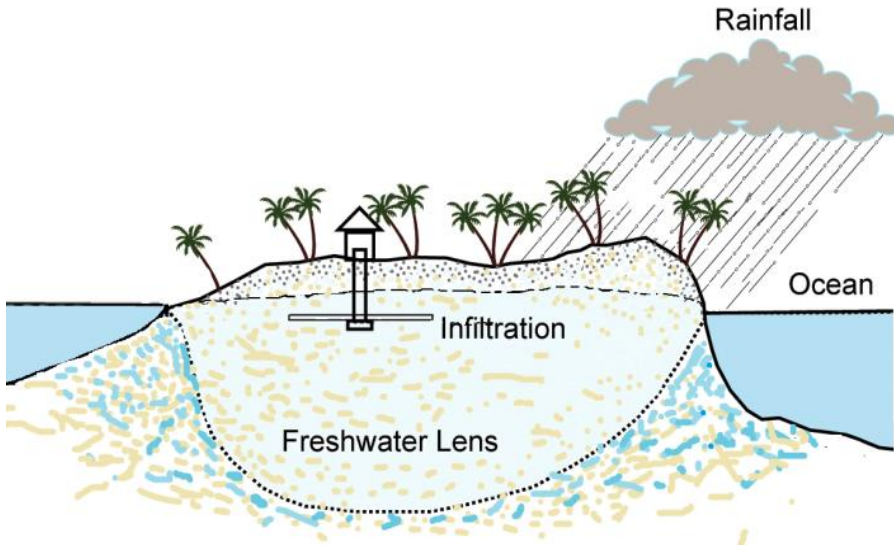


⑦ From Miyako Island to Samoa

⑦20 slides

I started JICA training on EPS in Okinawa from 2006.



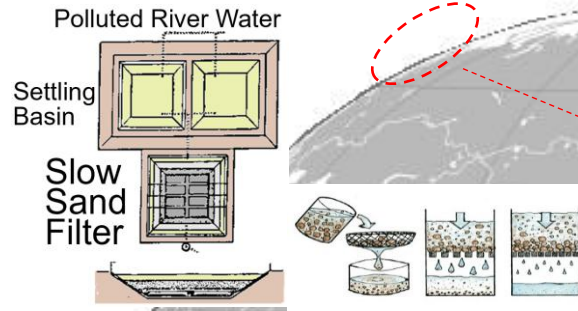
At the end of the six-week JICA training in Okinawa (September 1, 2010), Ms. Marista from the Solomon Islands, gave a speech of thanks on behalf of the trainees.



It is also worth appreciating the Ecological Purification System as taught by you, Dr. Nakamoto; a simple, natural and yet an effective water purification technology, we can all agree to as the most relevant technology for the Islands.

It is cheap to construct, operate and maintain which makes it even more attractive. We are grateful to your pioneering research on this technology and for generously impart this to us, so that the people of the pacific may in the very near future will have access to the high quality and delicious taste that this technology provides.

From JICA training in Miyako-island, Okinawa to Samoa



They believed **mechanical reduction** of polluted matter by fine sand under slow filtration.

Pre-chlorination was a popular water treatment to kill the algae in all over Japan and in the world. **This treatment was for Rapid sand filtration.**



Mr. Mitsutoshi **Tomari**, managing director of Sodeyama WTP, Miyako-island, **visited to Nakamoto**, Shinshu Univ. in **July 8, 1997**.

He **stopped** to injection of **algicide** into receiving well in **1997**.

As soon as the injection stop, the **taste of tap water became delicious**. Biological communities started to work in **SSF**. **Ecological Purification System** functionated in this **SSF**.



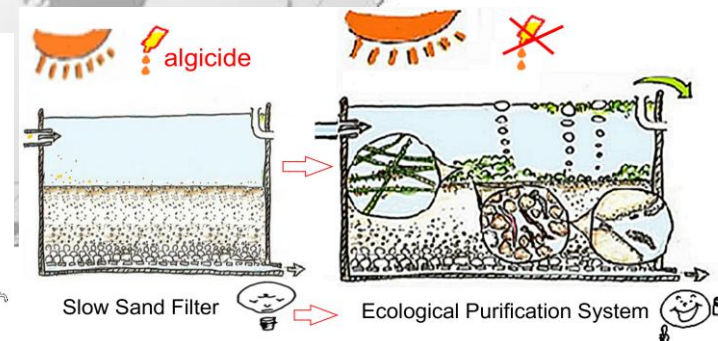
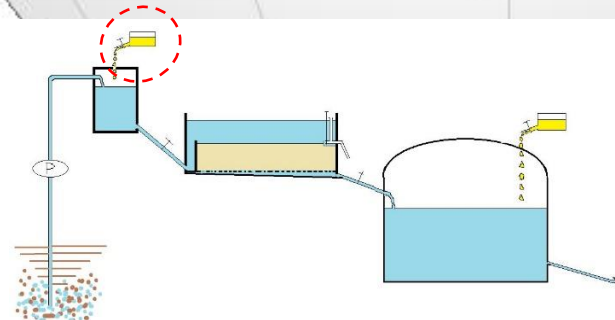
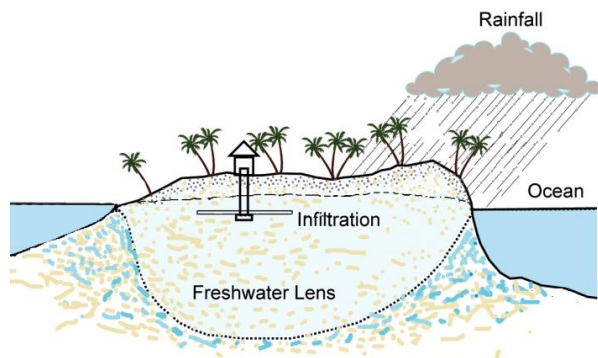
Miyako-island island is a raised coral reef where is quit different environment compared with main part of Japan.

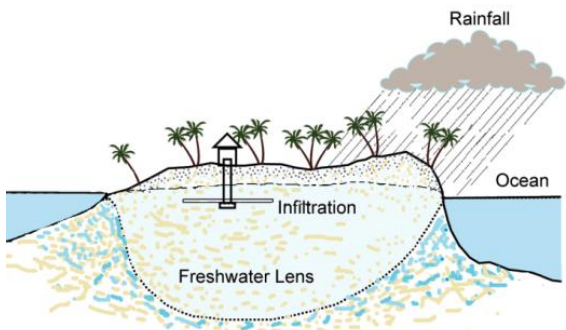


How to make delicious water

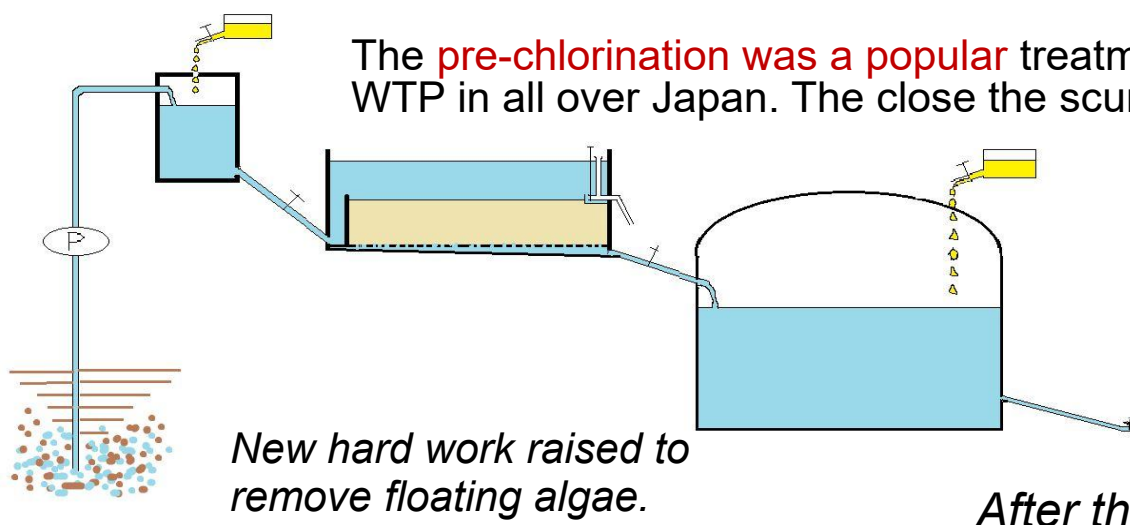


Nakamoto published Ecological Purification System text in 2005.





They pumped up the underground water as water source. They could not flow out from the scum out. In the pond, algal bloom was so severe. The pre-chlorination was introduced to kill the algal activity.

