

8 point

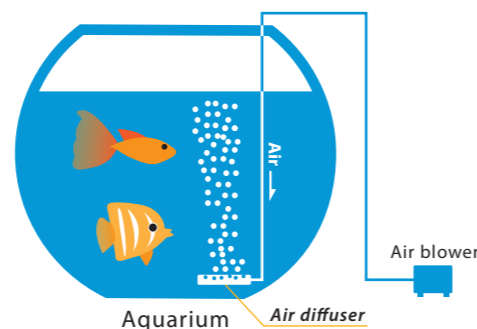
detailed guide

to air diffuser selection

Why are “air diffusers” necessary for wastewater treatment.

When you keep a fish in an aquarium, you will use an air diffuser for air bubbling.

For fish to breath, you need air bubbles that the water dissolves oxygen from.

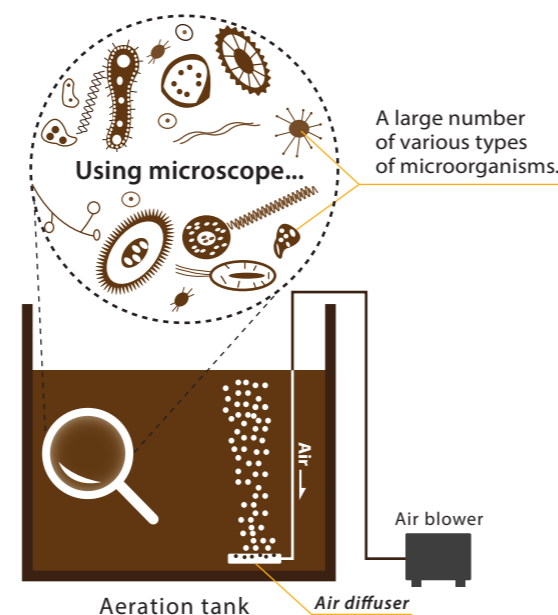


For wastewater treatment, the same thing applies as above. The most common wastewater treatment methods in the world use aerobic microorganisms. Wastewater is discharged from a factory and put into a tank (called a aeration tank) which has various aerobic microorganisms living in it treating the wastewater.

Microorganisms keep breathing to stay alive like fish and ourselves. Microorganisms need to be able to breath oxygen to effectively treat pollution.

If the air diffuser is not effective the microorganisms won't be active and the wastewater treatment system will fail.

※The reason why the color of water in the aeration tank is brown is because there are various microorganisms in the tank.



Making the wrong air diffuser choice will be very expensive.

An air diffuser is used to dissolve oxygen into wastewater and supply oxygen to microorganisms so it's a very important item. When an air diffuser does not work properly because of clogging and damage, microorganism's effectiveness when cleaning wastewater is also reduced. Therefore wastewater treatment will get worse affecting factory operations.

Air diffusers are used in very harsh conditions “consistently operating 24 hours a day, 365 days a year for many years in hundreds of tons of activated sludge containing pollution and microorganisms while withstanding high water pressure at the bottom of an aeration tank at depths of 4 to 5 meters or more”.

There are large numbers of air diffusers which are not up to the task and have been distributed around the market. Users of these air diffusers have suffered and incurred clean up, replacement, air blower power upgrade, loss of income and many other damages.

It can be said the first step in factory management is to select the correct air diffuser that lowers the break-even point and generates a profit.

Air diffusers total cost comparison.

Even if an air diffuser's purchase price is low, you will lose money on the high cost of installation and maintenance.

In order to avoid this, it is important to select an air diffuser based on “total cost” including the cost of installation and maintenance and not just based on comparison of unit purchase price.

Total cost of an air diffuser

- 1) Unit purchase price
- 2) Installation cost
- 3) Maintenance and Replacement cost
- 4) Air blower electricity cost
- 5) Wastewater treatment failure cost or ineffectiveness cost

Contents

1. Selection

- 1) What is your true Oxygen Transfer Rate? P.4, 5
- 2) Amount of generated 100µm-sized fine bubbles. P.6, 7
- 3) Replacement or no replacement cost. P.8, 9

2. Installation and Replacement

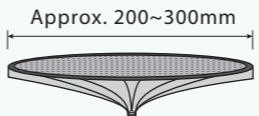

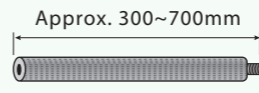
- Installation, replacement and labor costs. P.10, 11

3. Operation

- 1) Air blower electricity costs. P.12, 13
- 2) DO control. P.14, 15
- 3) Clogging problem. P.16, 17
- 4) Anaerobic sludge on the tank bottom. P.18, 19

●Porous and OHR air diffusers compared.

(Dimensions, air blowing amount, structure and material)

Porous air diffuser	OHR AERATOR [AE-130N model]
Dimensions and appearance	Dimensions and appearance
 Approx. 200~300mm Disc type porous air diffuser	 642mm 350mm
 Approx. 300~700mm Tube type porous air diffuser	Air blowing amount MIN: 500ℓ/min (=0.5m³/min) STD: 1,000ℓ/min (=1.0m³/min) MAX: 1,400ℓ/min (=1.4m³/min) [Equivalent to 5 to 14 porous air diffusers]
Air blowing amount Approx. 100~200ℓ/min (=0.1~0.2m³/min)	Material Polypropylene Plus shock, heat and weather resistant, enhancing materials used.
Material EPDM (rubber) Silicone rubber Ceramic Polyurethane Sintered plastic beads and pellets PVC	Structure of air discharge opening Only one large (φ30mm) hole.
Structure of air discharge opening The perforated sizes are several hundred microns.	

1. Selection

1) What is your true Oxygen Transfer Rate ?

Porous Air Diffuser

Publicized OTR value is high, the actual value is low.

The air dissolving method makes milli-sized bubbles in order to increase the contact area of the water and the air bubbles. This method is passive and doesn't have a mixing function. So the OTR in actual wastewater markedly decreases.

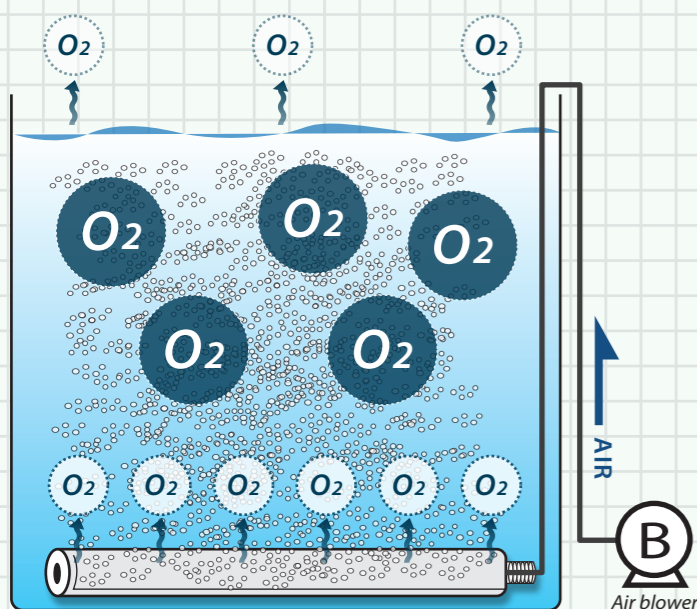
Data of OTR value is taken from **clean water**.

Since there are few impurities in clean water, oxygen in the air easily dissolves in clean water. So, air diffuser manufacture's publicized OTR value is very high. (e.g. 25%, 30%, or more)

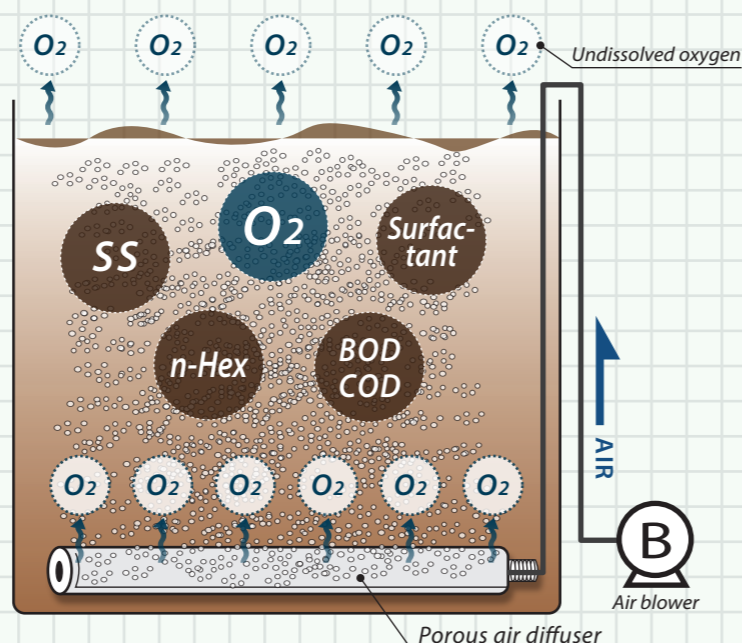
Air diffusers are actually used in **wastewater**.

Environmental researchers worldwide regularly report that the publicized OTR value of porous air diffusers markedly decreases in actual wastewater because a wide variety of impurities in wastewater prevent oxygen dissolving (=most oxygen leaves the water without dissolving).

