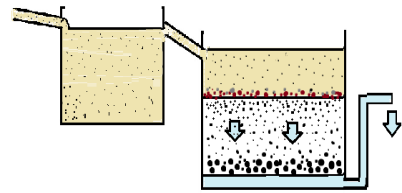
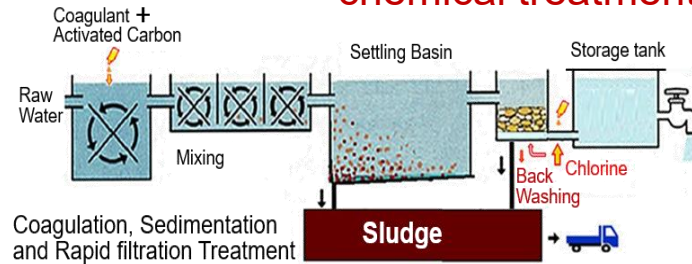


③ Chemical free URF and EPS

EPS 2026-OBW
Part ③:1-18 18 slides



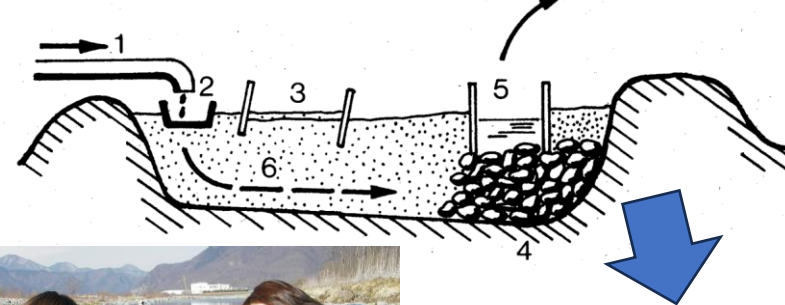
SSF was easy to block with fine turbid matter.



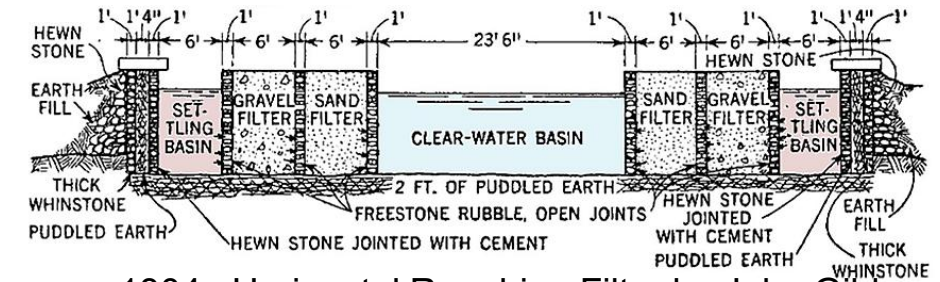
Cancer Risk by chemical treatment.



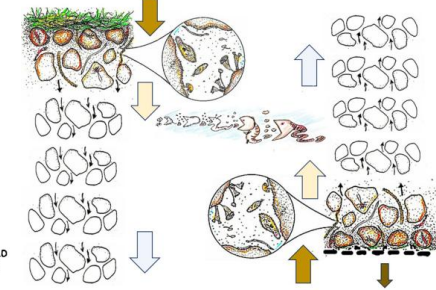
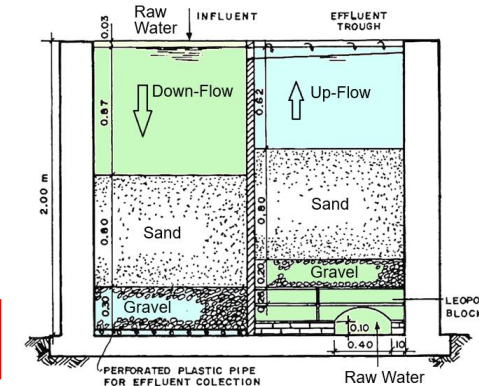
Horizontal flow sand filter



1 inlet pipe, 2 inlet through to prevent scouring, 3 barriers, 4 gravel 50 mm, 5 outlet through, 6 flow direction.



1804 : Horizontal Roughing Filter by John Gibb in Paisley, near Glasgow, Scotland, UK



Sand and gravel **does not move** under the vertical currents of down flow and up-flow. These are gentle for small organisms.

Contents:

① Introduction : EPS

② Quest for Pure Water : Food Chain is key.

③ Chemical free URF and EPS.

④ From Miyako Island to Samoa

⑤ From Okinawa to Fiji

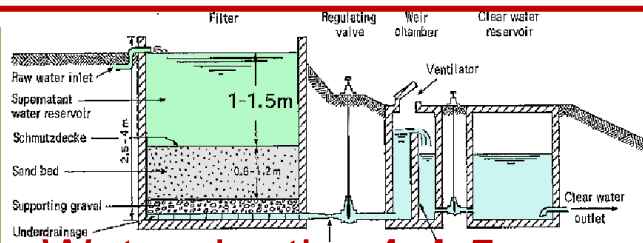
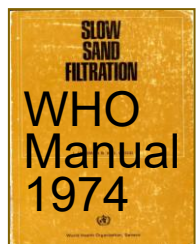
⑥ EPS as Social Contribution

⑦ EPS trial in Malaysia and Guyana

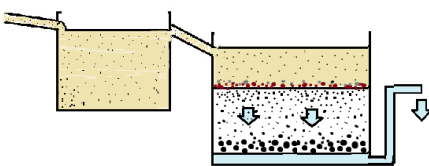
⑧ EPS in Sri Lanka and Pakistan

⑨ EPS: Trust Our Sense

Refocus to Roughing Filters as **chemical free** pre-treatment against turbid matter.



Water depth: 1-1.5m

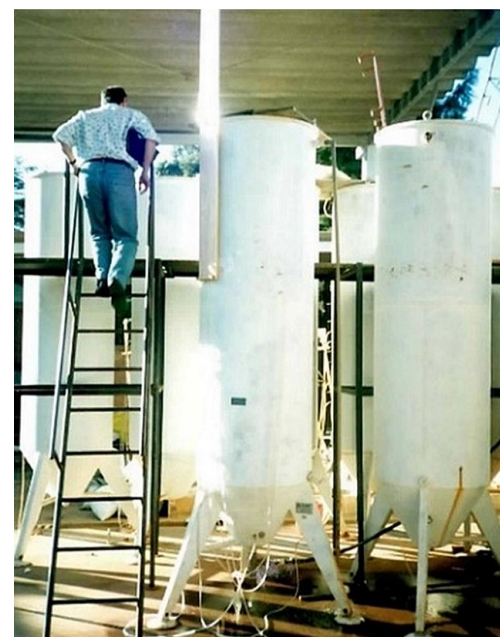
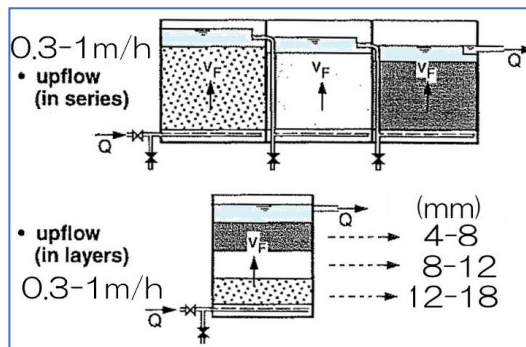
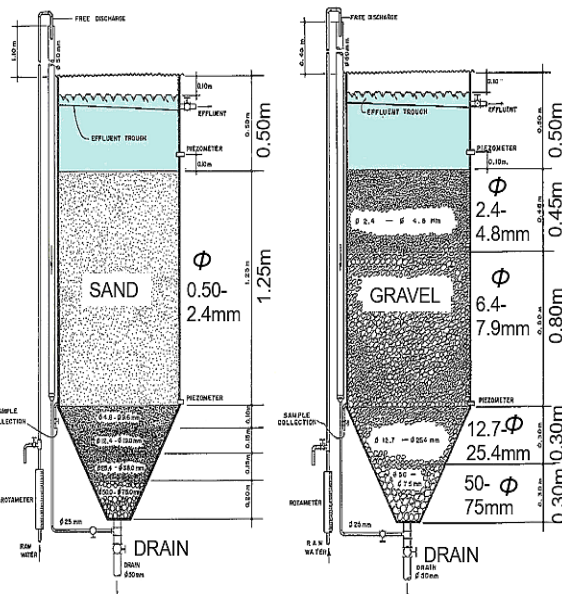
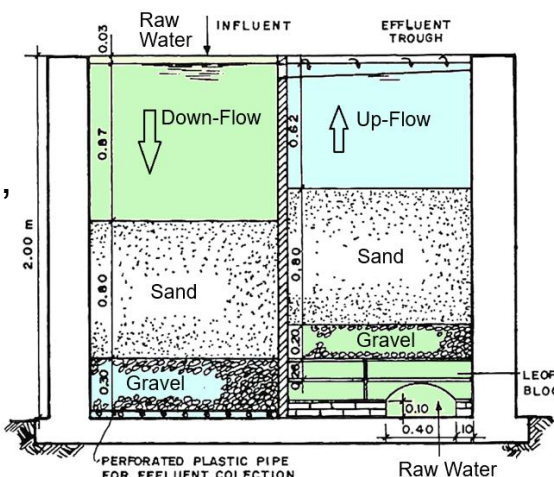


Fine suspended matter does not sink in settling basin.