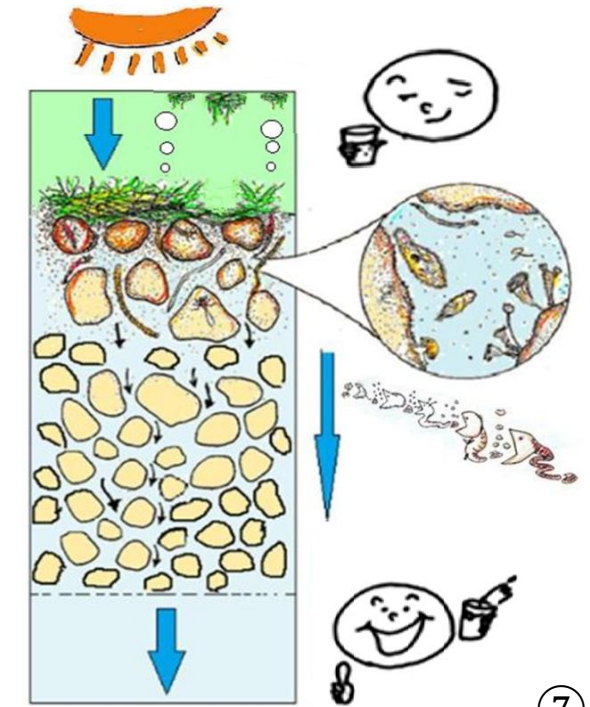
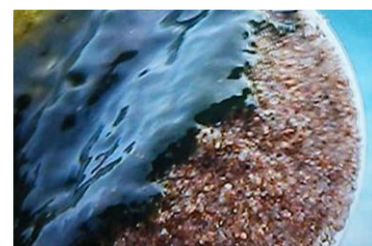
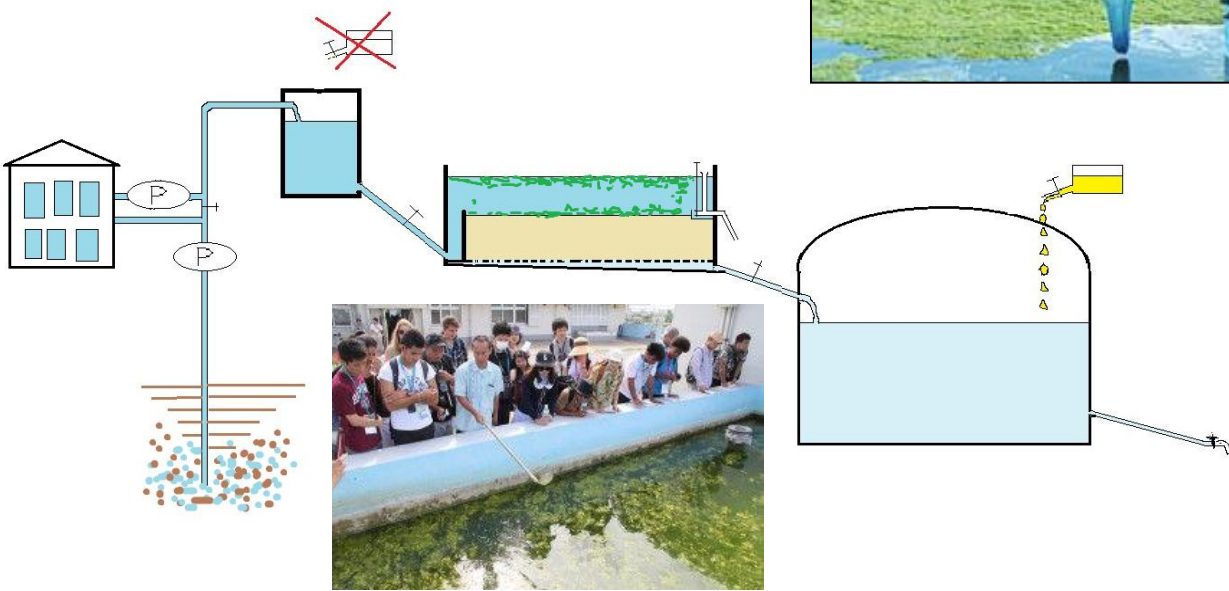


The **pre-chlorination** was a popular treatment to kill the algal growth for WTP in all over Japan. The close the scum out was also popular.

New hard work raised to remove floating algae.



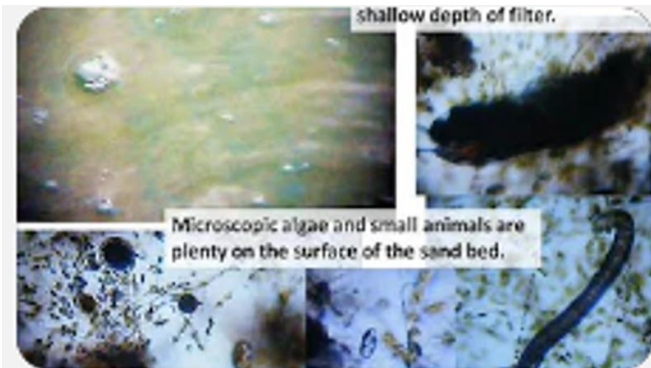
After the **injection stopped in 1997**, the **algae grew well** in filter ponds. **The taste of tap water became delicious.**



International Course on Slow Sand Filter in Okinawa, in 2010 by JICA

YouTube / 6:08

<https://www.youtube.com/watch?v=c3mVlbmFPqA&t=138s>



You can deepen your understanding through outdoor experience rather than classroom lectures.



Slow sand filter problem in Samoa was solved by ecological point in 2010 – YouTube / 13:45

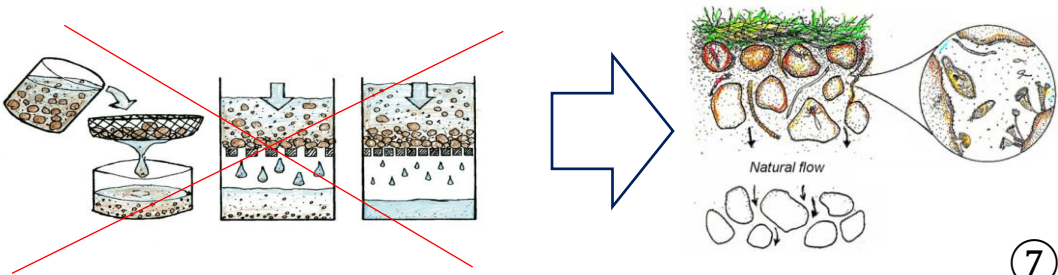


<https://www.youtube.com/watch?v=Kkk-wdIHui4>



During heavy flooding or rainy days – very high turbidity blocks sand filters

This problem was happened by the misunderstand of the real mechanism. Slow sand filter system is not simple mechanical filter. This is a real Ecological Purification System.



