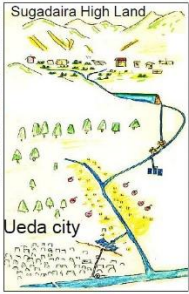
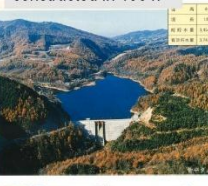




Odor problem of tap water happened in Ueda city.



Sugadaira Dam was constructed in 1964.



Odor problem in tap water in Ueda city.

From 1975, I worked as a teaching staff of Shinshu University at Ueda Campus.

→ Eutrophication study on Sugadaira Reservoir from 1975.

I explained on pollution and purification related with biological activity in Ueda city.

They (Ueda WTP) stopped algicide.



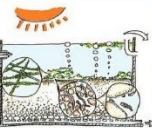
Delicious tap water

Original Water source of Someya WTP was sub-surface water of Chikuma river in 1923 (103 years ago).  
Surface water of Kangawa was taken from 1953 (73 years ago).

Heavy Algal bloom in a slow sand filter pond.



Plant manager said Good Algae in filter pond but Bad Algae in the reservoir.



I started to study Role of algae in SSF from 1984.

I noticed they misunderstood the purification mechanism in SSF.

①-5

1-5 上田市は菅平ダム湖が完成したら、水道水が不味くなった。原因は、殺藻剤で生物が活躍できなかった。生物処理の誤解だった。



Idea of Ecological Purification System was born from this plant, in Ueda, Nagano, Japan.



53 seconds

Invitation to the original plant of EPS of Someya Plant

<https://www.youtube.com/watch?v=b7wPQIKVIMY>

①-6

1-6 緩速ろ過の再認識は、上田市の染屋浄水場から始まった。現在でも使われている。QRコードで、見て下さい。

Slow Sand Filter is Wise Use of Natural Purification System to make artificial spring water.

Microorganisms trap and decompose dirt in water near the surface of the sand layer of slow sand filter (SSF).

Sieve filtration: Large particle, Hole size, Small particle. Like a paper with holes.

I noticed that Slow Sand Filter has been misunderstood by the name in the world.

I proposed Ecological Purification System (EPS) in 2004 instead of the name of Slow Sand Filter.

I, applied biologist, taught to the students that purification in nature and its application is called slow sand filtration. However, I pointed out that the name of SSF gave rise to a misunderstanding of how purification works. I have been teaching this EPS at JICA training since 2006.

The filtrate is clean and delicious water.

①-7

1-7 緩速ろ過は天然の湧水を人工的につくる仕組み。砂層上部で生物が活躍。中本は 2006 年から JICA 研修で、緩速ろ過は生物浄化法と教え、20 年間。中本は 2008 年3月に信州大を定年退職それから18年。

My first visit to Thames Water Company was on August 19<sup>th</sup> in 1992. I explained my study on the role of algae in SSF system in Ueda.

Ashford Common WTP

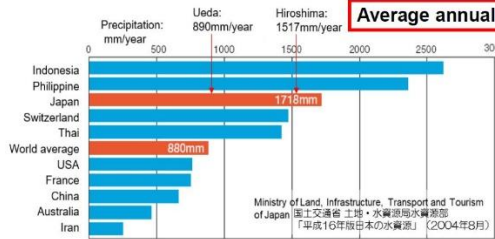
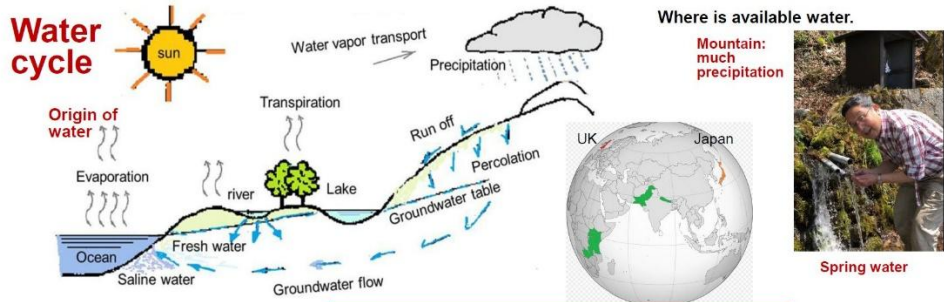
About higher flow rate asked by N. Nakamoto Michael Chipps Principal Research Scientist 2025/03/18

Since your visit (Aug. 19th 1992) we have added DO and turbidity monitoring on the outlet of all SSFs. Thames Water's asset standard says we can operate up to 0.5 m/h(12m/d), but in reality, we are usually in region of 0.25 to 0.35 m/h, but we can reach 0.4 m/h occasionally if we have to. We do have keep a careful eye on dissolved oxygen (DO).

Idea of EPS spreads from Japan to the world.

①-8

1-8 1992 年 8 月にテムズ水道で生物浄化の仕組み、溶存酸素 DO の変化で調べたと解説。テムズ水道では、その後、全てのろ過池で DO 測定した。テムズでは 12m/d(日本は 5m/d)でろ過しても良いとなった。



Areas close to the equator, with a lot of sunlight and the influence of the ocean, experience a lot of precipitation.

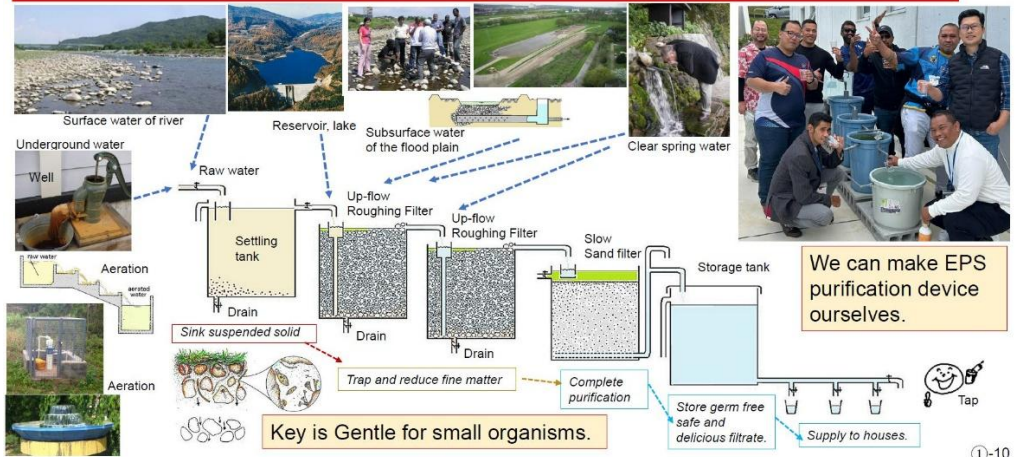
Even in areas close to the equator, inland areas experience less precipitation.

High latitude areas with less sunlight and less precipitation.

①-9

1-9 地球は水惑星。水の起源は海。海に囲まれた日本の降水量は多い。山では降水がある。雨が土壤に浸透し、湧き出し、その水は、おいしい水が普通。でも世界では、水に困っている地域が多い。

**Ecological Purification System (EPS) : This is Wise Use of Natural Phenomena. This is Chemical Free System to make Artificial Delicious Spring Water. This is a Smart and Eco-friendly technique.**



①-10

1-10 EPS の考えなら、薬品を使わないで、どんな原水でも、沈殿、上向流粗ろ過 URF (Up-flow Roughing Filter)、砂ろ過で、安全でおいしい水ができる。その水は、山裾の、おいしい湧水を人工的につくる仕組み。

JICA-Hiroshima, July, 2018

Microscopic organisms

2018/7/2 10:33

EPS mini model

July 2, 2018

EPS mini model

This is just model to explain the function of each part.

Aug. 9, 2018.

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

Practically, two URFs are better for practical use.

①-11

1-11 JICA 広島研修で、ミニモデルで解説。2018 年 New Caledonia での太平洋上下水道国際会議で EPS を発表。

**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

This is a concise English manual on EPS. You can download from the following address.

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

Fig.0. Fijian EPS using rain harvest tanks in a village. August 2018

Ecological Purification System for Safe Drinking Water Contents

1. Smart technology 3
2. Ecological point on slow sand filter 4-7
3. Refocus to chemical free SSF 8-10
4. Food chain 11-12
5. Bubble formation 13-17
6. Algal succession 18-20
7. Biological active layer 21-22
8. Filter resistance 23-27
9. Flow rate 28-29
10. Up-flow Roughing Filter 30-33
11. Instant purification 34-35
12. Dry and rewetting 36-37
13. Aeration 38
14. Capacity 39-40
15. JICA training 41-46
16. Samoa 47-60
17. Fiji 51-62
18. China 63-65
19. Social contribution 66-72
20. Acceptable risk 73-75
21. From Japan to the world 76
22. Ecological sense 77-80

Cost off 80% of image (approx)

Someya WTR Ueda

Settling Tank, Up-flow Roughing Filter, Sand Filter, Storage Tank, Tap

August 1992

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

①-12

1-12 2018 年の太平洋上下水道会議で英語版 EPS 冊子 80 ページを配った。QR でダウンロードできる。

Focus to Slow Sand Filter from Chemical treatment of Rapid Sand Filter in the world.

1988, Nov. 1st. SSF Conf. in London, UK

1991, Oct. 2nd. SSF Conf. in New Hampshire, USA

1996 April, 3rd SSF Conf. in London, UK

2014 June, 5th SSF Conf. in Nagoya, Japan

2006 May, 4th SSF Conf. in Mulheim, Germany

Key speech of Global 100 Eco-Tech Awards Ceremony, 2005 World Expo, Aichi, Japan.

Ecological Purification System was focused and recognized.

1-13 1988年にロンドンで初めての緩速ろ過国際会議。2014年は名古屋市で第5回会議。その様子はQRで。2005年愛知万博で、愛地球賞:受賞者代表スピーチ、QRで。

JICA supports EPS as Japanese innovation for the people.

How to make drinking water by Ecological purification system Aug. 2005.

August, 2018

July 2010, Portuguese, Brazil

March, 2009. Internet text by JICA

2021/12/23

Slow sand filtration: creating clean, safe water

2020/04/24

26 min Full

3 min Digest

1-14 技術解説本、ポルトガル語訳本、JICAもYouTubeで解説。

International Contribution Award of the 21st Japan Water Awards, Safe Drinking Water by Ecological Purification System

Chemical free purification system focused on food chain as a new treatment system from Japan.

25. June, 2019

Fig. 1. Delicious water by stopping the algicide

Fig. 2. Attention to the role of algae and micro-animals

Fig. 3. Algae and small animals are active at the top

Fig. 4. Settling tank and URF for turbid reduction

1-15 2019年はEPSで水大賞・国際貢献賞、QRで。

Web Japan Ministry of Foreign Affairs of Japan

Japan Video Topics

Feb. 2021.

Clean drinking water is essential for life, but expensive water filtration systems are out of reach for many communities around the world. Japanese scientist NAKAMOTO Nobutada is unlocking the water-cleaning power of algae and microorganisms to bring down costs!

QR codes for various languages: Japanese, English, Portuguese, Chinese, Spanish, Arabic, etc.

https://www.youtube.com/watch?v=ki8Qyb2IZ10

1-16 2021年は外務省のJapan Video Topicsで紹介。



A Japanese researcher has been promoting a method called the ecological purification system to purify water utilizing the activities of small organisms. **What is this low-tech but smart solution that produces safe and affordable drinking water to help protect people's health?**



"In places without safe access to this vital resource, slight improvements to water for drinking and cooking can reduce instances of diarrhea or dermatological diseases. You'll then see a change in people's health awareness. **The key is promoting sustainable, do-it-yourself technologies and fostering awareness.**"

①-17

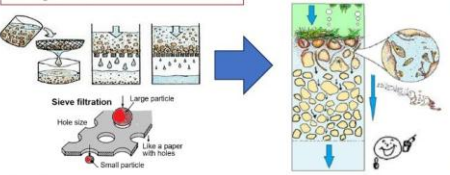
1-17 2023 年は日本政府の KIZUNA でも生物浄化法を紹介。

**② Quest for Pure Water from SSF to EPS.**

**Chemical free against SS: Up-flow Roughing Filter (URF)**

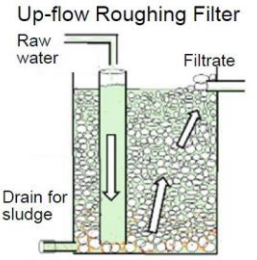
Purification mechanism of **SSF** was **misunderstood under the name.**

Image of Slow Sand Filter



**200 years** have passed, since SSF was developed to supply clean water to **urban** areas in London, UK.

SSF is to make **artificial spring water** by biological community. I, Nakamoto proposed **new name of EPS** instead of SSF.



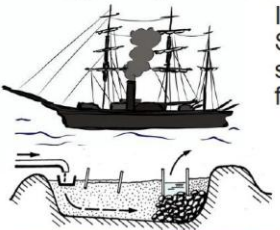
Artificial spring water, ss free water without chemicals.

②-1

2-1 純水の探求、緩速ろ過から生物浄化法、化学薬品を使わない濁り水対策の上向流粗ろ過(URF)の開発

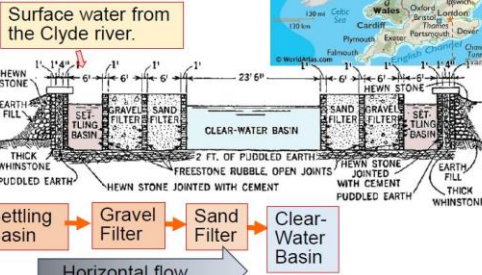
**Quest for Pure Water, Origin of Public Water Supply**

During the Age of Discovery, the textile industry developed.



In 1804, in Paisley, a suburb of Glasgow, Scotland, John Gibb created an artificial spring in a riverbed to wash away dye from dyed fabric.

He created an artificially clean spring water by horizontally through gravel and sand tanks.



This is said to be the **beginning of public water supply systems.** Gibb had water left over from his factory work, so he put it in barrels and sold it around the city by horse-drawn cart.

②-2

2-2 1804 年、グラスゴー郊外のペーズリーで、産業革命時代、染色した繊維の染料を洗う仕事をしていた John Gibb は河原の湧水を真似て、横流れのろ過装置をつくった。余った水を市内中に売り歩いたのが公共水道の始まり。

**During the Industrial Revolution, many people concentrated in cities, and urban rivers became polluted.**

The River Thames in London during the Industrial Revolution



1828 : Monster Soup

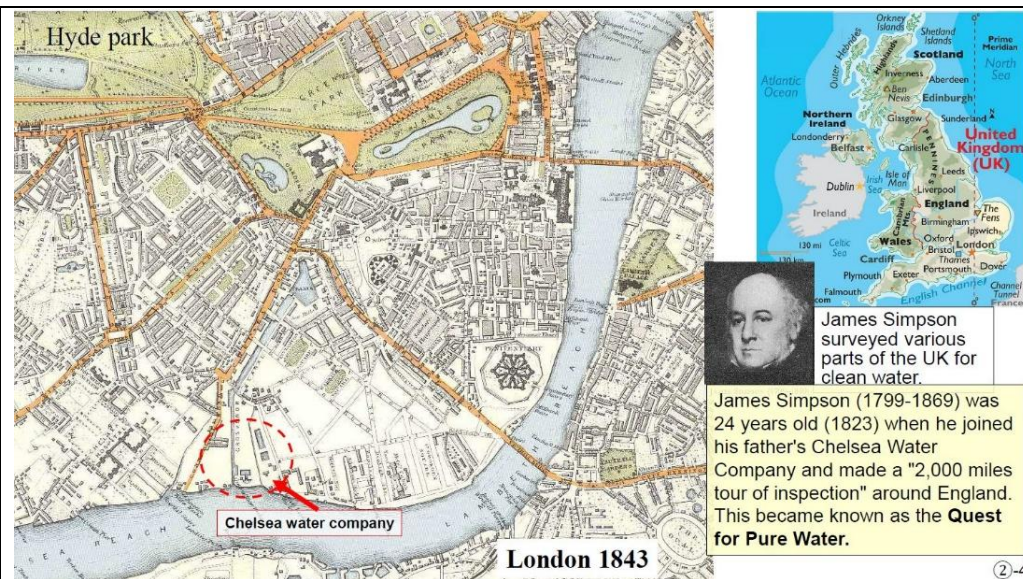
1832: Sewage was spilling into the Thames.

In search of clean water, citizens relied on springs and water vendors.

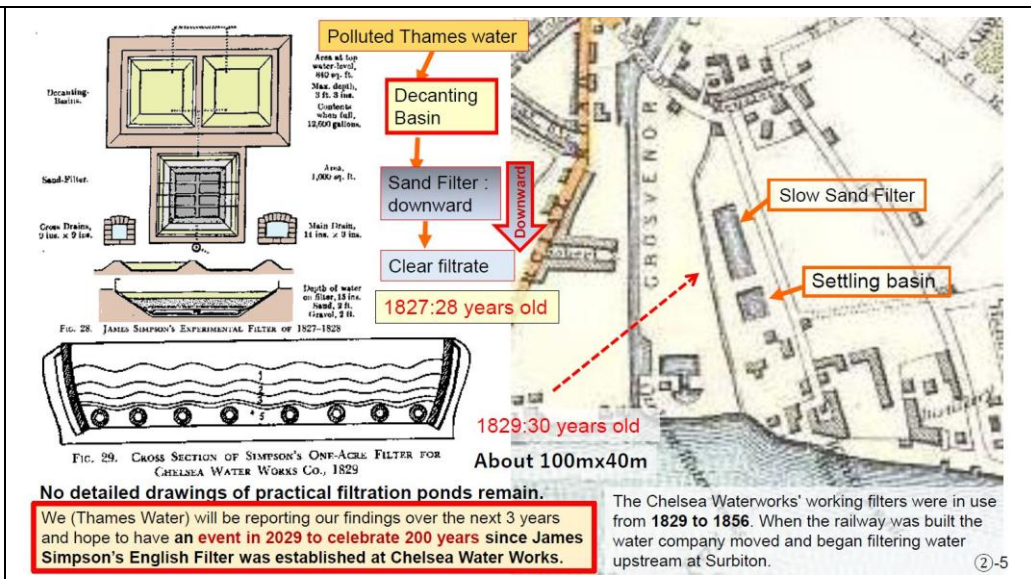


②-3

2-3 当時は、産業革命時代、都市に人口が集中し、ロンドンのテムズ河も、下水で汚れ、モンスタースープと言われていた。



2-4 James Simpson は 24 歳の時、父のチェルシー水道会社に就職し、英国中、水道技術を調べあつた。2000 マイルの純水の探求



2-5 テムズ河の汚れた水を沈殿池、上から下に流す緩速ろ過の実験を 1827-28 年に、1829 年に 1 エーカー(100mx40m)の実用のろ過池を 1856 年まで使った。テムズ水道では 2029 年にイベントを考えている。

*James Simpson and the Chelsea Water Works Company*

Best known of all the filtration pioneers is James Simpson. He was born July 25, 1799, at the official residence of his father, who was Inspector General (engineer) of the Chelsea Water Works Co. The house was on the north bank of the Thames, near the pumping station and near what was to become the site of the filter that was copied the world over. At the early age of 24, James Simpson was appointed Inspector (engineer) of the water company at a salary of £300 a year, after having acted in that capacity for a year and a half during the illness of his father. At 26, he was elected to the recently created Institution of Civil Engineers. At 28, he made his 2,000-mile inspection trip to Manchester, Glasgow and other towns in the North, after designing the model for a working-scale filter to be executed in his absence. On January 14, 1829, when Simpson was in his thirtieth year, the one-acre filter at Chelsea, commonly known as the first English slow sand filter, was put into operation.

Of the eight water companies supplying Metropolitan London in the 1820's, five, including the Chelsea until early in 1829, served raw water from the always polluted and sometimes turbid Thames, taken within the tidal reach of the stream into which numerous sewers discharged. The Chelsea Water Works Co., probably led by James Simpson, was the first to give official attention to this deplorable con-

M. N. Baker 1949.  
*The Quest for Pure Water*

**THE QUEST for PURE WATER**  
In Two Volumes  
*The History of Water Purification from the Earliest Records to the Twentieth Century*

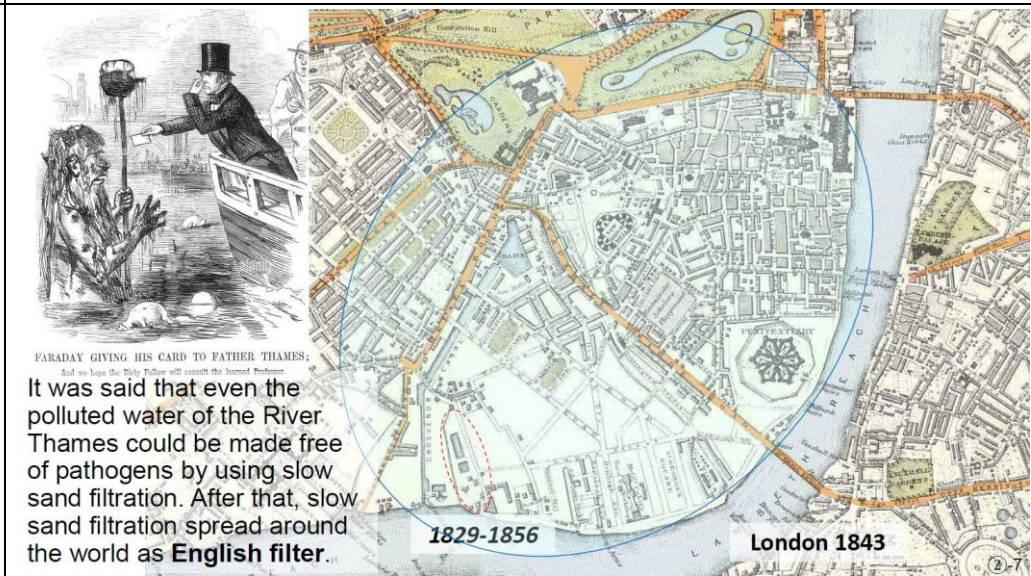
AMERICAN WATER WORKS ASSOCIATION

<https://babel.hathitrust.org/cgi/pt?id=mdp.39015007372272&seq=10>

Unfortunately, this drawing does not remain.

We (Thames Water) will be reporting our findings over the next 3 years and hope to have an **event in 2029 to celebrate 200 years** since James Simpson's English Filter was established at Chelsea Water Works. (2025/06/17)

2-6 シンプソンは 30 歳の時に実用のろ過池は、1829 年 1 月 14 日に完成。英国式緩速ろ過の完成と知られている。



2-7 このろ過水は、ウエスターミンスター寺院、バッキンガム宮殿などのロンドンの重要な区域に給水。病気になる水として評判に、世界へ広まる。

**James Simpson**  
 Experiment filter 1827-1829  
**28 years old**  
 Filter rate 2-3 m/d (10cm/h)

**38 cm Water depth**  
**61 cm Sand depth**  
**61 cm Gravel depth**

**30 years old**  
 The practical filter was completed in 1829.

**39 years old**  
 In 1838, James Simpson pointed out that slow sand filtration had greater removal capacity than mechanical filtration.

**Did Simpson feel that biological activity was involved?**

**The sand doesn't move.**

**The world's most widely used English filtration rate 4.8 m/d (20cm/h).**

**The mechanism of slow sand filtration that was able to remove fine particles at that time**

**The image of Slow Sand Filter**

**Sieve filtration**  
 Large particle  
 Hole size  
 Like a paper with holes

**Depth filtration**  
 Small particle  
 Thickness at which particles adhere

**Polluted Thames water**

**Decanting Basin**  
 Area at top water level, 460 sq. ft.  
 Max. depth, 9 ft. 3 in.  
 Contents, white fall, 12,000 gallons.

