



Introduction to high- concentration wastewater treatment technology VMBDR

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Technology of the high-concentration wastewater treatment (VDBDR)



Wastewater & Treatment technology

What is high-concentration wastewater treatment technology (VMBDR)?

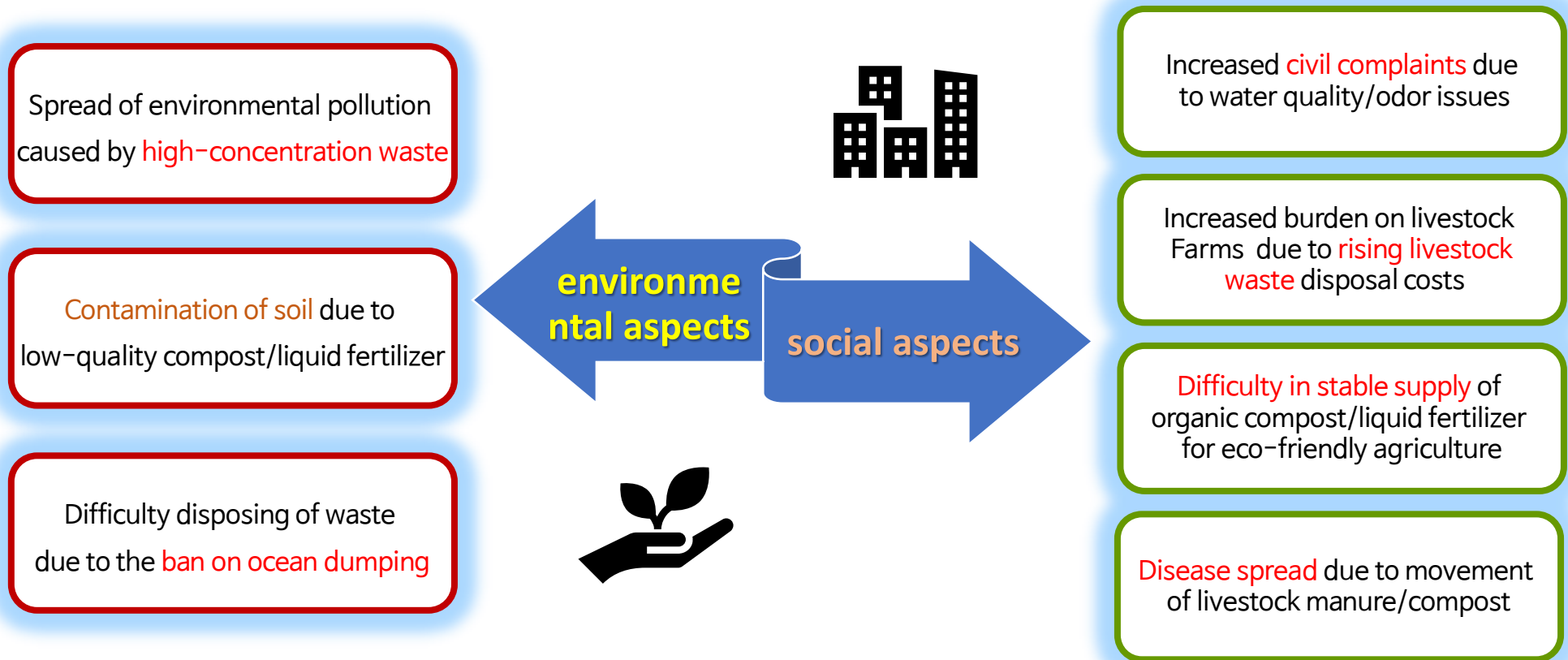
- Wastewater treatment is an important treatment process that requires basic knowledge and experience.
- In order to achieve the desired treatment conditions, not only technology but also operational know-how appropriate for the local wastewater is required.
- WK E&C. Co., Ltd. provides various construction experiences to ensure that the desired water quality is discharged.
- We provide high technology and know-how.
- Due to the recently increasing discharge water conditions, other companies were unable to proceed. We are continuously resolving requests from wastewater construction companies and providing optimized construction services to ensure economic feasibility.
- In addition, we are a company that continuously researches to provide higher technology and quality services..

