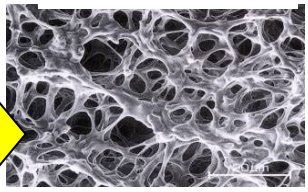
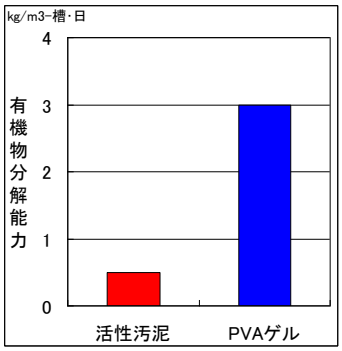
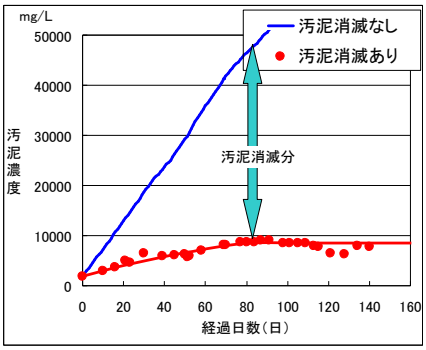
記入日　2020 年 8 月 5 日

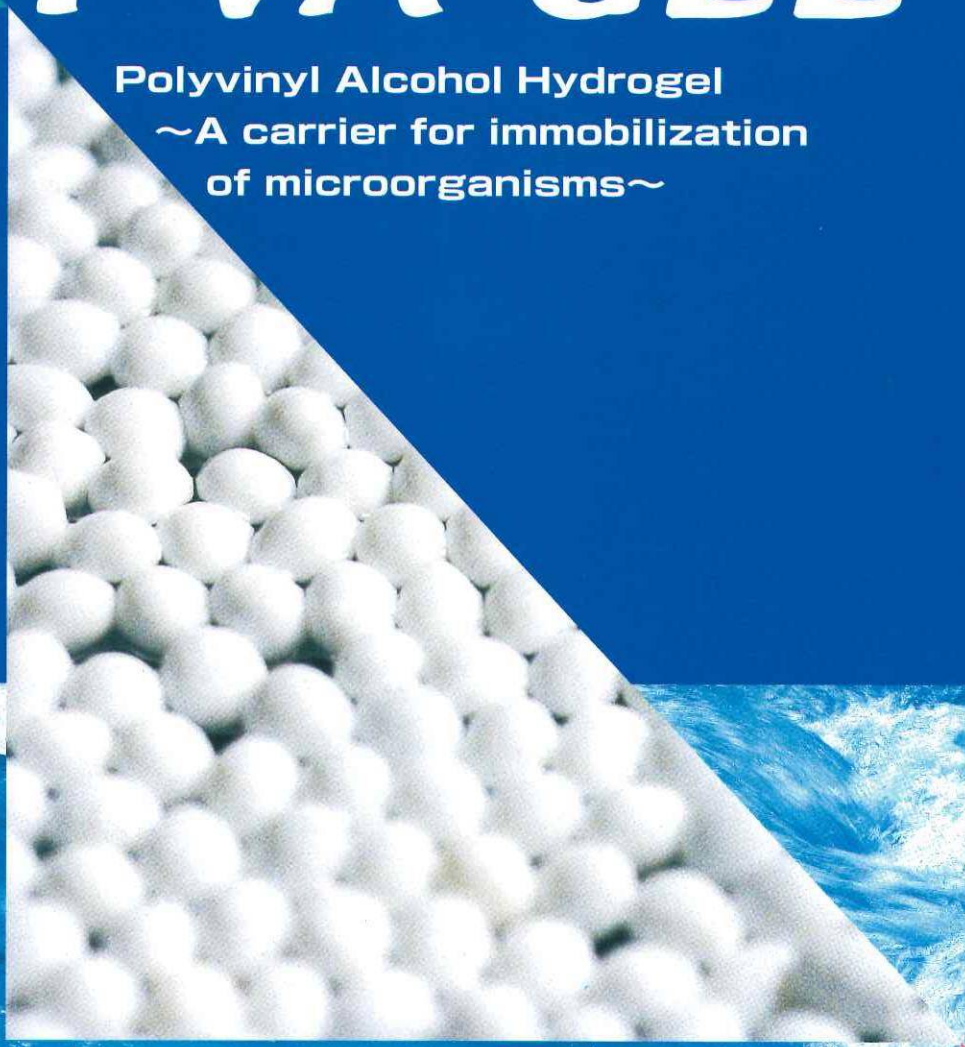
会社・団体名	株式会社クラレ 英文名：KURARAY CO., LTD.			
技術・設備名	排水処理用PVAゲル			
分類		（1）省エネルギー	○	（5）水処理
		（2）新エネルギー		（6）土壌汚染防止・土壌改良
		（3）大気汚染対策		（7）スマートシティ
		（4）循環経済		（8）その他
特徴（PRポイント）	ポバール（PVA）樹脂でできた白く小さな球体、それが菌固定担体<クラゲール>です。きわめて微細な網目状構造をもち、1 粒の中に 10 億個もの微生物が棲みつくことができます。微生物（バクテリア）の働きで産業排水や生活排水をきれいにし、自然に戻すことが<クラゲール>の役目です。			
具体的な省エネ・環境効果、経済性	◆生物親和性の高いポバール（PVA）を原料としており、微生物の棲息性が良好で、従来の活性汚泥法に比べて微生物濃度を大幅に高められるため、コンパクトな設備で効率的なBOD・窒素除去が行えます。 ◆システム構成により余剰汚泥がほとんど発生しない運転が行えます。 <クラゲール®> 直径 4mm の球状  電子顕微鏡写真  A工場（化学排水、BOD 500mg/L）   			
概要・原理				
実績	日本国内を中心に、電子・半導体産業、自動車・機械産業、化学・医薬産業、食品・醸造産業などで多数の納入実績があります。			

中国での連絡先	担当者名：石原　裕久（可楽麗国際貿易（上海）有限公司） TEL：+86-21-61198111 E-mail：Hirohisa.Ishihara@kuraray.com 〒200030 上海市徐匯区虹橋路 3 号 港匯中心二座 2207 単元
日本での連絡先	担当者名：成重　大知（クラレアクア株式会社、営業部） TEL：03-6701-1561 E-mail：Daichi.Narishige@kuraray.com 〒100-8115 東京都千代田区大手町 1-1-3 大手センタービル
Web URL	https://www.kuraray.co.jp

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 4mm spherical beads having a specific gravity of about 1.02 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 25kg 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.