**Sand filter**  
 Area, 1,000 sq. ft.

**Cross Drains**  
 9 in. x 9 in.

**Main Drain**  
 14 in. x 9 in.

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

**FIG. 29. CROSS SECTION OF SIMPSON'S ONE-ACRE FILTER FOR CANTONIA WATER WORKS CO., 1829**

**FIG. 30. MECHANISM OF SLOW SAND FILTRATION**

②-8

**In 1838, James Simpson pointed out that slow sand filtration had greater removal capacity than mechanical filtration.**

**Bacteria per Gram.**  
 100000  
 50000  
 10000

**Depth in Inches (2.5cm)**  
 0  
 1  
 2  
 3  
 4  
 5  
 6

**Layer removed by Scraping**

**Hazen, A. 1905: The Filtration of Public Water Supply**

**55 years after Simpson's findings, in 1893, a report from a water purification plant in Berlin stated that only the upper part of the sand layer was polluted. The erosion was deep in winter and shallow in summer. However, algae were in bloom in summer. When comparing open and covered filtration ponds and investigating bacterial removal for 20 years, the open filtration ponds had a better removal rate. The report said that this may have been something special.**

**The report said that temperature and solar radiation are related, that biological phenomena are involved, but that mechanical removal is the greater factor.**

**He was exactly as Simpson had described "slow sand filtration."**

**Considering the size of the pathogens, their removal cannot be explained by the size or gaps in the sand, nor by mechanical sieving or filtering through the sand.**

**Sieve filtration**  
 Large particle  
 Hole size  
 Like a paper with holes  
 Small particle

**Depth filtration**  
 Thickness at which particles adhere

②-10

2-8 シンプソンは、1838年、機械的(物理的)篩いろ過より、ろ過効率が良い。もしかしたらシンプソンは生物群集が関係していると感じた。

**Altona**  
 Water by slow sand filter

**Hamburg**

**Elbe**

**Robert Koch investigated bacteria in tap water and reported that water is safe for preventing cholera and typhoid if the general bacterial count is less than 100 per mL.**

**This idea and values are carried over to the current WHO drinking water standards.**

**This idea does not require complete sterilization.**

**This is an acceptable risk.**

**Clear evidence of the effectiveness of slow sand filtration came in 1892: a cholera epidemic broke out in Hamburg, killing 7,500 people. However, in the neighbor city of Altona, which was supplied with water that had been filtered by slow sand, there were almost no deaths.**

**Normally, even if we are exposed to small number of pathogens, humans have a strong immune system and are fine. Reduce the risk of danger, dilute it, or make it an acceptable level.**

**Danger** 100cfu/mL **Safe**

②-9

**Experiment filter 1827-1829**  
**Open Filtrate Basin**  
**Practical Filter 1829**  
**Germ free filtrate**

**1832: Richmond, Virginia, USA**

**From 1872: Poughkeepsie Filter plant, NY**  
 Sand filter  
 Filtrate basin  
 Open basin  
 May 1997

**1891: Ilion, NY.**  
 Filtrate basin  
 Covered basin  
 1907

**The average temperature in January is below 0 degrees.**

**In the United States, it is recommended to cover filter ponds and filtrate basins to prevent freezing.**

**New York gets very cold in the winter and hot in the summer.**

**Varry Water works, Dublin, Ireland, from 1860s.**  
**Clear water basin is open in 1998.**

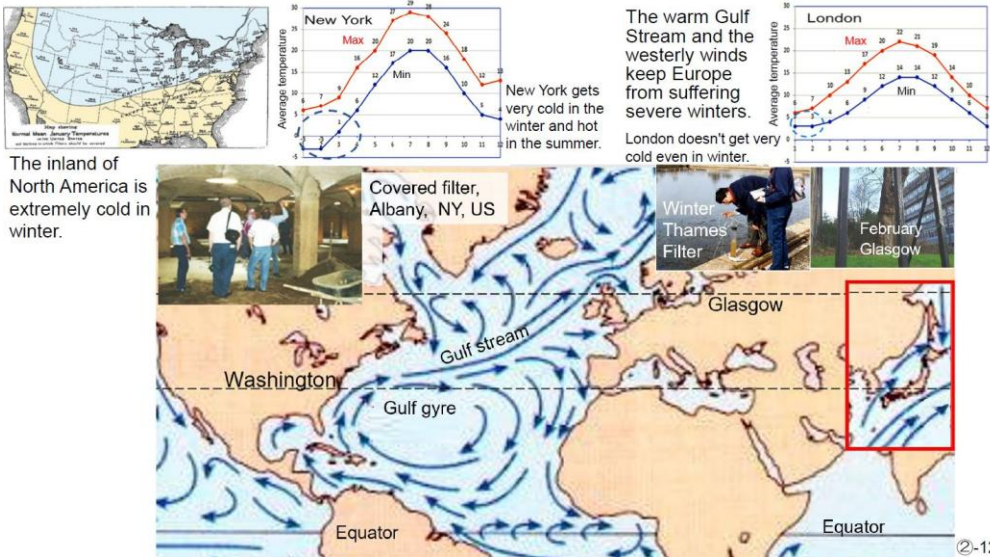
**London doesn't get very cold even in winter.**

**Normally, even if we are exposed to small number of pathogens, humans have a strong immune system and are fine.**

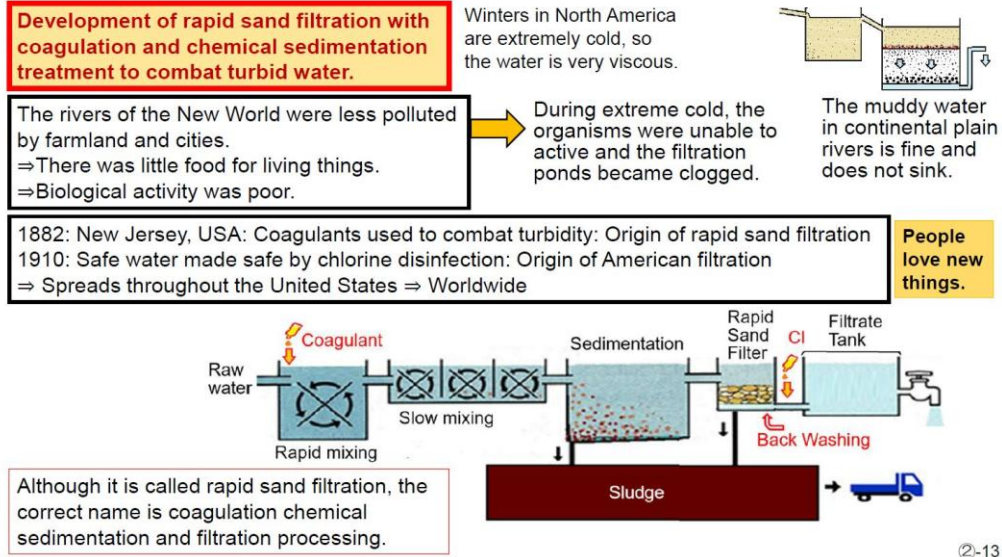
**Danger** 100cfu/mL **Safe**

②-11

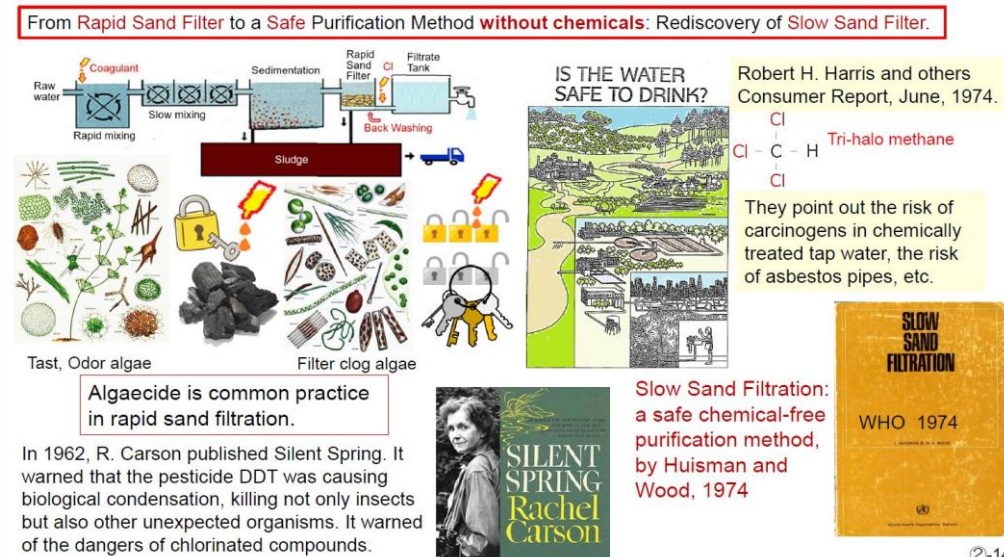
2-9 明らかな証拠は、ロバート・コッホが1892年、ドイツのハンブルグでコレラが流行した時、隣町は、緩速ろ過をしたら感染者がでなかった。一般細菌が1ml中に100以下なら安全と報告。現在のWHO基準に。無菌は必要ない。



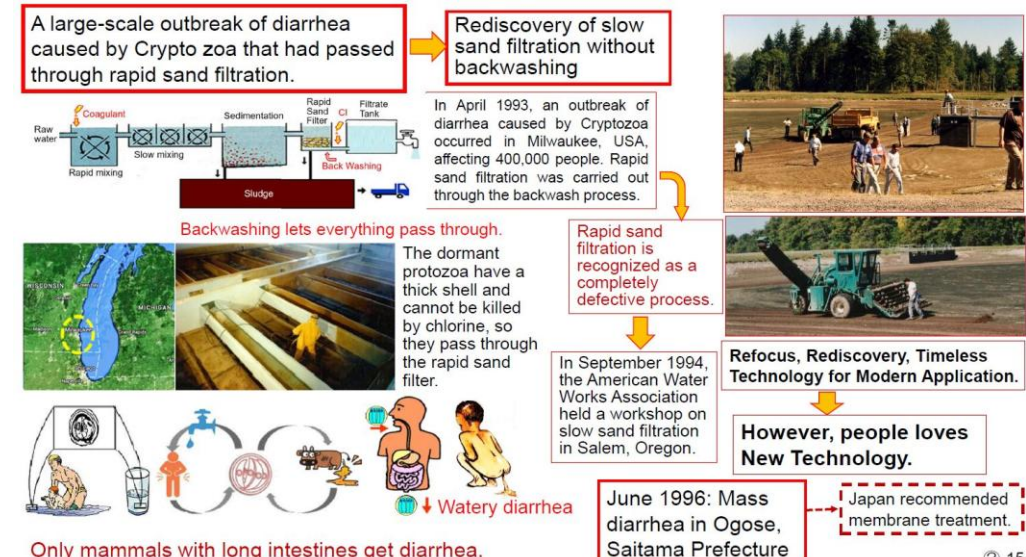
2-12 アメリカ大陸の冬は、厳寒。英国は高緯度でもメキシコ暖流と、偏西風の影響で厳寒にならない。グラスゴーでも芝生は、冬でも枯れない。



2-13 新大陸の河川は、ロンドンと比べ、汚れていない。1882年、濁り対策で、凝集剤を使う急速ろ過、1910年、最後に塩素で殺菌し、急速ろ過処理の完成。



2-14 1962年、沈黙の春で、化学薬品の危険性が問題。1974年、コンシューマー報告「飲み水は安全か?」。1974年、WHOは緩速ろ過指針発表。



2-15 1993年春、雪解け水にクリプト原虫がミルウオーキー市の急速ろ過処理を通過、40万人の集団下痢。翌1994年、アメリカ水道協会は緩速ろ過研修会。日本でも1996年埼玉県越生町でクリプト事故、日本は膜処理へ。

Development of Eco-friendly and Chemical-free turbidity countermeasures: **Up-flow Roughing Filter.**

Luiz Di Bernardo 1980  
Univ. São Paulo, Brazil

Up-flow Roughing Filter: presented at the International Conference on Slow Sand Filtration, London, 1988

At the international conference in 1988, Martin Wegelin from Switzerland reviewed past roughing filters  
⇒ International joint experiment  
⇒ In 1996, a roughing filter manual was published in Switzerland.

2-16 薬品を使わない濁り水対策で、上向流粗ろ過をサンパウロ大のベルナルドが実験、1988年のロンドンの国際会議で発表。国際共同研究、スイスのウエゲリンがまとめて粗ろ過指針を1996年に出版。

The role of the biological community was also key in Up-flow Roughing Filter.

Up-flow Roughing Filter Slow Sand Filter Up-flow Roughing Filter

Raw water Filtrate

Drain for sludge

It has good settling properties and is similar to activated sludge in sewage treatment, where the biological community is active.

The activity of biological communities is key.

2-17 指針を手に入れ、信州大で実験、見附市でパイロット試験。上向流粗ろ過は生物群集による浄化。排出污泥は、活性汚泥と同じ。生物群集による濁り捕捉と分解だった。

Photosynthesis is dependent on the amount of solar radiation.

Algae produce oxygen, making it easier for animals to thrive.

Gentle for small organisms. The sand does not move even when the flow rate changes.

Artificial delicious spring water

1mm = 1,000 μm

Organisms smaller than the size of sand are active here.

Hungry microscopic animals will eat anything.

2-18 食物連鎖が鍵だった。砂での篩いろ過でない。藻は酸素生産と、動物の餌になった。

**Hungry animals move around in search of food and will eat anything they can.**

Short time work.

Long-term action.

It only takes a split second for the microscopic organisms to capture food and any suspended matter.

The food that is eaten passes through the intestinal tract in a short time and is immediately excreted as feces.

Decomposition takes place over a long period of time within the feces. Fermentation progresses in the anaerobic environment with a lack of oxygen, breaking down polymers into smaller molecules.

2-19 動物が食べる時間は、短時間。糞塊の中で、酸素が無いので、発酵現象が生じ、高分子が低分子に分解する。この分解には、時間がかかる。

**When observed under a microscope, algae and other tiny organisms are at work.**

Tiny organisms

Filamentous green algae

Protozoa Vorticella

Filamentous diatom

Protozoa Ciliate

Oligochaeta

Nematoda

Rotifer

Chironomid larvae

Carnivorous dragonfly nymph

The snail eats green algae.

There are clams in the sand layer.

**In slow sand filters, the food chain is the key to purification - eating and being eaten.**

②-20

2-20 顕微鏡生物から、大きな動物まで、酸素がある環境が大切。

**Chironomid is not same as Mosquito.**

Chironomid

Non-biting Mosquito

Mosquito

Biting Mosquito (Female)

Troublesome Nuisance Insects

Vending Machine

Both Midge of Chironomid and Mosquito swarm for mating.

Midge swarming

Lake and Pond

Mosquito larvae live in stagnant environments.

The mosquito larvae float on the water surface, drifting with their tails up. Their tails act as respiratory organs, and they bring them to the surface to breathe.

Roughing filter

Ecological System under slow water current

Chironomid larvae: making nest at the bottom

Chironomid larvae are active on the muddy surface, sandy surface, and upper part of the sand layer. These environments with currents have dissolved oxygen.

②-21

2-21 ユスリカは、血を吸わない蚊。底で巣をつくる。ポーフラは、水面にぶら下って、空気を吸う。流れがあると流されてしまう。間違えやすい。

Algae grow on the sand surface.

Animals work near the surface of sand layer.

Image of Slow Sand Filter.

Sieve filtration

Large particle

Hole size

Small particle

Like a paper with holes

Like a paper with holes

Food chain is the Key.

1mm = 1,000 μm

Slow Filtration with fine sand under slow current.

Ecological Purification System

slow >> gentle

Hungry organisms works in this EPS.

②-22

2-22 スローとは、生物群集にやさしいという意味だった。微小動物、微小生物は餌がくる、砂面近くだけで活躍。

**Slow Sand Filter**

Mechanical filtration with fine sand under slow current

Purification mechanism of SSF was misunderstood by the name.

Sieve filtration

Large particle

Hole size

Small particle

Like a paper with holes

Like a paper with holes

Slow sand filtration, which originated in the UK 200 years ago, was reborn in Japan as the Ecological Purification System (EPS). From Japan, EPS began to spread throughout the world.

Ecological Purification System from Japan to the world

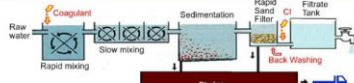
Super clean delicious water

Trust Our Sense!

②-23

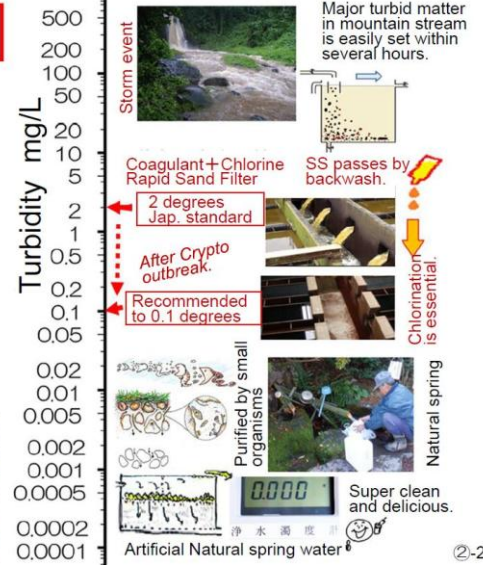
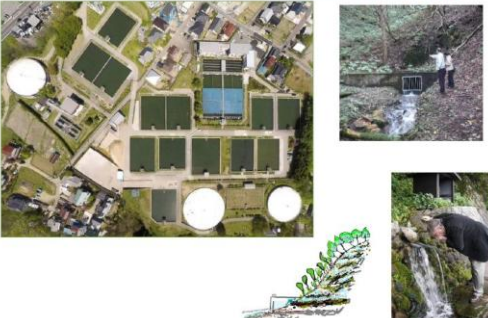
2-23 英国生まれの緩速ろ過処理は、日本で生物浄化法として再評価され、日本から、世界へ広まりだした。

A large-scale outbreak of diarrhea caused by Crypto zoa that had passed through rapid sand filtration in April 1993.



Backwashing lets everything pass through.

Refocus to Slow Sand Filtration after the large-scale outbreak of diarrhea caused by Crypto zoa.



Major turbid matter in mountain stream is easily set within several hours.

SS passes by backwash.

Chlorination is essential.

Natural spring

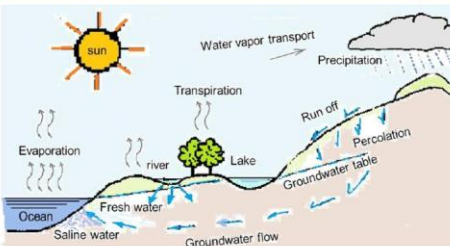
Super clean and delicious.

2-24

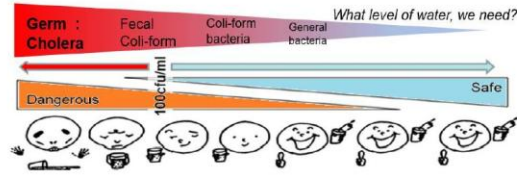
2-24 日本の基準濁度は、急速ろ過処理に合わせ、合格させるようになっている。緩速ろ過の水は、桁違いに、スーパークリーン。

### ③ Water Cycle, Safe and Acceptable Risk.

③11 slides  
We have to think about acceptable risk and treatment.



Traditional Welcome Ceremony of Kava Drink in a village in Fiji.



I could not say that bacteria free water is safe.

<https://www.youtube.com/watch?v=vQxpxhUVkM8>

49 seconds

3-1

3-1 水循環、許容できるリスク。何が本当に必要な処理か。無菌にしないと安全とは言いにくい。

Rain falls on mountains and islands. There is a lot of sunlight, clouds form, and rain falls. Rainwater seeps underground and comes to the surface as spring water. It is purified in the soil and becomes clean water.

Artificial clean subsurface water in a flood plain.

Image of Slow Sand Filter as Ecological Purification System (EPS).

EPS is a new purification system to make artificial spring water. This system is wise application of natural phenomena.

We have been used natural safe water which is natural spring water. This water is purified in nature without any chemical.

3-2

3-2 ペットボトルの水は、天然の湧水。緩速ろ過は、薬品を使わず、生物群集の活躍で、人工的に湧水をつくる。

### Familiar surface waters are not always safe. How to get safe water.

Surface water is easily contaminated by pathogens and other dangerous worms. It is not always safe to drink directly.

Fish is one of the indicator.

Multiple layer filter, Bio-Sand Filter and Ceramic candle filter do not perform completely at removing pathogens. These can be reduced the risk.

Almost all pathogens may be removed by ceramic filter. The pore size is smaller than 1.5 micron.

All the contaminated particulate matter can be removed by a membrane filter. But the running cost is so big.

Boiling is the best way against pathogens.

Heavy metals are easily dissolved in underground water. This water does not contain enough amount of dissolved oxygen.

3-3

3-3 身近な汚れた水でも、酸素があるなら魚が住んでいる。酸素が無い水は、鉄やマンガンなど溶けているので、空気に触れると析出する。素焼きのろ過器は、細菌が除けるので、世界中に広まっている。膜処理は本当に必要か。



Sweet drop (honey dew)  
Natural sweet and delicious water

Natural spring water and rain water are usually sweet and delicious.



Rain harvesting

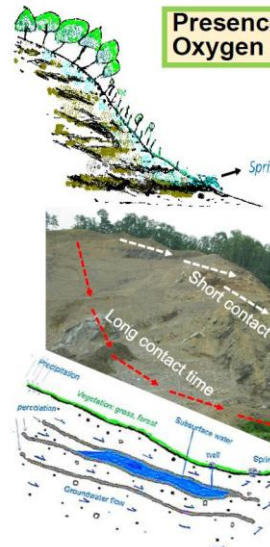


③-4

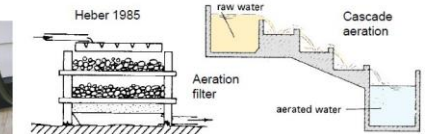
3-4 甘露水、天然のおいしい湧水。刺激がない、おいしい水。  
雨水も、刺激がない、おいしい水。

**Presence of Dissolved Oxygen is Key.**

Natural delicious spring water contains **enough amount of dissolved oxygen**. It is usually safe to drink.



Addition of oxygen:  
Aeration is frequently used for treatment of groundwater (reduction of unpleasant tastes and odors, discoloration, precipitation of iron and manganese).

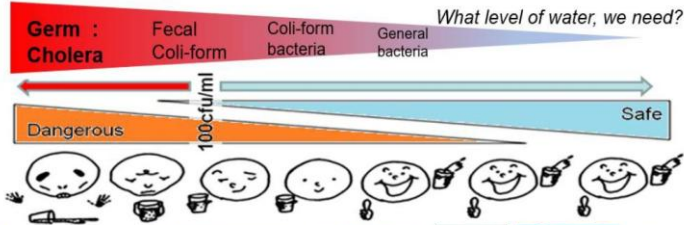


Iron and manganese are oxidized and form nearly insoluble hydroxide sludge. They can be removed in a settling tank (a coarse filter).

③-5

3-5 溶存酸素が鍵。酸素が消費され、無酸素の水だと、岩石から金属成分が溶け出す。この水は、酸化処理し、生物が反応しにくい状態にする必要がある。

**We have to think about acceptable risk and treatment.**



Is this, safe or not?

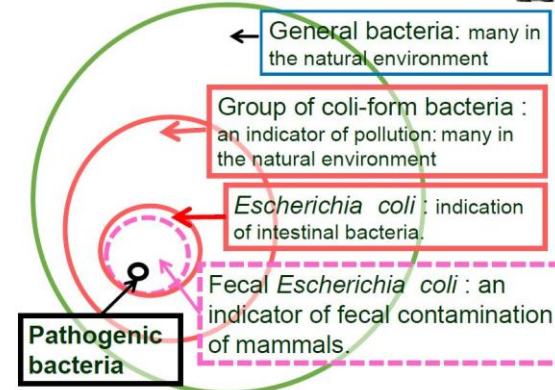
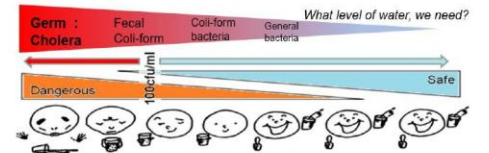
Which level of treatment, we need?



③-6

3-6 洗濯、トイレの水は殺菌する必要があるのか。  
素手で食べる。ご飯に、石が入っているなら、歯が欠けるので、危険。

**There are many kinds of bacteria in nature (in water and in the soil).**

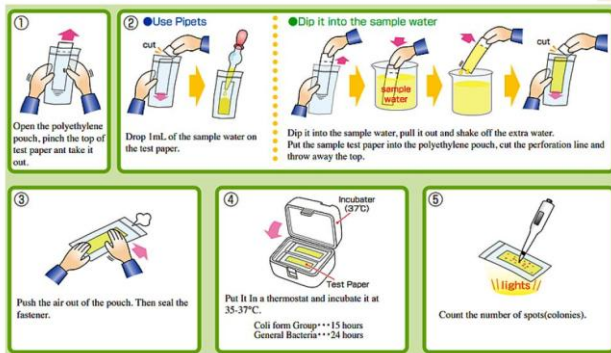


Wash hand!  
Reduce the risk.

③-7

3-7 自然界には、いろいろな細菌がいる。一般細菌、大腸菌群、糞便性大腸菌、これらは病原菌でない。病原菌だけが、問題。

Easy bacteria test paper of SUNCOLI paper  
[https://www.sibata.co.jp/wpcms/wp-content/themes/sibata/en/pdf/test\\_paper.pdf](https://www.sibata.co.jp/wpcms/wp-content/themes/sibata/en/pdf/test_paper.pdf)



Incubate at 35-37 C.  
 Coli form bacteria: 15 hrs.  
 General bacteria: 24 hrs.

Fluorescence emitted when exposed to ultraviolet rays in case of Coli form bacteria paper.

③-8

3-8 簡単に、細菌検査をすることができるサンコリ試験紙がある。糞便性大腸菌は、紫外線を照射すると、蛍光がでる。



At the opening ceremony of Safe Drinking water for rural people in Fiji, January 13th. 2013.

