

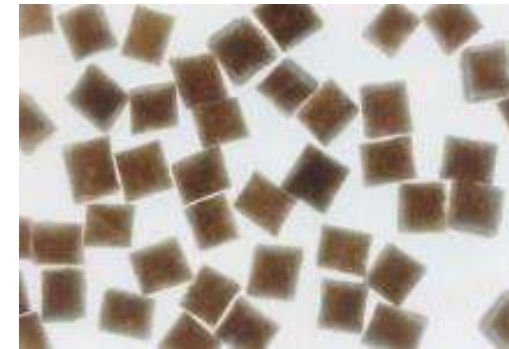
Hitachi Social Innovation is

POWERING GOOD

HITACHI
Inspire the Next

Advanced Nitrogen Removal System “PEGASUS”

Microbial Immobilization Technology

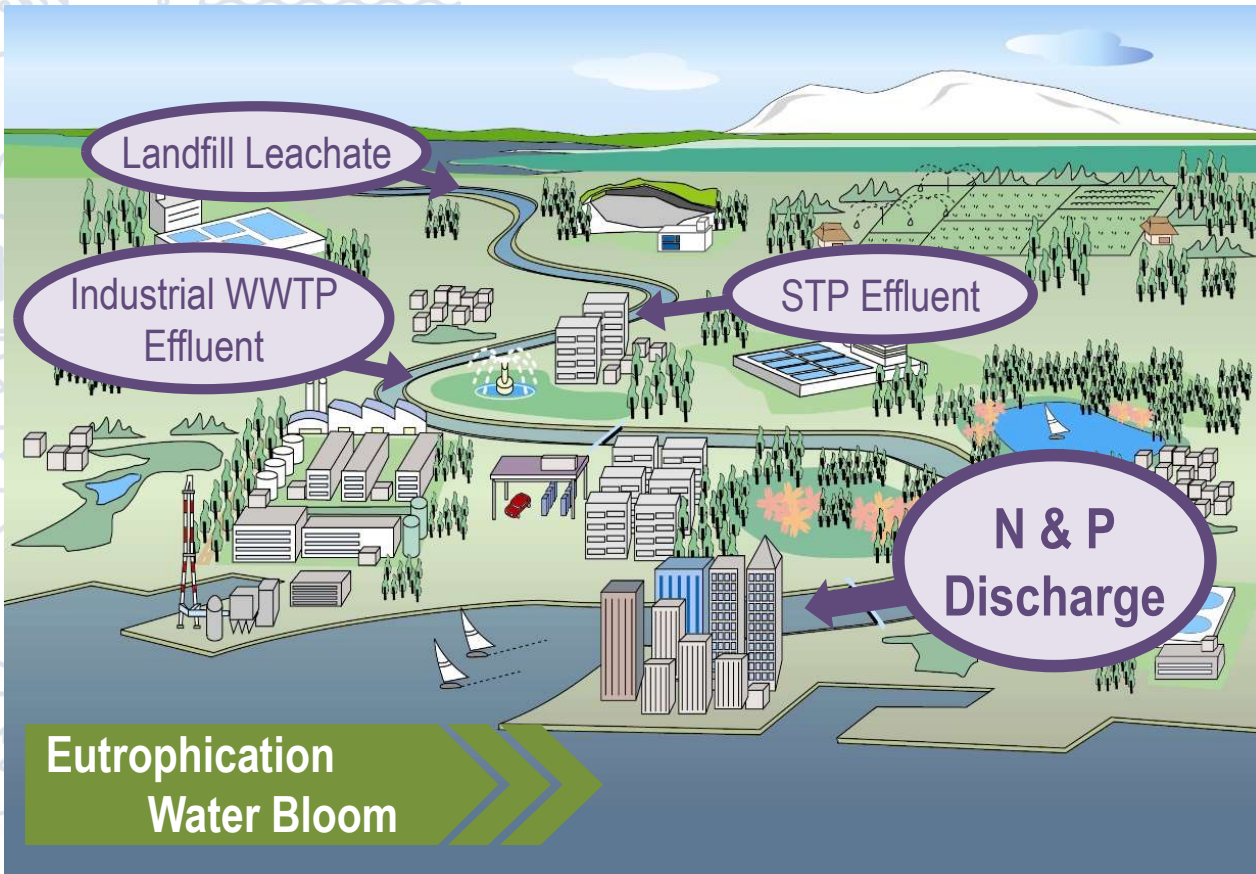


P : Poly
E : Ethylene
G : Glycol pellet
A : Aided
S : System for
U : Ueutrophication
S : Stop

Hitachi, Ltd.
Water Business Unit

*PEGASUS is a trademark of Hitachi, Ltd. and Japan Sewage Works Agency in Japan.