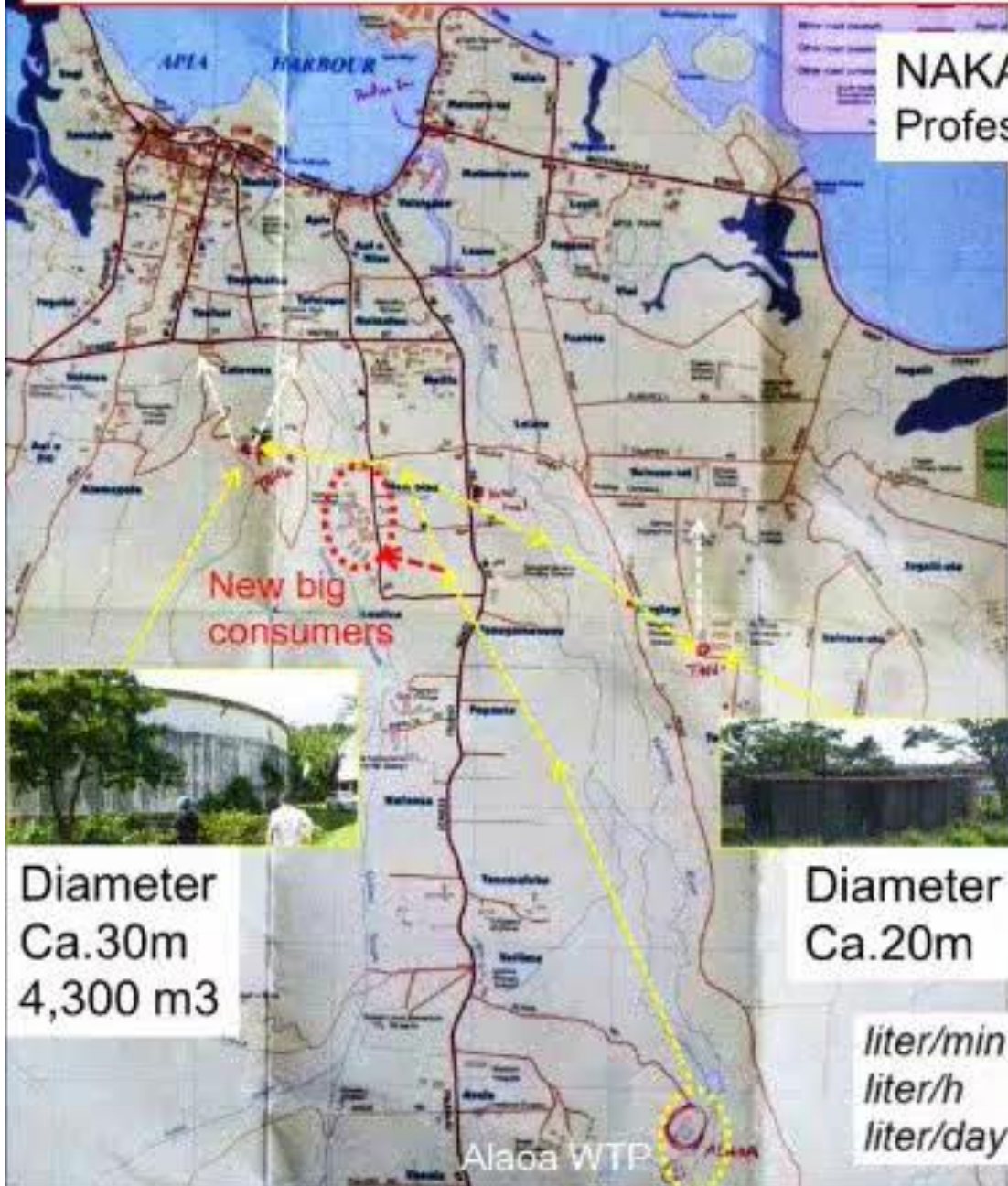
On the Alaoa Water Treatment Plant

Apia, Samoa

JICA Miyakojima Project, Feb. 2013

NAKAMOTO Nobutada, Dr. Sc.

Professor Emeritus of Shinshu University



liter/min	0.83	1.66	16.6	25
liter/h	50	100	1,000	1,500
liter/day	1,200	2,400	24,000	36,000

Close the tap:
Save the water.

Treated water is
limited amount.

Settling tanks

Joseph River company (Germany) constructed **5 slow sand filters only during 1984-87 in Samoa.**

2000

Roughing filters (URF)

Samoan people used non-treated water (Non-purified water), before construction of Alaoa Purification plant (1984).



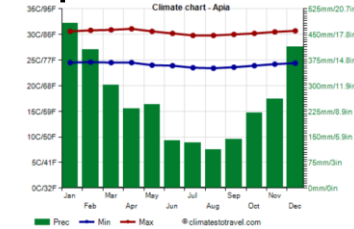
Filters were blocked with turbid matters by storm event.



Dorsch consult (Germany) constructed **Settling tanks** and **Up-flow roughing filters** in order to reduce the extraordinary load of surface run off by storm event in **2000**.

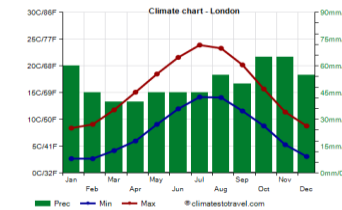


Apia, Samoa



3,100mm/year

London



690mm/year

400 mm/month from December to February, and less than 150 mm from June to September.

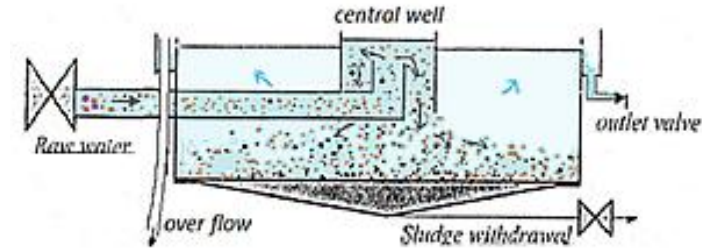
<https://eps.watervision.jp/wp-content/uploads/2025/04/AlaoaDurch-Manual.pdf>

Slow Sand Filter ⇒ Ecological Purification System :

Purification was done by the function of biological communities. It was the food chain.



Settling tanks



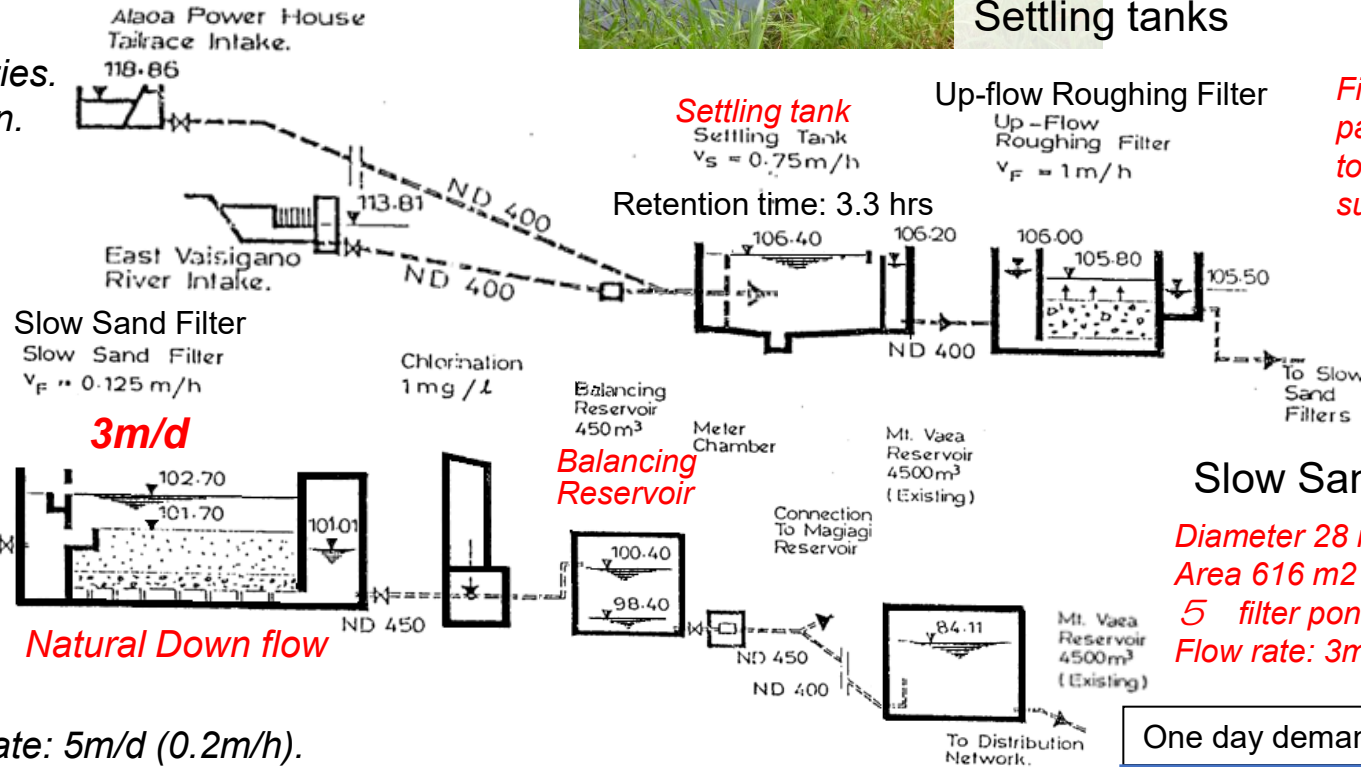
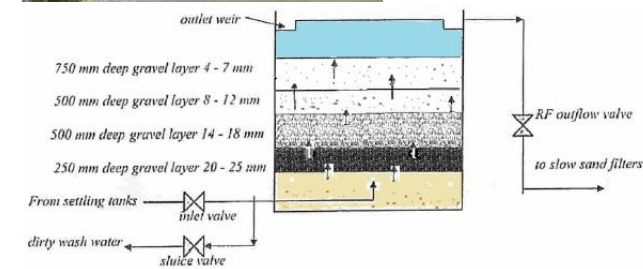
Diameter 17.8 m
Area 248.8 m²
2 tanks
Retention time: 3.3 hrs

Up-flow Roughing Filter:



Diameter 11.2 m
Area 98.5 m²
4 filters
Filter rate: 1m/h

Fine, light particles cling to the gravel surface



Slow Sand Filter

Diameter 28 m
Area 616 m²
5 filter ponds
Flow rate: 3m/d



Slow Sand Filter:

English standard rate: 5m/d (0.2m/h).

Present Thames rater: 10m/d(0.4m/h)

Our experiment in Samoa :2013: 5m/d、10m/d、20m/d

= Any rate is good results.

Samoa is located in warm region.

Biological Activity is always good.