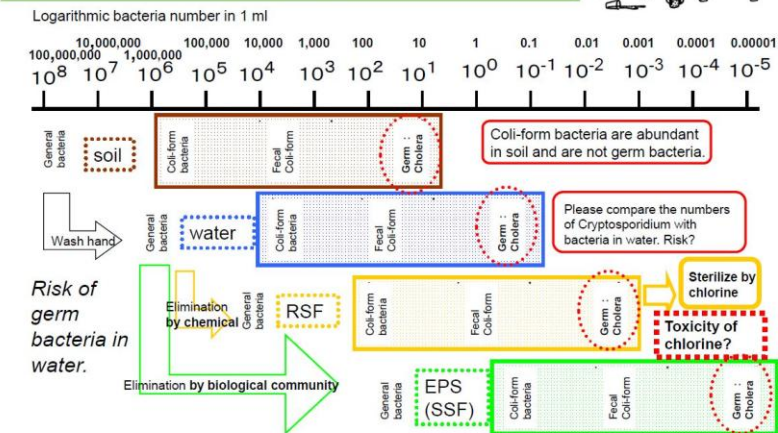
Bacteria Test by SUNCOLI test in Fiji Watch 3:21- 4:22  
 Total length 7:43  
<https://www.youtube.com/watch?v=Vrr2EOS1PMA&t=49s>



③-9

3-9 野外でも、簡単に検査できる。培養器があると良いが、体温程度の温度で培養すると良い。低温だと、細菌が増えるのに時間がかかる。

**There are so many bacteria.**  
 → **Medical doctor touches with patients.**  
**Medical Doctor is safe.**

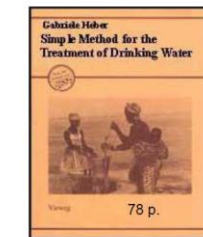


We have to think about acceptable risk.

③-10

3-10 土壌中には多数の細菌が。水中には、桁違いに少ない。急速ろ過でも減る。緩速ろ過なら、もっと少なくなる。

Gabriele Heber 1985: Simple Methods for the Treatment of Drinking Water



<https://www.ndl.org/cgi-bin/library.cgi?e=d-00000-00-off-0hdt-00.0-0-10.0-0-0direct-10-4-0-0.0l-11-en-50-20-about-00-0-1.00-0-11-1-OutZz-8-10&cl=CL3.21&d=HASH175e57dd8f453120fc2d5d1&gt=2>

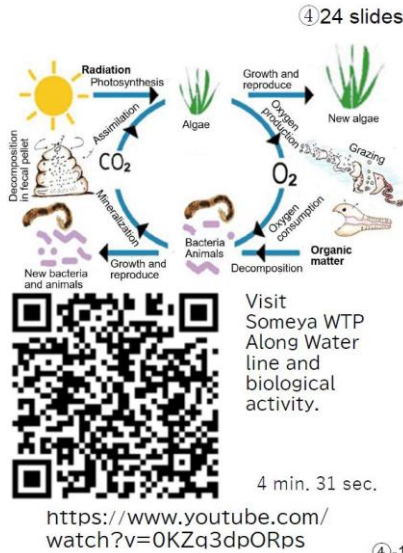


It is popular in the world to eat with our bare hands. We have to remove the contaminated small stones in food. This is a reasonable way.

③-11

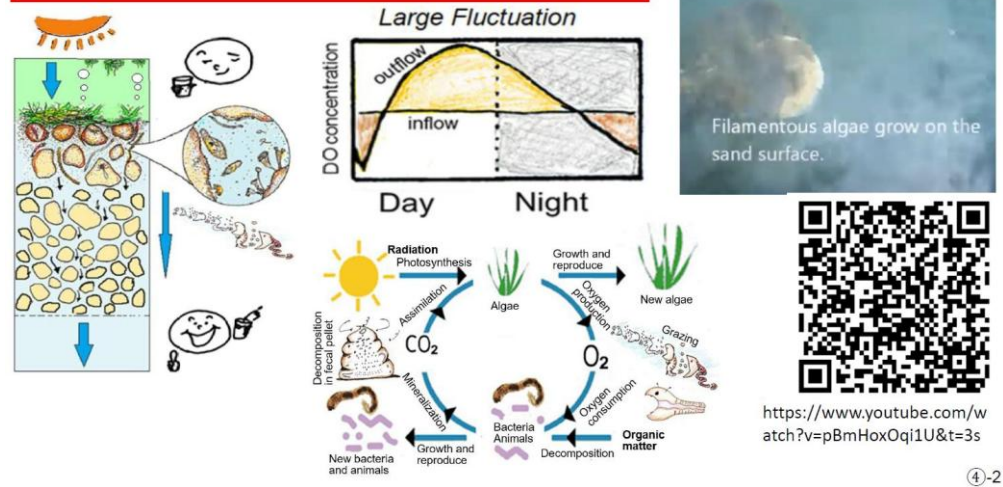
3-11 ドイツの簡易浄化法の本が参考になる。QR で見ることができる。

## ④ Food Chain is Key.



4-1 食物連鎖が鍵。

## Aerobic condition is essential.

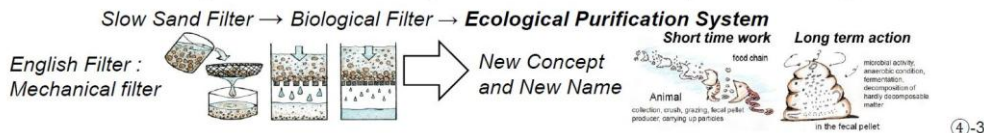


4-2 生物群集が安心して活躍するには、酸素が鍵。

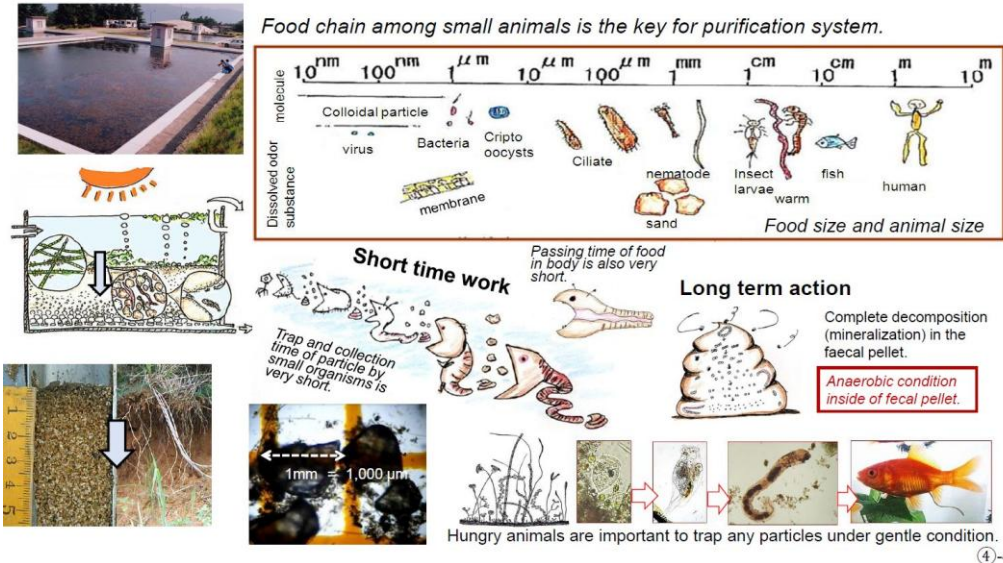
## THIS is FOOD CHAIN.

This is a summary of the open lecture at UCL and Univ. Glasgow, in May, 2011.

The first use of slow sand filter for the public supply of drinking water began in 1804 in Paisley, Scotland. The present vertical type of slow sand filter was devised by James Simpson in 1829 after his 2,000 miles inspection trip all over the Britain. This filter provided safe drinking water, free of pathogens to residents in London. This **vertical** type of filter spread round the world and was known as the “English Filter”. Slow sand filter has been believed that it was a **mechanical filter with fine sand under slow current**. However, the major contribution of the purification of the impurities is the **food chain** in this system. The word of “**slow**” was “**gentle for organisms**”. Recently, the English filter of “**Slow Sand Filter**” has been recognized as “**Ecological Purification System**” in Japan.



4-3 2011年5月、ロンドン大 University College of London とグラスゴー大 University of Glasgow で、頼まれて講演した要旨。英国生まれの緩速ろ過は日本で、生物浄化法として生まれ変わった。

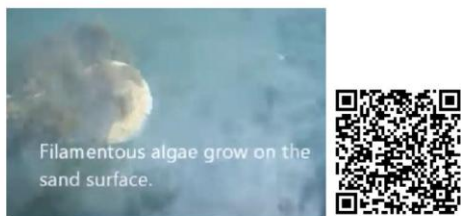


4-4 食物連鎖。口に入る大きさを考える。生物は餌があるところ、酸素があるところにいる。



Slow sand filter is real ecological purification system. Food chain is the key. It's an ecological purification system. / 5:22

Detail of Ecological Purification System for safe drinking water / 6:23



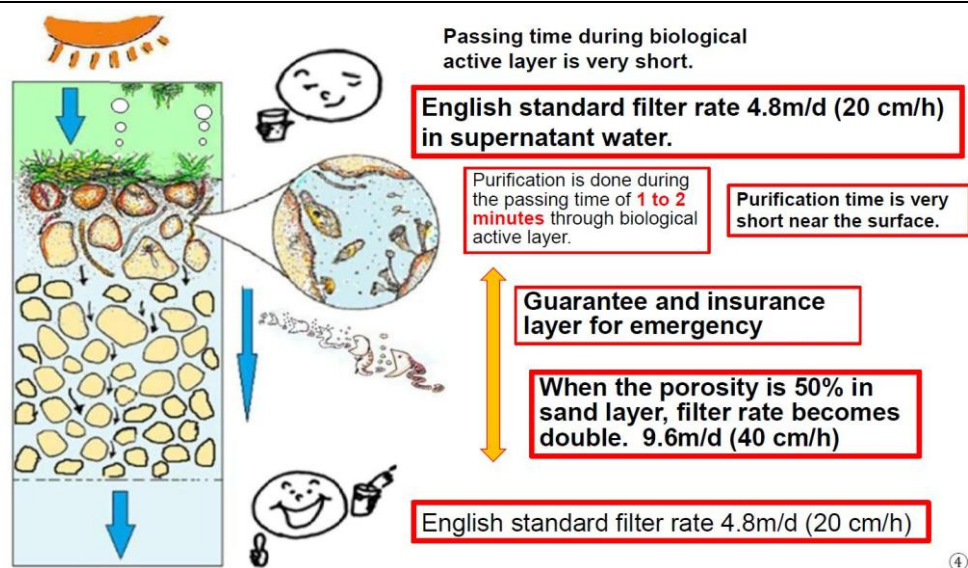
<https://www.youtube.com/watch?v=pBmHoxQj1U&t=3s>



[https://www.youtube.com/watch?v=Pk\\_JNC6RTyo](https://www.youtube.com/watch?v=Pk_JNC6RTyo)

④-5

4-5 QR で動画を見ると理解しやすい。



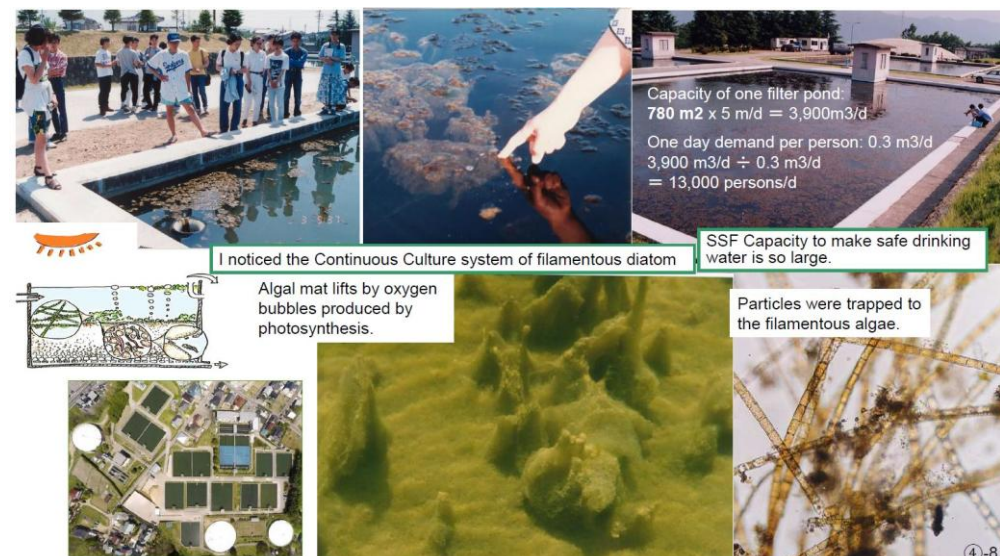
④-6

4-6 砂の間を水が流れる。その速度は、砂の上の水の速度の約倍だ。大部分の生物が活躍している厚みを通ずる時間は、1 から 2 分、瞬間浄化だった。砂層が 1m は、保険の層だった。



④-7

4-7 溪流で、岩がコケだらけなら、岩が動かない。増水して岩が転がれば、岩の上、岩の間で、生物は活躍できない。



④-8

4-8 砂面に日射が届くなら、光合成で生産された気泡の浮力で、水面に浮き上がる。流れがある環境なら、糸状になる藻が繁殖できる。

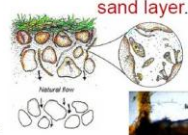
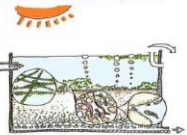
There is a thin **slimy (gelatinous) mat** known as the *Schmutzdecke*, or filter skin on the surface of the sand layer in many textbooks. **This explanation is not correct.**



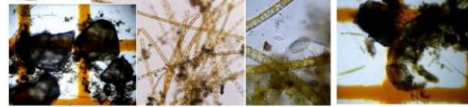
On the surface of sand layer, there is a **soft mat like light feather** mat. Filamentous algal mat is just lay down.

**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.

④-9

4-9 水中の砂面上に藻が、砂と一緒に持ちあげると砂は汚れる。私たちは、水を抜いた状態しか見ていない。だから、粘質状の生物膜と間違った。



### Schmutzdecke Sampler Reduces Filter Bed Damage

Nobutada Nakamoto  
Department of Applied Biological Science  
Shizuoka University  
Ueda, Japan

A *Schmutzdecke* is a sticky algal mat cultivated on the fine sand surface of a slow sand filter. The *Schmutzdecke* is valuable because it acts to remove turbidity without chemical coagulation. The algal prevents the filter from becoming clogged by trapping suspended matter and producing oxygen to promote decomposition activity on the surface sand. When a *Schmutzdecke* is properly maintained, it acts as an "automatic purifier." For a *Schmutzdecke* to form, flow rates must be kept very low.

Operators frequently have difficulty checking the condition of the *Schmutzdecke* while the slow sand filter is being operated. The device described in this article allows samples to be drawn so that the *Schmutzdecke* can be easily analyzed without any damage to

the sand surface during operation of the filter.

#### Sampler Components

The *Schmutzdecke* sampler shown in Figure 1 was assembled from the parts listed in the box below. Figure 2 (page 4) shows a schematic view of the sampler. The total costs of all components was estimated to be about \$100, primarily for the hand pump and acrylic tube. Several hours were required to construct the sampler.

#### Building the Sampler

The *Schmutzdecke* sampler can be constructed by following the steps listed below.

1. To construct the ring weight, drill an inner hole 1.4 in. (35.7 mm) in diameter in the 2.75-in. x 2-in. (70-mm x 50-mm) brass rod. Drill two holes through the ring weight for screws to secure the acrylic tube. Form the 0.3-in. (8-mm) edge on the bottom of the ring weight.
2. Drill a hole in the inner hammer rod for the hanger string.
3. In the stopper rod, drill 0.18-in. (4.6-mm) diameter holes in the center for



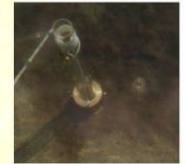
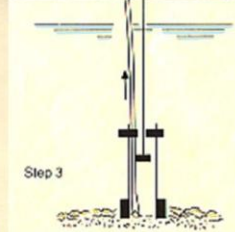
Figure 1 The *Schmutzdecke* sampler

(continued on page 4)

Item	Purpose	Cost
one brass rod, 2.75 in. x 2 in. (70 mm x 50 mm)	ring weight	\$ 1.50

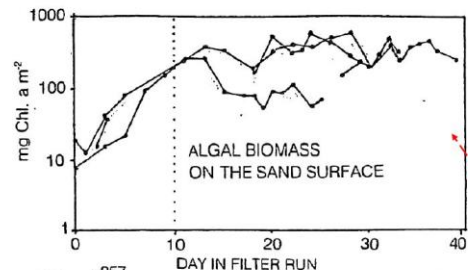
Opflow: American Water Works Association 1993.7.

I made algal mat sampler without any damage of sand filter during the filter run.

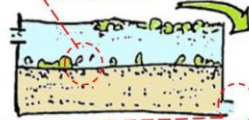
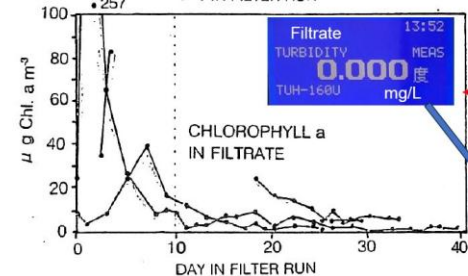


④-10

4-10 水を抜かないで、砂面上の藻類被膜を採取できる道具を考え、アメリカ水道協会の雑誌で発表した。



Algae grow well in summer. Continuous culture system of filamentous algae becomes after 10 days.



Filtrate water became clear water in 10 days. Grazing animal community grew well within 10 days.

Japanese standard of filtrate is 2 degrees (mg/L).

Super clean filtrate.

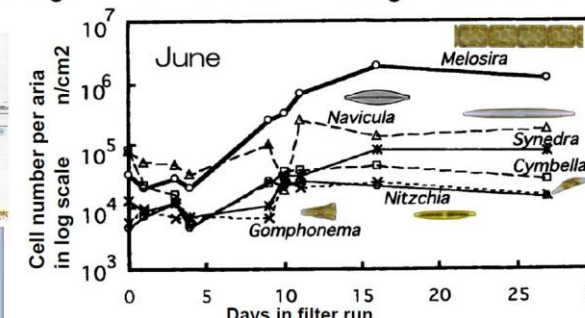


In summer, scrapping of surface mud is not necessary.

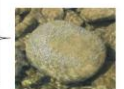
④-11

4-11 道具ができ、ろ過継続に伴う砂面上の藻類被膜の発達を調べた。夏、約2週間で、藻類被膜は一定になった。ろ過水に漏れる汚れを調べたら、藻類被膜が発達しない時は、汚れは通過していた。

### Development of algae on the sand bed during filter run in June in Ueda, Japan.

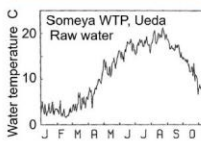


Filamentous algae grow well on the sand filter bed.



From a river

In June, algae first appear on the sand are the same as attached algae (periphyton) on the rock of riverbeds.



Someya WTP, Ueda Raw water

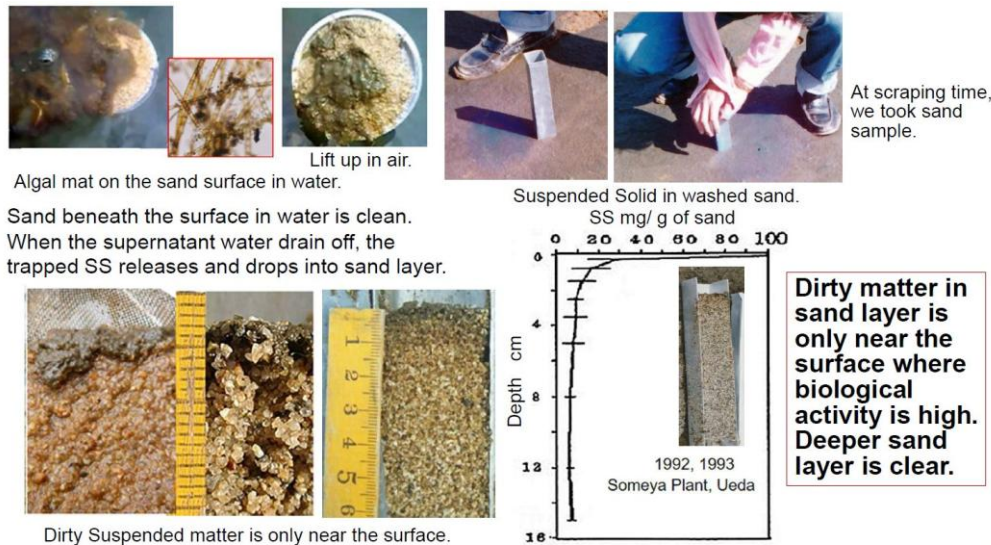
When the filtration continued, filamentous diatom of *Melosira* became dominant.



*Melosira* became dominates in cool water where grazing activity of animals is weak.

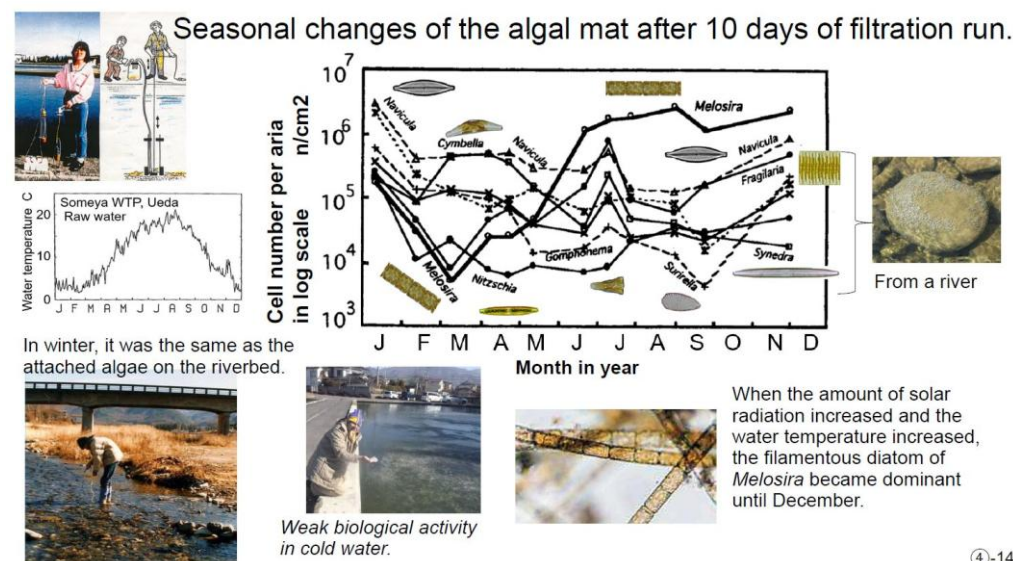
④-12

4-12 河川からは付着藻類が流れてくるが、糸状珪藻だけがろ過池で成長して増えていた。



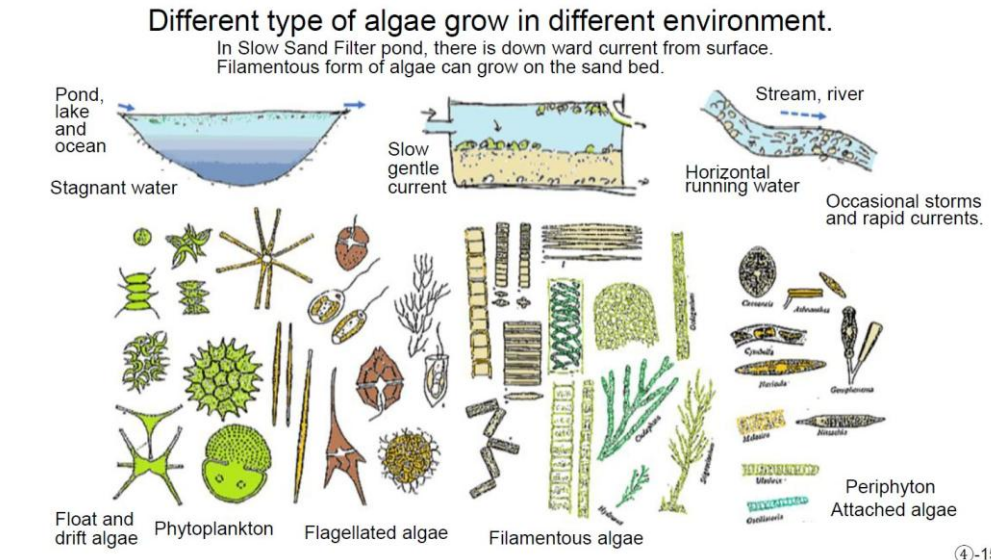
④-13

4-13 大部分の生物活動は、砂の上だけ。生物の餌がくるところ。



④-14

4-14 生物の活動は、温度と日射量に関する。



④-15

4-15 流れがない湖沼は浮いて繁殖する藻、流れがある河川では、河床の礫面に付着して繁殖する藻が、上から下へのゆっくりの流れがあるなら糸状になれる藻が繁殖する。



④-16

4-16 テムズでは、冬でも藻が繁殖。上田市では、厳寒期の冬に、藻が繁殖しないのは、もしかしたら栄養塩が足りないかと思い、栄養塩添加実験をした。でも繁殖しない。水深が関係していた。浅ければ厳寒期でも藻が繁殖した。

Continuous algal culture system is a nutrient reducing system.