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- Business overview
- Process overview
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- Advantages of
Technology

01. Business overview

❖ Impact of high-concentration wastewater and waste on the environment and society



01. Business overview

❖ Matters to consider when deciding on a high-concentration wastewater treatment technology

- What is **VMBDR** ? A fine bubble generating device with a special nozzle structure that circulates (vortexes) the aeration liquid and directly melts the air by contact with it .

1 • Economic feasibility and stability aspects



Stable treatment of **high concentration** wastewater



Minimal use of land area

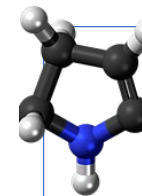


The treatment process is **simple and easy** to operate

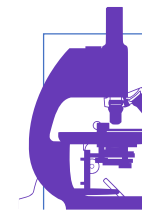
2 • High-concentration pollutant removal aspect



VMBDR (Vorticial Micro Bubble Diffuser reactor)



Biological nitrogen removal using **VMBDR**



Securing high concentration of **microorganisms** using **VMBDR**

01. Business overview

❖ Technology principle

- HYBRID wastewater treatment technology that combines the advantages of reactors

- In general, the types of reaction tanks applied in biological treatment methods are divided into [continuous stirring type reactors](#) and [continuous extrusion type reactors](#). This reactor combines the advantages of the ideal continuous stirring type reactor and continuous extrusion type reactor, and its internal space is oriented along the vertical axis. By meeting the [optimal reaction conditions](#) by configuring it in multiple stages, the treatment time for high-concentration organic wastewater was shortened and the organic matter removal efficiency was also increased.

- Increases the concentration of dissolved oxygen by maximizing O2 dissolution efficiency

- As the wastewater and air of a certain pressure introduced from the outside pass through the reactor nozzle, the acceleration increases rapidly and a high-speed rotational force is generated, generating a vacuum pressure at the end of the air inlet pipe.
- Due to this **vacuum pressure**, a large amount of air flows in through the air supply pipe and is stirred with waste water rotating at high speed in the mixing chamber of primary air and waste water, which is formed in a relatively small space. As they collide, [fine bubbles are created and again formed into a relatively large space](#). In the mixing room of secondary air and waste water, bubbles are created secondarily by mixing while stirring and colliding.
- These [fine bubbles maximize the oxygen dissolution efficiency](#) through contact with the mixed solution in the reaction tank, increasing the dissolved oxygen concentration and also serving as dilution and agitation.

02. Process overview

❖ Characteristics of processing technology

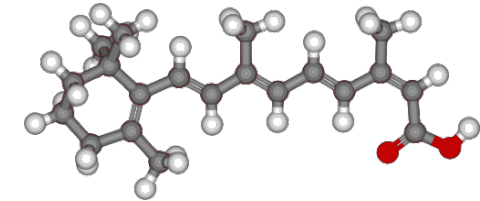


Division	VMBD microbubble aerobic biological reactor	general aerobic biological aeration tank
Oxygen dissolution method	Liquid and gas are mixed in the gas-liquid nozzle to form fine bubbles and connect to the aeration liquid in the reaction tank to maximize oxygen transfer efficiency.	Air bubbles are created by an air diffuser, and there is a limit to creating bubbles, so oxygen transfer efficiency is low.
Bubble size	micro bubbles	1 mm below
Gas-liquid contact area	Very large	small
Bad odor and generated gas	There is little odor and it is easy to collect and remove gas discharged through the exhaust pipe.	In case of general biological treatment, there is a lot of odor.
Shock load, toxic substances	It is possible to maintain a high concentration of MLSS, so the impact is relatively small.	Big impact
Driving convenience	Driving operation is relatively simple	Requires skilled professionals such as microbial management

* What is MLSS ? In the activated sludge method, the average concentration of suspended solids in the mixture in the aeration tank [mg/ l].

