CarbonFiber
Water Purification Technology for Waste Water Treatment

Mira Carbon®

so-en
think earth

SO-EN CO.,LTD
https://so-en.net/

MiraCarbon Technology for Water purification

Mira Carbon®

生物处理槽
Biological tank

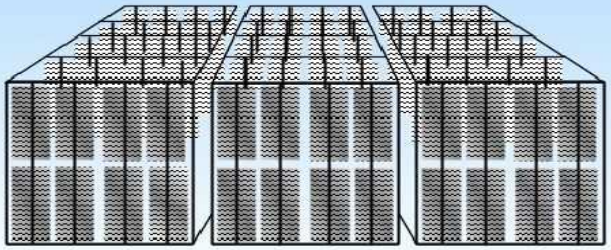
沈殿分離層
Settling tank

人工湿地
Artificial Wetland

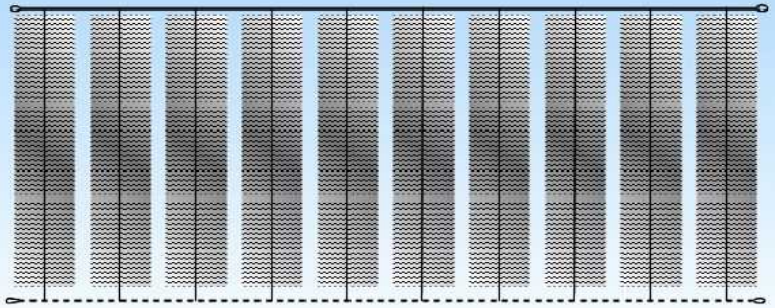
河川 湖沼
River & Lake

汚 水
Polluted water

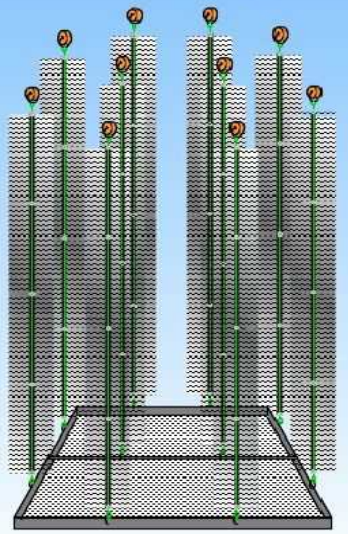
放流水
Final effluent



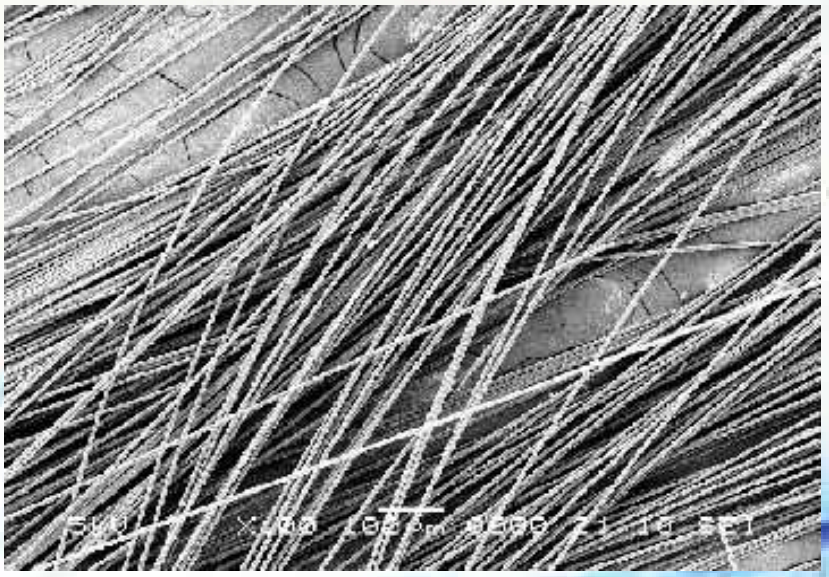
MiraCarbon Frame Unit



MiraCarbon Rope-Floating Unit



MiraCarbon Floating Unit

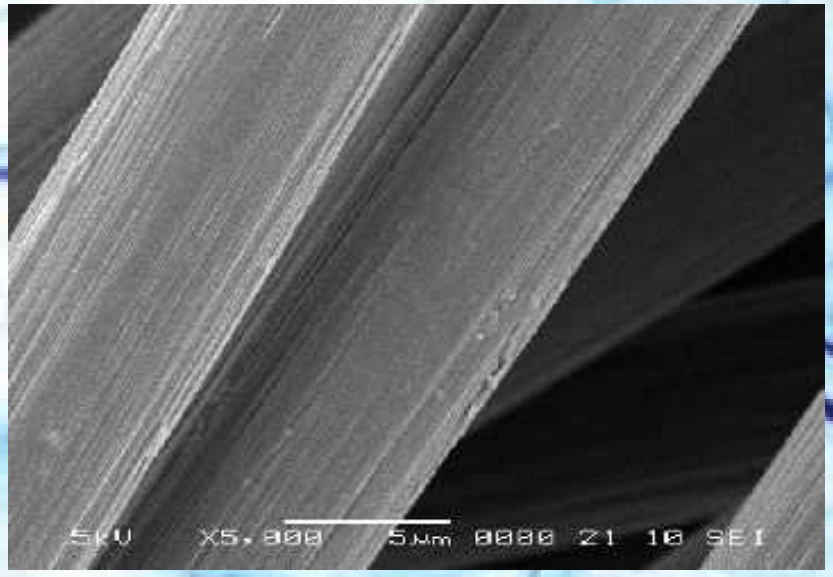


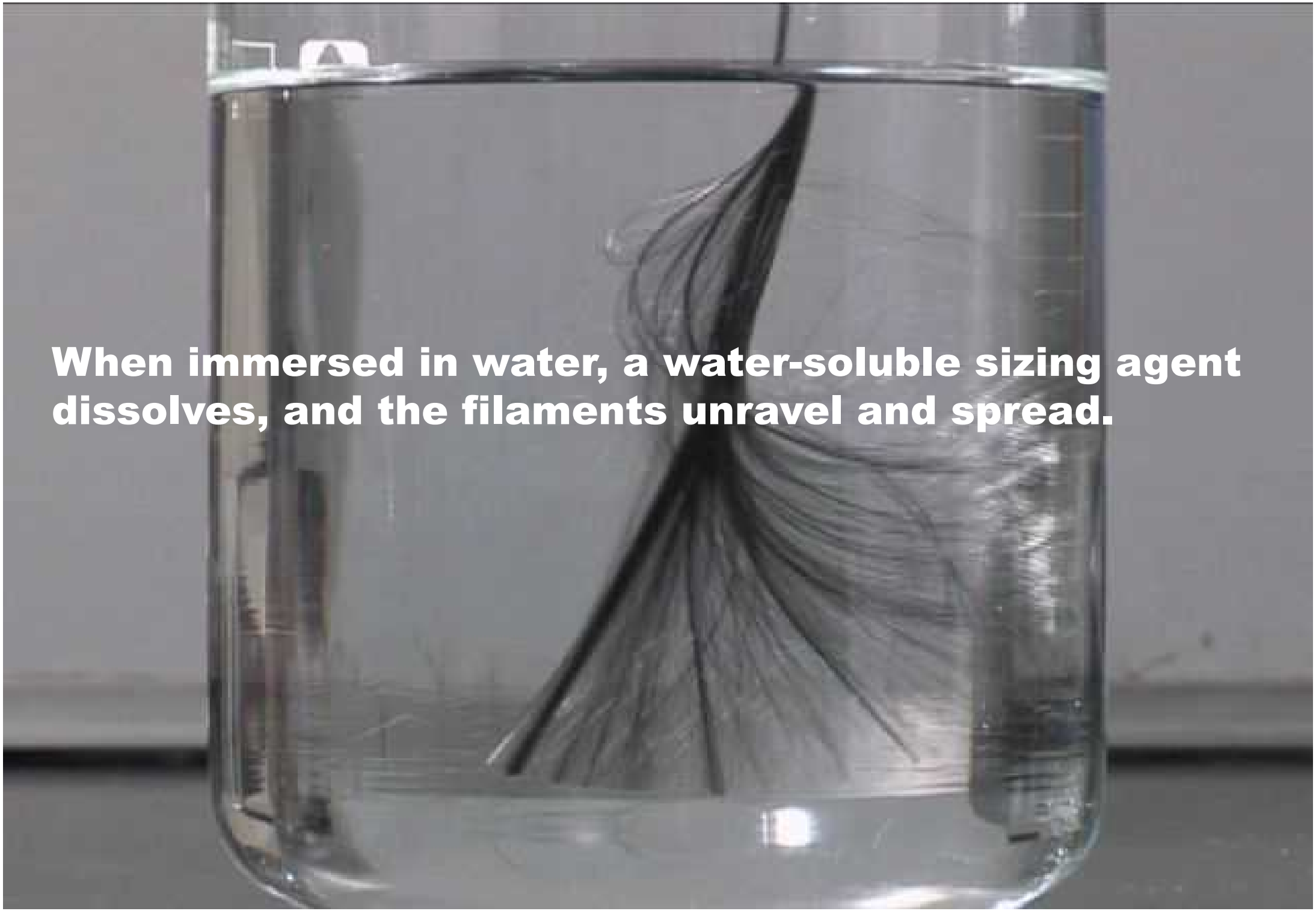
CarbonFiber is a strong, lightweight fiber substance having a fine graphite crystal structure.