Much nutrient → Over flow → Nutrient in algal mass → Less nutrient

**Harvest experiment was done.**

Average daily harvest during 11 days in July

Wet matter	173 g/m <sup>2</sup>
Dry matter	25.9 g/m <sup>2</sup>
Organic matter	7.81 g/m <sup>2</sup>
Nitrogen	373 mg/m <sup>2</sup>
Phosphorous	32 mg/m <sup>2</sup>

Nutrient reduction from inflow water to filtrate by algal growth.

Nutrient removal as Nitrogen 4.6 %  
Phosphorous 27%

4-17 夏に、どれだけ、藻が繁殖するのか、浮いてくる藻を全て収穫してみた。

Aerobic condition is essential for biological activity. There is down ward current.

Raw water → Filamentous algae → Oxygen production by photosynthesis → Small animals and microbes

Diurnal change of dissolved oxygen (DO) was measured.

$CO_2 + H_2O \rightarrow CH_2O + O_2$

Algal photosynthesis accelerates purification process.

Partial pressure of oxygen in bubbles was also measured.

Bubbles keep aerobic condition after sunset.

Dissolved Oxygen concentration mg O<sub>2</sub>/L

Saturation %

Day Night Day

After sun rise, DO in filtrate was rapidly increased.

Even after sunset, DO in filtrate was super saturated condition.

4-18 ろ過池の流入水とろ過水の酸素の日変化を測定した。日没後も酸素生産があるみたい。おかしい。それは、砂面に小さな気泡があったからだった。

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

Thames Bubbler

Queen Merry Reservoir

Nutrient rich water

Cladophora

Filamentous green algae bloom in summer

Melosira

Filamentous diatom in winter

Biological roughing filter without chemical.

100mx35m  
32 Filters

Ashford Common WTP, Thames Water

Temperature of surface water of reservoirs, Thames and Lee

London 1994

Summer-Autumn Winter-Spring

Algae: Melosira, Cladophora

Grazer: Midge larvae

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

4-19 テムズで、夏は緑藻クラドホラ、冬は珪藻メロシラ。その違いは捕食動物のユスリカの影響だった。

Thames water examined the effect of algal growth in the filter in comparison with an open filter and in a covered filter.

The Thames Water Company had a hard time removing the massive proliferation of filamentous green algae. They called it **blanket weed**.

Thames water concluded open filter is better than covered filter.

After the experiment, they confirmed "algal growth contributed better condition for biological purification process".

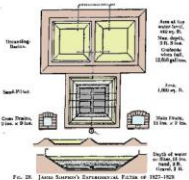
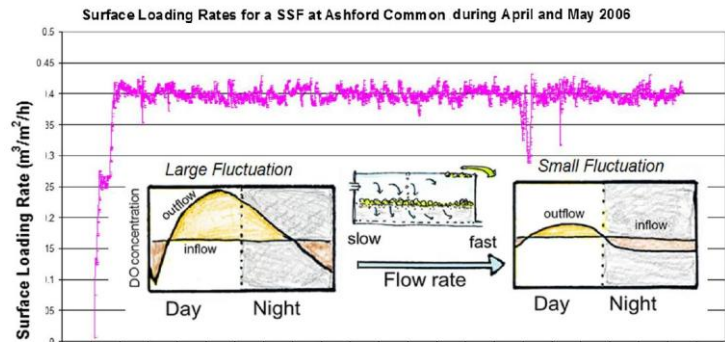
Algae produce oxygen through photosynthesis, and the presence of dissolved oxygen creates an environment in which heterotrophic organisms can thrive without worry.

Slow does not refer to speed, but to being gentle to the organisms.

4-20 テムズは、藻の影響を調べた。藻を繁殖させ動物群集を多くする方が、生物浄化機能が良くなるとの結論だった。

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

**Faster flow rate was better for small organisms in the filter.**



The filter rate was **2.3 m/d (10cm/h)**.  
38cm water depth  
200yrs ago

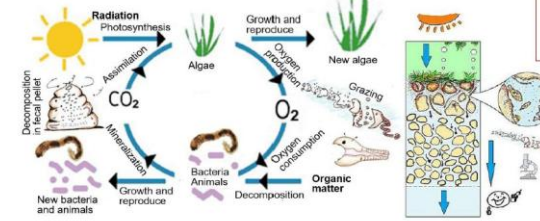
**4.8 m/d (20 cm/h)**  
World wide English Standard Filter rate

The filter rate of **9.6m/d(0.4m/h)** is adopted in Thames filter plants in London to escape oxygen drop in filtrate during the night time, in 2006.

Thames Water's asset standard says we can operate up to **12m/d(0.5 m/h)**, in 2025.

④-21

4-21 藻が多いと、溶存酸素の日変化が大きい。夜明けに酸素不足にならないように、ろ過速度を速くした方が良いとの結論。12m/d まで良いことにした。



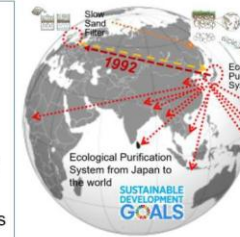
My first visit to Thames Water Company was on **August 19<sup>th</sup>** in 1992. I explained my study on the role of algae in SSF system in Ueda.



Ashford Common WTP

I explained the biological activity using DO changes in the filters.

Slow sand filtration is a purification process that relies on the efforts of a biological community. **Algae produce oxygen** through photosynthesis, and the **presence of dissolved oxygen creates an environment in which heterotrophic organisms can thrive without worry**. Slow does not refer to speed, but to being gentle to the organisms.



Idea of EPS spreads from Japan to the world.

**About higher flow rate asked by N. Nakamoto**  
Michael Chipps Principal Research Scientist 2025/03/18

Since your visit (Aug. 19th 1992) we have added DO and turbidity monitoring on the outlet of all SSFs. Thames Water's asset standard says we can operate up to **0.5 m/h(12m/d)**, but in reality, we are usually in region of 0.25 to 0.35 m/h, but we can reach 0.4 m/h occasionally if we have to. We do have to keep a careful eye on dissolved oxygen (DO).



④-22

4-22 溶存酸素を計りだしたのは、私が1992年で解説してからだ。生物活性を酸素の日変化で測定した。

W. K. Burton published "The Water Supply of Towns and the Construction of Waterworks" in 1894 in London.



On p94 practice. Dr. Koch, the eminent bacteriologist, has (the writer understands) come to the conclusion that a filtering speed should never exceed  $7\frac{3}{4}$  feet in twenty-four hours. It seems unlikely that any such hard-and-fast rule can hold good for all cases,\* for there can be no doubt that the efficiency of filtration varies with many circumstances—with the purity or the reverse of the water, for example; with the nature of the sand; and with the temperature.

Dr. R. Koch never exceed  $7\frac{3}{4}$  feet in 24 hrs. = **2.27 m/d**

\* A series of experiments, both biological and chemical, carried on in connection with the Osaka (Japan) waterworks, gave very different results from this. It has recently been discovered, at the Berlin waterworks, that covered filters are much less efficient than open.

Osaka(Japan) wks gave very different results from this. **faster rate?**

Berlin wks discovered that covered filters are much less efficient than open. **Open is better.**

English engineers adopted more 16 feet in 24 hrs. = **over 4.88 m/d**

Burton : max 10 feet in 24 hrs. = **max 3 m/d**

On the other hand, the much higher velocities—16 feet in twenty-four hours or even more—adopted by some English engineers, are undoubtedly too high.

It is with some diffidence that the writer states the conclusion he has come to—namely, that a **maximum filtering speed of 10 feet in twenty-four hours is quite permissible** in the case of water already fairly good. That is to say, with arrangements properly

At that time in 1894, he believed that purification was done by **slow speed with fine sand.**

This means **mechanical filtration.**

**Present Thames wks adopts 12 m/d.**

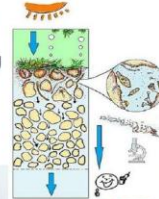
This is depended on Ecological Purification System.

④-23

4-23 英国でも、最初は、ろ過速度は遅かったが、だんだんと速くしてきた。

**Don't remove biological active layer.**

Slow sand filtration is a nature based chemical free process for purifying water by removing contaminants through biological and physical processes using fine sand.



In case of dry skimming to scrape upper dirty sand layer, this treatment is the removing biological active layer. It takes time to develop biological active layer.



<https://www.thameswater.co.uk/about-us/innovation/sandscape-project>

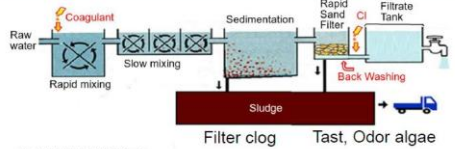


Thames Water tests new robotic underwater technologies designed to simplify and speed up the cleaning and maintenance of slow sand filtration methods used in the water treatment process.

④-24

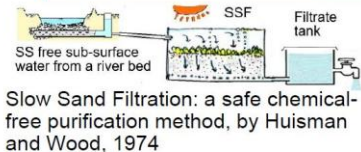
4-24 テムズでは、削り取りで生物群集を除くと、生物浄化機能が回復するのに日数がかかる。そこで、砂面を削らないで、砂面上の汚れだけを除く実験をしていると教えてくれた。

# ⑤ URF and EPS Model.

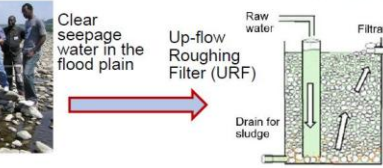
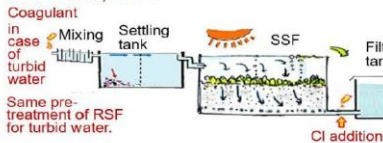


Rediscovery of Slow Sand Filter of chemical free treatment from Chemical treatment of Rapid Sand Filter.

⑤28 slides



Slow Sand Filtration: a safe chemical-free purification method, by Huisman and Wood, 1974

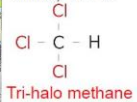


IS THE WATER SAFE TO DRINK?

PART 1: THE PROBLEM



Robert H. Harris and others Consumer Report, June, 1974.

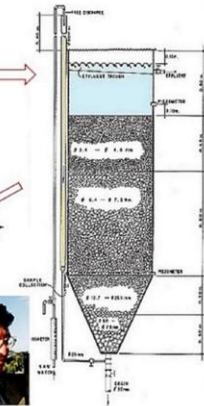
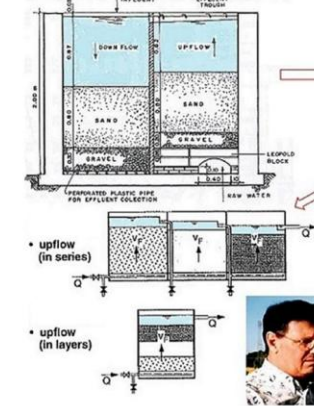


5-1 上向流粗ろ過 URF と EPS モデル

# Development of Eco-friendly and Chemical-free turbidity countermeasures: Up-flow Roughing Filter.

Down Flow and Up-Flow

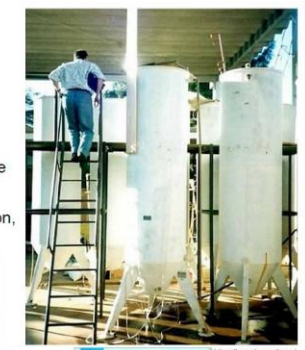
Luiz Di Bernardo 1980 Univ. São Paulo, Brazil



Up-flow Roughing Filter: presented at the International Conference on Slow Sand Filtration, London, 1988



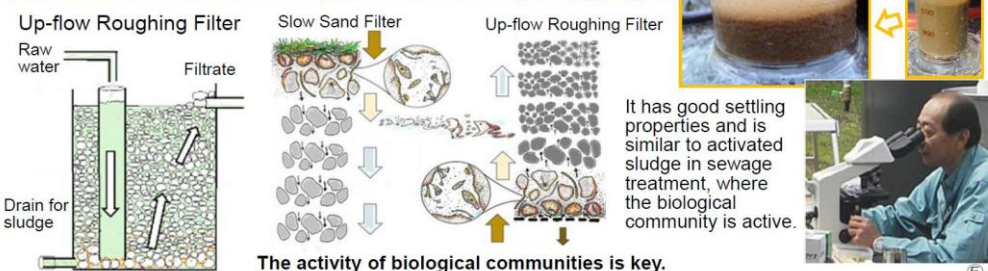
At the international conference in 1988, Martin Wegelin from Switzerland reviewed past roughing filters => International joint experiment => In 1996, a roughing filter manual was published in Switzerland.



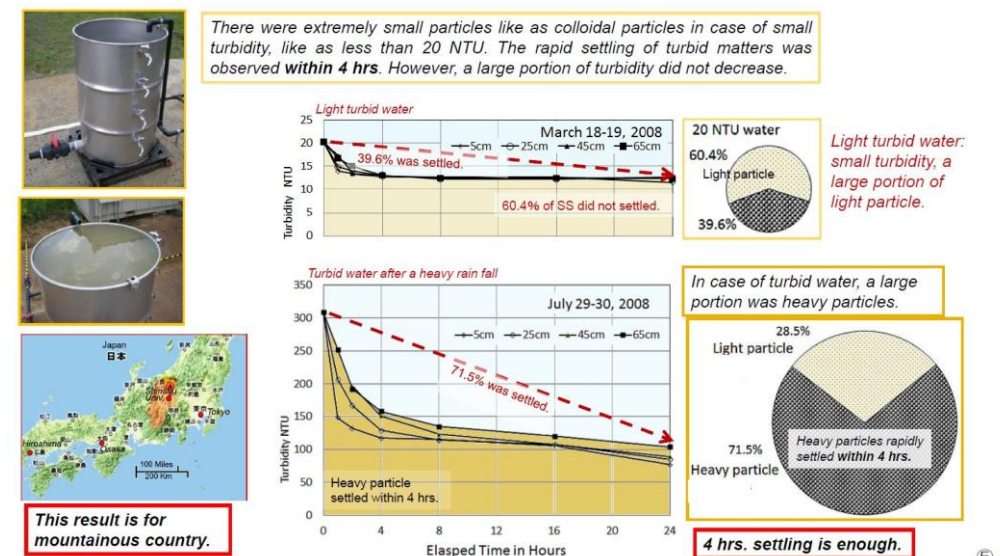
⑤-2

5-2 URF は Luiz Di Bernardo が 1980 年にブラジルで開発。1988 年にロンドンの国際会議で発表。

The role of the biological community was also key in Up-flow Roughing Filter.



5-3 薬品を使わない生物群集の活躍による浄化。



⑤-4

5-4 普通の濁りは 4 時間以内で沈む。細かな濁りは沈まない。大陸では、細かな沈みにくい濁りが多い。それなら、URF が良い。何段階もの URF が良い。



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



In Japan, river water is usually clear and small amount of water.

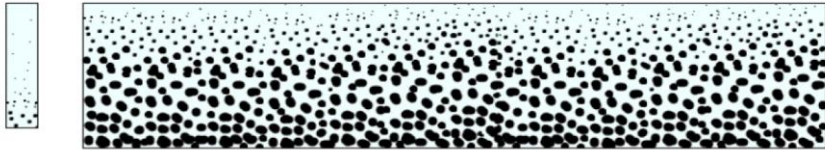
Clear and suspended free water from spring is found in a flood plain.



Light and small particle which is not easily settled.

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

Flood water is dirty. There is huge amount of soil matter from land surface.

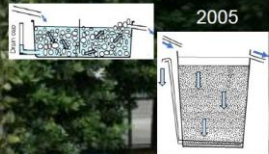


5-5

5-5 日本も台風があり、増水すると河川は直ぐに濁る。この濁りは、沈みやすい。熱帯は、細かな濁りが多いので、簡単には沈まない。多段の URF が良い。

OISCA (The Organization for Industrial, Spiritual and Cultural Advancement-International)

OISCA has started working on the idea that EPS, which applies natural mechanisms, can produce safe drinking water without relying on others.



2005



There are sedimentation tank, 4 gravel filters, and slow sand filter. Polluted water turns to safe and reliable water quality.

Polluted water from River Kanda, Tokyo is pumped up in 2005.

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.

5-7

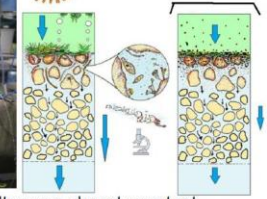
5-7 オイスカの木附文化さんは、東京の汚れた神田川の水を揚水し、沈殿、多段の粗ろ過、砂ろ過したら、飲用可の水になった。



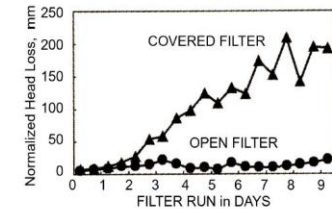
Multiple Roughing Filters to eliminate SS from an irrigation canal water.



Effect of open filter and covered filter.



Filter resistance (NHL) of Open filter was almost constant. But the resistance of Covered filter increased almost every day.



Algal growth under sunshine. Increase grazing activity by animal. These animals search for food, make holes, and do not increase the resistance of the water.

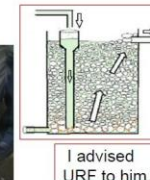
We confirmed the role of algae in EPS.

5-6

5-6 URF の実験。ろ過池の覆う場合と覆わない場合の実験をしたら、オープンの方が目詰まりしなかった。藻が繁殖すると動物の活躍が大きいかも。



OISCA Tokyo: polluted water → EPS → safe water



I advised URF to him.

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



Sri Lanka: 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.

2006

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

Three points worth to remember

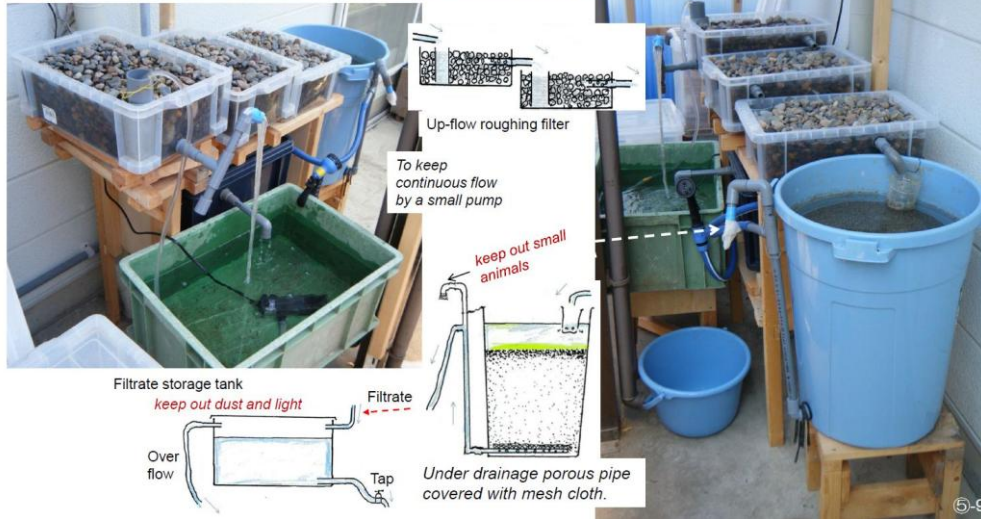
1. Knowing is NOT enough, we must APPLY it to something useful.
2. Willingness is NOT enough, we must PUT it into the PLAN and ACTION.
3. Putting the PLAN into action is NOT enough, we must ACCOMPLISH the goals.

When you receive money, you start to consider the intentions of the person who gave it to you.

5-8

5-8 オイスカの木附さんは、スリランカ、ミャンマーのマンダレーでも実験をし、皆に簡単に安全な水を確保できることを示してくれた。

To make subsurface suspension free clean water in the flood plain.



5-9 私も、上田市の自宅で、装置を作って実験をした。



わかる! 国際情勢 外務省 ODA白書 2014年7月1日  
Vol.116 Ministry of Foreign Affairs of Japan, July 1, 2014  
「未来への投資」としてのODA ~ 国際協力60周年



5-10 沖縄の JICA 研修でも。黄色の樽は、野沢菜の漬物樽を上田から沖縄に送り、研修で使った。



5-11 JICA 沖縄の研修では、毎年、研修生と一緒に、モデルを作成。研修生が仕組みを理解できるようにしている。

Receiving Tank (Settling Tank)

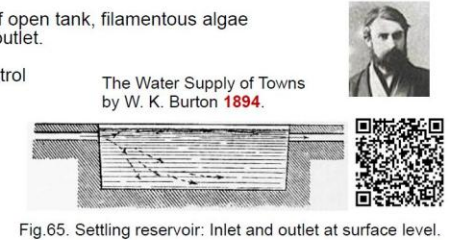
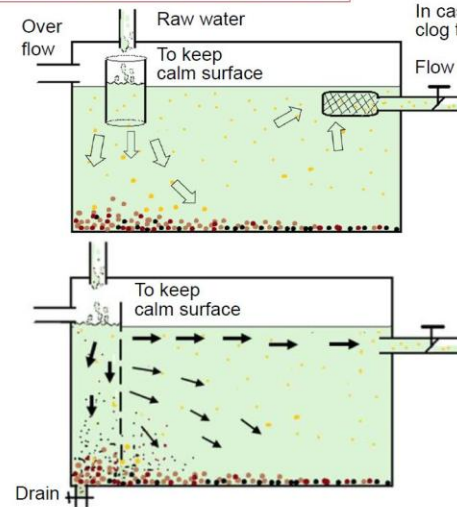


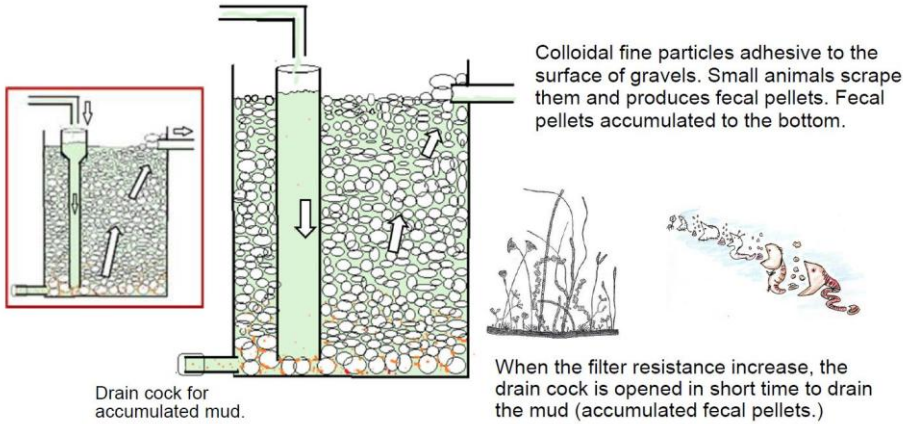
Fig.65. Settling reservoir: Inlet and outlet at surface level.

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

5-12 沈殿池の仕組み。なるべく、ゆっくりと流れる様に。

### Up-Flow Roughing Filter (URF): Gravel Filter

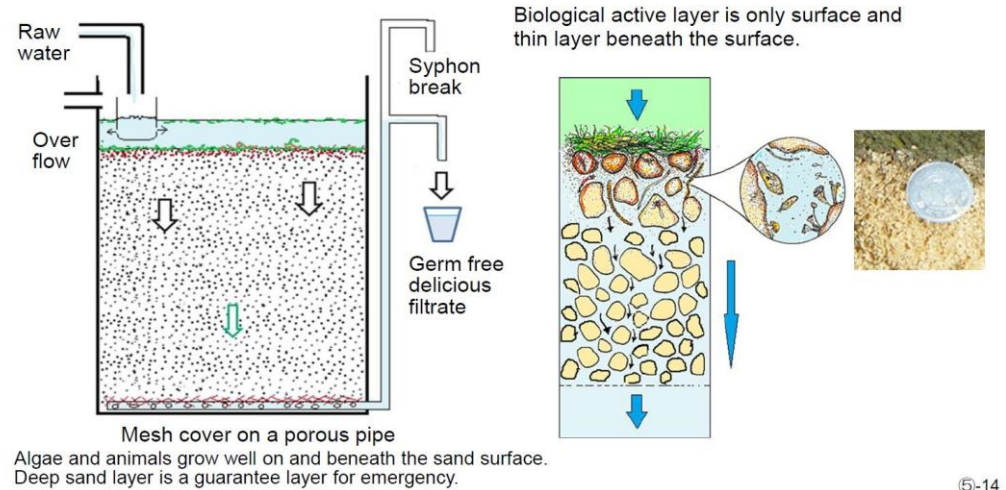
Additional URF if necessary.



