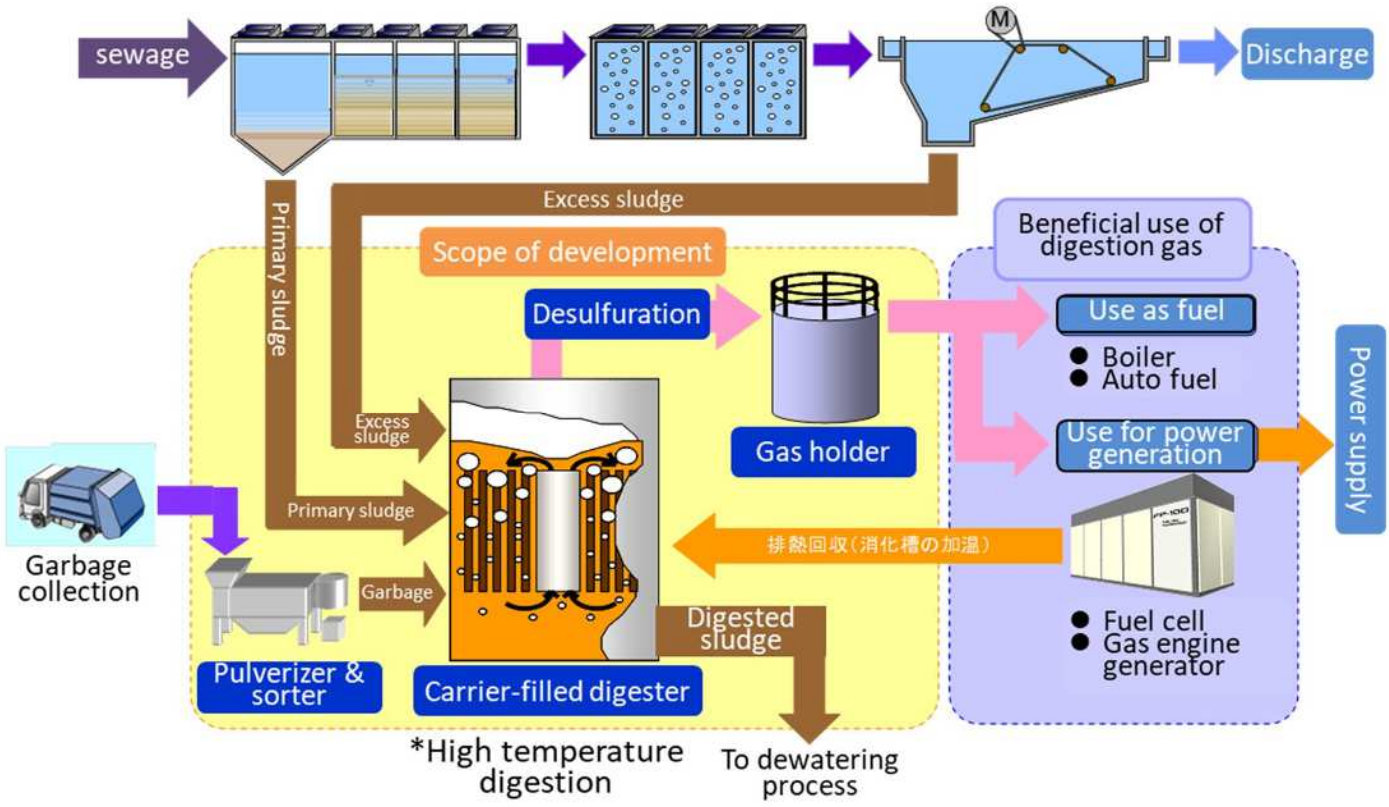
Benefits

- Cost reduction for subsequent sludge treatment and disposal
- Chemical cost reduction by reducing injection rate of polymer coagulant or change to inexpensive chemicals

Carrier-Filled High-Speed Methane Fermentation

Developers: METAWATER . Co., Ltd.

Carrier filling, a stainless steel plate digestion tank and the control of digestion inhibition decrease digestion periods, reduce construction costs, and achieve a stable fermentation



Needs

- Integrate local biomass
- Efficient digestion treatment and increase digestion gas yields

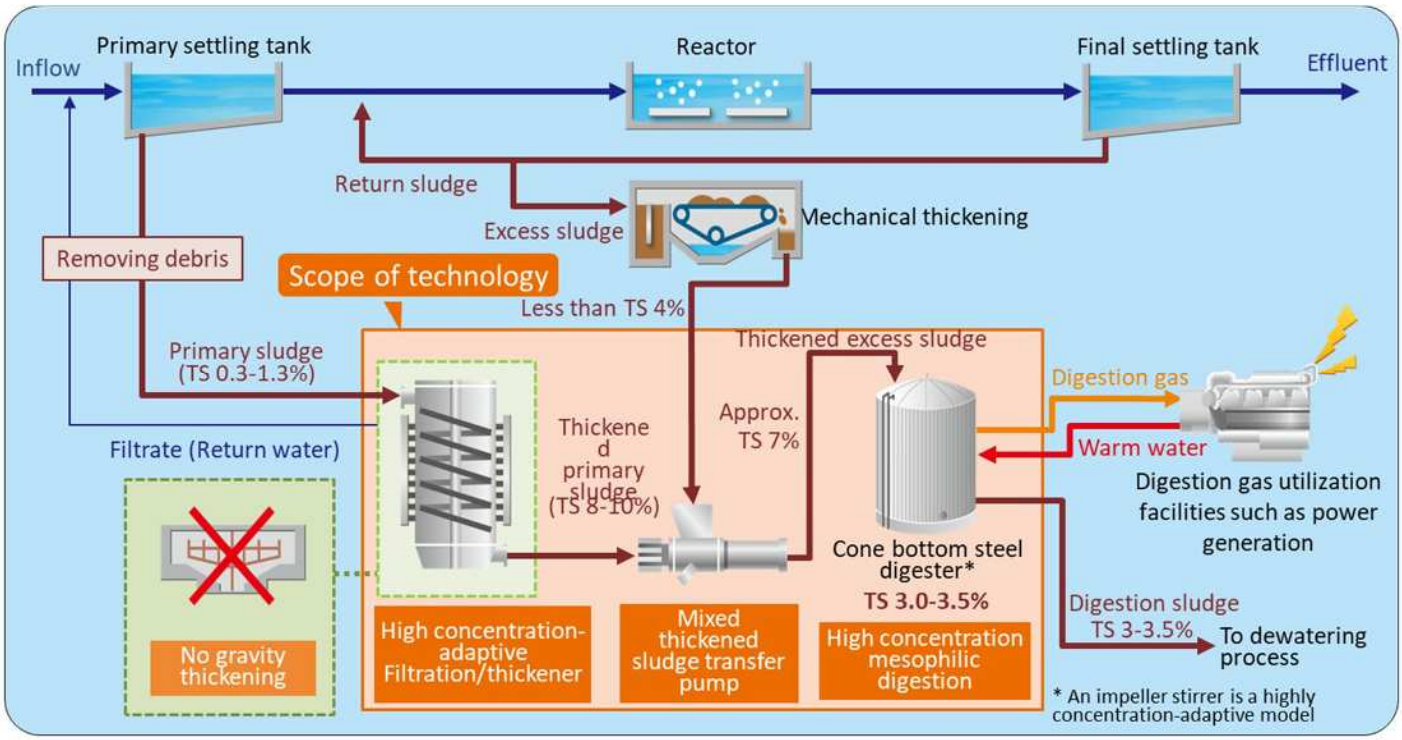
Benefits

- Equal or higher sludge decomposition rate and digestion gas yield with shorter retention time of 1/2 to 1/6 than the conventional mesophilic digestion
- A smaller digestion tank than the conventional system reduces costs
- Adaptable to a load fluctuation. Enable a mixing treatment with other biomass.
- An automatic fermentation control such as NH4-N concentration and charging load eliminates ammonia inhibition.

Enhanced Thickening with Filtration and Mesophilic Digestion System

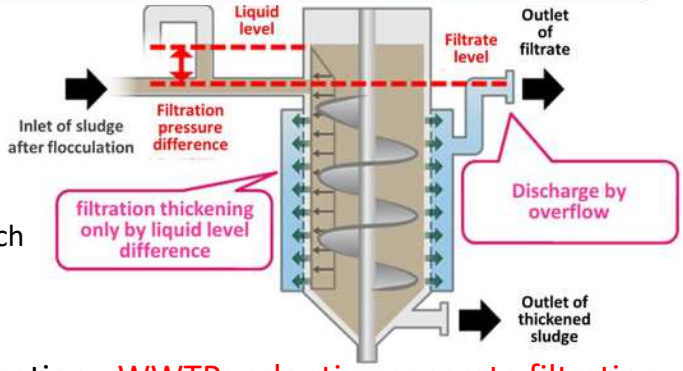
Developers: Tsukishima Kikai Co., Ltd.

High filterability with “micro pressure filtration” increases sludge concentration, reduces digestion tank volume, secures utilizable digestion gas yields and reduces costs for construction and O&M.



The small pressure difference in/out of the screen

The weak pressure on sludge prevents clogging caused by the cake layer



*The digestion facilities is only applicable to a cone bottom steel plate digestion tank registered on New Tech Implementation Program. Stirrers should be high concentration-adaptive models.
*Application to other digestion tanks except mentioned above requires consideration

Scope of application : WWTPs adopting separate filtration

Needs

- Reduce the required capacity of a new digestion tank and space-saving

Benefits

- The concentration of primary sludge is controllable at any level
- Digestion tank’s capacity, the heating calorific value, and facilities’ electric consumption are reducible by reducing supplied sludge to the tank
- Improve solid’s recovery rate in the primary sludge’s thickening process

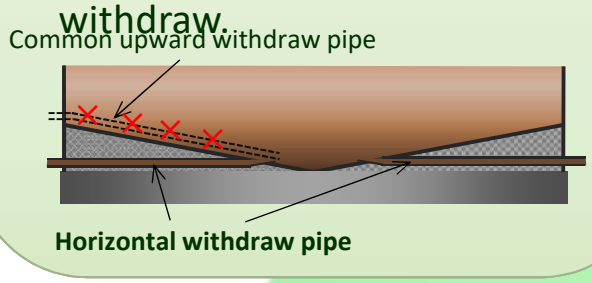
Cone-bottom Steel Plate Digestion Tank

Developers: Tsukishima Kikai Co., Ltd.

A digestion tank made of **steel plate reduces construction period**. Its **cone-bottom shape** enables **efficient discharge of suspended solids** and **energy-saving**

Cone-bottom steel plate digestion tank

- Aggregate suspended solids
- Cone-bottom shape prevents settling
- Sludge is taken out from the bottom effectively. The digestion tank has a horizontal withdraw pipe while the conventional tank has an upward pipe for sludge withdraw.



*The digestion tank has 35 years' durability with proper management, including anticorrosion coating.

Scope of application: primary/excess sludge, human waste, septic tank sludge, and biomass such as food waste

Needs

- Start using digestion gas early by reducing the construction period of the digestion tank

Benefits

- steel plate made tank body reduces the construction period
- Effective withdraw of suspended solids and settling control enable easy maintenance
- Impeller-type stirrers and automatic control of sludge circulation pump by accurate temperature measurement achieve significant energy saving

Four Divided Pit Steel Plate Digestion Tank

Developer: Ishigaki Company Ltd.

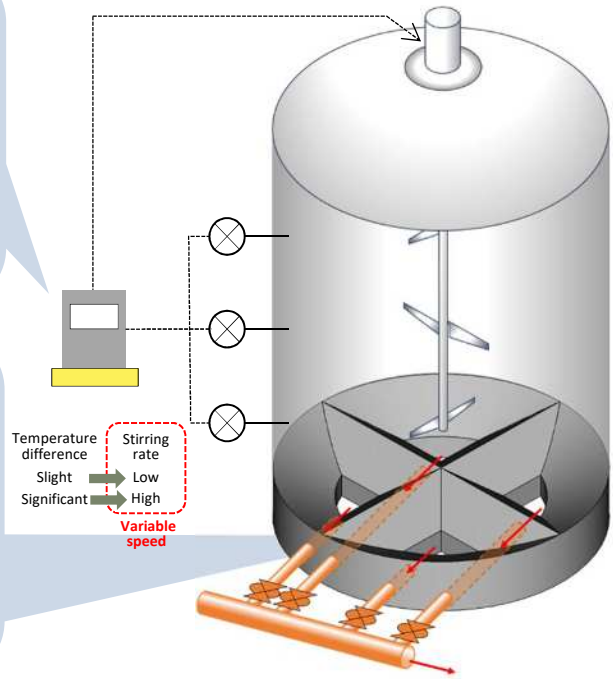
The new steel plate digestion tank has a four-divided pit structure bottom. The structure enables efficient discharge of inside sediment with withdrawing of digested sludge.

Stable control against temperature differences

The digestion tank achieves energy saving by controlling the stirring rate of the impeller stirrers, which detects the temperature difference inside the tank.

Four-divided pit structure

The bottom of the digestion tank has a structure of divided four sections. Each side of the pit has an appropriate slope to collect and withdraw the settled sludge, reducing sediment efficiently.



Scope of application: Primary sludge, Excess sludge

*The new digestion tank applies to mesophilic digestion
*Appropriate maintenance such as anti-corrosive coating secures tank bodies' service life for 35 years

* Dewatering performance varies depending on sludge properties. Ask JS for details.

Needs

- Use digestion gas as soon as possible by reducing the construction period of the digestion tank

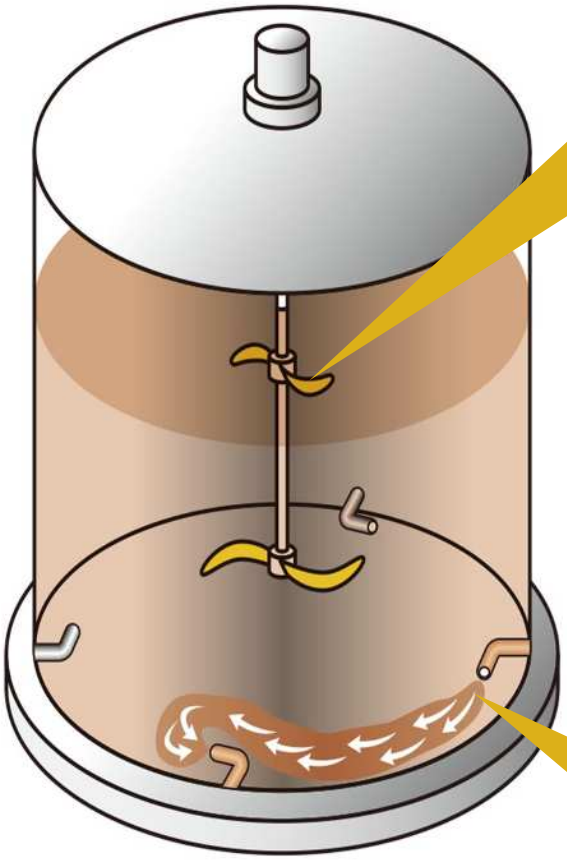
Benefits

- The steel plate digestion tank body requires a less construction period than a concrete body digestion tank.
- Impeller-type stirrers and stable control against temperature differences achieve energy saving for O&M.
- Efficient discharge of sediment and sediment prevention make maintenance easy.

Steel Plate Digestion Tank Using Injection Nozzles

Developers: JFE Engineering, FUSO Corporation

Steel plate and sediment removal structures achieve shortening construction periods and energy-saving.

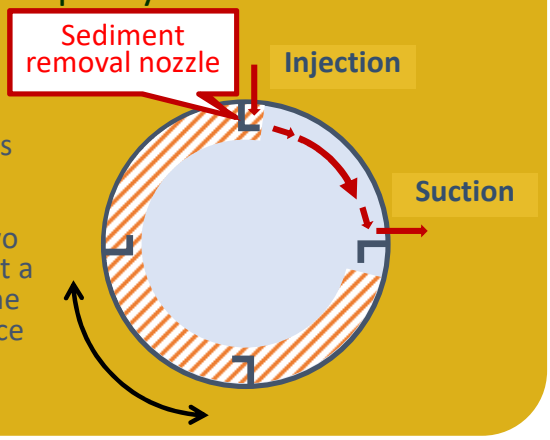


Swept wing agitator

High mixing efficiency at a low rate rotation, resistance against screenings twining requires no invert operation

Sediment removal structure

- A nozzle on the bottom injects digestion sludge to flow sediment like sand
- The next nozzle sucks digestion sludge and sediment to discharge them to the outside partly



* The nozzles remove sediment by switching two operations at a quarter of the circumference of a tank.

Scope of application:
sewage sludge (primary/excess sludge)

*Mesophilic digestion
*The tank body has a service life of 35 years with appropriate maintenance, including corrosion control coating.

Needs

* Dewatering performance varies depending on sludge properties. Ask JS for details.

- Use digestion gas as soon as possible by reducing the construction period of the digestion tank

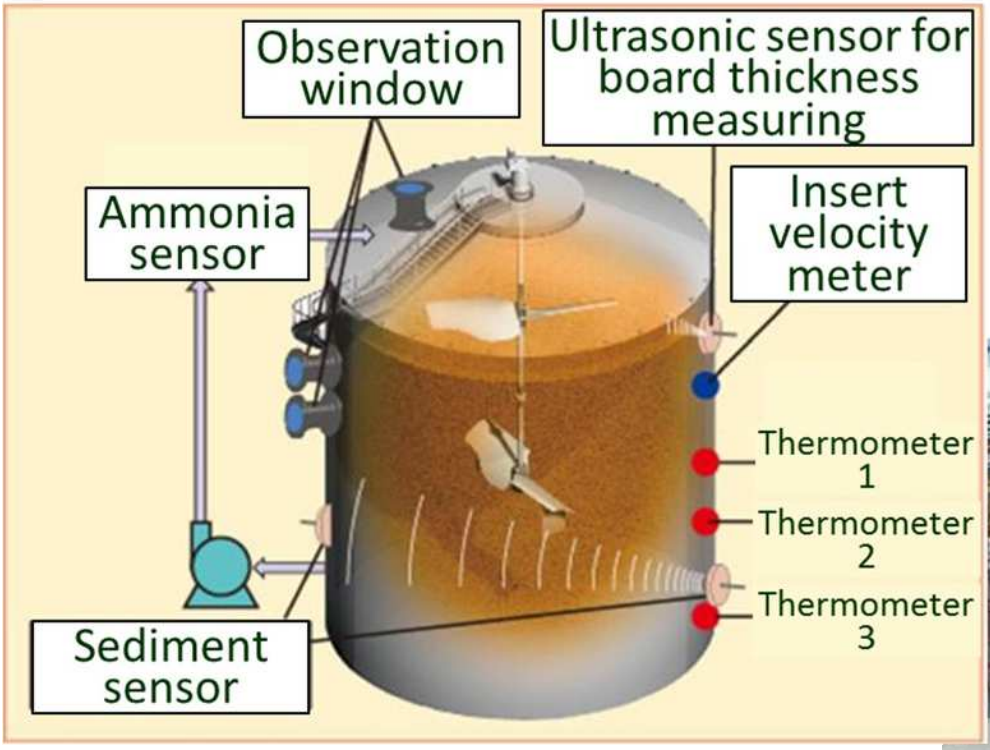
Benefits

- The digestion tank body made of steel plate can reduce the construction period
- Impeller-type agitators save energy
- Efficient flow and discharge of sediment make maintenance easy

Packaged Steel Plate Digestion Tank

Developers: Kobelco Eco-Solutions Co., Ltd.