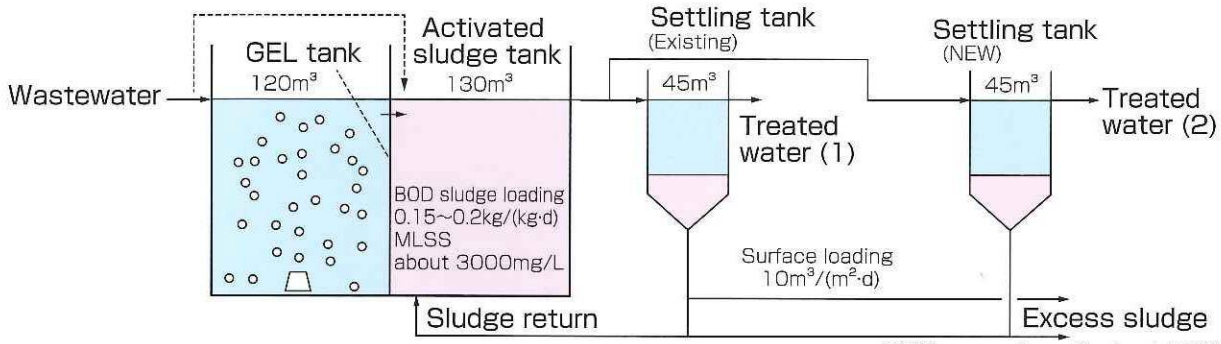
7 In addition to removal of common organic compounds (BOD cut), PVA gel can also be used for nitrification and denitrification as well as treatment of various industrial pollutants.

Examples of wastewater treatment using PVA gel beads

1.Treatment for BOD removal

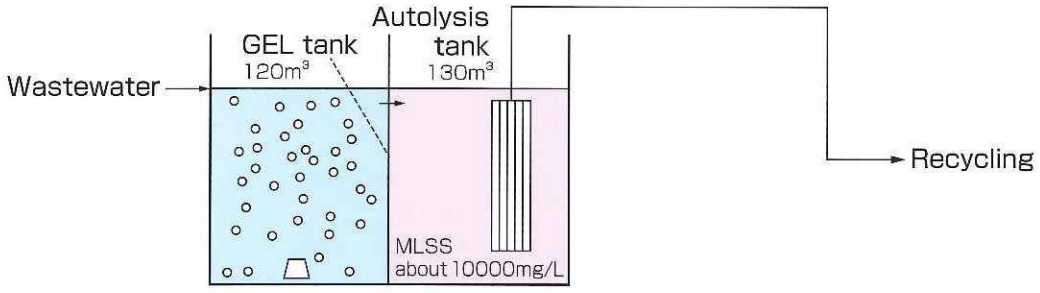
In the following example, an existing wastewater treatment plant is considered that has a 250m³ activated-sludge tank and a 45m³ clarifier. The plant was originally designed to handle 150m³/d with an influent BOD_5 of 1,000mg/L. However, the plant is now in need of an upgrade to handle an increased flow of 300m³/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+Activated Sludge Method (Excess Sludge Reduction System)



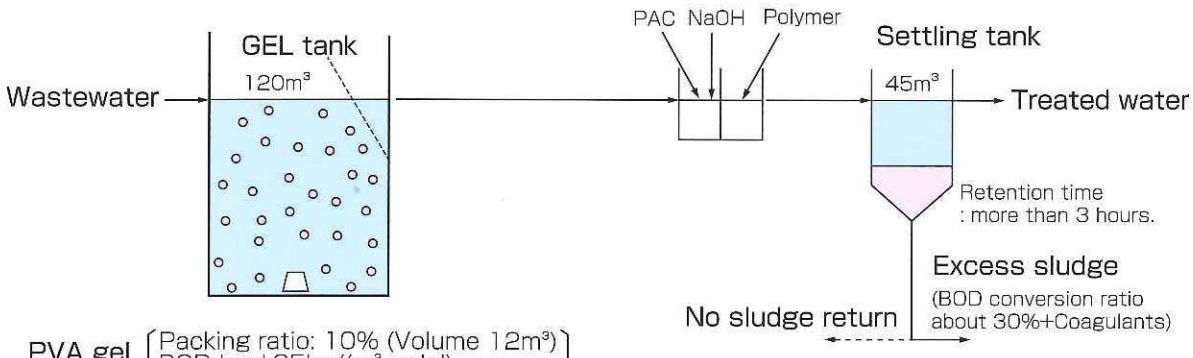
PVA gel { Packing ratio: 10% (Volume 12m³) / BOD load:25kg/(m³-gel·d) }

2 PVA gel+Autolysis Method (Zero Excess Sludge System)



PVA gel { Packing ratio: 10% (Volume 12m³) / BOD load:25kg/(m³-gel·d) }

3 PVA gel+Flocculation



PVA gel { Packing ratio: 10% (Volume 12m³) / BOD load:25kg/(m³-gel·d) }

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.

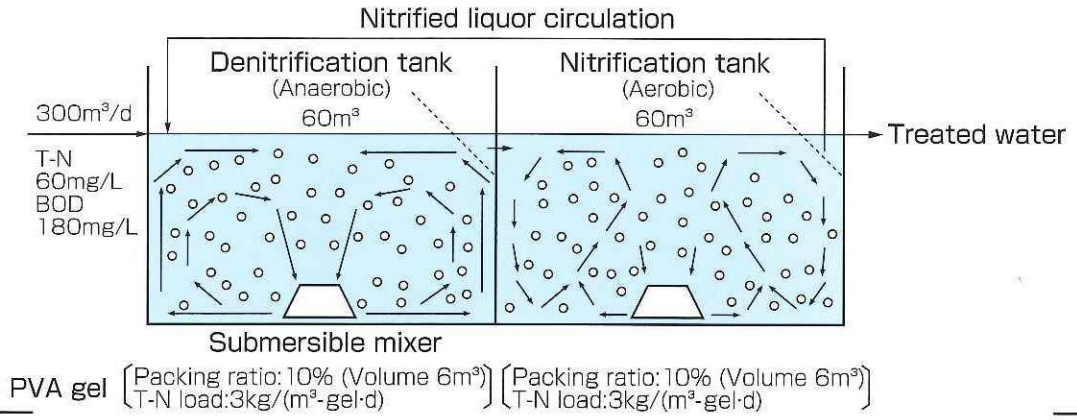
2.Treatment for nitrogen removal

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

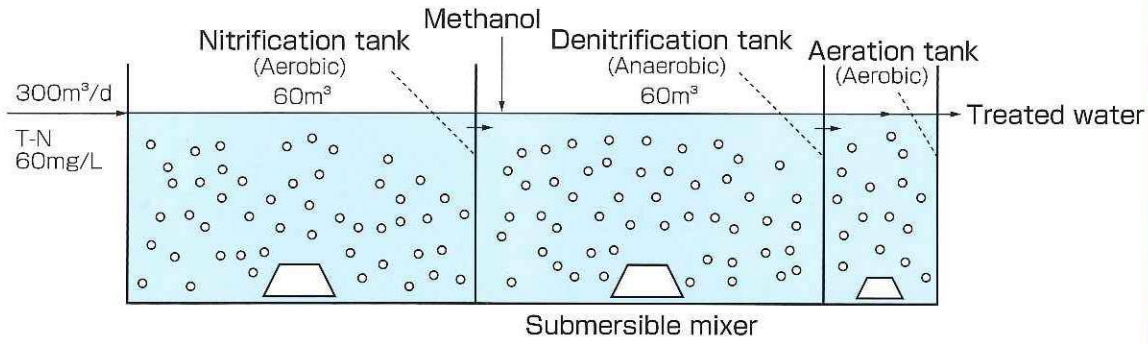
★Denitrification reaction (anoxic) Nitrate is converted to nitrite and then nitrogen gas (requiring sufficient organic carbon and minimal interference from dissolved oxygen).