5-13

5-13 上向流粗ろ過

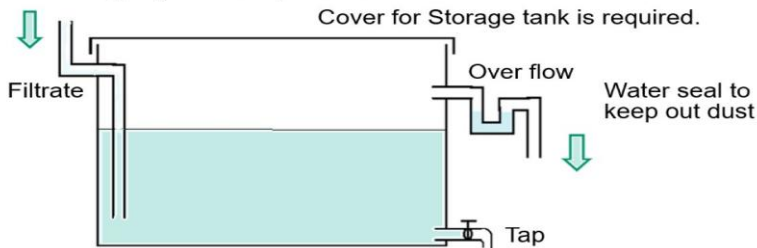
### EPS (Sand) Filter (Natural Down Flow) Ecological Purification System



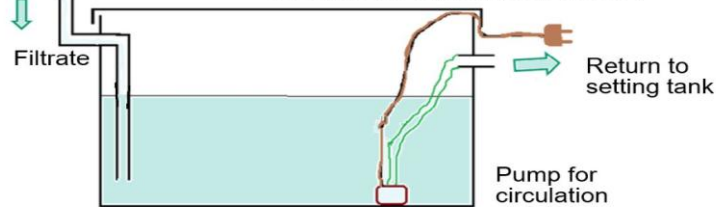
5-14

5-14 砂ろ過、完璧な生物浄化

### Storage (Filtrate) Tank

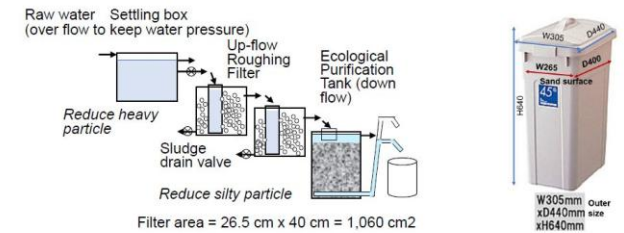


### In case of Circulation Model



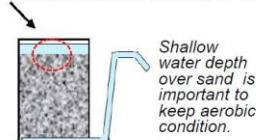
5-15

5-15 循環モデルなら、ポンプを使う。



Filter area = 26.5 cm x 40 cm = 1,060 cm<sup>2</sup>  
 In case of Present Thames filter rate (40cm/h = 9.6m/d)  
 Filtrate/min = 1,060 cm<sup>2</sup> x 40 cm/h / 60 (min) = 707 cm<sup>3</sup>(ml)/min  
 Filtrate/h = 1,060 cm<sup>2</sup> x 40 cm/h = 42,400 cm<sup>3</sup>/h = 42.4 liter/h  
 Filtrate/d = 42.4 liter x 24 hrs = 1.02 m<sup>3</sup>/d

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



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

5-16

5-16 浄化能力を、ろ過水を測定して計算してみた。

I studied on ecological function of Miyako-jima wks. I made a video on EPS function of Miyako wks in March 2004 and published a book in August 2005.



Quest for Safe and Delicious Tap Water, Miyako-jima, Island in March 2004. /15:22 With English subtitle version in Oct. 2007. <https://www.youtube.com/watch?v=r1LIPuQiu0&t=16s>



JICA training started in 2006.

JICA made Video in 2008

Slow sand filtration: creating clean, safe water(Full ver) in 2020 25min56sec



[https://www.youtube.com/watch?v=V6\\_uDZE\\_I8E&t=1218s](https://www.youtube.com/watch?v=V6_uDZE_I8E&t=1218s)

Slow sand filtration: (Digest ver) in 2021 3min26sec



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

Ecological Purification System : JICA training for SIWA, April 18, 2013 <https://www.youtube.com/watch?v=NCI9oeNM0aI>



5-17

5-17 生物浄化法の技術解説本は、最初は、宮古島への技術解説本として印刷・出版。その後の沖縄の研修では、毎年、現場と、モデル作成。

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=jz94KfKL3E>



NGO Okinawa Blue Water



5-18

5-18 皆と共同して手足を動かす事が大切だ。手足を動かさないと伝わらない。



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>

5-19

5-19 2017年のJICA広島研修でも、上田市の自宅から、モデルを運んで、皆でモデルを組み立てた。研修生がビデオを作成し、アップしてくれた。

Ecological Purification System Model for Safe Drinking Water JICA training in Okinawa, on Jan. 16, 2024.



Water circulation EPS model

5-20

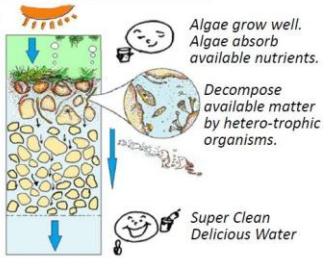
5-20 2024年の研修でもモデル作成。



After 3 weeks, they enjoyed delicious super clean water.



Filtrate Water that is free of substances that living things can react with. **It's water that tastes delicious and sweet.**



Sweet drop (honey dew) Natural sweet and delicious water



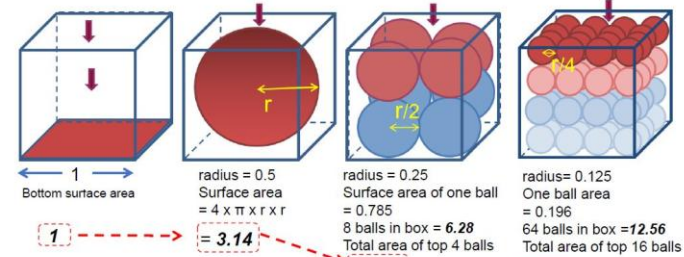
<https://www.youtube.com/watch?v=RJLgf63s5Og>



5-21

5-21 皆が喜んで、できた水を飲んでくれた。

Most of small organisms live on the surface of substrata (sand particle) under slow current condition. They live at the top of sand layer where food comes. They are always waiting for food. They are hungry.



Too small particle becomes a flat surface.

Surface area of a ball is 3.14 times than flat area.

Total surface area of top layer of balls is always same of 3.14 times than flat area. **Smaller ball makes larger area.**

And, total volume of balls is always same of 52 % (porosity : 48%) in a box.

Filter resistance increases toward smaller size of particle.



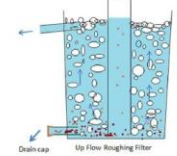
5-22

5-22 濁りは砂に最初は付着する。付着面が広い方が良い。それなら、細かい砂が良い。でも小さくなりすぎると、隙間が小さくなり、水が流れにくくなる。

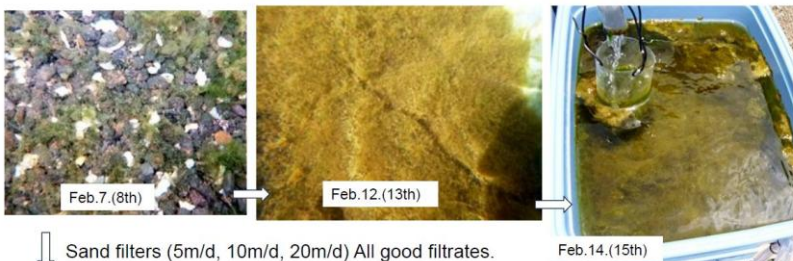
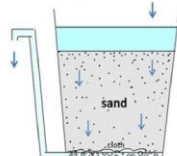
Points: shallow depth, enough radiation on the bottom, rapid growth, large size of sand.



Sand separated with mosquito mesh (1-2 mm)



Two up-flow roughing filters



Sand filters (5m/d, 10m/d, 20m/d) All good filtrates.

Shallow depth: Algae grow well.

5-23

5-23 生物活性が良い、サモアでは、粗い砂で実験をした。大丈夫だった。

URF Effect : Reduce scrape works after introduce URF.



Mr. K. SANDA informed me his wonderful result on URF.

To prevent clogging of the slow sand filter (SSF) and to reduce turbidity, a rapid sand filter (RSF) was installed. This RSF was removed and a new 3-step URF was installed.



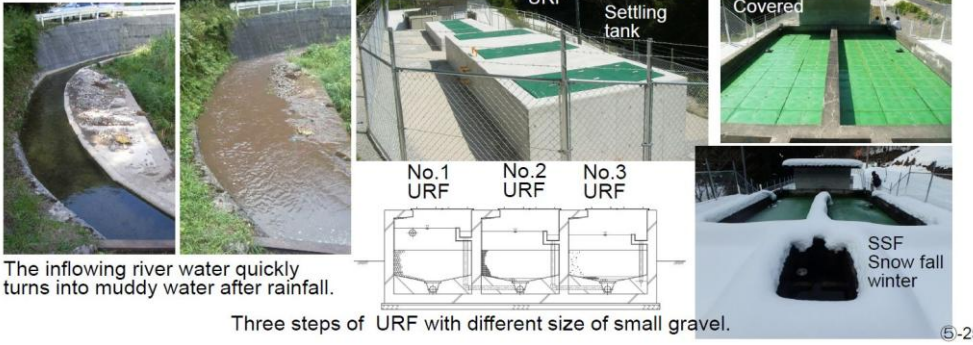
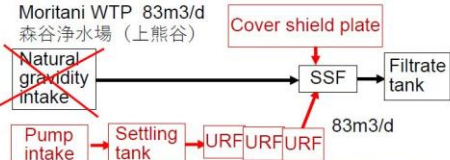
Inside URF



5-24

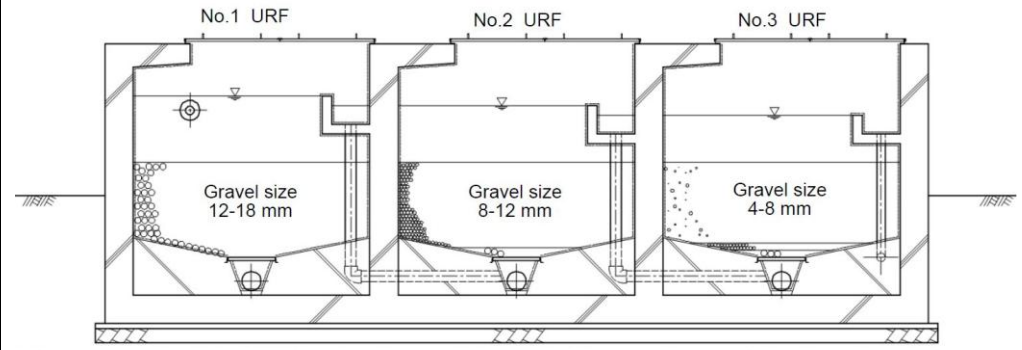
5-24 小規模簡易水道施設の急速ろ過器を止めて、3 段の URF を挿入した。

To prevent clogging of the slow sand filter (SSF), the water intake method was changed from natural gravity flow to pump intake, and a conventional settling tank and three stages of upward flow coarse filter (URF) were newly installed before the existing slow sand filter. To reduce the frequency of SSF erosion, a float-type light-shielding plate was installed in the slow sand filter (SSF).



Three steps of URF with different size of small gravel. 5-25

5-25 この簡易水道でも沈殿と3段のURFを挿入、ろ過池も覆いした。

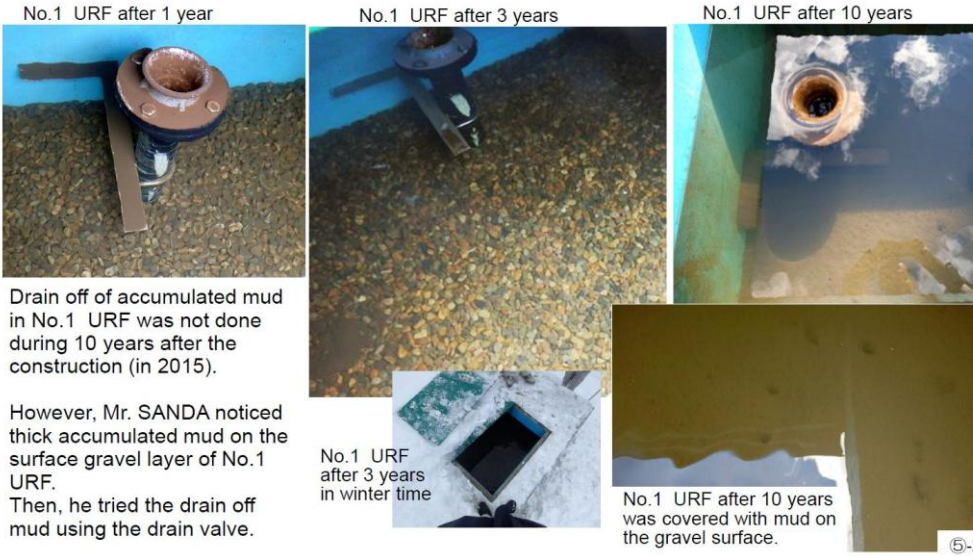


Management of the URF is simple, requiring only the opening and closing of a sludge discharge valve, and the draining process takes **only about 5 minutes per filter**, thus minimizing the time spent on maintenance. Drain of the settling tank is also the same.



The slow sand filter (SSF) requires less frequent scraping, thus reducing the manpower needed for scraping. 5-26

5-26 排泥は、1回5分程度。



Drain off of accumulated mud in No.1 URF was not done during 10 years after the construction (in 2015). However, Mr. SANDA noticed thick accumulated mud on the surface gravel layer of No.1 URF. Then, he tried the drain off mud using the drain valve.

No.1 URF after 10 years was covered with mud on the gravel surface. 5-27

5-27 URFの様子。何年も汚れない。10年後に排泥してみた。

Gravel size of URF粗ろ過機の粒径  
No. 1. 12-18 mm  
No. 2. 8-12 mm  
No. 3. 6-4 mm

上向流粗ろ過の排泥  
第1槽：未実施(2015年から10年間)  
第2槽：2015年から2回実施  
第3槽：年に1回の頻度で実施  
No.3：Once per year.

English with Jap. 10min 33sec  
Mr. SANDA found an interesting phenomena in this system. He took them in his video and sent me. Please watch this video.

Organisms are active throughout the entire layer.

Accumulated mud on the gravel layer.

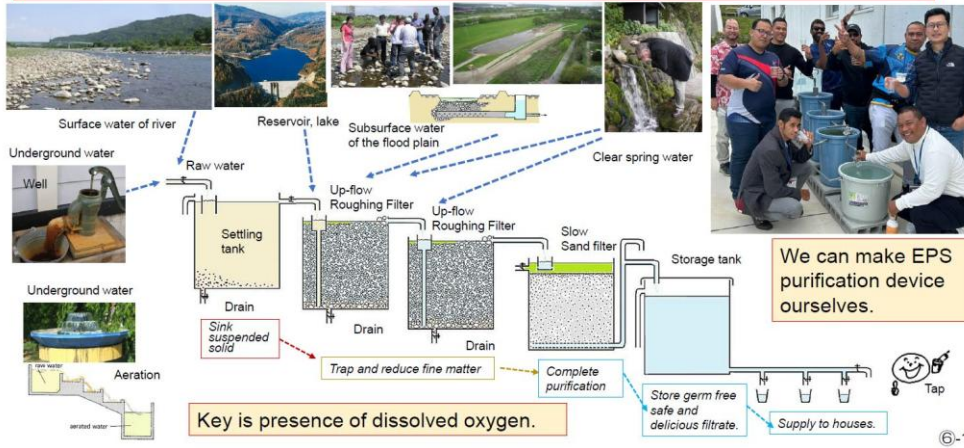
5-28

5-28 JRFの様子を、ビデオ撮影した。QRを見て。礫間に活性汚泥みたいのが舞っていた。

## ⑥ EPS trial in Malaysia and Guyana

⑥14 slides

Ecological Purification System (EPS) : This is Wise Use of Natural Phenomena.



⑥-1

6-1 EPS を作ってみる。マレーシア、ガイアナ

Ecological Purification System Model for Safe Drinking Water  
JICA training in Okinawa, on Jan. 16, 2024.



⑥-2

6-2 JICA 研修、ビデオは役立った。



Mr. Mhd Zairi, trainee of JICA Okinawa returned back to Malaysia after JICA EPS training in Okinawa from January to February 2024.

He applied EPS knowledge at his brother in law's house in April, 2024.

On April 6, he washed the sand.

And EPS model was completed on April 11 2024.

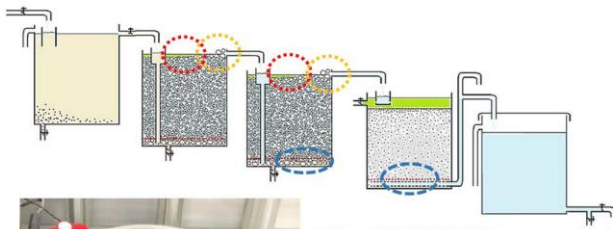
⑥-3

6-3 マレーシアの 2024 年2月に沖縄の研修生は、帰国し、親戚の家に浄化装置を作り、2024 年4月11日に完成した。



⑥-4

6-4 最初は濁っているが、直ぐに、きれいになるだろう。



We can easily confirm the clear water which is out.

Please watch this video how to set sand and gravel in URF and Sand Filter.



Please remove this red part of gravel to watch the clear spring water or not.



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



Daniel Castro  
2017/07/20 に公開

6-5

On April 11, 2024, Nakamoto:  
Thank you for your effort to make EPS model. I suggest that it is better to remove some gravel in URF. We can confirm the condition of URF which produce clear spring water. However, please cover the overflow pipe with gravel.

Mr. Mhd Zairi :  
Yes, I agree with you, round tank is the best shape as the water tend to force the square wall to become round. I just found it when I see the URF tank maintain the shape. It's a lesson learn to me on how to design the tank. I take note your advise, sir.



On April 11, 2024, Nakamoto advised:  
Well water (underground water: tubewell water) often contains iron and manganese.

Since there is sufficient dissolved oxygen in URF, these metal ions are removed by oxidation and precipitation.

Precipitated iron and manganese accumulate on the gravel surface and at the bottom of URF.

If the size of the URF gravel is too small, it will be difficult to remove the material that has hardly accumulated on the gravel surface over a long period of time even with mud removal operations at the bottom.

Therefore, in the case of well water, it is better to use large URF gravel of about 1 to 3 cm. It could be bigger.



6-6

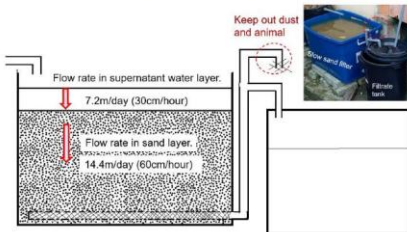
6-5 URF 上向流粗ろ過の上に少し水が見えると、きれいな水かできているかを見る事ができる。

6-6 礫層の上に水があると、水質状態を目視し、把握できる。



Nakamoto April 11, 2024:  
Round tank is better for the model. Round tank is gentle for small organisms. If the sand filter tank is square, when sand or water enters the tank, the tank will try to become round and expand.  
The actual facility is made of concrete, which is good.

Nakamoto April 12, 2024:  
I suggest you that please put L cap and cover with mesh to keep out dust and animal contamination to filtrate water. We call the flow rate is in the supernatant water over the sand layer. The real flow rate in the sand layer becomes about double.



Nakamoto April 12, 2024:  
The filtration speed of the sand filter tank is 7.2m/day (water layer above the sand), or 30cm per hour. In the sand layer, water passes through the gaps between the sand. The space per volume is about half. The speed will be approximately doubled. Therefore, the flow rate of water in the sand layer is 60 cm per hour. Slow filtration is said to take time. However, when we calculated the actual flow velocity ourselves, we found that it was faster than we imagined.

6-7

6-7 ろ過水槽へは、サイフォン状態を防ぐ仕組みがあるが、その口から、虫が入らないようにした方が良くとコメントした。



Mr. Mhd Zairi : Sept. 15, 2024: Just come back to home town in Kelantan after 5 months installing the EPS.  
Thank you for the knowledge you share and benefits the people in rural area to enjoy crystals clear, clean and delicious water.

I feel proud & thank full for the knowledge I gain from JICA Program.  
In addition, I want to share to all of you, up-flow filtration method is super value for money, maintenance & stress free as to compare to normal downflow filtration.

Non stop producing crystal clear spring water



Algae growth : URF



Sept. 15, 2024  
1st backwash after 5 months



Backwashing up-flow roughing filter

6-8

6-8 砂ろ過池、上向流粗ろ過槽に藻が繁殖。排泥をしてみた。

June 9, 2025: I asked to Mhd Zairi that this was **under construction photo** or not?  
 Mhd Zairi: Yes, this picture is before I connect the **filtrate pipe to kitchen tap behind the wall**. While the black storage tank after sand filter only store about **180liters** and **balance storage at the ceiling inside the house**.



Mhd Zairi : Sept. 21, 2024:  
 Done upgrading reticulation system from **56 liters** storage to **454 liters** for my village house.  
 Thank you for the support I have received all this time and I can describe EPS as "Old Is Gold".

Mhd Zairi : Sept. 21, 2024:  
 Floating valve help me to maintain the water level that self filling water (underground water) into the sedimentation tank.



6-9 貯水槽を大きくした。

On Jan. 25, 2025. Mr. Mhd Zairi :  
 I take this Chinese New Year holidays to review my EPS filtration after 8 months commissioned. The result still produce the same, fresh, cool and refreshing water.

**This is Super clean delicious water.**

On June 6, 2025. Mr. Mhd Zairi :  
 Comparison between 1st URF and 2nd URF. It shows 1st URF works well in filtration for underground water.

Nakamoto:  
 You mentioned that water source is underground water. The 1st drain is brown. This means oxidized iron and another metal ions. The 2nd is clear. This means that only one URF is very effective to remove dissolved metal ions in the underground water. I would like to set 2 URFs for safe system. I will introduce next this result for next JICA training. Thank you for this information.

Mr. Mhd Zairi :  
 Yes, 1st URF is enough but for safety purpose 2nd URF is a must. Exactly and I found actually 1URF is sufficient to filter the well water but having 2 sets of URF is highly recommended for safety reasons.

6-10

6-10 ろ過水は、スーパークリーンでおいしい。2つのURFの排泥。



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 3<sup>rd</sup> of September, 2025 and sent us.

6-11

6-11 ガイアナからの研修生も、帰国して作成。



[https://youtu.be/8auY7\\_MSIEK](https://youtu.be/8auY7_MSIEK)

[https://youtu.be/8auY7\\_MSIEK](https://youtu.be/8auY7_MSIEK)



6-12

6-12 ビデオを送ってくれた。研修の感想、帰国してからの状況を教えてくれるのはうれしい。

**SSF (EPS) Small sand**      **URF (EPS) Small stone or large sand**

Where is biological active layer.      Organisms are active throughout the entire layer.

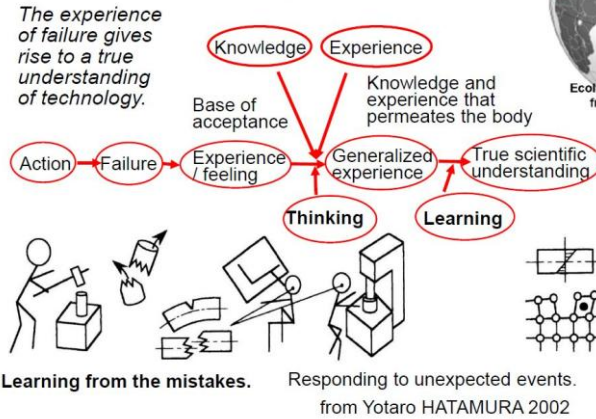
Slight light may reach to the inside wall of deep sand layer.      Complete shut out the light from the wall.

6-13

6-13 生物群集の活躍で、安全でおいしい水ができる。

## Don't afraid Failures. Recommending the Study of Failures

People always make mistakes. We think we are lucky if we fail.



Prof. Dr. Shiba Kumar Rai  
Professor & Research Director at Nepal Medical College

- Three Points worth to Remember**
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.

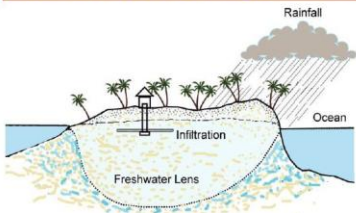
6-14

6-14 失敗を恐れない。失敗すると、どうしてかと自分で考え理解が深まる。

## ⑦ From Miyako Island to Samoa

⑦ 20 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.

⑦-1

7-1 宮古島からサモアへ。研修生の感謝のスピーチ「EPS は大洋州に広まります」は忘れない。

## From JICA training in Miyako-island, Okinawa to Samoa

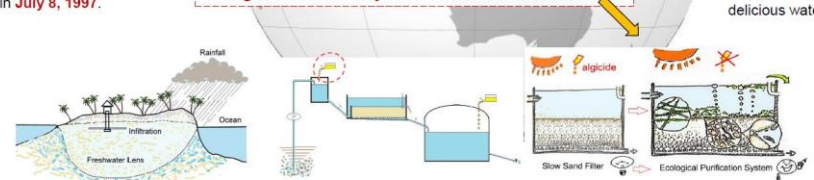


They believed mechanical reduction of polluted matter by fine sand under slow filtration.