Background



Eutrophication of Closed Water Area

Nitrogen & Phosphorus removal

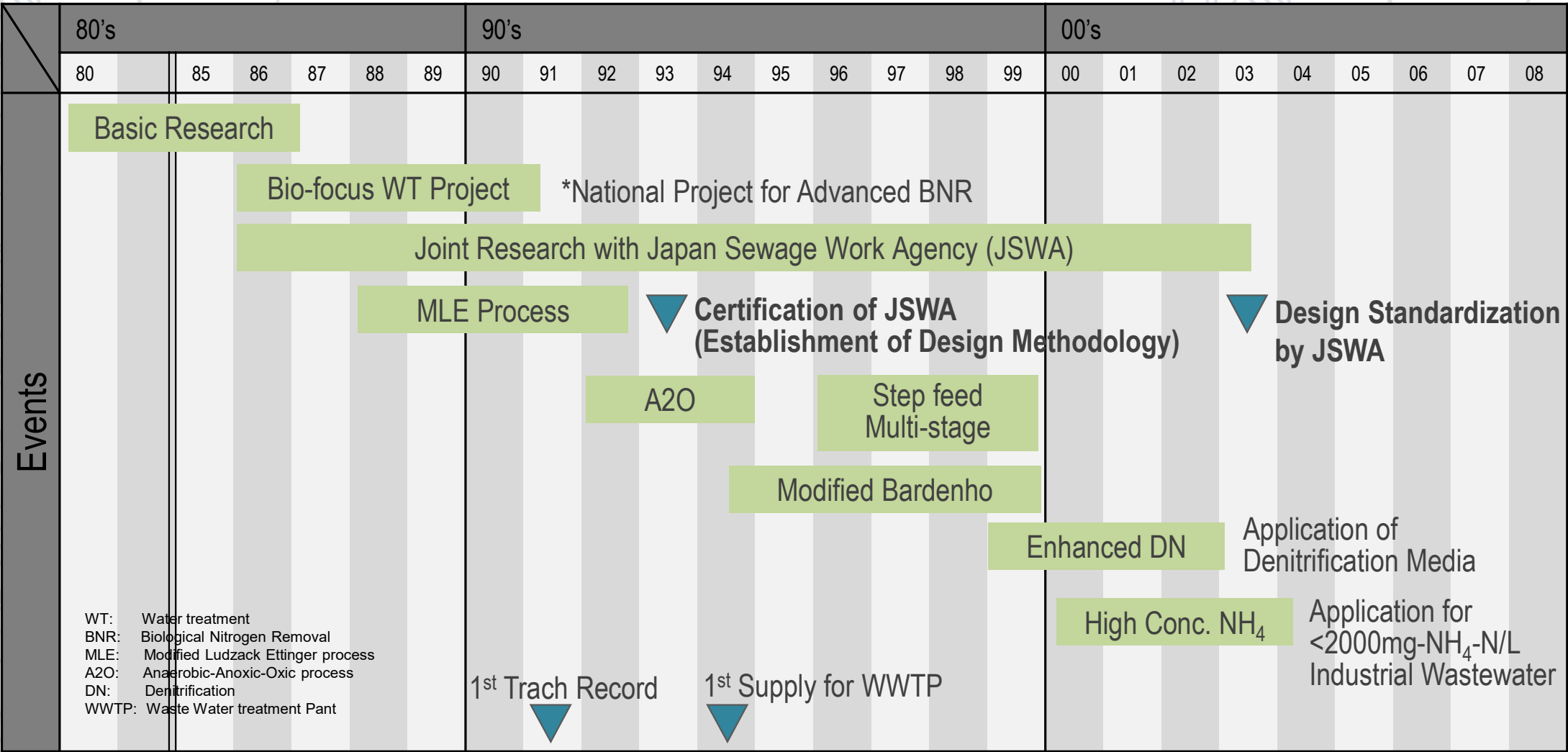
- Installation of Advanced Treatment
- Upgrading of Existing Plant

■ Requirement

- ✓ Space & Energy Saving
- ✓ High & Stable Performance
- ✓ Easy Operation & Maintenance

PEGASUS brings Solution for above Needs !

History of "PEGASUS"

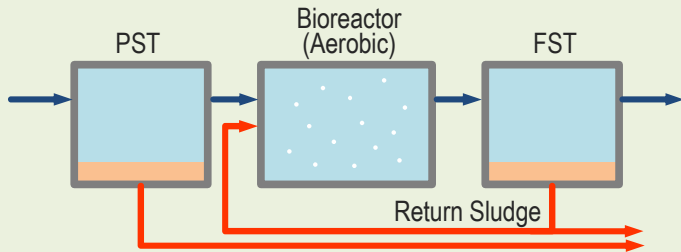


WT: Water treatment
 BNR: Biological Nitrogen Removal
 MLE: Modified Ludzack Ettinger process
 A2O: Anaerobic-Anoxic-Oxic process
 DN: Denitrification
 WWTP: Waste Water treatment Pant

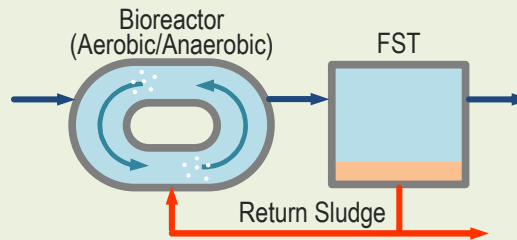
Typical Biological Treatment Process

Conventional Treatment (TSS & BOD Removal)