1 Nitrified Liquor Circulation Method



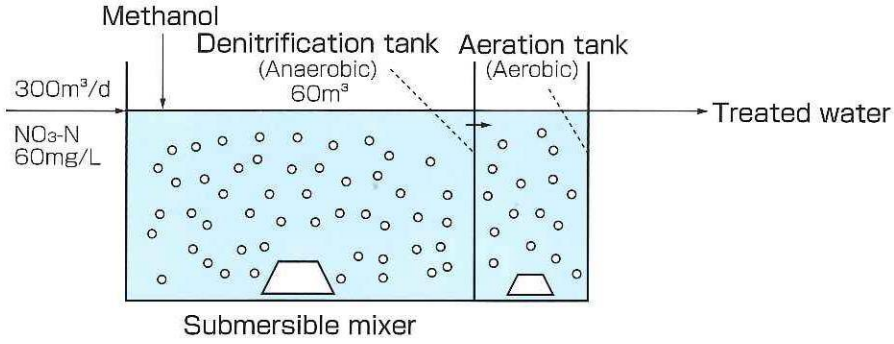
PVA gel [Packing ratio: 10% (Volume 6m³) T-N load:3kg/(m³-gel·d)] [Packing ratio: 10% (Volume 6m³) T-N load:3kg/(m³-gel·d)]

2 Nitrification, Denitrification and Aeration Method



PVA gel [Packing ratio: 10% (Volume 6m³) T-N load:3kg/(m³-gel·d)] [Packing ratio: 10% (Volume 6m³) T-N load:3kg/(m³-gel·d)]

3 Nitrate Removal (Denitrification)c



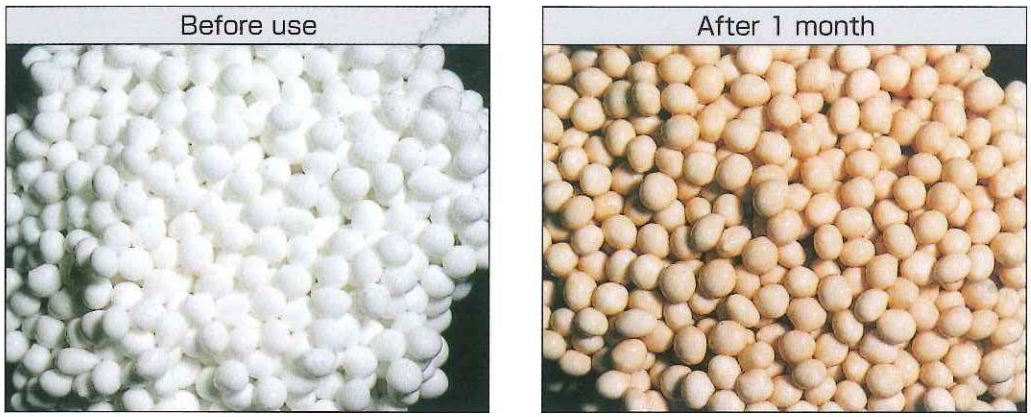
PVA del [Packing ratio: 10% (Volume 6m³) T-N load:3kg/(m³-gel·d)]

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.

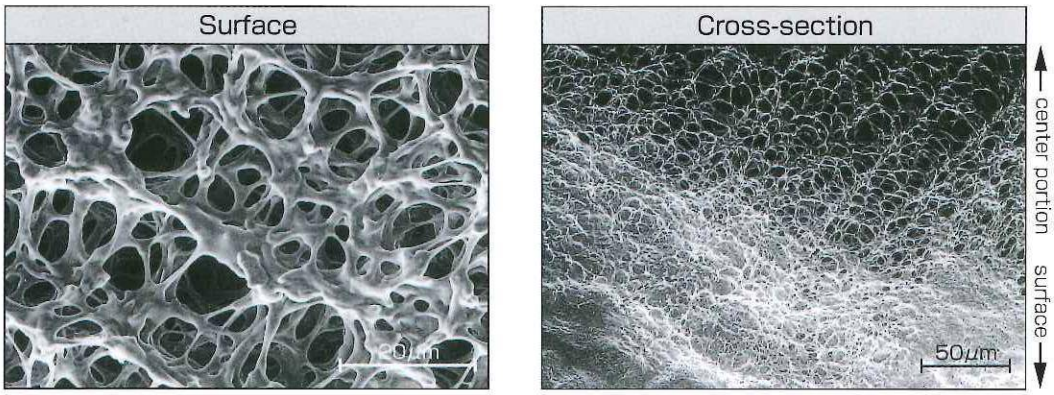
●When submersible switch mixers are used, a minimum clearance of 5mm shall be maintained between the impeller and its casing.

【Appearance of PVA gel】



【Microscopic structure of PVA gel】

Photograph taken with an Environmental Scanning Electron Microscope (ESEM)