A steel plate body and sensors' operation support enable a reduction of construction period, flexibility to a project master plan and stable fermentation



- Medium temperature digestion
- Tank body has 20 years' service life
  → flexible to reconsidering of project plan
- Good maintenance including anti-corrosion coating can extend service life of tank body 35 years

Scope of application: primary/excess sludge, human waste, septic tank sludge, and biomass

Needs

- Start using digestion gas early by reducing the construction period of the digestion tank

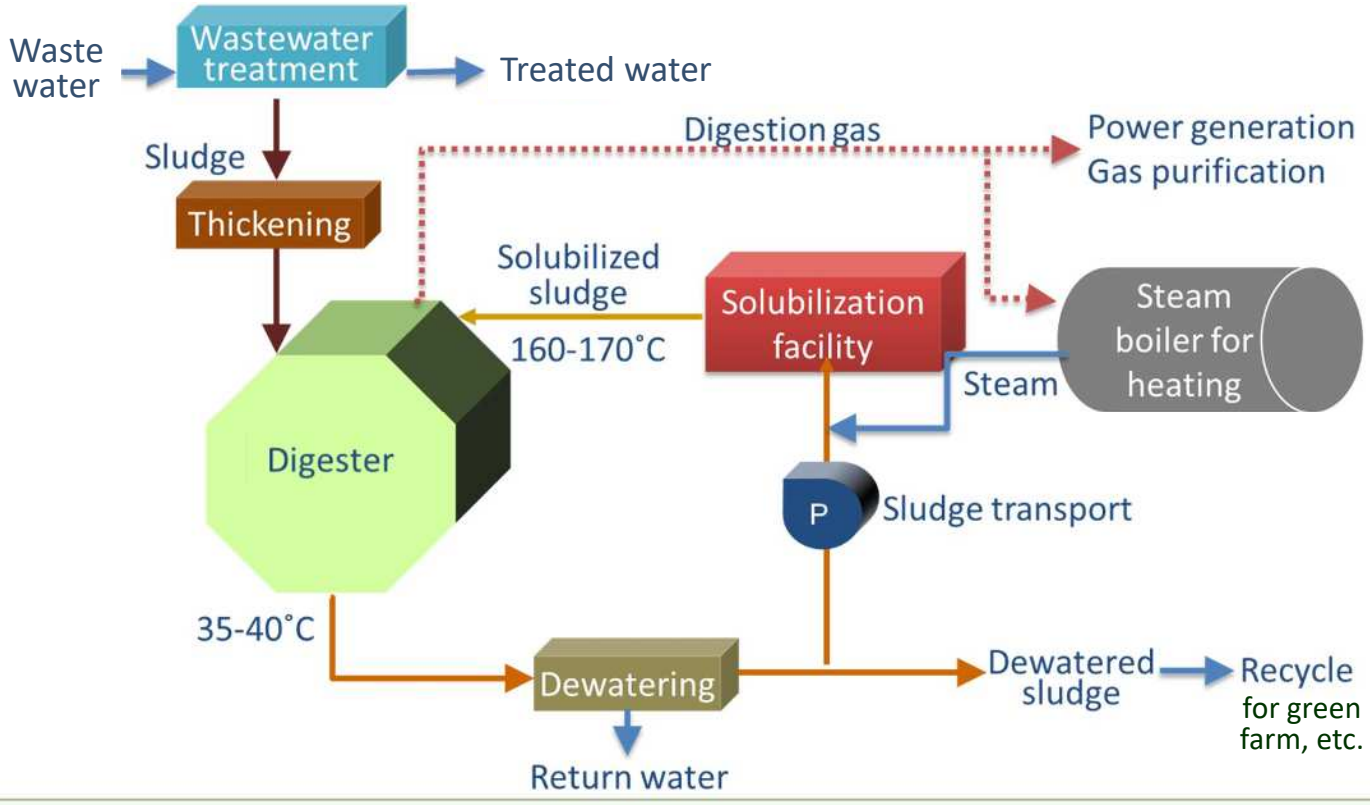
Benefits

- A steel plate digestion tank tank body reduces the construction period
- Impeller stirrers save energy consumption
- Various sensors visualizing the inside of a digestion tank enable an early detection of change or anomaly in operations

High-performance Anaerobic Digestion System with Thermal Hydrolysis Unit

Developers: Mitsubishi Kakoki Kaisha, Ltd.

The system thermally reforms sludge into easy decomposable organic matter and returns it to a digestion tank. It increases gas generation, shorten digestion periods and reduces sludge volume by the improvement of dewatering performance



Needs

- Solubilization treatment with the equivalent energy to the conventional digestion heating
- Apply to the existing digestion facilities with compact equipment
- Accept local biomass to WWTP to improve its power self-sufficiency

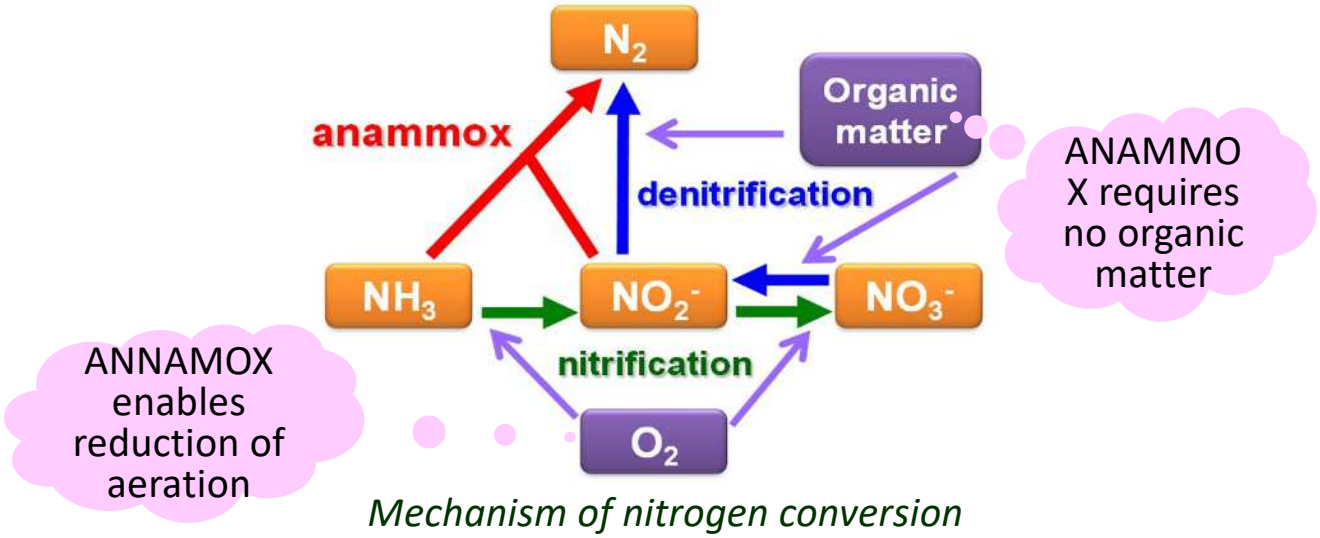
Benefits

- The increased organic matter decomposition rate increases digestion gas generation by 10-30% and reduces sludge generation to 1/2 to 2/3. The utilization of generated gas makes profits and reduces sludge disposal costs
- A shorter digestion period of 15 days, 20-30 days of the conventional process, makes smaller facilities than the traditional anaerobic digestion process

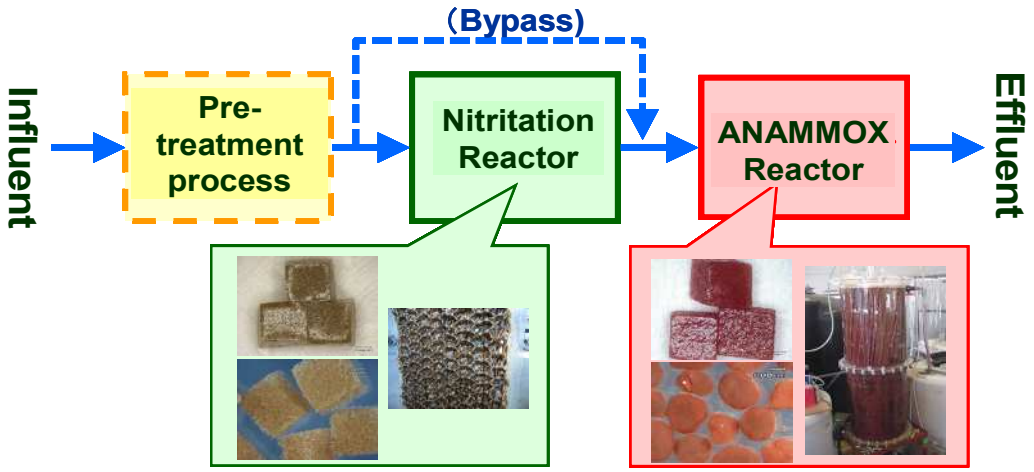
Nitrogen Removal Using ANAMMOX

Developers: TAKUMA CO., LTD., and METAWATER Co., Ltd.

Energy saving & low-cost nitrogen removal of filtrate in anaerobic digested sludge using ANAMMOX



Mechanism of nitrogen conversion



Treatment flowchart of nitrogen removal technology using ANAMMOX

Needs

- Anaerobic digestion system needs the separate treatment facilities for return water
- Adopt an anaerobic digestion process for sludge treatment.
- Accept biomass from outside.

Benefits

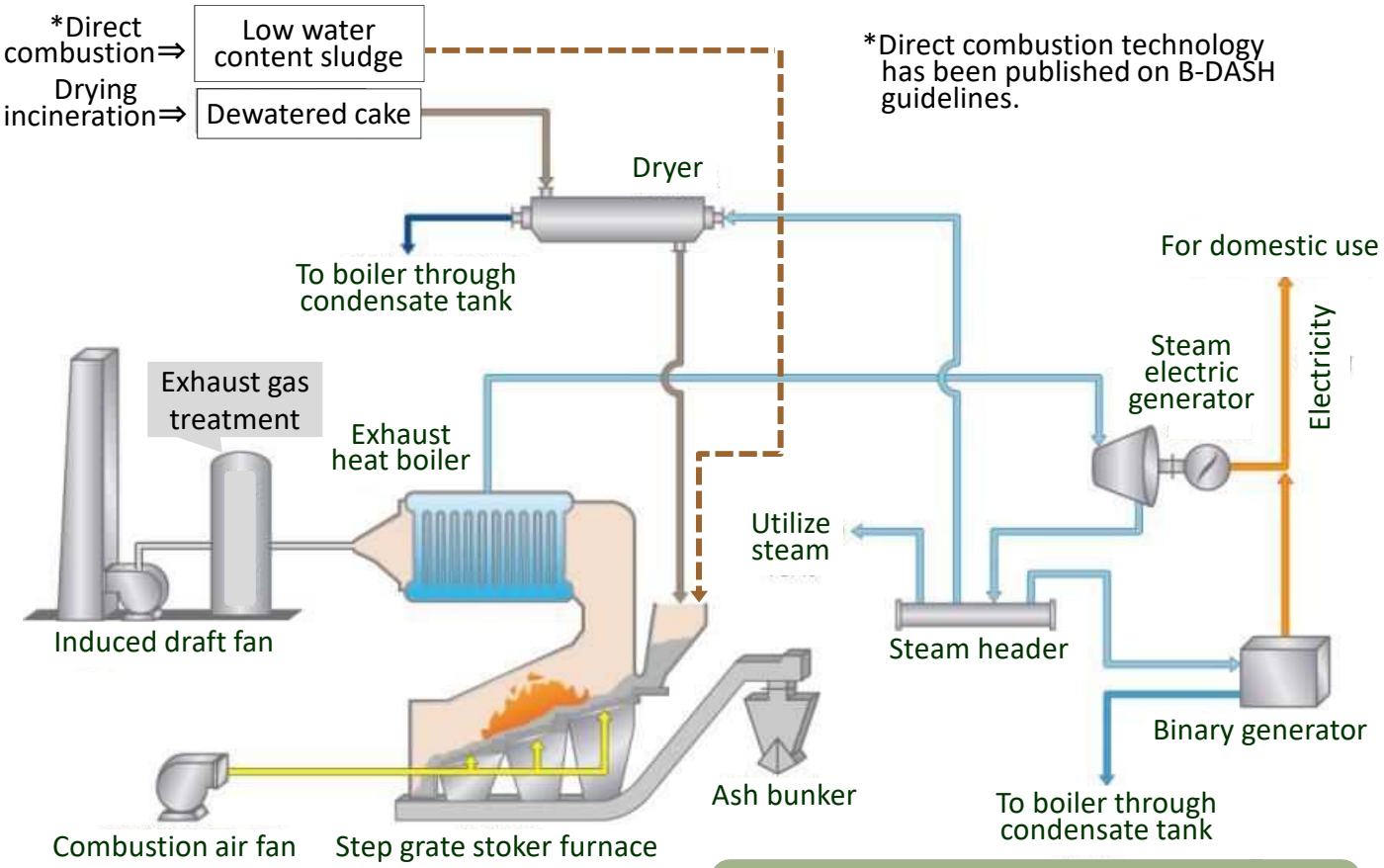
- Reduce utility costs and greenhouse gas emission
- Improve treated effluent quality of WWTPs using anaerobic digestion process

Power Generation System Using Step Grate Stoker Furnace

Developers: TAKUMA CO., LTD.

The combined system of low water content technology, step grate stoker furnace and waste heat boiler, and steam-electric generator requiring no auxiliary fuel achieves self-sustaining electric system.

Example of electric generation system flowchart



Low power consumption, low N_2O emission, stable self-sustaining combustion, less fixation

Power generation with low-pressure, small amount of steam and low temperature heat source. ⇒ Large scale power generation

Needs

- Power self-sufficiency inside the facility
- Use no supplemental fuel

Benefits

- Lower power consumption & N2O emissions than the conventional bubbling fluidized bed incinerator (high-temperature combustion) contribute to a reduction in greenhouse gas emissions for the entire system
- Facilities above a specific scale can self-sufficient energy with generated electricity
- Self-sustaining combustion needs no auxiliary fuel to reduce O&M costs

Multi-layer Fluidized Incinerator

Developers: Bureau of Sewerage, Tokyo Metropolitan Government, METAWATER Co.,Ltd.

Supply controlled combustion air from three inlets to optimize inner temperature. The incinerator enables low fuel consumption and reduction of greenhouse gas emissions

N_2O reduction

Low fuel consumption

Exhaust gas

(Exhaust gas treatment system is same as the conventional system)

Improve combustion efficiency inside furnace

Complete combustion zone

Complete combustion of unburnt gas

High temperature zone

accelerates degradation of N_2O

Tertiary air

Secondary air

Controlled gasification zone

Reduction of primary air **inhibits N_2O generation**

Supply combustion air from the central zone of a furnace

Multi-layer combustion control

Primary air

Reduce the combustion air volume from the bottom of a furnace

Needs

- Reduce both O&M costs and N_2O emissions
- Stable operation against load fluctuations

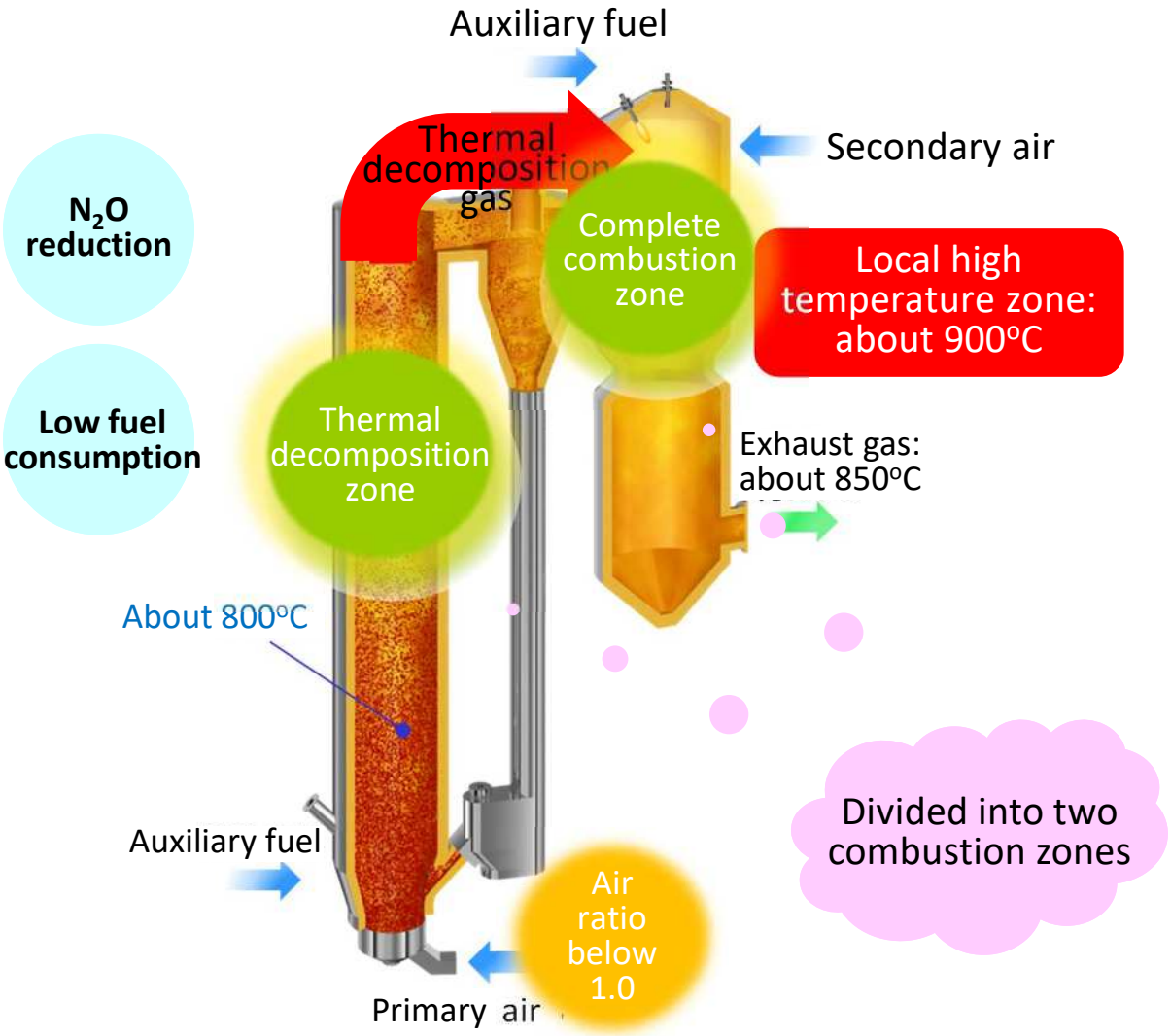
Benefits

- Low fuel consumption
- Inhibition of greenhouse gas (N2O) emissions

Advanced Two Stage Incinerator

Developer: Kobelco Eco-solutions Co., Ltd.

