

Dear Water Warriors,

Bugs are beautiful creatures and essential to our life as well. They have a very important role in our waste water management solutions and need careful consideration for pharmaceuticals or Drinking water use.

Engineers need to synergies their efforts with microbiology sans logics of Physics, Chemistry & Mathematics to optimize biological waste water systems.



I have pleasure in editing this issue of 'Waughter'

Dhruvi Vyas - Microbiologist

This Edition we focus on the "Microbiology of Wastewater and Drinking water" and try to make it useful to reader for the day-to-day work with water.

- 🕒 How bacteria go for biodegradation and contributes to Food chain
- 🕒 Some fundamentals of how Ancient lifestyle was much Reliable then our Modern Concepts.
- 🕒 Beautiful Organism *Escherichia Coli*
- 🕒 How Chlorination benefits for the removal of Deadly Parasites Giardia and Cryptosporidium

If you are eating curd, which is prepared by bacteria!! are you a Vegetarian or Non vegetarian?

Everyone will be thinking; Oh! We are eating bacteria.

Curd may contain a wide variety of bacteria like *Lactobacillus acidophilus*, *Lactococcus lactis* etc.

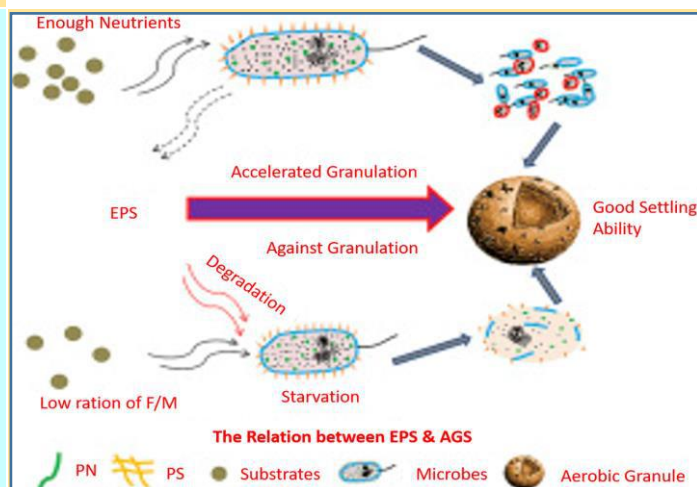
Curd is formed by the bacterial action on milk. When you eat *Curd* you are also eating millions of bacteria in the curd along with it.



You can label it as lacto-vegetarian!! Don't worry, bacteria are unicellular plants.

It has been a traditional practice to provide buttermilk to children suffering from diarrhoea. If it is not a probiotic, is buttermilk just keeping the children hydrated?

Curd and buttermilk, apart from being a part of our diet, are also taken by people who are lactose intolerant — cannot digest lactose since they lack the enzymes that are needed to break down lactose, the milk sugar.



Let's see how bacteria increases the biomass by eating the pollution or COD and acts good for biomass settling?

As a living matter, the microorganisms need sources for carbon, nitrogen and other nutrients as a requirement for reproduction, respiration and growth.

As a result, there will be an increase in the population leading to a greater number of them and consequently the process will be self-generating and no extra resource will be needed.

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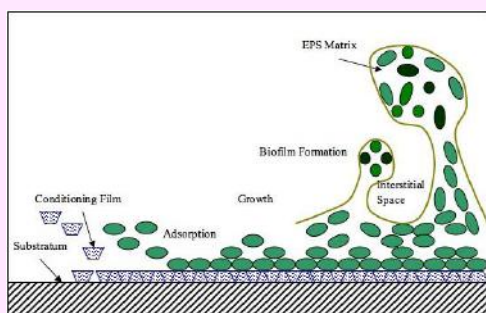
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From page 3...

The bacteria eat the organic matter; & excrete a substance called "Exopolysaccharide" that acts as a gluing material to which the other bacteria get attached. The organic matter also gets attached and form "floc" like structure which increases the biomass and leads for better settlement.

After eating all this pollutant at some stationary phase, the bacteria are dead. The dead cell $C_5H_7NO_2$ will release NH_3 that will be converted to NO_3 and ultimately forms Nitrogen which will contribute in Soil.

This N in soil utilized by plants and plants utilized by humans. So now imagine this is how the cycle works!! Microorganisms can therefore be seen as suppliers of so-called "ecosystem services".



Cryptosporidium and Giardia in Drinking water ☹️

Wondering Right! What are these things?

These are two dangerous higher form of lives we can say "Parasites" responsible for intestinal illnesses.



How dangerous they are?

The parasites can live in the environment for long periods, especially in lakes, rivers, streams and roof water.

