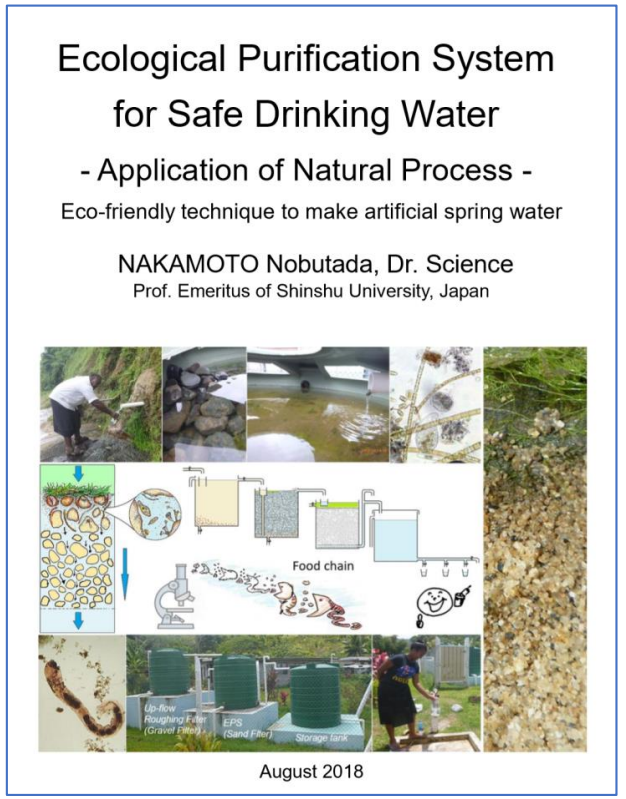
EPS Public Seminar/Workshop 11:30-12:30 Principle of EPS, Q&A

Ecological Purification System for Safe Drinking Water

- Application of Natural Process -

NAKAMOTO Nobutada, Dr. Scinece
Prof. Emeritus of Shinshu University

Eco-friendly technique to make artificial spring water



http://www.cwsc.or.jp/files/member_lmtd/doc25.pdf

Previous Principal Engineer Reguratory of DWS, Mr. Manasa Biusaya passed away on the last April 3rd, 2018, almost one year ago at the age of 48 years.

After his retirement in 2017, he passed away in the last year.

Director of DWS, Mrs. Susana Pulini Valemei passed away on this January 3rd. 2019 at the age of 34 years.

20180807 Noumea, New Caledonia at Pacific Water and Wastewater Conference & Expo 2018

These two unexpected events are so sad in my mind, in our mind.

I believe that they are watching Fijian EPS project from the heaven.

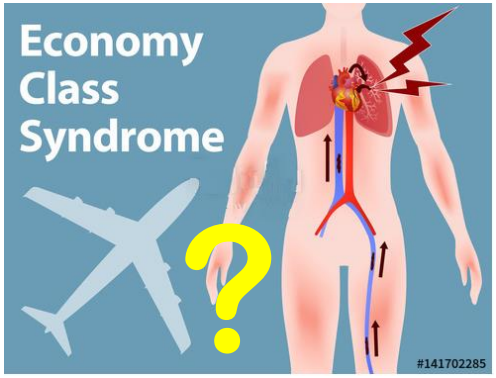
http://www.cwsc.or.jp/files/member_lmtd/doc25.pdf

At the first, I have to tell about my health problem.

Early in the morning till midnight
Wrestling with PC for a long time.

Like a statue

It does not move but
it lasts for a long time.



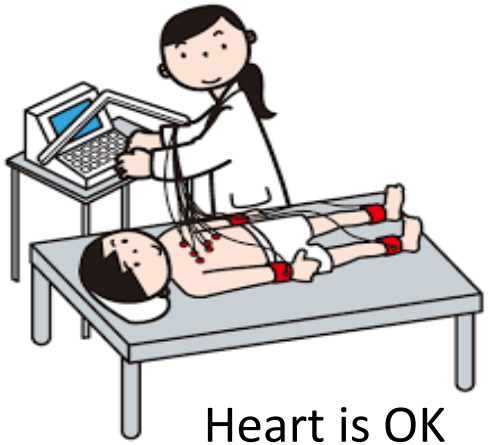
Something smothery

Last
December

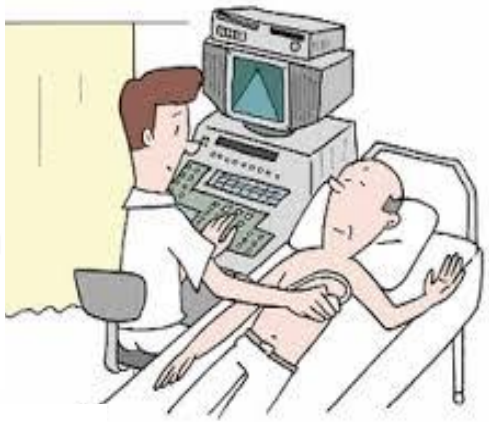
http://www.cwsc.or.jp/files/member_lmtd/doc25.pdf

huh!

Lung function is 95 yrs.



Heart is OK



Then, Acupuncture of Oriental medicine

Lung is normal by CT

Cause unknown in Western medicine

Looks a little nice

It's not easy to recover my body

Then, I give up my travel in abroad.

http://www.cwsc.or.jp/files/member_lmtd/doc25.pdf

1984.4.～
Ueda
Japan
Someya, Ueda, Nagano
Sendai
仙台
Tokyo
東京
Nagoya
名古屋
Osaka
大阪
Hiroshima
広島
Fukuoka
福岡
Busan
부산
From 2006, JICA training in Okinawa
Ishigakishi Water Treatment Plant
石垣市浄水場
Sodeyama
Ishigaki
Nago
名護
Naha
那覇
Miyakojima
宮古島
Okinawa
Ishigaki
石垣
Taketomi
竹富町
Taipei
台北
Taiwan
2011.8.
Super clean delicious water

Ueda city is located in the center of Japan where is surrounded by mountains.

Intake point

River Kangawa

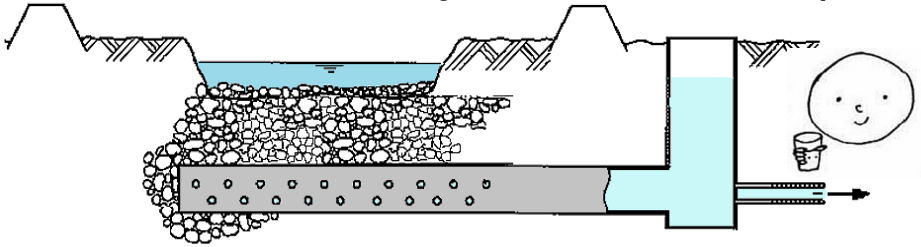
Intake point

Someya Water Works

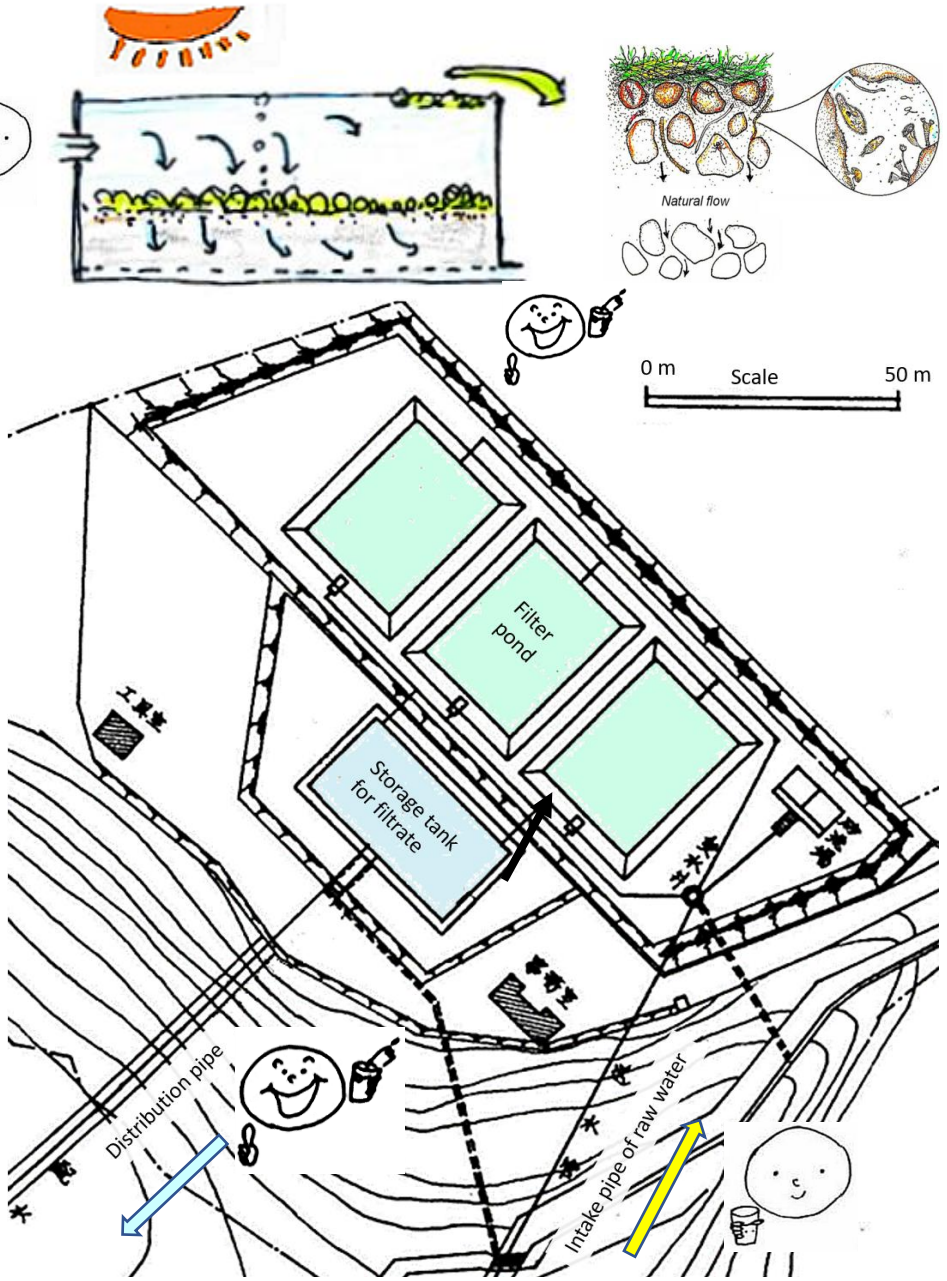
River Chikuma

Ueda city

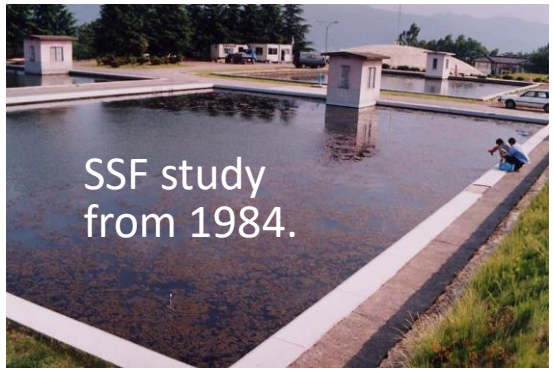
Clear water is easily found in a flood plain.



Subsurface intake system is the best for raw water to a filter plant.