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.



How to make delicious water



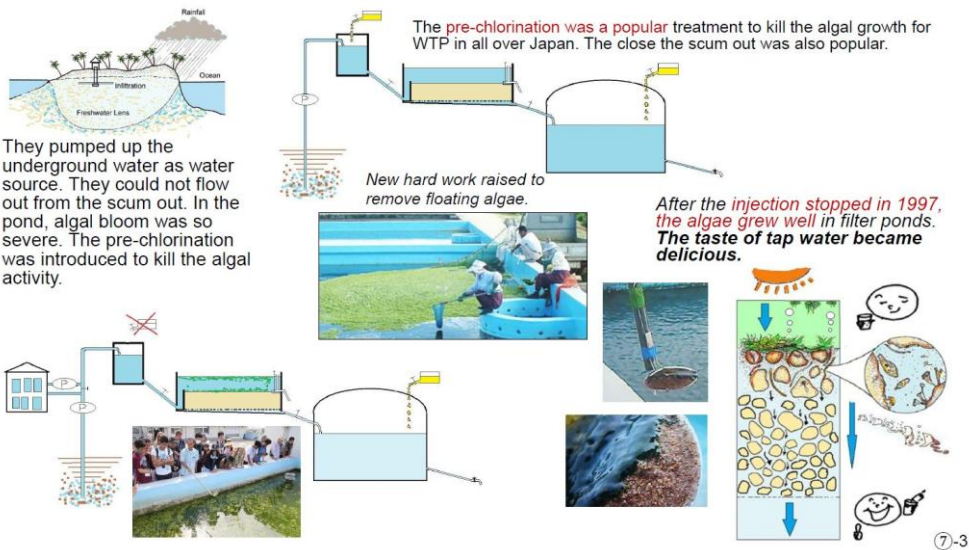
Miyako-island is a raised coral reef where is quite different environment compared with main part of Japan.



Nakamoto published Ecological Purification System text in 2005.

⑦-2

7-2 1997年7月、隆起サンゴ礁の宮古島の渡真利場長が始まり。

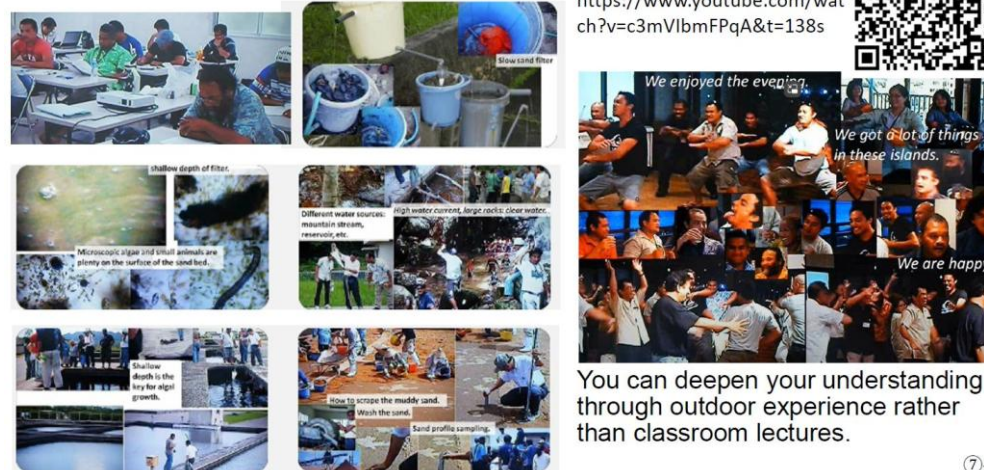


7-3 地下水は栄養塩が豊富、ろ過池で藻が大繁殖。生物群集が浄化している。

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

YouTube / 6:08

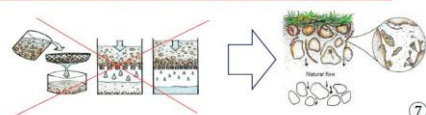
<https://www.youtube.com/watch?v=c3mVlbmFPqA&t=138s>



7-4 石垣島は、河川水が水源。いろいろな水源でも対応できる。



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.



7-5 サモアに、ドイツがつくった緩速ろ過施設があるが、雨期に目詰まりし困っていた。

**On the Alaoa Water Treatment Plant** Apia, Samoa  
JICA Miyakojima Project, Feb. 2013

NAKAMOTO Nobutada, Dr. Sc.  
Professor Emeritus of Shinshu University

Diameter Ca.30m  
4,300 m3

Diameter Ca.20m

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

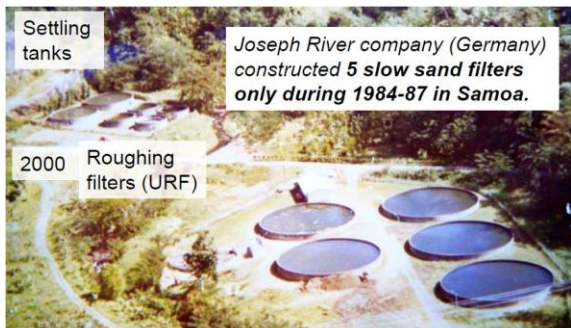
Close the tap:  
Save the water.

Treated water is limited amount.

Alaoa WTP

⑦-6

7-6 断水する事があるが、蛇口を閉める事が大切。



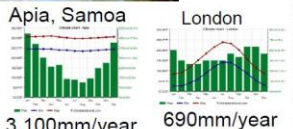
Joseph River company (Germany) constructed 5 slow sand filters only during 1984-87 in Samoa.

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.



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>

⑦-7

7-7 ドイツと熱帯圏の島の環境とは違う。ドイツは集中豪雨がでない。

**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 m<sup>2</sup>  
2 tanks  
Retention time: 3.3 hrs

**Up-flow Roughing Filter:**  
Diameter 11.2 m  
Area 98.5 m<sup>2</sup>  
4 filters  
Filter rate: 1m/h

**Slow Sand Filter**  
Diameter 28 m  
Area 616 m<sup>2</sup>  
5 filter ponds  
Flow rate: 3m/d

**Flow Calculations:**  
 616 m<sup>2</sup> × 3m/d = 1,848 m<sup>3</sup>/d × 5 filters = 9,240 m<sup>3</sup>/d ⇒ 0.2 m<sup>3</sup>/d = 46,200 persons  
 5m/d : 3,080 m<sup>3</sup>/d × 5 filters = 15,400 m<sup>3</sup>/d ⇒ 0.2 m<sup>3</sup>/d = 77,000 persons  
 10m/d : 6,160 m<sup>3</sup>/d × 5 filters = 30,800 m<sup>3</sup>/d ⇒ 0.2 m<sup>3</sup>/d = 154,000 persons

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

**One day demand:** 0.1 to 0.3 m<sup>3</sup>/day person (Japan)  
 1F: One day demand: 0.2 m<sup>3</sup>/day person (Samoa)

**Population:** Samoa 217,000 persons (2023)  
 Apia 36,000 persons (2021)

⑦-8

7-8 標準ろ過速度は 4.8m/d。でも、サモアは熱帯で、生物活性が良いのに、ろ過速度が 3m/d と遅すぎる。熱帯の豪雨の濁り水対策では容量が小さ過ぎる。

**We advised: Reduce inflow water for set turbid matter.**

Too much inflow. Short retention time.

The ideal is a calm surface.

Retention time: 3.3 hrs (design)

2013/02/22 We reduced the inflow rate.

26th Nov. 2010.

**We advised: Put more sand to make shallow depth.**

Deep 220 cm  
Almost no sand layer.

Shallower depth 160 cm  
Lifted algal mat with mud.

Design profile  
67 cm  
1m sand layer

Shallow depth: Active photosynthesis: much oxygen bubble formation.

⑦-9

7-9 沈殿池の容量不足、ろ過池に砂がない。水深が深すぎた。

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

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

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.**

Hardly growth of algae on the deep bottom.

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>

⑦-10

7-10 ろ過池では、底に泥が蓄積。浅い水深にする必要がある。

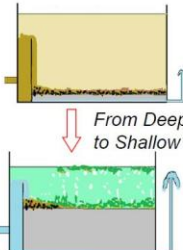
I advised to use beach sand and easy way to wash.



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



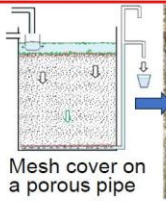
Put sand to make shallow depth.



From Deep to Shallow

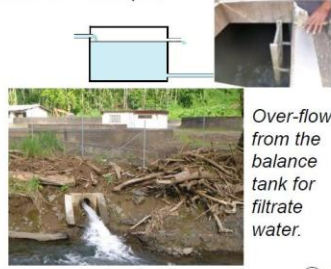
I advised easy way to put the sand using a cloth seat.

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.

⑦-11

7-11 河川の河口付近の海岸の砂を洗って、ろ過池を浅くしたら、藻が繁殖し、ろ過水が大量にできた。



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/1foI8D3tAAc>

4 min:12"



June, 2025

⑦-12

7-12 簡単な砂洗い法を教えた。底の礫の上に化繊の防草布を敷いて、その上は全て砂に。施工が簡単。



Stuffs of Samoa Water Authority presented their activity at the 5<sup>th</sup> 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



⑦-13

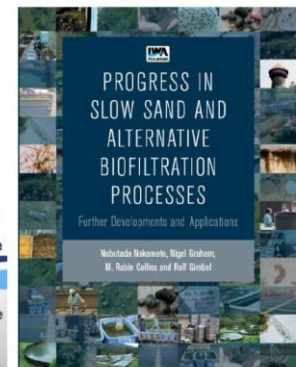
7-13 2014年の名古屋市で開催された第5回国際緩速ろ過会議で、サモア水道公社職員は、水深を浅くした効果を発表。



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



<https://www.youtube.com/watch?v=v1FxtkDfsM&t=2s>

5SSABC - YouTube / 14:15

⑦-14

7-14 2014年、名古屋市での第5回国際緩速生物ろ過会議では、生物群集の活躍の重要性が話題になった。会議の様子は、QRで。

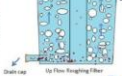
**Biological activity is related with radiation and temperature.**



Sand washed with mosquito mesh (1-2 mm)



Two up-flow roughing filters



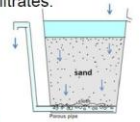
Up-Flow Roughing Filter

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



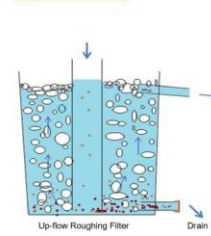
Different flow rate of sand filters (5m/d, 10m/d, 20m/d) All good quality of filtrates.

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



⑦-15

7-15 サモアで、モデルをつくり、粗い砂で、5m/d、10m/d、20m/d で実験をし、全て良い成果が得られた。



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



Active growth in URF



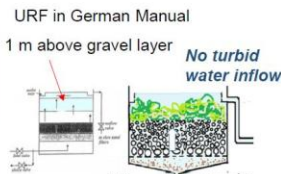
Full gravel with small crushed stones. In order to expand adhesive area of stone surface for suspended matter in raw water.



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

⑦-16

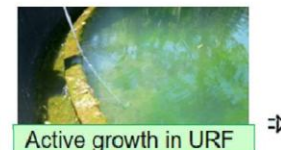
7-16 URF での濁り対策を大きくするために、礫を補充し、礫層を増やした。礫表面の面積を増やす事で、濁り付着面積を増やした。



URF in German Manual 1 m above gravel layer No turbid water inflow

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.

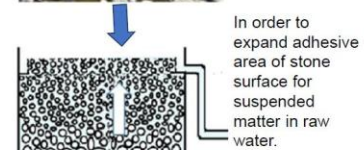
SWA Facebook (2026/5/5)



Active growth in URF



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



In order to expand adhesive area of stone surface for suspended matter in raw water. Put full gravel with small crushed stones.



⑦-17

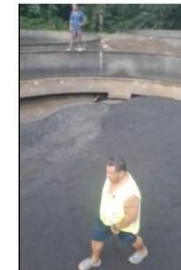
7-17 サモアの施設は、集中豪雨が無い国、ドイツでの経験での設計。水道技術は、その地域に適した方法が求められる。生物現象には違いがある。



April 21, 2025



May 19, 2026 Heavy rain



1min 58sec. <https://youtube.com/shorts/1nna1brMkyY>



Capacity over load for existing pretreatment.

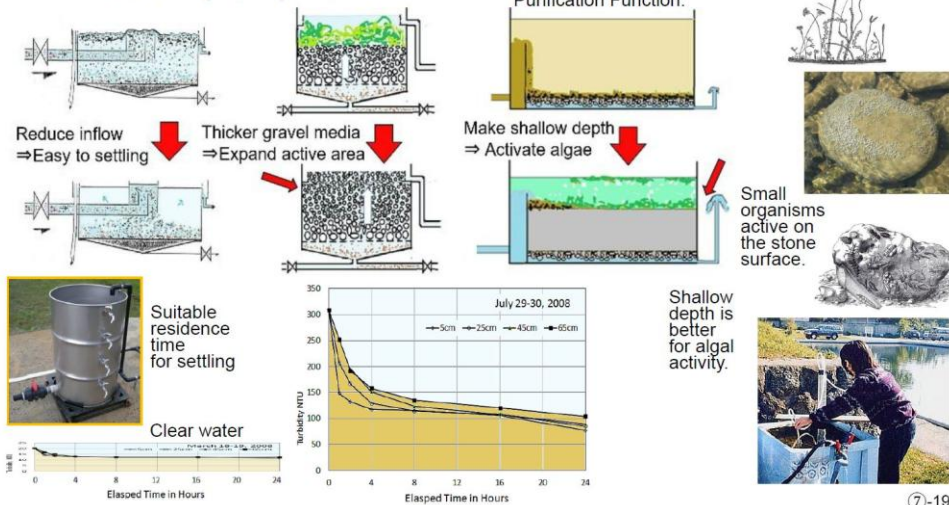


We have to expand more capacity of settling tank and additional several steps of URF.

⑦-18

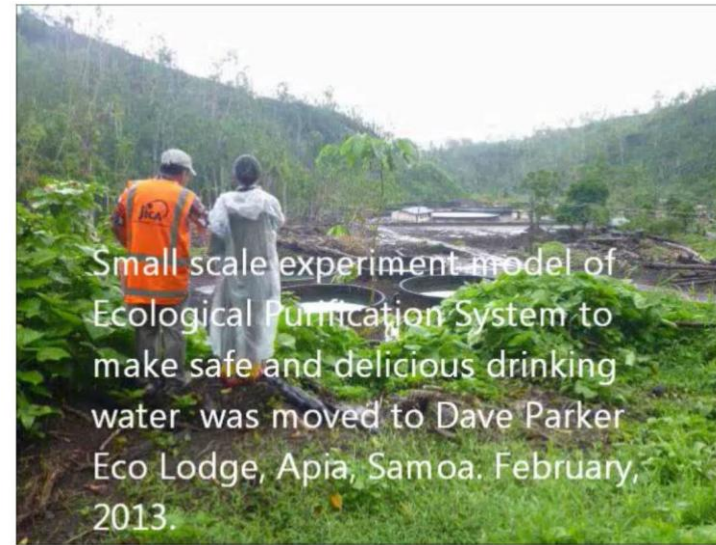
7-18 熱帯の濁り対策では、現在の施設は限界がある。多少の修復では、限界があった。沈殿、URF の容量を各段に大きくする必要がある。

Advise for a better plant system to Samoa



⑦-19

7-19 沈澱、URF、ろ過池の機能を理解し、その国の環境に適した工夫が必要。



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

4 min 24 sec



⑦-20

7-20 緩速ろ過は古く完成した技術ではない。まだまだ、改良の余地がある。

⑧ From Okinawa to Fiji

JICA training in Miyako Jima, in Aug. 2011.

⑧) 22 slides



Mr. Vishwa Jeet from Fiji asked me many questions during the training in 2011.



New plans for cleaner water

<https://www.youtube.com/watch?v=wxAGhjx7e40> 1:45

Hungry is Normal.

New Constitution of Fiji shall come on 7 September 2013. p24, No.36.

[https://laws.gov.fj/ResourceFile/G.../et/?fileName=2013%20Constitution%20of%20Fiji%20\(English\).pdf](https://laws.gov.fj/ResourceFile/G...)



36. Right to adequate food and water

36.—(1) The State must take reasonable measures within its available resources to achieve the progressive realisation of the right of every person to be free from hunger, to have adequate food of acceptable quality and to clean and safe water in adequate quantities.

Mr. Vishwa Jeet remember these words.

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.

⑧-1

8-1 沖縄から Fiji へ、村落へ安全な水供給事業に協力。Fiji の Vishwa Jeet さんは、研修中、熱心で、多くの質問があった。2013年の新憲法には、国民は安全な水を十分に受ける権利があると記載されていた。



Mr. Vishwa Jeet from Fiji gave many questions to me.



He returned back to Fiji. he made a model to make safe drinking water by EPS technology at the yard of Department of Sewage and Water. Water source was rain harvest tank.



Kick off Workshop on Jan. 16, 2013. at Holiday Inn. Commander Francis B. Kean, Permanent Secretary, Ministry of Works, Transport, Public Utilities.

Holiday Inn: Jan.16.2013



New plans for cleaner water

<https://www.youtube.com/watch?v=wxAGhjx7e40>



The Fiji Times ONLINE Quality water for all

With the new Ecological Purification System (EPS) in the pipeline, water quality enjoyed by urban people soon may also be made available to rural villages and communities.

A workshop on a new water treatment system, hosted by the Department for Water and in collaboration with the Japan International Cooperation Agency (JICA), Suva yesterday, revealed that EPS was an exceptional and economical way of purifying water.

Fiji's permanent secretary Commander Francis B. Kean said the plan to provide safe, adequate water and efficient sanitation to the whole population in Fiji was a government's mandate.

“About 10 per cent of our rural population drink water directly from creeks and river sources which are most... (text partially obscured) ...”



Jan. 17, 2013, Dept. Sewage and Water



Rain harvest tank of 2.7 tons for this project.

⑧-2

8-2 2011年、JICA 沖縄で学んだフィジーの研修生。帰国して装置を自作して、効果を確認、首相に訴えて、2013年1月、国家事業が動き出した。村落給水では 2.7m<sup>3</sup> の雨水貯留タンクを使う計画だった。

EPS technology is our technology for ours. We can make it by ourselves.



**KALOKOLEVU VILLAGERS WELCOME ACCESS TO CLEAN DRINKING WATER**

7/17/2013  
More than 270 villagers in Lami now have access to clean and safe drinking water through an ecological purification system (EPS), thanks to the partnership between the Department of Water and Sewerage, the Water Authority of Fiji (WAF) and the Japan International Cooperation Agency (JICA).

The EPS, which is the first of its kind to be installed in a local rural setting, was commissioned by the Ministry of Works, Transport and Public Utilities permanent secretary Commander Francis Kean in Kalokolevu village, Lami yesterday.

Commander Kean said the pilot project was aimed at improving accessibility to clean water and sanitation to people living in rural areas.

He said this is a major milestone for the country and the Government in particular in its desire to lift the living standards of people in the rural and maritime areas.

"Improving the living standards of the rural citizens through better accessibility to clean water and sanitation is one of the key priorities of this Government as enshrined in the Peoples Charter for Change, Peace and Progress and the Government Roadmap to Sustainable Development in the medium term," Commander Kean said.

Ecological Purification System in Fiji, 2013 for Safe Drinking Water - YouTube/ 3:05



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

Beginning of Ecological Purification System (EPS) to make safe drinking water in Fiji / 1:45



<https://www.youtube.com/watch?v=wxAGhjx7e40>

8-3 2013 年は、Fiji 政府上下水道局職員が自分らで、EPS 装置を完成させた。7月には、パイロット村の Kalokolevu 村で、盛大の開通式が。

EPS technology is our technology for ours. We can make it by ourselves.

Opening ceremony of public tap on September 11, 2013. at 2nd Eps.



**NAVATUVULA VILLAGERS GET ACCESS TO CLEAN DRINKING WATER**

9/12/2013  
Improving the living standards of the rural communities through better accessibility to safe drinking water and sanitation is one of the key priorities of the Fiji Government.

This was highlighted today by the Ministry for Works, Transport and Public Utilities permanent secretary, Mr Francis Kean at the commissioning of the second ecological water purifier (EPS) at Navatuvula village in Sawani, Naitasiri.

The first EPS was commissioned at Kalokolevu village in Lami about two months ago.

Mr Kean said his ministry's aim is to install EPS into rural water supply systems to ensure removal of contaminants before water is consumed.

"The incorporation of the EPS into rural water projects will take place after further monitoring the results of the pilot projects by the Water Authority of Fiji (WAF)," Mr Kean added.

Clean, safe water brings joy to village



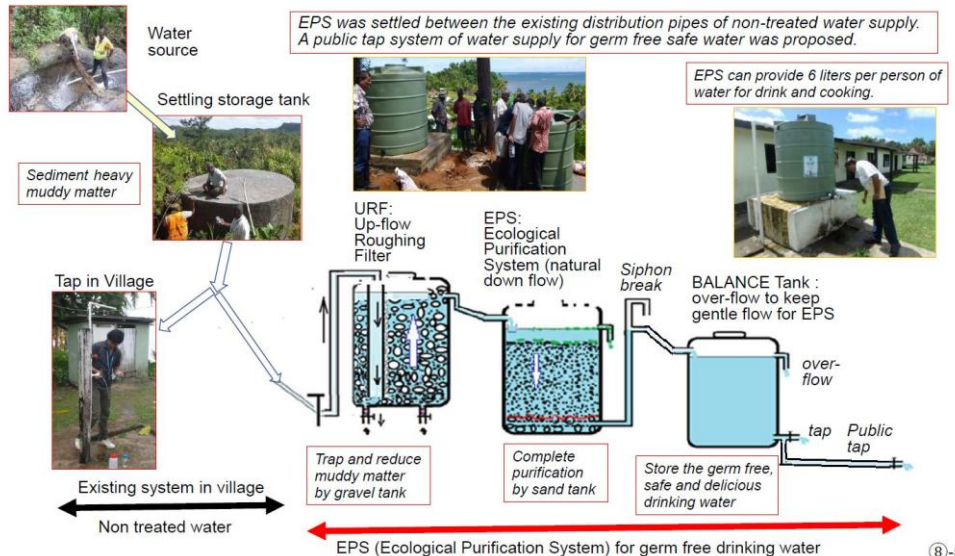
Villagers of Navatuvula, Naitasiri have a reason to smile, thanks to the governments of Fiji and Japan. From yesterday the villagers started drinking safe and clean water, commissioned by the Permanent Secretary for Works, Commander Francis Kean. The water is supplied through an ecological purification system (EPS) – similar to traditional mineral water production.