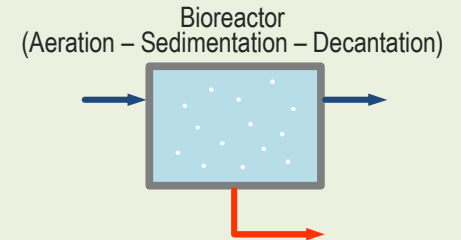
Conventional Activated Sludge (CAS)



Oxidation Ditch (OD)

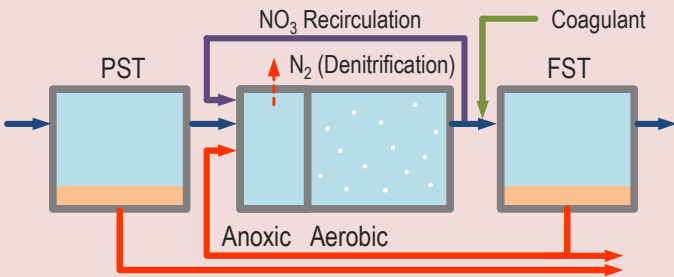


Sequential Batch Reactor (SBR)



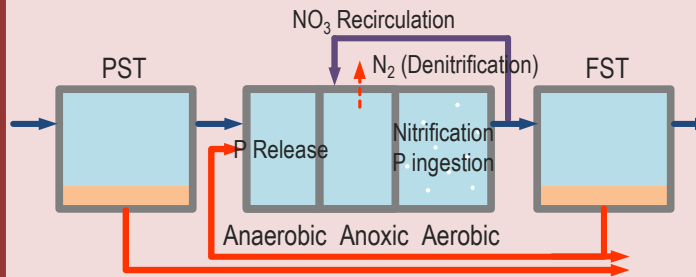
Advanced Treatment (TSS & BOD + Nitrogen, Phosphorus Removal)

Modified Ludzack-Ettinger Process (MLE)



- ✗ Long retention time
- ✗ Large water tank volume

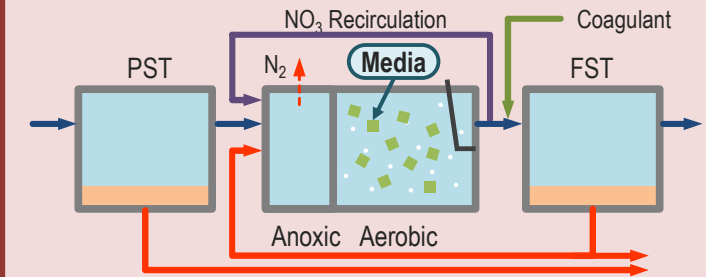
Anaerobic-Anoxic-Oxic Process (A2O)



- No coagulation is required for P removal
- ✗ Long retention time
- ✗ Large water tank volume

