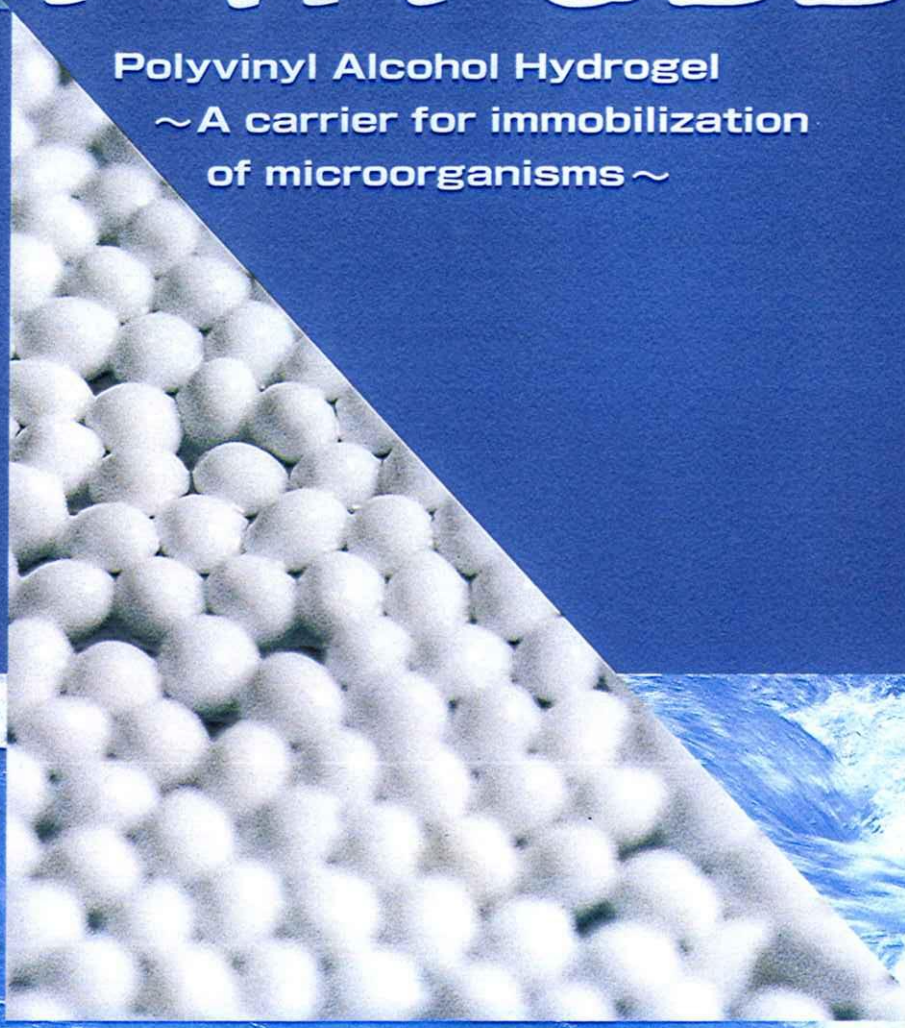