Data of OTR value is taken from **clean water**.



Air diffusers are actually used in **wastewater**.



Don't make the mistake of choosing an air diffuser according to the manufacturer's publicized OTR only.

Point!

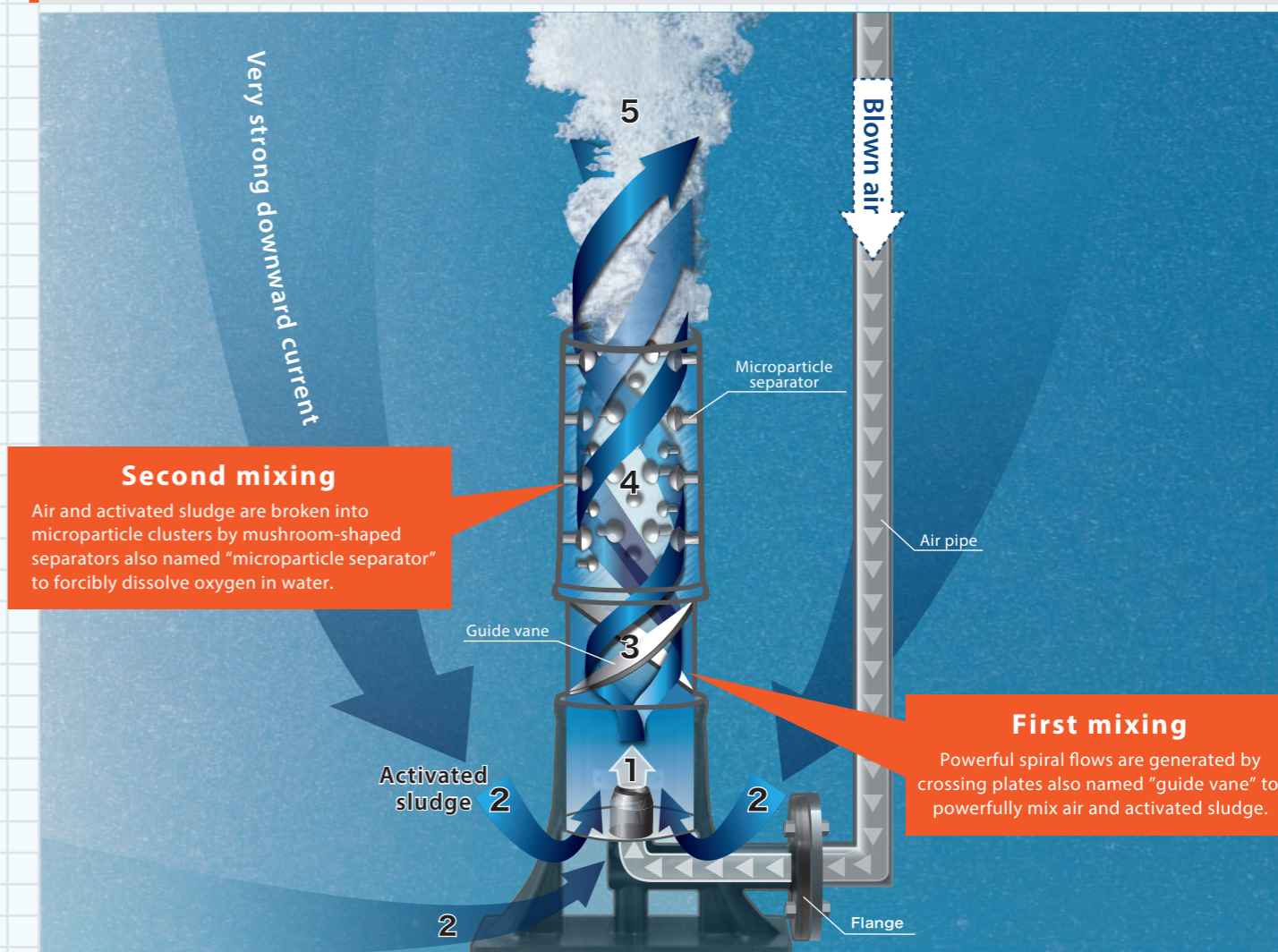
- Oxygen Transfer Rate (OTR) means the percentage of oxygen from the air that is dissolved into water. An OTR of 20% means the remaining 80% of the oxygen leaves the water without dissolving.
- Be careful of deceptively high OTR values claimed by other companies. These values are taken from clean water and not wastewater.

Actual rate is the same as the catalog value.

OHR AERATOR

After coarse bubbles are discharged, air and activated sludge are powerfully mixed continuously by two kinds of unique structures to forcibly dissolve oxygen in water. Therefore, the OTR does not decrease even in actual wastewater.

The OHR AERATOR can maintain a consistent treatment condition even in wastewater in which it is hard to dissolve oxygen (containing oil and fat content, surfactant, or high concentrated MLSS, etc.), and **has demonstrated in real cases an efficiency rate of two times more than a rubber made porous air diffuser**. For details, see the "What is the Alpha Value" leaflet.



1. Selection

2) Amount of generated 100µm-sized fine bubbles.

Point!

- The truth of the matter is that porous air diffusers can't generate as many micro-sized fine bubbles as expected.
- OHR AERATOR generates simultaneously 100µm-sized fine bubbles and centi-sized coarse bubbles that are excellent at strongly churning up the whole tank.

Porous Air Diffuser

Most generated air bubbles are Millimeter-sized bubbles.