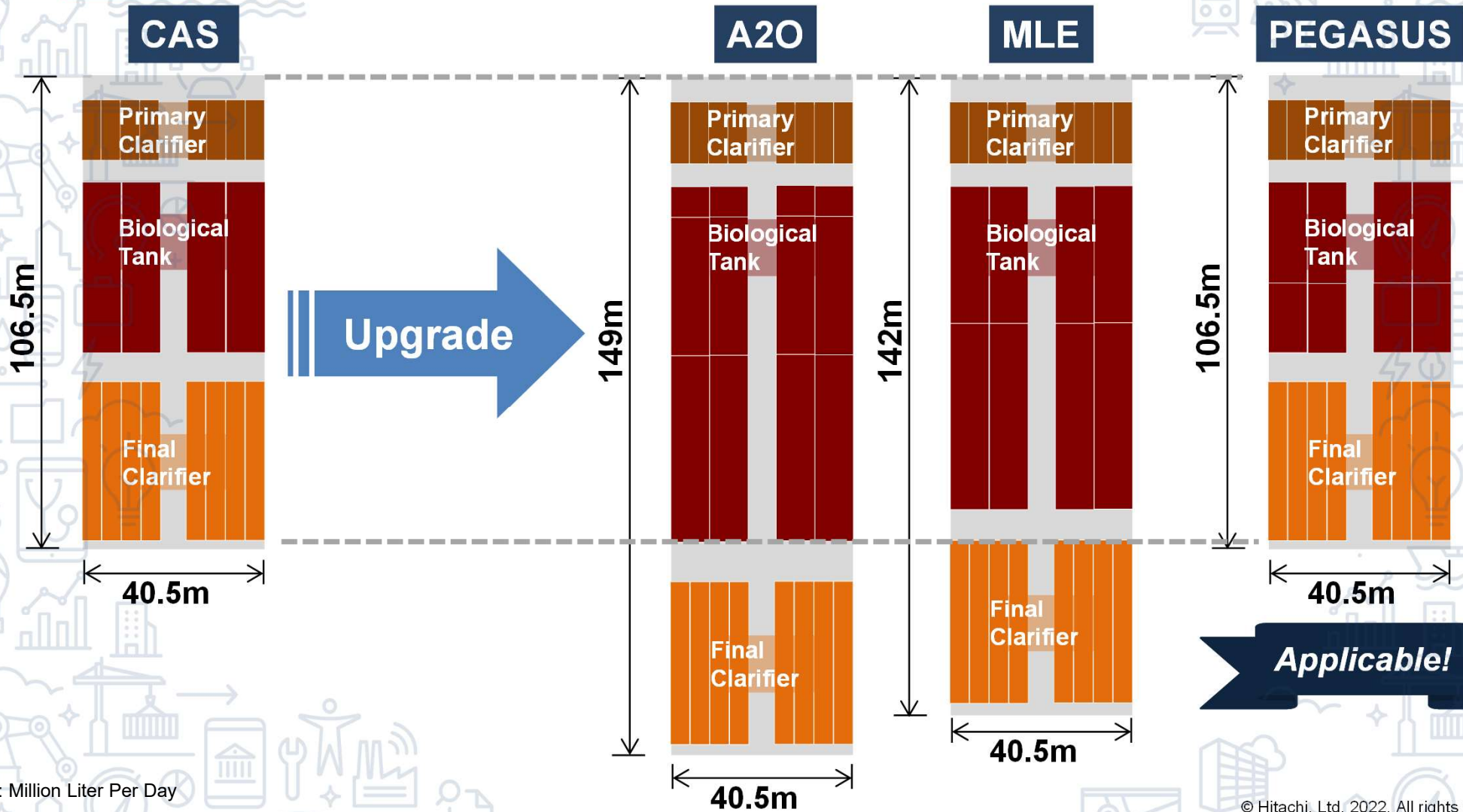
"PEGASUS" belongs to IFAS process

Integrated Fixed-film Activated Sludge (IFAS)



- ◎ Short retention time (same as CAS)
(Nitrification media is added in order to achieve high nitrification performance)

Footprint (case study as 20MLD)