02. Process overview

❖ Additive principle

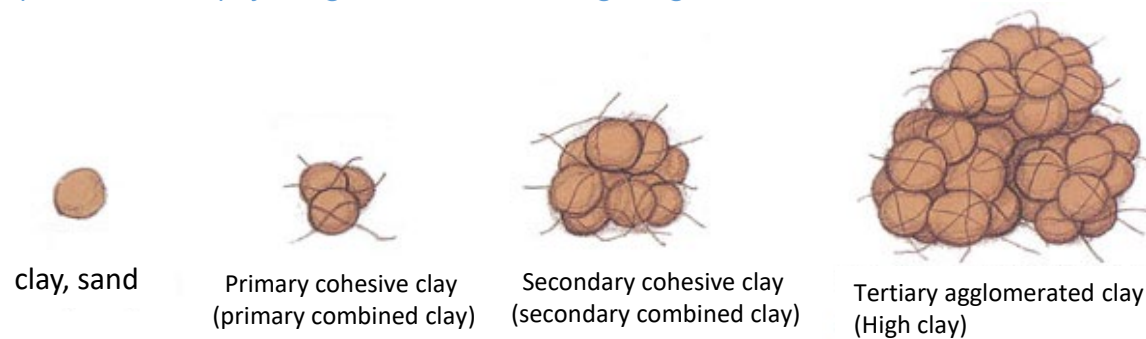


* What is water-resistant flocculation? A lump of soil in which soil particles stick together well even in water and are not dispersed into individual particles.

A. Additive water resistance cohesive structure formation mechanism (Mechanism)

① Primary flocculation formation	② Secondary flocculation formation	③ Water-resistant aggregate formation
<ul style="list-style-type: none"> - The hyphae of fungi living in humus soil entangle fine particles to form primary aggregation. 	<ul style="list-style-type: none"> - In the first stage of flocculation, the viscous substance of microorganisms of the genus <i>Pseudomonas</i> acts as a glue on the inner wall of the flocculation, causing the flocculation to flocculate and increase its size. - The size of the confluence increases as cohesive material repeatedly develops in the enlarged cohesion. 	<ul style="list-style-type: none"> - In secondary aggregation, when the fungus dies, the hyphae reach a stable material through a corrosion reaction, and the hyphae do not disappear, so the created aggregate is continuously maintained. - This structure is called water-resistant cohesive structure.

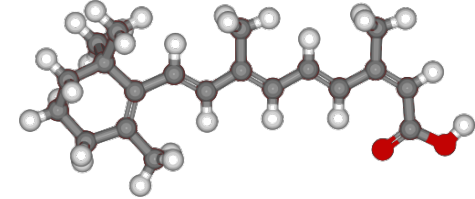
* Mechanism : The basic principles that cause physiological functions in living things



〈 Water-resistant aggregate formation process by microscopic hyphae〉

02. Process overview

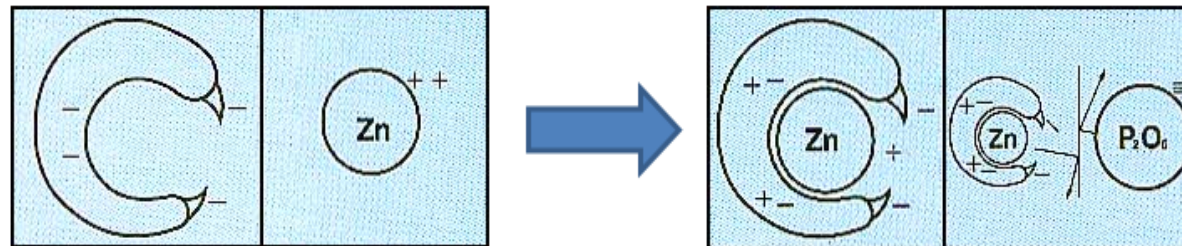
❖ Additive principle



B. Function of “additive” water-resistant aggregate structure

① Excellent cation adsorption capacity

- CEC (Cationic Electrons Capacity) is several to tens of times higher than montmorinite (a natural substance with high ion exchange capacity).



