



Where we can find Clean and Safe Water in Nature ?



0 0375 075 1.5 Miles



In mountainous country, many houses are scattered on the slope. They use natural spring on the slope.



Water source for Akan water works, Hokkaido, Japan

Porous pipes were placed under the gravel bed in a river. Almost suspended free water is taken for a slow sand filter plant. This is an intake of an artificial subsurface water.





Mr. Mitsutoshi Tomari, managing director of Sodeyama WTP, Miyako-Jima, visited to Nakamoto, Shinshu Univ. in July 8, **1997**. Nakamoto explained about the ecological purification system of slow sand filter.



Sodeyama Purification plant

Miyako-Jima, Okinawa

Hardness reduction plant



17.25m x 27.6m(x2.6m) x7 filter ponds (17.25m x 27.6m=476.1m2) 23.7m x 20.0m(x2.6m) x 1 filter pond (23.7m x 20.0m=474m2)

Designed capacity (7 filters, 1 filter is spare : 8(new)+1(old)=9 filters) 475m2 x 7m/d= 3,325 m3/d x 7 filters= 23,275 m3/d Water demand 400 liter per day per person = 58,000 persons 2021





JICA EPS training started from 2006 in Miyako-jima island, Okinawa to Pacific Islands and Asian countries.







Sand is clear. Algal mat is just laid on the sand surface.





Thread-like algae were observed on and between the sand. The size of algae is much smaller than the size of sand.

Fine sand. But this size is too large to separate the small organisms from the sand.



Sand size and microscopic organisms Aerobic condition for small animals is the key.

Sand is just habitat. Small sand and uniformity of sand size is not important. Large size of sand and higher flow rate are better for organisms.







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Shallow depth is better.

Touch the bottom by stick.

Super saturated dissolved oxygen at the bottom.

Shallow depth Active photosynthesis by algae and aerobic condition for small animals are the key.

Deep depth







Aerobic condition in the sand layer









Aerobic condition is essential for biological activity.





Aerobic condition is essential for hetero-tropic organisms in the sand layer.

4.8 m/d (20 cm/h)

World wide English

Standard Filter rate



The filter rate was

38cm water depth

200yrs ago

2-3 m/d (10cm/h).

The filter rate of 0.4 m/h (9.6 m/d) is adopted in Thames filter plants in London to escape oxygen drop in filtrate during the night time.

4-17

Faster flow rate is better for small organisms in the filter.

Aerobic condition is essential for biological

There is down ward current.



Algal photosynthesis accelerates purification process.

Sedimentation tank, inflow regulation system

Sedimentation tank, up-flow roughing filter, and slow sand filter Simple model of Ecological Purification System.

Slow sand filter

Up-flow roughing filter









Miyako-jima island is an uplifted coral island. There is no mountain and no river. They used rain fall and underground water. The water source of water purification plants is only the underground water which is hard water.







Heavy suspended matters sink down to the bottom. But fine particles do not sink. And surface water drifts near the surface and passes the sediment pond in fairly short time.



Ishigaki slow sand filter: Designe capacity: 30,160m3/d

Sedimentation pond

Slow sand filters

27mx17.6m=475.2m2 475.2m2x4m/d=1,901m3/d 1,901x16filters=30,413m3/d 2 filters are spare use. Water demand: 0.3m3/person/d⇒100,000persons. 0.5m3/person/d⇒ 60,000persons. Big capacity



I explain importance of depth and flow.

Shallow depth is the key for algal growth.

O MONOTO NAL





How to reduce the suspended matter without chemicals.



Ma'e sato reservoir

Mountain stream. Shiramizu intake

大浜地下水源地

Pump station for underground water

Omoto intake



Yoshihara plant



Designed capacity 1,040m3/d (2 filters and 1 spare)

Sedimentation pond: 3.2mx18.2mx3.0mx2ponds

Slow sand filter 9.4mx14.1m(x4.0m)x3filter(2+1) 9.4x14.1=132.54m2(1 filter) 132.54m2x4m/d=530.2m3/d

Nosoko plant Designed capacity 1,066m3/d (3 filters and 1 spare)

Sedimentation pond: 3.0x11.2x3.0x4ponds

Slow sand filter 11.0x13.5(x2.4)x4filter(3+1) 11.0x13.5=148.5m2(1 filter) 148.5m2x4m/d=594m3/d



I explained role of small organisms.