× 1,500

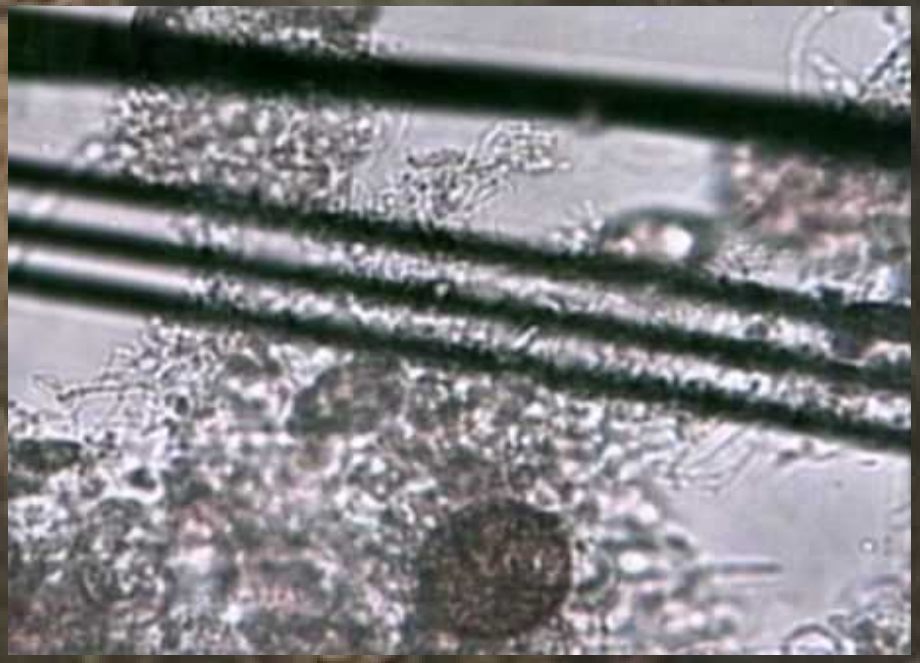
× 3,000

× 20,000



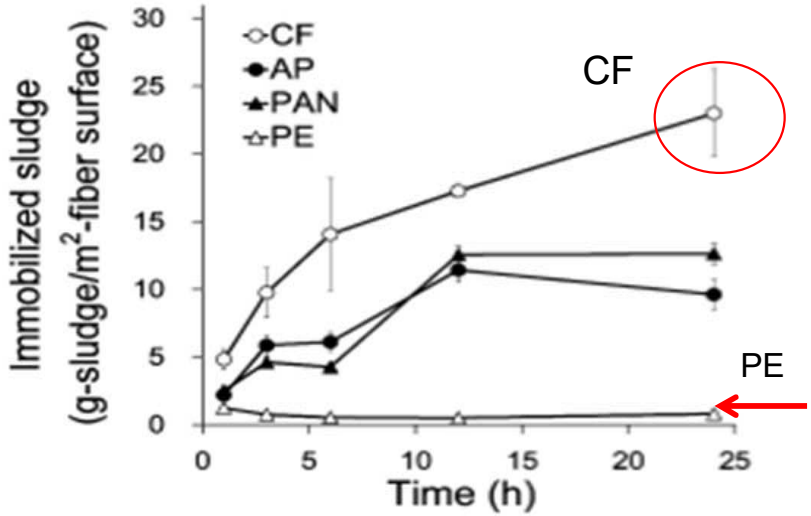

When immersed in water, a water-soluble sizing agent dissolves, and the filaments unravel and spread.

Pollutants are adsorbed and microorganisms are fixed on the large surface area of the CarbonFiber.