One day demand: 0.1 to 0.3 m³/day person (Japan)

IF: One day demand: 0.2 m³/day person (Samoa)

616 m² x 3m/d = 1,848 m³/d x 5 filters = 9,240 m³/d
5m/d : 3,080 m³/d x 5 filters = 15,400 m³/d
10m/d : 6,160 m³/d x 5 filters = 30,800 m³/d

⇒ 0.2 m³/d = 46,200 persons
⇒ 0.2 m³/d = 77,000 persons
⇒ 0.2 m³/d = 154,000 persons

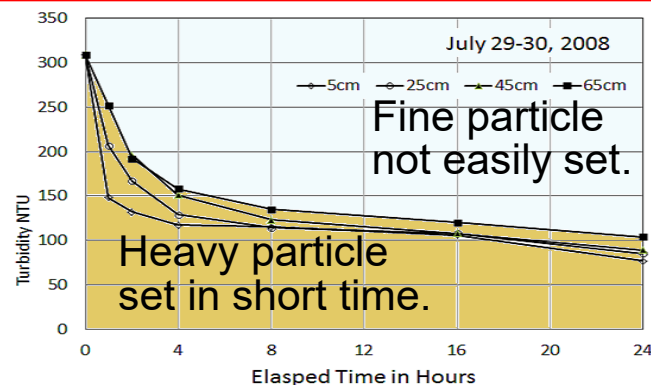
Samoa 217,000 persons (2023)
Apia 36,000 persons (2021)

Heavy rains during the rainy season cause filter blocks, which are a major problem. Water leakage from water supply pipes is also a problem.

We advised: Reduce inflow water for set turbid matter.



Too much inflow.
Short retention time.



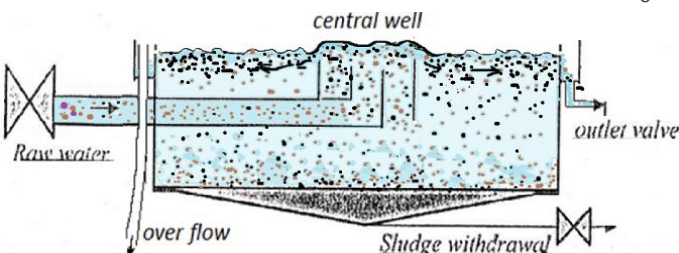
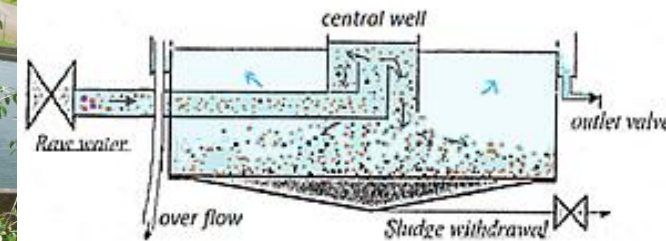
Fine particle
not easily set.

Heavy particle
set in short time.

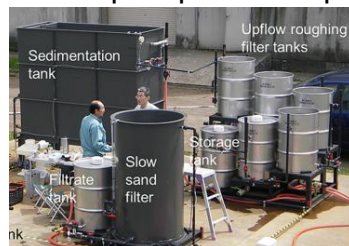


Retention time: 3.3 hrs (design)

The ideal is a calm surface.



Result of pilot plant in Japan.



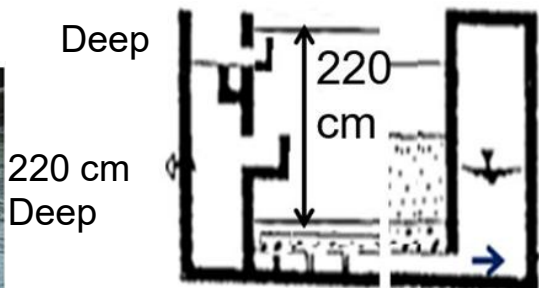
We reduced
the inflow rate.



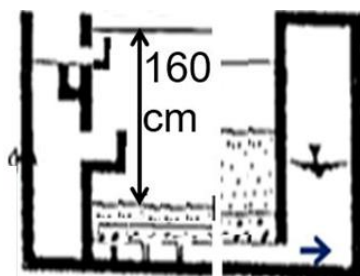
We advised: Put more sand to make shallow depth.



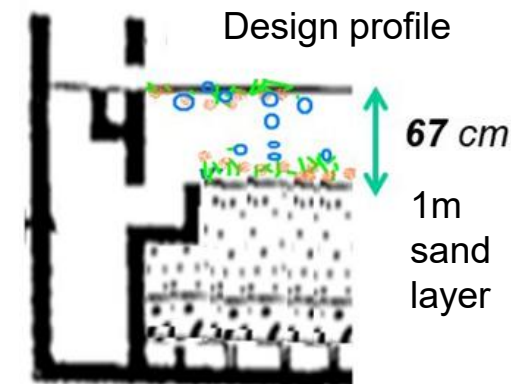
Large mud on
the bottom



Almost no
sand layer.




Shallower depth
Lifted algal mat with mud.

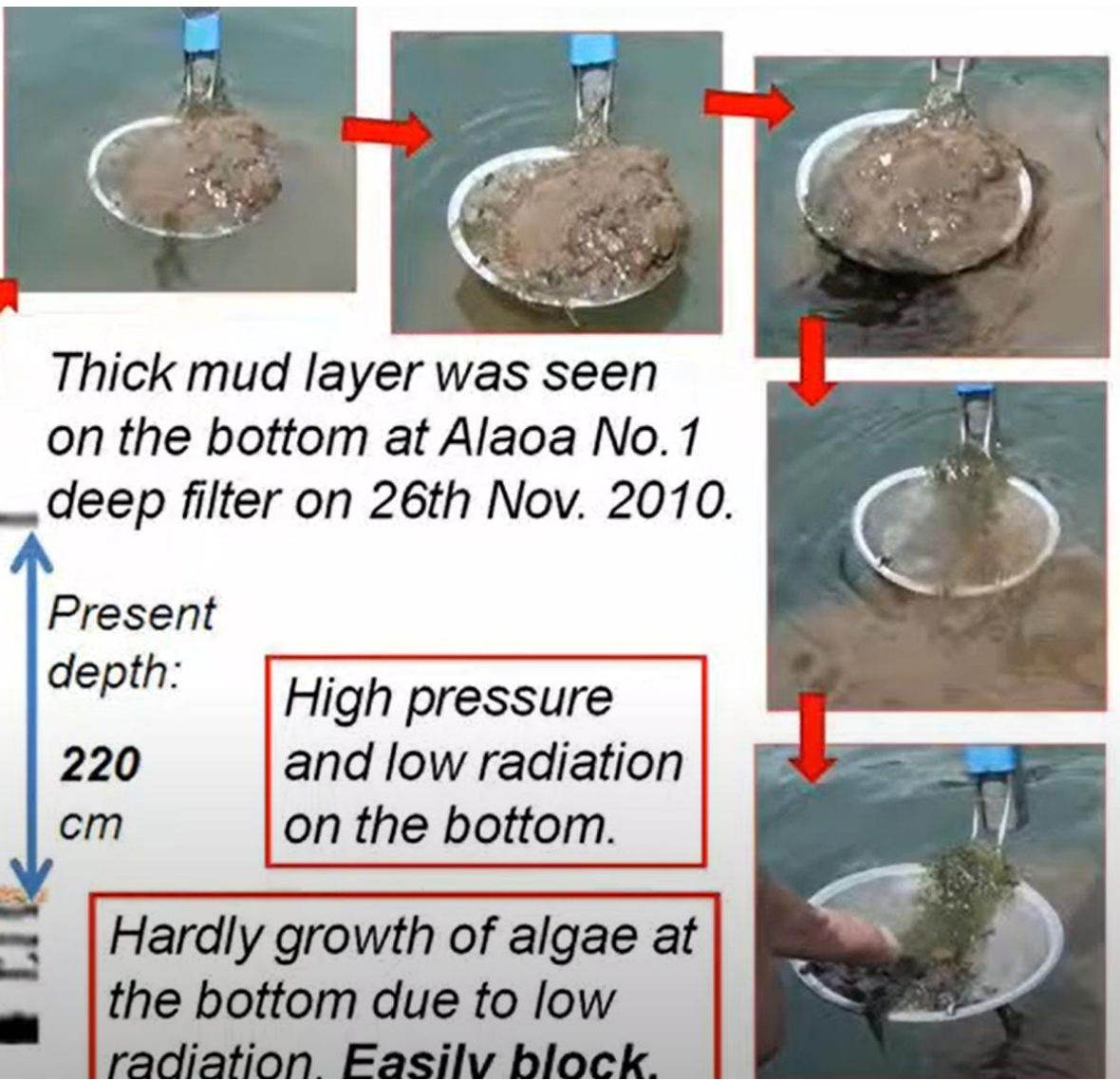


Shallow depth: Active
photosynthesis: much
oxygen bubble formation.