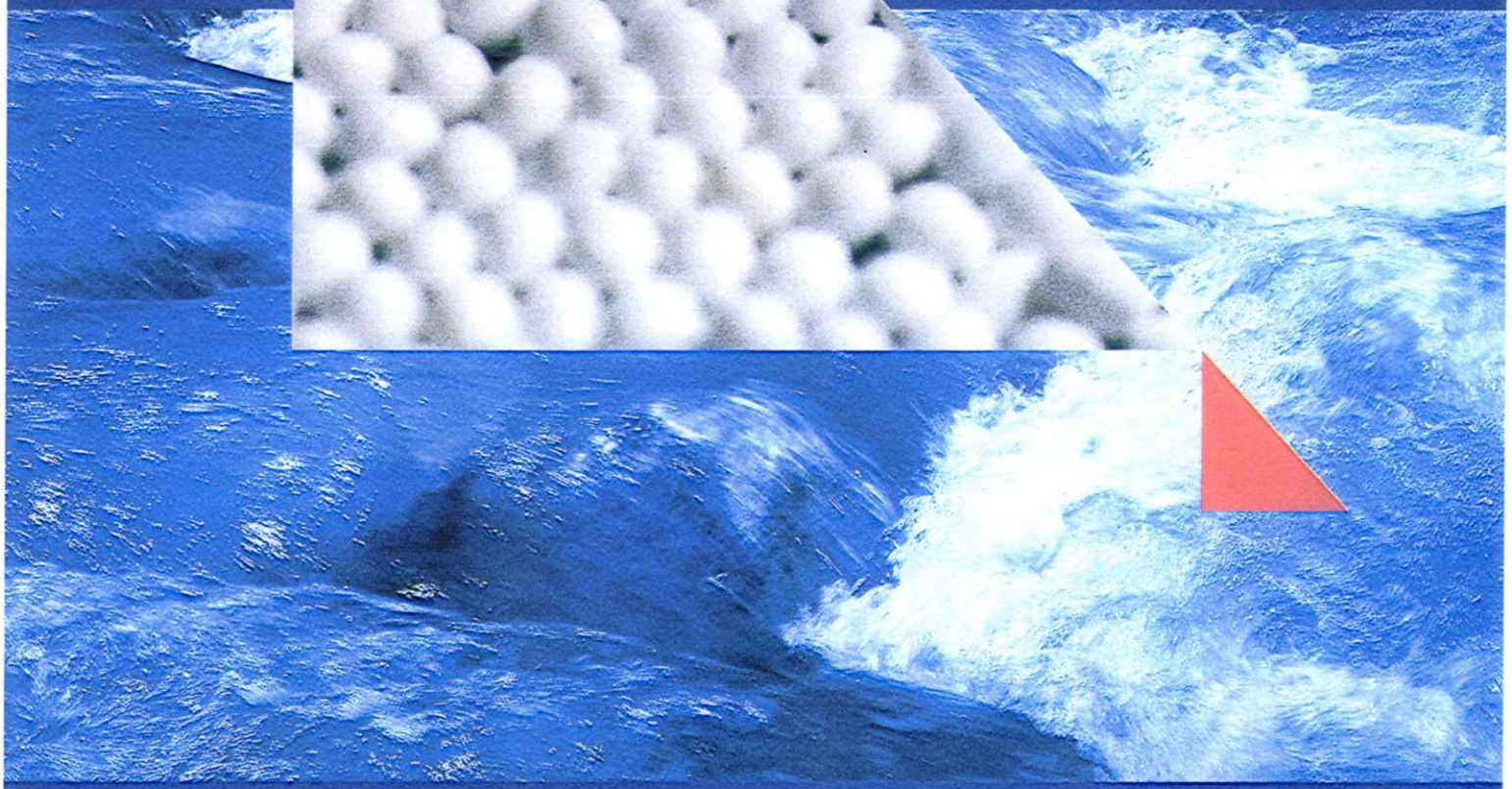
kuraray