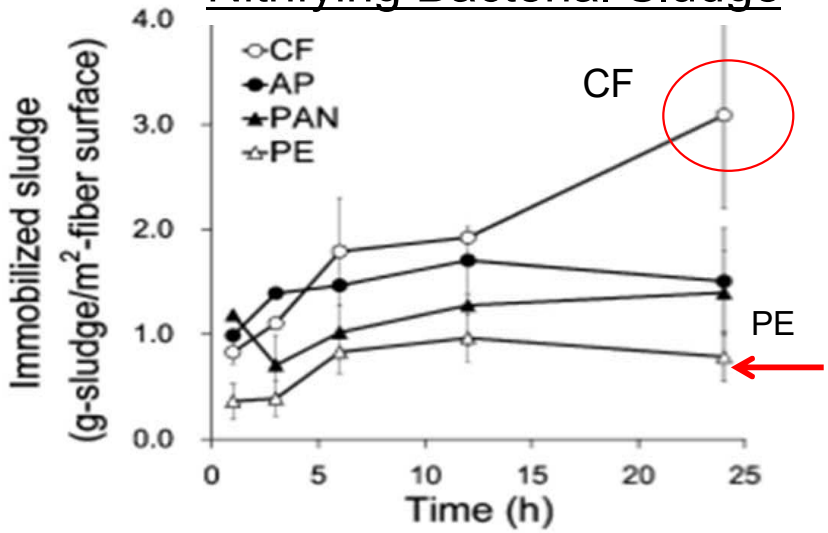


Excellent Biofilm Feature

Activated Sludge



Nitrifying Bacterial Sludge



Comparison of various materials

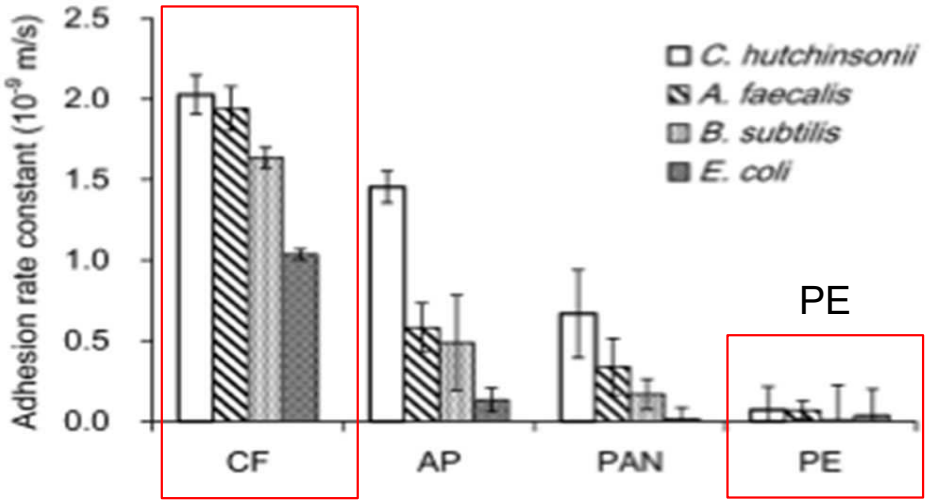


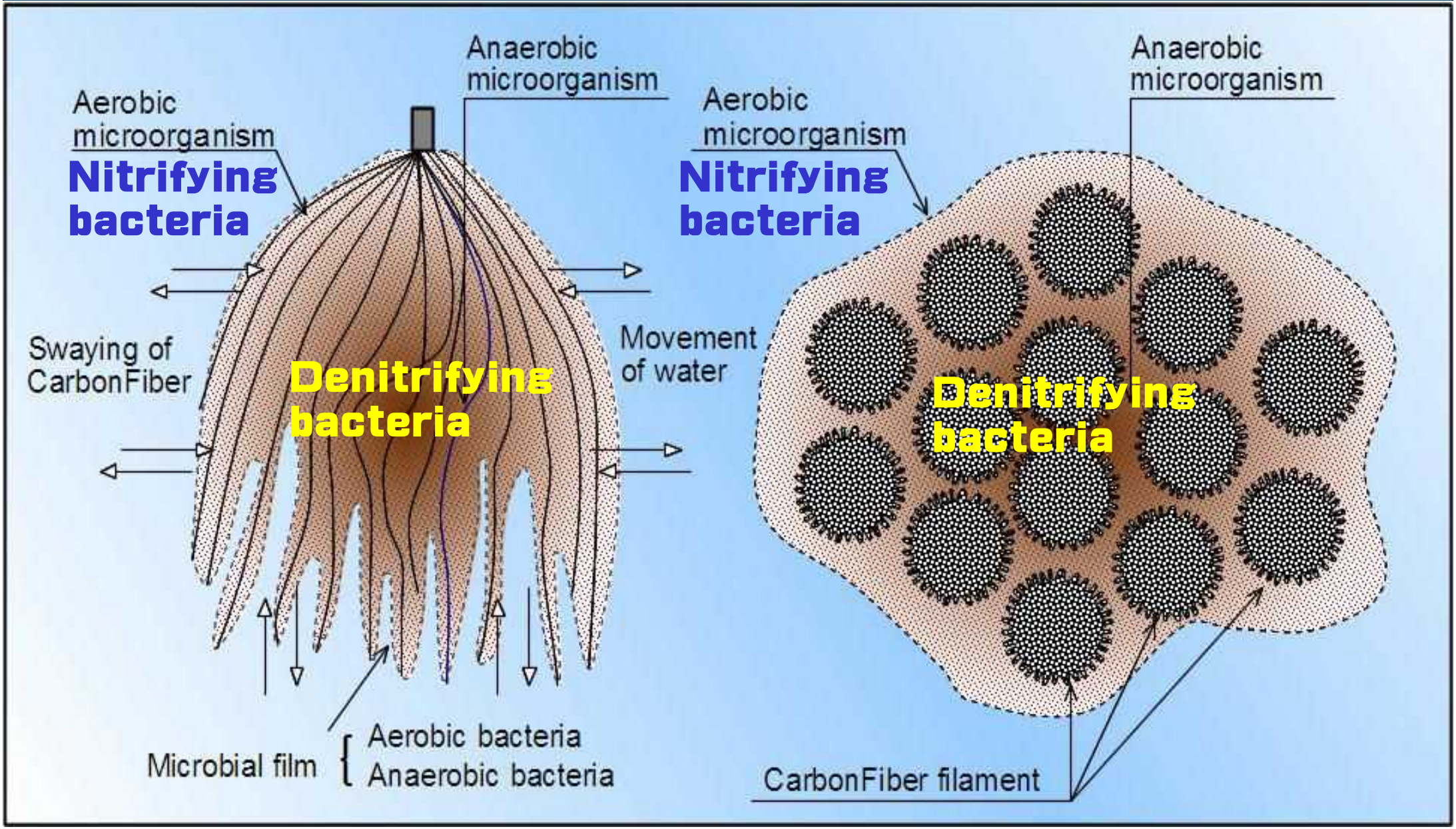
Figure 4. Adhesion rate constants of bacterial cells to fibrous supports. Mean value and standard deviations from five replicates are shown (I = 202 mM).

CF: Carbon Fiber
AP: Aromatic Polyamide
PAN: Preoxidized Polyacrylonitrile
PE: Polyethylene

Ref) Carbon Fiber as an Excellent Support Material for Waste Water (Environmental Science Technology 2012)

Mechanism of water purification

* Anaerobic bacteria stay inside of CarbonFiber while aerobic bacteria stay in its surface.



Improve Wastewater Treatment Facilities Function

Water purification by MiraCarbon

- Decrease Biological Oxygen Demand（BOD）
- Decrease Chemical Oxygen Demand（COD）
- Decomposability decrease Total Nitrogen（TN） and Total Phosphorus （TP）
- Adsorbable decrease Suspended Solid(（SS）
- Decrease heavy metals adsorption

Installation site in wastewater plants

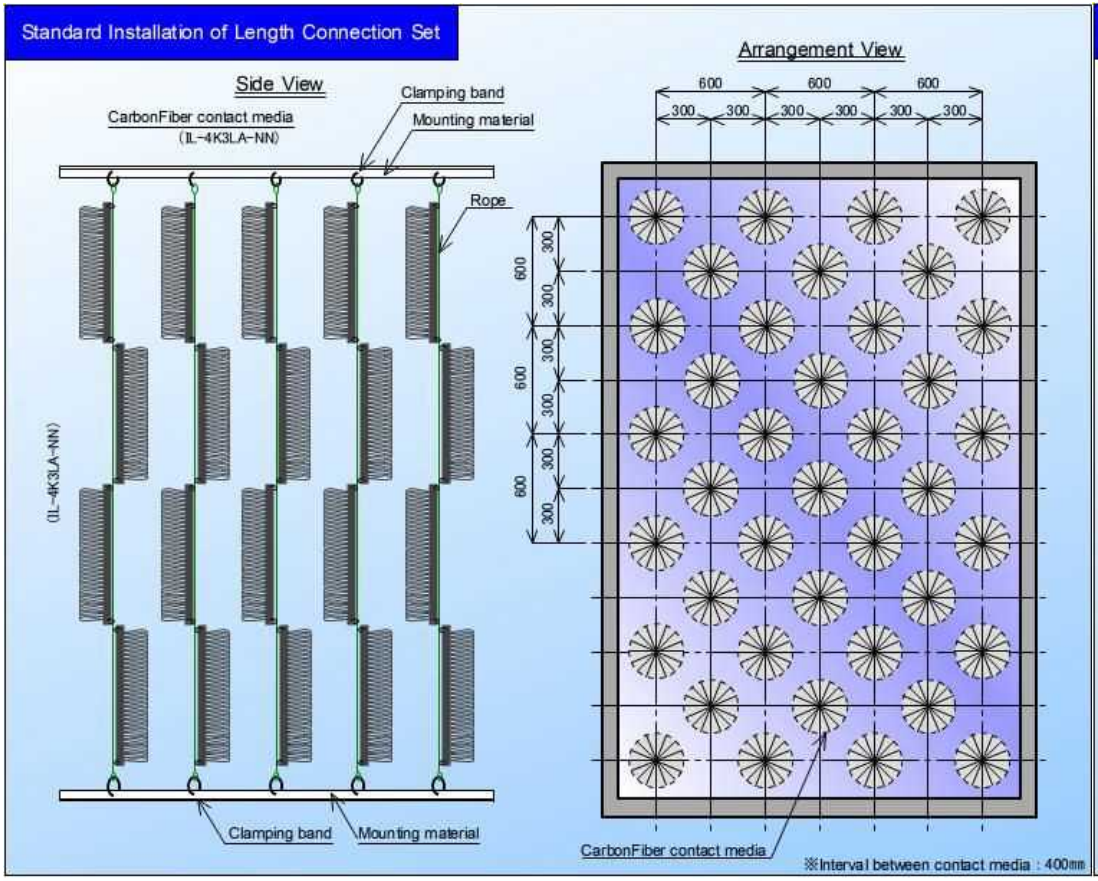
- Flow equalization tank (load reduction)
- Biological aeration tank (contact media)
- Settling tank (contact media, adsorb media)
- Filtration tank (contact media, adsorb media)
- Effluent tank (improvement of effluent water quality)