〈 Example of water-resistant cohesive structure and ionic bonding 〉

02. Process overview

B. Function of “additive” water-resistant aggregate structure

② Odor removal function

A) Removal of ammonia-based odor

As the nitrogen component is absorbed into the sludge due to the ion exchange ability of the inner wall of the water-resistant cohesive structure present in the sludge, the creation of ammonia-like odor is fundamentally impossible.

B) Removal of other odorous substances

The metabolites of microorganisms within the water-resistant aggregate structure include organic substances with chelating functions, such as quinic acid, zicalbonic acid, lichenic acid, amino sugar, and chelating Fulvic acid.

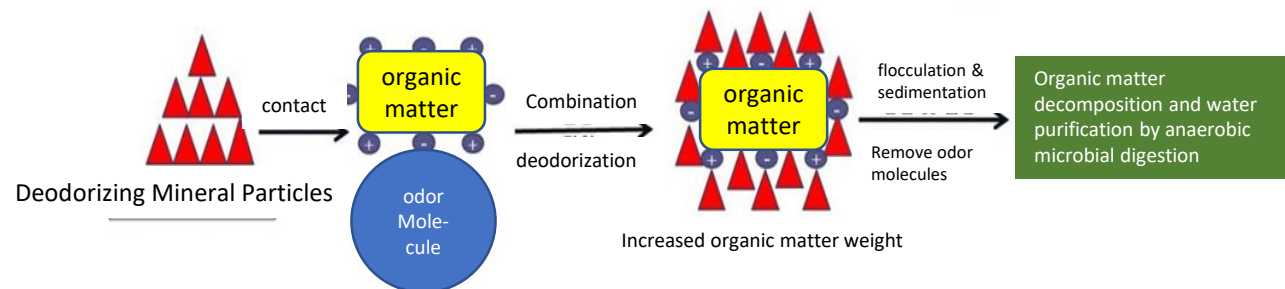
- Eliminates odor through the chelating effect of these organic substances

c) Reduction of odor through reduction of microorganisms involved in corruption

- As soil microorganisms with a water-resistant cohesive structure become dominant, the generation of bad odors caused by decay is blocked at the source by reducing the microorganisms involved in the decay process in the sludge.

※ Microorganisms involved in spoilage: Bacteroides, Streptococcus, Crostrigium, Escherichia coli, Pseudomonas aeruginosa, Proteus, Staphylococcus, Enterococcus, Erythrobacillus, Salmonella, Cholera, Vibrio parahaemolyticus, and Eubacterium are representative.

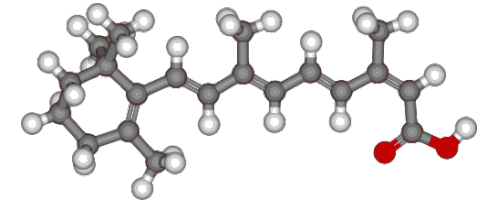
deodorization



< Odor molecule deodorization concept >

02. Process overview

❖ Additive principle



* Differences from existing water treatment technologies		
Division	Existing water treatment technology	VMBD -Water treatment technology with additives
microbe	Formation of microorganisms that grow on organic wastewater or organic waste	If soil particles and humic substances are added in advance to create a soil environment, microorganisms that prefer it will selectively inhabit it.
corrosion reaction	No corrosive reaction occurs as there are no environmental substances such as silicates or corrosive substances.	The corrosion reaction is promoted by adding activated silicate powder to the reaction tank.
Water-resistant granular structure	Since no corrosion reaction occurs, a water-resistant granular structure is not created.	The corrosion reaction is promoted, creating a water-resistant granular structure that is a clay corrosion complex.