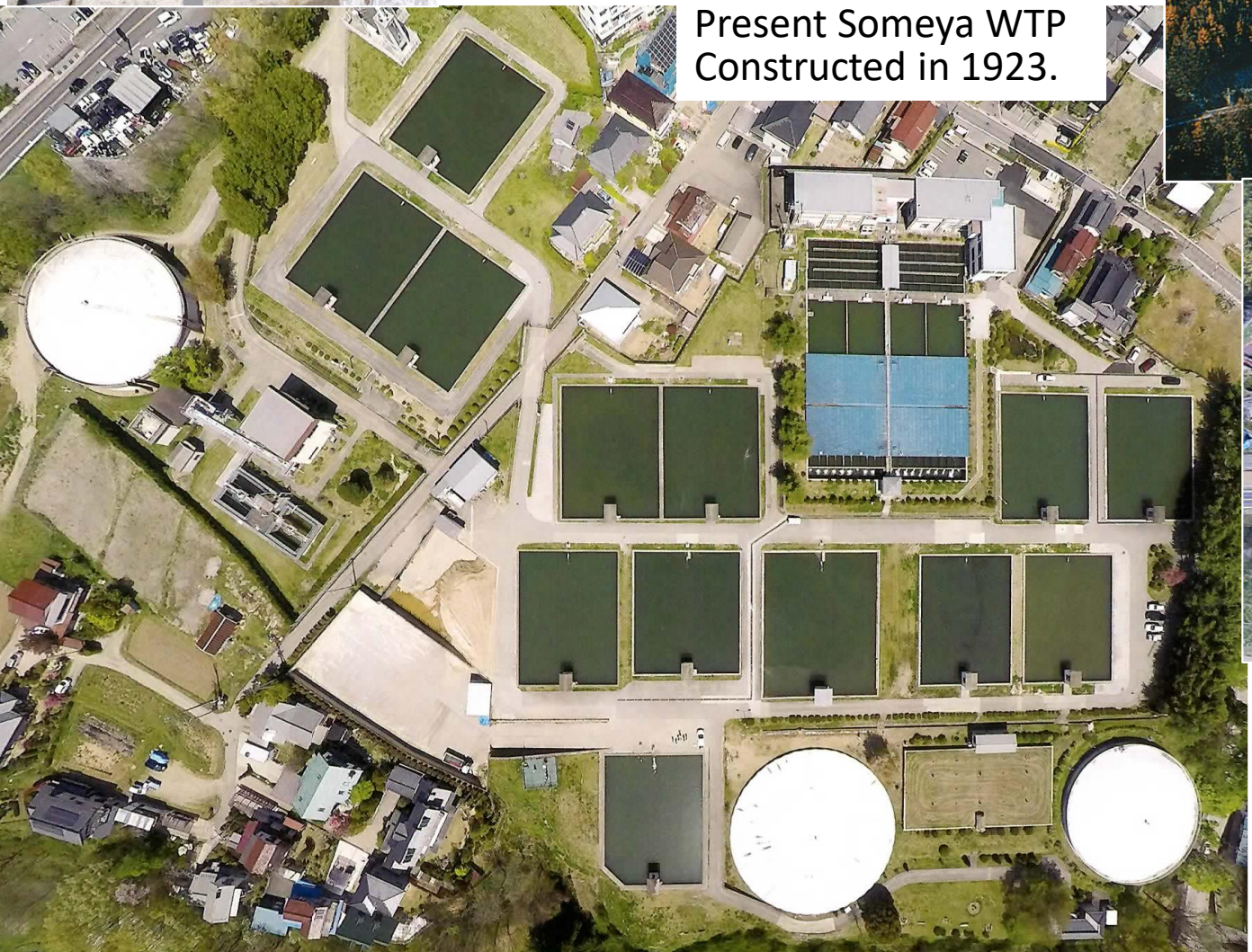


Someya Filter plant was constructed in 1923 in Ueda city.

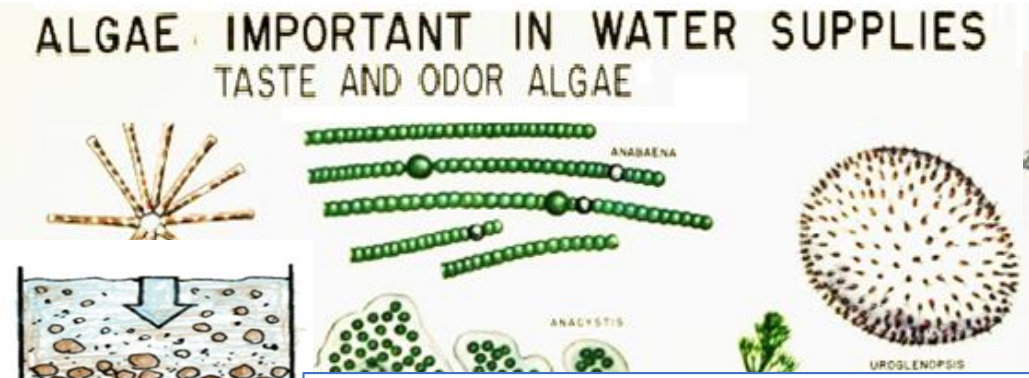


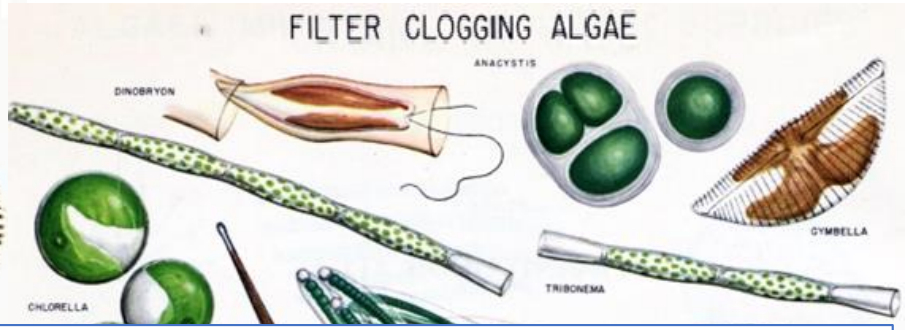
Sugadaira reservoir was constructed in 1968.

Present Someya WTP
Constructed in 1923.



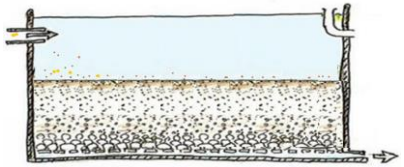
Intake point was changed from the river Kangawa. This is present main water source.





Algae had been trouble for the conventional filter (rapid sand filter) in US. Taste and odor algae, filter clogging algae are important in water supplies (Rapid Sand Filter).

Algicide



Mechanical filter

After the construction of a reservoir, odor problem happened.

Dissolved odor substances are passed through the sand filter.

Algae grew well after the stop of the chemicals.

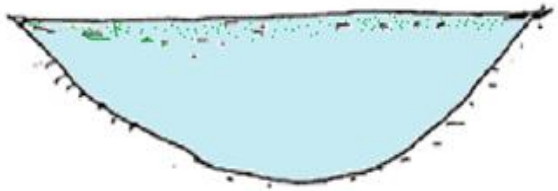
Filtrate became delicious.

I studied "Role of algae in SSF" with my students from 1984.

Filamentous algae dominate in a shallow slow sand filter pond.

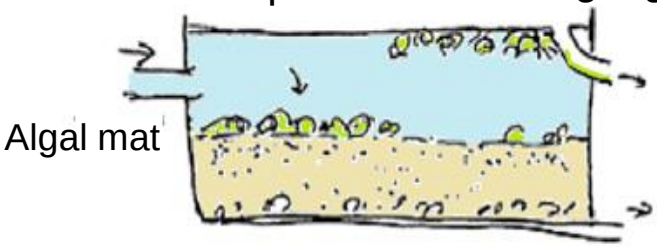
Filter pond where is slow down-ward current is the suitable environment for filamentous algae.

Pond / Lake



Stagnant water

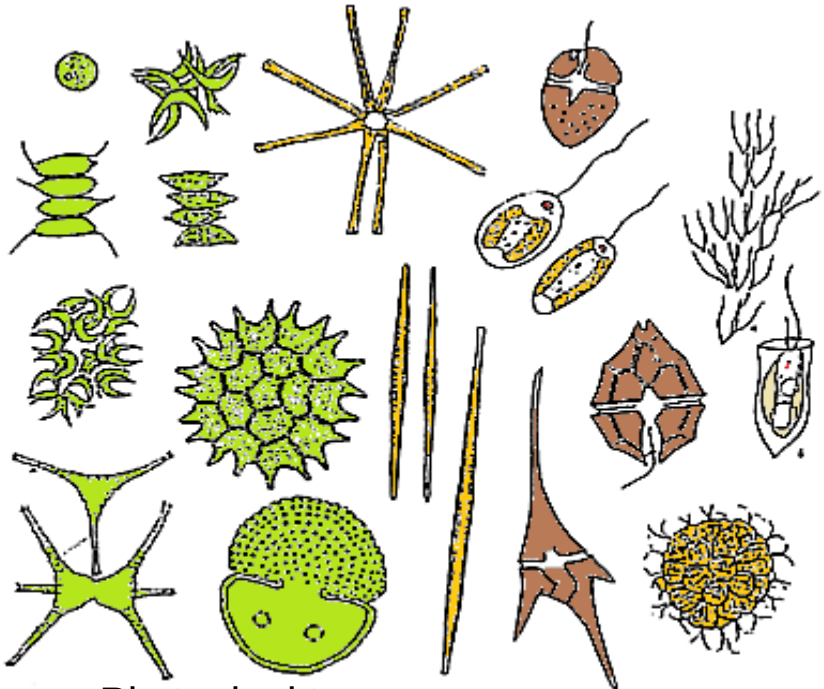
Filter pond *Floating algae*



Slow downward current

Stream

Running water, but unexpected flush out by storm event



Phytoplankton

Floating algae

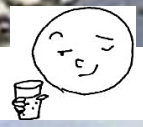
Filamentous algae

Periphyton

Attached algae

Suitable algae grow in that environment. But this algae die in un-suitable site.

Growth ⇒ death ⇒ algicide=bad smell (odor) : don't kill algae



Clear surface water turns to muddy water by a storm event.

Muddy water is something risky. This water is not suitable to drink directly.

River Chikuma in Ueda city.

After heavy rain, river water change colour from clear water colour to brown

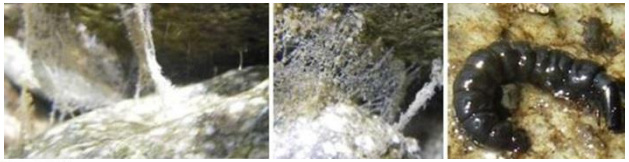
Mechanical Clean Up

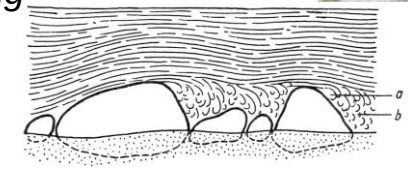
After heavy rain, muddy soil washed away and flew into a river from the water catchments.

Small animals are washed away after heavy rain

Natural Water Purification by Biological Community.

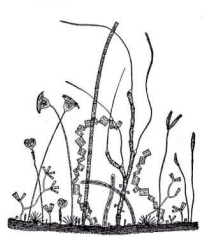
*Sand, stone and rocks **don't role and move** in a small creak among dense forest.*

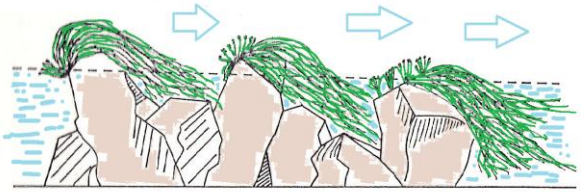


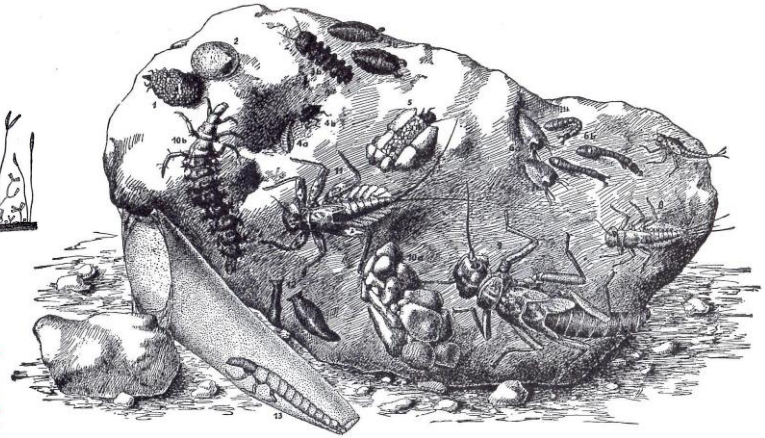


Small animals on the surface of rocks collect turbid matters.