The system has the additional combustion section after the circulating fluidized bed furnace to optimize combustion air supply and control inner temperature. The two-divisions structure enables low fuel consumption, electric power saving, and reduction of greenhouse gas emissions.



Needs

- Significant reduction of N_2O emissions

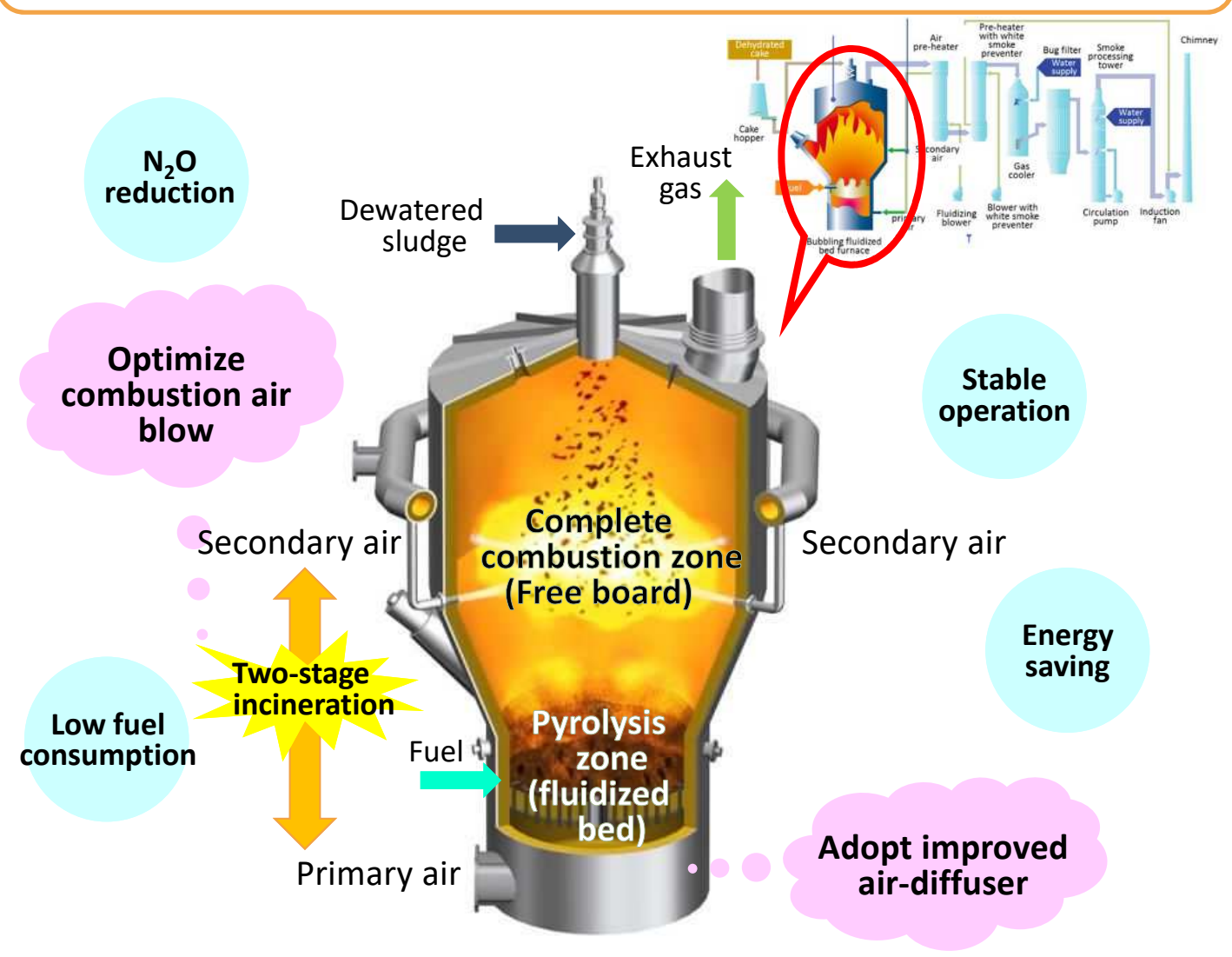
Benefits

- Low fuel consumption
- Energy saving
- Inhibition of greenhouse gas (N_2O) emission

Bubble Generation Two-stage Fluidized Incinerator

Developers: Kobelco Eco-Solutions Co., Ltd.

Optimize the process of combustion air blow to achieve low fuel consumption, save electric power consumption, and reduction of greenhouse gas emissions.



Needs

- Reduce O&M costs and N_2O emissions together

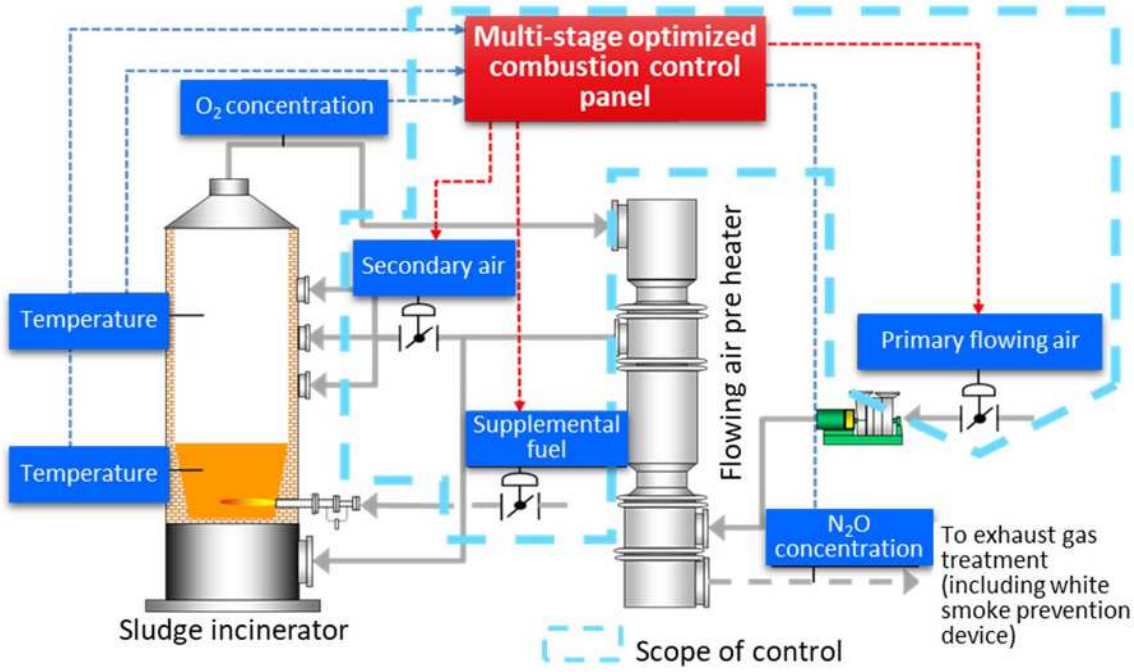
Benefits

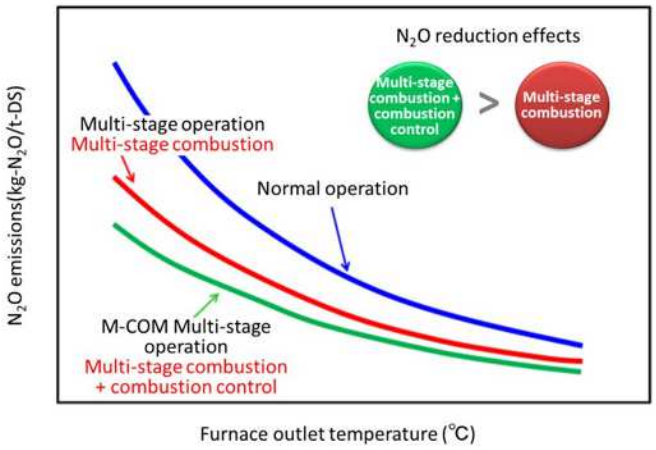
- Can reduce fluidized air volume while inhibiting supplemental fuel consumption, and inhibit greenhouse gas (N_2O) emission at the same time
- Improved air-diffuser reduces power consumption
- Proven technology provides the reliability of the system

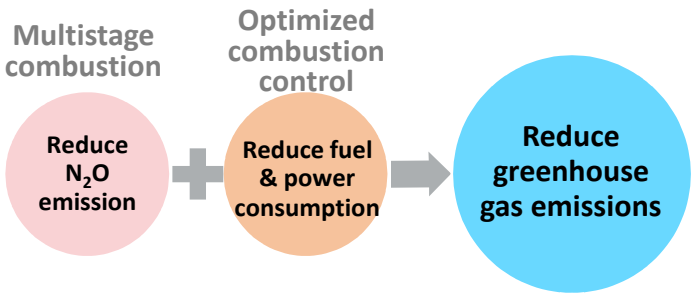
Multi-stage Bubbling Fluidized Bed Incineration System with Optimized Combustion Control

Developers : Mitsubishi Heavy Industries Environmental & Chemical Engineering Co., Ltd.,

The synergy effect of N_2O reduction by **multistage combustion** and fuel consumption reduction by **low air ratio operation** of combustion control technology **reduces greenhouse gas emissions**







Needs

- Reduce O&M costs and N2O emissions together with no furnace remodeling

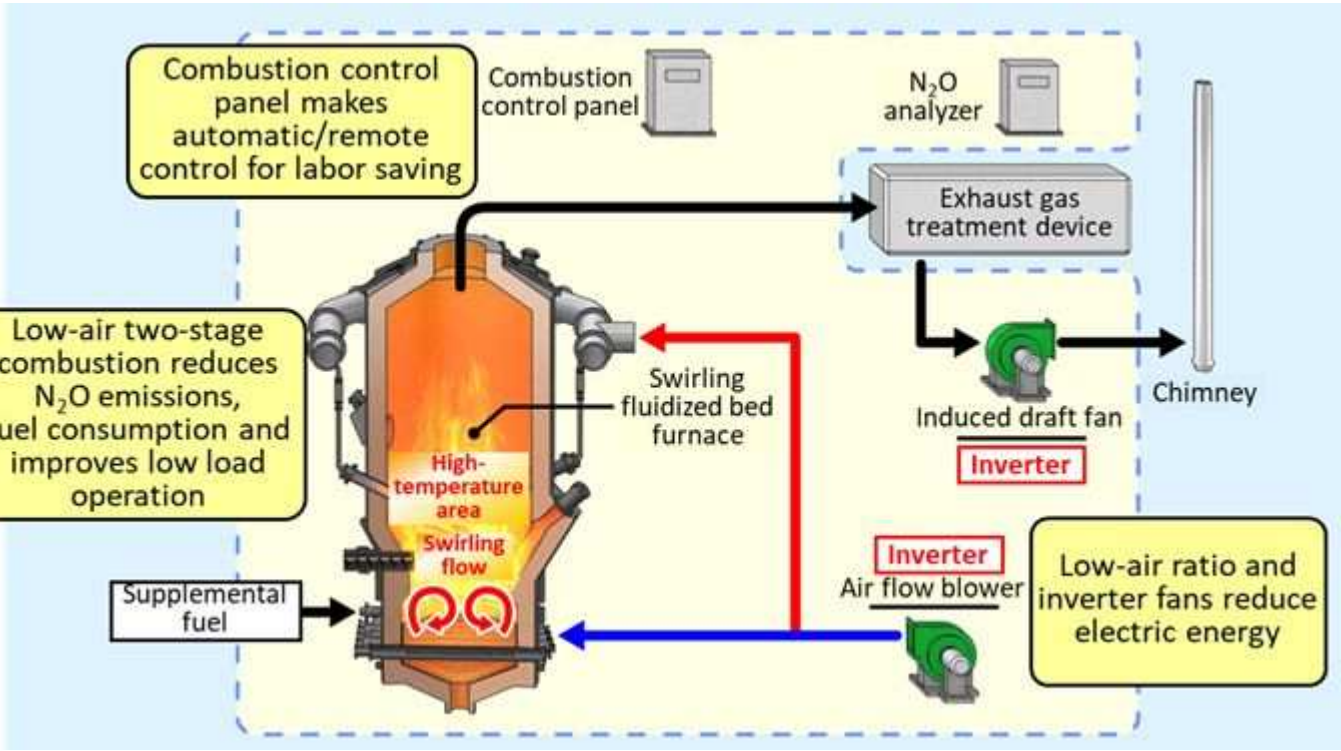
Benefits

- Reduction of greenhouse gas (N_2O) emissions, fuel and power consumptions

Two-stage Swirling Fluidized Bed Furnace

Developers : Swing Engineering corporation

Swirling fluidized bed furnace with high combustion efficiency, which employs two-stage combustion technology and low airflow ratio, achieves energy-saving and reduces greenhouse gas emissions.



Needs

- Selectable incinerator operation according to O&M conditions and needs, including reduction of fuel consumption and greenhouse gas emissions

Benefits

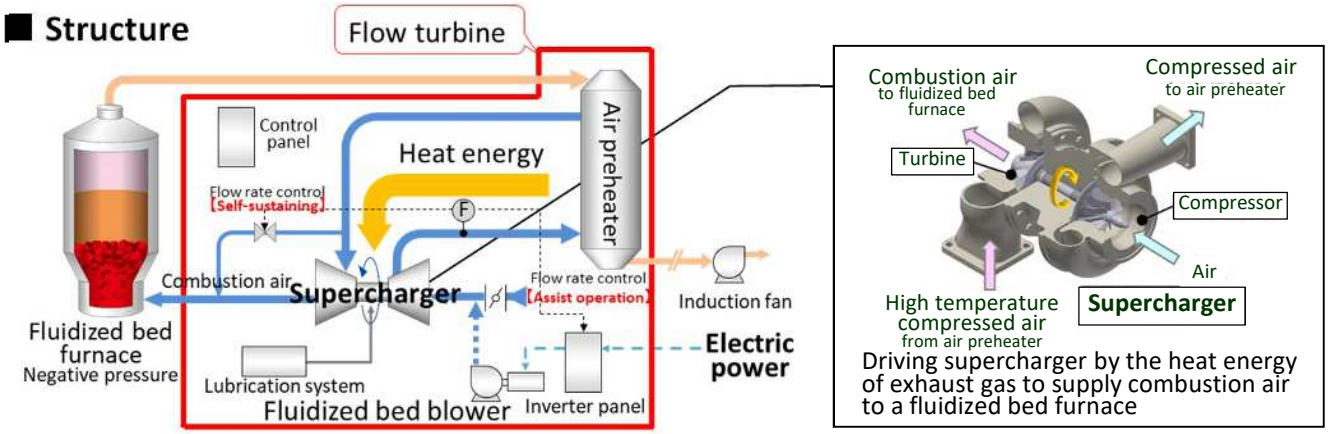
- Can choose either fuel-saving operation or N_2O reduction operation
- Reduce fuel consumption, power consumption, and greenhouse gas (N_2O) emissions

Flow Turbine: Energy-saving Supercharged Blowing System For Fluid Bed Furnace

Developers: METAWATER Co., Ltd., KUBOTA Corporation.

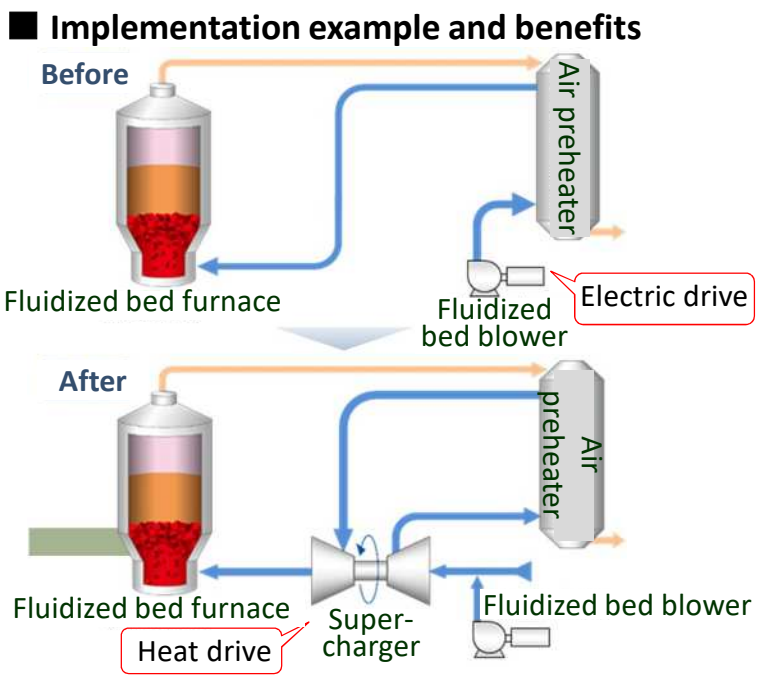
A supercharged blower driven by the heat energy of exhaust gas is installed in a combusted air flow line and has an alternative function to a flowing blower.

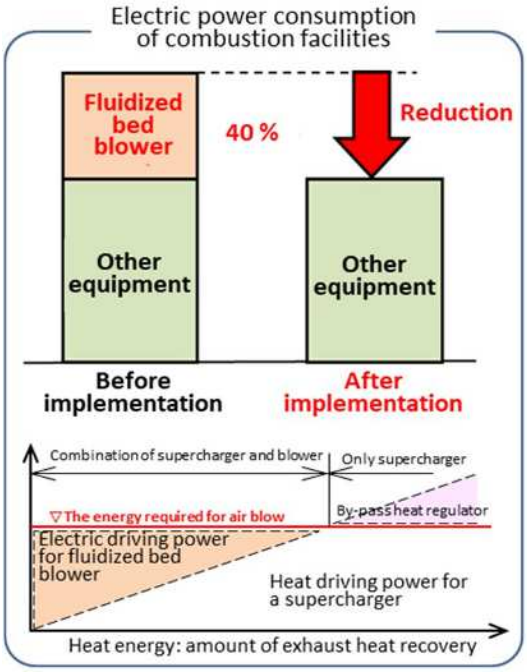
■ Structure



*Automatic control of the supercharger according to thermal energy volume allows switching between "self-sustaining" and "assist operation."