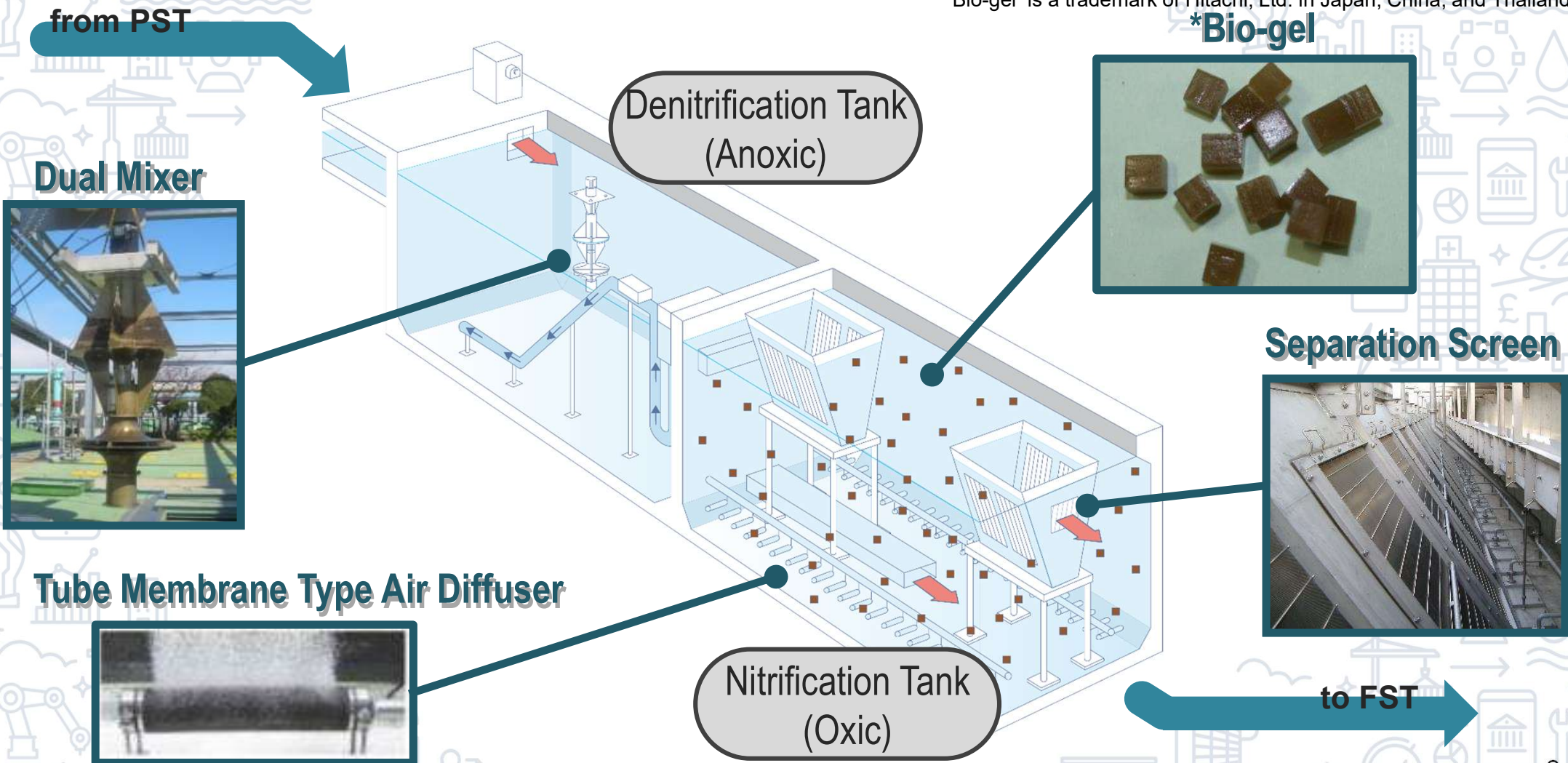


Applicable!

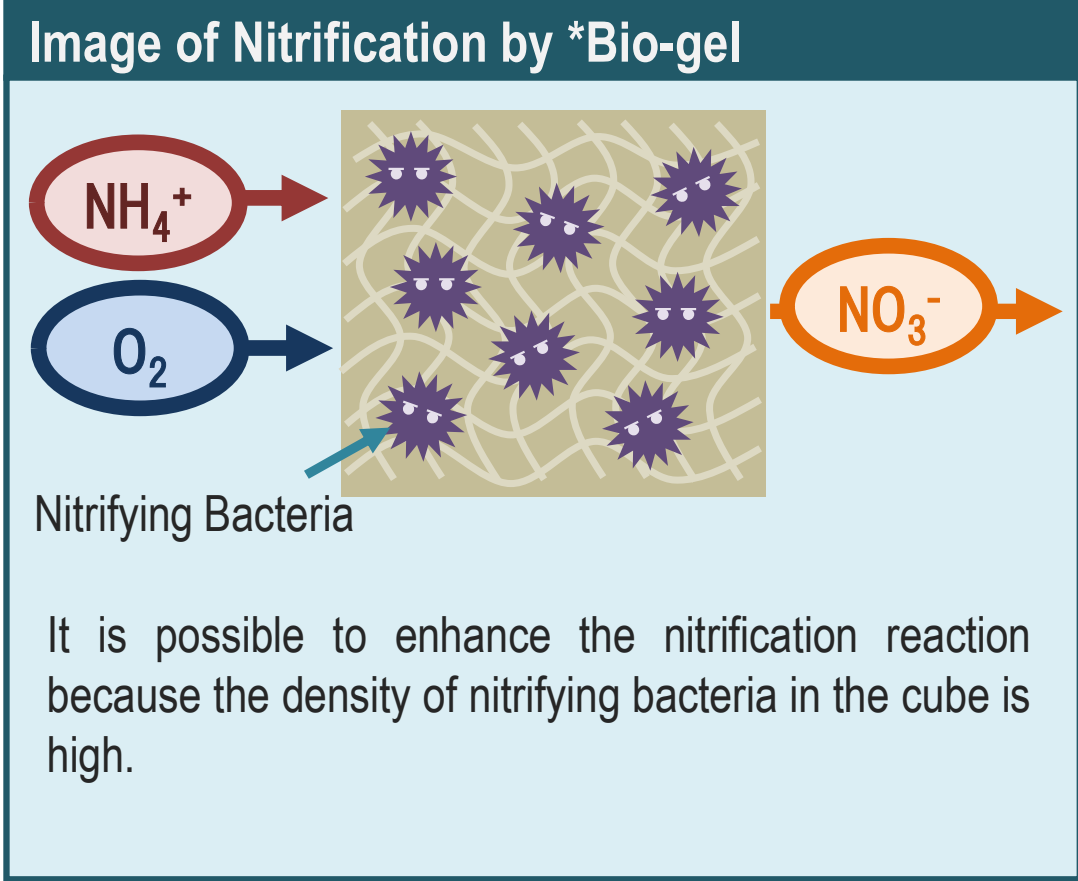
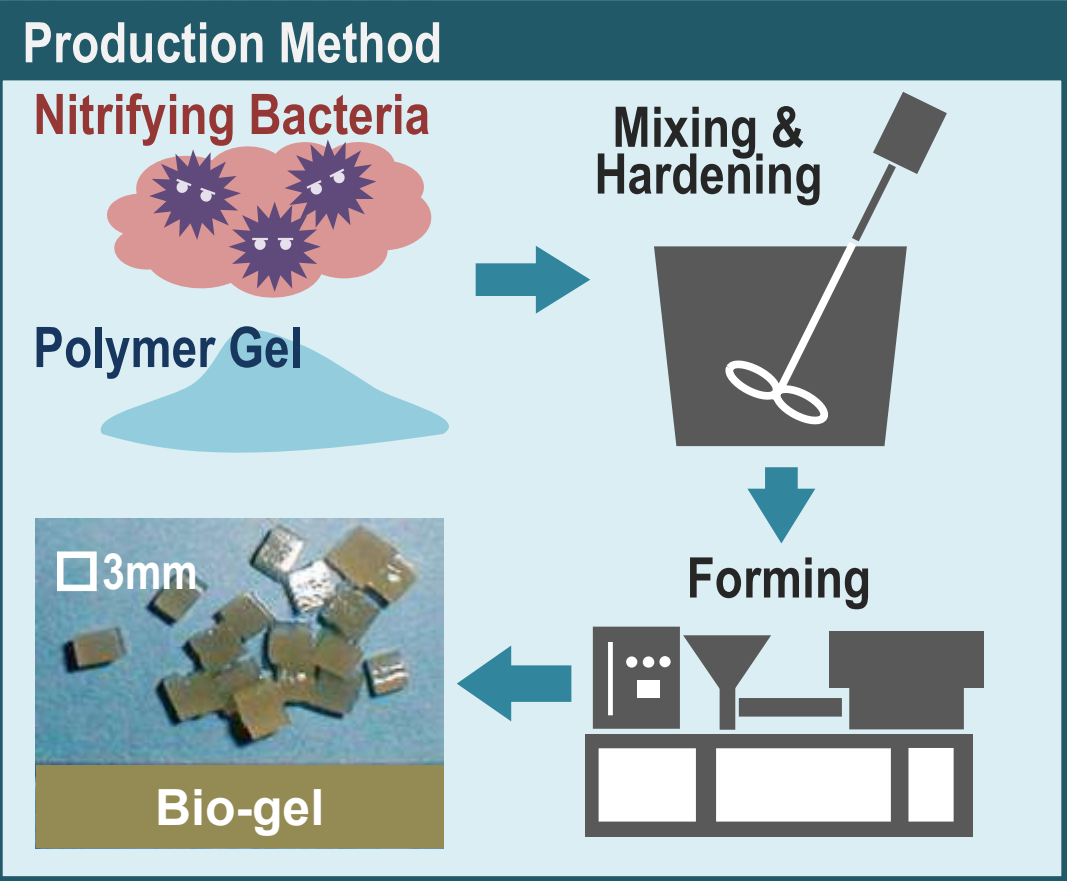
MLD: Million Liter Per Day