Scraping the surface at Ishigaki plant.



In case of surface water intake, muddy materials are easily accumulated at the surface of sand filter. Sand is clear. We need not remove all of the biological active layer.



Biological activity is high in warm region.



Muddy materials are trapped at the surface. Sand is always clear. Biological community works near the surface. There is food for them near the surface.



Drain off filter for scraping. Many fishes and mollusks are remarkable.

This is just natural ecosystem. Inflow mud does not enter the sand layer. Sand is clear.



I investigated the seasonal change of algae in Thames filters in London from 1994 to 1996, more than 30 years ago.





Diatom to Green algae in summer is due to grazing activity.

This change is also due to grazing activity in Ueda.

Scrape under wet condition and short time.

> Mollusk is grazing animal of green algae. Long filter run.

Clean sand means that dirty matter does not enter in deep.

Oligochaeta in top of sand layer.

If filter surface is dried up, these animals escape into deep sand layer.





IS THE WATER SAFE TO DRINK? CI - C - H Harris Report 1974 CI



Robert H. Harris and others 1974 pointed out the risk of formation of tri-halo-methane by chemical addition of chlorine.

Water color is brown in the filter pond in the Water treatment plant in Edinburgh in Scotland. Raw water comes from peat land.



Vartry Waterworks, Dublin, Ireland. I could see brown water in open clear water tank (filtered water tank). They have served from 1860s.

Rapid Sand Filter produces Cancer Risk by chlorine addition.

SS free sub-surface water is taken.

Long filter run Good filter condition

No.1 ろ通調整池 サンブリングボンブ

pump

DO SAT

DAY

12

06

Sampling

Turbidity is high and fluctuates in day time, in fine day.

0.101 #1_1720D

0.000



Photosynthetic activity is high in day time. DO concentration becomes super-saturation. After the sampling pump, oxygen bubbles form in water. Turbidity is due to bubbles.

Micro bubbles are observed.





Turbidity meter value is not equal to real suspended matter. This particulate by the meter is micro-bubble.

Oofunato WTP (1,500m3/d), Iwate, Japan, from 1954 was attacked Great East Japan Earthquake (The 2011 off the Pacific coast of Tohoku Earthquake) on March 11th 2011.



Since construction, no coagulant has been used. Even after the earthquake, the plant was functioning without any problems.







It was determined that the concrete filter was damaged, and the filter was rebuilt. However, there were **no cracks** in the concrete filter.

The only damage to water pipes caused by the tsunami was **exposed areas such as bridges**.

Although the pipes buried underground in the city were not earthquake-resistant pipes, **there was no damage**. Since the water pipes are **not large in diameter**, they have **good earthquake resistance**.

EPS-Use of Natural Process-Chemical Free : Gentle for small organisms



People prefer to drink natural spring water.

People does not like chlorinated tap water.

This water is not guarantied by the authority. However people trusts this water.

Is this water is safe? Harris 1974



Algal activity relates to **solar radiation**.

Activity of heterotrophic organisms (bacteria, small animals) relates to temperature and amount of food for them.





Vertical current is gentle for small animals on the surface of sand and soil particle.



Small animals on the surface of rocks collect turbid matters.

Sand, stone and rocks **don't role and move** in a small creak among dense forest.



Running water, but unexpected flush out by storm event When plants and animals do not flush out, water is always clear.





"slow" means "gentle for organisms"









This is Smart Treatment System to make Artificial Spring Water by Eco-friendly Technique of Ecological Purification System.

EPS from Japan to the World

Slow Sand Filter

Wise Use of Natural Phenomena for Human Life. Safe and Delicious Water by EPS, Our Technology.

Ecological Purification

System









Trust Our Sense ! Super clean delicious water



Remember Three Steps

- 1. Knowing is NOT enough, we must APPLY it to something useful.
- 2. Willingness is NOT enough, we must PUT it into the PLAN and ACTION.
- 3. Putting the PLAN into action is NOT enough, we must ACCOMPLISH the goals.