■ Implementation example and benefits





Needs

- Saving power consumption for a fluidized bed furnace and reducing greenhouse gas emissions
- Saving energy of incineration facilities along with renewing air preheater

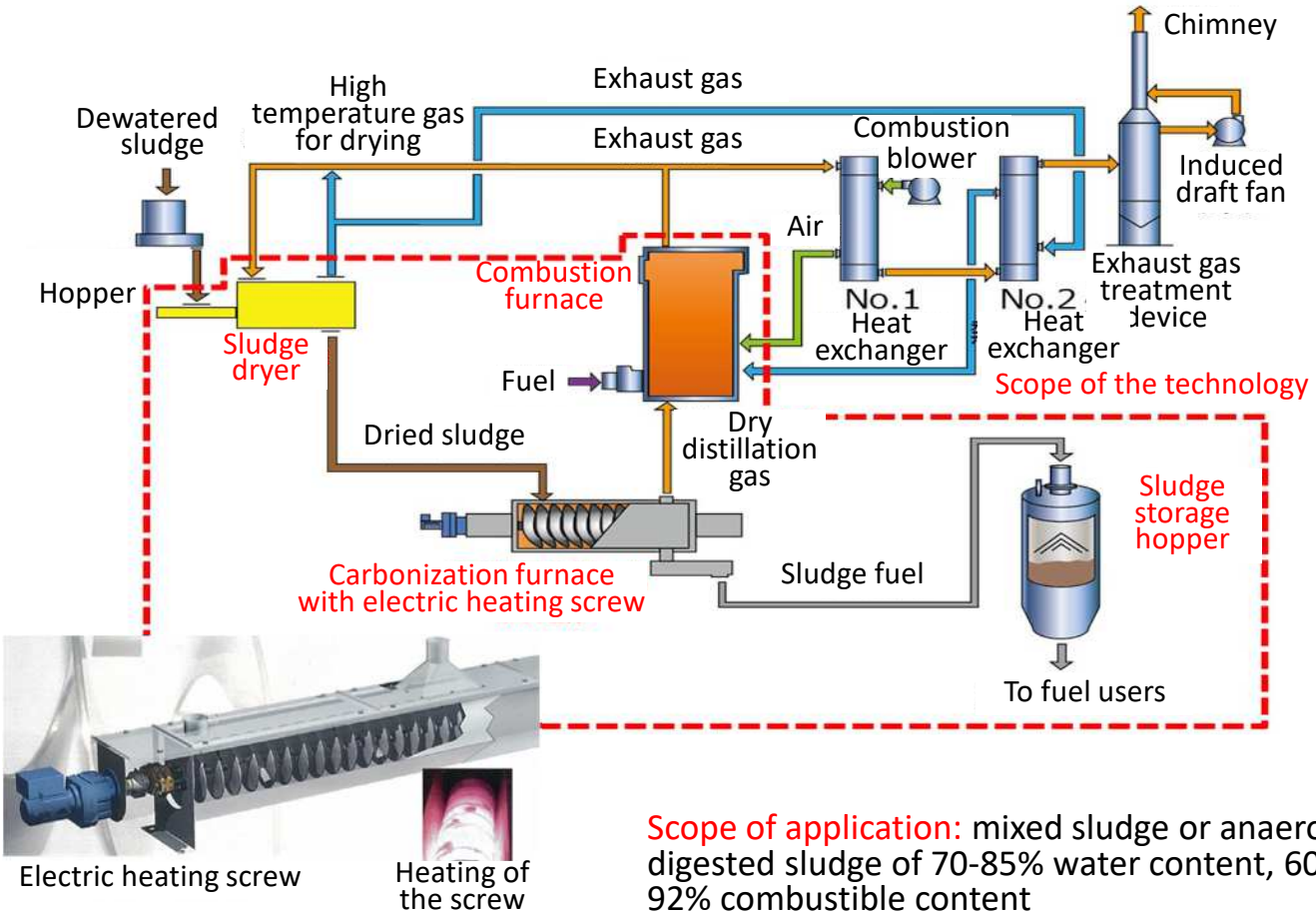
Benefits

- Reducing power consumption of the whole incineration system and CO^2 emissions from electric power while keeping the safety of a fluidized bed furnace

Sludge Fuelization Using Carbonizing Furnace with Electric Heating Screw

Developer: Kobelco Eco-solutions Co., Ltd.

Sludge carbonization technology that uses electricity as a heat source requires no hot air generation furnace, which the conventional combustion furnace needs. The compact and simple system achieves a significant energy saving and sludge fuelization with stable calorific value.



Electric heating screw

Heating of the screw

Scope of application: mixed sludge or anaerobic digested sludge of 70-85% water content, 60-92% combustible content

* Dewatering performance varies depending on sludge properties. Ask JS for details.

Needs

- Promote the fuelization of sludge with various properties
- Use digestion gas generated from the existing facilities or digestion facilities under consideration as a supplemental fuel

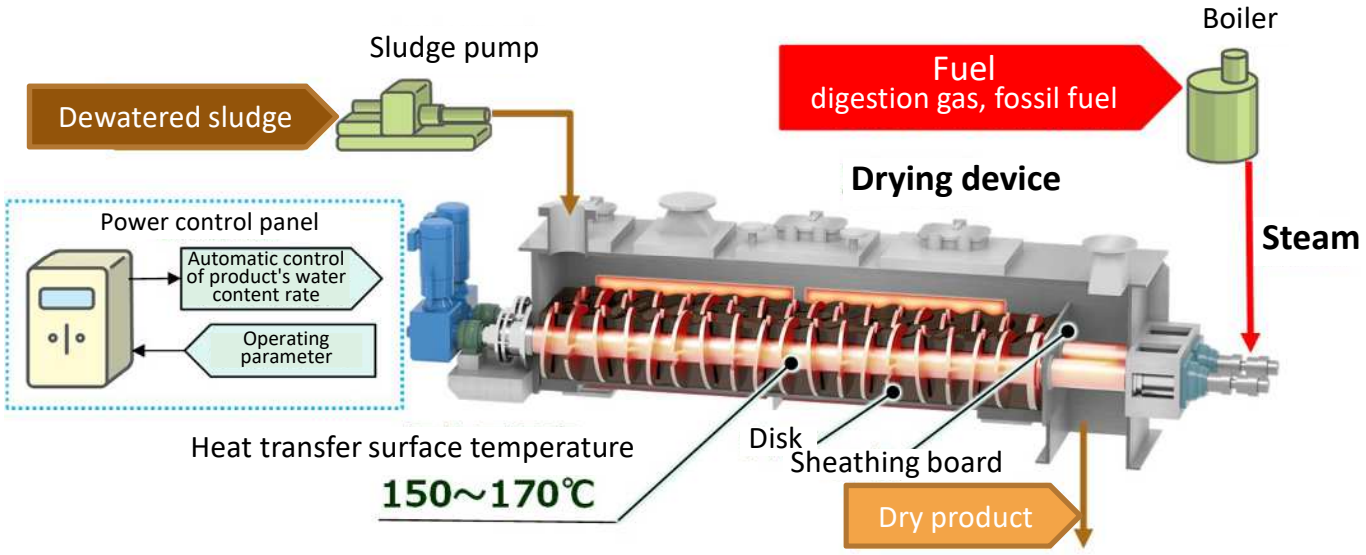
Benefits

- Further energy saving than the conventional outer heating kiln carbonizing furnace
- Generating sludge fuel with a stable calorific value

Sludge Property Fluctuation-adaptive Steam Drying System

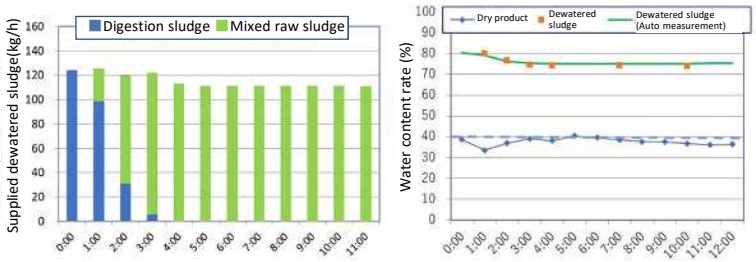
Developer: Swing Engineering Corporation

Consolidating sewage sludge in wide-area and collaborative manners may cause fluctuations in sludge property. The system allows dry products stable the water content rate by automatic control and significantly reduces fuel consumption by using low-pressure steam as a heat source.



Automatic stable control of the water content rate of dry products

Automatic control of operating parameters such as the height of the dam board and steam pressure achieves stable producing dry products



Property fluctuation test example of supplied sludge

Scope of application: Mixed sludge or anaerobic digested sludge, Supplied sludge: 72-86% water content and 60-92% organic component ratio for using dry products as fuel, Dry products: 20-40% water content

Needs

- Utilizing sewage sludge with various properties as fuel/fertilizer
- Use digestion gas generated from the existing facilities or digestion facilities under consideration as a supplemental fuel

Benefits

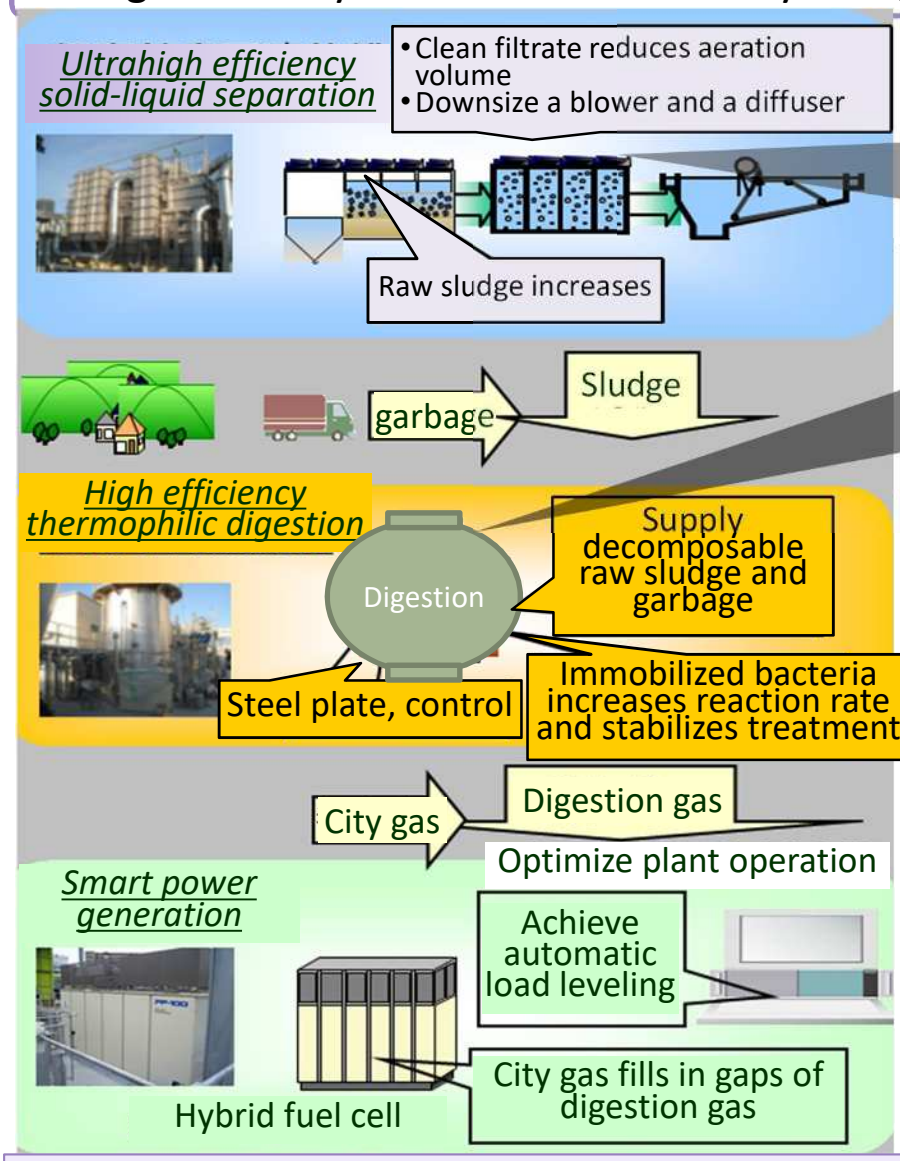
- Producing dry products responding to sewage sludge fluctuation
- Reducing fuel/power consumption and LCC than the conventional technologies

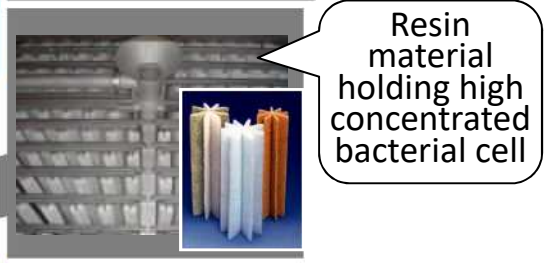
B-DASH Project

Demonstration Study of an Energy Management System Using Intensive Solid-liquid Separation Technology

Implementer: The Consortium of METAWATER Co., Ltd. and JS

Energy self-sufficiency rate improved by the increase in the raw sludge recovery rate and the efficiency of digestion





Technology Overview

1. Ultrahigh efficiency solid liquid separation enables energy saving for wastewater treatment process, and energy generation at sludge treatment process.
2. A steel plate digestion tank with garbage supplying, high temperature, high concentration and carrier allows a short digestion period and downsizing.
3. Smart power generation system utilizes 100% digestion gas as hybrid with city gas

Achievements

- **Performance of solid-liquid separation:** achieve **70%** removal of SS, reduce power consumption for aeration by **13%**, improve raw sludge recovery rate by **51% → increase digestion gas generation**
- **Capability of high temperature digestion: r**educe digestion periods from 20 days to **5 days**, downsize digestion tank to **one fourth**, reduce construction costs **by 33%.**
- **Energy self-sufficiency: reduce** power consumption of whole WWTP **by 59%.**

Demonstration of a Technology for Highly Efficient Nitrogen Removal Using Fixed-bed Anammox Process

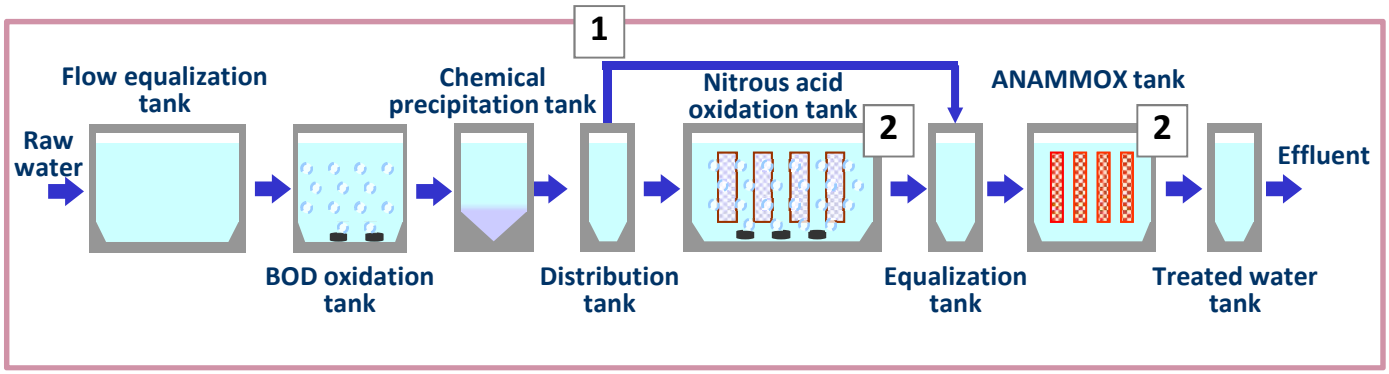
Implementer: The consortium of Kumamoto City, JS, and TAKUMA CO., LTD.

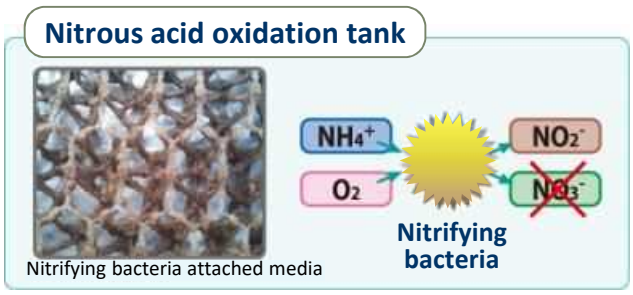
High-efficiency nitrogen removal from filtrate of anaerobically digested sludge at low-cost and energy-saving

Technology Overview

1. **Bypass method :** Control the concentration ratios of ammonia and nitrate by water amount of bypass.
2. **Fixed-bed method :** Resistance to a load fluctuation and stable operation.

Treatment flowchart





Achievements

The whole process could **remove more than 80% of nitrogen.**
Compared to *Carrier-added step-feed two-stage nitrification denitrification process*, the demonstration technology **reduces***:

- Construction costs **by 20%**
- O&M costs **by 35%**
- LCC **by 27%**
- Energy consumption **by 44%**
- Greenhouse gas emission **by 65%**

*Calculated under the assumption that nitrogen removal facilities for filtrate of anaerobic digested sludge are introduced to WWTP with an anaerobic digestion tank and treatment capacity of 50,000m^3/day(7t-DS/day)

Demonstration of an Electricity Generation System from Sewage Biomass Source

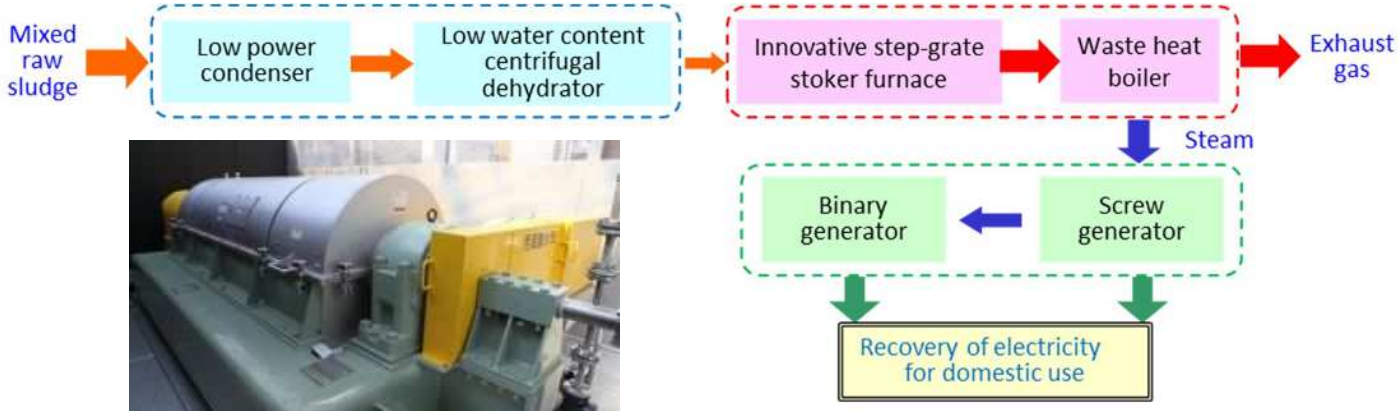
Implementer: The consortium of Wakayama City, JS, Kyoto University, Nishihara Environment Co.,Ltd., and Takuma Co.,Ltd.

Energy self-sufficiency improved by power generation with waste heat from sewage sludge incineration

Technology Overview

1. Low water content of sludge using centrifugal dewatering device with internal double coagulation
2. Energy recycling with innovative step-grate stoker furnace
3. Energy conversion using a binary generators, etc.