02. Process overview

❖ Characteristics comparison of VMBD (Vortical Micro Bubble Diffuser) vs Diffuser

Division	Unit	VMBD	Disk diffuser
oxygen delivery rate	KgO ₂ /KW.h	3~10	1.2~2.0
amount of oxygen delivered	KgO ₂ /m ³ .h	0.5~3.0	0.06~0.2
oxygen utilization	%	15~35	5~15
BOD-Volume load factor	KgBOD/m ³ .d	5~6	0.3~0.8
TNK-Volume load factor	KgTNK/m ³ .d	0.4~1.2	< 0.2
MLSS density	mg/L	Over 5,000	1,500~5000
Active bacterial fraction	%	70	35
Amount of excess sludge generated	KgTS/KgBOD ₅	0.4~0.6	0.6~1.0
land required	%	5~20	1000
processing efficiency	%	Over 95	Difficult to handle high concentrations



VMBD



Disc type diffuser

* What is a diffuser (device)? A device that disperses and injects compressed air into dirty water to decompose contaminants..

02. Process overview

❖ Advantages of VMBD

- Advantages of V.M.B.D (Vorticial Micro Bubble Diffuser)

- Highly active bacteria accumulate at a high concentration, enabling relatively stable operation even under high loads and inflow of toxic substances, and recovery is quick even from shock loads.
- Since there is a large amount of circulation in the reactor and mixing is perfect, there is no microbial shock due to contaminants and loads in some spaces within the reactor.
- High-load operation minimizes the site area.
- It is easy to apply to existing treatment facilities with low water levels, and can solve the lack of reactor capacity.
- Since there are no mechanical devices inside the reactor, there are no breakdowns and repairs are easy.
- The reactor nozzle is made of materials such as STS or PE, can be used semi-permanently, and is easy to maintain with a constant supply of oxygen.
- Due to high microbial activity, odor in the treatment plant is reduced.

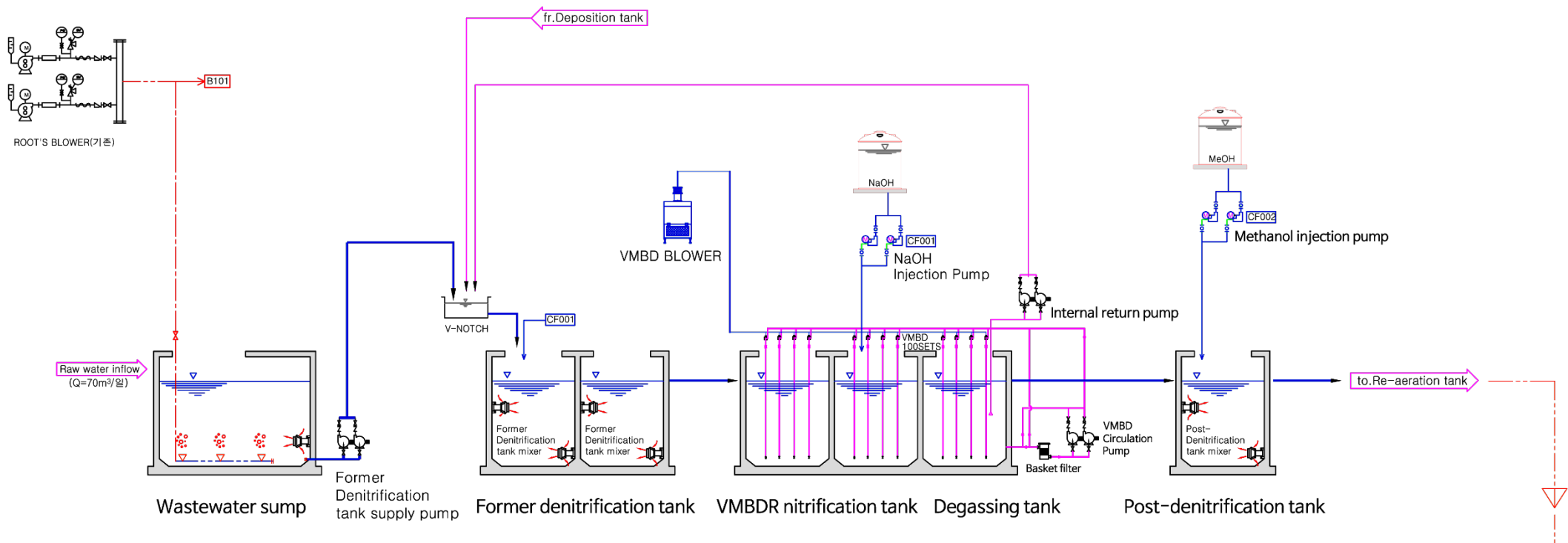
➤ Discharged water quality is designed and applied based on the most economical standards depending on facility installation conditions..