Quality Water for All : Safe and Clean Water Project in Fiji, 2013 - YouTube/ 7:43

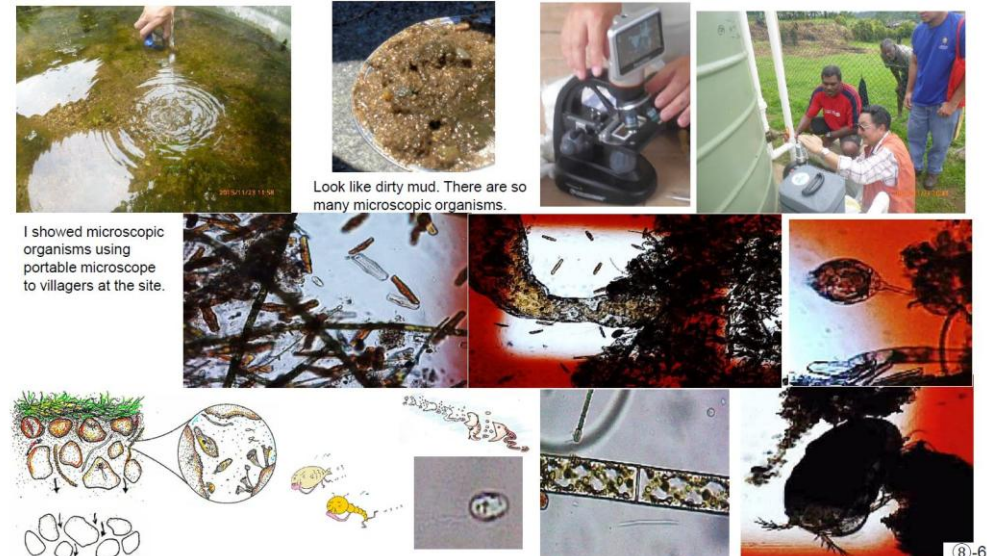


<https://www.youtube.com/watch?v=Vrr2E0S1PMA>

8-4 9月にも、Navatuvula 村でも盛大に、開通式が行われた。



8-5 でも、実際のプラントは、設計が悪かった。そこで、中本に専門家要請があり、中本は、サモアや国内でも活動していたので、長期は無理で、短期専門家として現地で、装置の改良に協力した。JICA はボランティアも派遣してくれた。



8-6 現地では、各村へ、EPS の説明、各地区での技術者への指導などを行った。



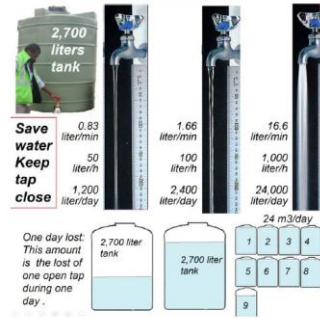
8-7

8-7 熱帯では、生物活性が良く、生物群集の活躍は、表面近くだけ。

Comment on more use of EPS water in a village



EPS capacity of 2,700 liters tank									
radius (r) = 0.7m (π x r x r) = 1.54m <sup>2</sup>									
flow rate		filtrate			Available persons			remarks	
m/d	cm/h	m <sup>3</sup> /d	liter/d	liter/h	liter/min	2 liter/d	6 liter/d	100 liter/d	
2	8	3.1	3,080	128	2.1	1,540	513	31	Original flow rate in UK, 1829
5	20	7.4	7,392	308	5.1	3,696	1,232	74	English standard rate
10	42	15.4	15,400	642	10.7	7,700	2,567	154	Present Thames Water rate
15	63	23.1	23,100	963	16.0	11,550	3,850	231	Possible rate in warm region
20	83	30.8	30,800	1,283	21.4	15,400	5,133	308	Possible rate in warm region

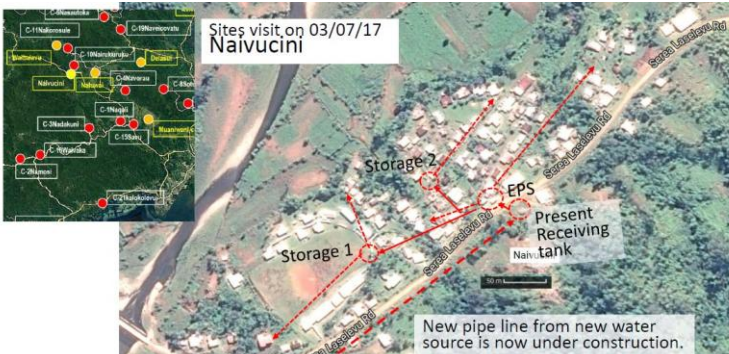


1. Block distribution system for EPS water is recommended.  
2. Install more public taps for villagers.  
3. Training for the save the limited amount of EPS water.

There is non-detected leak, therefore we have to install EPS pipe with may public taps in a small village (even up to 200 persons).  
If there is absolutely no leak problem, we may connect to present distribution pipe in case of a small village. But this is risky. I cannot recommend this connection.

8-8

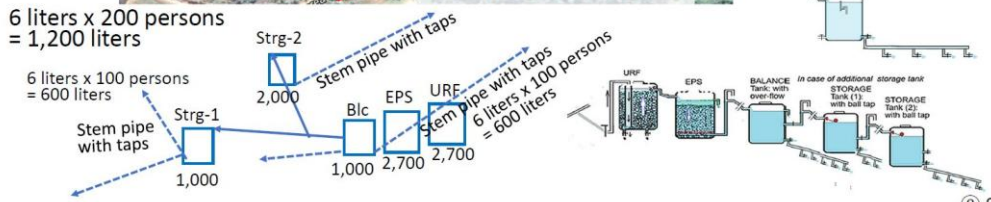
8-8 装置の浄化能力から、共同水栓方式で飲み水と調理なら、多くの住民に給水できると解説。蛇口を閉めない、貯留槽の大きさに限界があると解説。



Present Receiving tank. Water shortage problem.



NEMANI TG 9501657  
500 persons 120 houses  
More use of EPS water is key to be better quality.

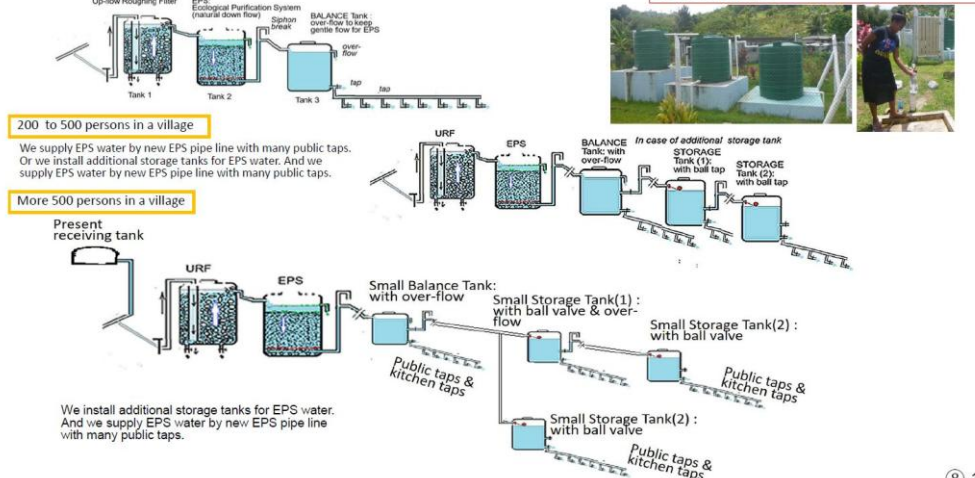


8-9

8-9 一つの浄化装置から、大きな村に給水する。それなら、貯留槽を増やす仕組みを勧めた。

Comment on more use of EPS water in a village

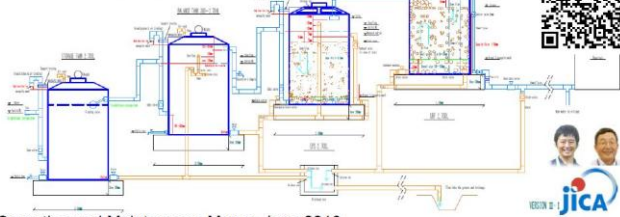
Up to 200 persons in a village: If there is no leak problem, we may connect to present distribution pipe in case of a small village. But this is risky. I cannot recommend this connection.  
There is non-detected leak, therefore we have to install EPS pipe with may public taps in a small village.



8-10

8-10 村の大きさ、追加の貯留槽と共同水栓での、利用の仕組み案を提示した。

Ecological Purification System for Fijian 2,700 Rota Tank Plant  
Design by Hide (Hidemitsu EGUCHI) and Nobutada NAKAMOTO  
JICA 16/June/2016



[https://eps.watervision.jp/wp-content/uploads/2025/04/EP\\_S\\_design.pdf](https://eps.watervision.jp/wp-content/uploads/2025/04/EP_S_design.pdf)



<https://eps.watervision.jp/wp-content/uploads/2025/04/Fiji-EPS-2016-tank300-2700CAD-Design.pdf>

Operation and Maintenance Manua June 2016



[https://eps.watervision.jp/wp-content/uploads/2025/04/160614-Eng-Fiji-EPS-Manual\\_Eng.pdf](https://eps.watervision.jp/wp-content/uploads/2025/04/160614-Eng-Fiji-EPS-Manual_Eng.pdf)



8-11

8-11 私と江口ボランティアで、設計建設指針、維持管理指針を作った。QRで。

World Water Day 2018, March 22/23 Lautoka, Fiji



DWS actively promoted EPS when it had the chance.



New movement to make more large scale EPS plant arises by own activities of a rural village in March, 2018.

8-12

8-12 Fiji の上下水道公社は、熱心に EPS を国中で、機会がある度に宣伝を。

Nakamoto : Short term expert 2014.10~2018.11.  
8 times of a month visit during 4 years.

Hidemitsu Eguchi Volunteer 2015~2016

Isamu Shioiri Volunteer 2017~2018

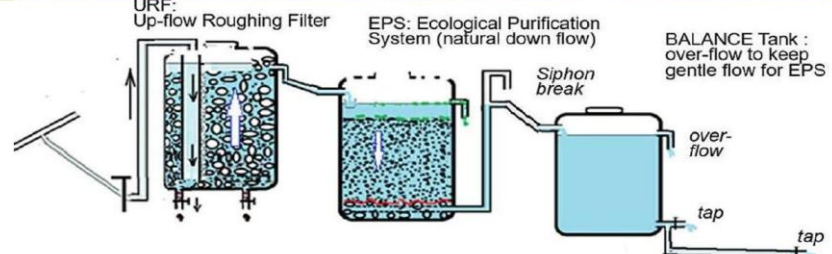
EPS sites completed during 4 years.

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

EPS project started from Kalokolevu and Navatuvula in 2013

The project was implemented under the initiative of the Fiji government, and construction of around 30 plants was covered by the government budget every year, and JICA only provided technical cooperation by dispatching Nakamoto and volunteers. EPS technology has been transmitted from Japan to Fiji as a technology that can be done by themselves.

8-14



8-13

8-13 中本は、短期専門家。1 回約1月間で年2回、2年間の派遣。中本がない時は、シニアボランティアが、フィジー政府の EPS 事業を手伝ってくれた。

8-14 中本は短期専門家として2年間だけでなく、その後も、2年間、合計4年間。1回約1月間、8回でかけて協力。4年間で、フィジー中に、約 100 の EPS 装置が完成し、稼働した。全村の約1割に完成させるのに協力した。



This seminar was held at the end of 4 years EPS JICA contribution (Nov.2014 to Dec.2018) in Fiji by Nakamoto.

EPS Fiji Wksp 2019 for safe water / 7:08

People loved the latest advanced technology. However, there is suitable technology for each country. That can be maintained and managed by local people. That is EPS.



EPS Seminar/ Wksp at USP, Suva, Fiji March 2019/ 4:32  
<https://www.youtube.com/watch?v=fE15ghBzfMw&t=23s>

**EPS**  
Public Seminar/  
Workshop

*"An approach to securing the safe water"*

Revisiting Fiji's successful EPS implementation at Rural Area and future perspective of implementation in PSC  
**12 & 13 March 2019**  
 @ Japan-Pacific ICT Centre, USP Lavasa Campus

Day 1: 09:30-17:00 Public Seminar (for non-English speakers)  
 Main Presenter: Dr. Nobutada NAKAMOTO  
 JICA experts: EPS experts and local leaders support  
 Presenters: Members of Ministry of Health, Japan  
 Local audience: 200-300, 10000 people

Day 2: 09:00-18:30 Workshop & Study Tour (in case)  
 Workshop - Demonstration of EPS Construction  
 Study Tour - EPS Site Visit to NAKINI Village  
 18:30-20:00 - Evening Reception (optional)

**jica**

Free registration is required at Day 1 (before 11:00 AM) at limited space.  
 For further details, please contact JICA by clicking on email: [public.seminar@jica.go.jp](mailto:public.seminar@jica.go.jp)  
 Tel: 03-3591-5111

©-15

8-15 中本の派遣は、2018年12月に終了した。その成果を大洋州に広めようと3月に国際セミナーを企画した。でも、中本は体調不良で、東京の JICA 本部からネットで講演して協力した。QR で見て。

Fijian Minister for Infrastructure opens the Ecological Purification System Project at USP (The University of South Pacific)

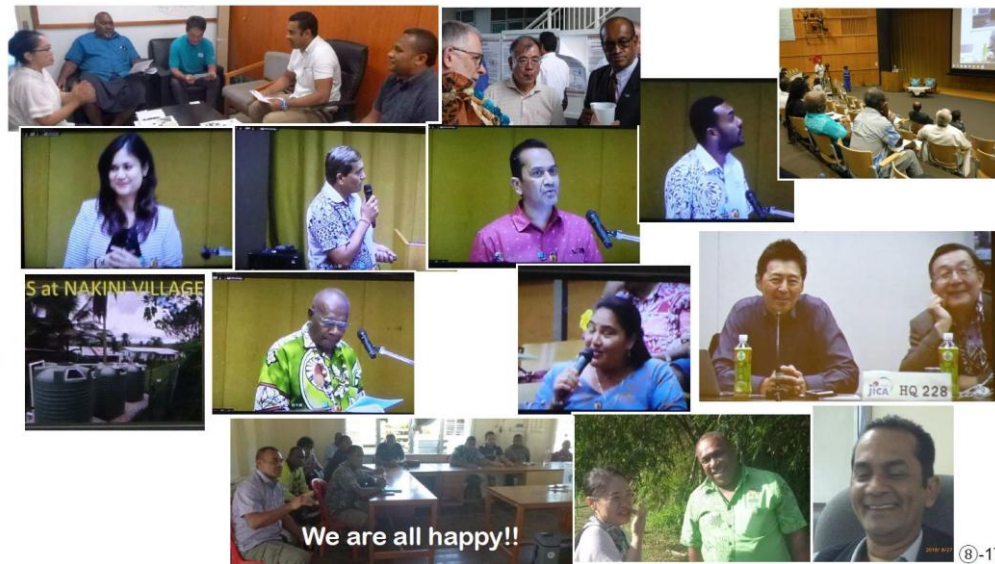
<https://www.youtube.com/watch?v=iBcjbocOleQ&t=2s>  
 11 min 21 sec  
 Fiji Government



The implementation of community based Ecological Purification System was made possible through the funding of government.  
 The Fijian Minister for Infrastructure, Transport, Disaster Management and Meteorological Services Hon. Jone Usamate, in saying this, officiated as Chief Guest at the opening of the Ecological Purification System (EPS) Workshop which was held at The University of the South Pacific.  
**The EPS is a chemical-free and energy-free water purification technology** which was initiated by Dr. Nobutada Nakamoto, Professor Emeritus of Shinshu University in Japan.  
 Also present at the opening event was special guest was Deputy Vice Chancellor of USP Mr. Derrick Armstrong.  
 The workshop is a two-day event hosted by JICA from 12-13 March, 2019 at The University of the South Pacific ICT Centre in Suva, Fiji.

©-16

8-16 フィジーの南太平洋大学の講堂には、多くの関係者が参加してくれた。現地での協力で、サモアから、沖縄から、日本からフィジーに行ってくれたセミナーと現地指導に協力してくれた。QR で見て。



©-17

8-17 盛大な国際セミナーに参加し、皆がハッピーであった。

**EPS**  
Public Seminar/  
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 Tel: 03-3591-5111

**17:30-18:30 Wrap-up**

**We are happy.**

**Fijian people made EPS plants by themselves.**

©-18

8-18 フィジーの皆が、全村の人々に、安全な水をとの国家事業に熱心だった。その技術は、JICA 沖縄での研修で学んだのを、フィジーで実現させた。

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. Science Prof. Emeritus of Shinshu University  
Eco-friendly technique to make artificial spring water

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

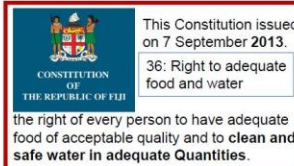


<https://www.youtube.com/watch?v=fE15ghBzfMw&t=62s>  
4min 32 sec

EPS to make safe drinking water is real our technology.



<https://www.youtube.com/watch?v=vj0ay-7GA8&t=254s>  
7min 08 sec



the right of every person to have adequate food of acceptable quality and to clean and safe water in adequate Quantities.

⑧-19

8-19 中本は、熱心な研修生の思いに応え、協力した。



SSF was recognized as Ecological Purification System in Ueda, Japan.

JICA training began in Okinawa, from 2006.

Fijian people made a big effort for the people.

EPS spread to Pacific countries.

⑧-20

8-20 緩速ろ過は生物浄化法と気づき、2006年から沖縄で JICA 研修が始まった。フィジーからの一人の熱心な研修生が実現させるのに協力した。

*This is Fijian EPS project.  
Fijian people made EPS by themselves.*



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 SHIIRI  
2017-2018

We assisted a little for this project.

The contribution of short-term expert by Nakamoto was from Oct. 2014 to Nov. 2018.

This Fijian EPS project for rural people still continues until now by Fijian government in 2024.

This is a real technical transfer from JICA training.

*EPS is Our Smart Treatment System. Fijian people realized and certified. We can have safe and delicious water.*

⑧-21

8-21 EPS は私たちのスマートな技術。熱心なフィジー政府の上下水道職員の活動を、中本だけでなく、二人のシニアボランティア江口秀満さん、塩入勇さんの協力で成功させた。



Timaima Bolaciri, carrying Taniela Tabukarawa, and Una Koroi try out the new ecological purification system at Kalokolevu Village yesterday. Picture: JONACANI LALAKOBAU

<https://www.youtube.com/watch?v=SVuR44Xwu7s&t=43s>  
3 min



⑧-22

8-22 人口 90 万の島国。自分らの責任で、国民のためにと動いていた。フィジー政府の事業を、JICA が少し協力。日本は中本と二人のボランティアの日本とフィジーへの飛行機代と滞在費だけ。フィジー内の旅費はフィジー政府が負担。

# ⑨ From Japan to the world by the social contribution.

⑨ 17 slides + NHK world China EPS



⑨-1

9-1 社会貢献活動で、日本から世界へ。

## Ecological Purification System for Safe Drinking Water

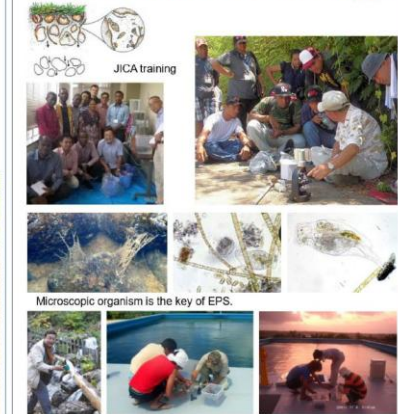
- Application of Natural Process -  
Eco-friendly technique to make artificial spring water

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



August 2018

## This is our technology.



Ecological Purification System NAKAMOTO 2018

Toward Zero Waste World by Chemical-free System

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



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

⑨-2

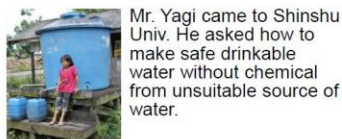
9-2 英語の指針が役立つ(1-12と同じ)。

## I cooperated with Yamaha Motor's social contribution activities by EPS technology.

There was a factory in Jakarta, Indonesia that manufactured engines for outboard motors, boats, motorcycles, and other automobiles. Since it was related to water, they also manufactured water purifiers.

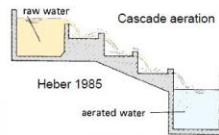


YAMAHA motor company in Indonesia made a purifier for clean and safe water in 1991.



Mr. Yagi came to Shinshu Univ. He asked how to make safe drinkable water without chemical from unsuitable source of water.

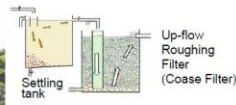
Underground water contains iron and manganese in Jakarta plain. Well water was clear. But the brown colloidal particle was formed soon. They could make clear water using cascade aeration system without any chemical reagent.



Iron and manganese are oxidized and form nearly insoluble hydroxide sludge. They can be removed in a settling tank (a coarse filter).

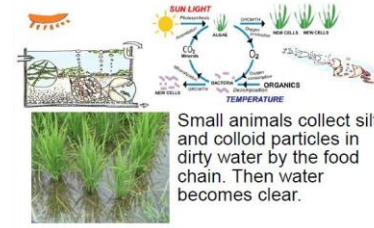


I advised we can make safe water by ecological purification system of wise use of natural phenomena.



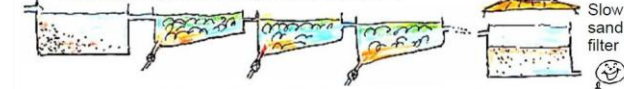
⑨-3

9-3 私はヤマハ発動機の社会貢献事業に協力した。インドネシアの地下水は鉄やマンガンが多い、それでも安全な水にできないかと八木澄夫さんが訪ねてきた。英語文献で解説。カスケードで酸化処理をすれば良いと助言。



Small animals collect silt and colloid particles in dirty water by the food chain. Then water becomes clear.

Active growth of algae and grazing animals grow well in the channel. Active photosynthesis keeps aerobic condition.



Sedimentation tank: Animals grazed particulate matter (living and non-living). Periodical small drain to eliminate precipitate material and unhealthy organisms.

This is new idea of ecological pretreatment system without chemical to reduce silt and colloidal particle for sand filter instead of URF.



Public Tap System

16.6 liter/min  
1,000 liter/h  
24 m3/day  
Free tap is very risky. It makes empty of the tank.



⑨-4

9-4 ジャカルタ郊外の村で、灌漑用水路の水で安全な水をと考えた。水田では、藻や動物が繁殖し、濁りを捕捉して分解する。その後の水を緩速砂ろ過をすれば良いと助言した。

Indonesia 2000



Tap keeper collects money for the bottle for the maintenance cost of the plant.

Tap control is key. Lady collects the money for the amount of water. Free water is not good. It is necessary to collect money for the maintenance of the plant.



The good quality of Yamaha clean water was also transmitted to neighboring villages. Delivery service has also started.

Two bottles of 20 liters per 1 family.

This water is used for drinking and cooking only. This water is not used for bathing and washing hands.

Diarrhea and eye sickness are disappeared. →Health village  
 →sanitary sense and its level are distributed among the villagers.  
 →This acts to protect naturally against sickness.



1. Safe drinking water system which can maintain by local villagers as a **Social Contribution of Yamaha Motor Company**.
2. Pilot test plant with several public taps was donated from Yamaha Company to Kagawong village near Jakarta, Indonesia.
3. **Villagers discussed how to maintain this plant by villagers.**
4. Villagers decided to **collect money** from the users in order to stock for maintenance.
5. Water committee started a **delivery service** to other villages.
6. **Water committee maintains more than 15 years without any trouble.**

This pilot plant developed to new Yamaha Clean Water Indonesia to Asia and Africa. System in 2010 and distribute from Indonesia, Vietnam, Cambodia, Laos, Myanmar, Sri Lanka Senegal, etc.



9-5

9-5 1 家族 20 リットルタンク2本、飲み水と調理だけ、それでも、村では下痢や病気が無くなった。健康村に。清潔志向が向上し、健康意識が向上した。村では装置の維持方法を模索し、その後、村人が維持管理した。

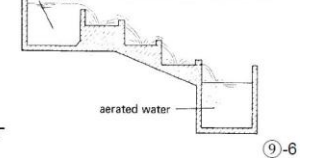
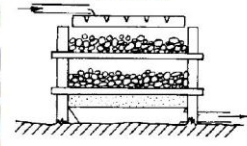


Wise use of natural phenomena for small organisms.



Aeration filter

Cascade aeration



9-6

9-6 大陸では、酸素不足の地下水利用が多い。酸素不足の水では、必ず、前処理では、エアレーションするのが、常識だった。

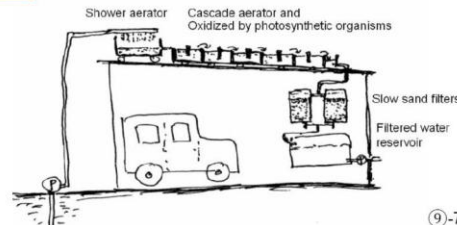
High concentration of iron and manganese in a tube-well water was treated by a cascade aeration using an ecological purification system.



Pre-treatment of cascade aerator using biological activity of bacteria, algae and animals.



Final treatment of slow sand filter.  
Mr. Jun Kinoshita



9-7

9-7 自宅に水道を引くにはお金がかかり過ぎる。そこで、井戸を掘ったら金気の水。困って相談してきた木下順さん。カスケード酸化処理を勧めた。

Use of natural slope, drinking water could be made by EPS, Bolivia, 2008

Volunteer JICA's report, Horie, T. 2009

Pump for groundwater and source water tank



3 gravel filters



Use of natural slope, pour in sand filter



Los animales pueden venir



Filtered water tank

After 4 days, filtered water became clear. After one month, the water became drinkable water, in which coli-form bacteria form was not detected.

9-8

9-8 ボリビア派遣のボランティアの堀江俊樹さん。地下水を EPS の考えで、酸化処理し、砂ろ過で、安全な飲める水にした。



ApamNapat Art Project (Mr. Sohei Iwata managed near Korcata in 2008).



9-9

9-9 インドのコルカタで、岩田宗平さんは、腐植で褐色の地下水を、何段もの上向流粗ろ過を繰り返して、飲める水にした。難分解性の腐植も生物分解できた。

Mr. Jin Shengzhe, translator of Chinese version, made several water plants in China in 2008 after the Sichuan great earthquake, May 12, 2008.



This is 30 tons per day.



金勝哲



9-10

9-10 私の技術解説本を中国語に翻訳している最中の金勝哲さん。四川大地震で、水に困っていた。そこで、四川で、生物浄化装置を3ヶ所建設した。

China: Mr. Huo Daishan 霍岱珊 and his sons built EPS to make safe drinking water. (helped by Mr. Jin Shengzhe 金勝哲)

2008 covered 2016

EPS for a school and villagers was built in 2014.8.

Photo in 2016

70-80 t/d, 4,600 villagers (246 students) 16 liter/person/d

6 t/d, 500 persons. 12 liter/person/d

Supply to owner's kitchen.

Mr. Huo and his sons made 40 plants of EPS by themselves.