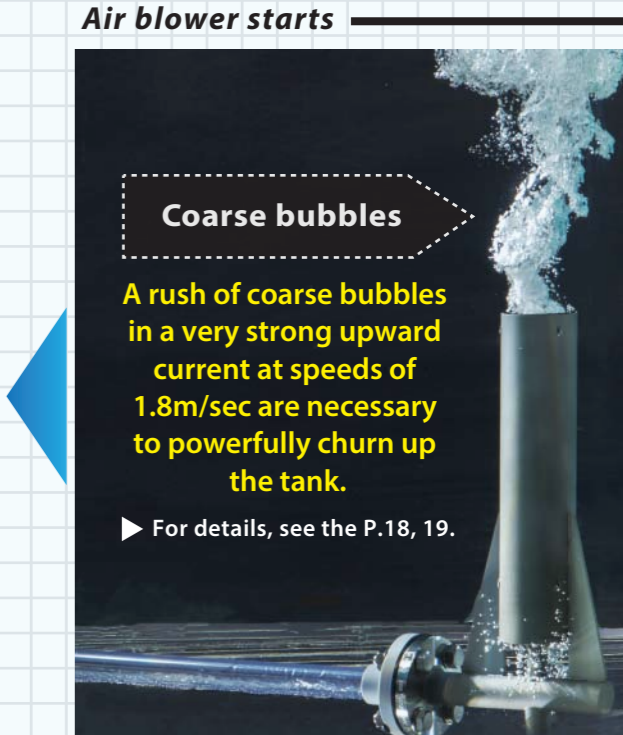
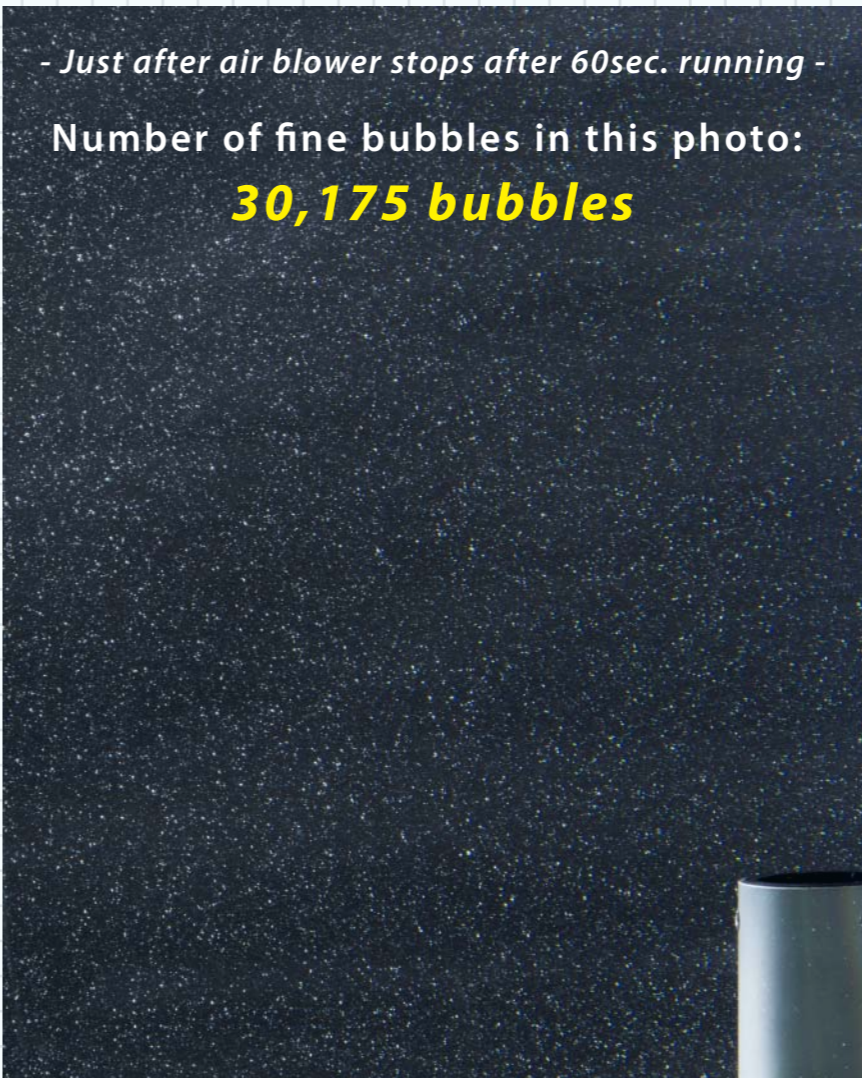
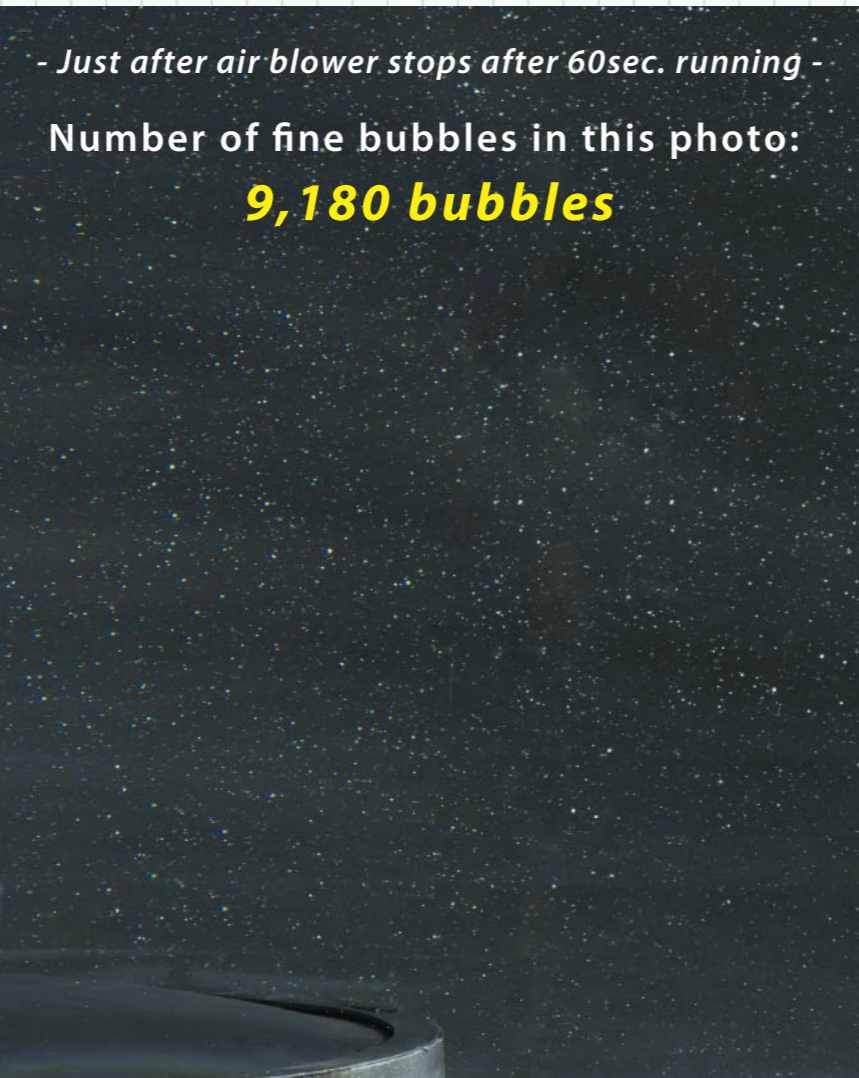
Generates a lot of very fine air bubbles that are approx.100µm-size.

OHR AERATOR

Fine bubbles

Porous air diffusers have only one function which is to make milli-sized air bubbles that increase the surface area oxygen can be dissolved into the water.
This is only effective in clean water where oxygen is easily dissolvable naturally but not effective in wastewater because porous air diffusers don't have a mixing function.
► For details, see the P.4, 5.

Air and wastewater are powerfully mixed by two kinds of original structures.
Therefore many 100µm-sized fine bubbles are generated that contribute to increasing DO levels.

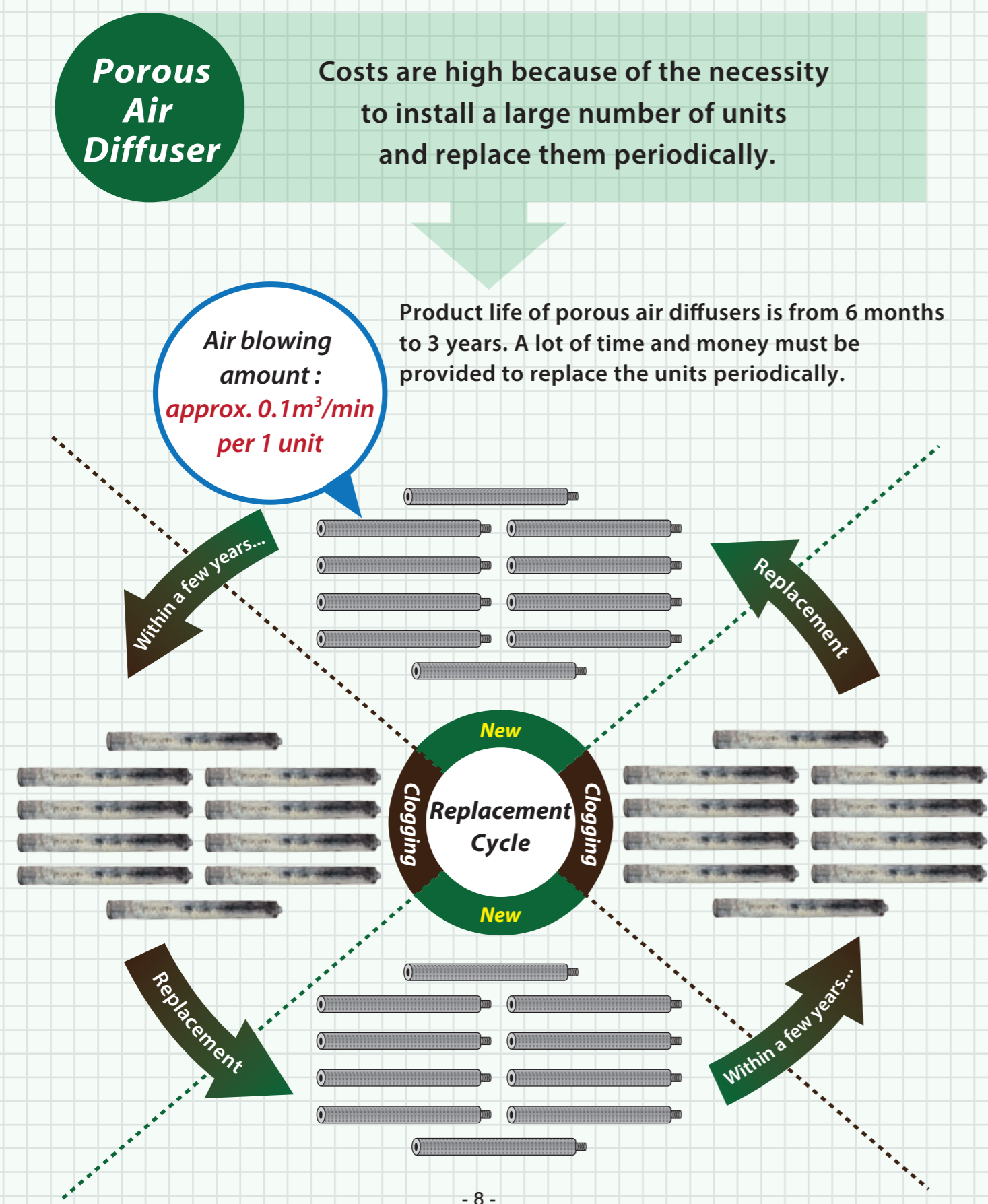


1. Selection

3) Replacement or no replacement cost.

Point!

- Porous air diffusers must be replaced within a few years. It is accepted by industrial wastewater engineers that porous air diffusers clog up.
- The required number of OHR AERATORS is one-tenth of the required number of porous air diffusers.



OHR AERATOR

The required number is very small.
No need to replace.

Never clogs. The product life is over 15 years.
A lot lower total installation and purchasing costs because the required number is one-tenth of the number of porous air diffusers.

This amount is over 10 times more than the porous air diffusers.
Air blowing amount :
Max 1.4m³/min per 1 unit

Installation
In most cases the number of OHR installation units are very small so purchase costs are less.

Real photo taken after 16 years.
Inside of the OHR AERATOR is clean as new because of the constant self-cleaning function coming from the powerful spiral flow mechanism. This will remain the same throughout the material life of the OHR AERATOR.

Replacement

2. Installation and replacement

Installation, replacement and labor costs.

Point!