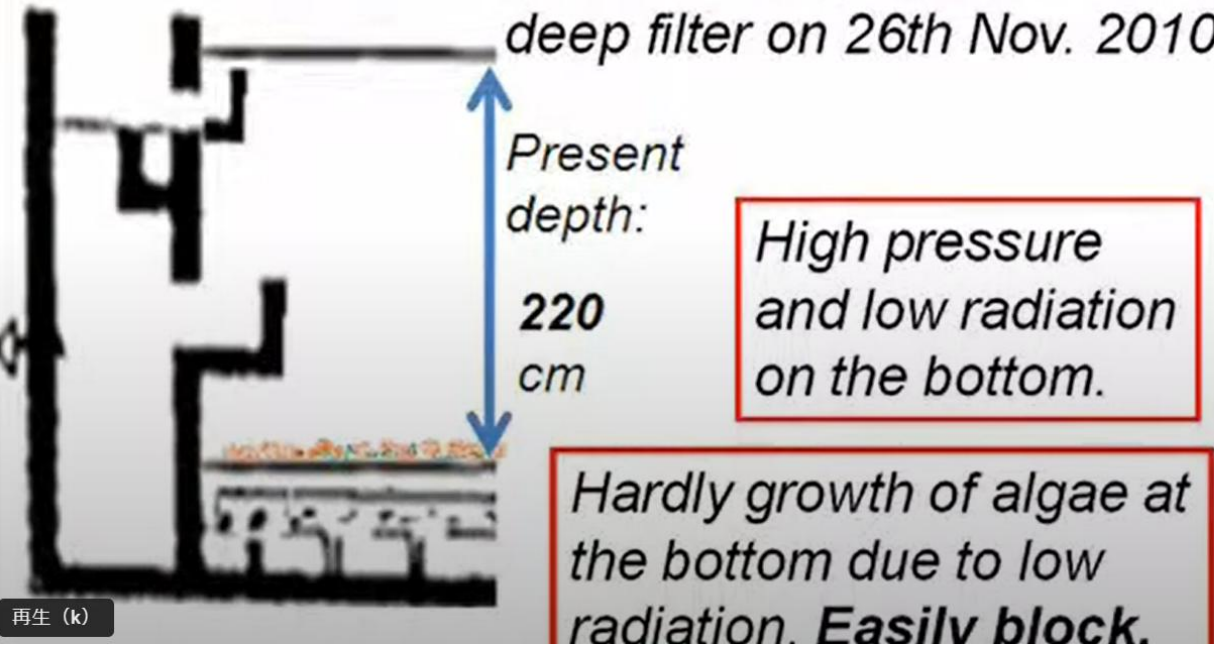
Shallow Water Depth is the Key for Ecological Purification System of a Filter Pond.



No floating algal mat.



Thick mud layer was seen on the bottom at Alaoa No. 1 deep filter on 26th Nov. 2010.



Present depth: 220 cm

High pressure and low radiation on the bottom.

Hardly growth of algae at the bottom due to low radiation. Easily block.

In shallower pond, algal mat lifts up by photosynthetic bubbles.



Role of algal mat in slow sand filter, shallow depth is key: experience in Samoa - YouTube/ 5:05

<https://www.youtube.com/watch?v=ot-KAm6TuaY>

Hardly growth of algae on the deep bottom.

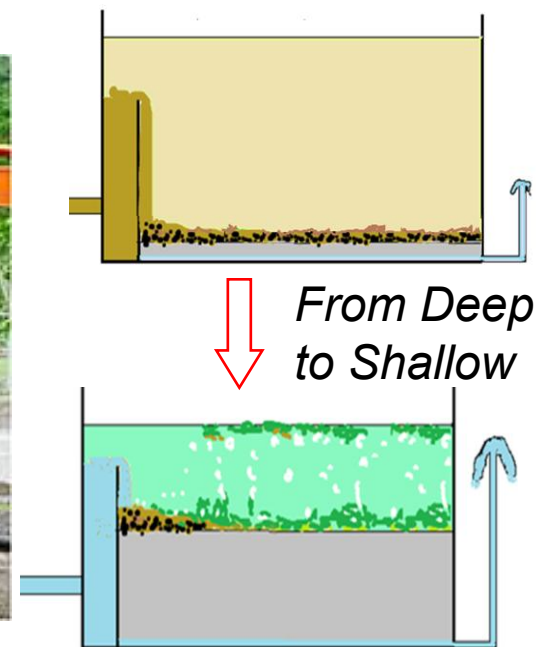
I advised to use beach sand and easy way to wash.



Beach sand near a river mouth was washed to make a shallow depth of slow sand filter pond.

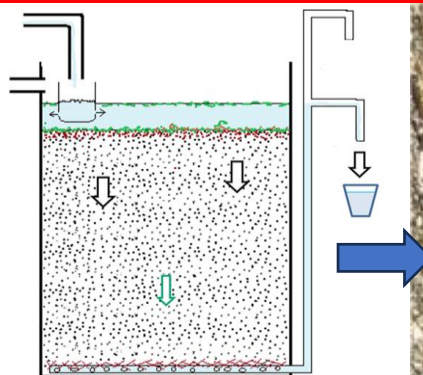
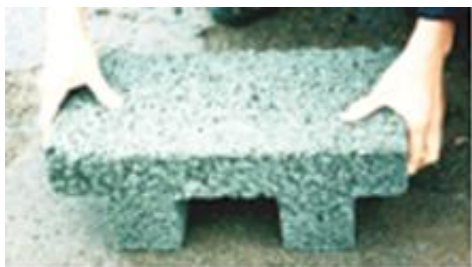


Put sand to make shallow depth.



I advised easy way to put the sand using a cloth seat.

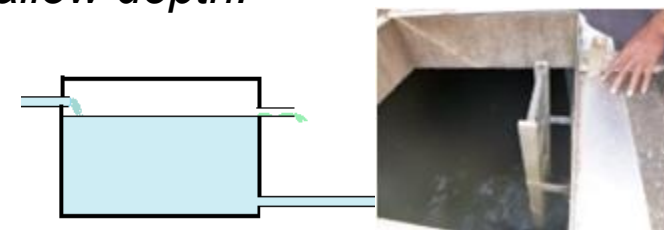
I knew there was only sand layer on bottom porous brick in slow sand filter pond in UK.



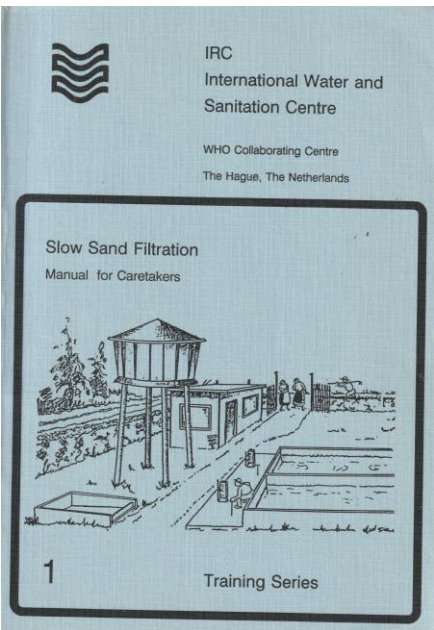
Mesh cover on a porous pipe



Only the sand was put on the gravel layer using a cloth to separate them.



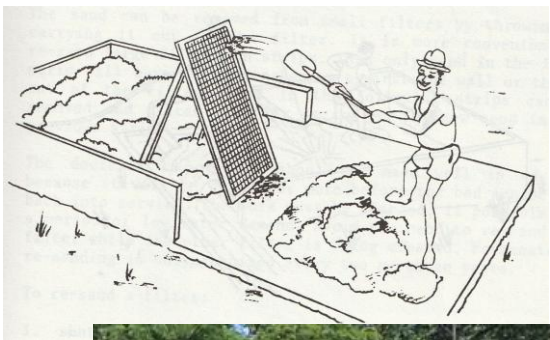
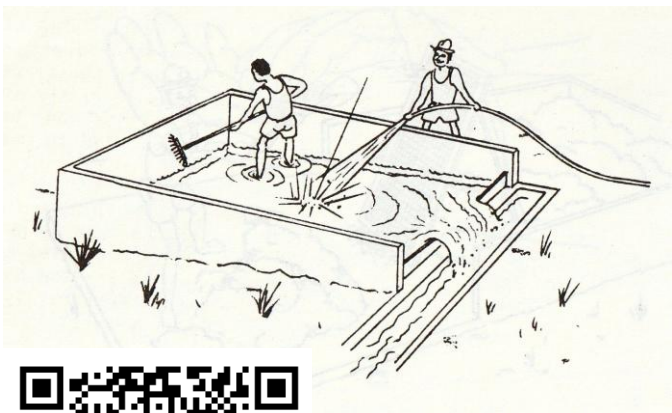
Over-flow from the balance tank for filtrate water.



IRC Slow Sand Filtration
Manual for caretakers



<https://www.ircwash.org/sites/default/files/255.1-85SL-1994.pdf>



From the video photo of friend of Samoa Water Authority.



How to wash the sand.
How to set the gravel layer
and sand layer.