PVA GEL

Polyvinyl Alcohol Hydrogel
～A carrier for immobilization of microorganisms～





KURARAY CO., LTD.

PVA gel from Kuraray Company is a biocarrier used to enhance wastewater treatment and thus protect our Earth's environment.

Through over a decade of research and development, Kuraray Company has established PVA-gel beads as an effective biological wastewater treatment technology.
PVA (polyvinyl alcohol) gel is a porous hydrogel that is ideally suited for immobilization of microorganisms essential for the degradation of environmental pollutants.

Advantages of PVA-gel beads:

1 PVA gel is formed as 4 mm spherical beads having a specific gravity of 1.025±0.01 and thus excellent fluidity in water requiring minimal energy for mixing.

2 PVA gel has a network of minute pores about 20 microns in diameter tunneling through each bead.
Useful bacteria can thus be enriched in large numbers in the protective core of the beads greatly reducing sloughing of biomass while maintaining stable treatment efficiencies often at rates in excess of 25 kg BOD/(m^3-gel·d.)

3 PVA gel treatment yields less excess sludge as compared to conventional biological methods.

4 PVA gel has a very high water content due to its extensive porosity, thus allowing for favorable permeability of oxygen and nutrients to the bacteria colonized inside the beads.

5 Polymerized PVA gel is essentially insoluble in water and is not know to be biodegradable.

6 Depending on the characteristics of the wastewater, treatment ability using PVA gel can be enhanced up to 5 times that of conventional activated sludge, thus allowing for upgrading of existing overloaded systems or for design of new process units with greatly reduced footprints.

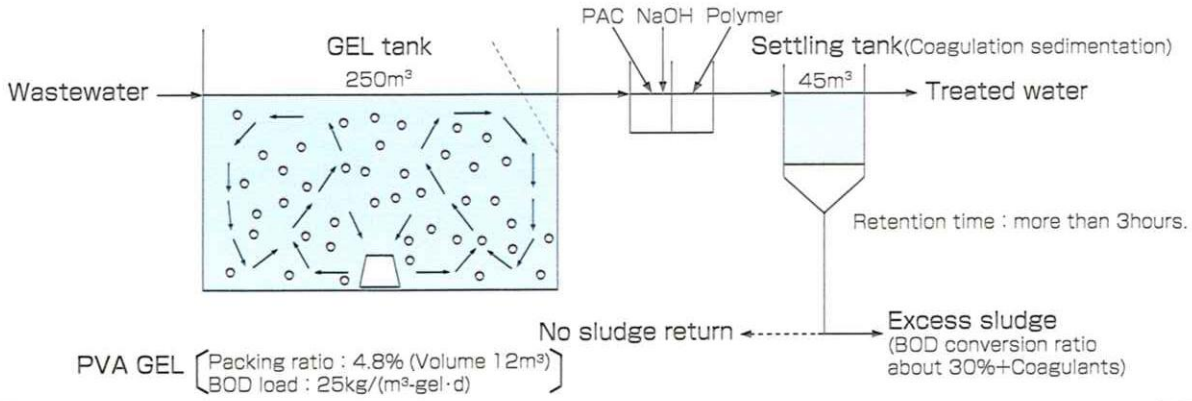
7 In addition to removal of common organic compounds (BOD cut), PVA gel can also be used for nitrification and denitrification as well as treatment of various industrial pollutants.