Configuration of PEGASUS Process

*Bio-gel is a trademark of Hitachi, Ltd. in Japan, China, and Thailand



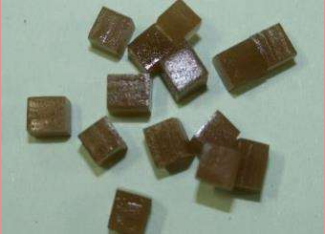
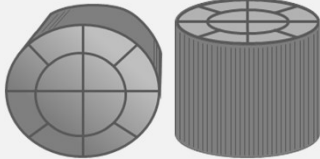
What's Microbial Immobilization Technology?



Bio-gel can drastically enhance nitrifying performance !

*Bio-gel is a trademark of Hitachi, Ltd. in Japan, China, and Thailand

Bio-gel Characteristics

Item	Media	Bio-gel (PEGASUS)	Plastic Media (Competitor's IFAS)
Structure		 <p>Bacteria are integrated in pellets at the factory</p>	 <p>Bacteria are integrated on the surface after filling in the reactor</p>
Material & Dimensions		Polymer Gel (PEG), □3mm Cubic	HDPE/PP, φ10 ~ 30mm Cylindrical
Nitrification Performance		Very Good	Lower than Bio-N-Cube
Filling Rate		Very Small (5-10%V/V)	Large (40-60%V/V)
Acclimatization Period		Very short (less than 1 month)	Long (several months)
Specific Gravity		1.02 (The Bio-N-Cube surely settles)	Approx. 0.95 (Media floats on the water surface)
Flowability		Good	Not good
Life		More than 15 years	(unknown)
Stability & Tolerance		Good	(unknown)