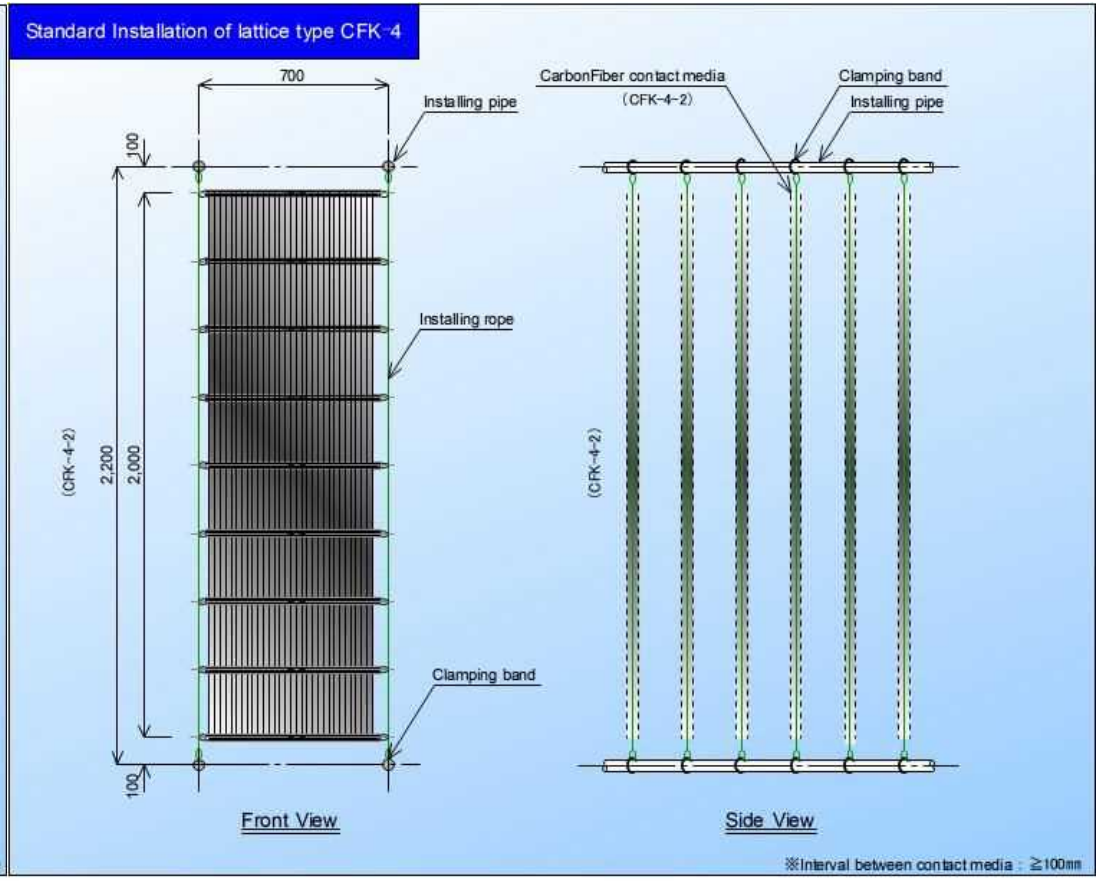
MiraCarbon Installation for WWT

Assemble and install MiraCarbon singlemodule according to CarbonFiber amount & Installation method.

MiraCarbon singlemodule

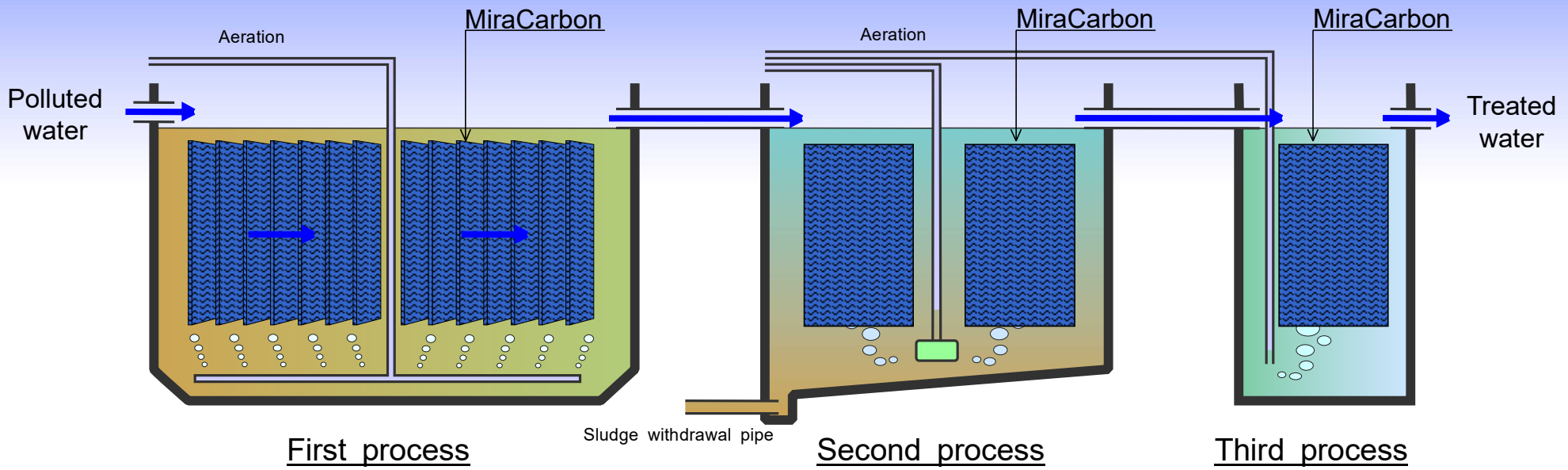
Model	Tassel Type【CFK-3】	Tassel Type 【CFS-2】	Lattice Type【CFK-4】	Textile Type【CFH-2】
Image				
CarbonFiber Amount	20 g	20 g	60 g	400g±10%
Effective Surface	10㎡	10㎡	15㎡	40㎡





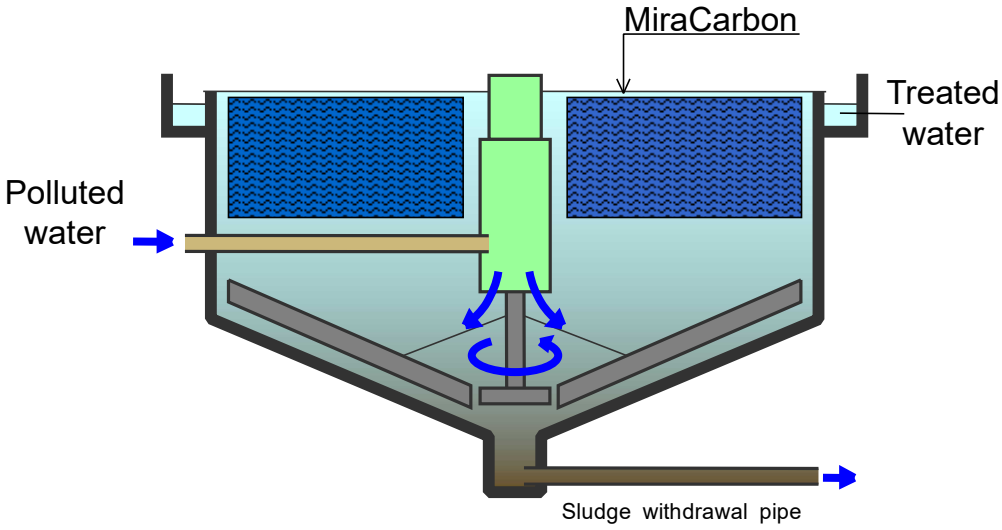
■ Biological Treatment Tank

With MiraCarbon, using the activated sludge method and contact aeration method etc. as a contacting media in biological treatment tank,it active microorganisms improvement and stable of treatment.



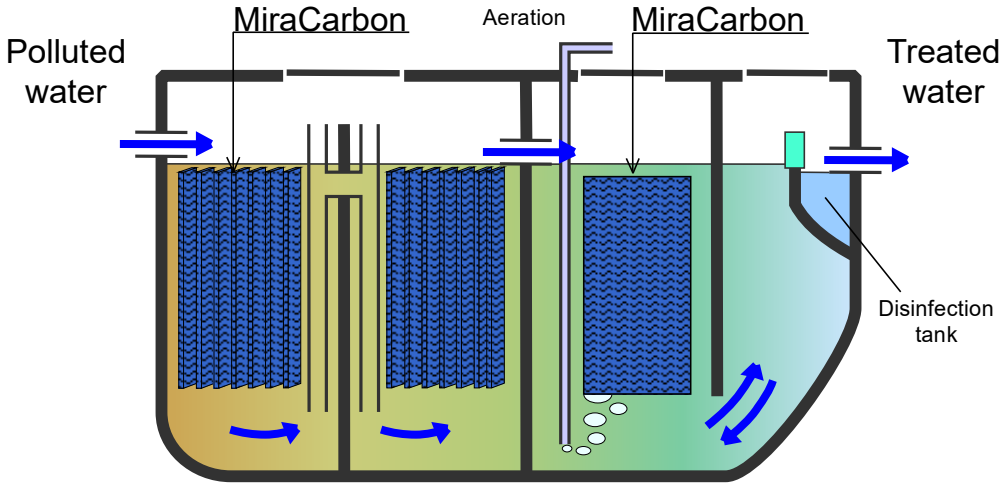
■ Settling Tank

Suspended solid and microorganisms in settling tank are adsorbed on the MiraCarbon, it biodegrade and improve treatment water quality.



■ Septic Tank

With MiraCarbon in anaerobic and contact aeration tank, it promote biological decomposition contaminants.



Advantages of CarbonFiber method

With ativated microoganisms

Improve treatment speed!

Reduce contact time

Improve treatment capacity!

If it is same contact time

Improve water purification!