Examples of wastewater treatment using PVA-gel beads

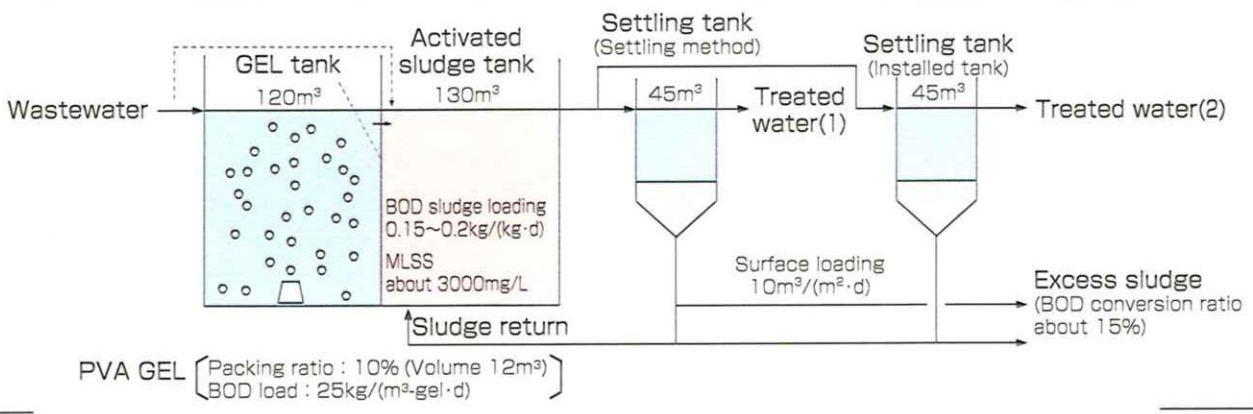
1.Treatment for BOD removal

In the following example, an existing wastewater treatment plant is considered that has a 250 m³ activated-sludge tank and a 45 m³ clarifier. The plant was originally designed to handle 150 m³/d with an influent BOD_5 of 1,000 mg/L. However, the plant is now in need of an upgrade to handle an increased flow of 300 m³/d (with the same BOD_5), for which three design options are shown below. A conventional activated-sludge system would require about twice the existing tank volumes to treat the increased loading (not shown).

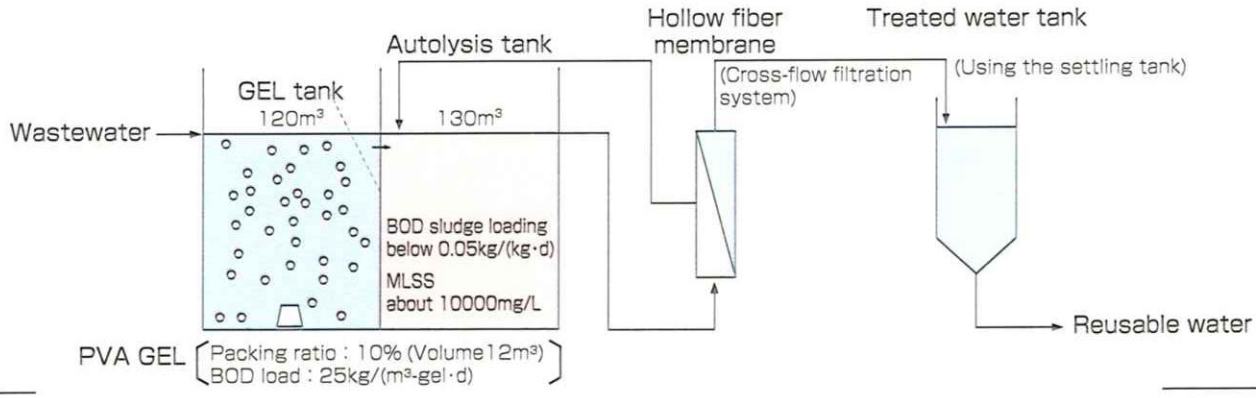
1 PVA GEL+Flocculation



2 PVA GEL+Activated Sludge Method (Excess Sludge Reduction System)



3 PVA GEL+Autolysis Method (Zero Excess Sludge System)



Notes
- The flow diagrams shown here are only typical examples for BOD removal and no performance guarantees are implied. System performance may vary based on various environmental factors and wastewater characteristics.
- Submersible mixers and appropriate aeration equipment shall be used for fluidization of gel and oxygen supply (when needed), respectively.
- When submersible switch mixers are used, a minimum clearance of 5mm shall be maintained between the impeller and its casing.