<https://youtu.be/lfol8D3tAAc>

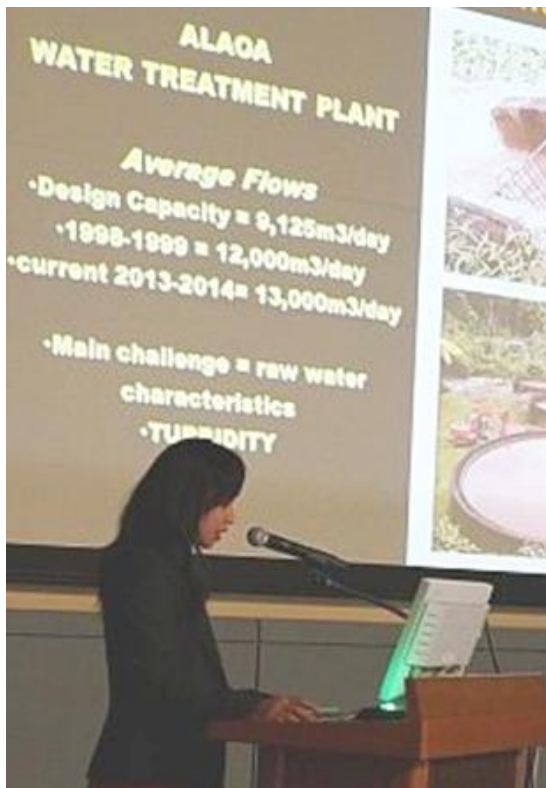
4 min:12"

June, 2025



Stuffs of Samoa Water Authority presented their activity at the 5th Conference at Nagoya, Japan in 2014.

They made shallow water depth of 0.5 - 1m.



CONCLUSION

- **Shallower water depth improves SSF Performance**
 - Increased uplift of algae
 - Increased sediment removal
 - Self cleaning process reducing scraping frequency
 - Reduction in SSF scraping – Reallocation of manpower





名古屋市上下水道100周年

The 100th Anniversary of
Waterworks & Sewerage of Nagoya



The 100th Anniversary of
Waterworks & Sewerage of Nagoya

5SSABC

第5回 緩速・生物ろ過国際会議 19th(Thu) June - 21st(Sat) June 2014

The 5th International Slow Sand and Alternative Biological Filtration Conference



The 5th International Slow Sand and Alternative Biological Filtration Conference

第5回 緩速・生物ろ過国際会議

■ Date : 19th (Thu) June - 21st (Sat) June 2014
■ Venue : Civic Reception House Nagoya, JAPAN



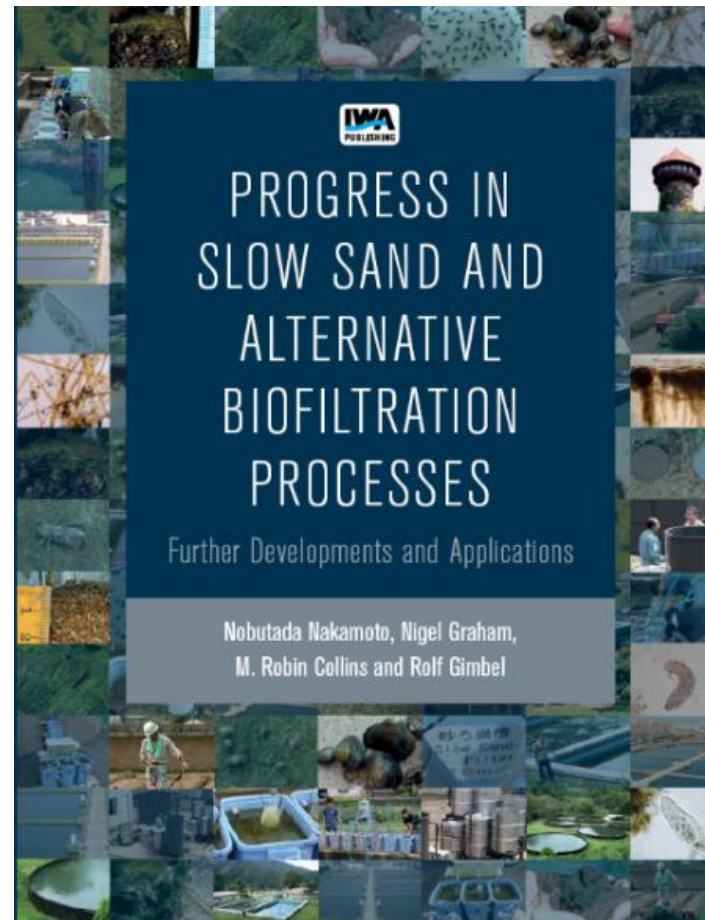
Professor
Nigel J.D. Graham
Imperial College London, UK
Chairman,
Program Committee



Professor
M. Robin Collins, Ph.D., P.E.
University of New Hampshire
Vice-chairman,
Program Committee



Professor (Emeritus)
Nobutada Nakamoto
Shinshu University, Japan
Vice-chairman,
Program Committee



PROGRESS IN SLOW SAND AND ALTERNATIVE BIOFILTRATION PROCESSES

Further Developments and Applications

Nobutada Nakamoto, Nigel Graham,
M. Robin Collins and Rolf Gimbel



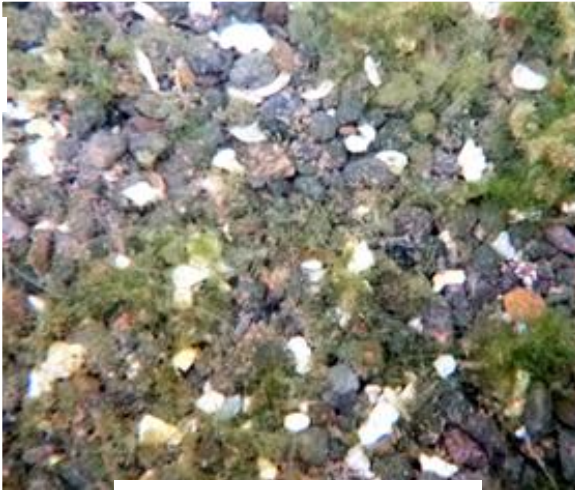
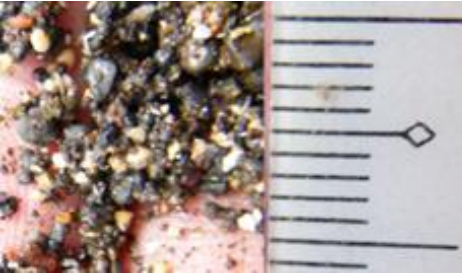
<https://www.youtube.com/watch?v=Wv1FxTkDfsM&t=2s>

5SSABC -
YouTube /
14:15

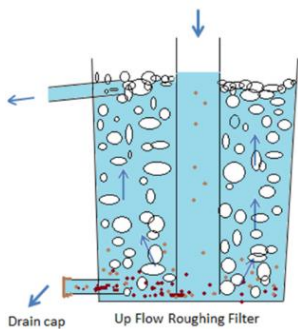
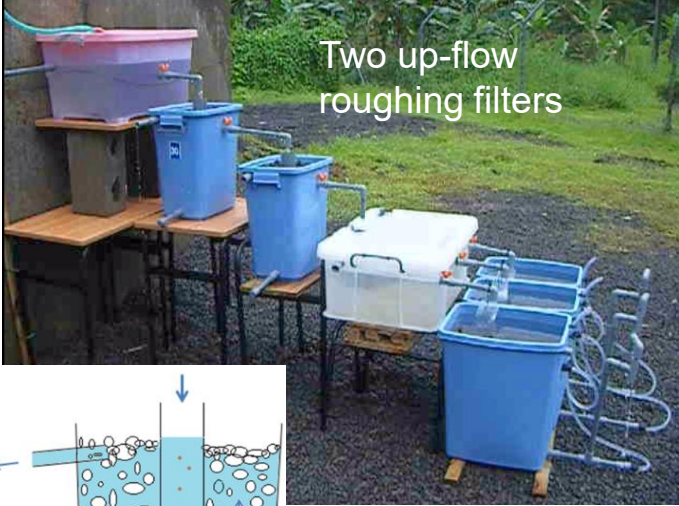
Biological activity is related with radiation and temperature.



Sand washed with mosquito mesh (1-2 mm)



Feb.7.(8th) 2013



Feb.14.(15th)

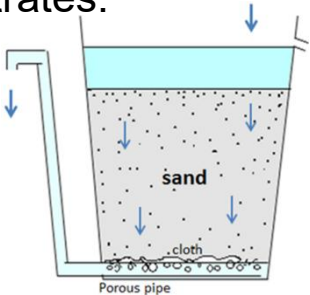
Shallow depth: Algae grow well

High flow rate experiment for the performance of slow sand filter was done in Samoa (tropical region) from Dec. 2012 to Feb. 2013.