1974 – 1980s: Refocus to SSF.

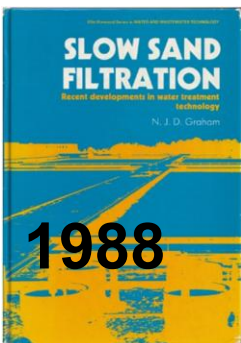


Luiz Di Bernardo,
Univ. São Paulo,
Brazil: Roughing
filter experiment
(Master student
report 1980)



*Nakamoto was a JICA
advisor of the control of
a reservoir ecosystem
to Univ. São Paulo in
1974 and Federal Univ.
of São Carlos in 1976.*

I visited São Carlos, Brazil in Aug. 1995.
Bernardo still examined URF.

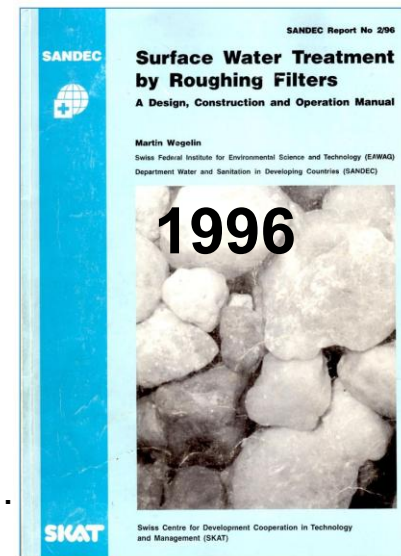


The First International
Meeting on SSF was held
in London, in 1988. Luiz Di
Bernardo presented.

And Martin Wegelin
(Switzerland) reviewed past
pre-treatments and related
activities in the world.

Chemical free roughing filter was focused in this meeting.

After this meeting,
Martin Wegelin
(Switzerland)
summarized to
“Surface Water
Treatment by Roughing
Filters” in 1996 and
distributed from London.



<https://www.ircwash.org/sites/default/files/Wegelin-1996-Surface.pdf>



Martin Wegelin
Swiss Federal Institute
of Aquatic Science and
Technology

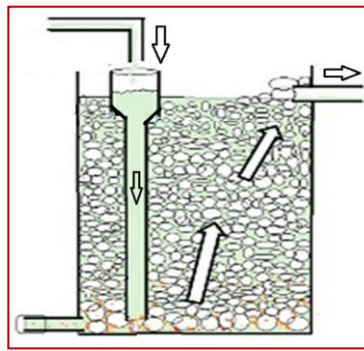
Mr. Fumio KIZUKI 2005
OISCA (The Organization for
Industrial, Spiritual and Cultural
Advancement-International)



There are sedimentation tank,
several gravel filter, and slow
sand filter. Polluted water
turns to safe and reliable
water quality.

Polluted water (Kanda river,
Tokyo)→gravel filter → gravel filter
→sand filter→ safe water

No detection of coli-form bacteria, lead, herbicides
of Atrazine and Simazine. Nitrate N concentration :
2.0 mg/l, Nitrite N: 0 mg/l, pH8.5, total hardness:
250 mg/l and residual chlorine 0 mg/l.



I advised URF to him.

Sri Lank: three Up flow
roughing filters → sand
filter → safe drinking
water (300 liters / day).
This water is the
demand of safe drinking
and cooking water for 5-
6 families.

*Mr. Fumio KIZUKI knew this EPS is reliable
technology and applied it for villagers. Wise use
of natural phenomena. We can easily get safe
drinking water by ourselves.*



2006



Mandalay, Myanmar: Pond →
settling tank → 3 Up-flow
Roughing Filters → Sand Filter
→ safe drinking water.

Try it !
First, check it by yourself
without any grant money.

If you think something is good, you check it for yourself.

It doesn't have to be perfect.

It's okay to fail. You can get something from it.

I was inspired by Kizuki's attitude and his ability to get things done.

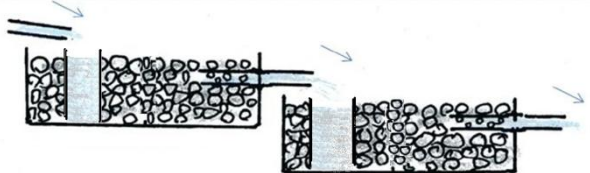


To keep continuous flow by a small pump

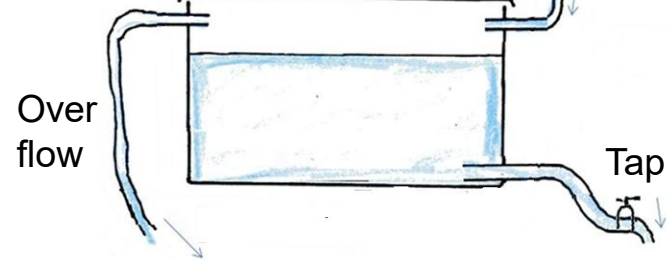


keep out small animals

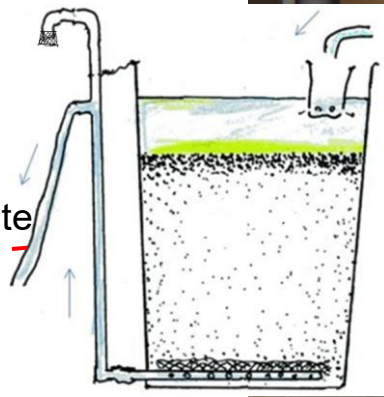
Up-flow roughing filter
To make subsurface suspension free clean water in the flood plain.