When plants and animals do not flush out, water is always clear.





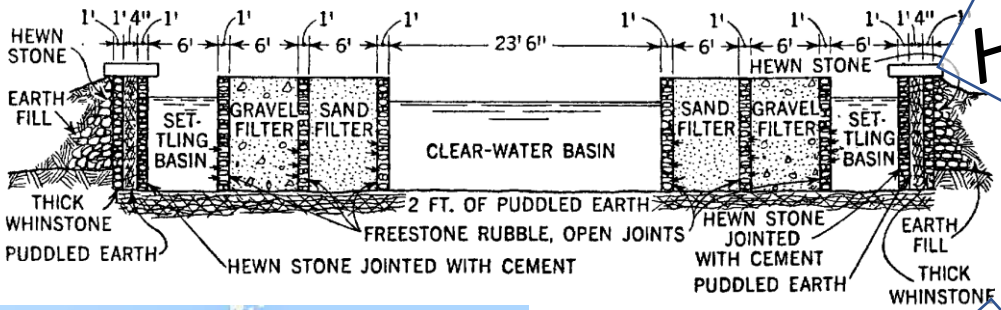


The history of the modern water purification system is only 200 years.

Origin of Slow Sand Filter

John Gibb *in* ***Paisley near Glasgow****, Scotland. He made an artificial clear seepage water of the flood plain in 1804, in industrial period.*

Horizontal



James Simpson (1799-1869)
Chelsea Water Works Co., in London: **1829**.

James Simpson made "**2,000-mile inspection trip**" all over the Britain.

Vertical

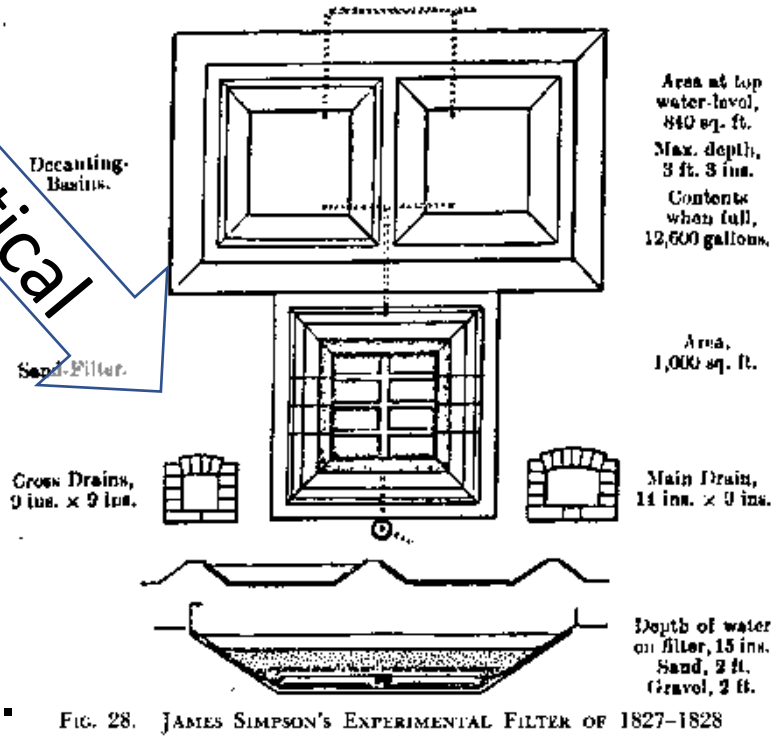
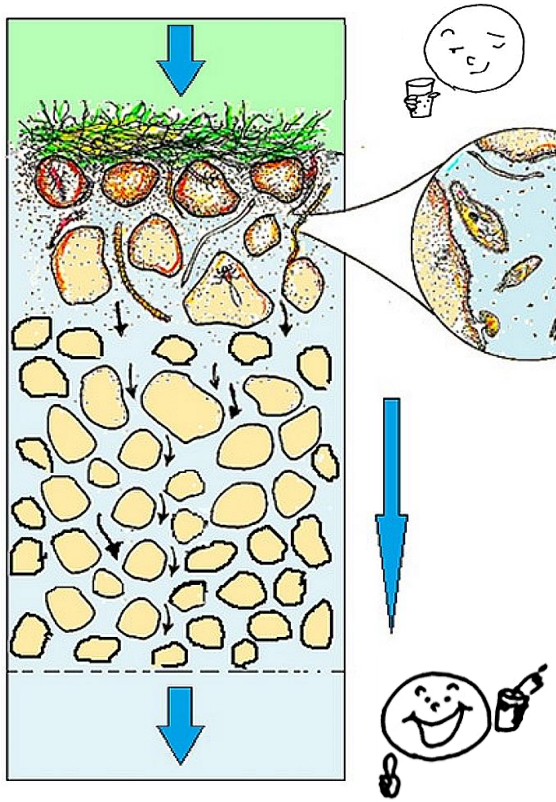


FIG. 28. JAMES SIMPSON'S EXPERIMENTAL FILTER OF 1827–1828

Original filter rate was 2-3 m/d (10cm/h).



THIS is FOOD CHAIN

1) The present vertical type of slow sand filter provided safe drinking water, free of pathogens to residents in London.

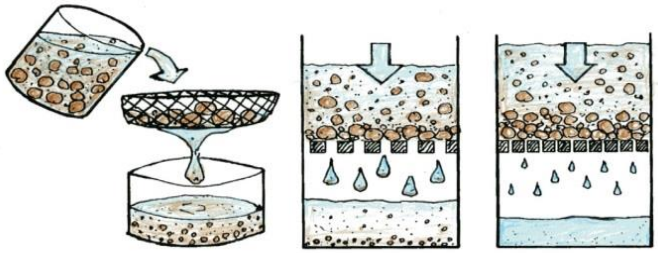
2) Slow sand filter has been believed that it was a mechanical filter with fine sand under slow current.

3) However, the major contribution of the purification of the impurities is the food chain in this system.

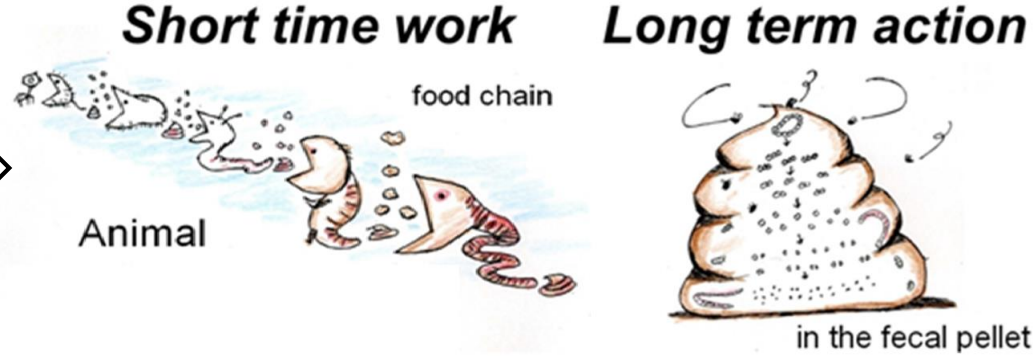
4) The word of "**slow**" was "**gentle for organisms**". Recently, "**Slow Sand Filter**" has been recognized as "**Ecological Purification System**" in Japan.

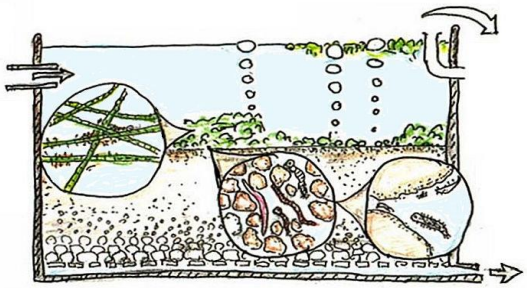
New Concept and New Name

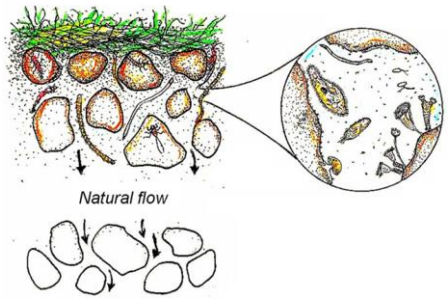
Slow Sand Filter → *Biological Filter* → ***Ecological Purification System***

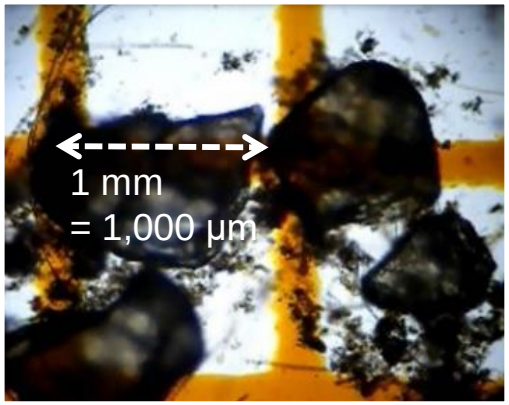


English Filter : Mechanical filter

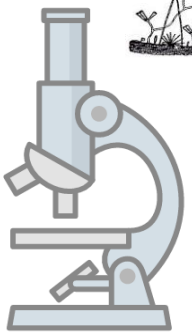


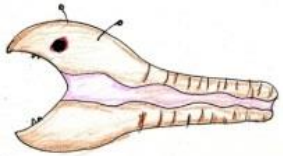


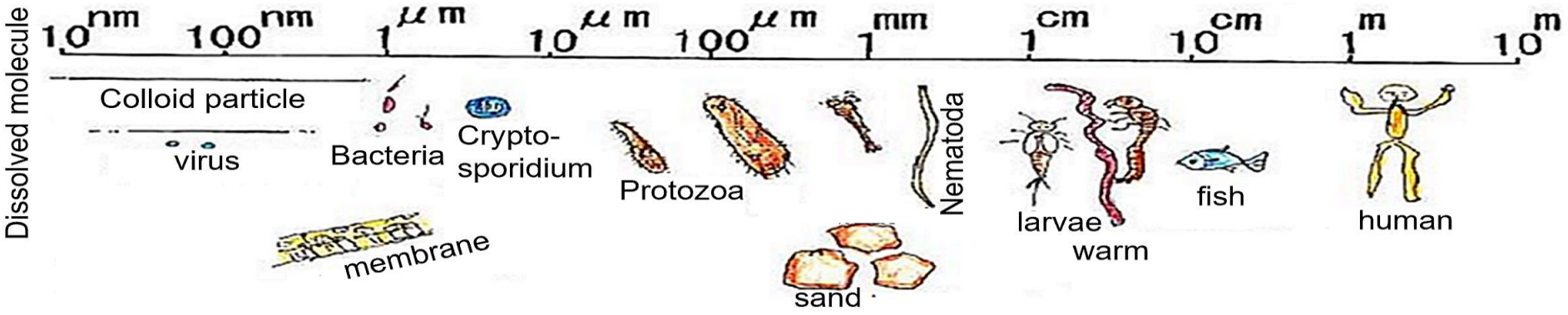




Food chain by small animals is the key for purification system.