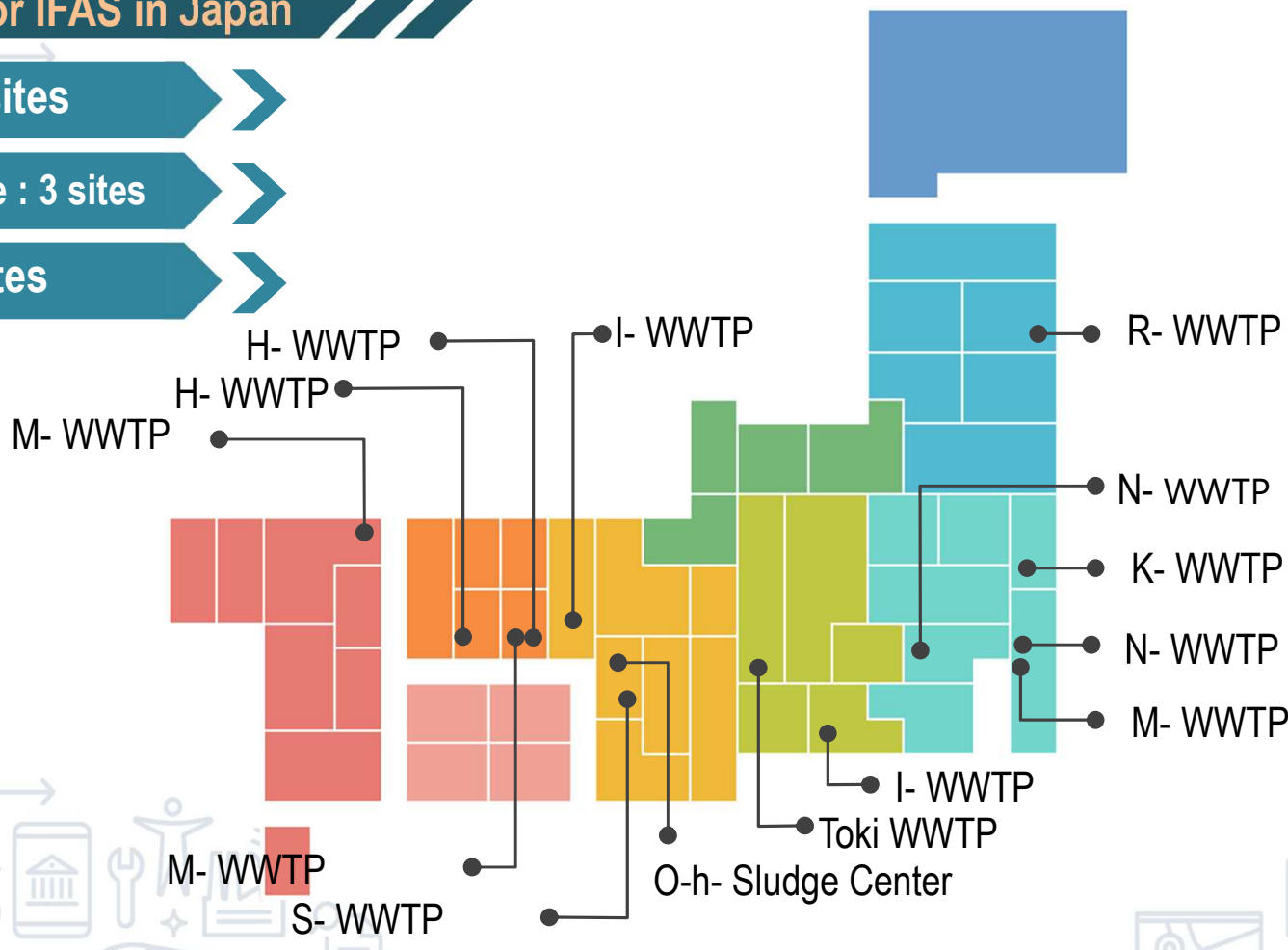
Supply Record

Municipal WWTP : 15 sites
50% of Share for IFAS in Japan

Industrial : 20 sites

Landfill Leachate : 3 sites

Overseas : 4 sites



Supply Record ~ Ex-1: Nishiura WWTP

Nishiura WWTP in Chiba Prefecture ~Typical Retrofit to CAS~

- Capacity : 70MLD (18.5MGD)
- All trains are applied PEGASUS
- **Bio-gel** still been used for **more 19 years**
- Biological Tank HRT : 7hr
- TN Removal Ratio : Approx. >70%

Item	Influent (mg/L)	Effluent (mg/L)	Removal (%)
BOD	135	10	93
SS	103	16	84
TN	31.5	<10	68
TP	4.1	<0.5	88

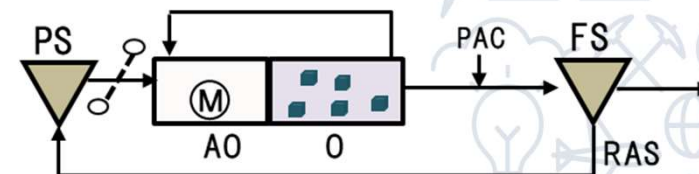
Before (CAS Process)