Advantages

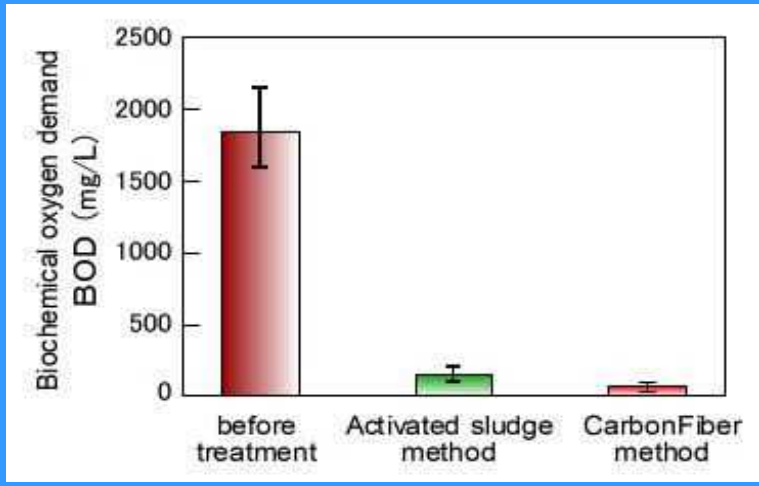
☆ Decomposition processing speed of organic matter etc. is fast due to microbial activation.
→ Reduce contact time
→ Increase volume of treated water
→ Improve treatment quality
☆ Large denitrification, dephosphorylation.
☆ Suppression of greenhouse gas emissions.
☆ Less excess sludge generation.
☆ Small odor occurs.
☆ High suspended supplementary effect.
☆ Reduction of aeration volume.
☆ Reduction of chemicals.
☆ Low installation cost.
☆ Easy maintenance.

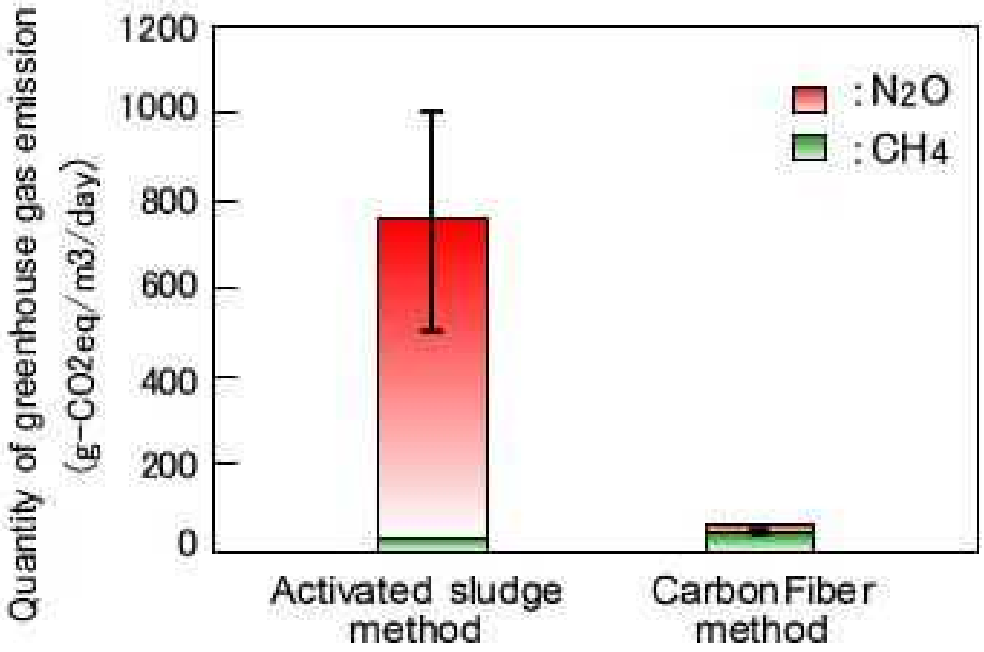
Comparison of Effect

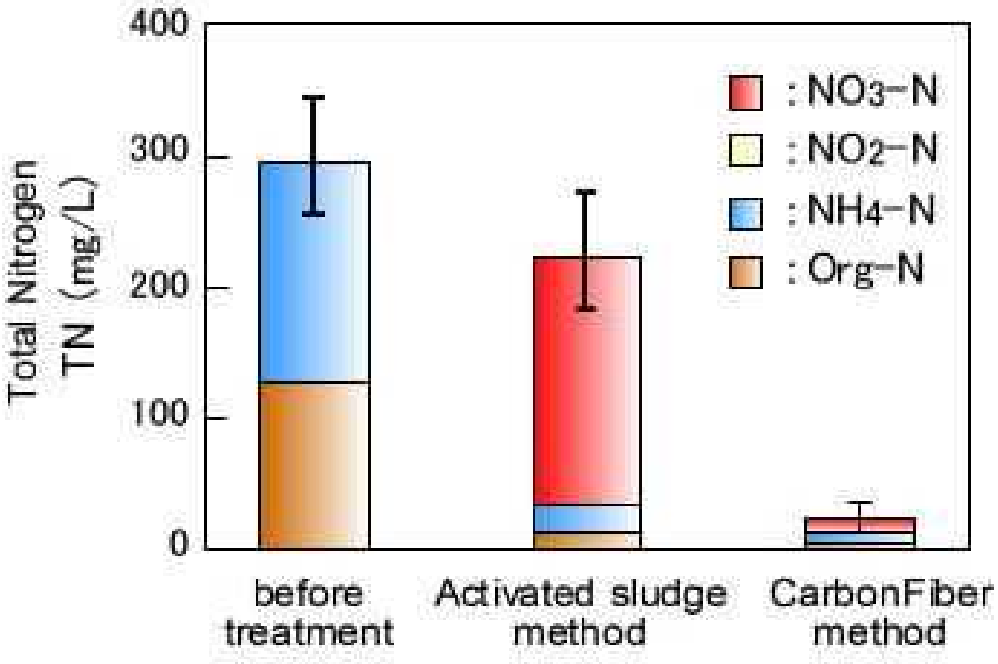
Activated sludge method

Vs

CarbonFiber method







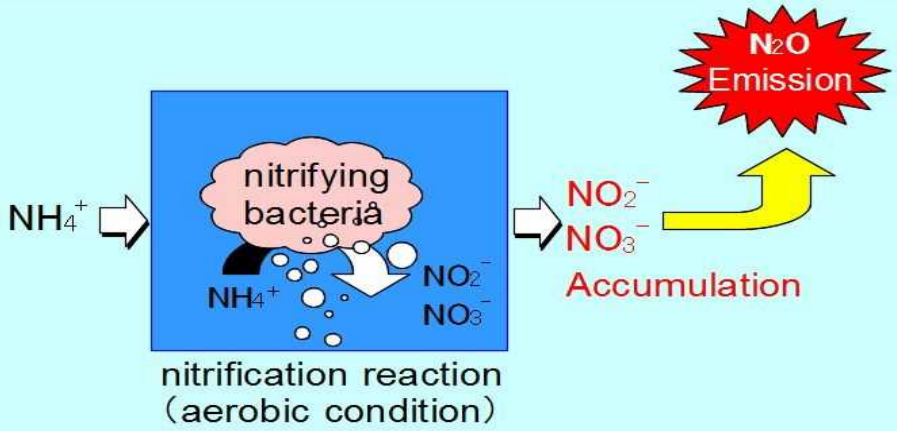
Ref) Mitigation of nitrous oxide (N2O) emission from swine waste water treatment in an aerobic bioreactor packed with carbon fibers, Animal Science Journal, In Press, 2015

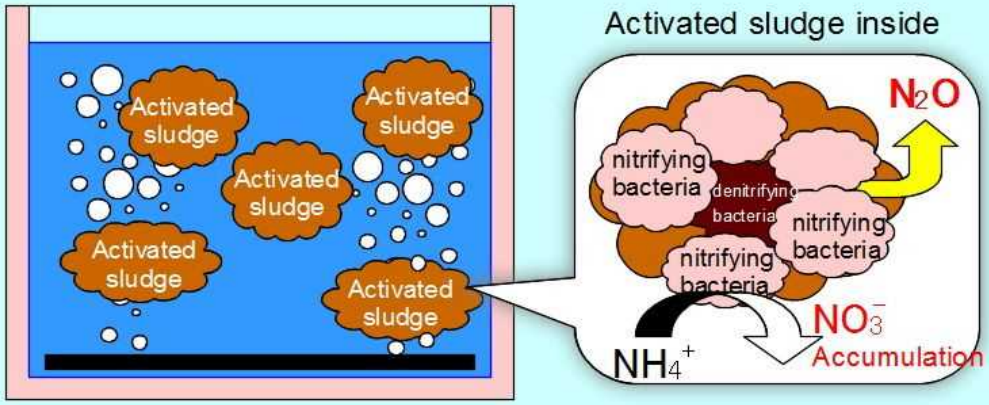
Nitrogen removal with MiraCarbon

Comparison with wastewater treatment method

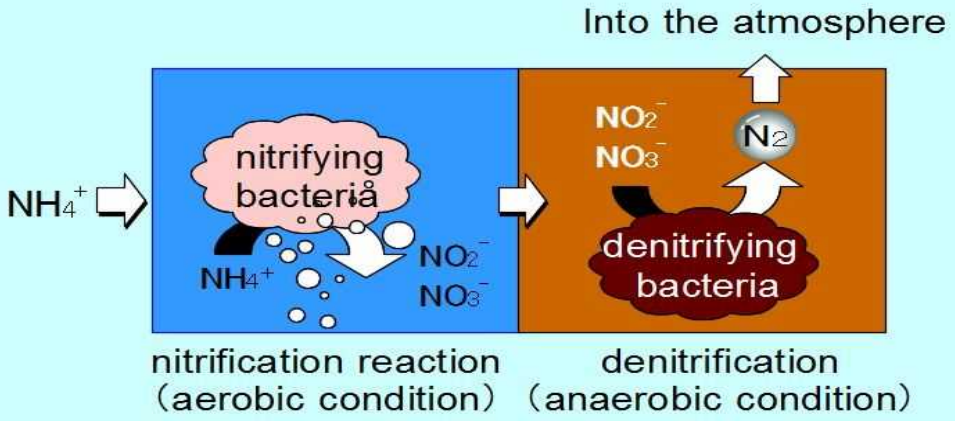
Suppression of greenhouse gas N2O emission