Design is applied by standard that discharge quality of water is economic performance most according to facilities establishment situation.

02. Process overview

❖ High-concentration wastewater treatment plant and sewage treatment plant operation status

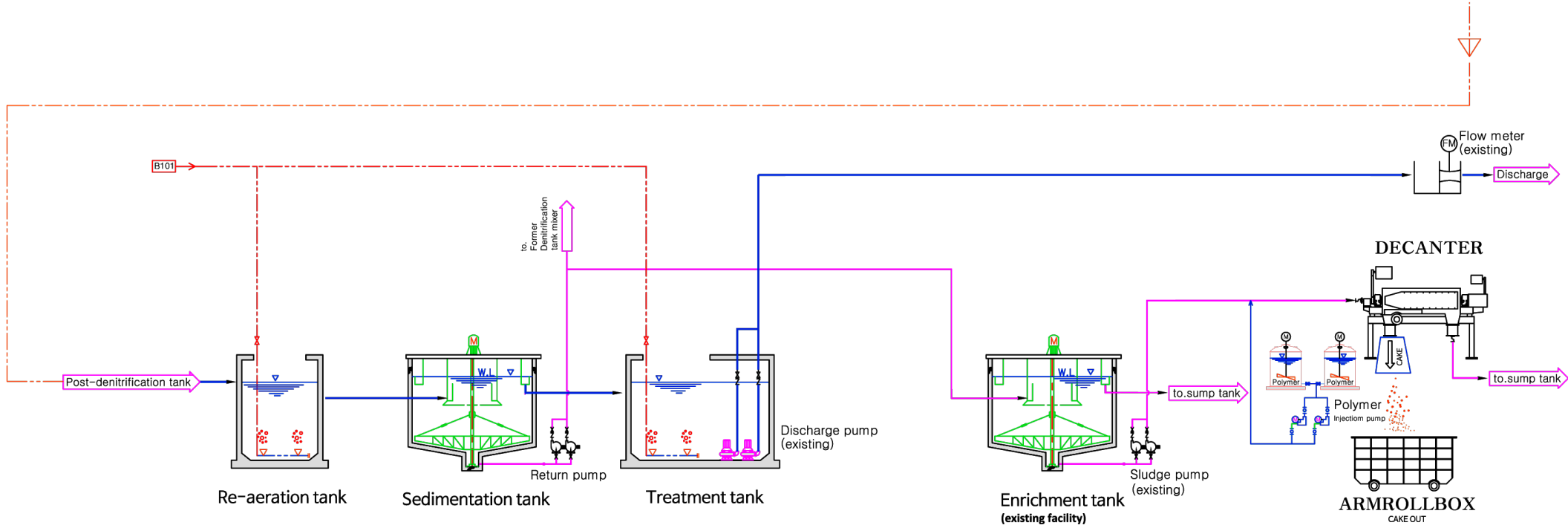
[Wastewater treatment facility-high concentration treatment opening drawing-2]