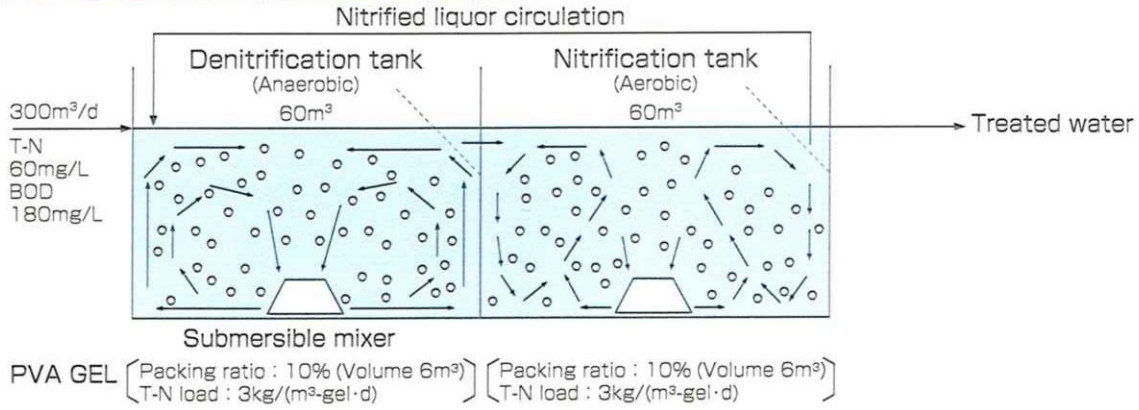
2.Treatment for nitrogen removal

In the following example, an influent wastewater flow of 300 m³/d is considered with total nitrogen (T-N) of 60 mg/L. Three design options are shown.

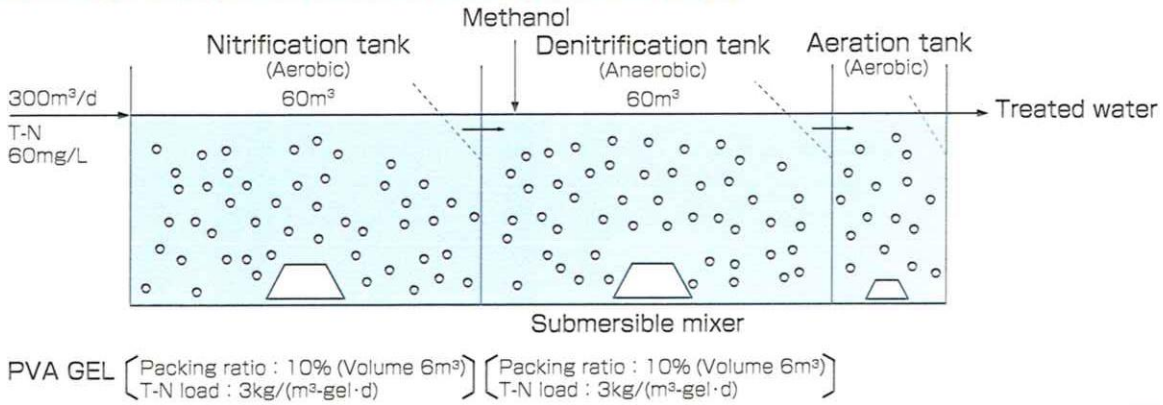
★Nitrification reaction (aerobic) Ammonia-form nitrogen is converted to nitrite and then nitrate (requiring sufficient dissolved oxygen and minimal interference from organic carbon).

★Denitrification reaction (anoxic) Nitrate is converted to nitrite and then nitrogen gas (requiring sufficient organic carbon and minimal interference from dissolved oxygen).