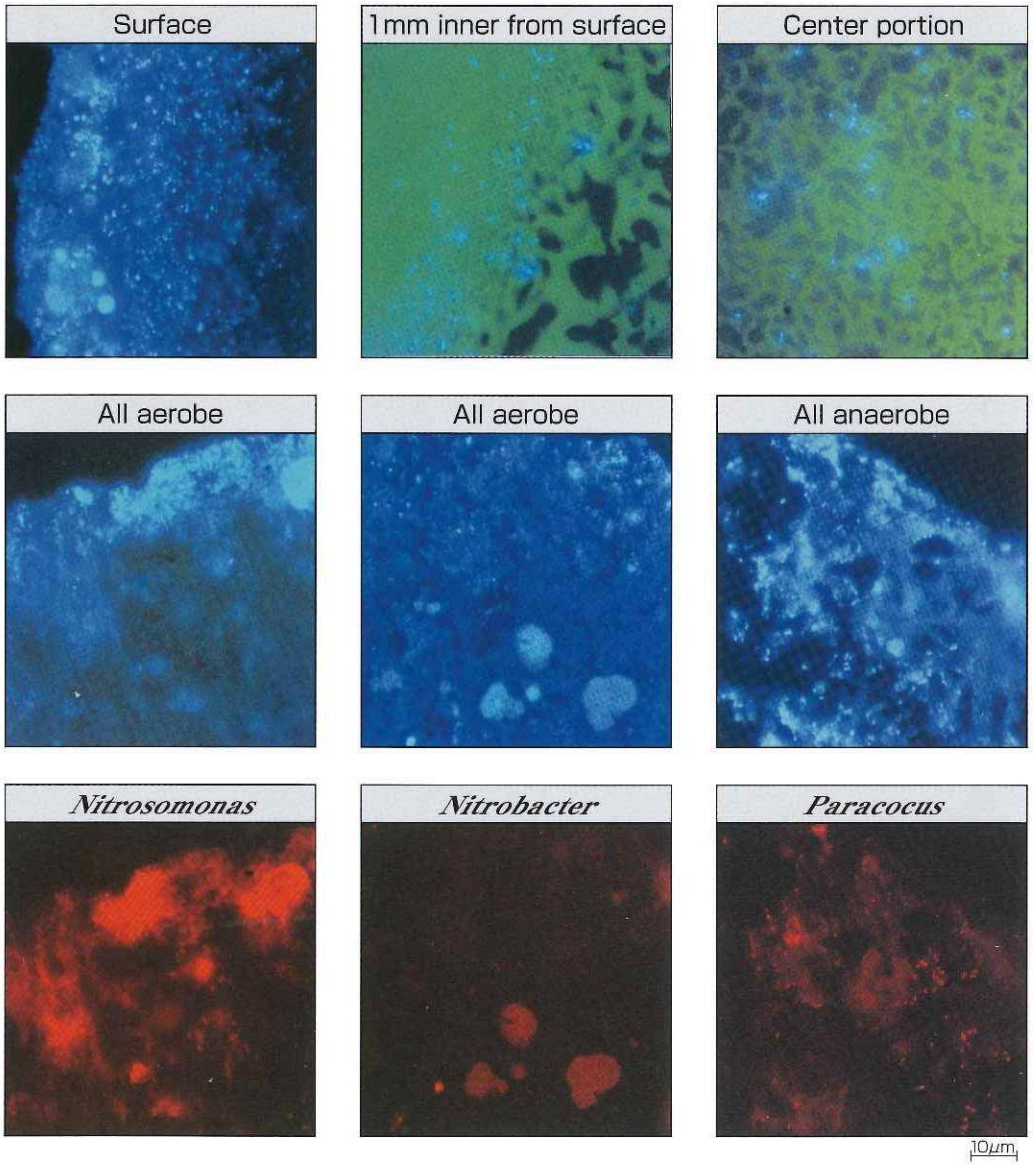


【Distribution of Bacteria】

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

PVA GEL

Polyvinyl Alcohol Hydrogel
~A carrier for immobilization of microorganisms~

■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

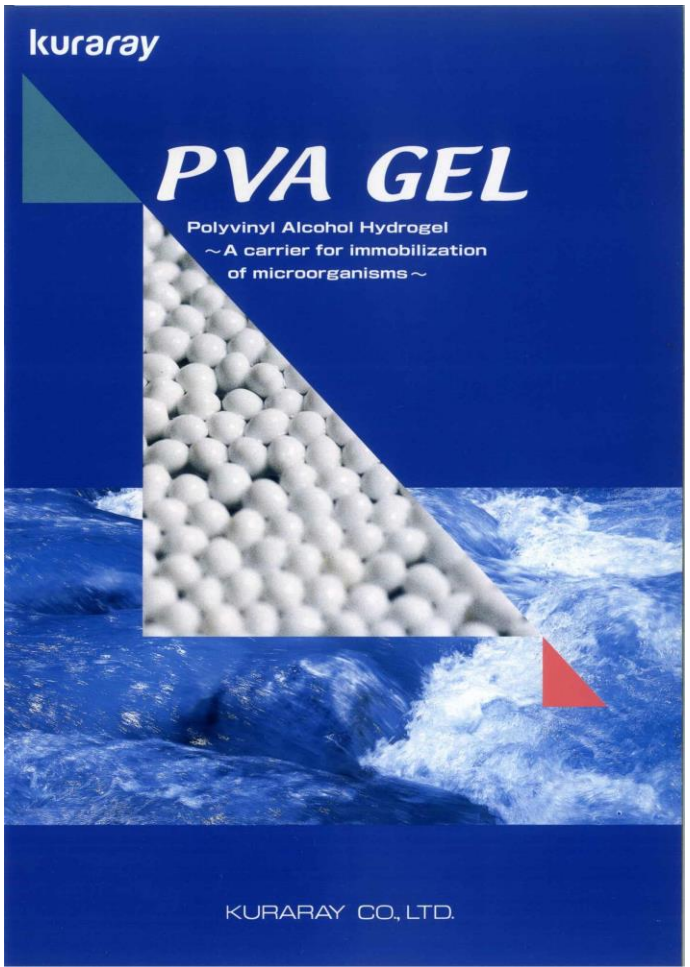
- ●PVA gel beads are a slipping hazard when spilled on walking surfaces.
- ●The water used for packing PVA gel during storage and shipping may be slightly acidic, thus wash thoroughly after contact with skin.
- ●If the packing water gets in eyes, wash eyes thoroughly with clean water and consult a physician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

KURARAY CO., LTD.