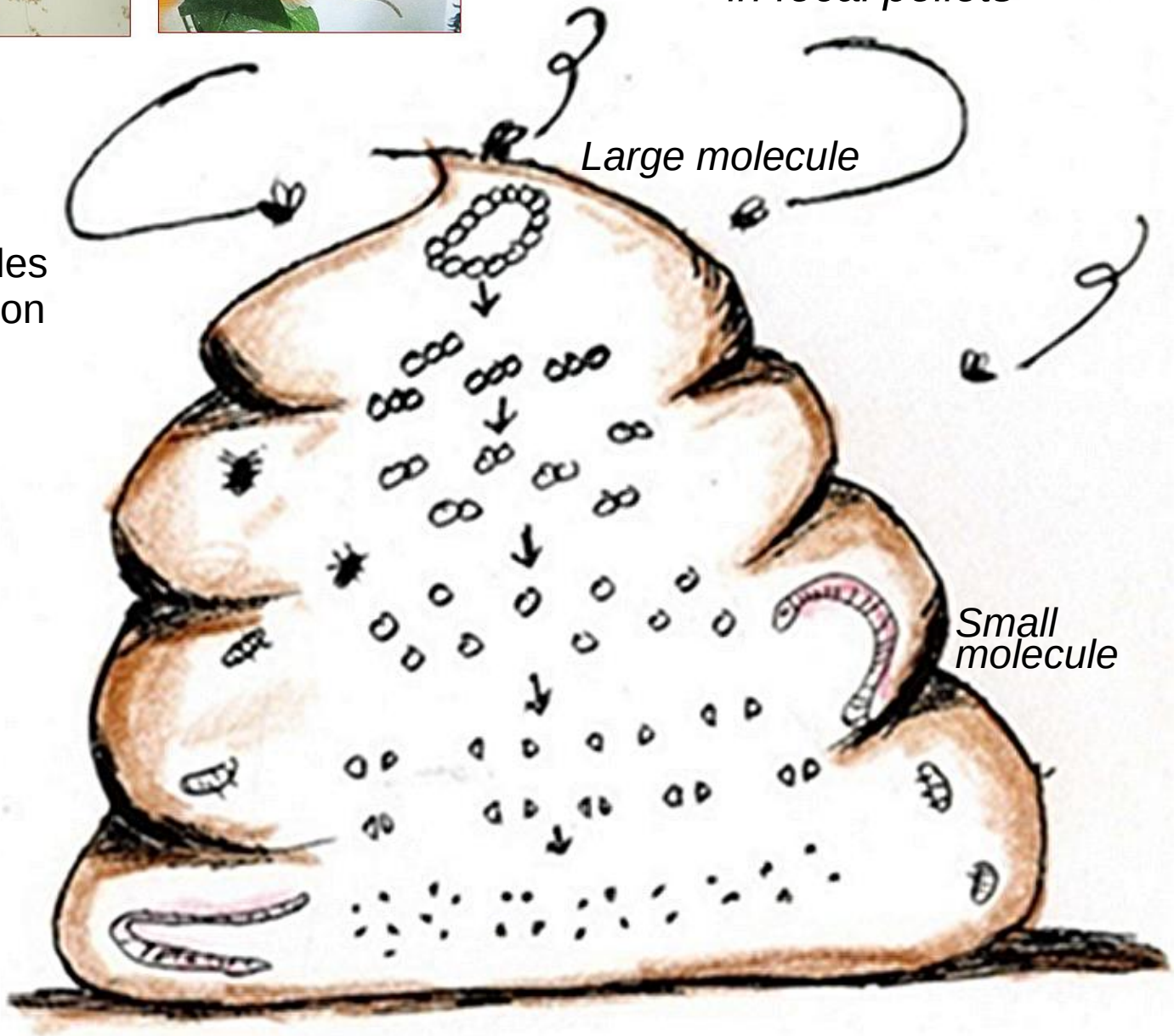




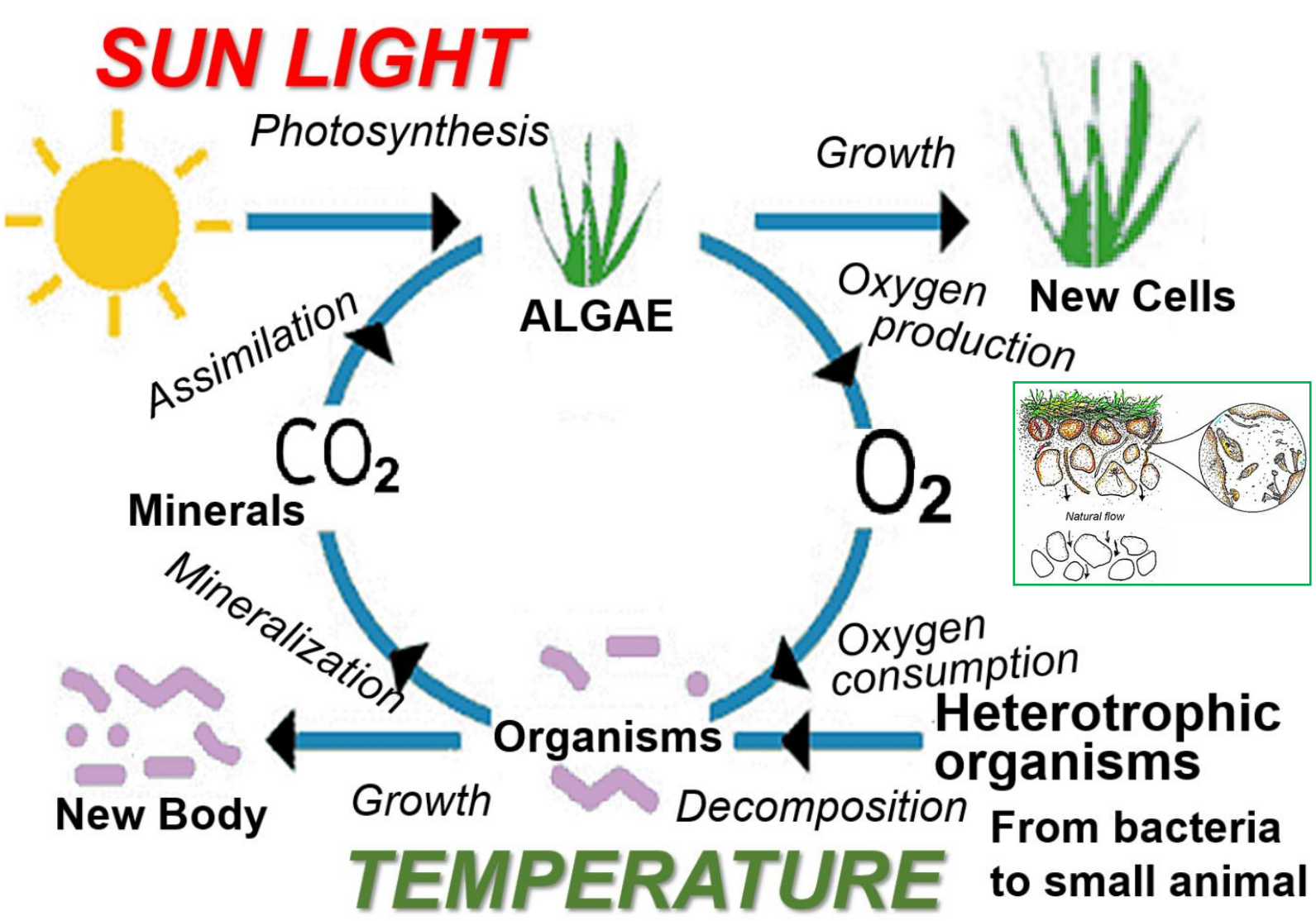



Decomposition and fermentation in fecal pellets

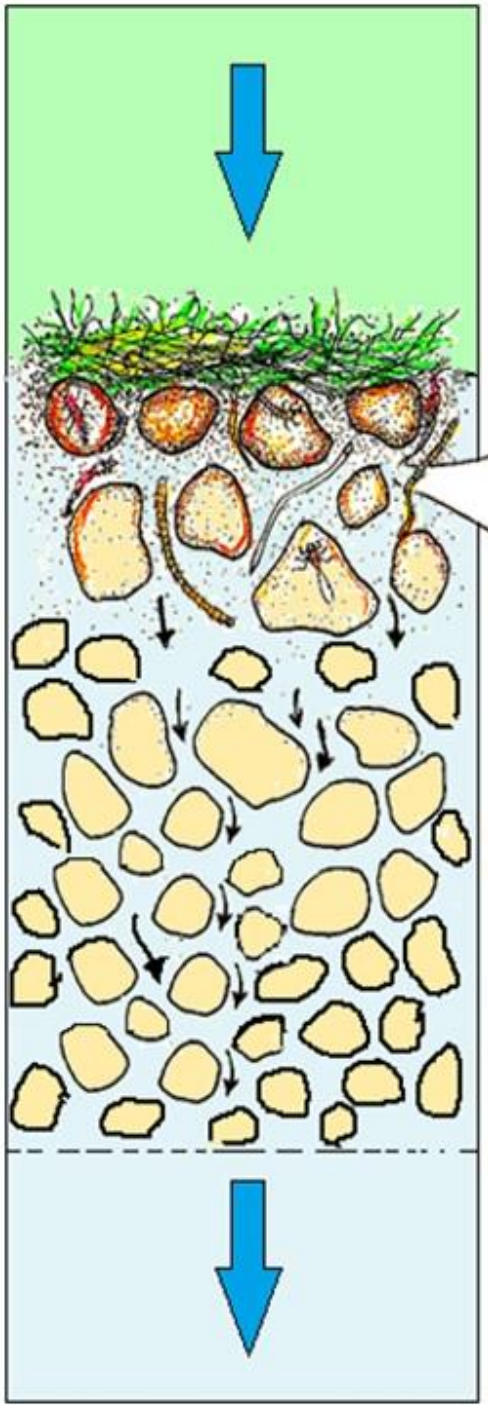
Large molecules are broken to small molecules under anaerobic condition in fecal pellets.



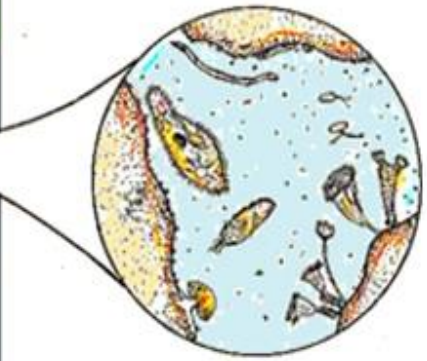
Symbiotic relationship between bacteria and algae in water



Algal photosynthesis relates to solar radiation and the activities of bacteria and animals relate to temperature.



English standard filter rate
4.8m/d (20cm/h)



When the porosity is 50% in sand layer, filter rate becomes double.
9.6m/d (40cm/h)

English standard filter rate
4.8m/d (20cm/h)

Passing time during biological active layer is very short.

Purification is done during the passing time of 1 to 2 minutes through the biological active layer.

Purification time is very short near the surface.

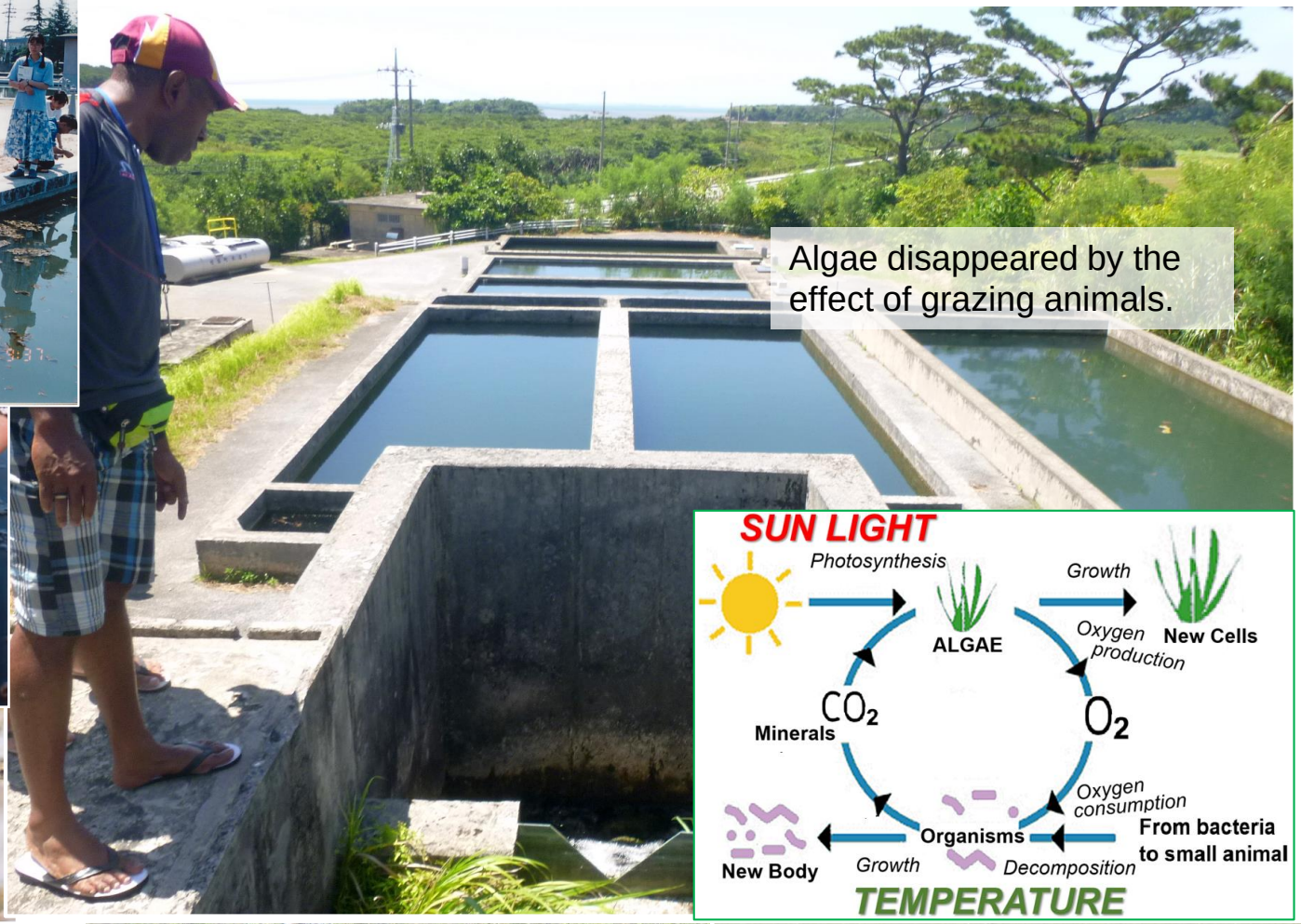
Guarantee and insurance layer for emergency