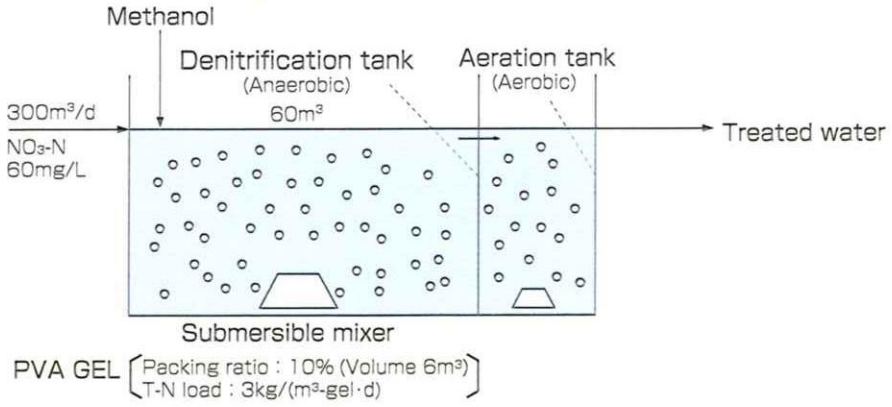
1 Nitrified Liquor Circulation Method



2 Nitrification, Denitrification and Aeration Method



3 Nitrate Removal (Denitrification)

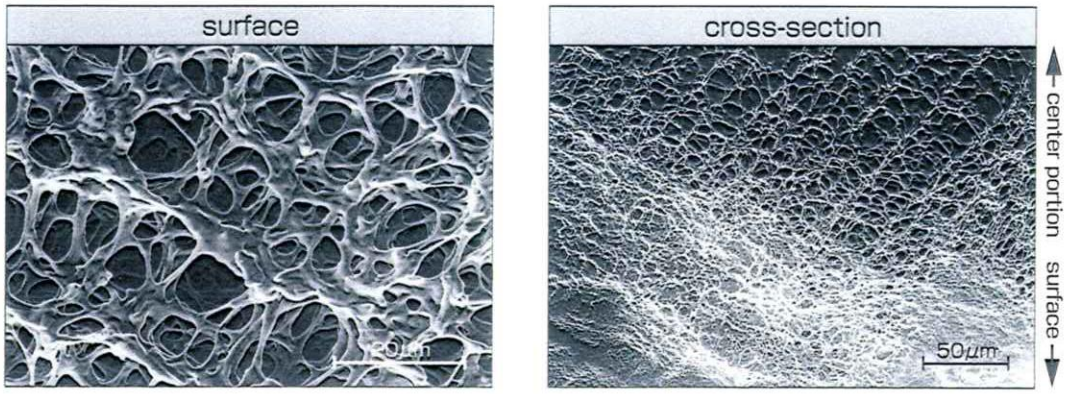


Notes
- The flow diagrams shown here are only typical examples for nitrogen removal and no performance guarantees are implied. System performance may vary based on various environmental factors and wastewater characteristics.
- Submersible mixers and appropriate aeration equipment shall be used for fluidization of gel and oxygen supply (when needed), respectively.
- When submersible switch mixers are used, a minimum clearance of 5mm shall be maintained between the impeller and its casing.

【Appearance of PVA GEL】

【Microscopic structure of PVA GEL】

photograph taken with an Environmental Scanning Electron Microscope (ESEM)