02. Process overview

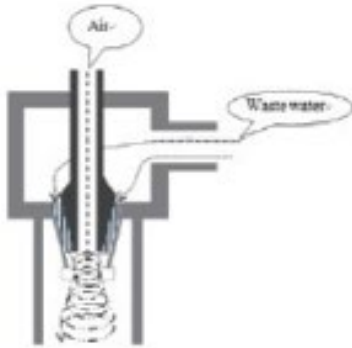
❖ High-concentration wastewater treatment plant and sewage treatment plant operation status

[Wastewater treatment facility-high concentration treatment opening drawing-1]



02. Process overview

❖ VMBD

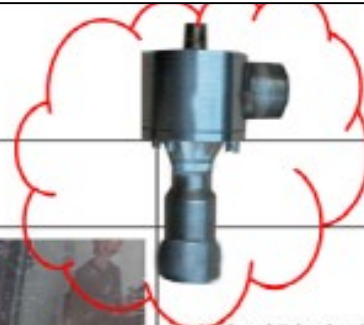


VMBD (Vortical Micro Bubble Diffuser) is a microbubble generator with a specially structured nozzle that circulates aeration liquid and dissolves it by direct contact with air.

Operation photo



How it Works



When wastewater at a certain pressure passes through a nozzle with a special structure, a whirlwind phenomenon with high-speed rotational force and acceleration is generated at the nozzle outlet. The strong whirlwind phenomenon that rotates and moves at high speed causes a high level of vibration in the air inlet pipe located in the center of the nozzle. The principle of VMDR is that pneumatic pressure is generated and a large amount of air is sucked in.

03. Application example

❖ Food dehydration liquid

- ❖ Daily throughput: 150m³/day
- ❖ Influent concentration : BOD 8,000ppm, TN 3,000ppm (After solid-liquid separation)
- ❖ Treated water concentration: BOD 50ppm or less, TN 150ppm or less

- Installation photo



- Installation photo



03. Application example

❖ Busan Environmental Management Corporation sewage sludge condensate treatment facility

- * Daily throughput: 680m³/day
- * Influent concentration: BOD 300ppm, TN 1,307ppm
- * Treatment water concentration: BOD 20ppm or less, TN 20ppm or less

- Installation photo



- Installation photo



03. Application example

❖ 00 Animal husbandry

** Capable of processing 275 tons through GBT facility without civil engineering work at existing 100 ton facility

- * Daily throughput: 275m³/day
- * Influent concentration: BOD 8,000ppm, TN 1,600ppm (after solid-liquid separation)
- * Treatment water concentration: BOD 50ppm or less, TN 60ppm or less

- Installation photo



- Installation photo



03. Application example

❖ 00 Animal husbandry

- * Daily throughput: 150m³/day
- * Influent concentration: BOD 8,000ppm, TN 1,500ppm (after solid-liquid separation)
- * Treatment water concentration: BOD 50ppm or less, TN 60ppm or less

- Installation photo



- Installation photo



03. Application example

❖ 00 Paper manufacture

- * Daily throughput: 6,000m³/day
- * Influent concentration: BOD 1,500ppm, COD 900ppm
- * Treatment water concentration: BOD 5ppm or less, COD 30~50ppm