Filtrate storage tank
keep out dust and light



Filtrate



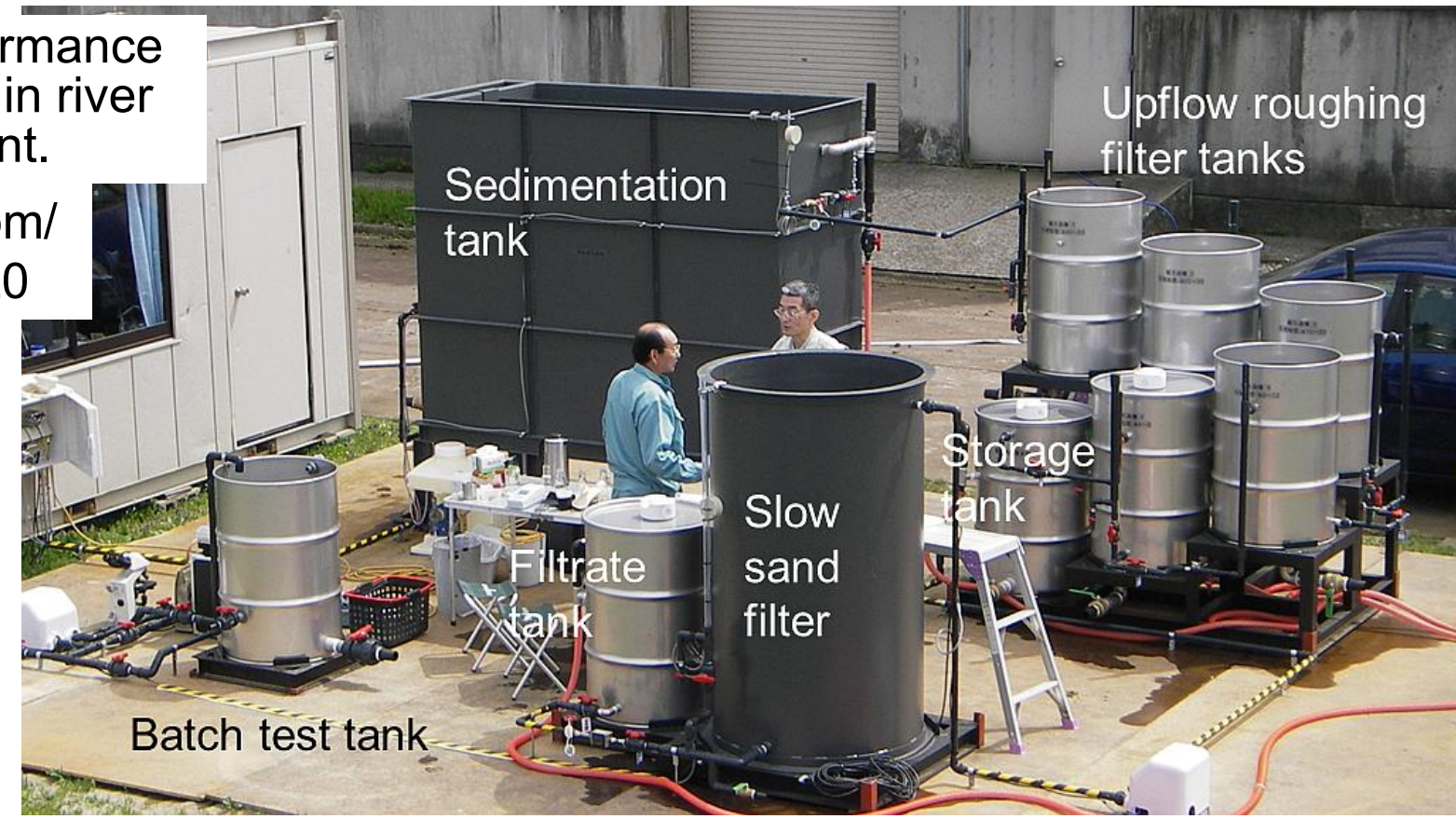
Under drainage porous pipe covered with mesh cloth.

We examined the performance of **URF** to eliminate SS in river water by pilot experiment.

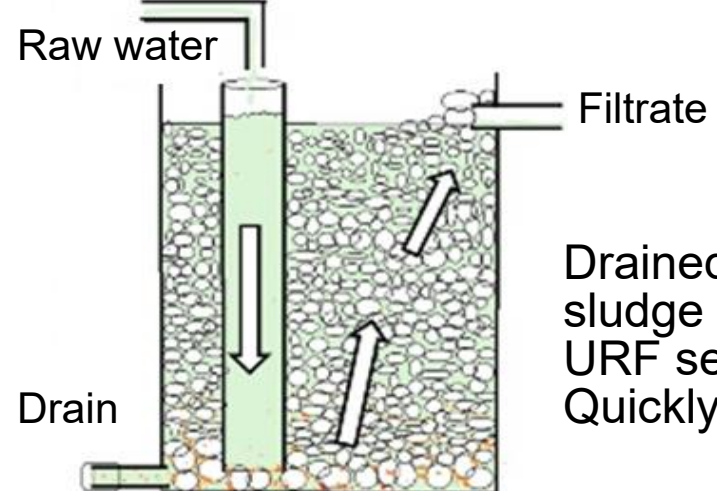
<https://www.youtube.com/watch?v=YhGoFefRRL0>



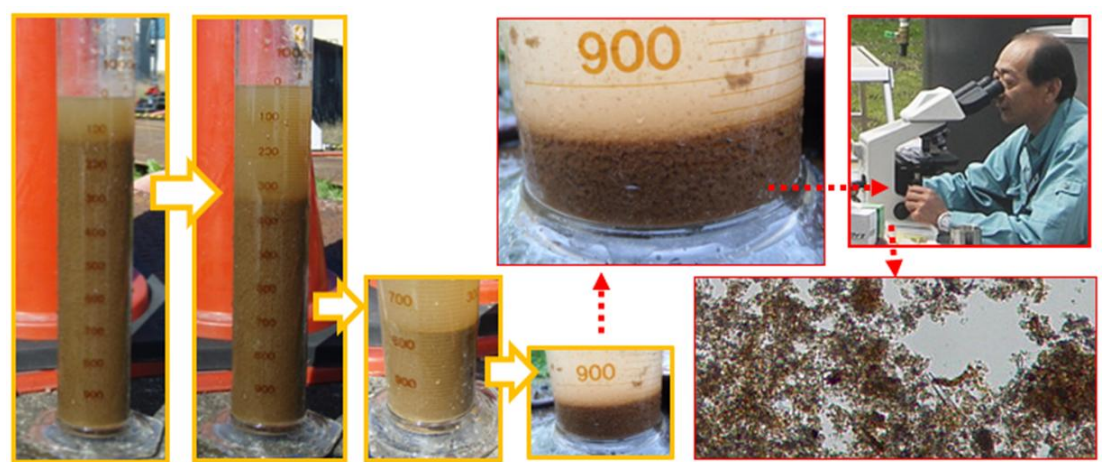
1:04



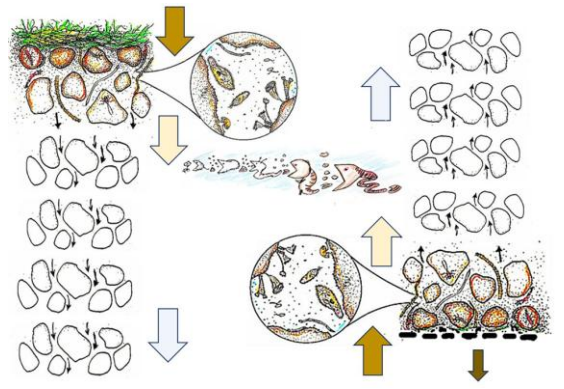
Up-flow Roughing Filter (Gravel Filter)



Drained sludge from URF settled Quickly.



Coagulated particles like an activated sludge.



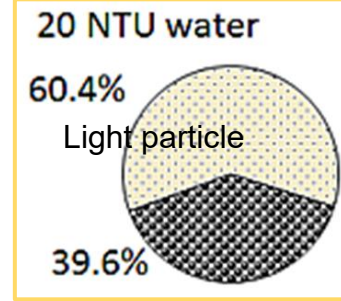
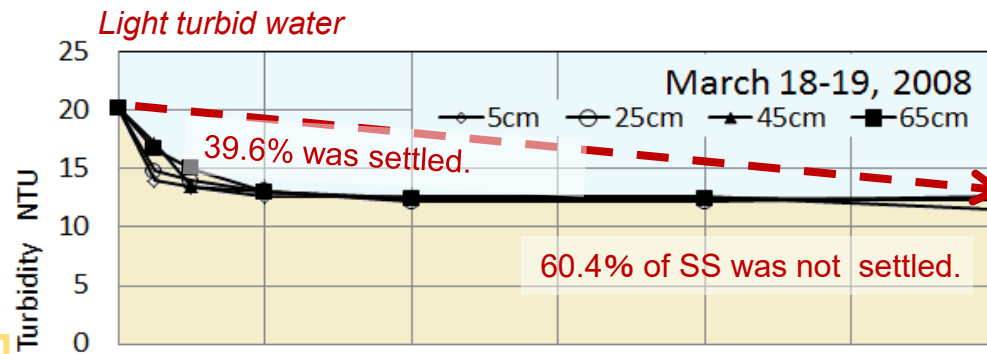
We confirmed URF is also EPS.