There is no way of telling by taste, sight or smell if soil, food, water or a surface has cryptosporidium or giardia parasites. You get infected when you swallow the parasites, for example, by drinking contaminated water or touching your mouth with contaminated hands.

People or animals who have cryptosporidium or giardia pass on the parasites in their faeces (poo). The parasites can contaminate (make unsafe) soil, food or water, or surfaces such as toys, bathroom taps or doors, and nappy change tables.

How to avoid these organisms?

To kill or inactivate Crypto, bring your water to a rolling boil for one minute. Water should then be allowed to cool, stored in a clean sanitized container with a tight cover, and refrigerated.

An alternative to boiling water is using a point-of-use filter also Chlorination. The modern method is chlorination. But at this stage, worldwide people think chlorine is a bad substance or it is carcinogenic.

Chlorine kills pathogens such as bacteria and viruses by breaking the chemical bonds in their molecules.

When enzymes are exposed to chlorine, one or more of the hydrogen atoms in the molecule are replaced by chlorine. This causes the entire molecule to change shape or fall apart. When enzymes do not function properly, a cell or bacterium will die.

Which Option is fine Disinfection by Chlorine or Getting Sick through diarrhoea?

Its true chlorine is dangerous, but it can be used for disinfection up to certain Amount. For under developed or developing nations like India, Afghanistan, Bangladesh, Myanmar, Nepal etc where sanitization is the major concern area, the chlorination is still Best Available Technique (BAT).

If chlorination or disinfection did not go well, diseases like diarrhoea, cholera, hay fever, intestinal infections etc may happen.

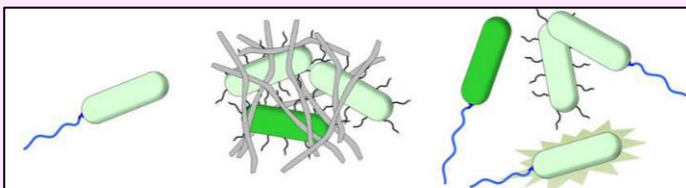
So, I would say! Chlorination is good for all drinking water schemes of public health. Rural departments must assure that water is chlorinated to 0.3 ppm free residual chlorine level. It may give foul smell, but it's better than having diarrhoea.

Doesn't the Glue-like material Exopolysaccharide work as magic for Microbial Interaction! Let me brief you all about Biofilm and Planktonic Growth?

Exopolysaccharide contributes as a communicating agent for bacteria, technically called "Quorum Sensing" (QS).

Via QS these bacteria stick with each other and removes the pollutants from water. These cell grouping is very difficult to break as many communities are present in this cell grouping.

This is the major worldwide concern, as due to this biofilm formation Anti- Microbial resistance has risen the concern for our doctors.



Planktonic	Biofilm	Dispersal
- homogeneous population	- phenotypic diversity	- phenotypic diversity
- single cell	- aggregates	- single cells and aggregates
- specific substrate	- various substrate utilization	- various substrates utilization
- high metabolism	- low metabolism	- high metabolism
- high motility	- low motility	- high and low motility
- low attachment	- high attachment	- high and low attachment
- antibiotic susceptibility	- antibiotic resistance	- antibiotic resistance
- low virulence	- virulence	- virulence

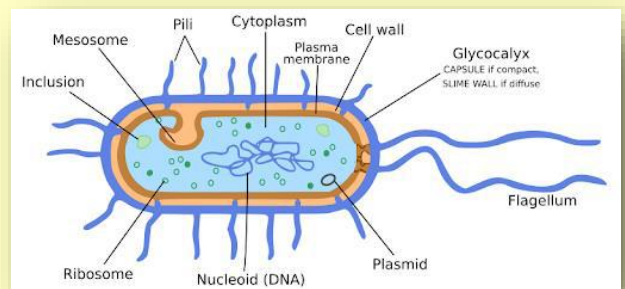
Planktonic growth on contrary is the free-swimming growth of bacteria; they do not form any flocs in water, hence not much useful in Wastewater treatment with the exception of modern Membrane Bio Reactor based waste water treatment plant.

In MBR since all kinds of bugs can be effectively filtered and retained in aeration tank, it is considered as one of the best techniques for C, N & P removal.

Have you ever come across a word *E-Coli* or *Escherichia Coli*? If yes! Then how moody organism it is..Isn't it?

E. coli is a facultative (aerobic and anaerobic growth) gram-negative, rod shaped bacteria that can be commonly found in animal faeces, lower intestines of mammals, and even on the edge of hot springs. They grow best at 37 C.

When *E. coli* locates in human's large intestines, it can help digestion processes, food breakdown and absorption, and vitamin K production.