9-11

9-11 河南省で淮河が工業廃水で地下水汚染が酷く癌患者が多かった。金さんは、生物浄化法で飲料可の水にするのに協力した。霍さんは40ヶ所以上に生物浄化施設を建設した。2016年、大塚健司さんに誘われ訪問。

NHK World Living beyond boundaries Dec. 13, 2014.

Huo Daishan constructed about 50 EPS Plants for 80,000 villagers from 2008 to 2019 during 10 years.

EPS, which originated in Japan, has also begun to spread in China. 9-12

9-12 霍さんは、マグサイサイ賞、欧州の環境賞をもらい、その説明に、日本の技術とあった。中国の日本大使館が気づき、支援をした。英語のNHK Worldで2014年12月13日に放映した。中本はフィジーを見た。

Since 2002, I have cooperated with the Asian Arsenic Network (AAN, NGO) activity in Bangladesh.

Surface water is polluted. The people use underground water. However, this water was contaminated Arsenic. AAN checked the Arsenate contamination.



Wells contaminated with arsenic were painted red.

AAN made Slow Sand Filtration system for safe water. I advised better SSF system using biological activity to AAN.

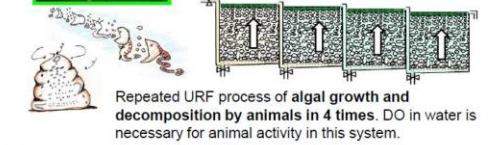
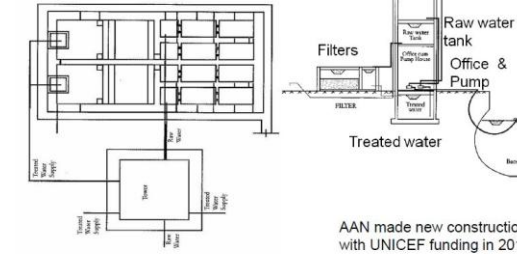
Then, I was asked to consider a mechanism that can decompose pesticides without using chemicals.



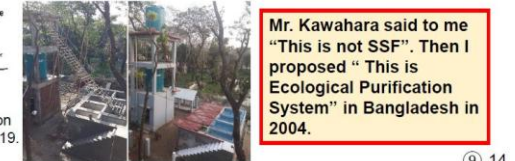
Repeated growth of algae and decomposition by grazing animals, and real decomposition of pesticides and herbicides under anerobic condition in fecal pellets.

9-13

9-13 バングラデッシュの砒素汚染を調査していたアジア砒素ネットワークの人に頼まれ、2002年から対策の助言をした。



Repeated URF process of algal growth and decomposition by animals in 4 times. DO in water is necessary for animal activity in this system.



Mr. Kawahara said to me "This is not SSF". Then I proposed "This is Ecological Purification System" in Bangladesh in 2004.

9-14

9-14 難分解性の農薬も分解するために、URF を4回繰り返した。川原一之さんは「緩速ろ過でない」と指摘。私は「生物浄化法 EPS」と言い出した。

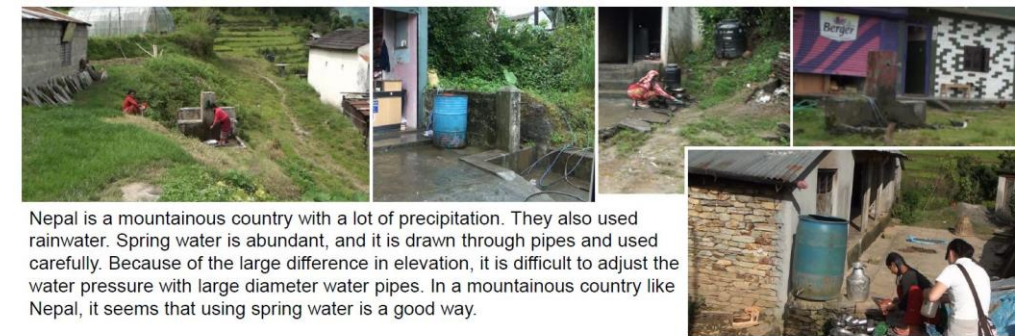
In mountainous country like Nepal, many houses are scattered on the slope. They use natural spring on the slope. I visited Nepal in September, 2011.



These waters by natural purified process are always clear and safe to use.

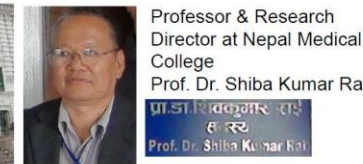
9-15

9-15 ネパールのポカラに緩速ろ過をと視察した。山の傾斜が凄い。良質の湧水が多い。広域の水道施設は、減圧装置が必要。湧水利用が良いと助言。



Nepal is a mountainous country with a lot of precipitation. They also used rainwater. Spring water is abundant, and it is drawn through pipes and used carefully. Because of the large difference in elevation, it is difficult to adjust the water pressure with large diameter water pipes. In a mountainous country like Nepal, it seems that using spring water is a good way.

I gave a talk on water purification to students at this university. I found a wonderful slogan in Professor Shiba Kumar Rai's room.



Professor & Research Director at Nepal Medical College  
Prof. Dr. Shiba Kumar Rai  
प्रो. शिवाकुमार राय

Three points worth to remember

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

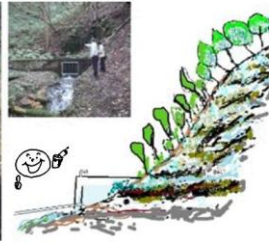
9-16

9-16 カトマンズの医療大で講演をした。S. K. Rai 教授の部屋に素晴らしい言葉：知るだけで意味がない、実行して成果をという 3 つの格言があった。私も同じ教育者：良い言葉を広めようと思った。

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.



In case of mountain area, we can find a good quality of spring water.



Wise use of natural purified water is the best.

⑨-17

9-17 日本は山国、良質の湧水が身近にある。河床の伏流水取水が良い。

⑩ Sri Lanka, Pakistan



I advised a renewal WTP of National Hospital in Sri Lanka in 2000.

Mr. Okada, Japanese consultant visited to the Ratnapura Hospital site. Existing old Rapid Sand Filter plant did not work well. Original plan was a renewal of RSF. He asked me that a suitable treatment system for turbid water in tropical region. I advised to use of new URF system for turbid water. ⑩8 slides

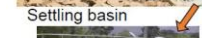


Two set of settling basins, URFs and sand filters were constructed for easy maintenance.

These open system was covered with metal mesh screen to protect fallen leaves and plastic bags.



Intake for raw water



Settling basin

3 step of Up-flow Roughing (gravel) Filters

Slow sand filter

Storage Tank



Sank heavy particles



A fairly large size of 3 steps of URF



Slow Sand Filter



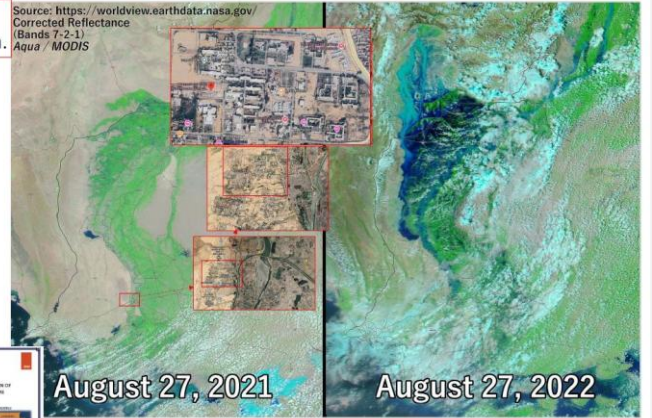
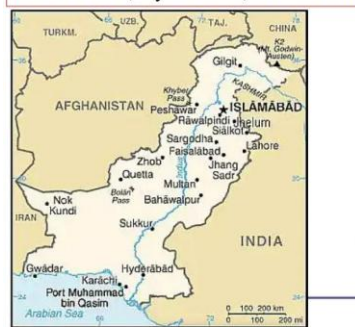
Storage tank

⑩-1

10-1 スリランカ国立病院への水道施設の改良に 2000 年に協力。熱帯の泥水河川。沈殿、3段の URF、緩速ろ過の施設の設計、現場指導で協力した。

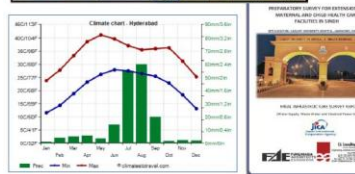
EPS plant for a big national hospital in Jamshoro, Hyderabad, in Pakistan.

Source: [https://worldview.earthdata.nasa.gov/Corrected Reflectance \(Bands 7-2-1\) Aqua / MODIS](https://worldview.earthdata.nasa.gov/Corrected Reflectance (Bands 7-2-1) Aqua / MODIS)



August 27, 2021

August 27, 2022



There is heavy rain from July to September, Indian monsoon period. In this period, there is often a big flood of Indus River. However, there is severe dry period.

I advised to construction of a new water purification plant for safe water to a big national hospital (Maternal and Child Health Center LUMHS Jamshoro) in Jamshoro, Hyderabad, in Pakistan from 2019.

⑩-3

10-2 完成時、現場監督 Ananda Weeratne は、コマーシャル・フィルターだったが、これはナチュラル・フィルターと言った。自然界の生物現象の応用する浄化の仕組みの EPS を理解してくれた。10 年後、再訪、問題なかった。

10-3 パキスタンのハイデルバードの国立病院の水道水用浄化施設建設に協力した。雨期乾期が明確、雨期はもの凄い泥水が水源。既存は急速ろ過だが、上手く機能していなかった。





<https://youtu.be/cWxalGnK4R4>

10 min 12 sec.



Please watch this YouTube.



10-8

10-8 自然界では、活発に活動している時期と、休憩し、繁殖する機会を待ちかまえている期間があるのは普通。

# 11 EPS: Our Technology, Trust Our Sense.

11 12 slides



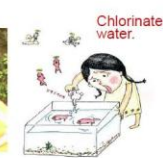
Remember Three Steps

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.



Ecological Purification System from Japan to the world

Trust Our Sense !



Present for you! This is new technology.



Don't believe the commercial.

11-1

11-1 生物浄化法 EPS。私たちの技術。私たちのセンス感覚を信用しよう。

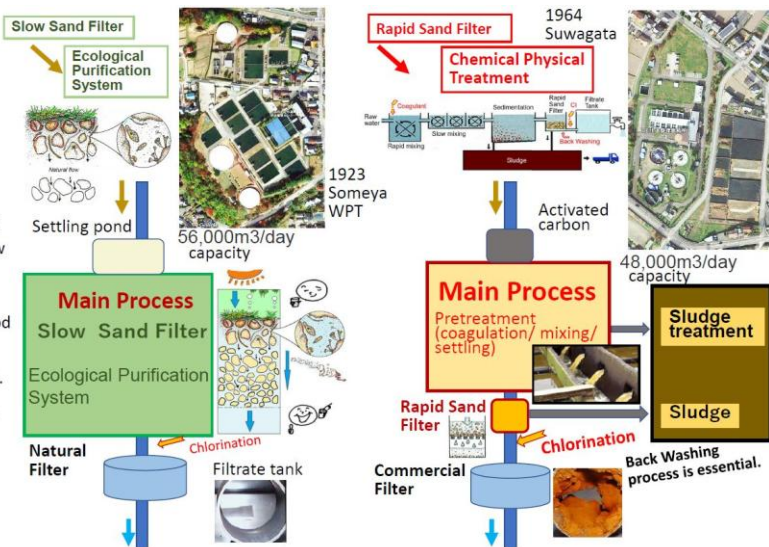
Confirm by yourself. Don't believe commercial.

Trust your true sense.

I, applied biologist, began to study the role of algae in slow sand filter pond.

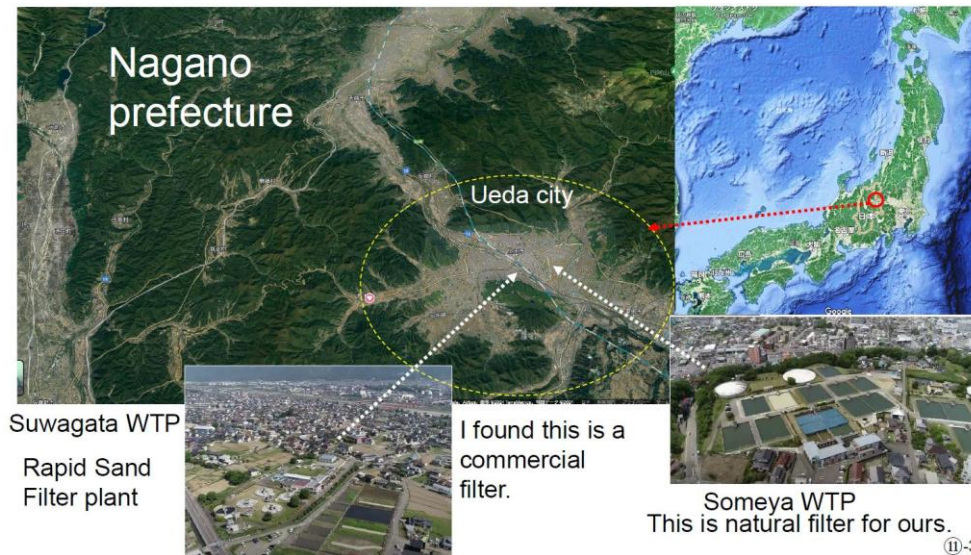
I noticed SSF has been misunderstood by the name. This is Ecological purification system.

This system is wise application of natural system to make an artificial spring water.



11-2

11-2 業者の宣伝でなく、自分で確かめよう。緩速ろ過はろ過池が主役。急速ろ過は、前処理、後処理が大変。ろ過池は一部。それでも良い水はできない。コマール・フィルターだ。



11-3

11-3 長野県、上田市は、乾燥している地域。でも周囲の山には降雨がある。その水源開発をした。長野県企業局の急速ろ過の施設があり、遠くの長野市まで送水している。二つがあり、比較できた。違いがハッキリする。



11-4

11-4 山があれば、必ず降雨がある。湧水がある。その利用を考えたい。



11-5

11-5 広島市には、緩速ろ過処理の府中浄水場が1965年に稼働したが、現在は中止している。稼働しているとき、JICA 研修で見学した。



11-6

11-6 当時は JICA 研修で、砂の上で生物が活躍するのを実感した。

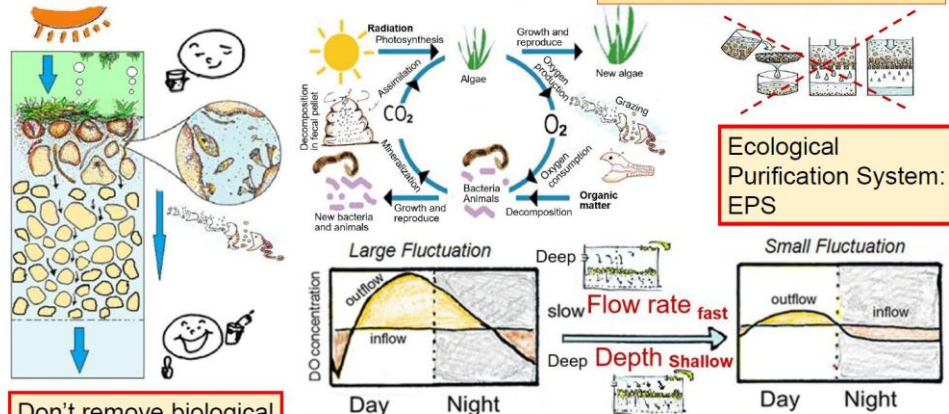


11-7

11-7 自然界での生物群集による浄化の仕組みを理解すれば、EPS の装置は、自分らでも建設できる。生物浄化法 EPS は自分らの技術。

Food chain is the key for real decomposition.

Purification mechanism of SSF was misunderstood under the name.

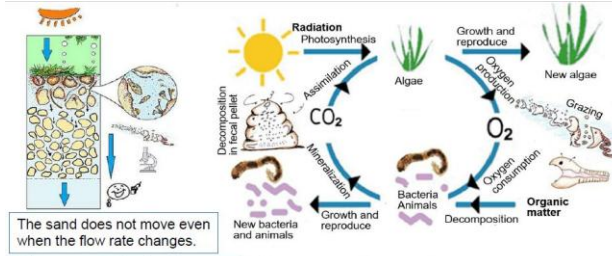


Don't remove biological active layer.

Aerobic condition is essential. Gentle for small organisms.

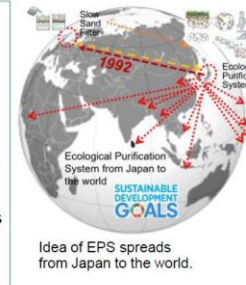
11-8

11-8 食物連鎖が鍵。藻や役立っていた。溶存酸素濃度の変化に注目したい。早い過速度、浅い水深は生物群集に良い環境。生物群集を除かないが鍵。



The sand does not move even when the flow rate changes.

Slow sand filtration is a purification process that relies on the efforts of a biological community. Algae produce oxygen through photosynthesis, and the presence of dissolved oxygen creates an environment in which heterotrophic organisms can thrive without worry. Slow does not refer to speed, but to being gentle to the organisms.



Idea of EPS spreads from Japan to the world.

My first visit to Thames Water Company was on August 19th in 1992. I explained my study on the role of algae in SSF system in Ueda.



Ashford Common WTP

About higher flow rate asked by N. Nakamoto Michael Chipps Principal Research Scientist 2025/03/18

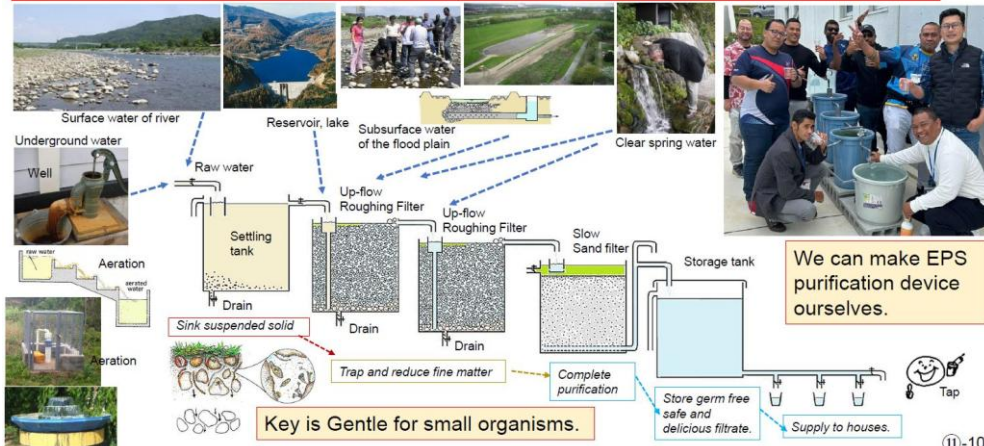
Since your visit (Aug. 19th 1992) we have added DO and turbidity monitoring on the outlet of all SSFs. Thames Water's asset standard says we can operate up to 0.5 m/h(12m/d), but in reality, we are usually in region of 0.25 to 0.35 m/h, but we can reach 0.4 m/h occasionally if we have to. We do have to keep a careful eye on dissolved oxygen (DO).



11-9

11-9 上田市での藻と微小動物の役割研究。溶存酸素が良い指標だった。テムズ水道は、上田市での研究成果を、維持管理法の改良に参考にした。

Ecological Purification System (EPS) : This is Wise Use of Natural Phenomena. This is Chemical Free System to make Artificial Delicious Spring Water. This is a Smart and Eco-friendly technique.



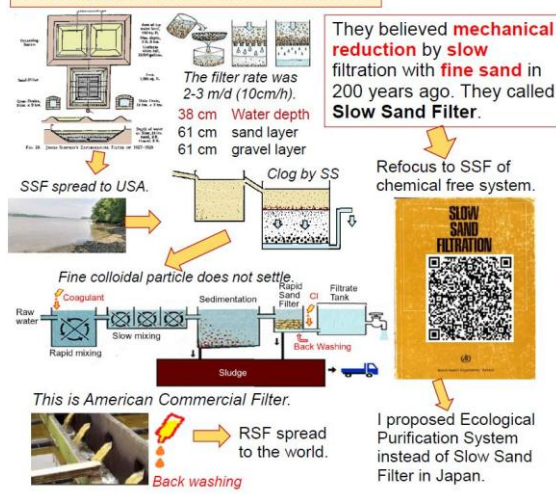
We can make EPS purification device ourselves.

Key is Gentle for small organisms.

11-10

11-10 EPS の考えで、どの様な、原水でも安全でおいしい水にできる。(6-1再掲)

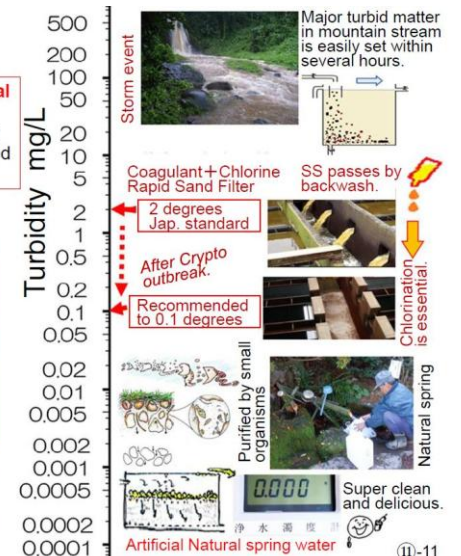
The name of Slow Sand Filter caused a misunderstand of real mechanism.



They believed mechanical reduction by slow filtration with fine sand in 200 years ago. They called Slow Sand Filter.

Refocus to SSF of chemical free system.

I proposed Ecological Purification System instead of Slow Sand Filter in Japan.



Major turbid matter in mountain stream is easily set within several hours.

Coagulant+Chlorine Rapid Sand Filter SS passes by backwash.

2 degrees Jap. standard

After Crypto outbreak Recommended to 0.1 degrees

Purified by small organisms

Chlorination is essential

Artificial Natural spring water

11-11

11-11 英国で 200 年前に開発された緩速ろ過は、アメリカで濁り対策で薬品処理の急速ろ過が生まれた。化学薬品の安全性に問題があり、緩速ろ過を再認識された。基準の水と、本当に安全でおいしい水はと考えたい。

EPS from Japan to the World

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

Purification mechanism of SSF was misunderstood by the name. → Ecological Purification System

1887  
1992

Gentle for small organisms  
Food chain

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.

Trust Our Sense!  
Super clean delicious water

Nigeria

11-12

11-12 EPS の考えは、日本から世界へ広まりつつある。

Three points worth to remember (9-6 参照)

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.

覚えておくべき 3 つのポイント(9-6 参照)

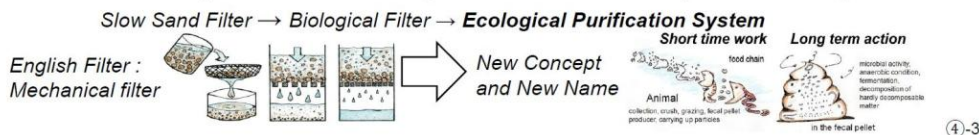
1. 知っているだけでは不十分です。それを何か役に立つことに応用しなければなりません。
2. やる気があるだけでは不十分です。それを計画と行動に移さなければなりません。
3. 計画を実行するだけでは不十分です。目標を達成しなければなりません。

#### 4-3 再掲

### THIS is FOOD CHAIN.

This is a summary of the open lecture at UCL and Univ. Glasgow, in May, 2011.

The first use of slow sand filter for the public supply of drinking water began in 1804 in Paisley, Scotland. The present vertical type of slow sand filter was devised by James Simpson in 1829 after his 2,000 miles inspection trip all over the Britain. This filter provided safe drinking water, free of pathogens to residents in London. This **vertical** type of filter spread round the world and was known as the “English Filter”. Slow sand filter has been believed that it was a **mechanical filter with fine sand under slow current**. However, the major contribution of the purification of the impurities is the **food chain** in this system. The word of “**slow**” was “**gentle for organisms**”. Recently, the English filter of “**Slow Sand Filter**” has been recognized as “**Ecological Purification System**” in Japan.



1804 年にスコットランドのペイズリーで緩速砂ろ過処理の水が初めて公共の飲料水供給に使用された。1829 年にジェームズ・シンプソンが英国全土を 2,000 マイル(約 3,200 キロメートル)調査した後、現在の上から下へ流す緩速砂ろ過を考案した。ロンドンの住民に病原菌のない安全な飲料水を提供した。この浄化法は世界中に広まり、英国式ろ過として知られるようになった。緩速砂ろ過は、細かな砂をゆっくりと流す機械式篩いろ過だと考えられてきた。しかし、浄化に大きく貢献していたのは、食物連鎖であった。「緩速」という言葉は、「生物に優しい」という意味だった。近年、この「緩速砂濾過器」は、日本で「生物浄化法 Ecological Purification System」として認識された。

2011 年5月 UCL と Univ. Glasgow での講演要旨