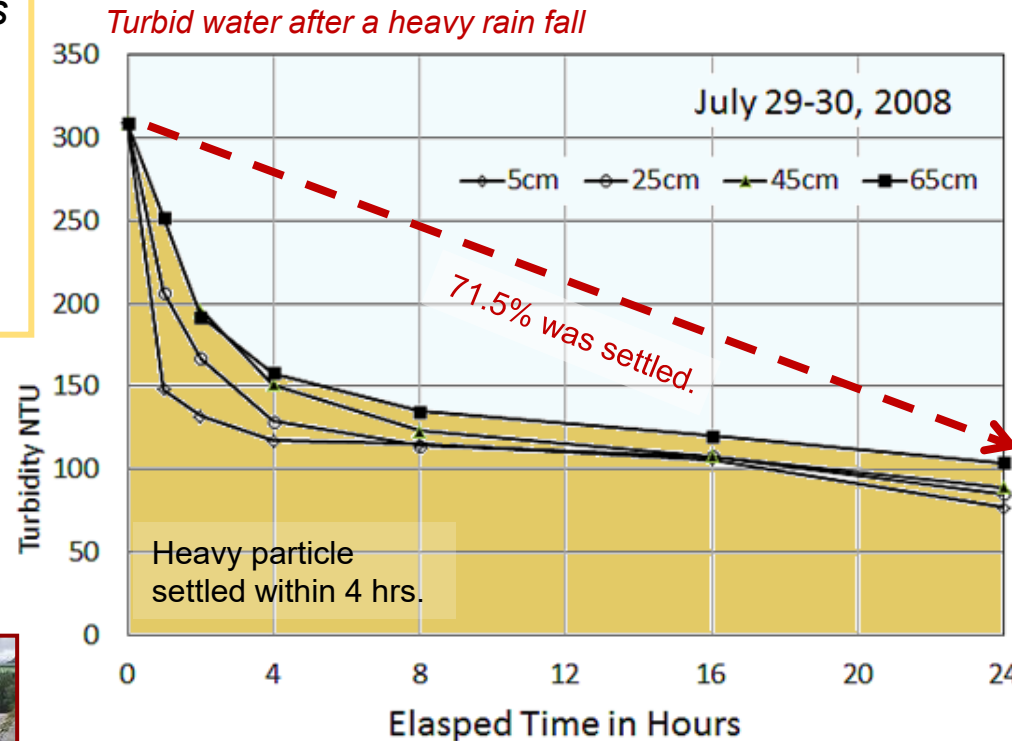
There were extremely small particles like as colloidal particles in case of small turbidity, like as less than 20 NTU. The rapid settling of turbid matters was observed **within 4 hrs.** However, a large portion of turbidity did not decrease.



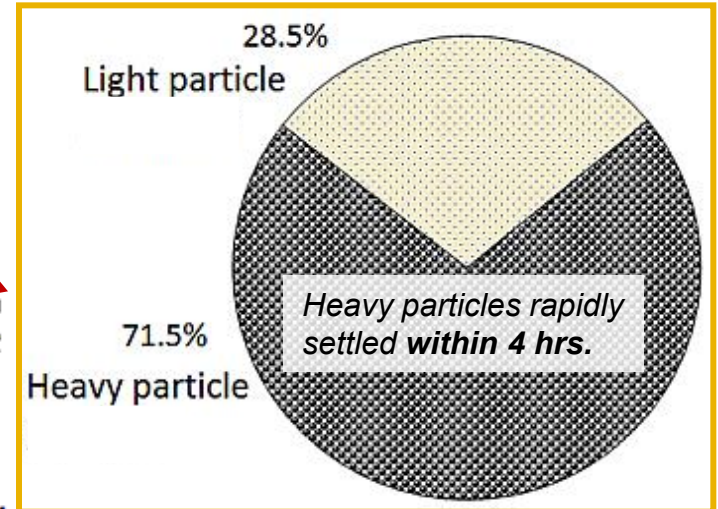
Light and small particle which is not easily settled.



Light turbid water: small turbidity, a large portion of light particle.

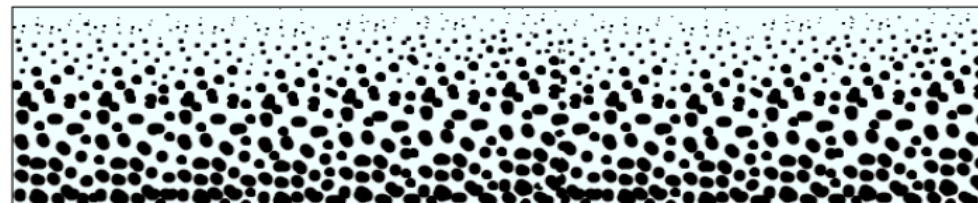


In case of turbid water, a large portion was heavy particles.



4 hrs. settling is enough.

After heavy storm event, river water becomes dirty and rapidly increases.



A large amount of heavy and large particles in a storm water.

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



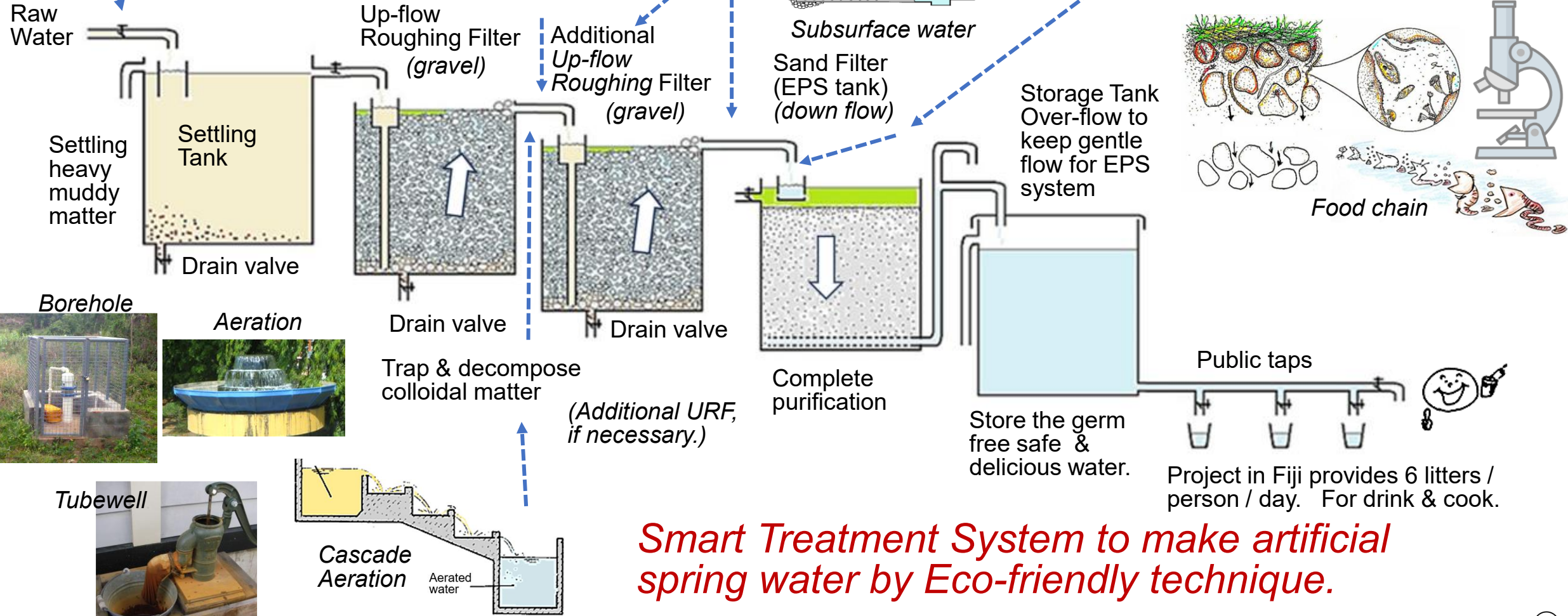
Surface stream



Reservoir



Clean spring water



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

Using the Bucket Model in JICA training from 2006

I studied on ecological function of Miyako-Jima wks from 1997.
I made a video on EPS function of Miyako wks in March 2004
and published a book (How to make delicious water) in August 2005.



<https://www.youtube.com/watch?v=r1LIPuQliu0&t=16s>

Quest for Safe and Delicious Tap Water, Miyako-Jima, Island in March 2004. /15:22 With English subtitle version in Oct. 2007.

JICA training began in 2006.



JICA made Video in 2008



Ecological Purification System : JICA training for SIWA, April 18, 2013 at Miyako-Jima.