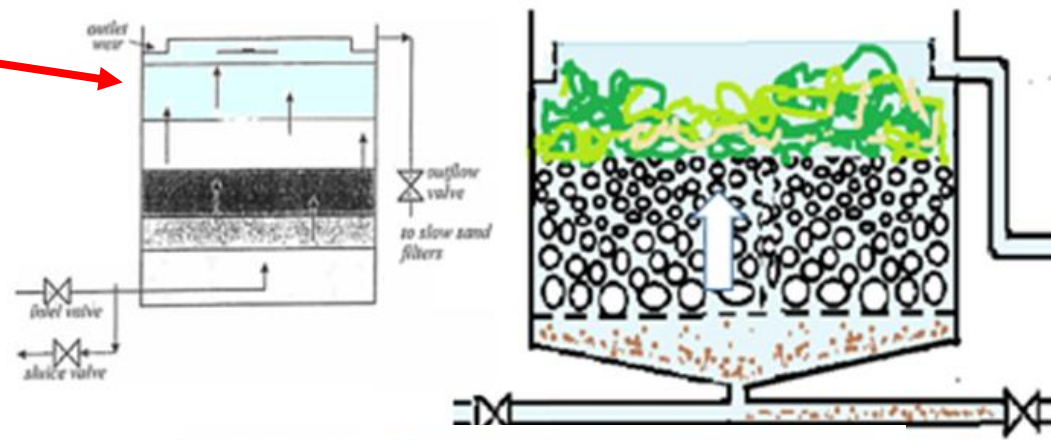


Different flow rate of sand filters (5m/d, 10m/d, 20m/d)
All good quality of filtrates.

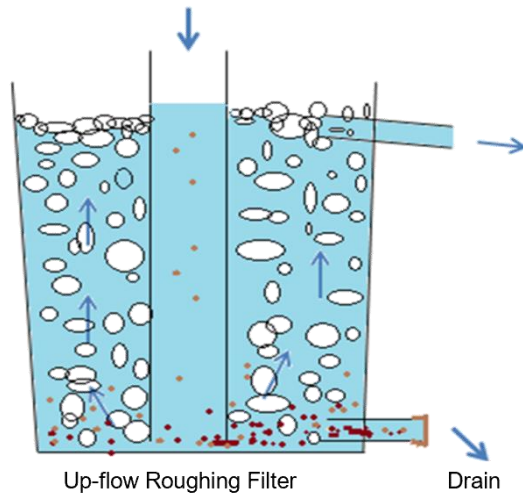
Points:
shallow depth,
enough radiation
on the bottom,
rapid growth,
large size of sand.



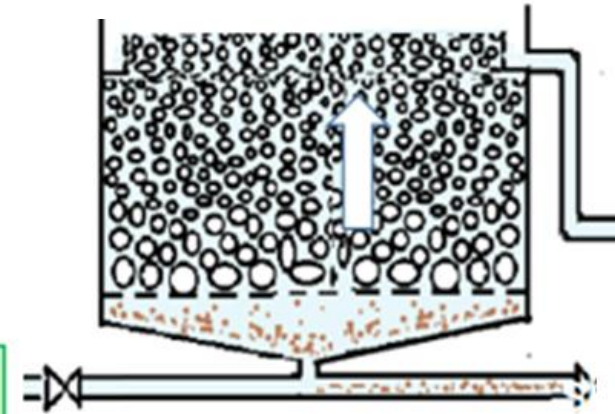
Dorsch 1 m



Clear water in river bed in enough area of gravel surface.



Active growth in URF



Full gravel with small crushed stones.

In order to expand adhesive area of stone surface for suspended matter in raw water.

Large area of gravel surface is important to adhere suspended matter in URF.



Putting the gravel to URF was continued in March, 2026.

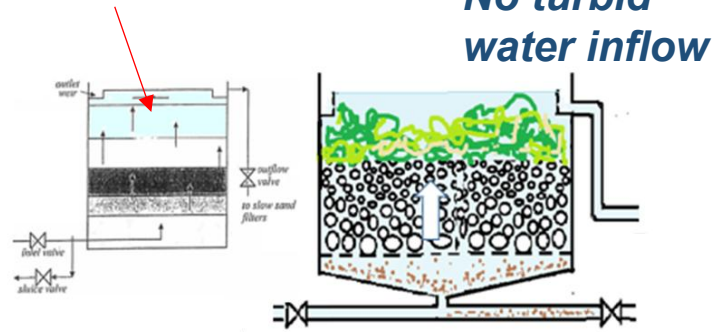


5 SSFs were built *during 1984-87 in Samoa*. 2 settling tanks and 4 URFs were built in 2000 to reduce extraordinary heavy turbid inflow. However, this pre-treatment was not enough.

SWA Facebook (2026/5/5)



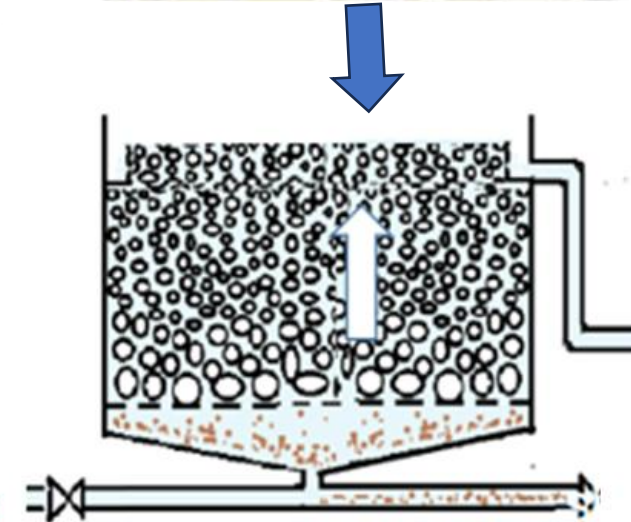
URF in German Manual
1 m above gravel layer



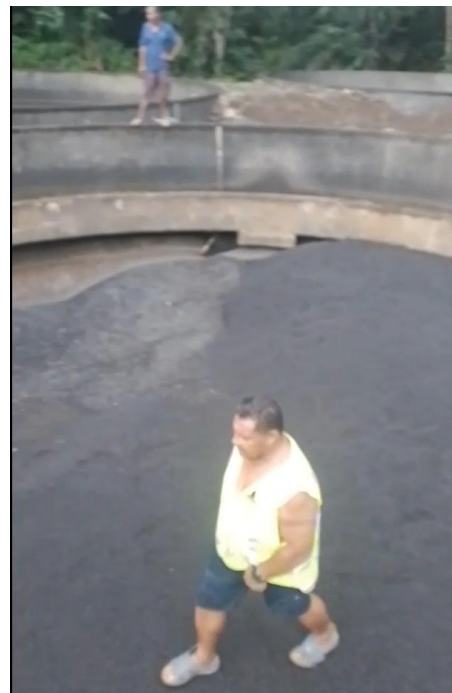
Active growth in URF



Clear water in river bed in enough area of gravel surface.



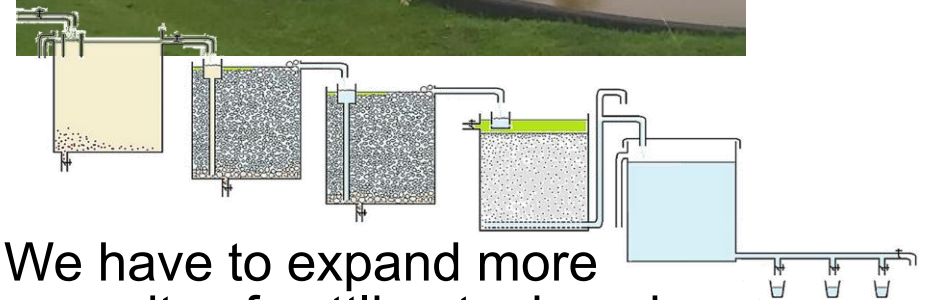
April 21. 2025



1min 58sec.

<https://youtube.com/shorts/1nna1brMkyY>

Capacity over load for existing pretreatment.

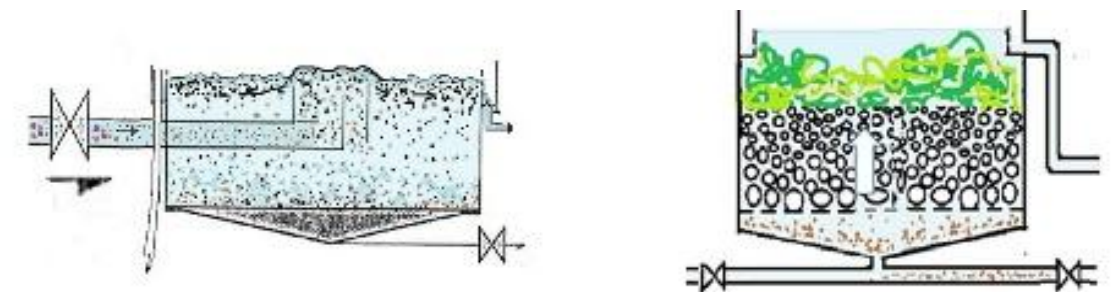


We have to expand more capacity of settling tank and additional several steps of URF.