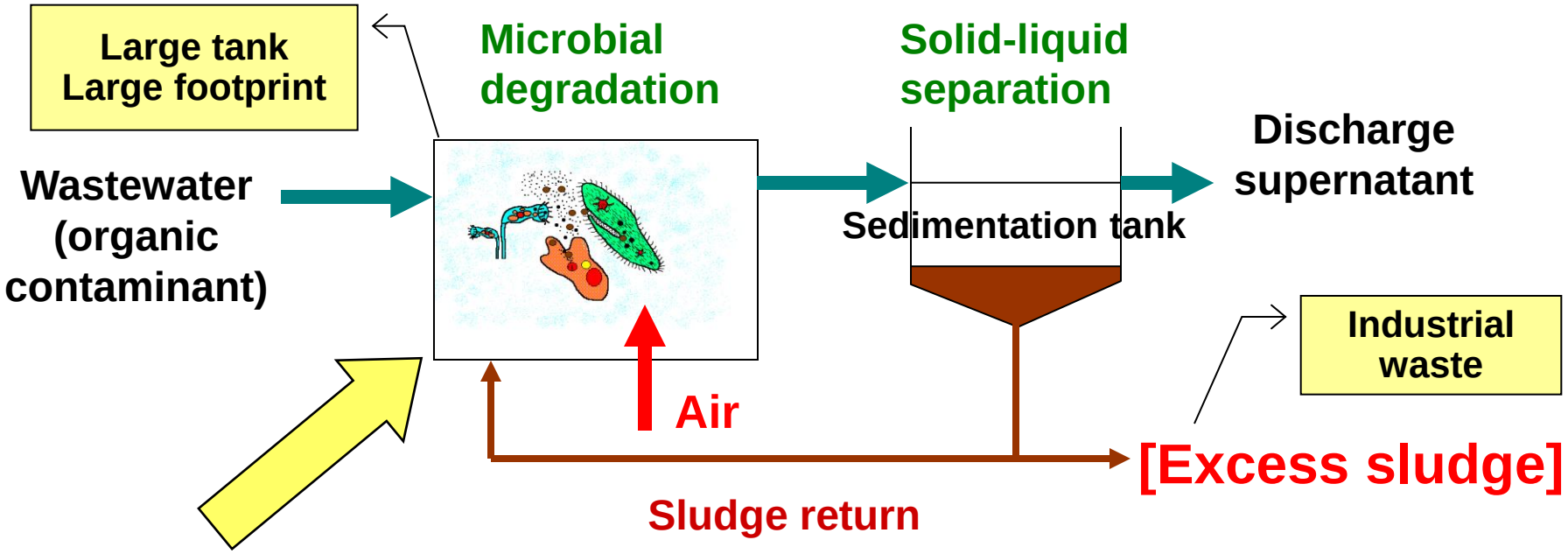
Environmental Business Development and Promotion Division
OTE CENTER BLDG., 1-1-3. Otemachi, Chiyoda-ku, Tokyo 100-8115, Japan
TEL:+81-3-6701-1550 FAX:+81-3-6701-1654
http://www.kuraray.co.jp/

Selling agency :

PVA Gel Beads
For Biological Wastewater Treatment



Conventional Biological Wastewater Treatment



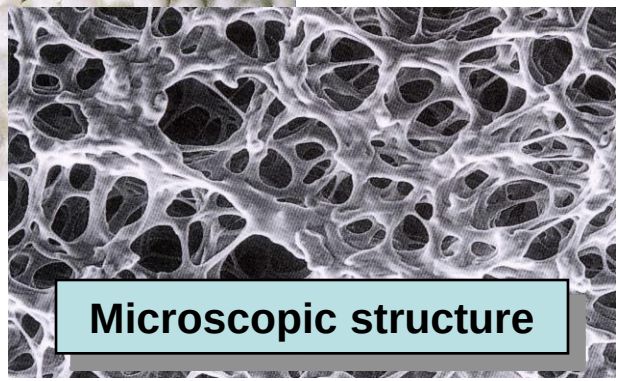
Activated sludge ("sludge" is the mixture of bacteria, protozoa and metazoa.)

Microorganisms grow by eating organic substances (about 50% of organic substances (BOD) converts to CO_2/ H_2O and the rest converts to excess sludge). The excess sludge must be discharged periodically.

PVA-gel Beads as Bio-carrier

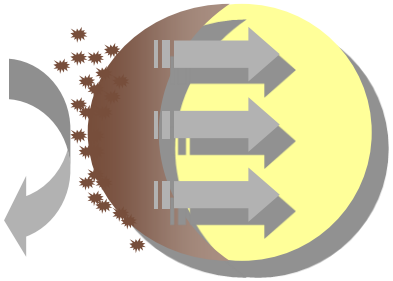


Material: Polyvinyl alcohol (PVA)
Size: 5mmΦ beads
Specific gravity: 1.015



Microscopic structure





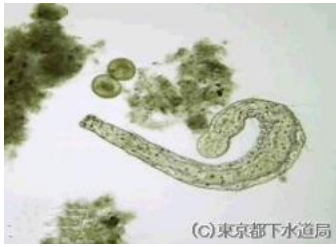
Protozoa, Metazoa

Only bacteria can enter into PVA Gel.