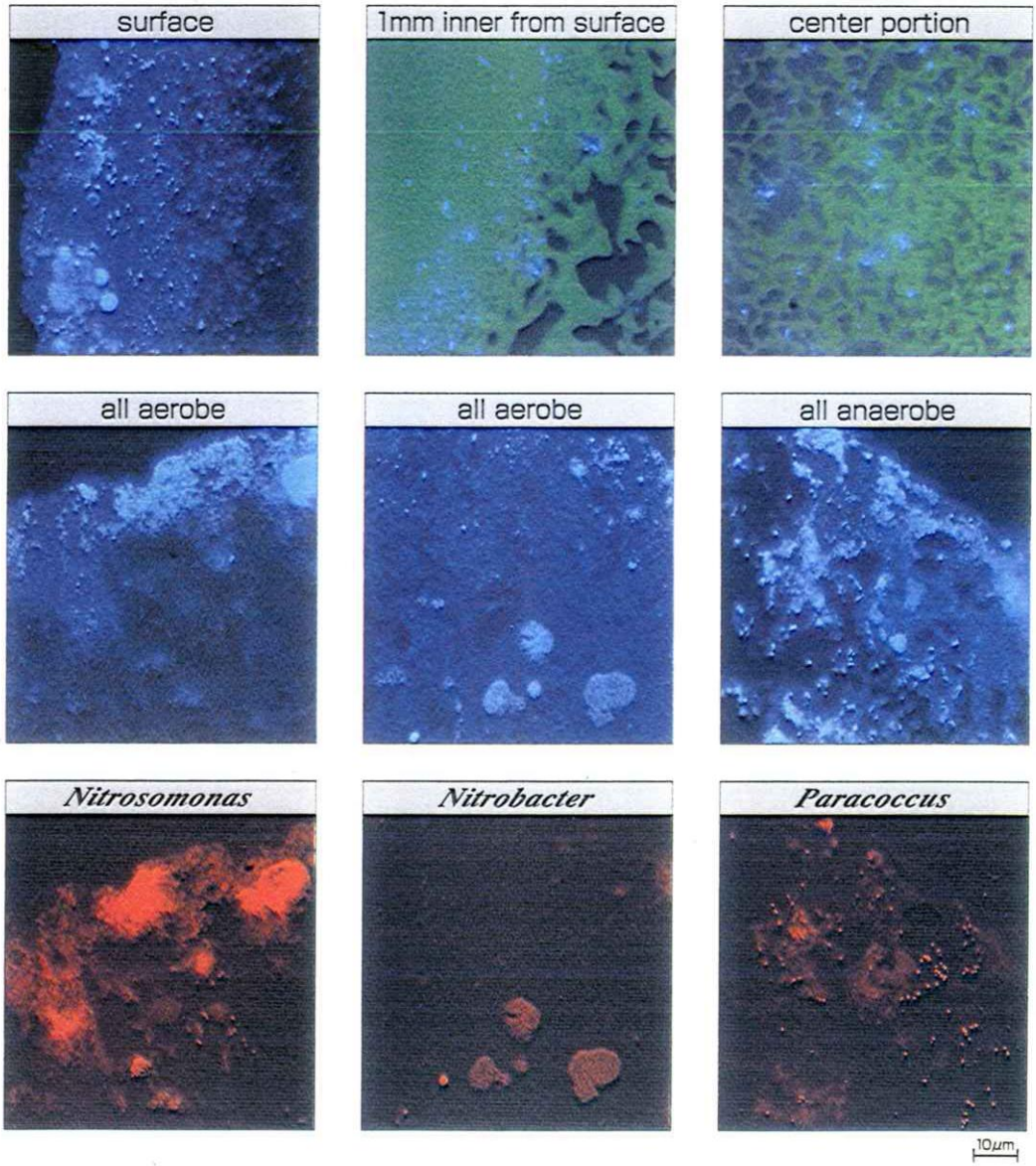


【Distribution of Bacteria】

Fluorescence *in situ* hybridization (FISH) method

■Bacteria multiply toward the center portion of PVA GEL.

■Same field of view.



Example of an autolysis system used for elimination of excess sludge. PVA-gel beads are used for biological treatment of industrial wastewater and membranes are used for sludge-water separation.

	Wastewater	Gel tank exit	Autolysis tank	Treated water
s-BOD_5(mg/L)	5000	30	—	5
s-COD_{Mn}(mg/L)	4000	500	—	20
MLSS (mg/L)	0	1000	10000	0

GEL tank : BOD volume loading 4 kg/m^3·d
Autolysis tank : BOD sludge loading 0.05 kg/kg-MLSS·d

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■Methods of handling PVA-gel beads

- Keep container tightly sealed and out of reach of children when not in use.
- Used PVA gel containing active biomass must be handled with caution (as activated sludge).
- If PVA gel is to be disposed of, it shall be handled as an industrial waste.
- Do not use PVA gel for any other purpose than wastewater treatment.
- Refer to the MSDS prior to handling.

■Caution

- PVA-gel beads are a slipping hazard when spilled on walking surfaces.
- The water used for packing PVA gel during storage and shipping may be slightly acidic, thus wash thoroughly after contact with skin.
- If the packing water gets in eyes, wash eyes thoroughly with clean water and consult a physician immediately.
- If PVA gel or the packing water is ingested, consult a physician immediately.

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