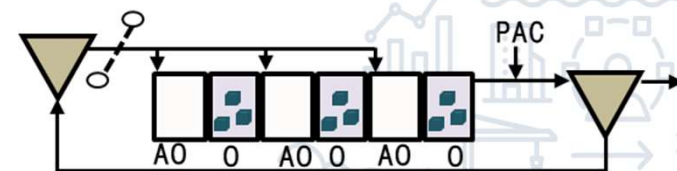
After Upgrading



Phase A : MLE Process



Phase B : Step Feed 3 Stages Process



SS:Suspended Solid
TN:Total Nitrogen
TP:Total Phosphorus

Supply Records ~ Ex2: S WWTP in O-City

<Biggest Plant in Hitachi's Experience>

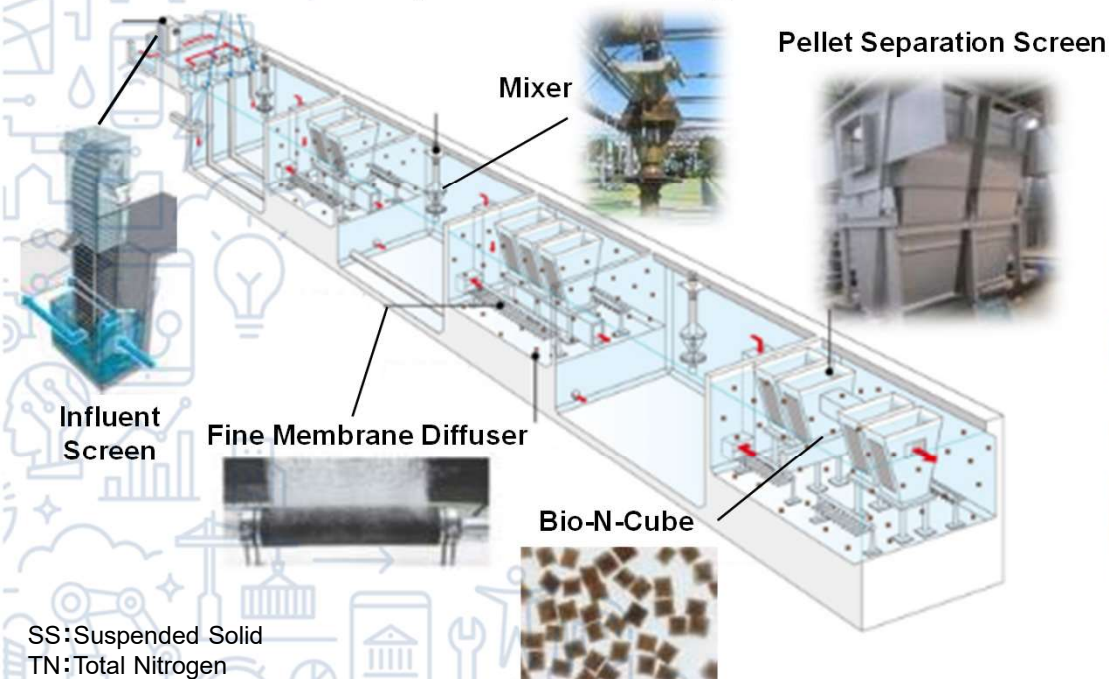
- **Capacity : 120MLD (32MGD)**
- **Biological Tank HRT : 6.4hr**
- **Deep Depth of Biological Tank (8m)**
- **TN Removal Ratio : Approx. 78%**
- **Process : Step Feed 3 Stages Process**

■ Water Treatment Quality:

Item	Influent (PS Effluent)	Effluent	Removal ratio (%)
BOD	97	6.3	94
SS	62	6.2	88
TN	30	6.4	78
TP	4.3	0.44	90

■ Design Water Temperature : 15°C

■ 1st Train Completion : 2008



SS:Suspended Solid
TN:Total Nitrogen
TP:Total Phosphorus

Evaluation of PEGASUS on US Wastewater.

<Bench Scale Test & Pilot test>

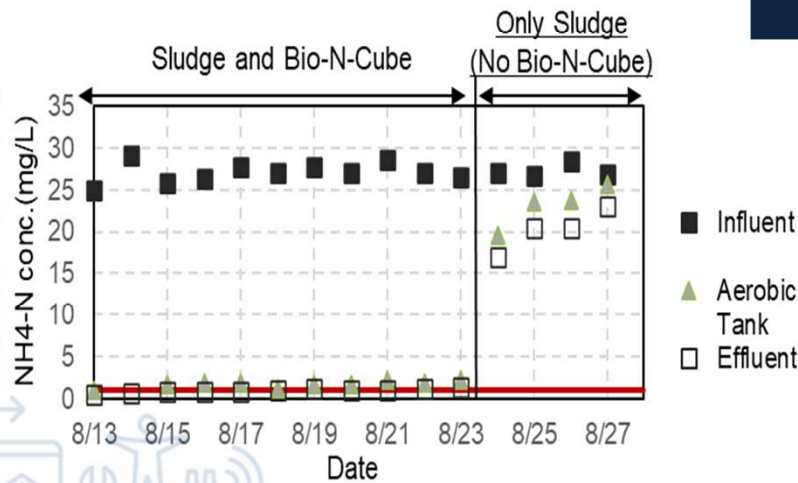
■ Hitachi demonstrated the feasibility for US Wastewater

Parameter	Value
Process	Pegasus Process
Influent Flow, HRT	60L/day, 6hr
Water Temp.	20°C
Filling fraction(%)	7%
Influent NH ₄ -N	25-30mg/L
Effluent NH ₄ -N	(see below figure)

Test Results(in 2018):

- **Acclimation Period was 2 weeks**
- **Effluent NH₄-N Concentration < 1mg/L**
- **Most of NH₄-N was nitrified by Bio-gel**

Hitachi is conducting Pilot Scale Test to confirm the long-term stability of the performance in Dallas.



Containerized Test plant



Summary

High Performance

- High nitrification rate
- Stable performance

Small Footprint

- Same as CAS
- Half of MLE process

Easy Handling

- Small media volume
- Fast acclimatization

Wide Applicability

- Experiences in various processes
- Municipal , Industrial, Landfill leachate

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