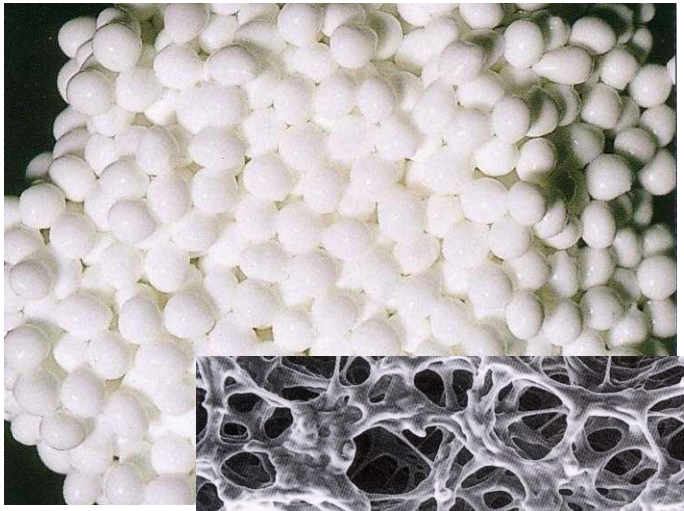
1 μm　10 μm　100 μm　1,000 μm

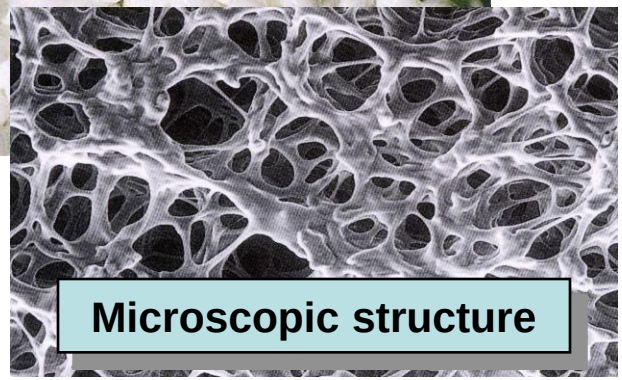
Bacteria
Several μm

Size of micro pores on the surface of the PVA Gel
5～20 μm

Protozoa, Metazoa

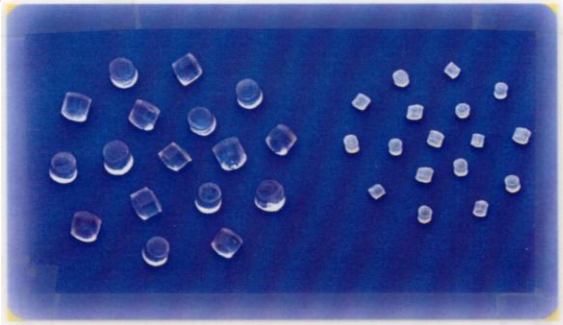
Examples of bio-carriers

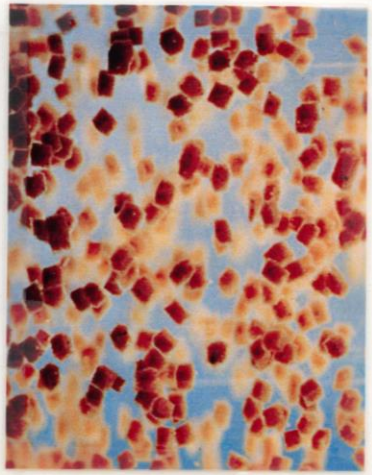




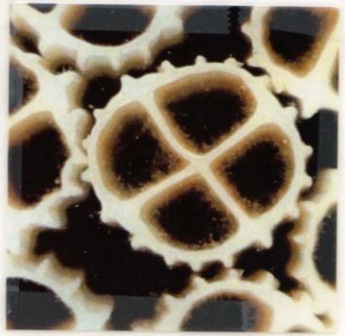
Kuraray PVA-Gel

Unlike PVA gel beads, most of the other carriers do not have porous structures, thus can only retain bacteria on their surface.

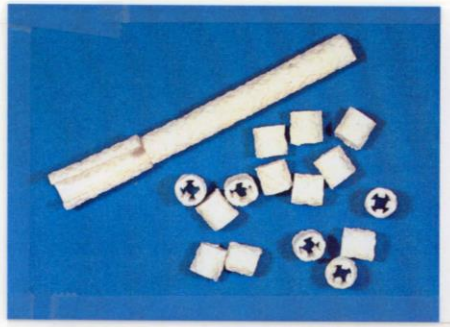












Feature of wastewater treatment using PVA-Gel

1. *Quite high load is possible.*
   (5 times or higher than conventional activated sludge)

2. *PVA-gel can also be used for biological nitrification and denitrification processes.*

3. *The amount of excess sludge can be reduced.*
   (We have some special techniques to reduce excess sludge dramatically with PVA-gel.)

Comparison of Capability

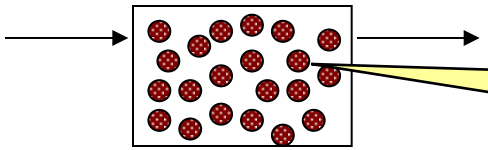
Conventional system

Mixture of Bacteria, protozoa, metazoa, etc.

Activated sludge tank

Tank volume can be reduced to 1/6, or volume load can be increased by 6 times

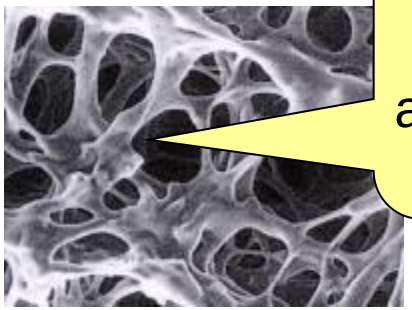
PVA gel (10 % vol. packing)