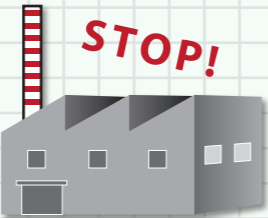
- Installation costs and time vary a lot depending on whether draining from aeration tank is needed or not.
- You will make a big mistake if you choose air diffusers according to unit purchase price only and not installation costs as well.

Porous Air Diffuser

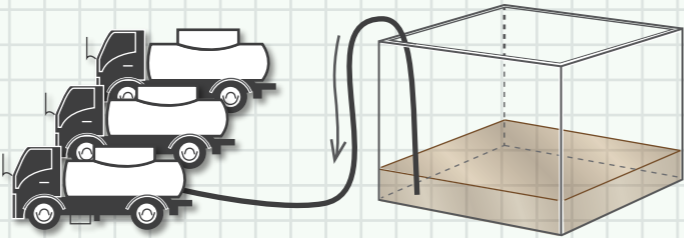
Requires too much money and time.

It's necessary to enter the tanks and so wastewater flowing to the aeration tanks must be stopped and activated sludge removed. This means factory operations must be halted.

Stop outflow of factory wastewater to aeration tanks which curtails factory operations.



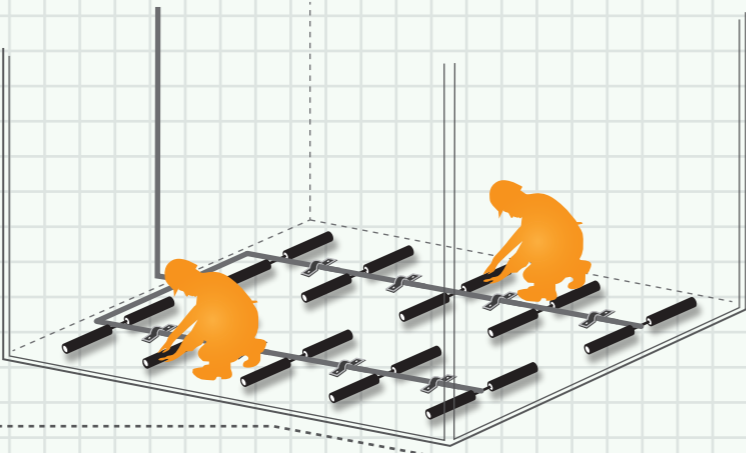
Drain the large amount of activated sludge from the aeration tank to a tanker or other tank.



Discharge hydrogen sulfide gas and remove accumulated sludge for the safety of workers. Workers replace or clean the units and pipes.

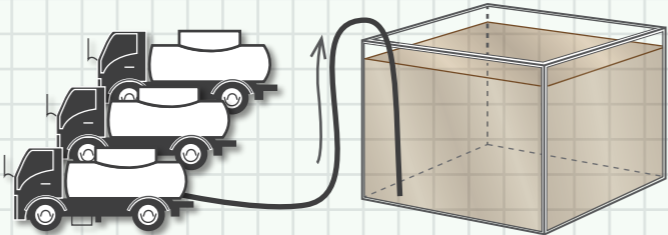
CAUTION

BEFORE ENTERING TANK,
MUST BE SUPPLIED FRESH AIR
INTO THE TANK
AND TOXIC GAS REMOVED.



Return the activated sludge into the aeration tank.

Restart normal aeration operations.

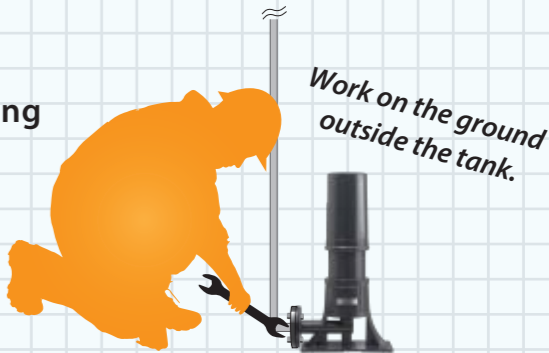


No need to drain the tank to install.

OHR AERATOR

No need to enter inside the aeration tank.

Assemble air pipes and OHR AERATOR on the ground and lower into the tank filled with activated sludge using crane, and connect the air pipes to the header pipes.

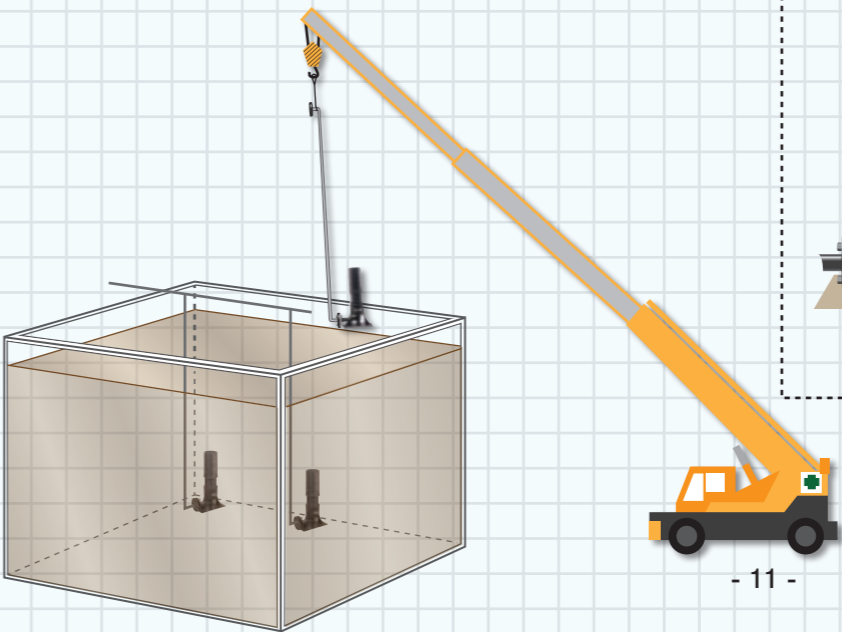


Installation

Assemble air pipes to the OHR AERATOR on the ground.

Lift the OHR AERATOR and connected air pipes by a crane or chain block and lower into the aeration tank filled with water.

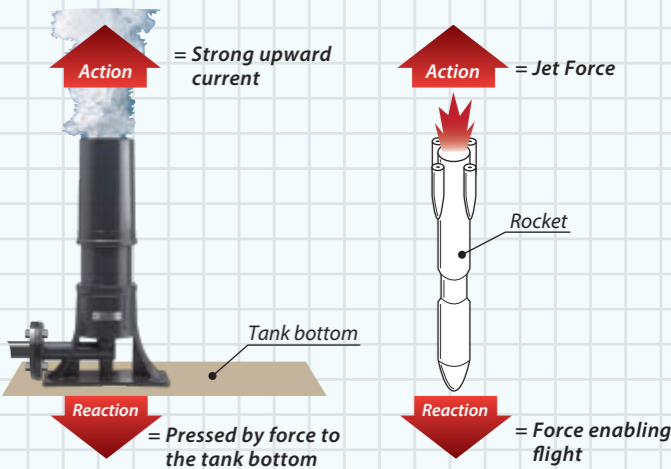
When the OHR AERATOR is attached to the tank bottom, connect the pipes to the header air pipes and start aeration.



Why the OHR AERATOR doesn't need anchoring to the tank bottom?

Air is blown out powerfully from OHR AERATOR pressing the OHR AERATOR to the tank bottom strongly which has the same effect as anchoring.

This is known as action-reaction force. This action-reaction force is the same as a rocket flying as a result of jet flows injection.



3. Operation

1) Air blower electricity costs.