Left: Screw type generator
Right: Binary type generator



Two-agent sludge conditioning centrifugal dewatering device

Achievements

Feasibility study of single-coagulant dewatering + fluidized bed incineration with capacity of 100t/day (24t-DS)

- **Reduce** O&M cost **by 50%**
- **Reduce** greenhouse gas emission **by 90%**
- **Reduce** energy consumption **by 70%**
- Generate electricity of 2,400MWh/year*

*** Equivalent to 30% of electric power consumption of whole WWTP**

Demonstration on Efficient Sewer Management System Using Advanced Image-recognition Technology

Implementer : The consortium of Funabashi City, JS, and NEC Corporation

Efficient and low-cost sewer inspection with a massive amount of data achieved by leading-edge technologies (image recognition, sensing, mechatronics)

Technology Overview

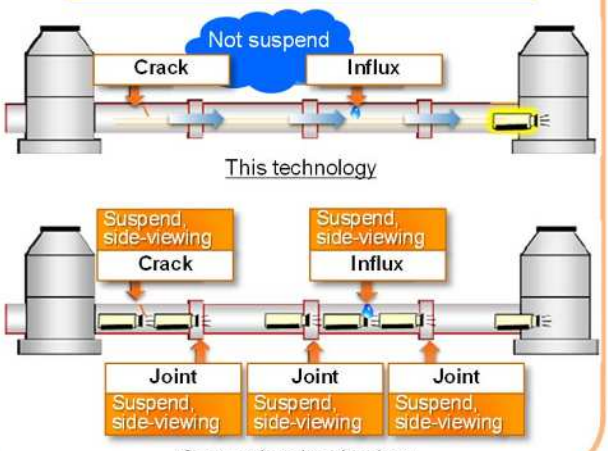
Sewer inspection using TV camera

- High travelling performance
  → Adaptive to long-distance inspection
- Advanced image recognition technology
  → Detect problems automatically
- Sewer management technology using ICT
  → Create a database from inspection results

Operation with game controller

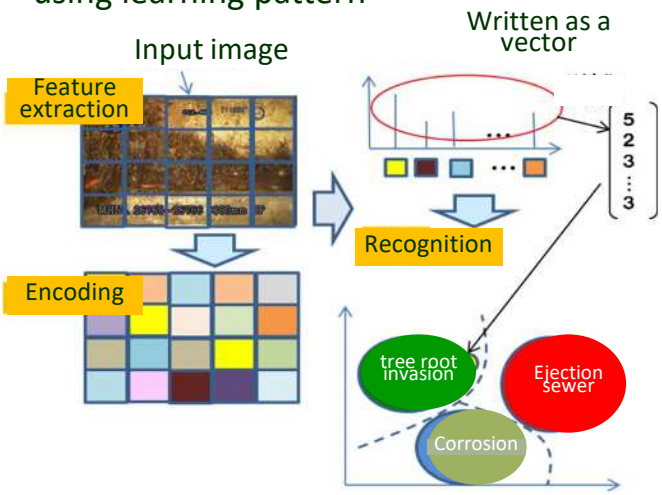
Image recognition camera

Comparison with the conventional camera



Learning image recognition

1. Divide input image into multiple parts to extract their features
2. Encode input images
3. Group examples into similar category using learning pattern



Achievements

Comparison with the conventional self-propelled TV camera

- Traveling performance: detectable to internal diameter of ϕ200 to 700, span length of 500 m
  - ➢Require no cleaning for 20% or less sediment
  - ➢Require no water stop except for a camera submerged
- Image recognition performance: detectable ten kinds* of anomaly.
  **Rank A corrosion or rank a damage having negative impacts on sewer can be found with 75-86% accuracy.*
- Reduce inspection costs by 40%, and improve daily travelling distance to 160%

Demonstration on New Sewage Treatment Technology Using Circulation and No-aeration

Implementer: The consortium of Kochi City, Kochi University, JS, and METAWATER Co., Ltd.

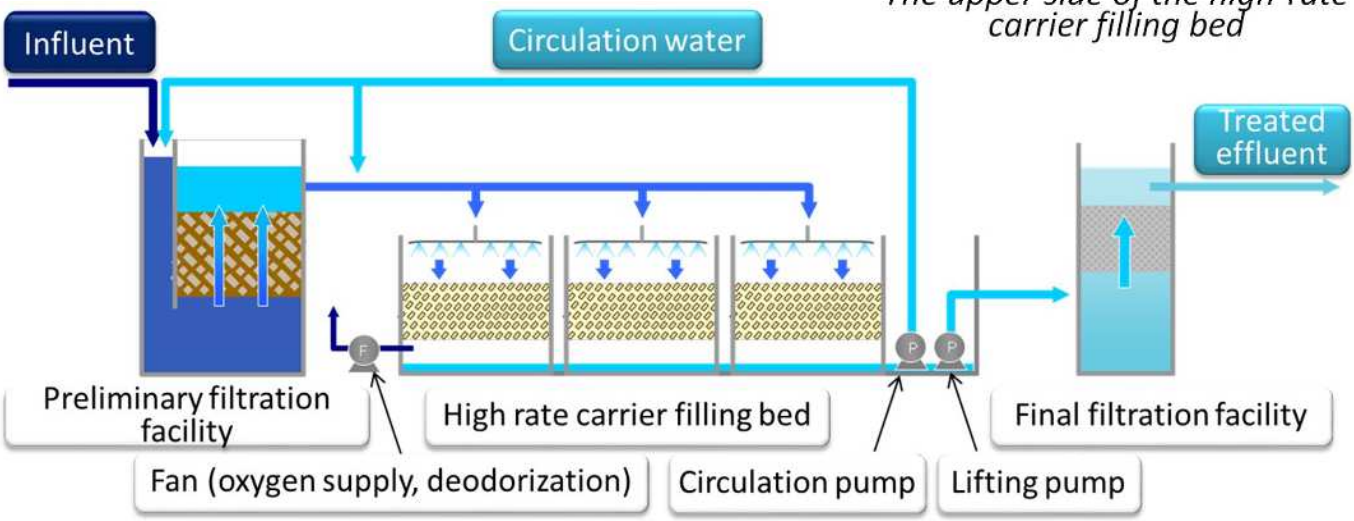
Energy-saving wastewater treatment technology replacing the Conventional Activated Sludge (CAS) Process
Major reduction of power consumption achieved while utilizing an existing facilities

Technology Overview

1. Oxygen supply with gas-liquid contact method substantially reduces power consumption
2. Circulation of second filtrate and final filtrate generates treated water with stable quality
3. Applicable to existing CAS facilities

The upper side of the high-rate carrier filling bed

Flowchart of demonstration technology



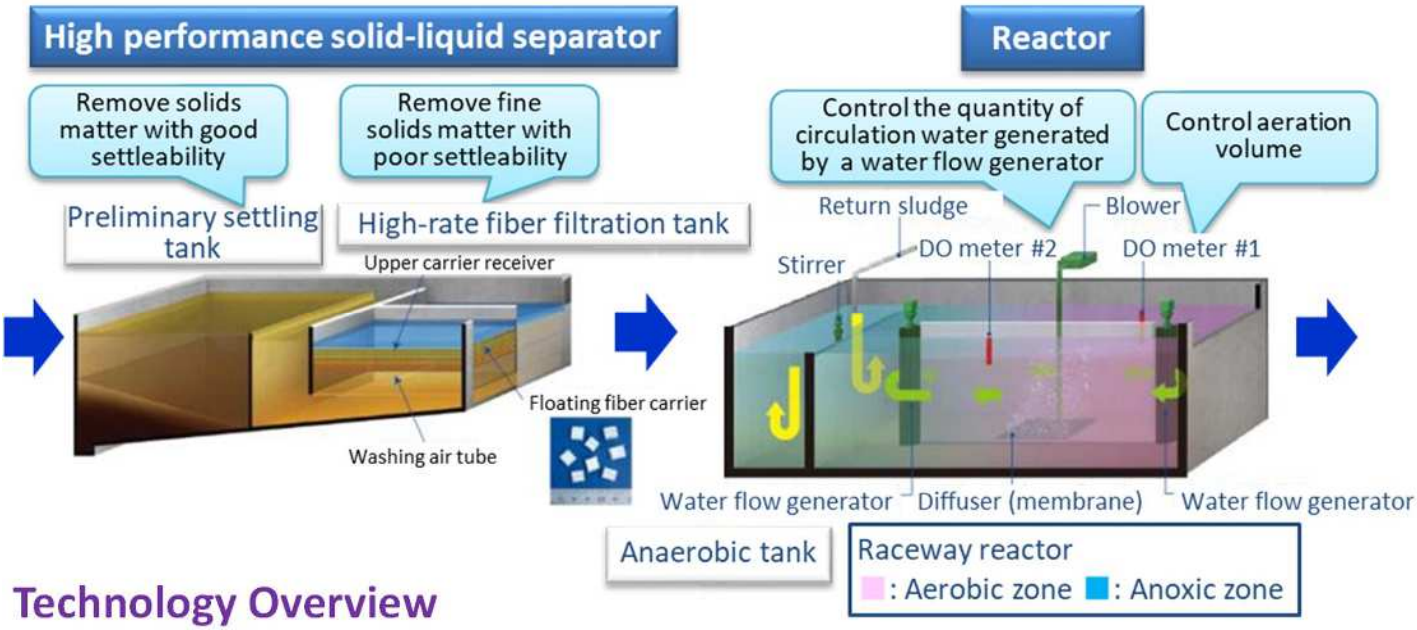
Achievements

- Satisfy the designed effluent water quality: BOD of less than or equal to 10-15mg/L
  ⇒ Applicable to the high-load operation
  (more inflow than the existing CAS process by 25%)
- Cost reduction
  (assuming the maximum daily treatment capacity of 50,000m^3. Compared to CAS process)
  ⇒ Reduce construction costs by **10%**, O&M costs by **36%**, power consumption by **53%**

Demonstration on Energy-saving Wastewater Treatment System Using Highly Efficient Solid-liquid Separation Technology and Dual Dissolved Oxygen Control Technology

Implementer: The consortium of Maezawa Industries, Inc., ISHIGAKI COMPANY, LTD., JS and Saitama Prefecture

Retrofit of CAS with energy-saving nutrients removal achieved without expansion



Technology Overview

- High performance solid-liquid separator installed in the primary settling tank
  - ➢ Significant SS removal
  - ➢ Reduction of aeration volume and retention time for a reactor
- Dual DO control of a raceway reactor
  - ➢ High nitrogen removal by forming stable aerobic and anoxic zones

No additional reactor is required at retrofit into nutrients removal

Achievements

- Treatment performance: satisfy the prescribed effluent water quality: BOD: **15mg/L** or less, T-N: **10mg/L** or less, T-P: 3mg/L or less
- Compared to retrofitting into nutrients removal (A_2O process),
  - ➢ Reduce construction costs by **18%**,
  - ➢ Reduce O&M costs by **16%**,
  - ➢ Reduce energy consumption by **40%**

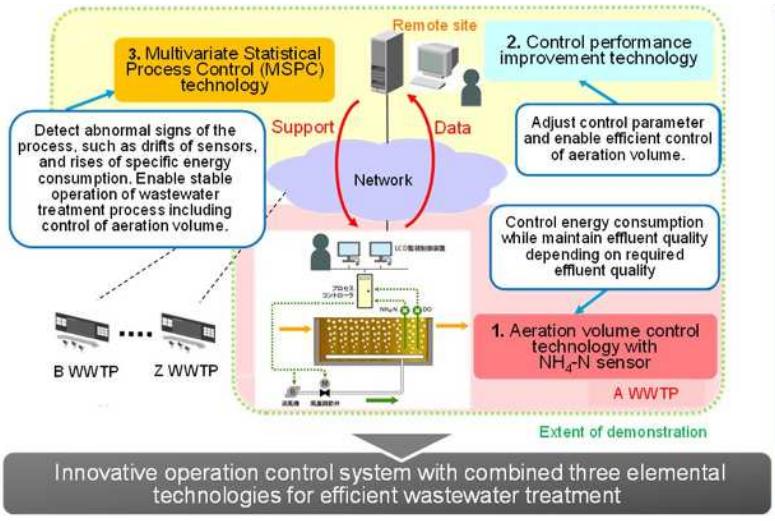
Demonstration on Efficient Sewage Treatment Control Using Process Control and Remote Diagnosis with ICT

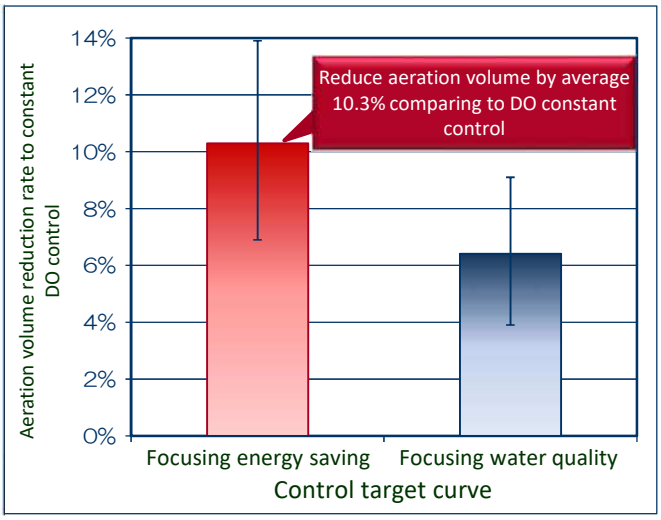
Implementer: The consortium of Toshiba Corporation, JS, Fukuoka Prefecture and Center for Sewage Management of Fukuoka

Energy saving and stable quality of treated wastewater achieved by the combination of aeration control and remote diagnosis

Technology Overview

1. NH_4-N/DO control technology: automatically control target value of DO concentration based on NH_4-N concentration.
   → Reduce aeration volume, stabilize effluent quality (NH_4-N)
2. Control performance improvement technology: automatically diagnose and optimizes control parameter values based on the above operational performance.
   → Stabilize NH_4-N/DO control function and reduce operation costs
3. Multivariate Statistical Process Control (MSPC) technology: detects troubles in early stages and estimates their causes in the process using measuring data collected at running facilities
   → Stabilize NH_4-N/DO control function and reduce operation costs, improve O&M performance by early-stage trouble detection.





Achievements

- Reduction rate of aeration volume: **10.3%** *compared to constant control of DO * Equivalent to **33%** reduction rate against constant control of aeration volume.*
- NH_4-N concentration of treated water: **1.0 mg/L or less** *except for holidays*
- Cost recovery: **within 3 years**
  **Based on a feasibility study assuming treatment capacity with 50,000m³/day, and conventional technology is constant aeration control.*
- Control performance improvement technology: Stable followability to a target DO value
- MSPC Technology: Anomaly detection by test scenario, etc.

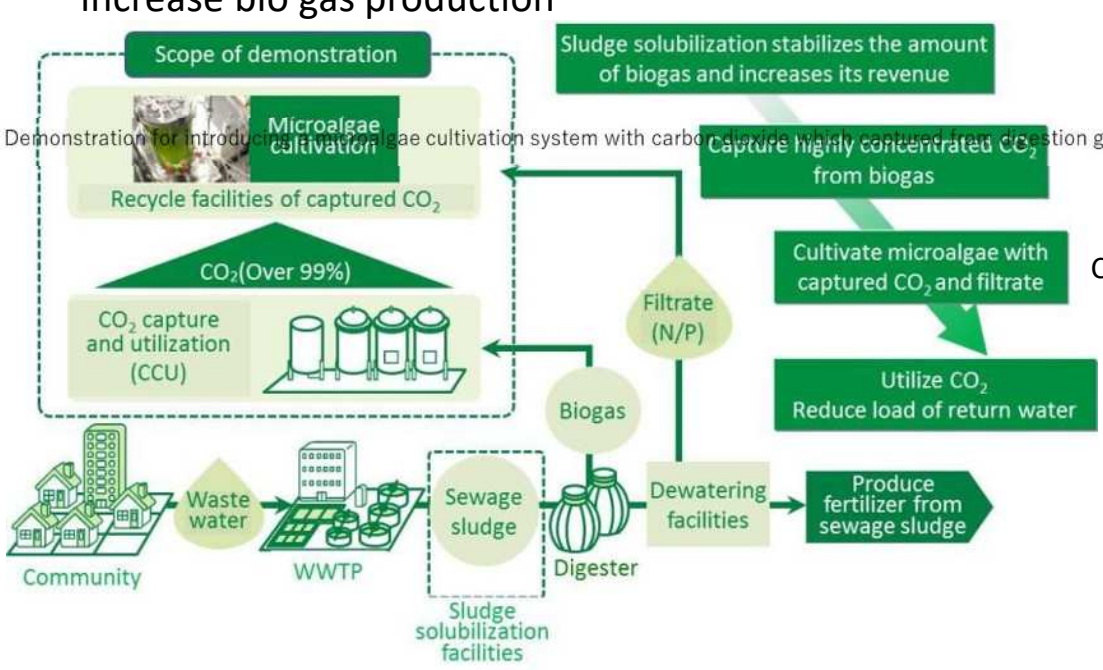
Demonstration for introducing a microalgae cultivation system with carbon dioxide which captured from digestion gas in the sewage treatment plant

Implementer: The consortium of Toshiba Corporation, euglena Co.,Ltd., Nikkan Tokushu Co., Ltd., Nihon Suido Consultants Co., Ltd., JS and Saga City

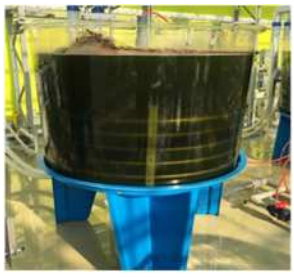
High value-added microalgae (euglena) cultivated with CO_2 from sewerage biogas and N/P from filtrate

Technology Overview

- CCU (CO_2 Capture and Utilization) facilities: Separate and capture high grade carbon dioxide (CO_2) and CH_4 from sewage biogas with PSA (Pressure Swing Adsorption) method.
- Microalgae cultivation facilities: Cultivate/capture microalgae with CO_2 captured from bio gas and N and P in filtrate
- Sludge solubilization facilities (supplementary facilities) : cavitation behavior generated by high speed disk rotation solubilizes sludge to increase bio gas production