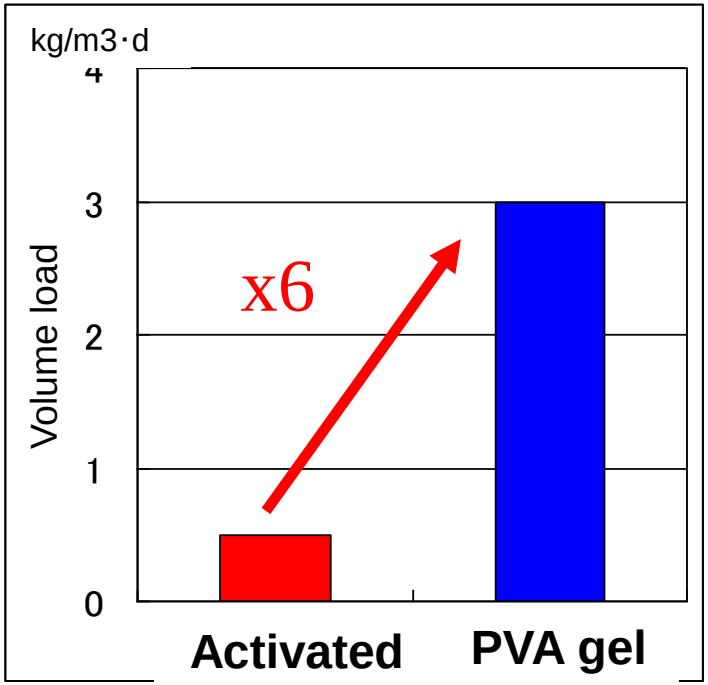
Only effective bacteria

PVA gel tank

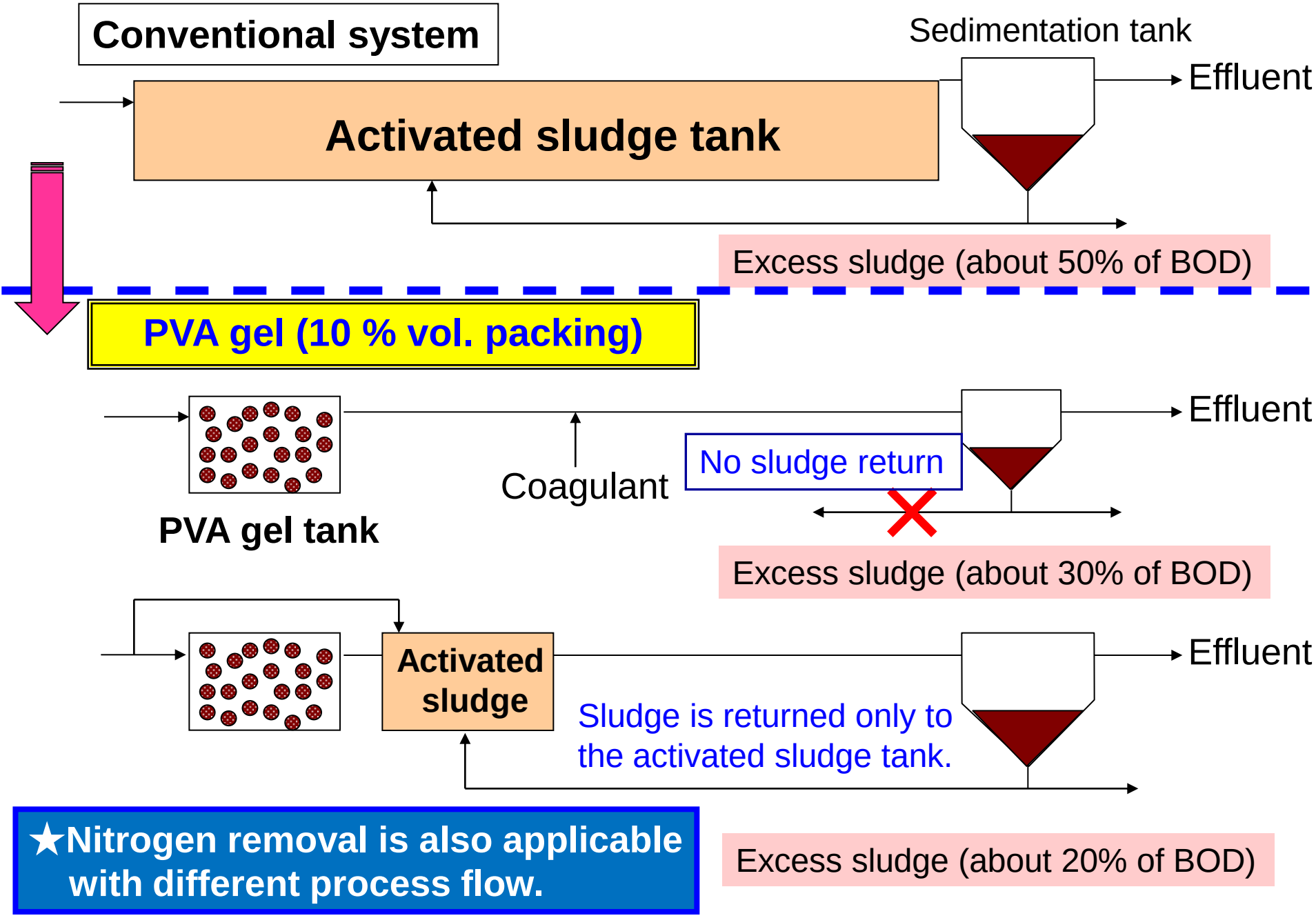




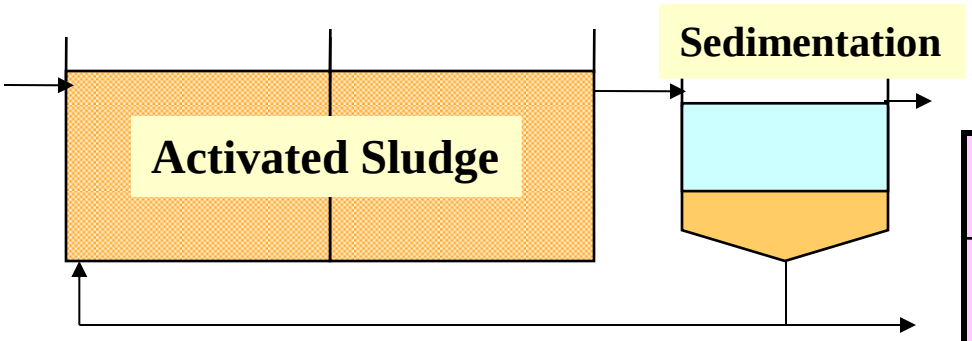
Countless bacteria are retained in PVA gel.



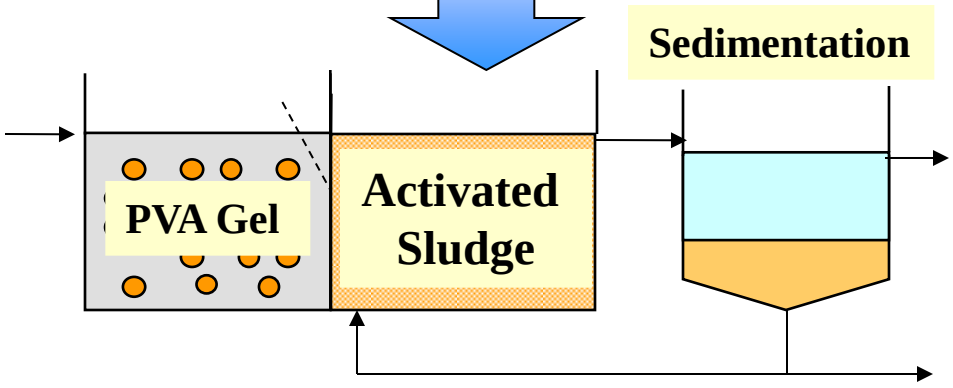
High Efficiency and Low Excess Sludge



Installation Example (1) Food factory (BOD removal)



Increase the capacity of BOD removal with no tank expansion.



- Increase the capacity of BOD removal
- Reduction of excess sludge

	Before	After	
Flow rate [m^3/d]	50	50	–
Volume load [$kg/m^3/日$]	0.5	1.2	2.4 times
BOD of effluent [mg/L]	180	< 30	–
Excess sludge [m^3/Y]	2470	740	1/3

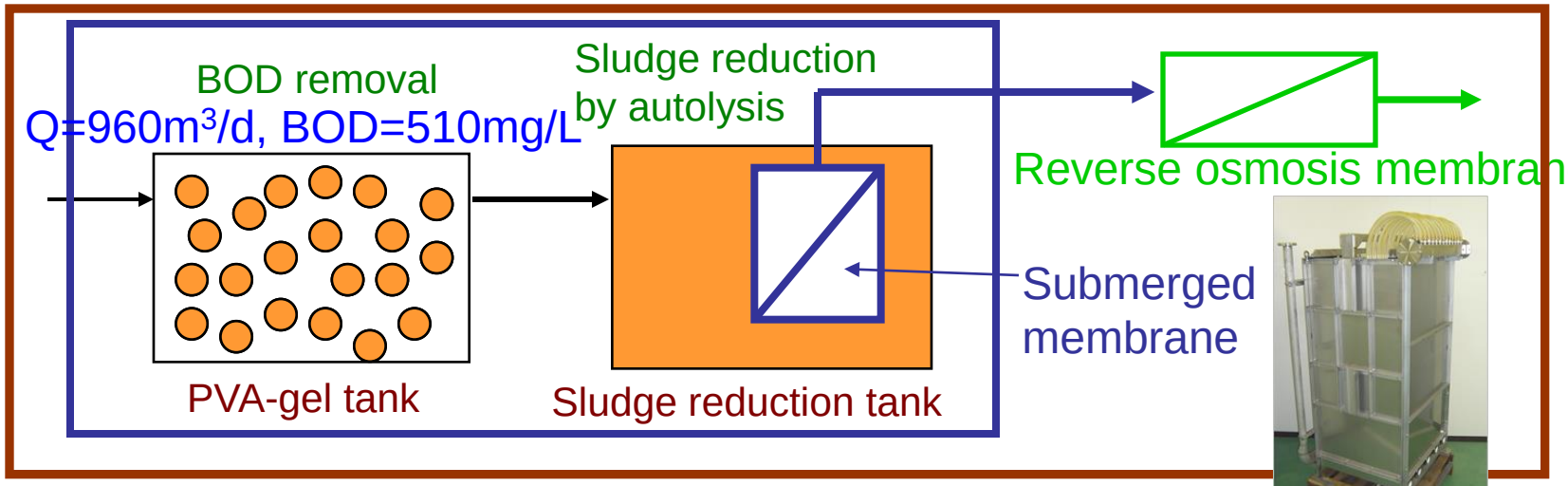
Installation Example (2) Recycle of the wastewater as ultra pure water and sludge reduction (Taiwan)