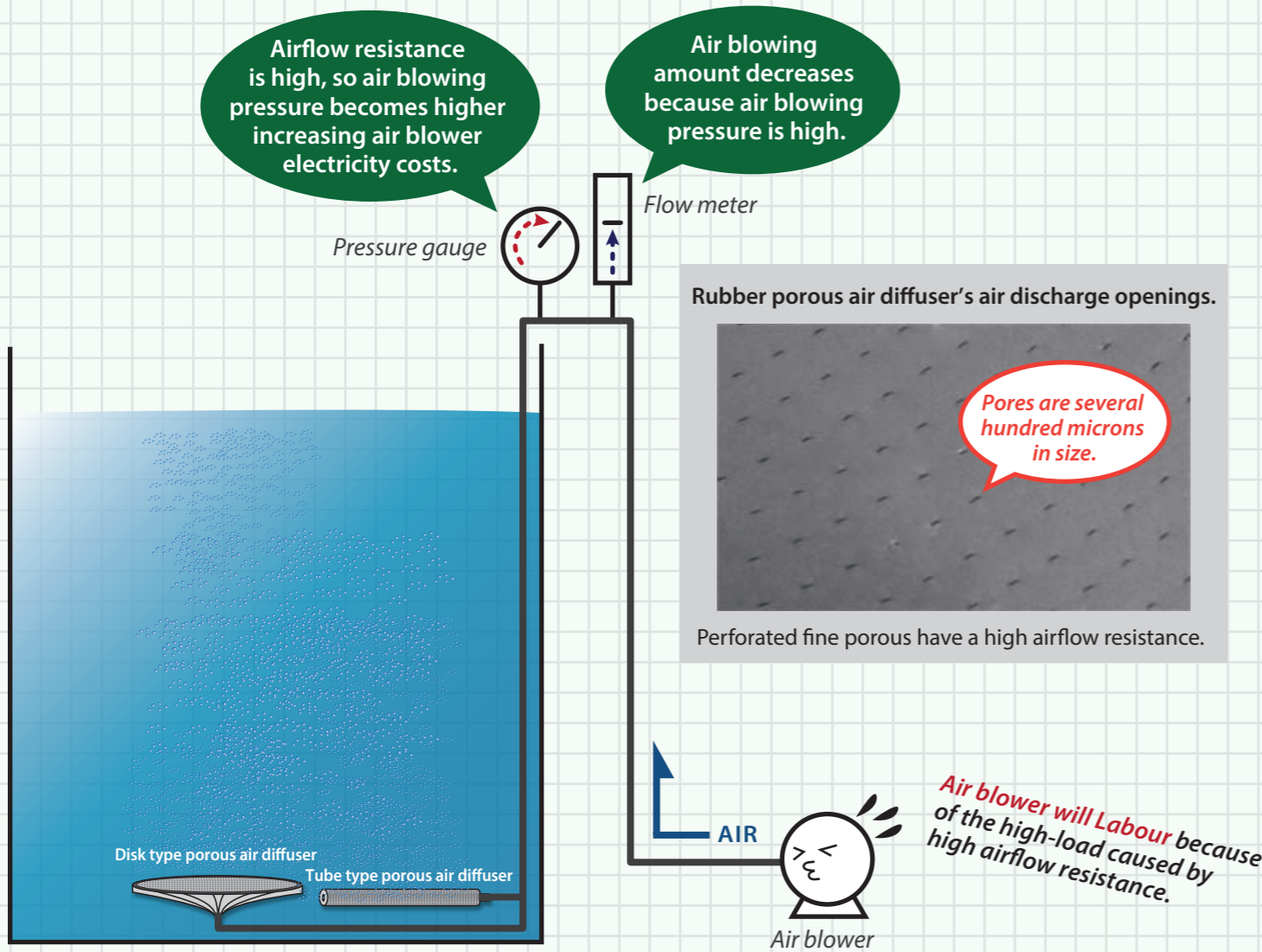
Point!

- Air blower's electricity cost and product life is largely dependent on the high / low airflow resistance and clogging or not clogging of air diffuser.

**Porous
Air
Diffuser**

Airflow resistance is large.
= Air blower electricity costs are high.

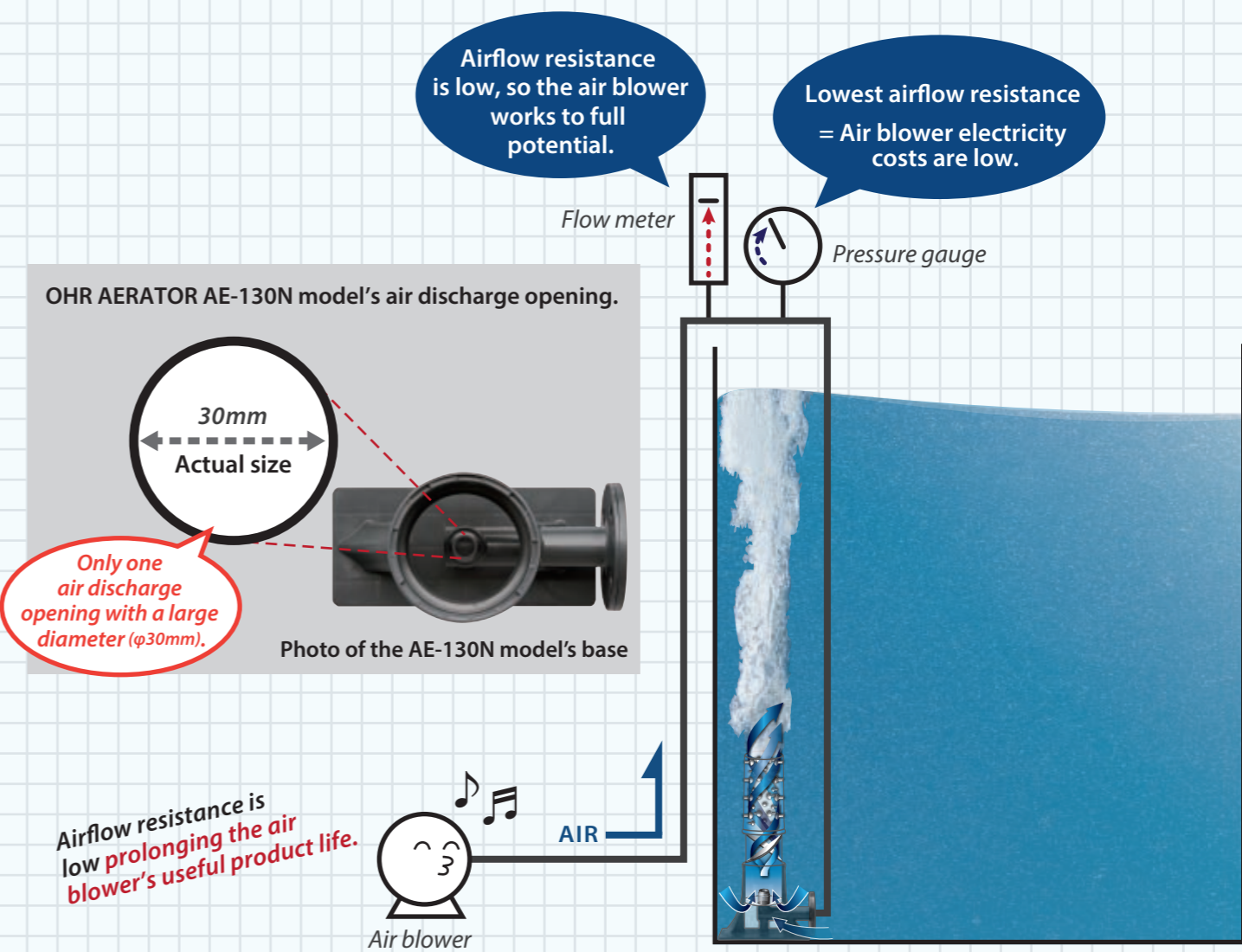
The air discharge opening of rubber porous air diffusers consist of perforated fine pores which are several hundred microns in size.
These pores have a high airflow resistance and a large amount of air blower power is needed. In addition, airflow resistance increases day by day because of clogging.



**OHR
AERATOR**

Airflow resistance is low.
= Air blower electricity costs are low.

Air discharge opening is only one with a large diameter ($\phi 30\text{mm}$).
So the airflow resistance is the lowest on the market and so air blower's electricity cost is lower.
In addition, the electricity costs are kept low because no clogging occurs.



Electricity costs

3. Operation

2) DO control.

Point!

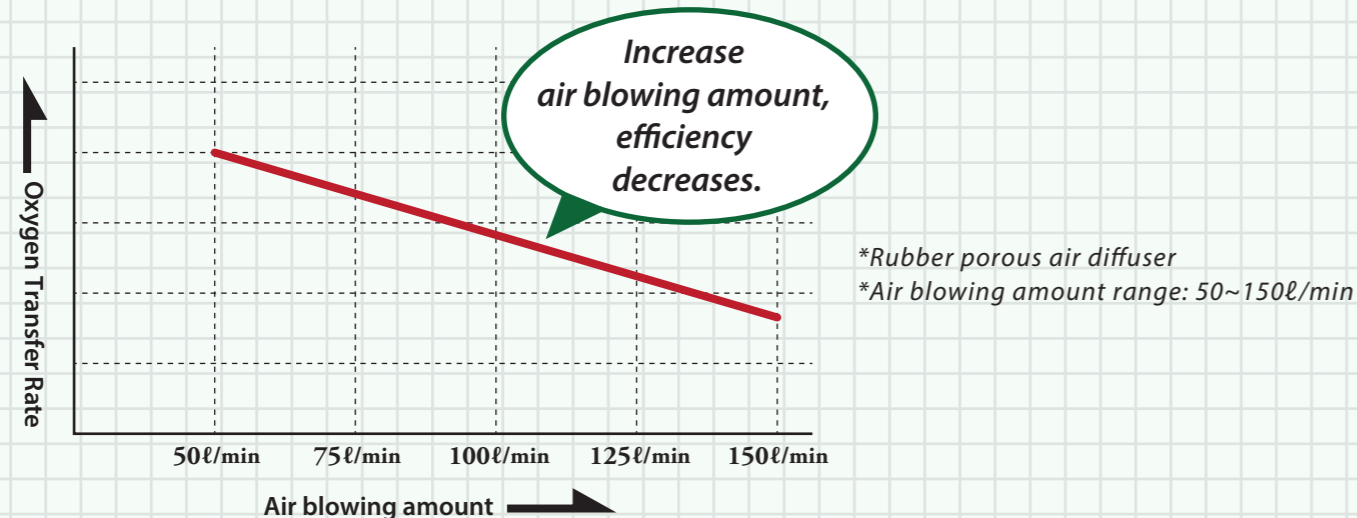
- Porous air diffuser's DO adjustment range is limited causing the air blowing amount and Oxygen Transfer Rate (OTR) to inversely relate.
- OHR AERATOR DO adjustment range is wide making it easy to control the aeration intensity as a result the air blowing amount and OTR is proportional.