CO_2 Separation/Capture facilities



Microalgae cultivation tank

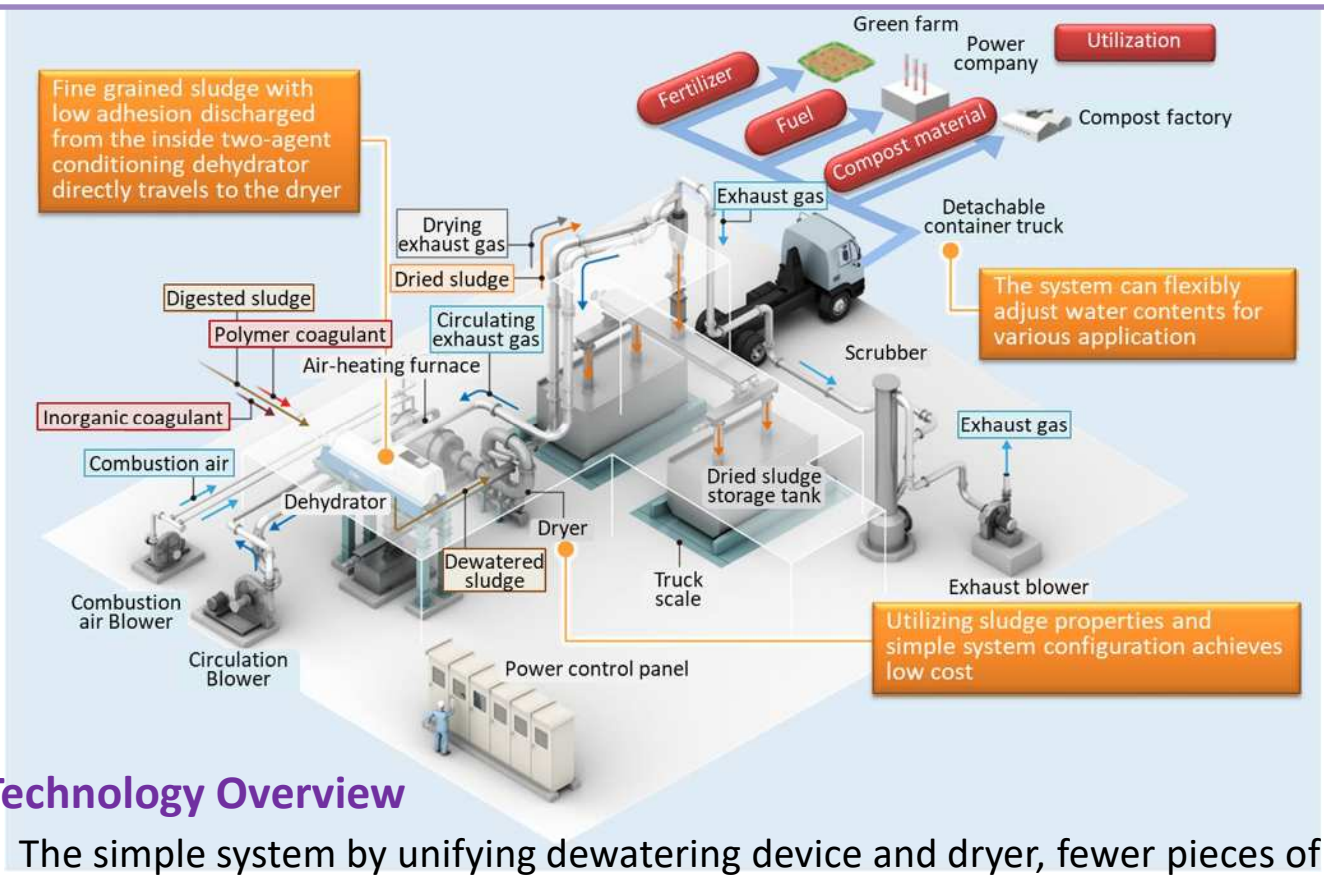
Achievements

- Separation/Capture performance: more than **99% CO_2 concentration, 90% CH_4 concentration**
- Microalgae productivity: Average production rate of **0.833g/L/14days (0.542g/L/7days)**. Reduce 95% of medium cost
- Removability: Utilize **95% of T-P, 20% of T-N** in filtrate of 3 dilution magnification used for microalgae cultivation (14 day's cultivation)
- Bio gas production: **Increased by 10%** when solubilizing 1/3 of sludge supplied into digestion tank

Demonstration of Sewage Sludge Conversion to Fertilizer/Fuel with Dewatering and Drying System

Implementer: The consortium of Tsukishima Kikai Co., Ltd., Sun Eco Thermal Co., Ltd., JS, Kanuma City, and Kanuma City Agriculture Public Corporation

The simple mechanism enabling efficient sludge dewatering and drying. Adjustability to any water content rate achieves various applications



Technology Overview

- The simple system by unifying dewatering device and dryer, fewer pieces of equipment.
- Water content rate is adjustable for various applications with the temperature control of air-heating furnace.
- Save man power with the automatic control of dewatering and drying system.

Achievements

Dewatering/Drying	• **Water content rate**: adjustable at **10-50%** • Fuel (heavy oil) consumption: **275L/t-ds*** When water content rate of dried sludge is 30%
Use as fertilizer	• **Reduce chemical fertilizer cost by 60%** at fertilizer effect test • Meet the standard of fertilizer control low
Use as fuel	• Calorific value: **15MJ/kg and over**(JIS Z 7312) • Safe storage, stable combustion

Demonstration of Flow Fluctuation Adaptive Wastewater Treatment Technology using DHS System

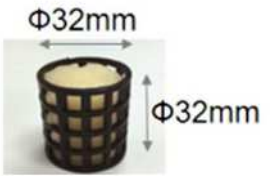
Implementer: The consortium of Sanki Engineering Co.,Ltd., Tohoku University, National Institute of Technology, Kagawa College, National Institute of Technology, Kochi College, JS, and Susaki City

Alternative to the Conventional Activated Sludge (CAS) Process, flow fluctuation tracking wastewater treatment technology that enables efficient downsizing

Technology Overview: The combination of **DHS* filter bed** and **biological filtration tank** can track flow fluctuation tracking

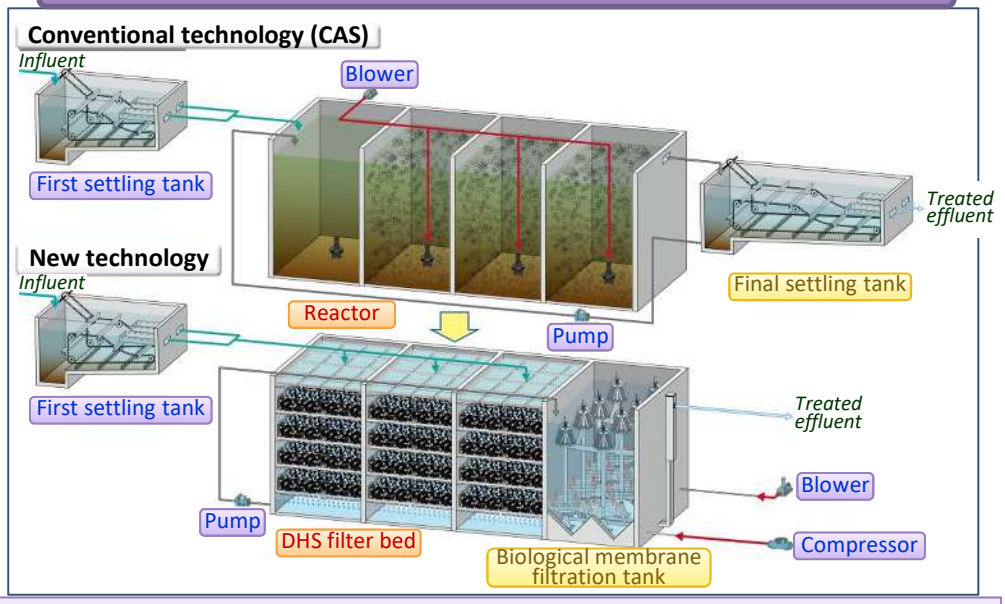
- The reduction of power consumption and sludge generation reduce LCC.
- Generate treated effluent of equivalent quality to CAS process, improve the quality of treated effluent depending on the fewer inflow amount
- Can be installed in the existing CAS facilities
- Fewer pieces of maintenance items and equipment make O&M easy

DHS carrier bed



**DHS: Down-flow Hanging Sponge*

Treatment flow diagram of the demonstration technology



Achievements

- Quality of treated water: **less than 15mg/L BOD**
- Power consumption for wastewater treatment can be reduced according to the inflow reduction
- Sludge generation rate per inflowing SS: **0.4** (CAS:1.0)
- Maintainability: **Visual inspection of twice a week** can keep a good condition of facilities
- LCC: Reduce by **37%** compared to CAS when downsizing treatment capacity by 1/3

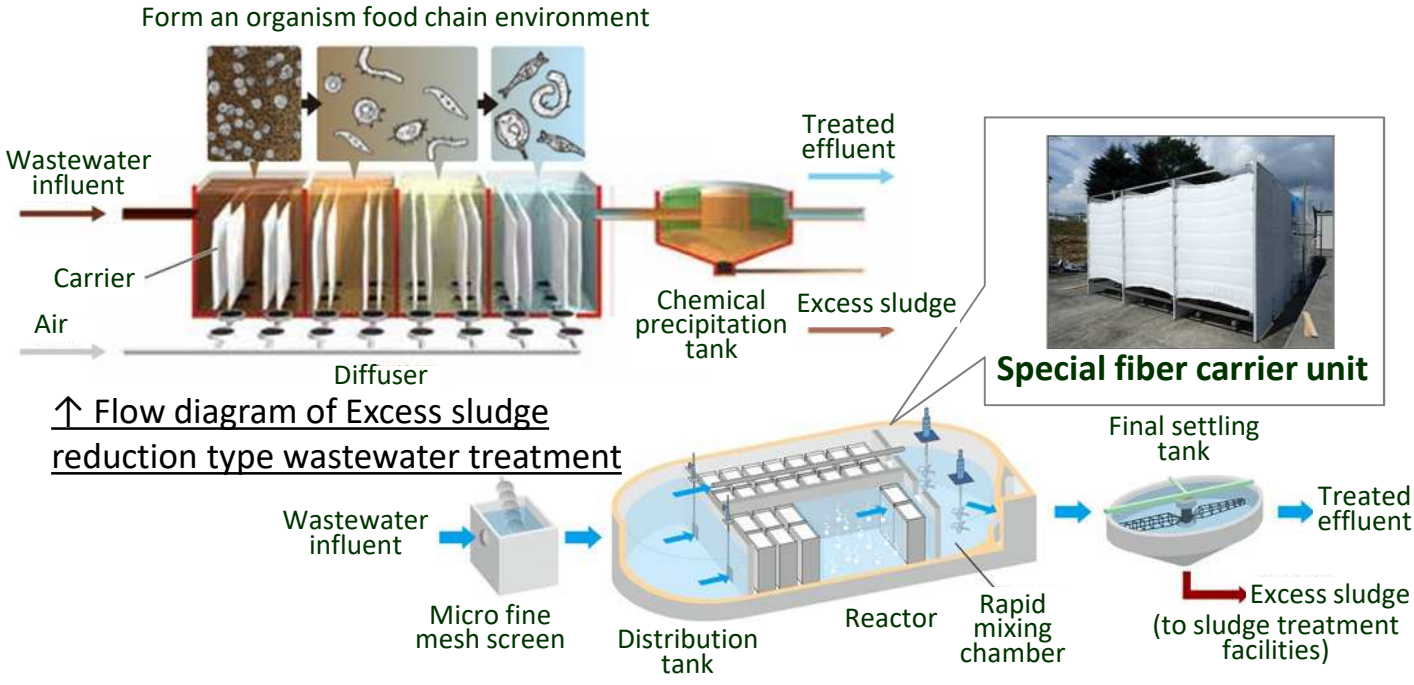
Demonstration of Wastewater Treatment Technology Using Special Fiber Carrier for Excess Sludge Reduction

Implementer: The consortium of IHI Plant Services Corporation, TEIJIN FRONTIER CO., LTD., JS, and Tatsuno Town

Excess sludge reduction and LCC reduction achieved at retrofitting the existing OD process

Technology Overview

1. Retrofit an existing OD process with multistage contact aeration process
   Divide OD tank into a distribution tank, reactor, and rapid mixing chamber.
   Divide the reactor into 12 rooms each of that has fiber carrier.
2. Substantially reduce excess sludge generation
   Microbial flora generated on the surface of special fiber carriers encourage self-oxidation and increase a hierarchy of food chain.
3. Reduce costs of sludge treatment and disposal ⇒ Reduce LCC
   Downsize sludge treatment facilities including dewatering device



↑ Flow diagram of Excess sludge reduction type wastewater treatment

↑ Image of introduction to OD process

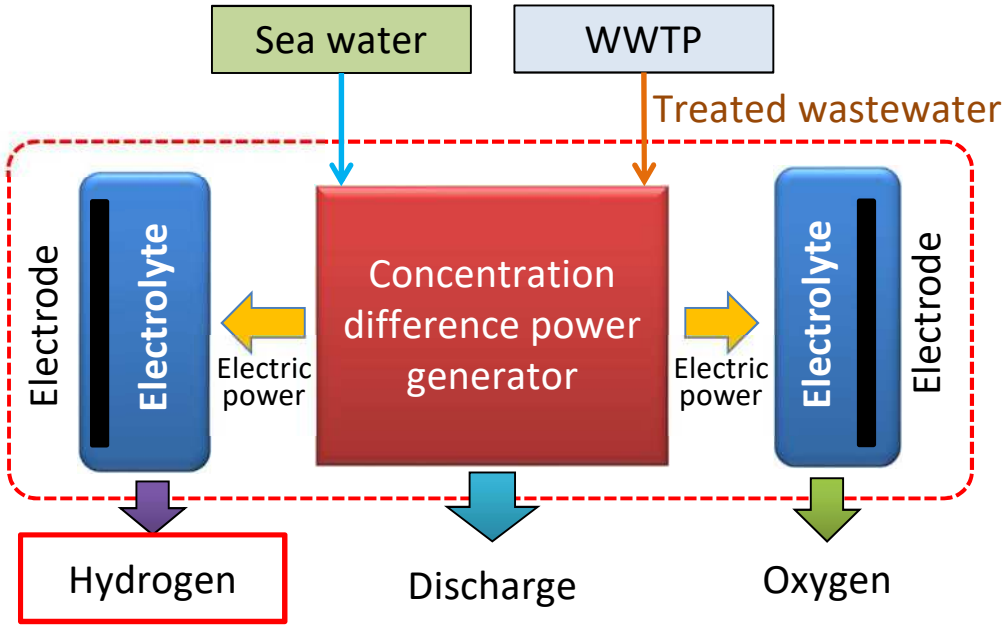
Achievements

- Reduction rate of excess sludge generation: **55%** against the OD process
  *Equivalent yearly average value as an extrapolation of result between September and February.
- Reduction rate of total costs: **4-17%** against the OD process
  *Equivalent yearly average value as an extrapolation of result between September and December.
- BOD of treated effluent: **less than 15mg/L** at the annual maximum value

Feasibility Study* on the Practical Application of Hydrogen Production System Using Salinity Difference between Treated Wastewater and Seawater

Implementer: The consortium of Yamaguchi University, SEIKO ELECTRIC CO., LTD. and JS

Generate high-purity CO_2 free hydrogen from treated wastewater and seawater by using ion-exchange membrane



Technology Overview

- Stable water quality and quantity by the utilization of treated wastewater achieve low cost for pumping
- High power generation by high conductivity and high water temperature of sea water
- Capable to produce hydrogen at any sludge treatment process regardless of anaerobic digestion
- Enable production of high-purity hydrogen and oxygen, separately

Achievements

- Hydrogen conversion efficiency: **96 % and over**
- The purity of hydrogen: **91.2 %** (when water is removed: 94.0 %)
- The purity of oxygen: **70.8 %** (when water is removed: 73.0 %)
- No power decline for 750 hours operation

* Preliminary feasibility study was conducted for two years from 2016 to consider the feasibility including the effects of adoption, and verify the technical performance.

Demonstration of Treatment Performance Improvement Technology for Final Settling Tanks

Implementer: The consortium of METAWATER Co., Ltd., JS, and Matsumoto City

Final settling tank containing filtration part improves treatment performance **quantitatively** and **qualitatively**

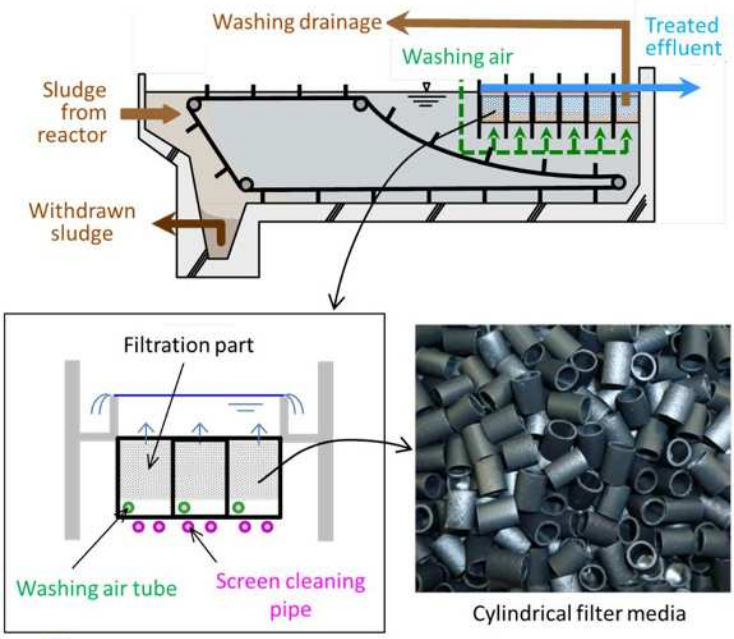
Technology Overview

① **A filtration part in the downstream of the final settling tank** : improves treatment performance

② **Cylindrical filter media with a small pressure loss :** enables operation with the conventional water level differences

③ **Prefabricated filtration part :** enables reducing on-site works and great time shortening of water flow stopping

The upper part of filtration area



Benefits

- **No expansion of the final settling tank** is required : solve the problem of the shortage of treatment capability caused by merging of WWTPs
- **No rapid filtration facilities** are required

Achievements

Quantitative improvement

- Increase the **treatment quantity twice** as the conventional process while having the equivalent water quality
- Reduce the construction cost **by 58%** compared to the extension of final settling tank