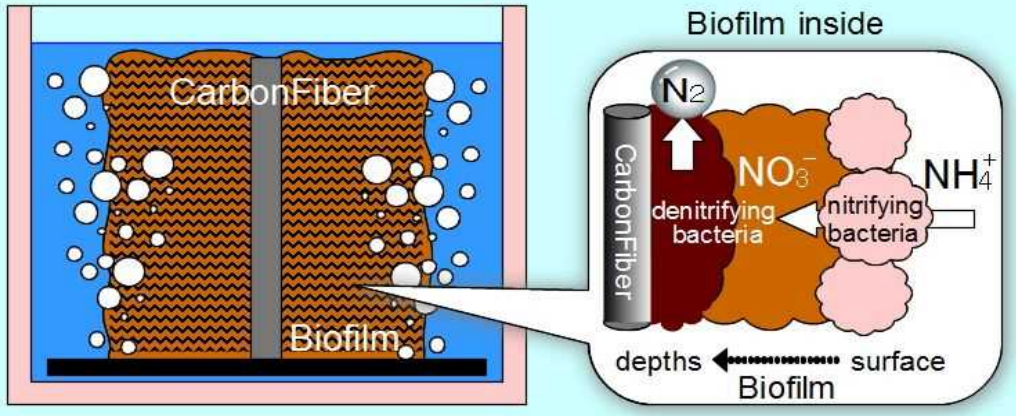
Activated sludge method





CarbonFiber method





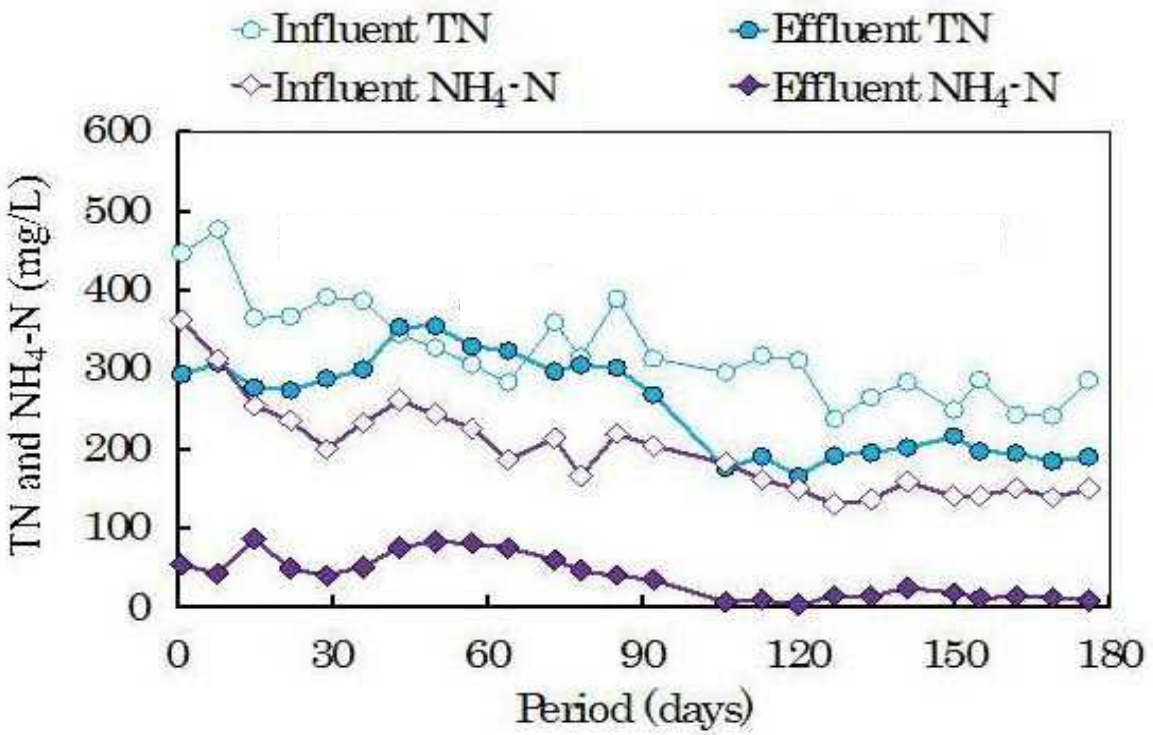
Comparison of nitrogen removal

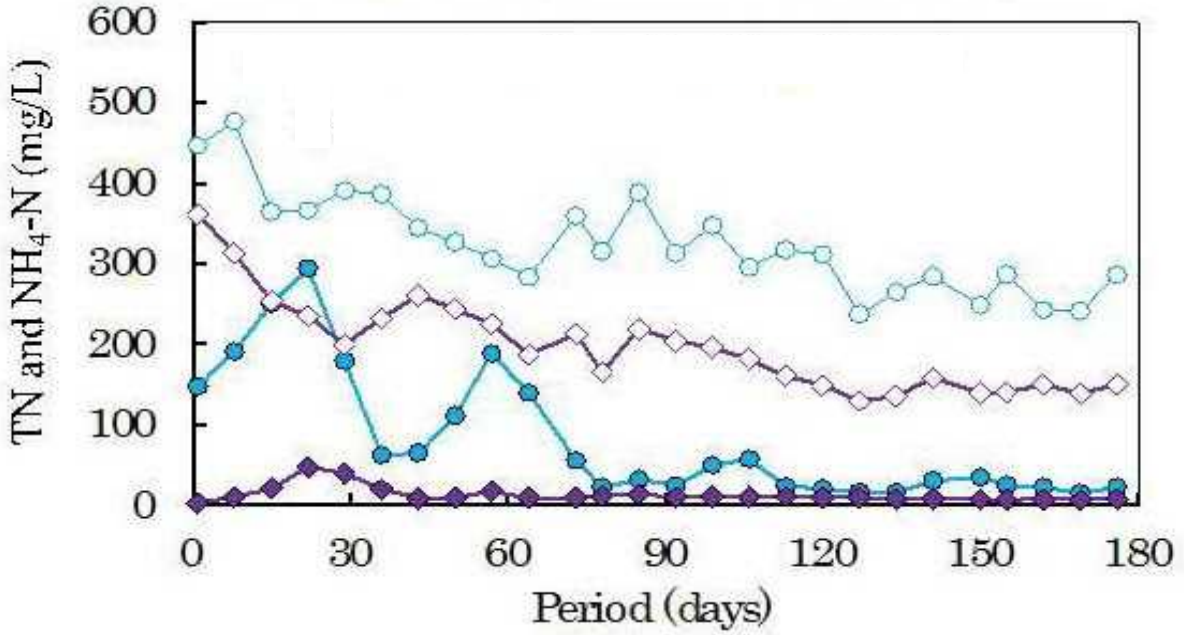
Activated sludge method

By nitrifying bacteria
NH4 → NO2 → NO3
NH4 : Decreases
Total nitrogen TN : Remains

CarbonFiber method

By nitrifying bacteria
NH4 → NO2 → NO3
By denitrifying bacteria
NO3 → N2 + H2O
Total nitrogen TN : Removed