“Slow” means **“Gentle for living organisms”.**

The real mechanism has been mislead by the name of “Slow sand filter”.

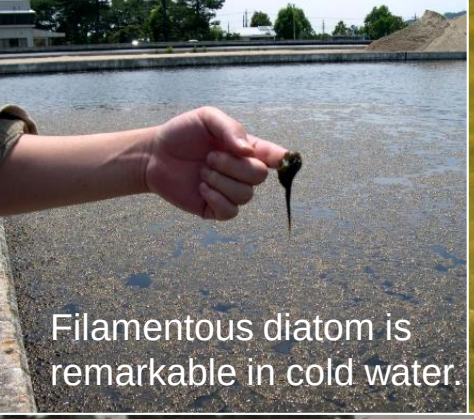
Ecological Purification System

Filamentous diatom is remarkable in cold water.

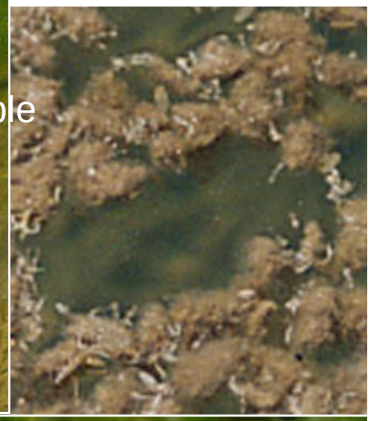


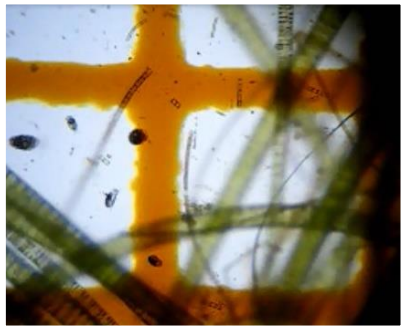
Algae disappeared by the effect of grazing animals.

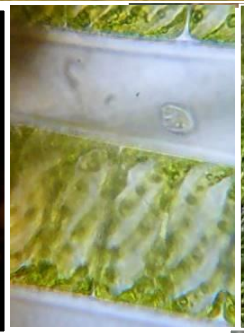
Grazing animals are active in warm period and region.


Filamentous diatom is remarkable in cold water.

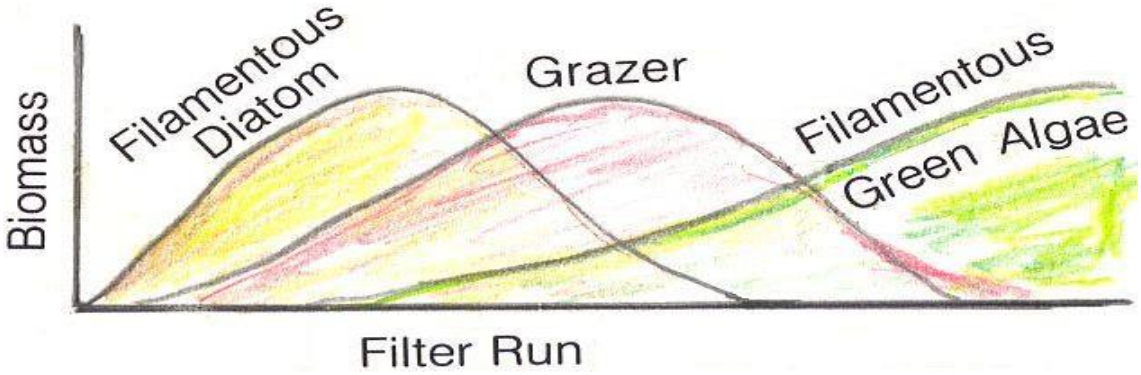
Casting skin of midge(*Chironomid*) and adult midge are remarkable in warm water.







Filamentous diatom was grazed up and filamentous green algae are remarkable in warm water or in case of long filter run.



At the beginning, filamentous diatom dominates. However, filamentous green algae becomes dominant during the long filter run.

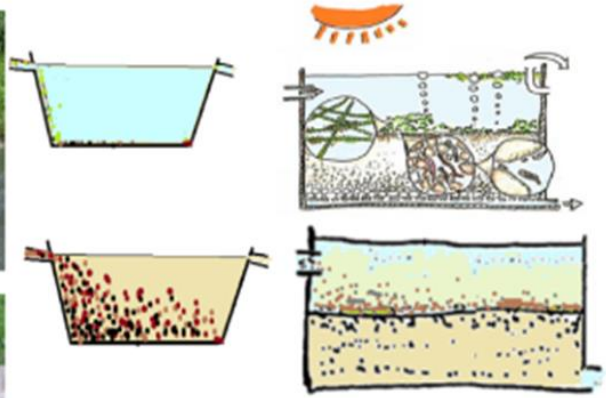
After diatom is grazed by small animals, filamentous green algae (*Cladophora, Spirogyra, Hydrodictyon, etc.*) are remarkable. These green algae have hard cell wall and larger size. After that , Mollusk appears as a grazer of green alga.

Trap and decompose layer by microscopic and small organisms

Insurance layer for adhesion of leak matters from biological active layer near surface.

Mr. Vishwa Jeet participated JICA Okinawa training in 2011. He transferred new EPS to Fiji.

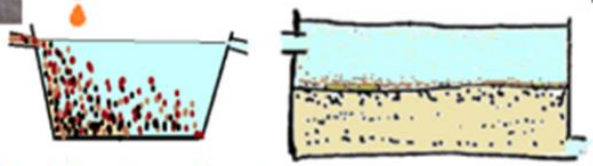
Delicious spring water



Ecological Purification System is functioning to make safe and delicious drinking water.

The filter was blocked with turbid matter. Sedimentation basin is not so effective to remove colloidal matter.

Coagulant was used for turbid water.



IS THE WATER SAFE TO DRINK?

By Robert H. Harris and Edward M. Brecher, and the Editors of Consumer Reports

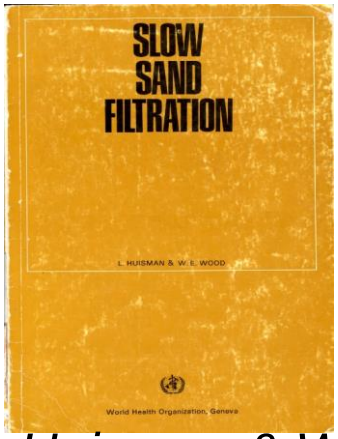
PART 1: THE PROBLEM

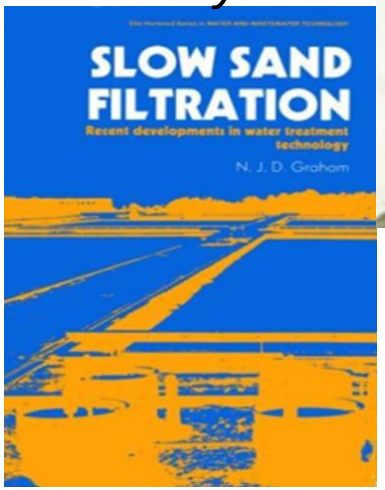
Harris pointed out on cancer risk by chlorination in 1974.

***Chlorine dose** to kill germ bacteria.*

Ecological Purification System is weakened by chemicals.

Refocus to Safe treatment system by chemical free





N.J.D. Graham

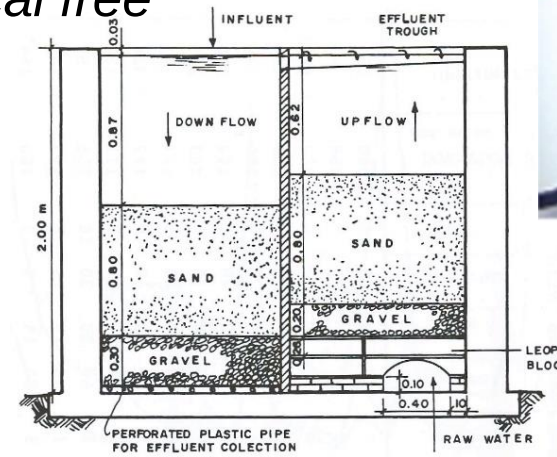


FIGURE 1 - UPFLOW AND DOWNFLOW FILTERS (2)