<https://www.youtube.com/watch?v=NCI9oeNM0aI>



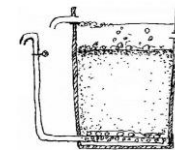
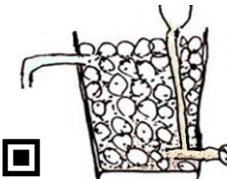
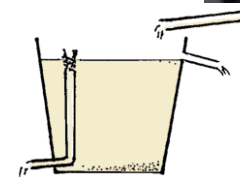
Slow sand filtration: creating clean, safe water (Full ver) in 2020 /26min



Slow sand filtration: (Digest ver) in 2021 /3:26



<https://www.youtube.com/watch?v=QAH1SoAgfL0&t=37s>



サモア・水道事業運営（宮古島モデル）支援協力 JICA提供

ODA as an Investment in the Future: 60 Years of International Cooperation (JICA 2014)

JICA Training on Ecological Purification System (EPS) in Okinawa, Japan in 2022

DIY EPS bucket model making 2022 - YouTube / 38:01

<https://www.youtube.com/watch?v=jz94KfKLL3E>



NGO Okinawa
Blue Water





Un sistema ecológico, económico y replicable que puede ser utilizado por pequeñas, medianas y grandes comunidades. Este sistema fue desarrollado por el Doctor Nobutada Nakamoto

– Ecological Purification System



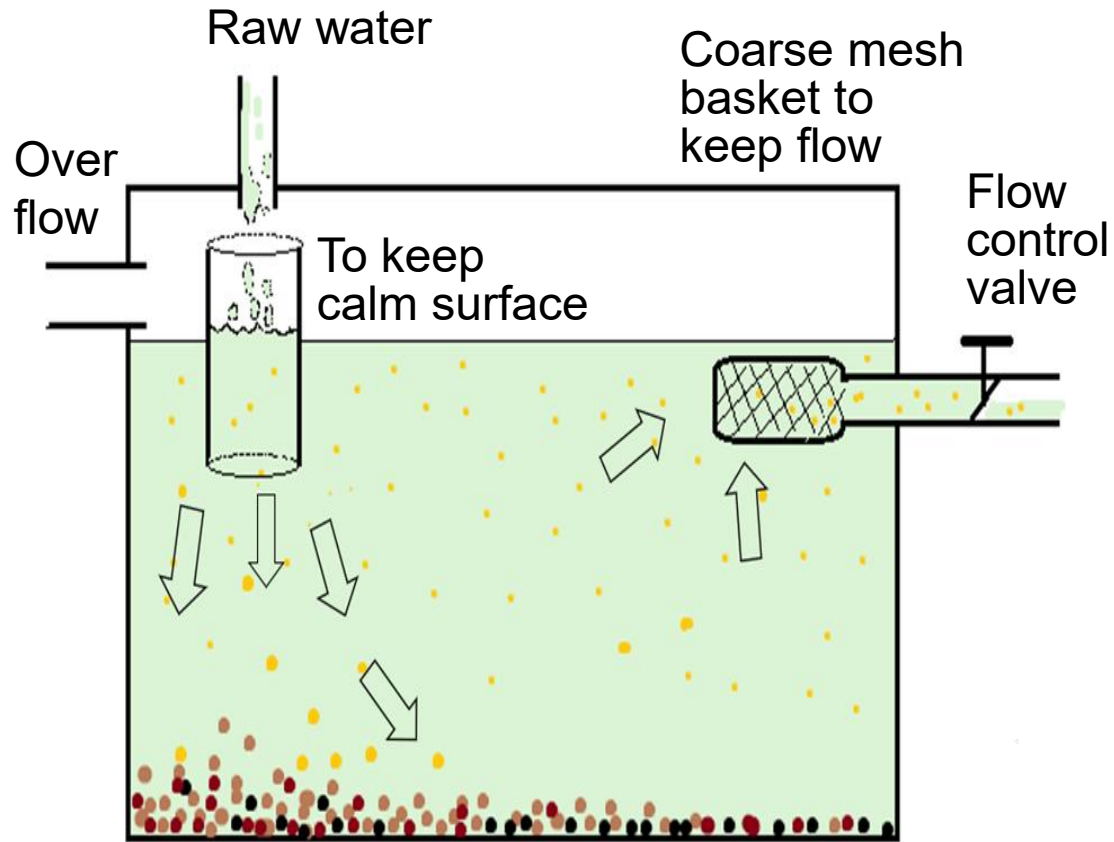
Daniel Castro
2017/07/20 に公開

<https://www.youtube.com/watch?v=Ye-POV6qBU0&t=39s>



JICA-Hiroshima, July, 2018
Microscopic organisms

Receiving Tank (Settling Tank)

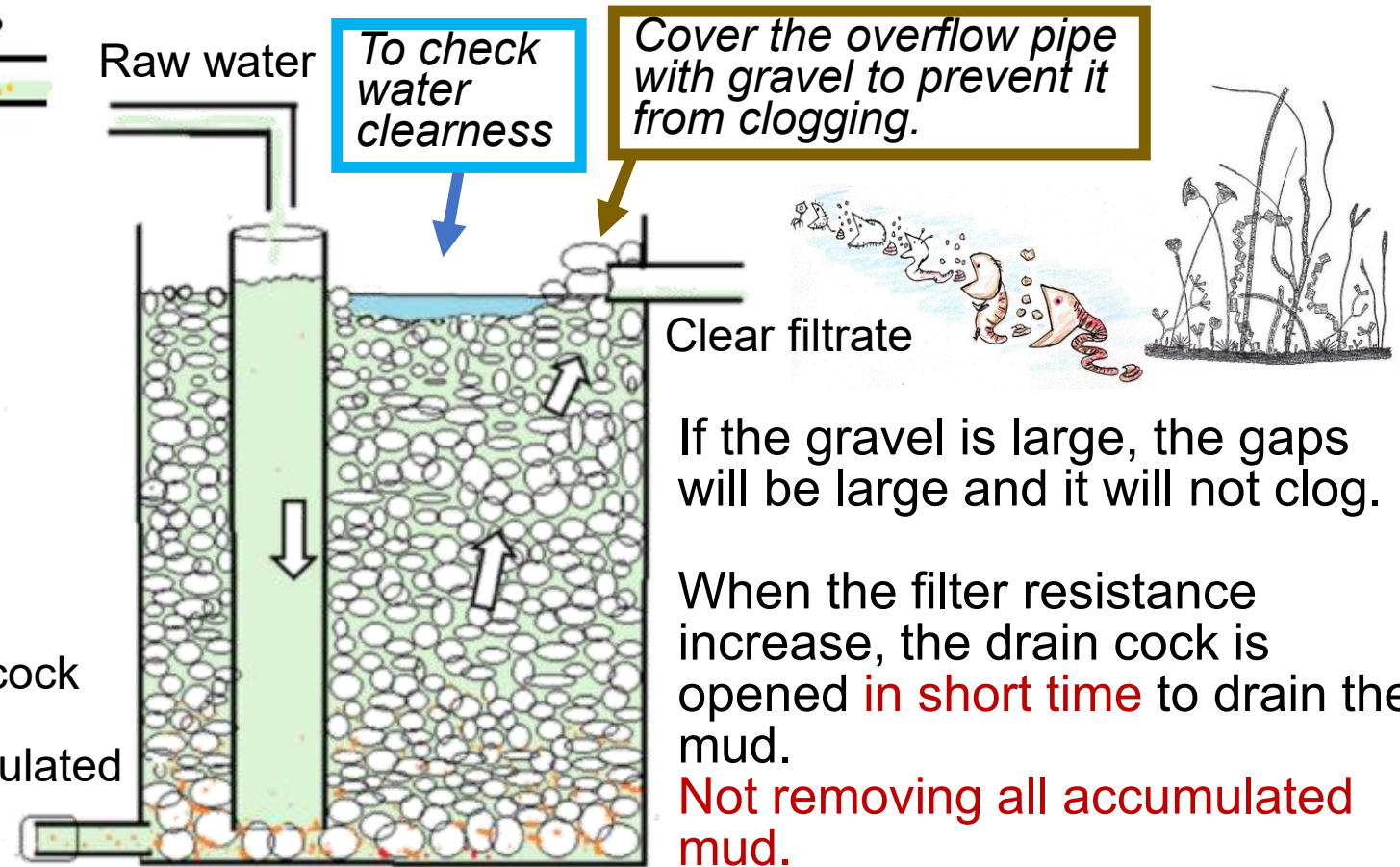


Heavy particulate matters are easily settled.
However, colloidal light particles like silt material are not settled in this settling tank.

Up-Flow Roughing Filter (URF) : Gravel Filter

Additional URF if necessary.

Colloidal fine particles adhesive to the surface of gravels. Small animals scrape them and produces fecal pellets. Fecal pellets accumulated to the bottom.