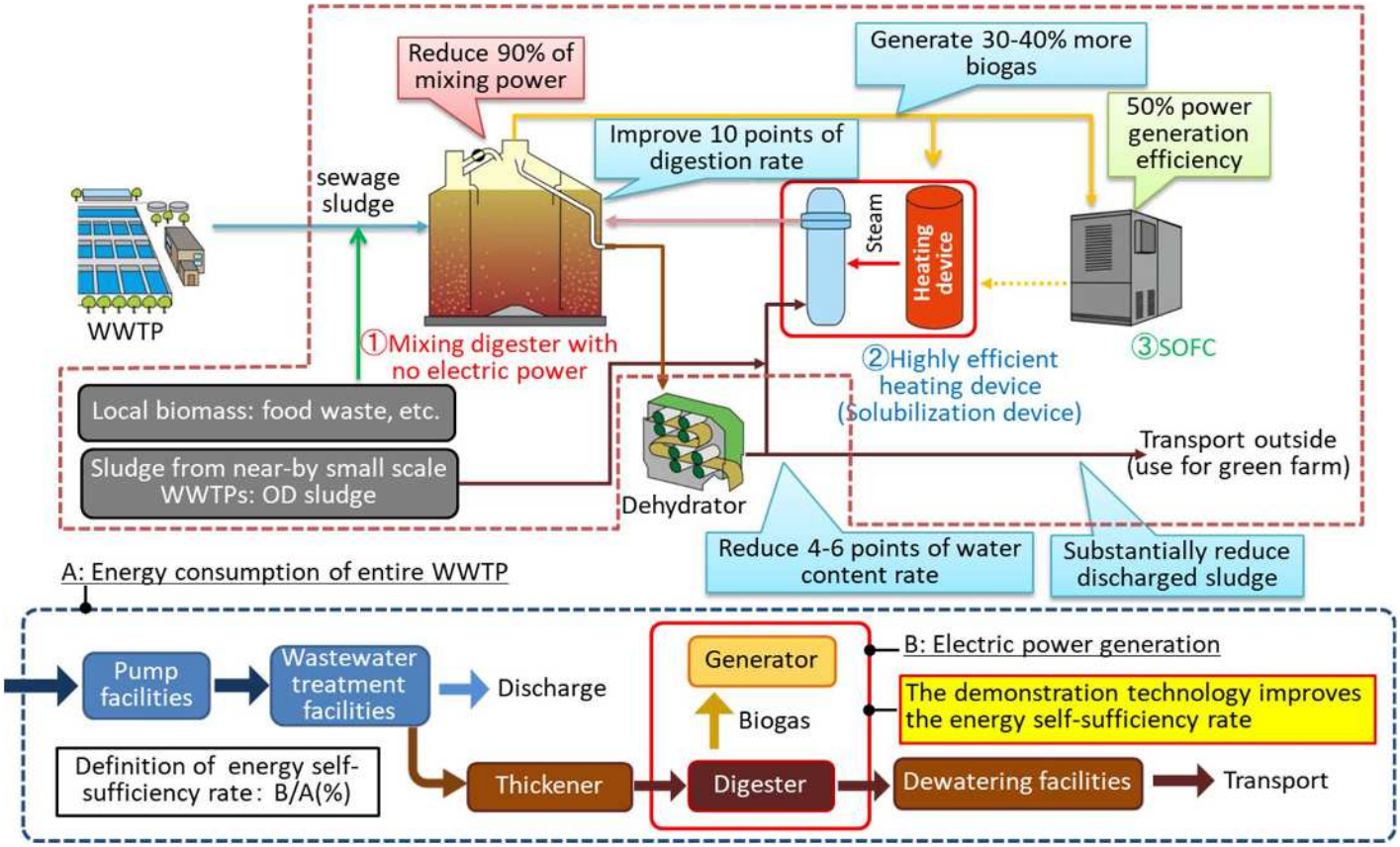
Qualitative improvement

- Achieve **BOD ≦ 10mg/L** and **equivalent water quality to** that of the **rapid filtration process**
- Reduce the construction cost by **71%** compared to the new construction of rapid filtration facilities

Demonstration project for the practical use of local energy production and local consumption technology with high-efficiency anaerobic digestion system

Implementer: The consortium of Mitsubishi Kakoki Kaisha, Ltd., Kyushu University, JS, and Karatsu City

The combination of three innovative technologies and the utilization of local biomass improve energy self efficiency



Technology Overview

① Mixing digestion tank with no electric power : The pressure of generated biogas stirs sludge with no electric power.
② Highly efficient solubilization device : Reduce digestion periods and increase biogas generation. Sludge reforming reduces water content rate and sludge generation.
③ Solid oxide fuel cell (SOFC) : Simple pretreatment process (desulfurization, siloxane removal) enables power generation

Achievements

- Energy saving: Reduce digestion tank power consumption by **90% or more**
- Digestion performance: Increase gas generation by **30% or more**
- **40%** or more reduction of sludge generation
- **41.4%** energy self-sufficiency *

*Estimation of daily average 30,000m³/day +local biomass

Demonstration of the practical application of power generation type sewage sludge incineration technology for greenhouse gas reduction

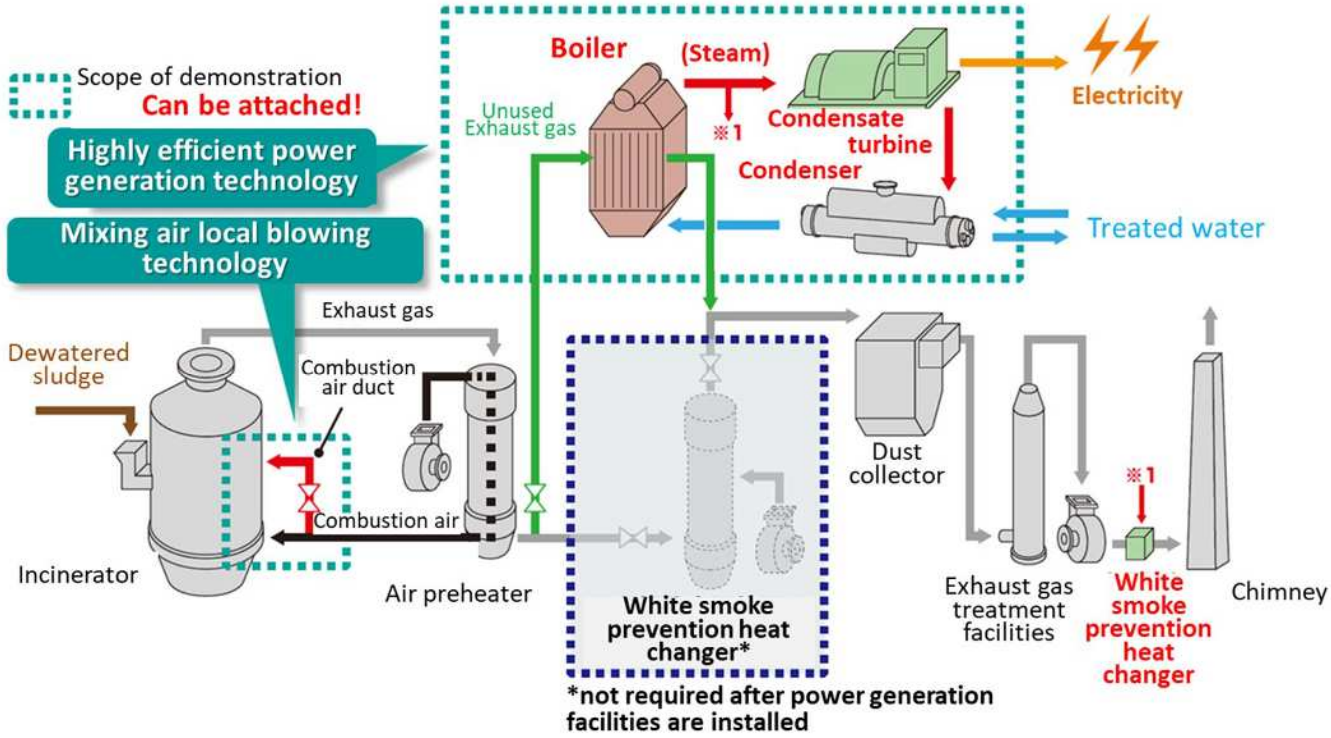
Implementer: The consortium of JFE Engineering Corporation, JS and Kawasaki City

Massively reduce N_2O emission in the sludge combustion process, and high-efficiency power generation utilizing treated wastewater contributes to global warming prevention

Technology Overview

① High-efficiency power generation technology: Boiler recovering waste heat from incineration, and condensate turbine utilizing treated wastewater as cooling water achieve highly efficient power generation of 150-1500kW.

② Mixing air local blowing technology: Space-saving, low-cost air blow into the freeboard of furnace reduces N_2O and NO_x emissions together.



Achievements

*Installed a demonstration facility with a fluidized-bed incinerator of 150 watts/day

- Generated an average of **1.4 times,** which is 230-771kWh, electricity as much as the target value of 59× H-574(H: heat input to furnace, GJ/h) In a specific condition*1, **electricity self-sufficiency***2 was verified.
- Achieved the reduction of N_2O and NO_x by **50% or more***3 at the same time.

*1: For mixed sludge of 150wet-t/day: water content of 72% or installation in more than 2 furnaces with 150 wet-t/day, For digestion sludge of 150wet-t/day: use digestion gas as supplemental fuel

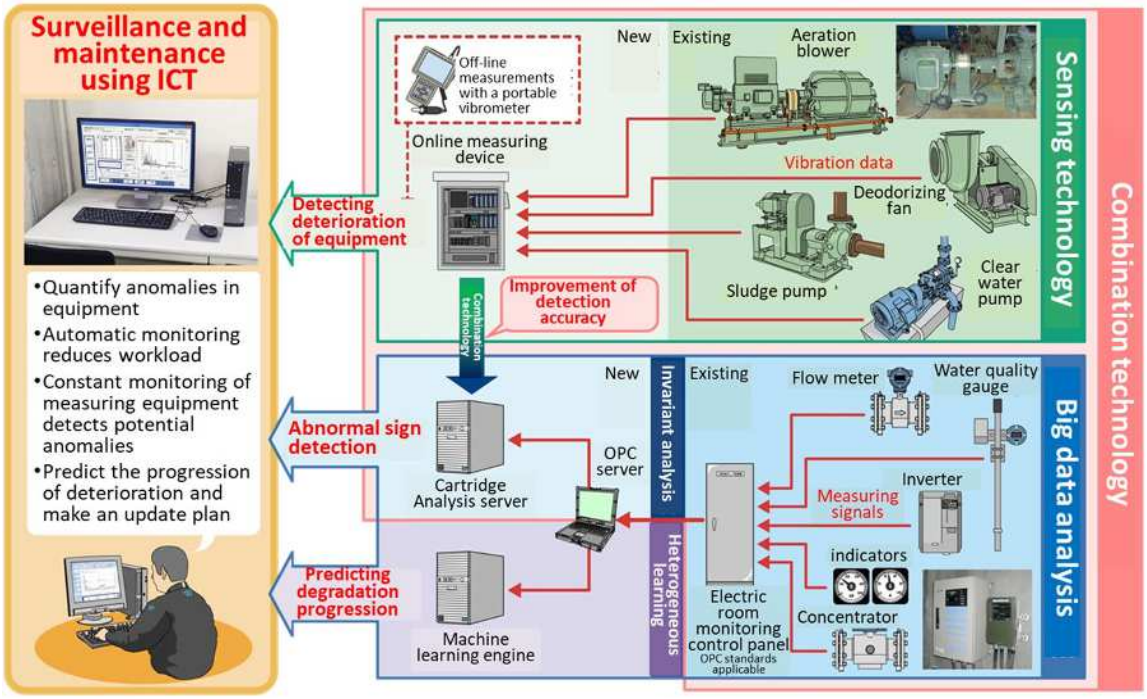
*2: Power generation (kWh) > Energy consumption of single-row incineration facility and demonstration facilities

*3: With no mixing air local blowing technology, Case when the sludge disposal volume of the incineration facility is greater than the rated load

Demonstration of Diagnosis Technologies Applied for Conditions of Deteriorated Sewage Treatment Utilities Using Vibration Data Sensing and Big Data Analysis

Implementer: The consortium of Water Agency Inc., NEC Corporation, Asahi Kasei Engineering Corporation, JS, Moriya City and Hidaka City

Sensing Technology using ICT and Big Data Analysis to monitor and analyze the deterioration of sewerage facilities quantitively. Knowing the signs of abnormalities in equipment and facilities in advance allows preventing sudden equipment failures and abnormal conditions.



Technology Overview

- Sensing Technology: Remote monitoring of equipment degradation trends based on vibration sensor's information,
- Big data analysis (invariant analysis and heterogeneous learning): Monitoring of anomalies and prediction of the equipment degradation's progress based on the existing sensors' information
- Combination technology of sensing technology and invariant analysis

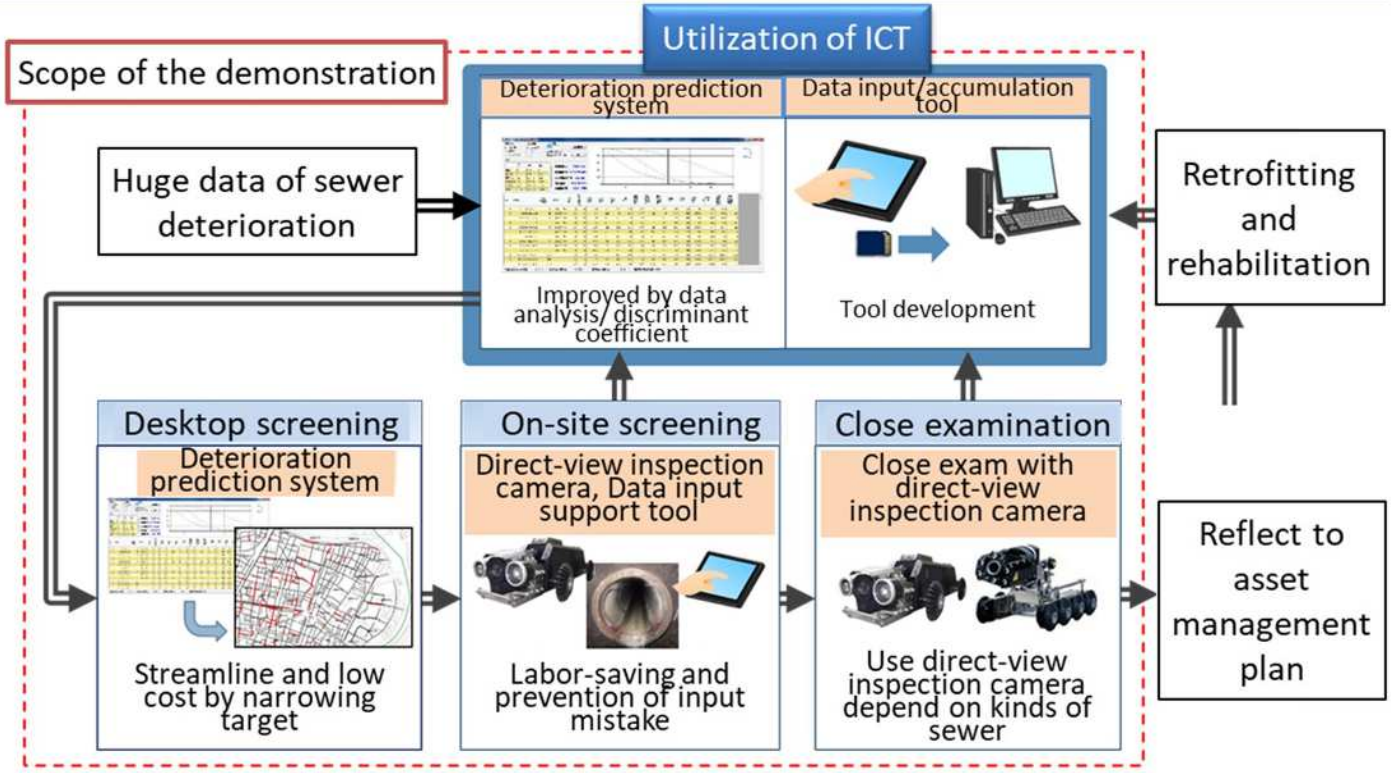
Achievements

- Failure prevention **reduces failure frequency by 5.8%**
- Extended inspection cycle reduces costs; **1.2 times the disassembly cycle** and **1.1 times the equipment replacement cycle**
- Number of instrumentation requiring inspection is **reduced by 72%** by reduction of workload and time, substituting inspection work, etc.
- A combination of technologies **detects minute signs of anomalies** such as residues blockage and V-belt degradation
- Monitoring data accumulation and modeling to **predict the progress of sewage main pump deterioration**
- Verify that the durability of vibration sensors and signal converters is **more than 3 years**

Demonstration on Comprehensive Gradual Sewer Diagnosis System by Using ICT

Implementer: The consortium of Clearwater OSAKA Corporation, JS, and Osaka City

Deterioration prediction system, data input and accumulation tools using ICT, and direct inspection cameras to streamline pipeline diagnostics



Technology Overview

- Deterioration prediction system: utilizing data on the attributes and deterioration of sewer pipelines, analyzes the deterioration trend of pipelines and calculates priorities for inspection and investigation
- Data input/accumulation tool: accumulates pipeline information and inspection results entered in the field by smartphones as O&M data.
- Direct-view inspection camera: specializes in screening, requiring no pre-cleaning or pausing at abnormalities as with conventional cameras.

Achievements

- Narrowing investigation target enables streamlining and low costs
- On-site screening enhances streamlining
- Data input/accumulation tool enables low costs

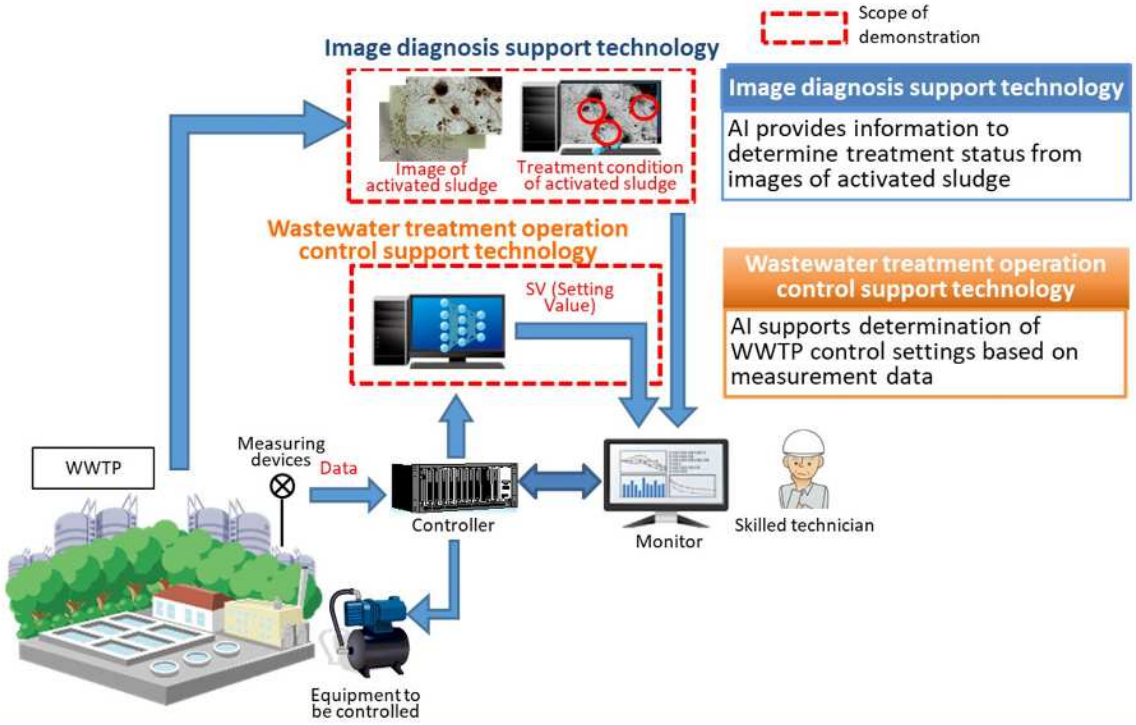
Feasibility Study on Wastewater Treatment Operation Management Supporting Technology Using AI

Implementer: The consortium of YASKAWA Electric Corporation, Maezawa Industries, Inc. & JS

Using AI to support the operation of wastewater treatment facilities to improve efficiency and labor saving in operation management and address the shortage of skilled engineers

Technology Overview

- **Wastewater treatment operation control support technology**: Random forests provide guidance by estimating the operation control setting values (e.g., aeration volume, excess sludge withdrawal volume, etc.) of a WWTP based on a number of measurement data.
- **Image diagnosis support technology**: Identify and count specific microorganisms (e.g., protozoa and micro metazoan) by image recognition using deep learning for microscopic observation images of activated sludge.