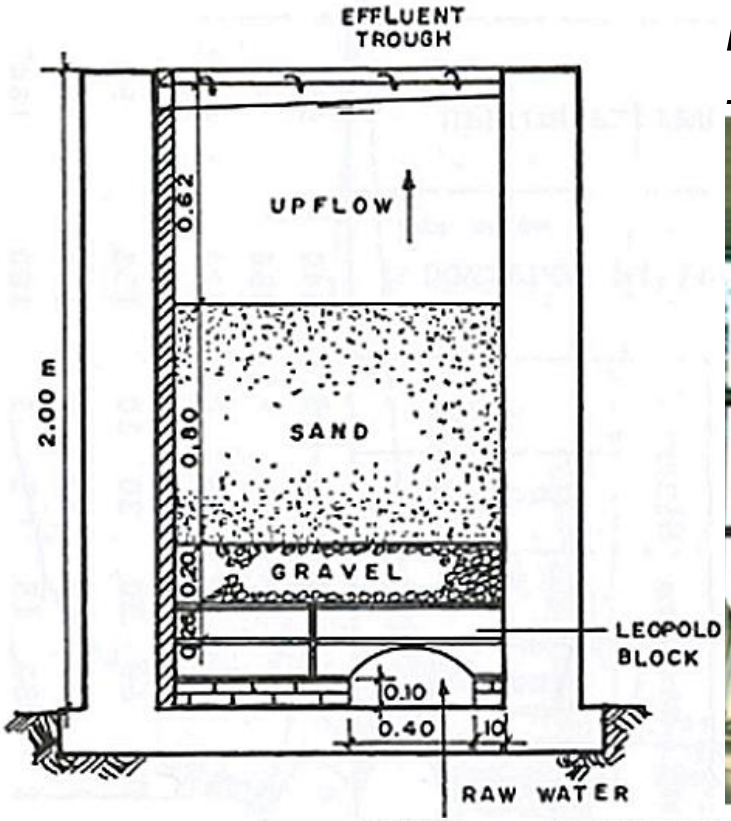
Luiz Di Bernardo Univ. São Paulo

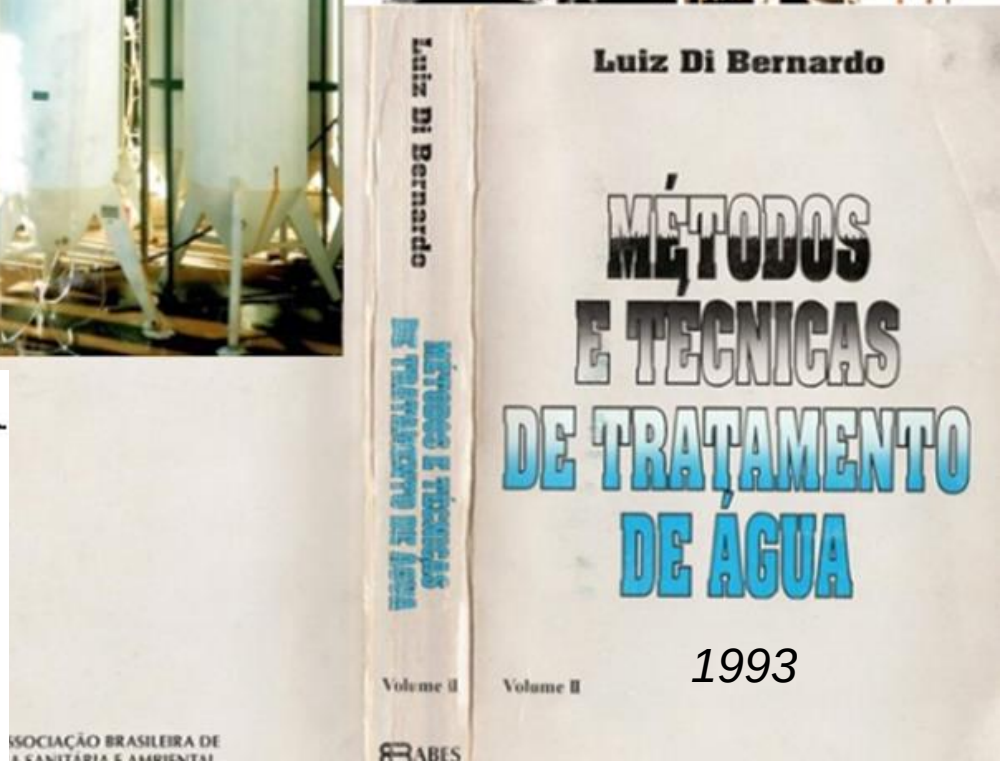
Huisman & Wood : Slow Sand Filtration WHO 1974

1988, London Int. Conf. SSF

Up-flow and down-flow roughing filters were reported.

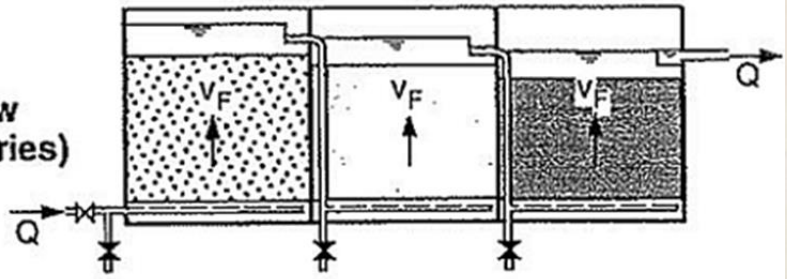
Prof. Luiz Di Bernardo, Univ. São Paulo, Brazil
1980: Thesis of his master student



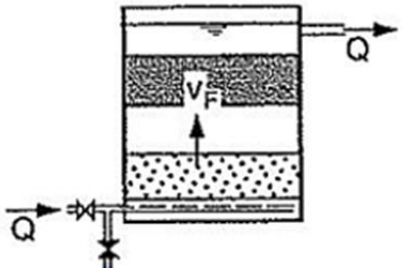


1993

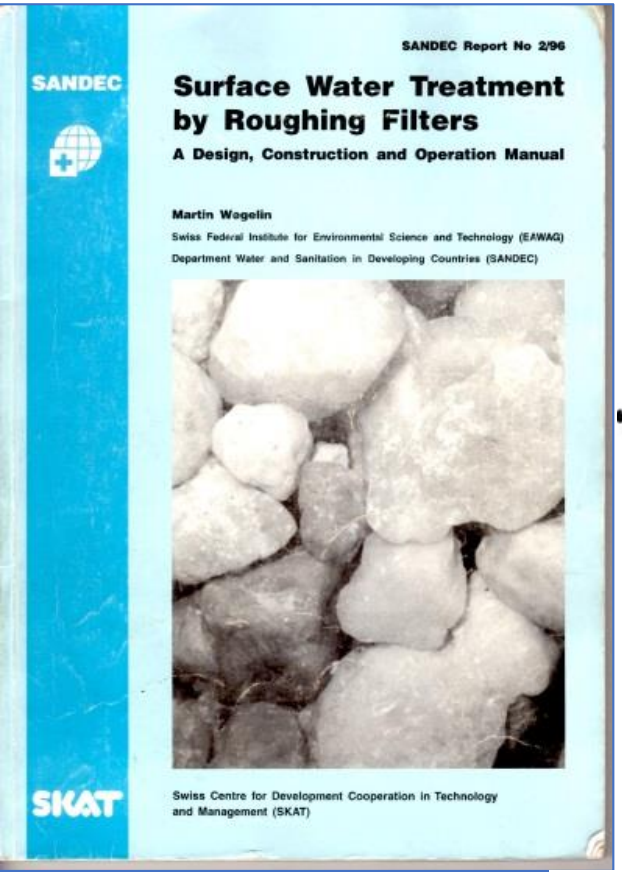
- upflow (in series)

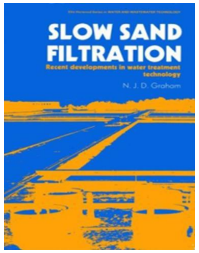


- upflow (in layers)

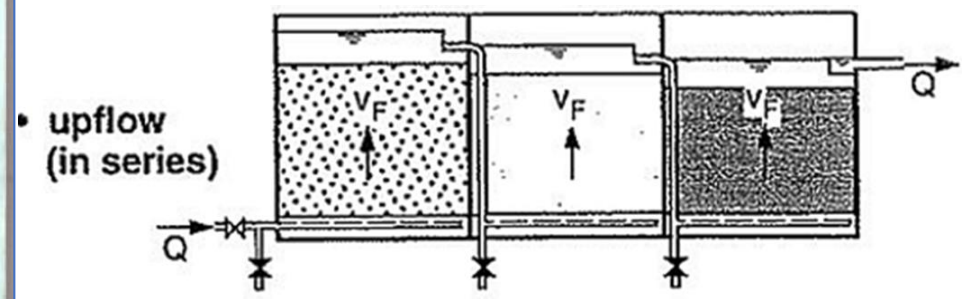


Luiz Di Bernardo reported about URF to reduce turbidity without chemicals on his Portuguese textbook (1993).

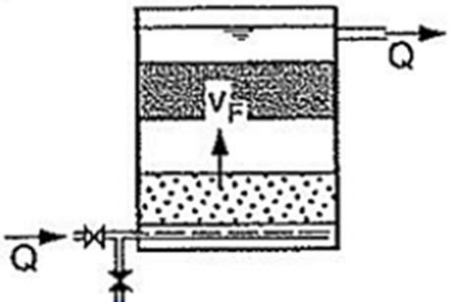




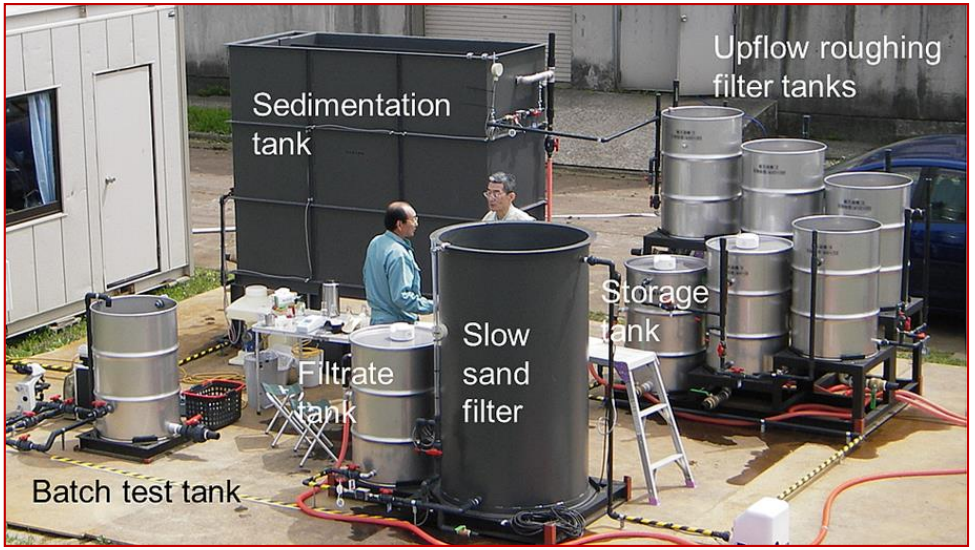
Roughing filter working group was organized after Luiz Di Bernardo report in 1988. And Martin Wegelin summarized and published a book "Surface Water Treatment by Roughing Filters" from Switzerland in October, 1996.

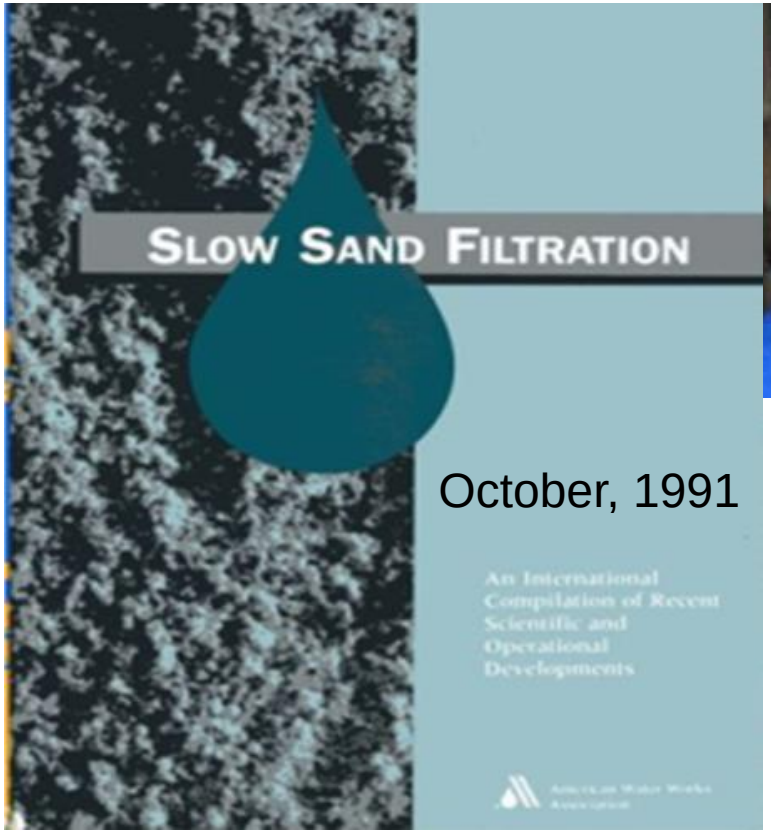


1996.



Performance of URF was examined.





October, 1991, Prof. Michael Robin Collins of University of New Hampshire organized the 2nd. SSF Conf. in New Hampshire, USA, supported by AWWA.

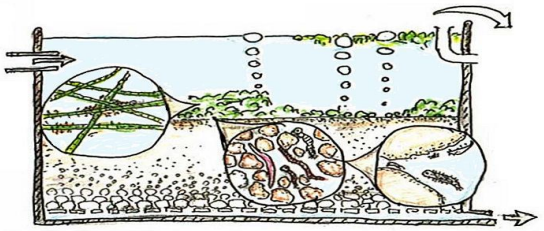
After the large outbreak of diarrhea by cryptosporidium in Milwaukee, Michigan state, US, in April, 1993, SSF was refocused as more safe treatment system without chemicals. SSF workshop was held in Oregon by AWWA in September 1994.