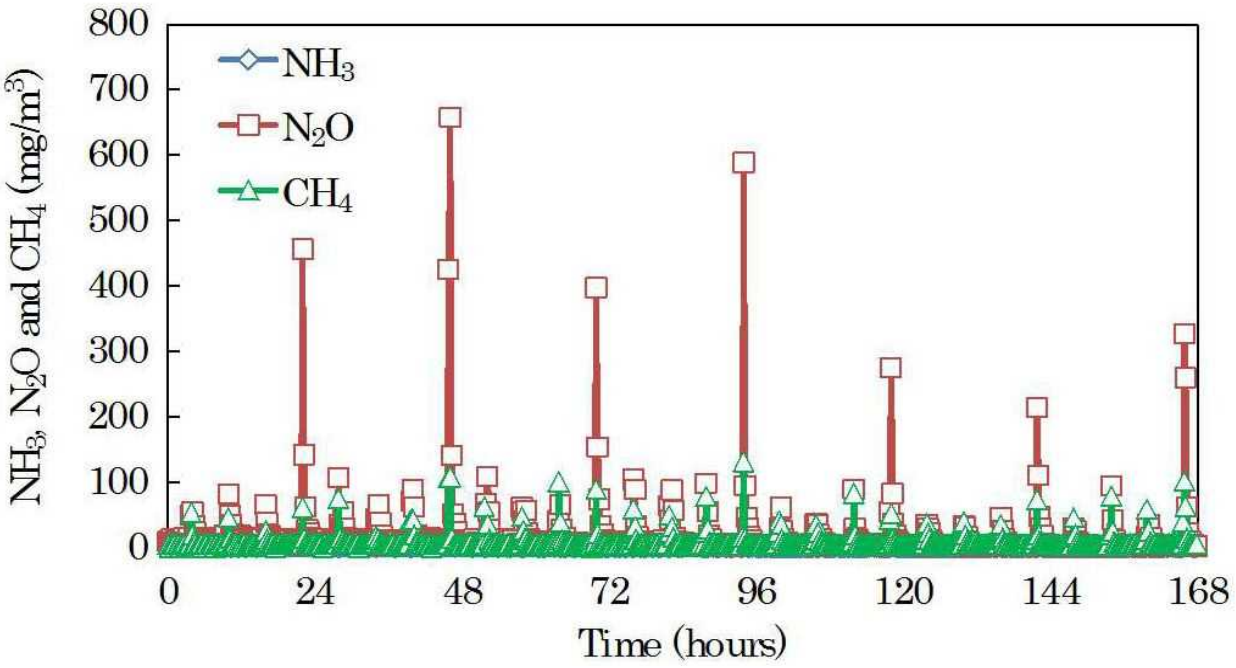




Comparison of greenhouse gases

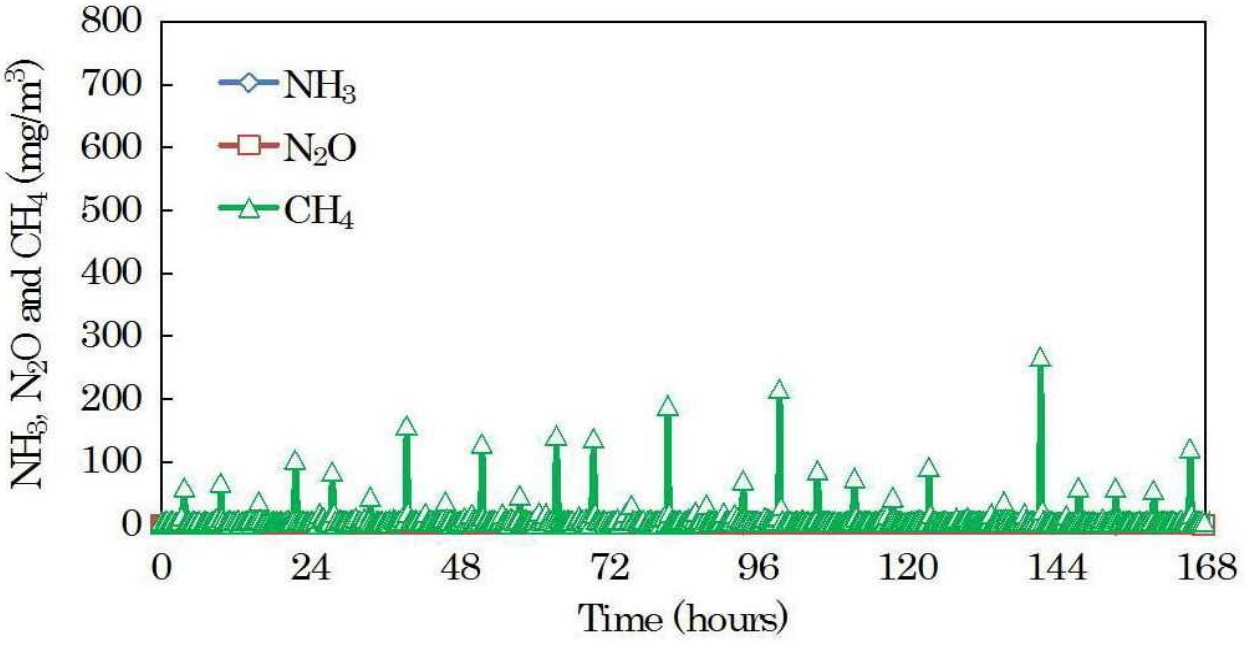
Activated sludge method

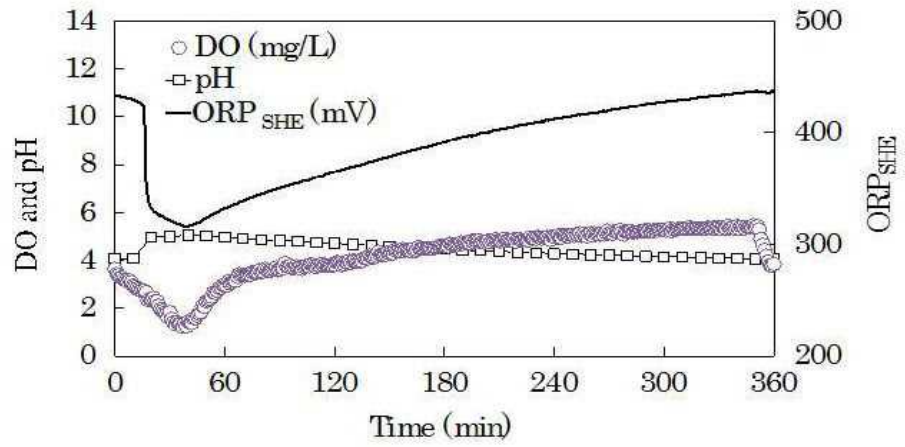
Greenhouse gas N2O are generated by accumulation of nitrogen component (NH4 + NO2 + NO 3)

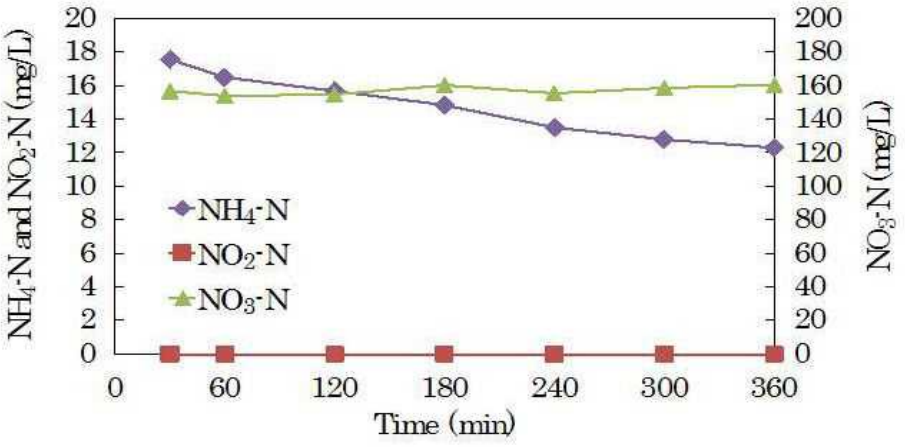


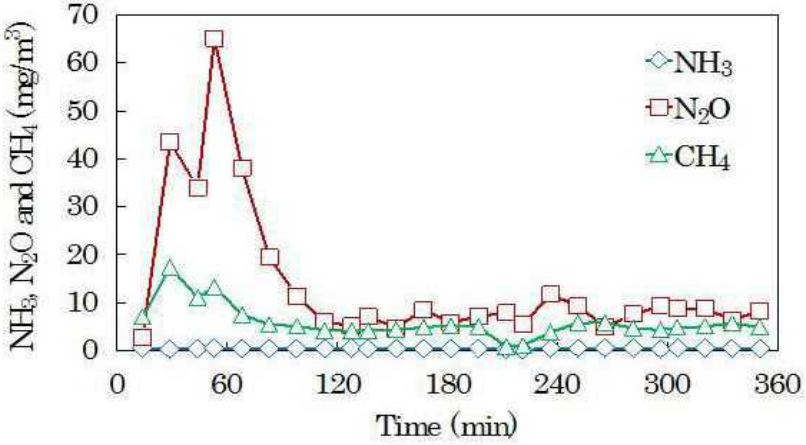
CarbonFiber method

Nitrogen component are decomposed and removed and greenhouse gas N2O does not occur.
NH4 → NO2 → NO3 → N2