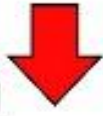
May 19. 2026 Heavy rain



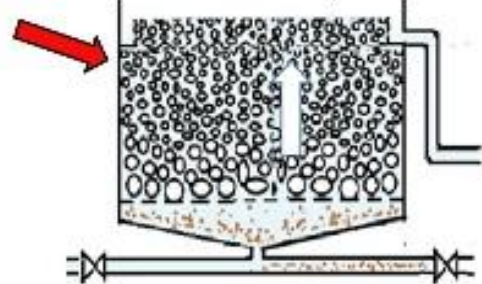
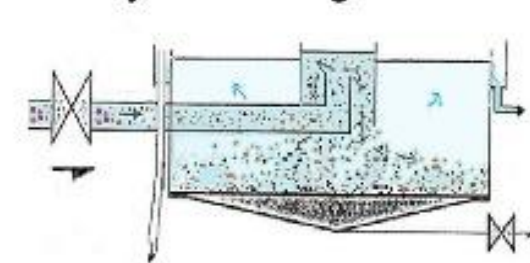
Advise for a better plant system to Samoa



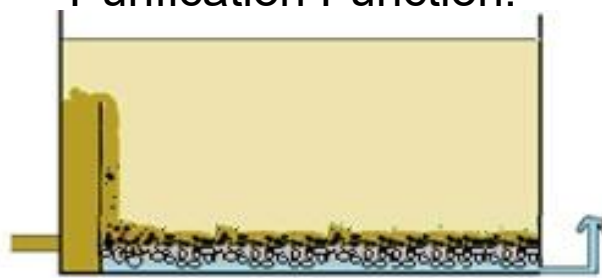
Reduce inflow
⇒ Easy to settling



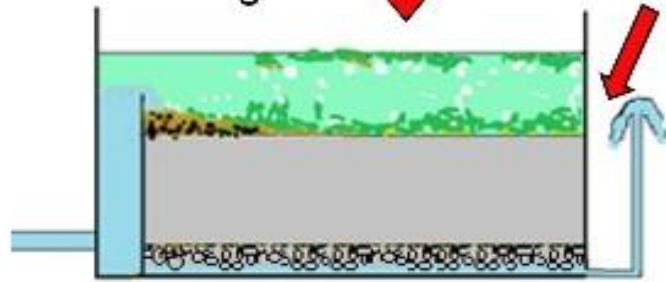
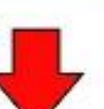
Thicker gravel media
⇒ Expand active area



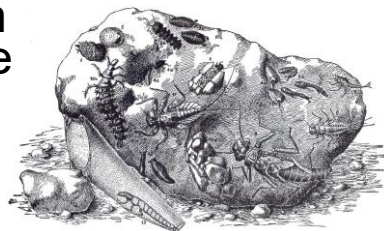
Improvements to the Purification Function.



Make shallow depth
⇒ Activate algae

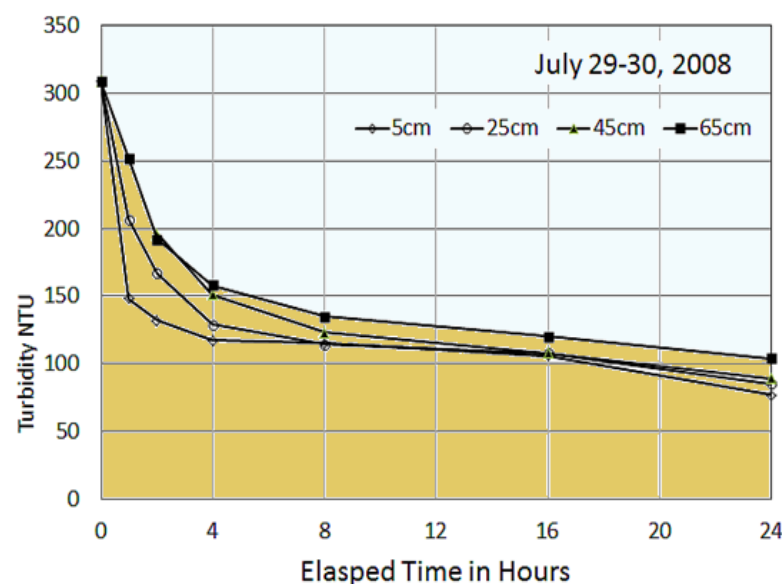
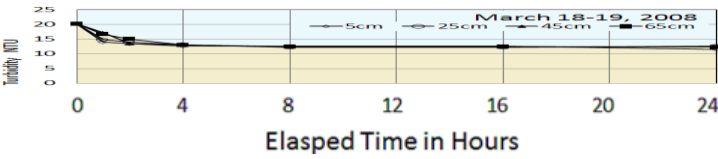


Small organisms active on the stone surface.



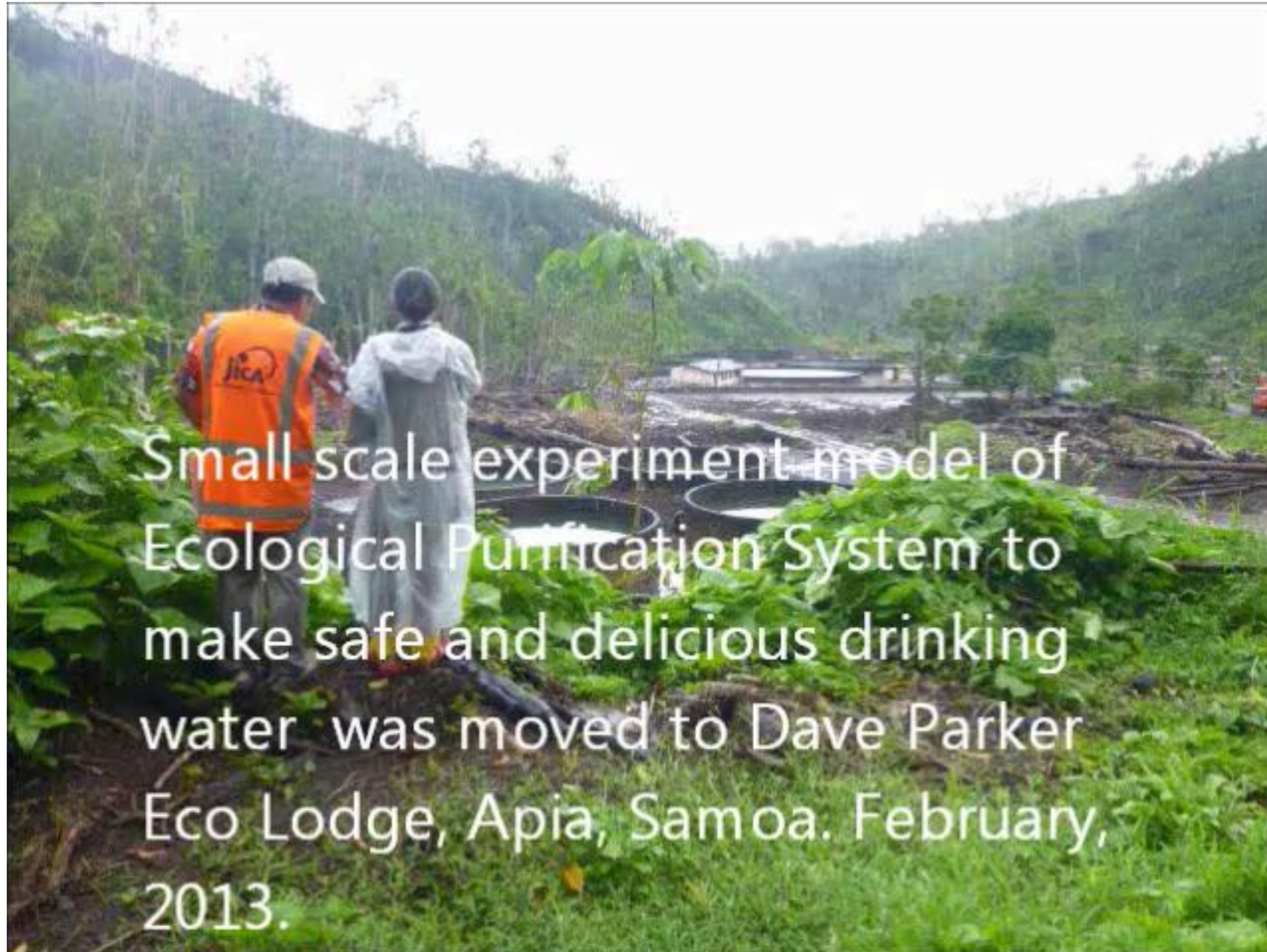
Suitable residence time for settling

Clear water



Shallow depth is better for algal activity.





Small scale experiment model of Ecological Purification System to make safe and delicious drinking water was moved to Dave Parker Eco Lodge, Apia, Samoa. February, 2013.

<https://www.youtube.com/watch?v=YsITuNHXxZg&t=112s>

4 min 24 sec