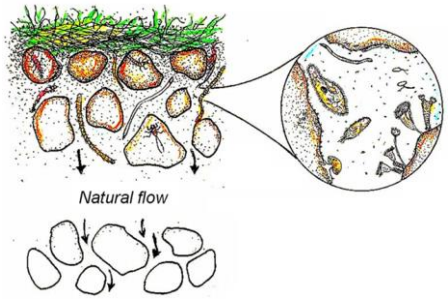
Refocus, Re-discovery, Timeless technology for modern application.

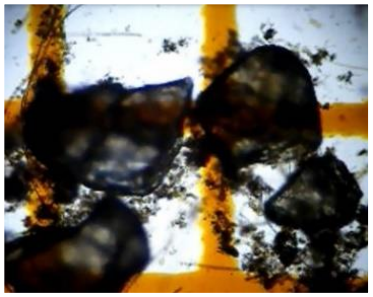
In the text, on the surface of the sand there is a thin slimy (gelatinous) mat known as the *Schmutzdecke*, or filter skin. This explanation is not correct.

On the surface of sand layer, there is a soft mat like light feather mat.
Filamentous algal mat is just lay down.

Sand is clear at the site in water. When we pull up this mat from the bottom to surface and in air, sand turns dirty color. A large amount of trapped SS among filamentous algal mat drops into sand layer.

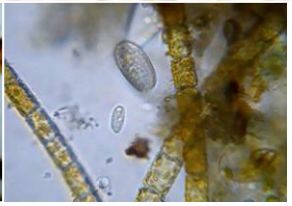






On the shallow bottom, filamentous algae grow well.

Algae are the best food for animal.



Filamentous diatom is a pioneer plant in cold water.

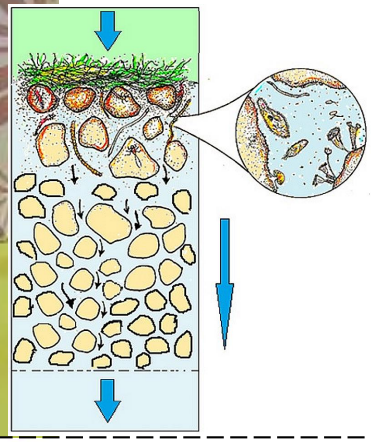
The key of EPS is the function of microscopic organisms.

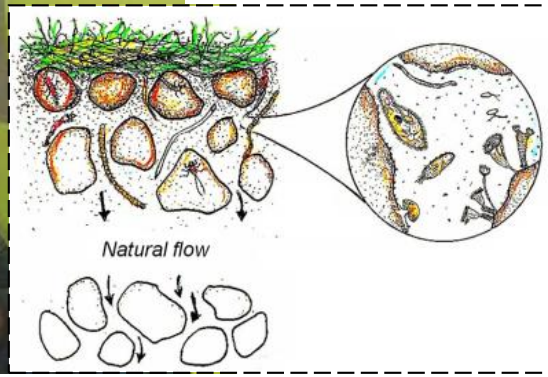
JICA training in Okinawa.

http://www.cwsc.or.jp/files/member_lmtd/doc25.pdf

Key is upper dirty layer.

Gentle for small organisms.





At Alaoa WTP in Samoa

Every person must understand that EPS is real natural ecosystem.

http://www.cwsc.or.jp/files/member_lmtd/doc25.pdf


JICA trainees understand the mechanism and principle of EPS.








JICA trainees made a EPS model.

At every JICA training, we made a bucket EPS model to understand the principle and mechanism.

Mr. Makoto Yano helped JICA Okinawa training.

Yano-san made EPS model at his house. Water is circulated using a pump.


Yano-san
Isamu-san
LOS ANGELES
RAMS
NFC WEST
EST. 1937

EPS was inserted in to the existing water supply system of non-treated water.

Water source

Receiving tank

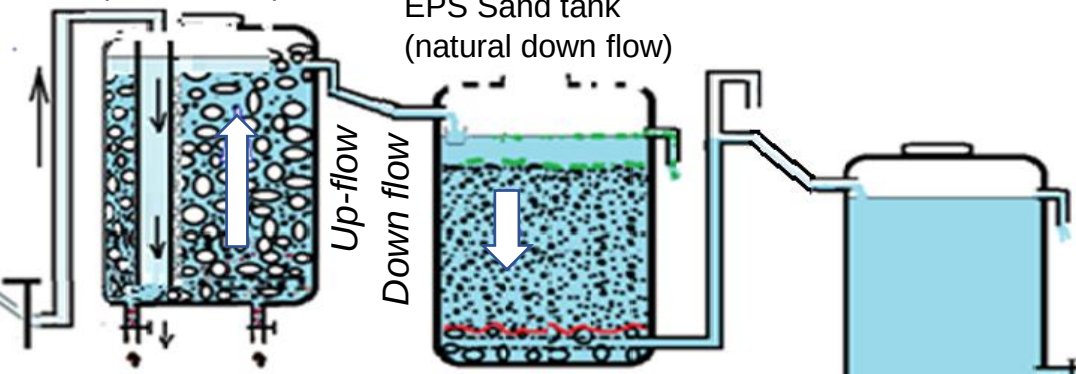
Sediment heavy muddy matter

Turbidity Reduction

Up-flow Roughing Filter (Gravel tank)

A public tap system of water supply for germ free safe water was proposed.

EPS Sand tank (natural down flow)



Public tap

Tap in village

Trap and reduce muddy matter by gravel tank

Complete purification by sand tank

Store the germ free, safe and delicious drinking water

*Fijian project provides **6 liters /person/day** for drink and cook.*

Existing system in village

non-treated water

EPS (Ecological Purification System) for germ free drinking water

August, 2011 Mr. Vishwa Jeet learned EPS in Okinawa.

Jan. 16. 2013. Kick off Workshop on at Holiday Inn, by MoIT

July & September, 2013. Opening ceremonies in two pilot EPS plant.

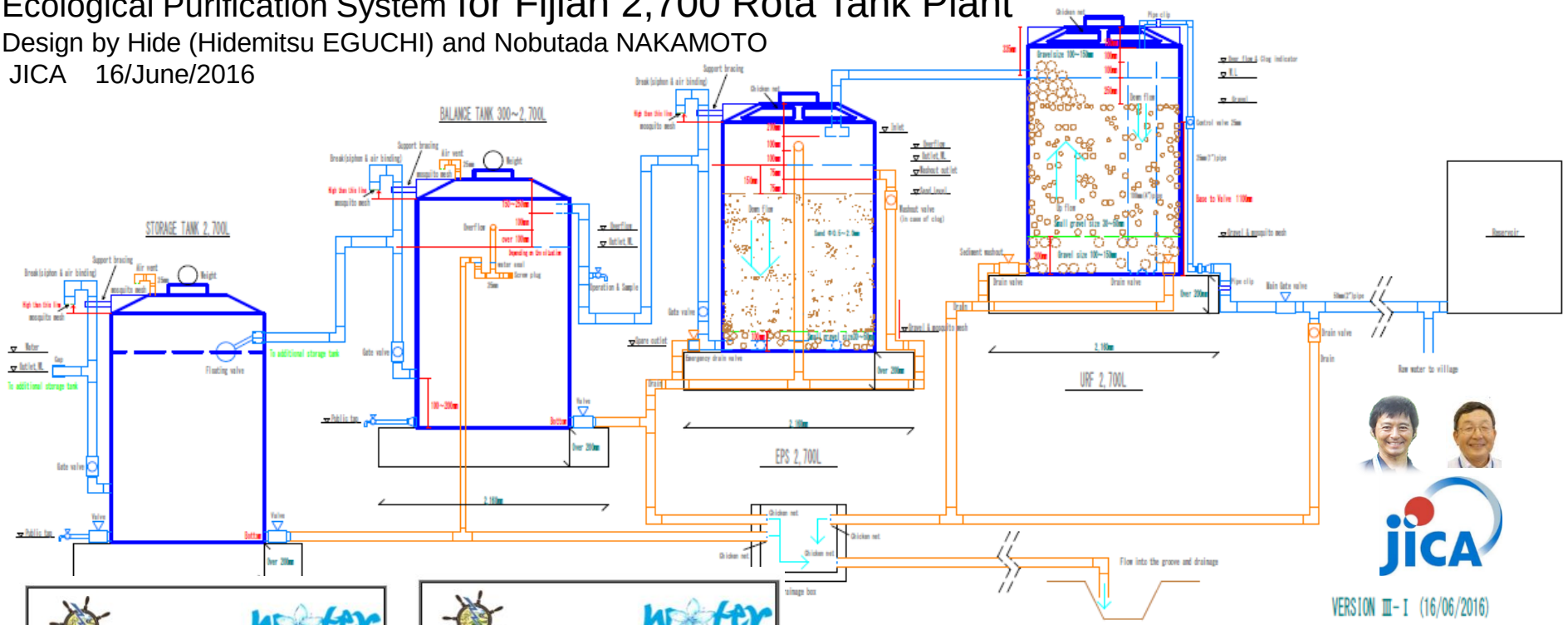
JICA short term Expert
N. NAKAMOTO
Oct. 2014-Nov.2018
8 times: Each about one month

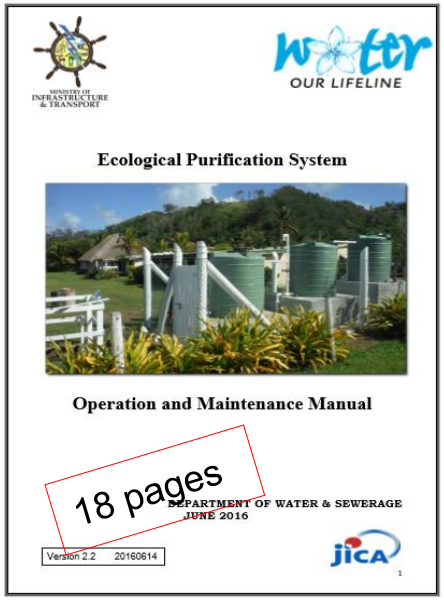
JICA Volunteer
Hide EGUCHI
2015-2016

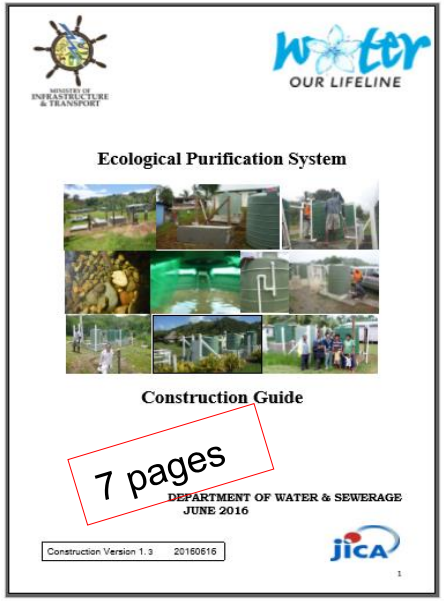
JICA Volunteer
Isamu SHIOIRI
2017-2018

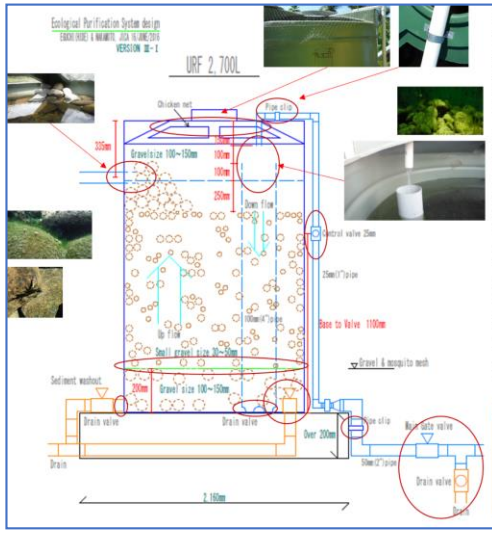
Ecological Purification System for Fijian 2,700 Rota Tank Plant