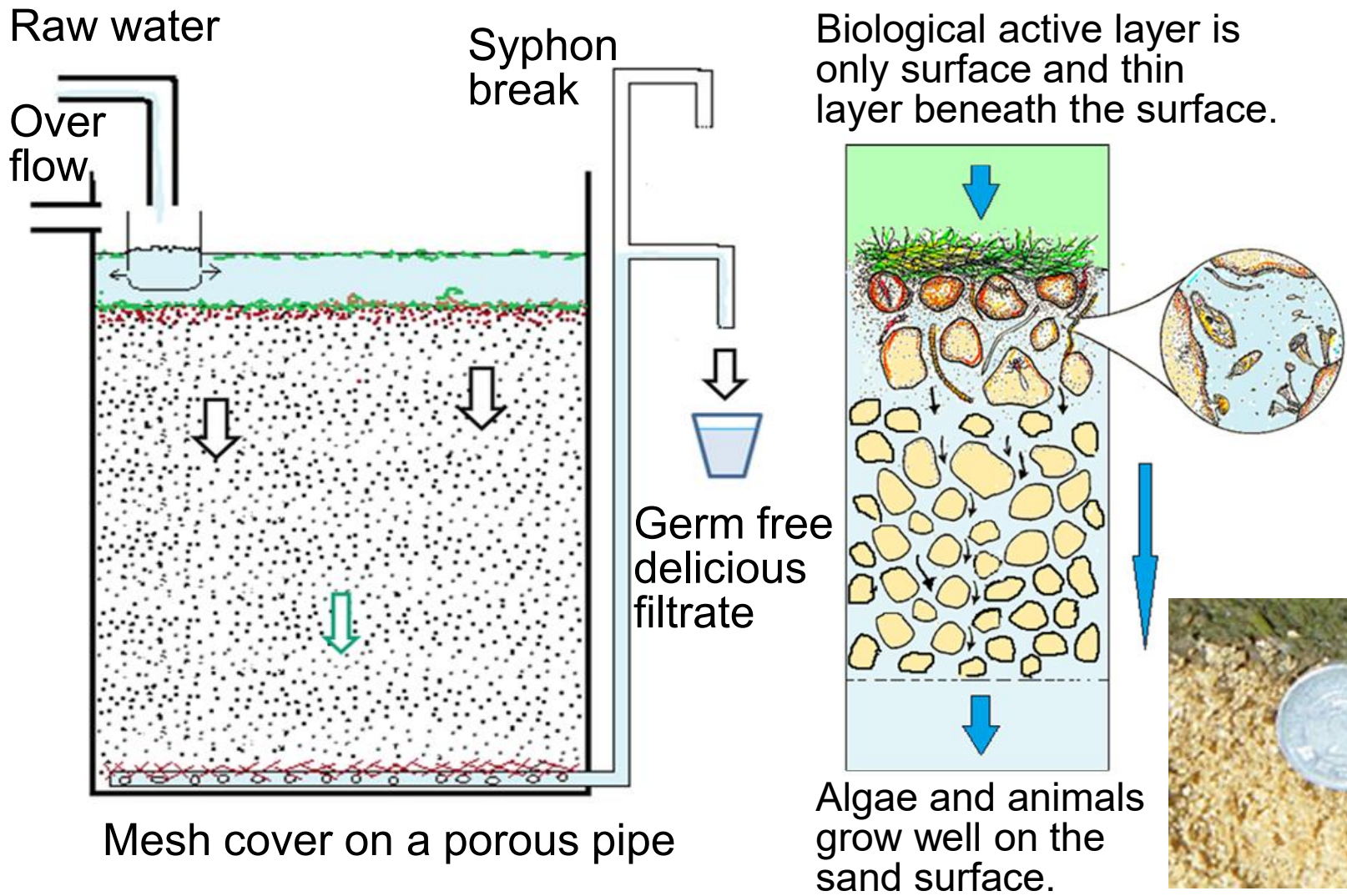
If the gravel is large, the gaps will be large and it will not clog.

When the filter resistance increase, the drain cock is opened **in short time** to drain the mud.

Not removing all accumulated mud.

EPS (Sand) Filter (Natural Down Flow)

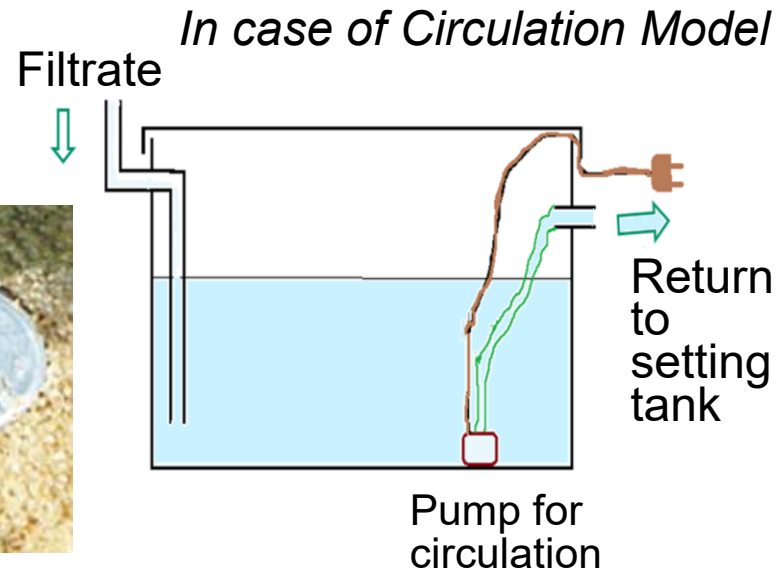
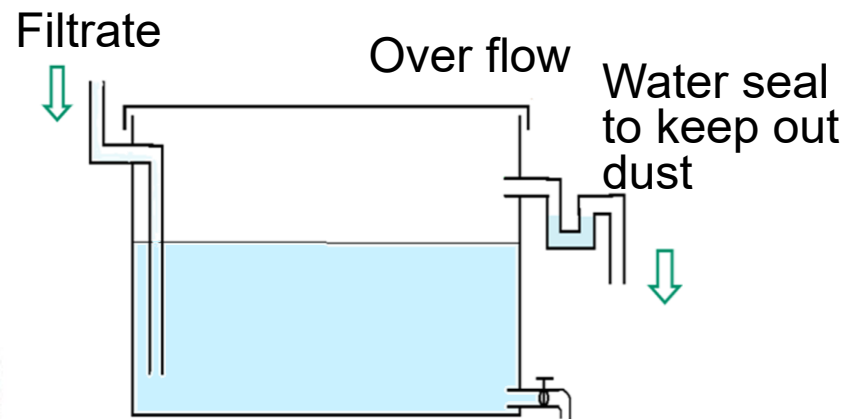
Ecological Purification System



Deep sand layer is a guarantee layer for emergency.

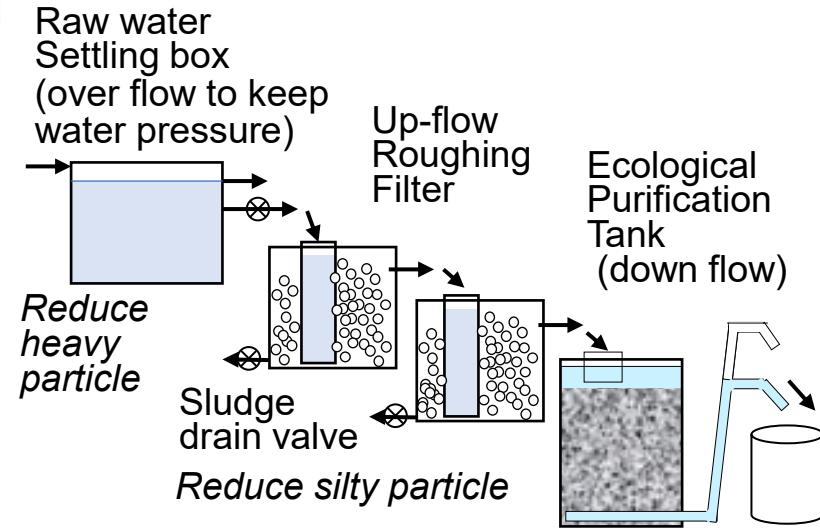
Storage (Filtrate) Tank

Cover for Storage tank is required to keep out dust.





W305mm
xD440mm
xH640mm



Filter rate
can be
measured
using a cup
and is
regulated
by a cock.