The *E. coli*-index can indicate how much human faeces is in the water. The reason why *E. coli* is used as an indicator is due to a significant larger amount of *E. coli* in human faeces than other bacterial organisms.

Oh, yes! *E-coli* can be helpful as well as Dangerous for human body. When humans drink water containing *E-coli* it causes diarrhoea, stomach pain and cramps and low-grade fever. Some *E. coli* infections can be dangerous.

As per IS: 10500 (2012), *E. Coli* or other thermotolerant coliform bacteria shall be Absent in any 100 ml sample collected.

Terms like Pili, Cytoplasm, Ribosome, Glycocalyx, Flagellum etc. relate more to life science and can be ignored.

In ancient India it was forbidden to use toilet near to the water bodies and "*Human faeces*" was covered with Ash and buried in Soil to allow Anaerobic Digestion. In our Modern World, the toilets are formed within the house or bedrooms, so *E-coli* started to enter water bodies. This means greater need of sewage treatment and serious expenses to avoid contamination of water bodies.



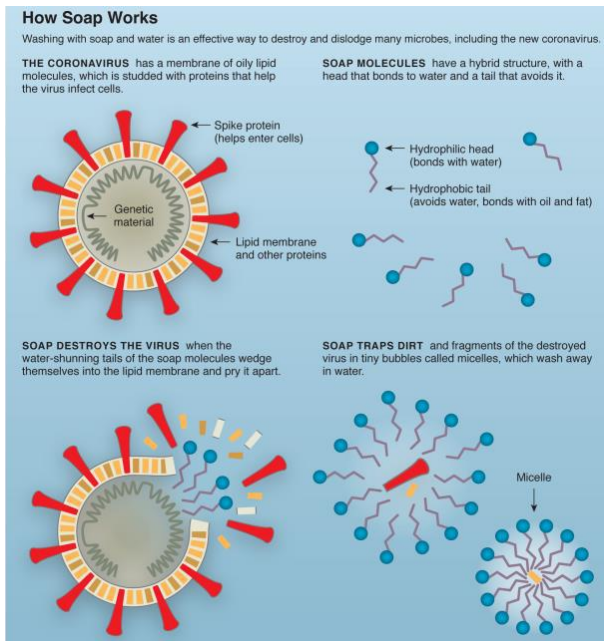
Kena Upadhyay
our summer intern a Chemical Engineering contributed to the concepts and assisted our Microbiologist in developing the content for this edition.

We wish her good luck!!

Hand-Washing to prevent Corona Virus!!

You can't necessarily control what you touch. You can't control who else touched it. But you can look after your own hands.

Generally, the virus is made up of genetic material wrapped in fatty coating like lipids membrane. This coating helps the virus to multiply also infect people. So, when you wash your hands the soap molecule "competes" with the lipids in the virus membrane.



The "Spike" of virus is lost into the surrounding environment rendering the virus inactive.

The Physical action of scrubbing your hands can also help to dislodge viral particles, which is why there has been so much emphasis on how we wash our hands and how long for.

जल जीवन जननी !!

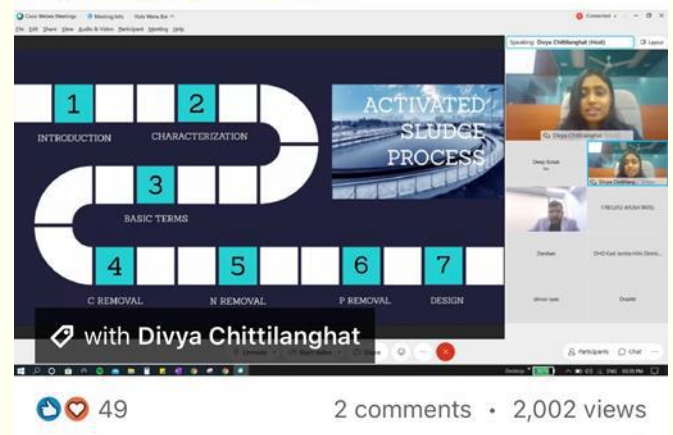


Sanjeev Srivastava

Lead Technology at Aktion Consultancy
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On World Water Day'21, we conducted a 2-hour webinar for all the water warriors. We had a wonderful interactive session and are awarding the best three participants **Sifa Pathan**, **TARUN GURNANI**, **Zeel Devidar**. Interested people can contact us on environment@aktionindiaa.com for the Design XSL of Activated Sludge Process and the webinar presentation.

#water #environment #webinar #people #design #sustainability #innovation



Our world is Waughter

With 3 editions to cover Water Chemistry, Microbiology & Waste Water Terminologies, we stressed on importance of Water Analysis Report understanding. Now we focus on **Treatment & Technology**.

Our next edition focuses on: **Industrial Water Treatment**

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