Design by Hide (Hidemitsu EGUCHI) and Nobutada NAKAMOTO
JICA 16/June/2016

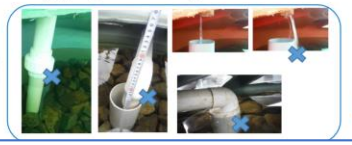








1) Inlet pipe size is 1 inch and is fixed with a clip to avoid any damage of the inlet pipe by shaking.
2) Flow rate can be controlled using a control valve (1 inch size) by watching the pouring of an inflow water. (Suitable valve setting height is 1,100 mm from the base.)
3) A gap of 100 mm between the inlet pipe (1 inch size) and the inner pipe (4 inches size) is necessary to confirm the flow rate and to sampling the raw water.
4) The height difference of 100 mm between the top edge of the inner pipe (4 inches) and the bottom height of the outlet (over-flow) pipe is requested to keep the level of seepage water from gravels. In order to guard the outlet pipe against the excess floating scum, the larger size of gravels are heaped up the outlet pipe
5) Insert a mosquito mesh (plastic) between the bottom a large gravel layer (100-150 mm size) and a gravel layer (30-50 mm size) to avoid dropping small stones from the gravel layer and to easy drain the accumulated muddy matter.
6) One drain pipe and valve are set near the bottom of the inner pipe to easy drain.
6) Open (cut) windows are covered with chicken mesh to avoid fallen leaves. And one cover near the inlet pipe can be lifted for a caretaker maintenance.
7) Each tank connecter must be tightly connect from both sides (inside and outside) by two persons. Then the empty tank is filled with water. After the confirmation of no leakage from the connect point, this tank can be filled with the large gravel, mesh and small gravel.



http://www.cwsc.or.jp/files/member_lmtd/doc25.pdf

Ecological Purification System for Safe Drinking Water

- Application of Natural Process -

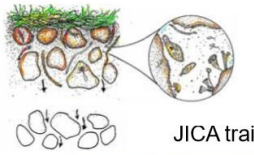
Eco-friendly technique to make artificial spring water

NAKAMOTO Nobutada, Dr. Science
Prof. Emeritus of Shinshu University, Japan

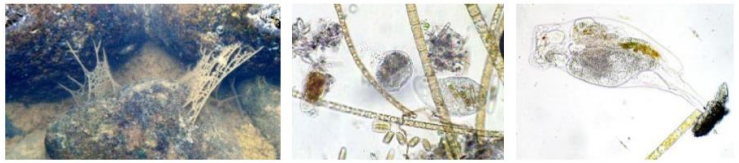
August 2018

Smart Treatment System to make artificial spring water by Eco-friendly technique.

Toward Zero Waste World by Chemical-free System



JICA training

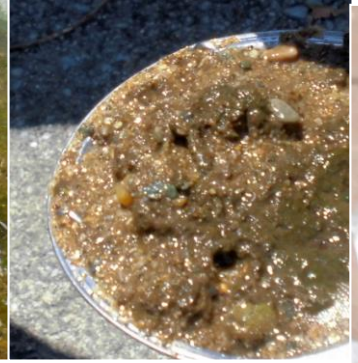


Microscopic organism is the key of EPS.

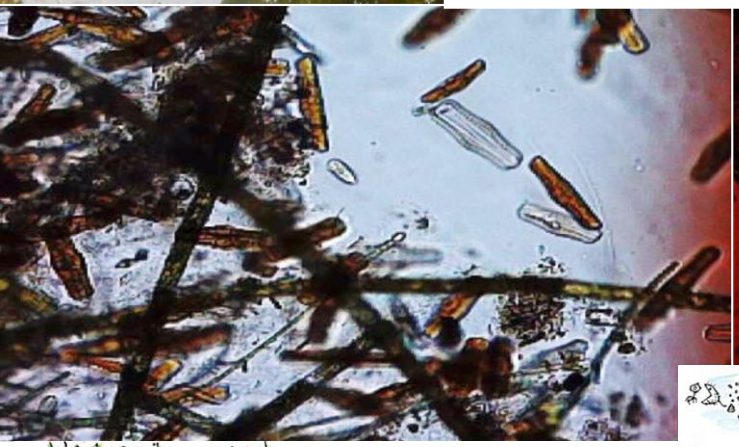
Biological activity was evaluated by the diurnal change of dissolved oxygen.

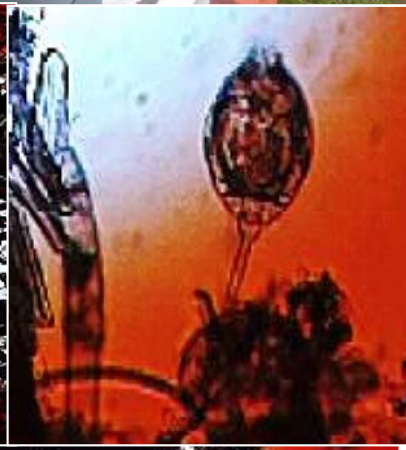
http://www.cwsc.or.jp/files/member_lmtd/doc25.pdf

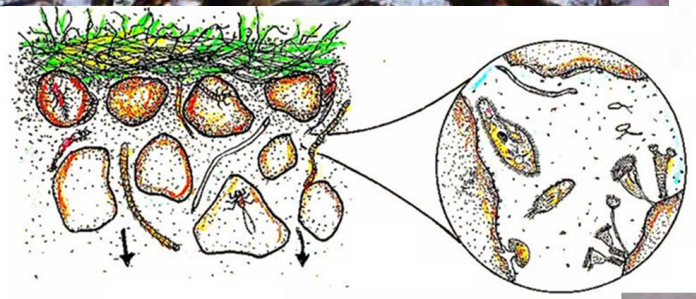
http://www.cwsc.or.jp/files/member_lmtd/doc25.pdf

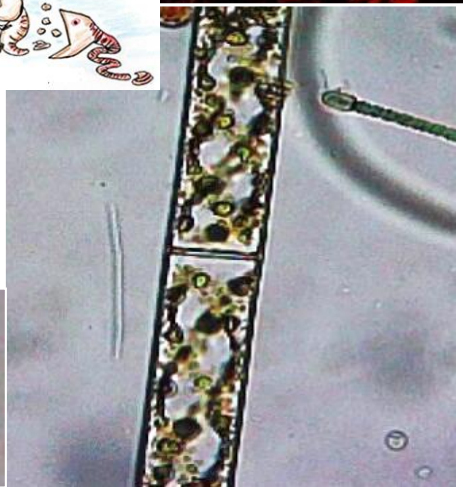


Look like dirty mud. There are so many microscopic organisms.

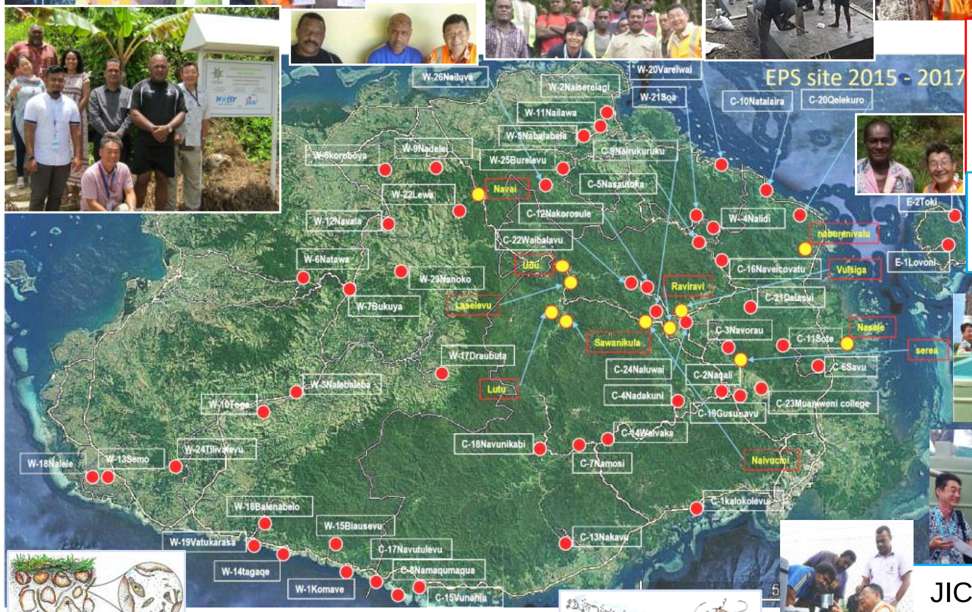








Cleaner Water Project by EPS (Ecological Purification System: Wise Use of Natural Phenomena) for Rural People in Fiji

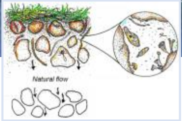


2 pilot sites :Kalokolevu and Navatuvule of 2013 project. EPS project completed 2015 fiscal year : 46 villages . Another 12 villages were completed until May 2016. Total village sites were completed 60 (58 + 2 pilot sites) until June 2016. 98 villages were completed until Jan. 2018.

EPS project started from Kalokolevu and Navatuvula in 2013

EPS Engineer Meeting 2015

JICA president visited Kalokolevu on April 7. 2018



Food Chain is the Key

JICA short Expert
N. NAKAMOTO
2014-2018
Oct. Nov.
8times: each about 1 month

JICA Volunteer
Hide EGUCHI
2015-16

JICA staff
K. OHARA

JICA Volunteer
Isamu SHIOIRI
2017-18

JICA staff
A. KANI

98 EPS plants were completed until Jan. 2018. Project was supported by Fijian government and JICA assisted only advice.

1.Shallow depth

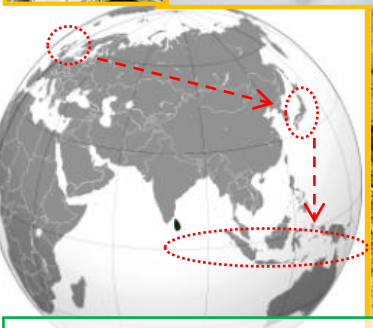
2.Active Photosynthesis

3.Bubble

4.Lift up

5.Microbe to animal

6.Collect, graze and decompose



7.Food chain is the key for purification.

8.Sand is habitat.

9.Large Sand

10.Activety depend on Temp & Radiation.

11.Pass time is 1 or 2 minutes.

Smart Treatment System to make artificial spring water by Eco-friendly technique.

Chemical Free : Gentle for small organisms

JICA training on EPS from 7th to 12th August, 2010 in Miyako and Ishigaki islands, Okinawa, Japan.

This speech by Ms. Manista from Solomon islands on September 1, 2010.

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.

EPS

Public Seminar/ Workshop

" An approach to securing the safe water "

Reviewing Fiji's successful EPS implementation at Rural Area and future perspective of implementation in PICs

12 & 13 March 2019

@ Japan-Pacific ICT Centre, USP Laucala Campus

Day 1 09:30~17:00 Public Seminar (inc. refreshments & lunch)
Main Presenter - Dr Nobutada NAKAMOTO*
JICA Expert, EPS advisor for Rural Water Supply
Professor Emeritus of Shinshu University, Japan
* Live lecture from JICA HQ, Tokyo Japan

Day 2 09:00~18:30 Workshop & Study Tour (inc. lunch)**
Workshop - Demonstration of EPS Construction
By Mr Makoto YANO, Okinawa Blue Water, Japan
Study Tour - EPS Site Visit to NAKINI Village
18:30~20:00 - Evening Reception (Cocktail Party)

JICA

** Pre-registration is required at Day 1 (close at 11:30) due to limited space.
For further details, please contact JICA Fiji Office by email: jicafj-recept@jjca.go.jp or telephone: +679 330 2522

ECOLOGICAL PURIFICATION SYSTEM

EPS technology is open for every person.

Chemical Free : Gentle for small organisms

Smart Treatment System to make artificial spring water by Eco-friendly technique.

Ecological Purification System
for Safe Drinking Water
- Application of Natural Process -
Eco-friendly technique to make artificial spring water

NAKAMOTO Nobutada, Dr. Science
Prof. Emeritus of Shinshu University, Japan

August 2018

The people of the pacific may in the very near future will have access to the high quality and delicious taste water.

This EPS technology is not a commercial technology.
You can make this EPS by yourselves. EPS is our technology.

http://www.cwsc.or.jp/files/member_lmtd/doc25.pdf