Achievements:

1) Wastewater treatment operation control support technology

The model for predicting aeration volume and excess sludge withdrawn amount achieved a prediction accuracy satisfying the setting values (**annual average error rate of 10% or less**)

2) Image diagnosis support technology

Three representative types of microbial image data provided a recognition accuracy **satisfying the setting value (>80% fit)**

Demonstration Project on the Efficient Energy Utilization Technology Using High-solids Anaerobic Digestion and Energy-saving Biogas Purification

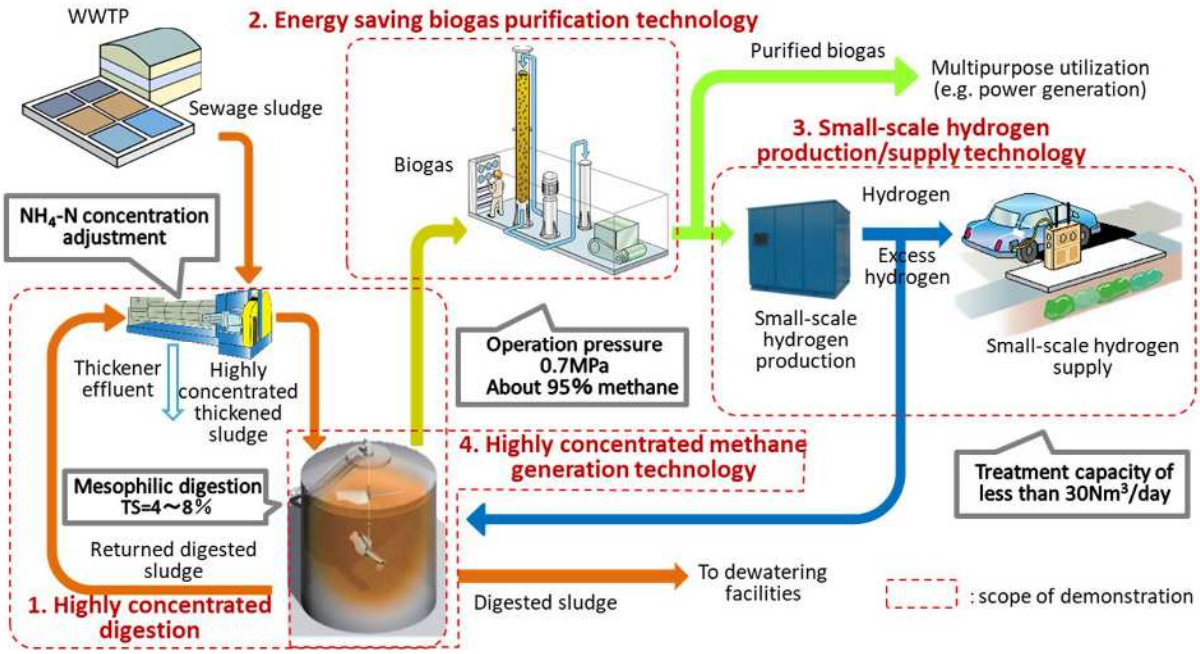
Implementer: The consortium of Kobelco Eco-solutions, Co., Ltd., JS, and Fuji City

The efficient energy recovery/utilization system combined methane fermenter, biogas purification facilities, and small-scale hydrogen production/supply device

Technology Overview

Maintains the same level of digestion and dehydration by increasing inner concentration of the digestion tank to more than twice that of conventional systems and adjusting the NH_4-N concentration. By reviewing the scale of the facility, **no qualified personnel** and **legal inspections** are required.

1. Cost reduction by reducing digestion capacity to one third
2. Improved energy conversion rate: Allowing for multiple energy uses in a medium-scale facilities
3. Supplying hydrogen for fuel cell vehicles for small-scale new demand



Achievements

- Total cost (annual construction cost + maintenance cost) reduction: **10%**[*1]
- Increase in total energy output: **20%**[*1]
- Digestion performance: **gas yield 500Nm³/t-input VS**[*2]

*1: Based on the results of FS for 50,000 m3/day (8.5 t-DS/day) in a virtual treatment plant (with anaerobic digestion and power generation)
*2: When the VS load supplied into the digestion tank was less than 4.4 kg/m3/day maximum

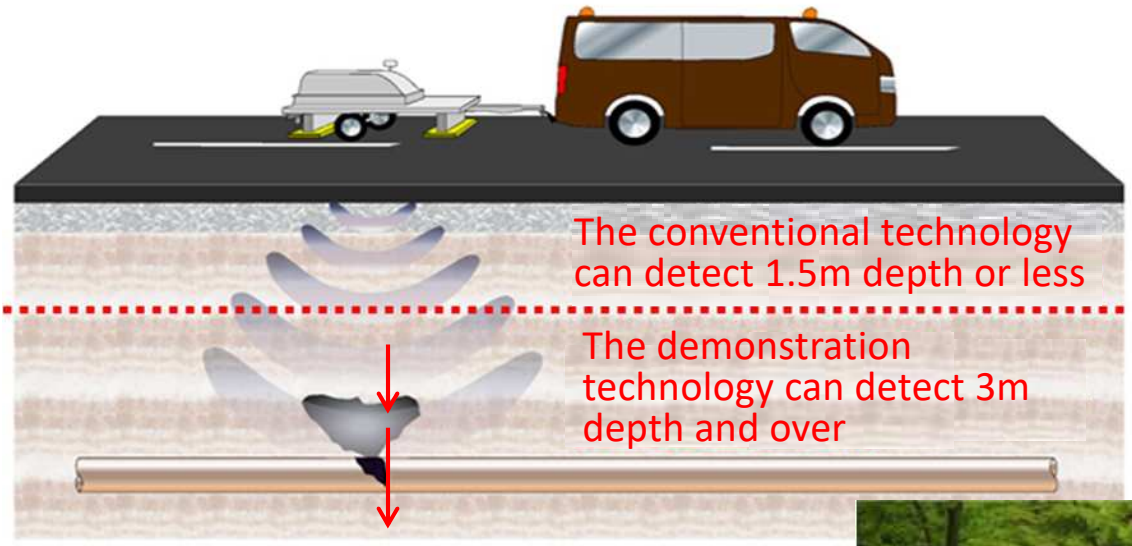
Demonstration for the Practical Application of Underground Cavities Detection with a Towing Vehicle

Implementer: The consortium of Kawasaki Geological Engineering Co.,Ltd., JS and Funabashi City

Technology Overview

- Vehicle towing type cavity detection system
- Chirp system[*1] , adopted as a signal transmission for underground detection, improves detection-able depth compared to the conventional pulse system[*2].

*1: Chirp system can detect deeper than pulse system, and recognition ability is high.
*2: The pulse system has a high recognition ability but has a small detectable depth.



Achievements

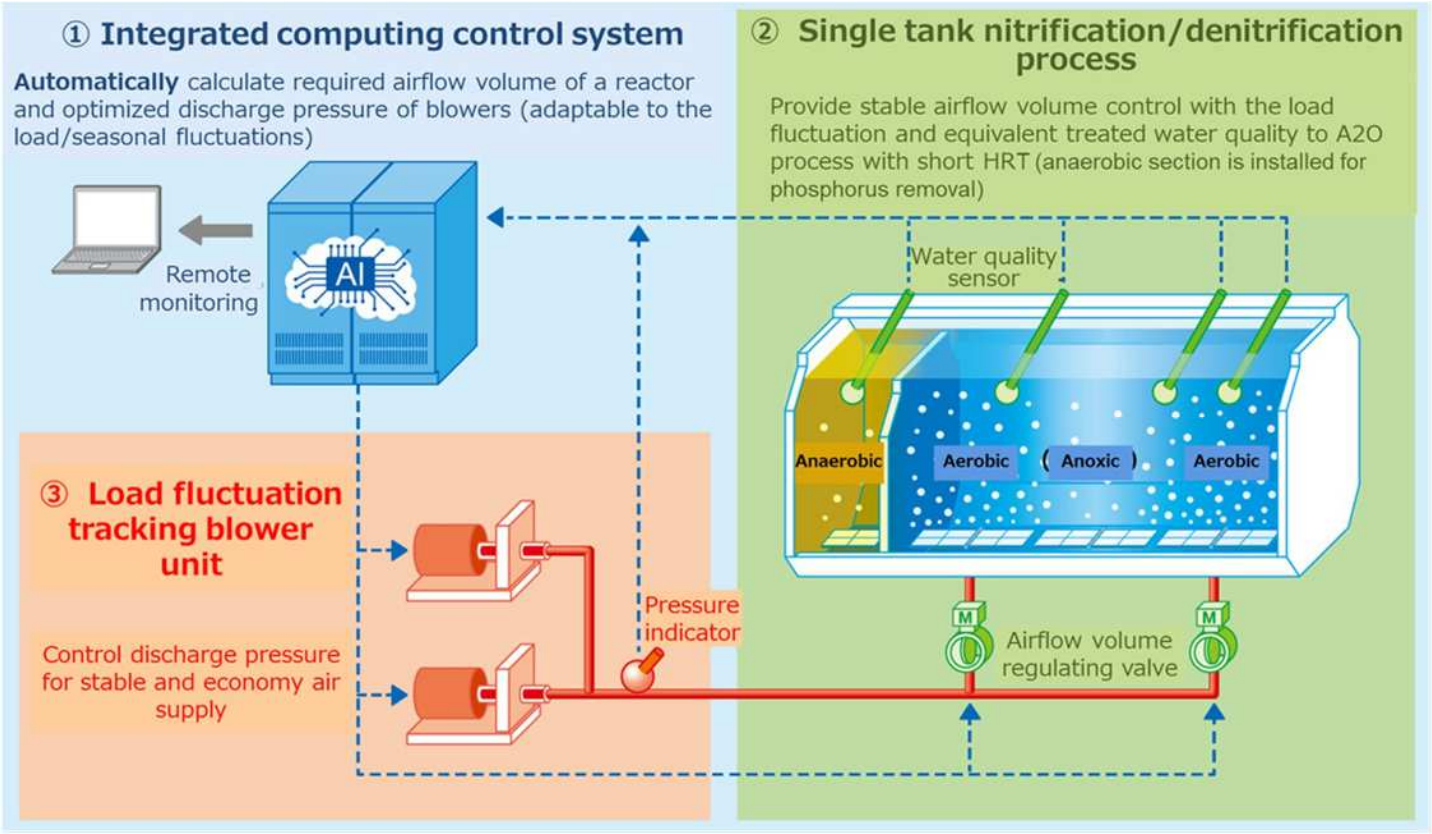
- The new system improves detectable depth twice as the conventional underground cavity detection system.
  - The conventional system: depth of 1.5m or less
  - The new system: depth of 3.0m or more
- The detection system can drive 50km/hour

Advanced Treatment Technology by Controlling Single Tank Nitrification Denitrification Process with ICT and AI

Implementer: The consortium of METAWATER Co., Ltd., JS and Machida city

Technology Overview

- Achieve **short HRT** by air volume control using ICT
- Achieve facility cooperation using ICT and **blower power reduction** by pressure reduction
- Adaptable to seasonal inflow fluctuation by using AI and **reduce operation adjustment work**



Achievements

- Treated water quality: equivalent or more to A2O process; T-BOD of 5.1mg/L, T-N of average 10.6mg/L, T-P of average 1.3mg/L, nitrogen removal rate of 68.1%, all values are average
- *design value: T-BOD≦15㎎, T-P≦3mg/L, the nitrogen removal rate 60-70%
- Power consumption: reduce 16% (per 1Nm3 air volume) against pressure constant control and 29% (per 1m3 treated water) against A2O process
- Total costs*: reduce 18% against A2O process *based on the FS for the construction and O&M costs of reaction tank and blowers at the facility of maximum inflow 50,000m3/day

Feasibility Study on the Practical Application of Ai-based Sewer Diagnosis System

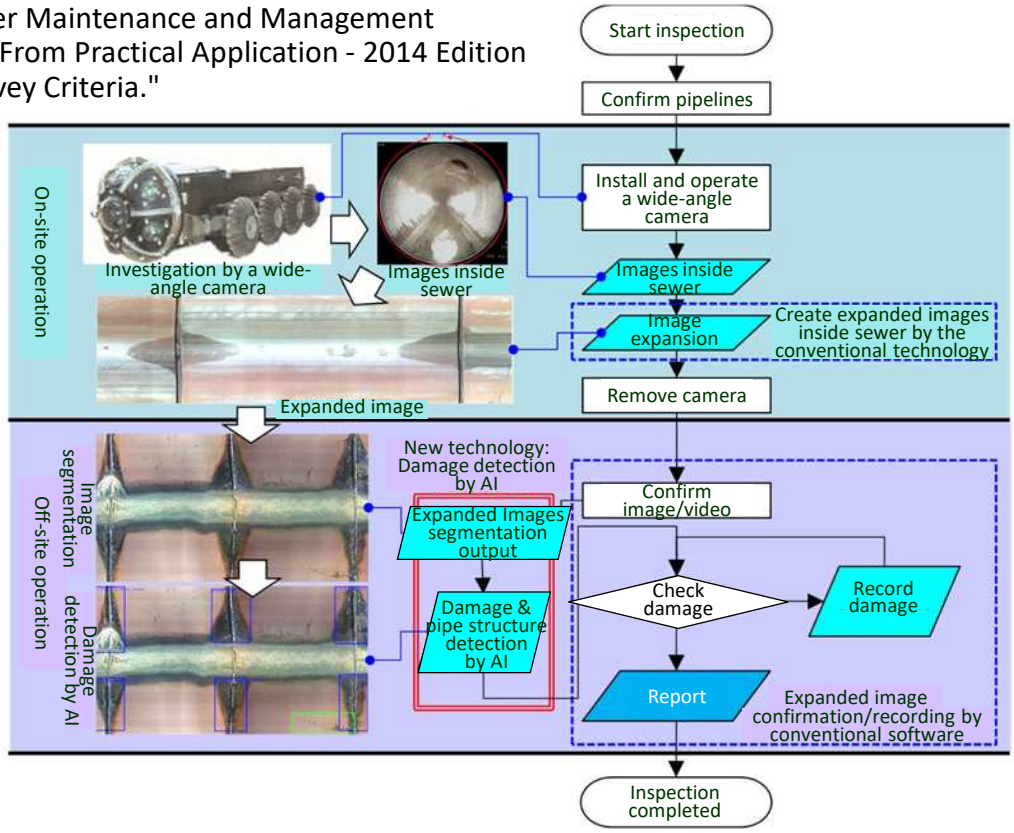
Implementer: The consortium of OKUMURA CORPORATION, JS, Saitama City, Funabashi City, Fukui City, Fujisawa City, and JUST Ltd.

Achieve an efficient and detailed sewer pipeline inspection using AI image diagnosis technology

Technology Overview

- Capture image data with a wide-angle TV camera
- Based on the data, analyze and detect the following items using AI.
- Pipe structure information (joint location, attached pipe location)
- Damage information (rupture, crack, inundation)
- Damage degree* (a, b, c)

*From Sewer Maintenance and Management Guidelines. From Practical Application - 2014 Edition - P113 "Survey Criteria."



Achievements

- Detection accuracy of pipe structure information (reproduction rate*1, matching rate*2): 80% or more (Target value: 75%)

*1: An index to evaluate AI omissions; the ratio of the number of detections by AI to the number of judgments by expert technicians.
*2: An index to evaluate over-detection by AI; the ratio of the number of judgments made by expert technicians to the number detected by AI.
*As a preliminary step to the full-scale testing level, the feasibility study was conducted in 2020.

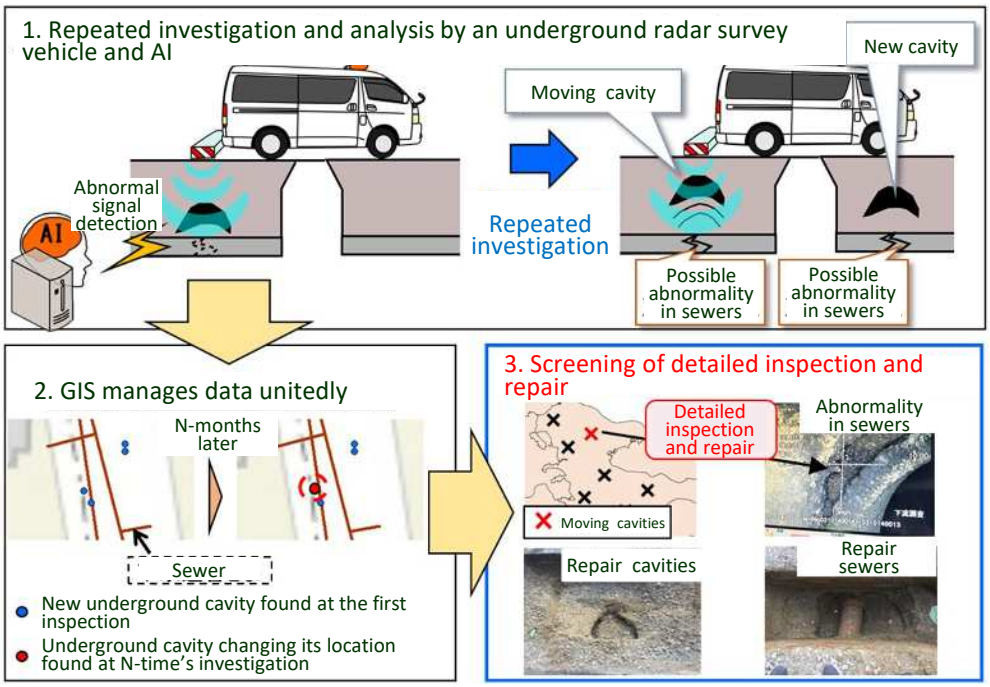
Feasibility Study on the Practical Application of Screening Technologies of Underground Radar Survey Vehicle System and Ai-based Cavity Detection System

Implementer: The consortium of Kawasaki geological engineering co., Ltd., and JS

Efficiently identify severely deteriorated sewer and connection pipes causing road surface deformation and subsidence

Technology Overview

- Focusing on underground cavities moving to shallower areas enables efficient screening of sewers and connection pipes with severe abnormalities.
- The AI-based cavity localization based on the signal data from underground radar survey vehicle reduces personnel and costs for the survey without traffic restrictions.
- GIS can manage the changing cavity locations centrally to narrow the scope of detailed inspection and repair points effectively.



Achievements

- About 90% of the sewer pipelines around the changed cavities had abnormalities.
- The percentage of moderately to severely deformed sewers and connection pipes around the changed cavities was as high as 70%. The rate was as low as 25% in the sewer pipelines around the still cavities

* As a preliminary step to the full-scale testing level, the feasibility study was conducted in 2020-21.

New Technologies Meeting Your Needs
August 2022
Published by Solutions Department, ***Japan Sewage Works Agency***
Yushima 2-31-27, Bunkyo-city, Tokyo, 113-0034