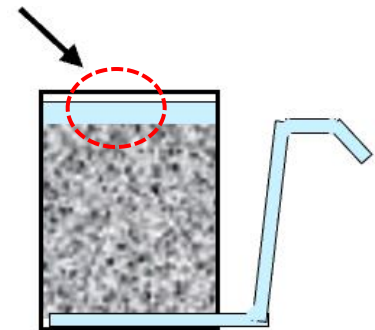
Filter area = 30.5 cm x 44 cm = 1,342 cm²

In case of Present Thames filter rate (40cm/h = 9.6m/d)

Filtrate/min = 1,342 cm² x 40 cm/h / 60 (min) = 895 cm³(ml)/min

Filtrate/h = 1,342 cm² x 40 cm/h = 53,680 cm³/h = 53.7 liter/h

Filtrate/d = 53.7 liters x 24 hrs = 1.29 m³/d



Shallow water
depth over sand
is important to
**keep aerobic
condition.**

**Passing time of water is shorter
in shallower depth.
And higher flow rate is also
better to keep aerobic condition.**

	unit	Simpson 1829	English Filter	Present Thames Filter	Experiment in Samoa
Flow rate	m/d	2	4.8	9.6	20
	cm/h	8.3	20	40	83
Flow rate in sand layer (50% porosity)	cm/h	16.7	40	80	167
Passing time of 1 m sand layer	hr	6	2.5	1.25	0.6
Passing time of upper active 1 cm	min	3.6	1.5	0.75	0.36



11th Pacific Water and Waste water conference, Noumena, New Caledonia, August, 2018



I used a transparent container to show how it works at the conference exhibition site.

If the container is transparent, algae will grow on the inside walls. In reality, a container that blocks light is better.

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



Fig.0. Fijian EPS using rain harvest tanks in a village.

August 2018

Ecological Purification System for Safe Drinking Water

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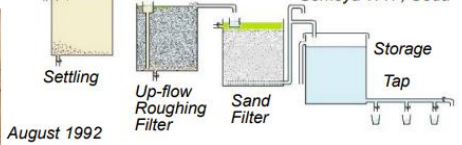
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Cast off skins of midge larvae



Someya WTP, Ueda



2



I distributed this textbook. You can download this.

<https://eps.watervision.jp/wp-content/uploads/2025/04/EPStext-NC-2019.pdf>



**After 5months, still
crystal-clear water
produce**

2024/09/15

Thanks to Dr. Nakamoto,
Yano San, Maho San,
Mariko San and all EPS
member for the
knowledge & support all
this time. I feel proud &
thank full for the
knowledge I gain from
JICA KCCP Program.

In addition, I want to share to all of you, up-flow filtration method is super value, value for money, maintenance & stress free as to compare to normal downflow filtration.
From Mr. Mohamed Zairi, a trainee from Malaysia.

JICA-Okinawa Training on Small water supply and EPS.



Mr. RAMJUG Jawaharlall (Guyana Water Incorporated/ Operations/ Head of Non-Revenue Water) returned back to Guyana from JICA training in Feb. 2015. He made a bucket model of EPS. He made a video on 3rd of September, 2025 and sent us.



9 min 45 seconds

<https://youtu.be/uMdhSdxOSsQ>



Mr.RAMJUG Jawaharlall (Guyana Water Incorporated/Operations/Head of Non-Revenue Water) returned back to Guyana. He made a bucket model of EPS. He made a video on 3rd of September, and sent us.



Hiroshima :How to make model.



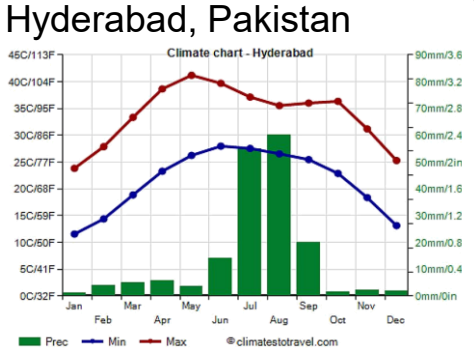
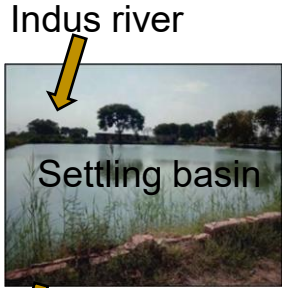
Malaysia: Practical small system



Pakistan small plant : 2025

I added some additional explanations to the video on his smartphone. I also added photos of the training model created at JICA Hiroshima, a video of trainees in Malaysia, and the construction of a purification plant in Pakistan in 2025.

URF is the best pre-treatment for turbid water



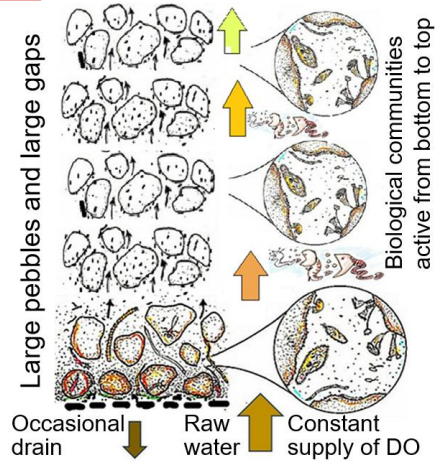
Coagulation treatment



Biological communities (Flocculant) in URF trap and decompose turbid matter.

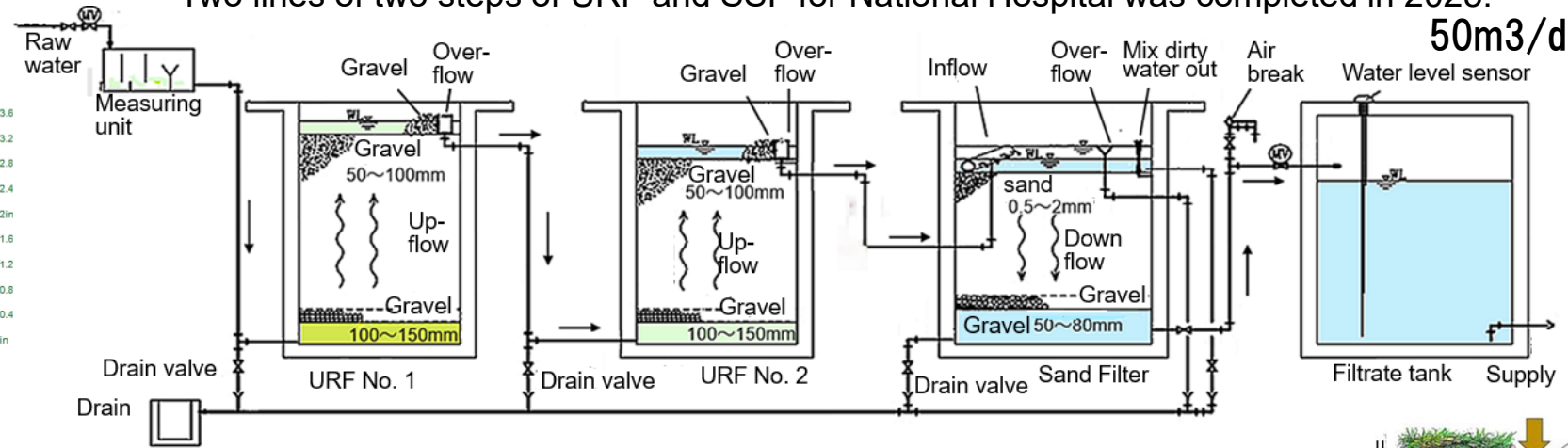


Test run

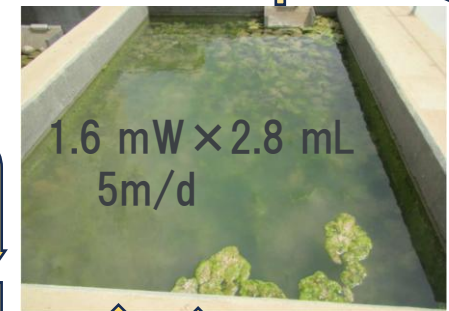


Two lines of two steps of URF and SSF for National Hospital was completed in 2025.