Reverse osmosis membrane

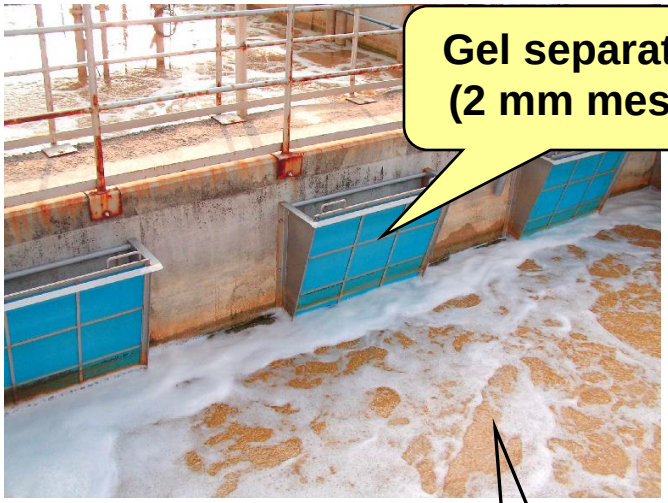
PVA-gel beads + sludge reduction (installed underground)

- 85% of the wastewater can be recycled as ultra pure water.
- Greatly reduced excess organic sludge by autolysis.

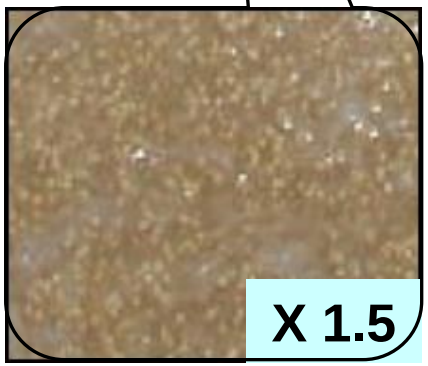


Installation Example (3): Sludge Reduction System

Kuraray Saijo Plant (400m^3/d)



PVA Gel tank (BOD removal)



BOD removal and sludge reduction

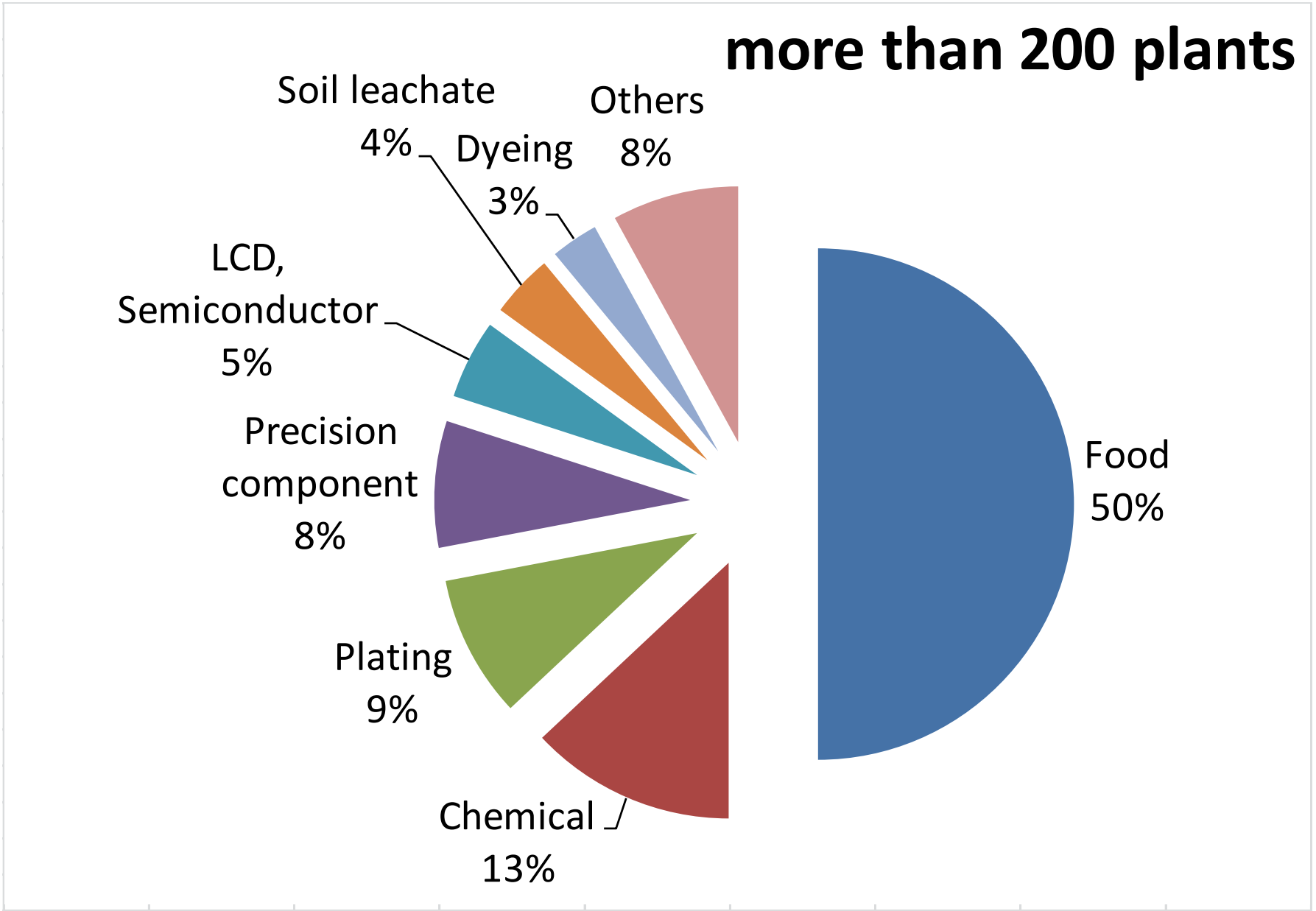


Sludge reduction tank



Sedimentation tank

Delivery record of PVA-Gel for each industry sector



Overseas bases & Global launch of PVA-Gel