Porous Air Diffuser

Increase air blowing amount, decrease efficiency.

Increase air blowing amount in order to achieve a higher DO level.
➔ But the OTR is decreased. ➔ DO level doesn't go up smoothly.

Decrease air blowing amount in order to achieve a lower DO level.
➔ But the OTR is increased. ➔ DO level doesn't go down smoothly.



OHR AERATOR

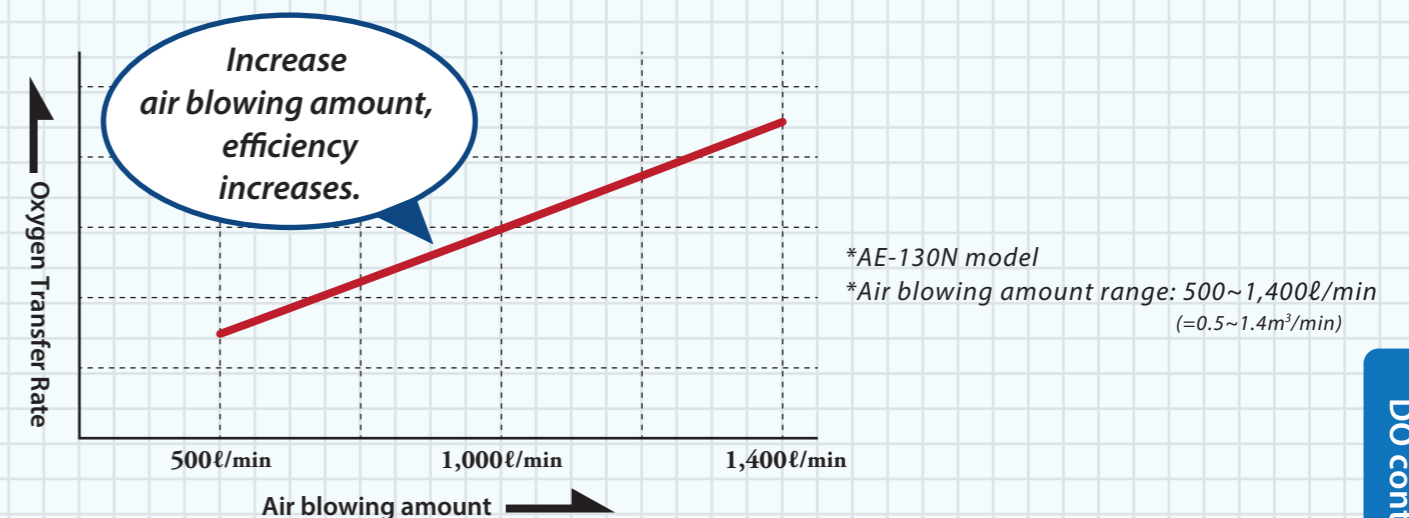
Increase air blowing amount, increase efficiency.

Increase air blowing amount in order to achieve a higher DO level.

➔ The OTR is increased. (Because OHR's mixing function becomes stronger.) ➔ DO level goes up smoothly.

Decrease air blowing amount in order to achieve lower DO level.

➔ The OTR is decreased. (Because OHR's mixing function becomes weaker.) ➔ DO level goes down smoothly.

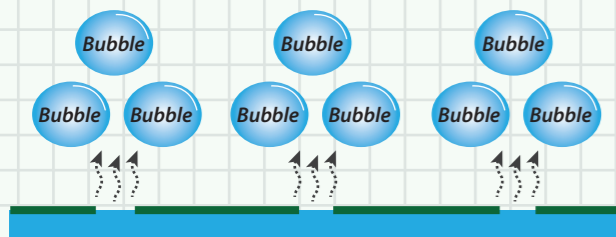


Why does the air blowing amount and OTR efficiency inversely relate?

In the case of **decreasing** air blowing amount.

Air and water **contact area** will become larger because the bubbles size will be smaller.
Air and water **contact time** will become longer because the bubbles upward speed will be slower.

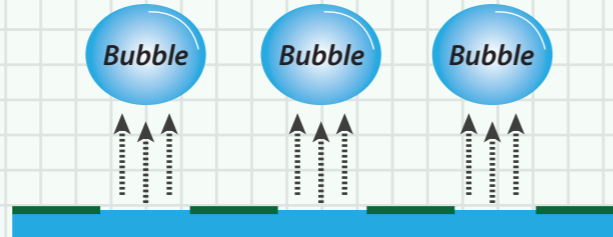
OTR is **increased**



In the case of **increasing** air blowing amount.

Air and water **contact area** will become smaller because the bubbles size will be bigger.
Air and water **contact time** will become shorter because the bubbles upward speed will be faster.

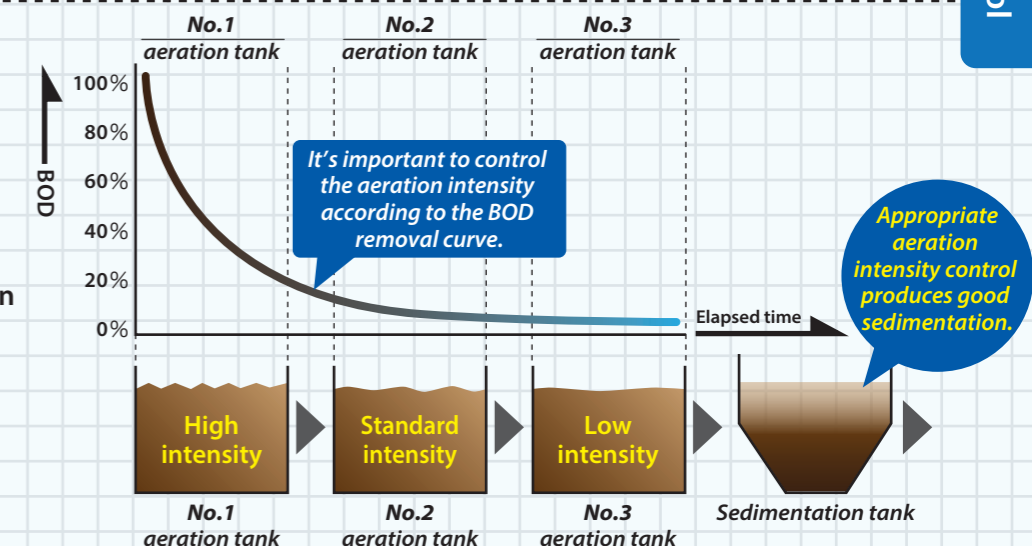
OTR is **decreased**



You can control aeration intensity accurately and as a result follow the BOD removal curve.

You can choose intermittent aeration without fear of clogging.

Intermittent aeration is an aeration operation technique that intermittently enables the running and stopping of the air blower saving power and enabling more DO control.



DO control

3. Operation

3) Clogging problem.

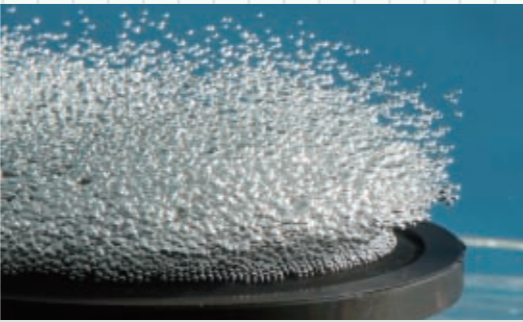
Point!

- When air is discharged into activated sludge, activated sludge counterflows into the air discharge opening of air diffusers simultaneously. This phenomenon is the same in any air diffuser.
- Counterflowed activated sludge in porous air diffusers gets stuck in and around the fine pores. On the other hand counterflowed activated sludge in the OHR AERATOR does not get stuck and comes out smoothly. This is the difference between clogging or not.