50m³/day



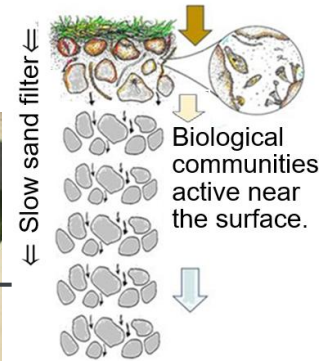
URF No. 1



URF No.2



Sand filter



To storage

The URF does not become clogged with large gravel. DO is constantly supplied from the bottom, keeping the biological community active.

It is sufficient to drain a small amount of sludge from the URF from time to time. Do not remove it all.

It is better to have shallow water in the sand tank so that there is no shortage of oxygen at night.

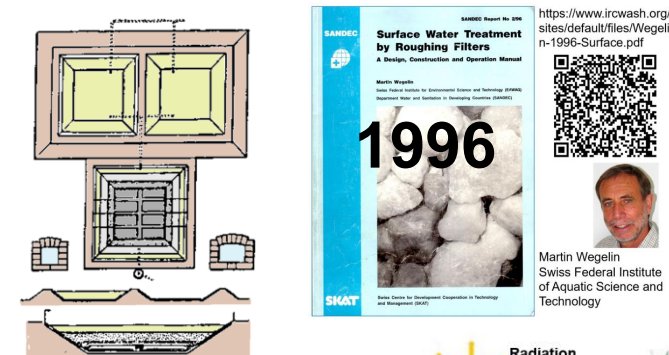
A faster flow rate is better.

When biological communities are active, they capture and break down dissolved substances and turbidity that react with living organisms.

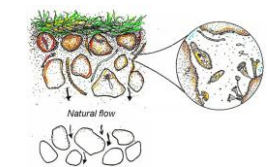
When the biological community is active, clogging does not occur.



The WHO manual, as well as L. Bernardo and M. Wegelin, **did not consider the activity of algae and micro-animals to be a key factor**; consequently, the water depth in the filtration ponds was set to be **deep**.

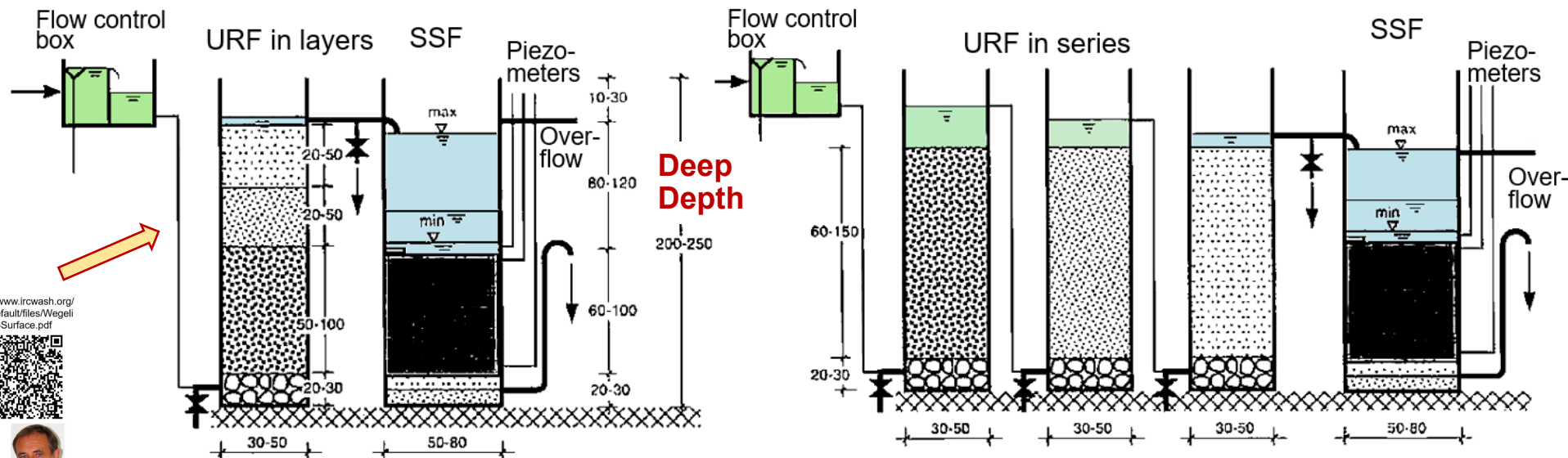
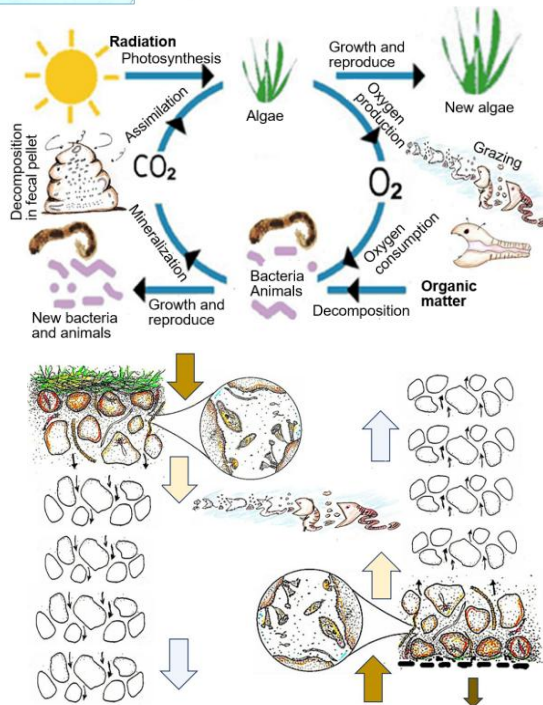


The water depth of Simpson's filter in 1827 was **shallow, at 38 cm**.

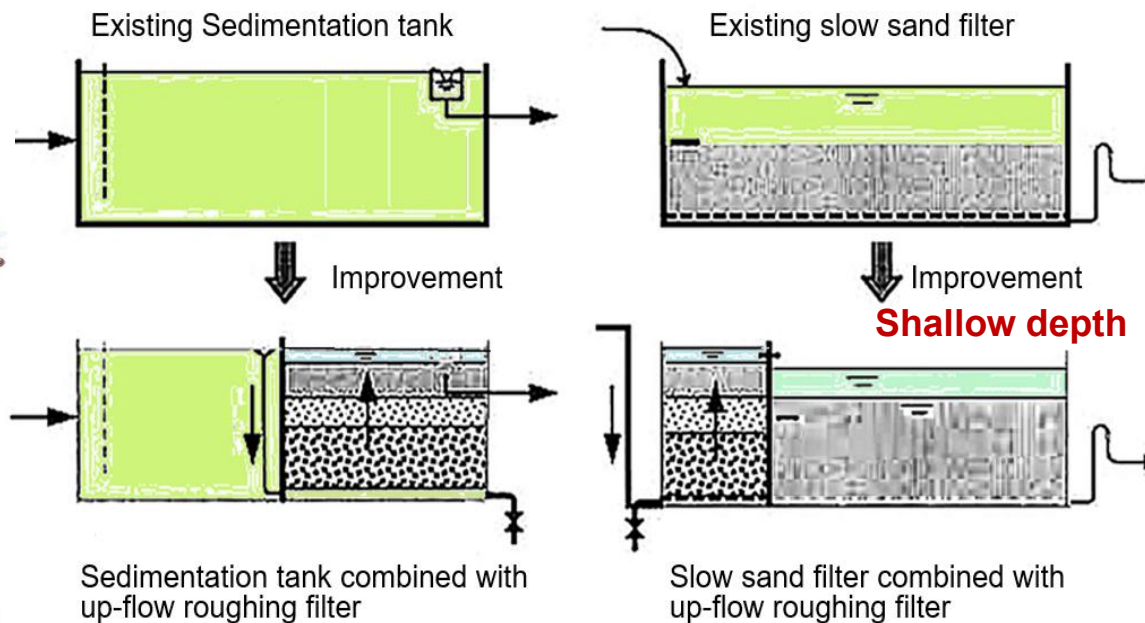


Gentle for small organisms.

SSF and URF are EPS.



Pilot plant examples for URF in layers and for URF in series in SANDEC manual (M. Wegelin)1996 (Fig. 5/1)



Possible layouts for the integration of URF into existing sedimentation tanks or slow sand filters, in SANDEC manual (M. Wegelin) 1996 (Annex 6/5)

URF removes turbidity, thereby reducing resistance and allowing for faster filtration speeds.

It also enables a reduction in filtration area.