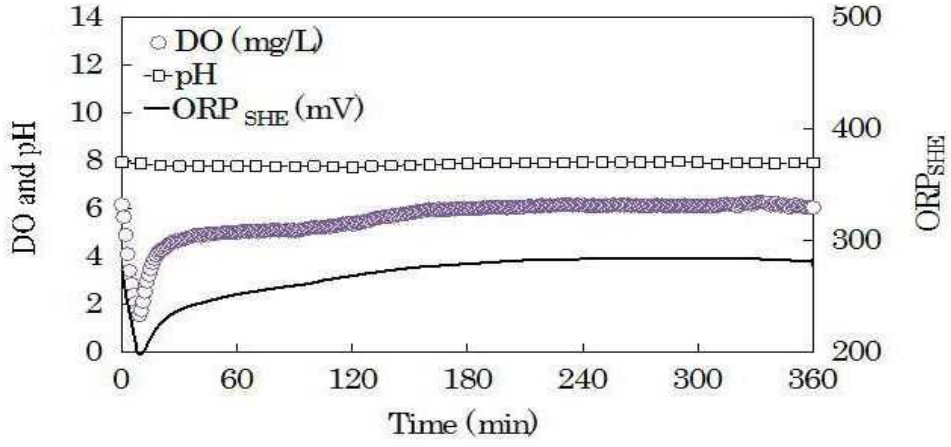


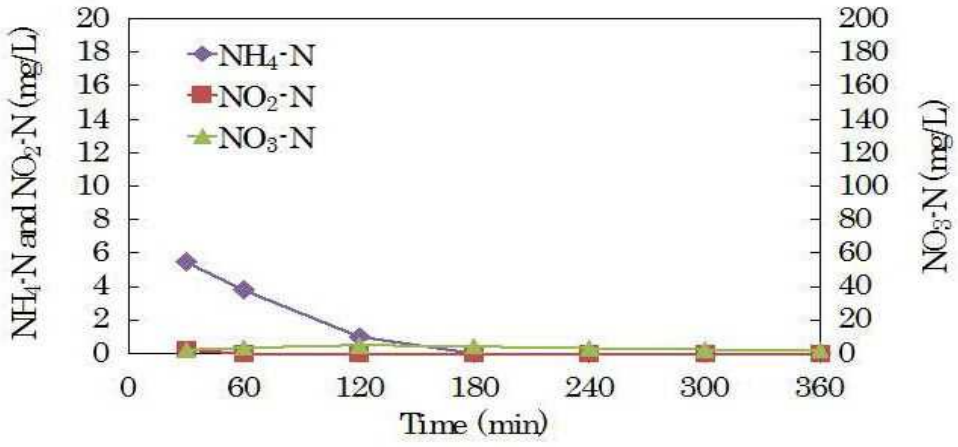


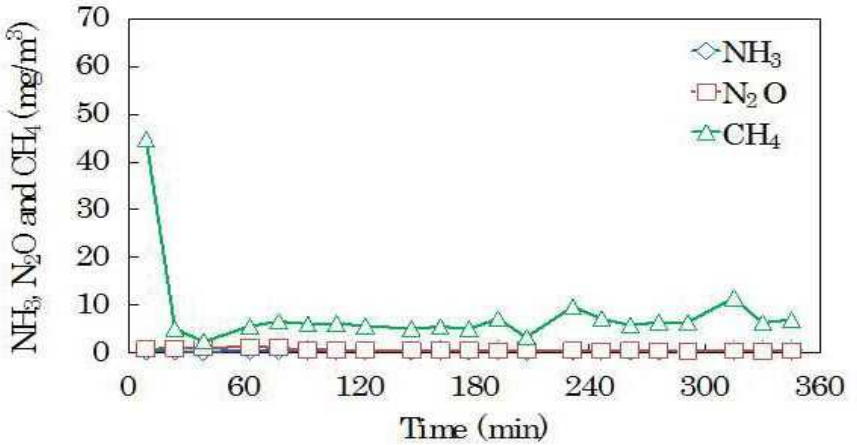




Activated sludge method



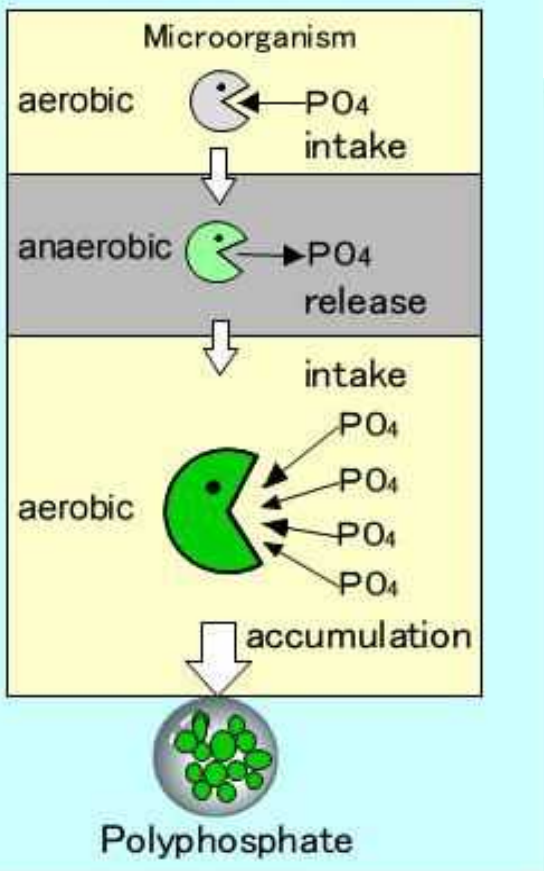




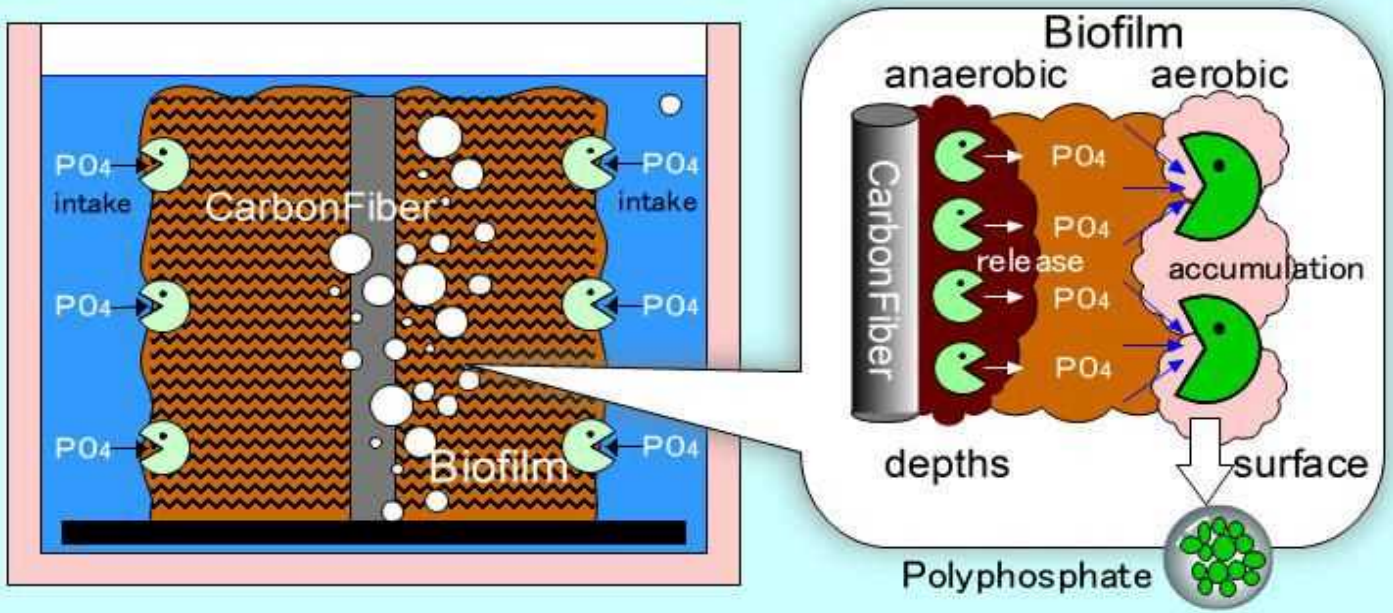
CarbonFiber method

Phosphorus removal with MiraCarbon
Biological treatment method

Phosphate Intake by Microorganism (aerobic) → Release (anaerobic) → Mass Intake (aerobic)



PO4 release in depths of CarbonFiber. (anaerobic)
PO4 intake at the surface of CarbonFiber. (aerobic)



Phosphorus removal with MiraCarbon ＋ Cation

Phosphate ion combined with Iron ion to form Iron phosphate

$PO_4^{3-} + Fe^{3+} \rightarrow FePO_4$

◆Relations between CarbonFiber and metal ion
Electronegativity：Carbon［C］＞ Iron［Fe］