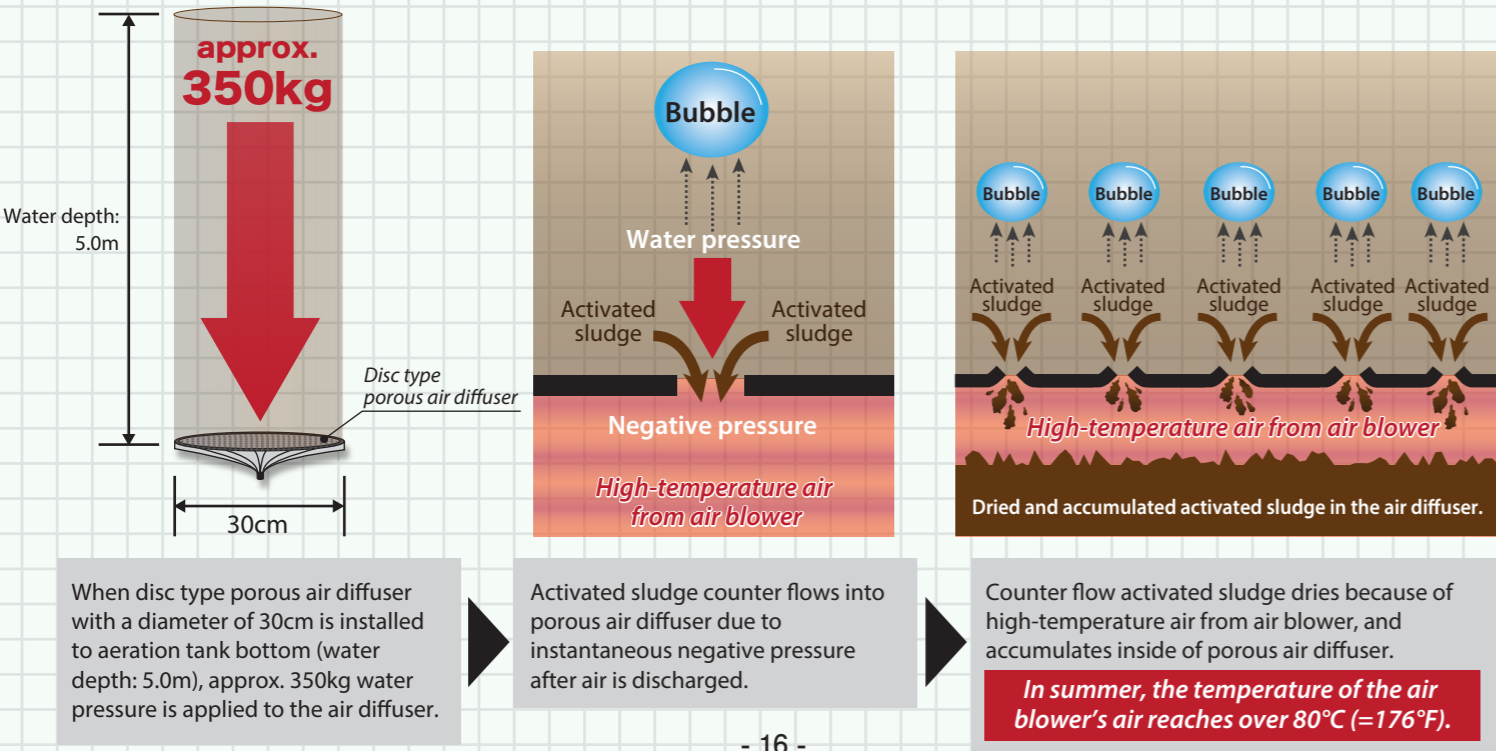
**Porous
Air
Diffuser**

Inevitably clogs.

Air is discharged intermittently due to airflow resistance and water pressure.
That's why "spherical" air bubbles are produced.



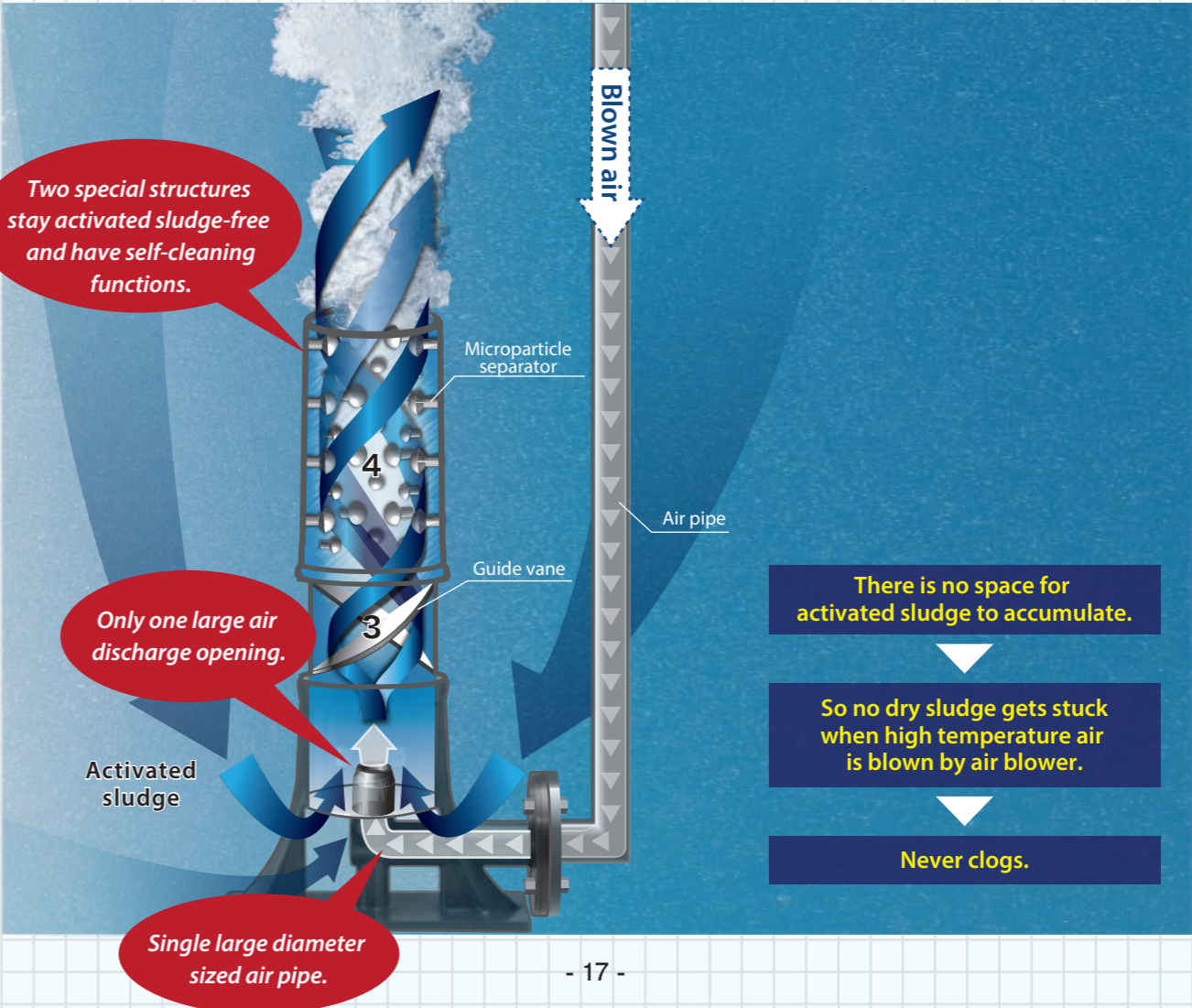
Activated sludge counter flows into porous air diffusers due to instantaneous negative pressure after air is discharged. The air discharge openings are too small to remove counter flow activated sludge.
Counter flow activated sludge dries up because of high-temperature air from air blower, and it accumulates inside of porous air diffuser. Therefore, porous air diffusers must get clogged.



Never clogs.

**OHR
AERATOR**

Even though activated sludge counterflows into the OHR's air discharge opening during operation like other air diffusers, it never clogs because the air discharge opening is only one and is a large diameter size so the activated sludge is pushed out easily by the blown air.
This is different to porous air diffusers and other types of air diffusers which have narrow openings that easily clog. Therefore, OHR AERATOR never clogs.



Clogging

3. Operation

4) Anaerobic sludge on the tank bottom.

Point!

- Even though the amount of air that is blown is the same if the type of air diffuser is different there can be a big difference in the churn up effectiveness in the tank.
- Large-sized bubbles are absolutely imperative for strongly churning up the whole tank continuously.