- Installation photo

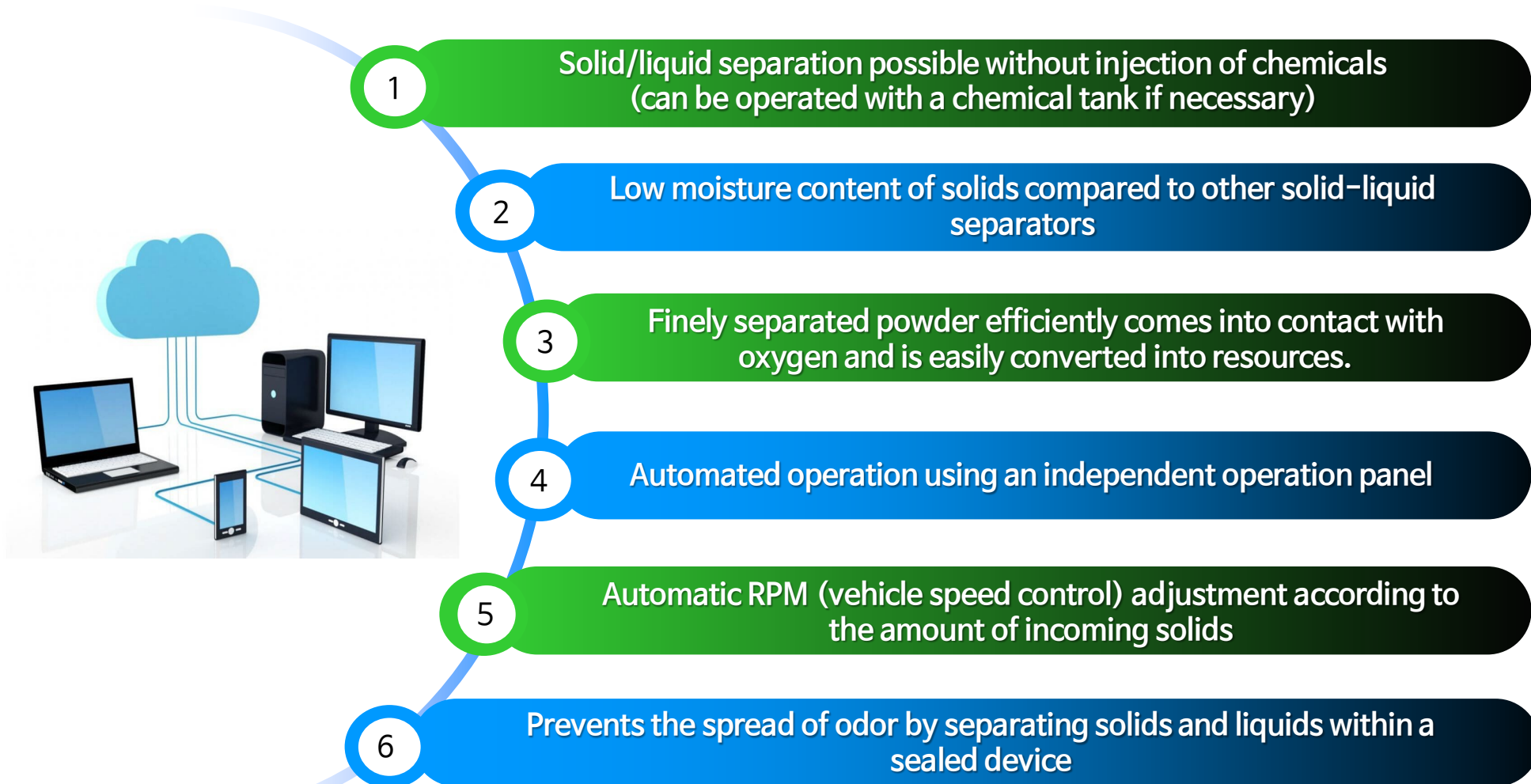


- Installation photo



04. Advantages of Business

❖ Characteristics of the process



04. Advantages of Business

❖ Effect of applying technology

- * Combining composting + liquefaction + purification treatment
- * Solved the problem of securing liquid fertilizer spraying area and the timing of spraying
- * Resolving environmental hazards caused by unstable supply and demand of moisture conditioners and excessive use

- * Increased profitability of livestock farms by relieving the burden of wastewater treatment
- * Increased profits of seed farms by supplying high-quality compost/liquid fertilizer
- * Restore intellectual strength by supplying high-quality liquid fertilizer

- * Solving odor and civil complaints caused by spraying low-quality liquid fertilizer
- * Effect of improving the image of the farm as a source of environmental pollution and converting it into a nature-friendly business





We will continue our efforts to protect healthy water nature through high-concentration wastewater treatment technology.



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