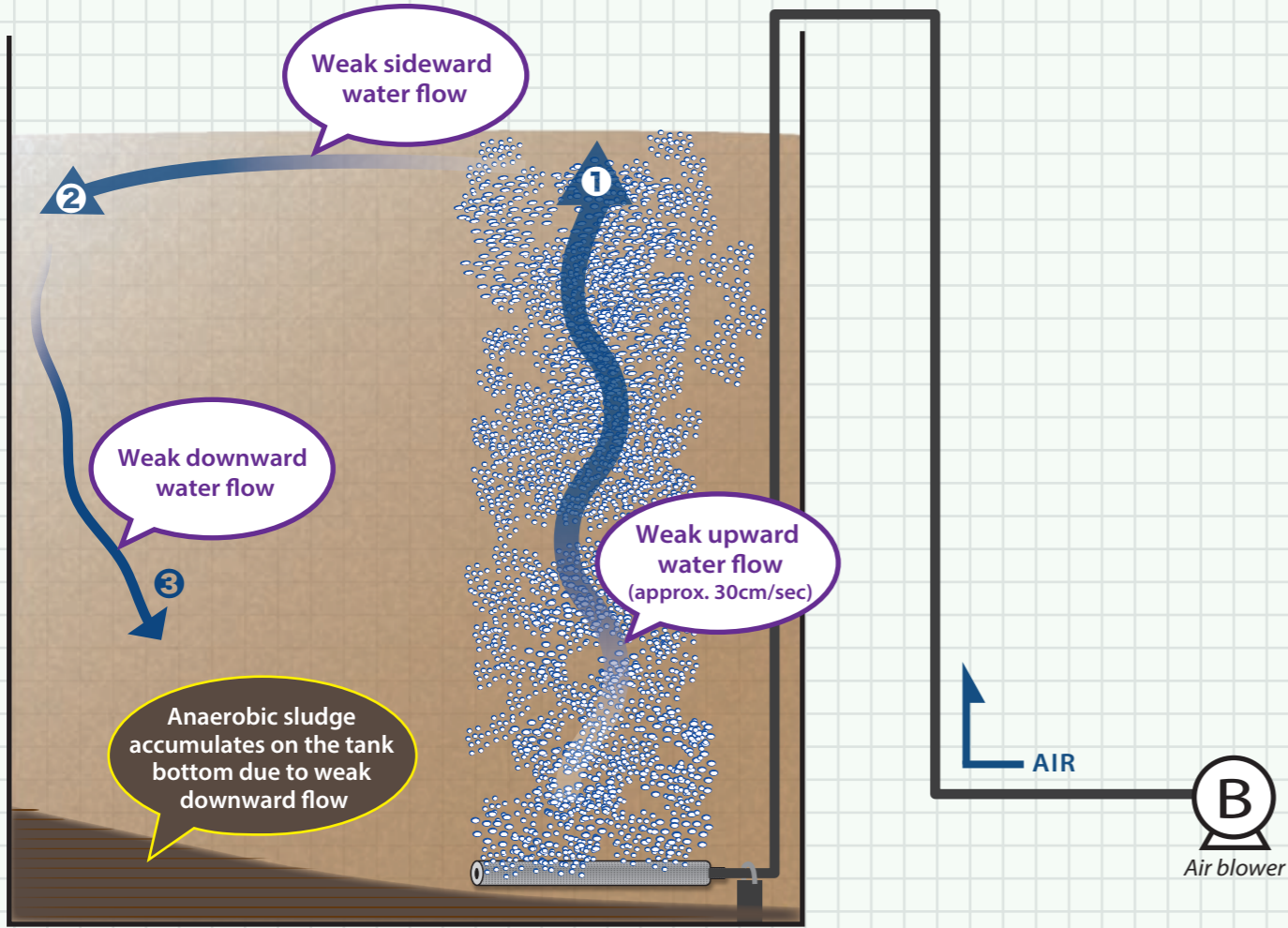
Porous Air Diffuser

Activated sludge is more likely to accumulate on the tank bottom.
Accumulated sludge causes oxygen deficiency and worsening wastewater treatment conditions.



Discharged air bubbles are several milli-sized that have small buoyancy and move upward slowly. So porous air diffusers can't generate a sufficiently strong enough water flow at the tank bottom needed to sweep away and prevent accumulating sludge. So sludge (anaerobic sludge) must accumulate.

This weakness is worldwide assessment.



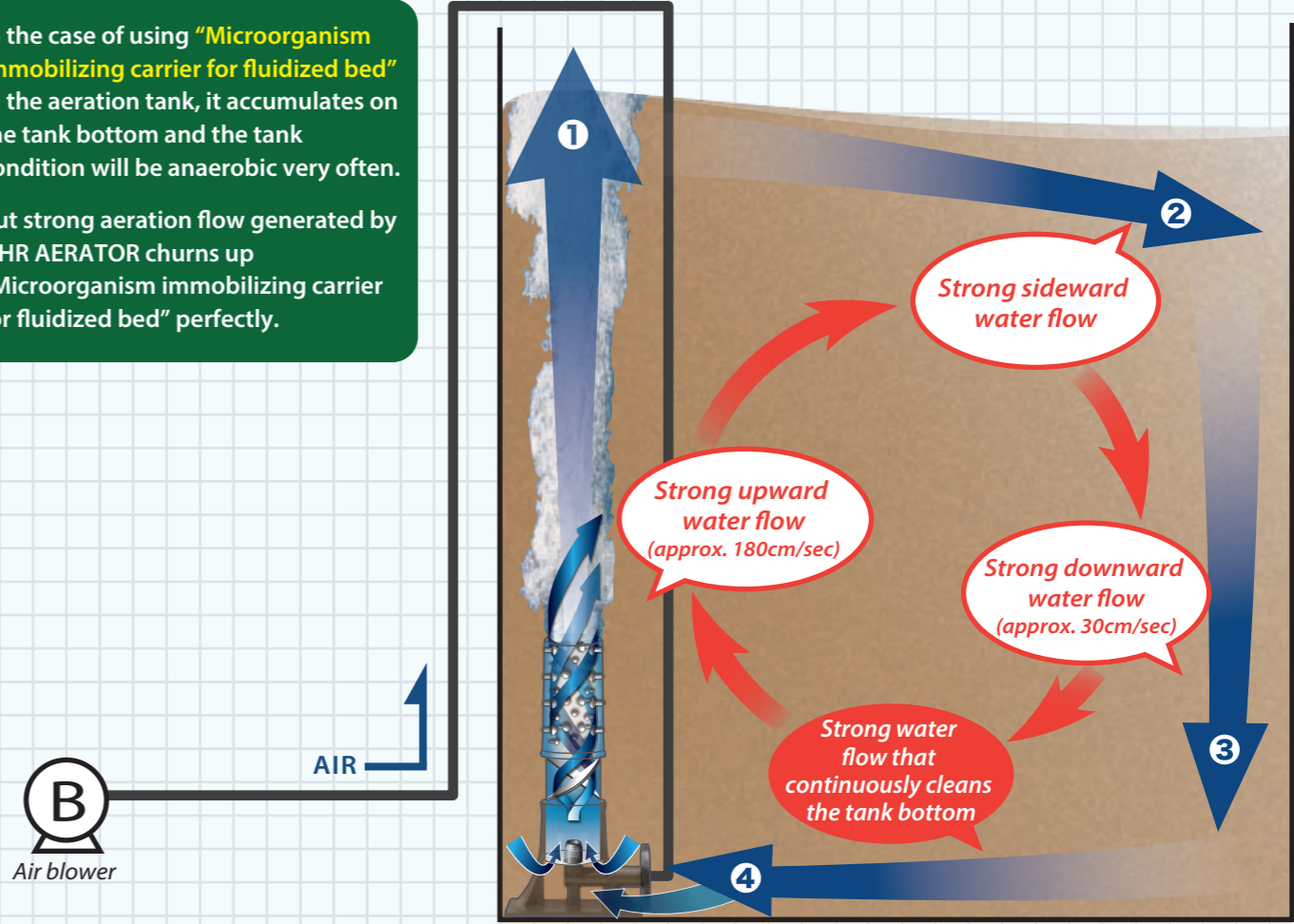
Doesn't accumulate on the tank bottom at all.

OHR AERATOR



Large-sized bubbles that are blown from OHR AERATOR moves upward faster at 1.8m/sec. This faster upward flow generates **strong upward water flow** that is necessary to create a strong circulating flow in the tank, and it is converted to **strong sideward water flow**, **strong downward water flow** and **strong water flow that continuously cleans the tank bottom**.
Therefore, no sludge accumulation on the tank bottom.

In the case of using "Microorganism immobilizing carrier for fluidized bed" in the aeration tank, it accumulates on the tank bottom and the tank condition will be anaerobic very often. But strong aeration flow generated by OHR AERATOR churns up "Microorganism immobilizing carrier for fluidized bed" perfectly.



Accumulated sludge

OHR AERATOR Reference Material List

**We will provide you with the following materials.
Please feel free to inquire by E-mail.**

■ Evidence and data about what changes happen between before and after installation of an OHR AERATOR

- “User’s evidence” (1 page)
- “Before and after installation data” (4 pages)
- “Delivery performances for chemical reaction” (3 pages)
- “Digest version/Delivery record” (3 pages)
- “Full Version/Industry-classified delivery records” (14 pages)

Publicly released reports by users

- ☐ “Tobu Plant, Mitsui Sugar Co., Ltd.” (Sugar factory)
[No clogging occurred even at 50,000~60,000mg/ℓ of MLSS]
- ☐ “Integrated Basic Plant, Megmilk Snow Brand Co., Ltd.” (Dairy industry)
[Air blower electricity costs reduced by 26.9% per year]
- ☐ “Osaka Plant, Sonton Food Industry Co., Ltd.” (Food factory)
[DO value and ORP value were achieved with marked improvements]
- ☐ “Yashio Plant, Rengo Co., Ltd.” (Paper mill)
[Air blower electricity costs reduced by 21%]
- ☐ “Osaka Plant, Oji Materia Co., Ltd.” (Paper mill)
[Air volume reduced by 24%]
- ☐ Other []

■ Performance data

- “Alpha Value of OHR AERATOR/Evaluation report by S company” (5 pages)
- “Experiment report on OHR AERATOR Oxygen Transfer Rate” (22 pages)

■ Brochures

- “OHR AERATOR general brochure” (8 pages)
- “Comparison photos of generated fine bubbles by Porous air diffuser and OHR AERATOR” (1 page)
- “What is the Alpha Value?” (1 page)
- “The reason why the OHR AERATOR never clogs” (1 page)

▶ Please feel free to inquire by E-mail.



Developed, Manufactured, and Sold by

株式会社OHR流体工学研究所
OHR LABORATORY CORPORATION

536-1 Noda, Irumashi, Saitama 358-0054 JAPAN

TEL. +814-2932-5466 FAX. +814-2932-5605

Demo room: 6-1 Minamishincho, Hachioijishi, Tokyo 192-0075 JAPAN

Website: <http://www.ohr-labo.com/en> E-mail: info@ohr-labo.com