Earthly Perspective

For the only habitable planet, people and beyond

FEATURED

Fighting Environmental Injustice

An Interview of
Dr. Marc Edwards
by **Rabia Nusrat**

Page 12

JULY 2022

www.earthlyperspectivemag.org

FROM THE DIRECTOR

“

Earthly perspective is an online science magazine founded by a team of young, qualified and enthusiastic team of Scientists and Engineers from Pakistan. I think this magazine can serve a pivotal role in expanding science journalism in Pakistan. I encourage industries and academia to share their successful scientific achievements via this platform and increase their visibility worldwide.

— **Dr. Saqib Nawaz**

”

FROM THE TEAM

A year ago, we came together as a team of a few young environmental enthusiasts with the mission to digitally mainstream the agenda of creating literacy on environmental issues in Pakistan. We aim to create awareness about the environmental issues we are facing on national and international levels and spread the news on breakthrough research in environmental science, engineering, and technology. This magazine issue is the showcase of our one-year efforts to take forward our mission of serving the audience. Engaging with our readers through different activities helped us row from scratch to 1000+ followers. This has been made possible by the motivation and consistency of our diverse and talented team members. All in all, it has been a great experience to work for the sake of our environment.

CONTENTS

INTERVIEW

ENGINEERING, EMPATHY & INNOVATION: PAKVITAE SOLVING WATER PROBLEMS FOR THE WORLD

Page — 3

INTERVIEW

FIGHTING ENVIRONMENTAL INJUSTICE

Page — 7

BIOGRAPHY

DR. SYLVIA EARLE: A HERO FOR THE PLANET

Page — 10

BIOGRAPHY

ELLEN SWALLOW RICHARDS

Page — 15

BIOGRAPHY

RACHEL CARSON – A BORN ECOLOGIST

Page — 17

BIOGRAPHY

RUTH MYRTLE PATRICK: A NATURE LOVER

Page — 19

ENGINEERING

AERO ENGINE CRAFT/ CON-TRAIL-FREE AERO-ENGINES

Page — 23

ENGINEERING

REMOTE SENSING AND GIS FOR WATER RESOURCE MANAGEMENT

Page — 25

SCIENCE

SMOG: CAUSES, FORMATION, EFFECTS AND PREVENTIONS

Page — 27

TECHNOLOGY

ELECTRIC VEHICLES: A STEP TOWARDS A BETTER FUTURE

Page — 31

ENGINEERING

ENVIRONMENTAL IMPACTS OF INCINERATION OF HOSPITAL WASTE

Page — 34

COMMUNICATION

KNOW YOUR TAP WATER!!

Page — 39

COMMUNICATION
LIFE CYCLE ASSESSMENT
Page — 40

SCIENCE
PAKISTAN'S FLOATING WETLANDS:
LOW-COST REMEDY FOR WASTEWATER
Page — 41

SCIENCE
MITIGATING THE OUTBREAK USING WASTEWATER-BASED EPIDEMIOLOGY
Page — 45

SCIENCE
WATER:
AN EXTREMELY VALUABLE AND SCARCE RESOURCE
Page — 47

SCIENCE

WATER POLLUTION

Page — 51

SCIENCE

ENVIRONMENTAL EPIDEMIOLOGY: ITS CLASSIFICATION, PREVENTION, AND CONTROL

Page — 53

ENGINEERING

REMOVAL OF MICROPOLLUTANTS AND CLOSING THE WATER CYCLE USING **HOLLOW-FIBER NANOFILTRATION MEMBRANES**

Page — 57

SCIENCE

CLATHRATE: A IMPLICIT ENERGY SOURCE AND A CLIMATE CHANGE CONTRIBUTOR

Page — 61

Beware! Coronavirus cases are spiking again. This time the virus has been mutated and the new variant, known as the 'Omicron', has been declared as the 'variant of concern' by WHO officials.

Omicron strain was detected in California's Wastewater even before WHO declared it a "Variant of Concern"

INTERVIEW

Engineering, Empathy & Innovation

PakVitae Solving Water Problems for the World

This article is originally published in **Spectra Magazine.** [1]
The original interview has been transcribed and condensed by
Rabia Nusrat & **Fahad Hassan Shah.**
Credits: Interview **by Rabia Nusrat**, ideaXme Public Interviewer

JAN 29, 2021

Shayan Sohail Sarwar, the co-founder of Pak-Vitae, is dedicated to solving water scarcity, water drinkability, and sanitation problems of Pakistan (Source: Techjuice.pk)

Rabia Nusrat, ideaXme's Public Interviewer and an environmental engineering enthusiast from UET Lahore, interviewed Shayan Sohail Sarwar, a chemical engineer from the University of Engineering & Technology Lahore, Pakistan. Shayan Sohail Sarwar is a young innovator, and chief technology officer of Pak Vitae, a company dedicated to solving water problems for low-income communities. Driven by his curiosity from an early age in membrane filtration, Shayan along with his R&D team developed the world's first intrinsically antimicrobial membranes.

Watch the complete interview here:
https://youtu.be/mkFGkW36cFo

World's First Intrinsically Antimicrobial Membrane

"After collecting water samples, we identified another problem in the filtered water. We were stunned to see contamination in the water. Our hollow fiber membrane employs size-based filtration. Anything bigger than the membrane's pore size cannot pass through. It means that a football cannot pass through a pore the size of a golf ball.

Surprisingly, the clean side of the membrane was contaminated with bacteria and it took us two and a half years to successfully incorporate anti-microbial technology into the membranes. Our membranes are the world's first intrinsically anti-microbial membranes. Intrinsically anti-microbial means these membranes will remain anti-microbial throughout their lifetime. Even if you cut any part of it, you scratch any part of it, you erode any part of it, every new surface that will appear will be anti-microbial."

"In the process of making our antimicrobial membranes, the huge challenge was to make nanometals intact with our membrane at each stage of membrane manufacturing. The reason is when you dissolve the polymer in a solvent all the nanoparticles get separated from the polymer chains. Doing it in a way that nanometals stay attached is what we have done successfully. It has not only solved household water problems but is also a global space water achievement as it has mitigated the development of biofilm

What Makes an Innovator

"You will see every type of innovator. Some people are pushed into it, people who are doing it because it is fun. You will come across people who are doing it because it is a lifelong goal. It does not depend on your personality; it has more to do with your environment, circumstances, and background."

Reasons for Lack of Innovation in the Developing World

- Lack of funding and exposure

"Funding and exposure are the main problems in Pakistan and underdeveloped countries. Universities cannot fund big science competitions, exhibitions, or science fairs. They do not have industries here because Pakistan is an agricultural country, it is not an industrial country. The industrialization here is very limited, people do not even have jobs."

Reasons for Lack of Innovation in Pakistan

"One reason for lack of innovation in Pakistan is industrial behavior because the government policies are not very supportive of industries. The government runs opposite every year and the private industrial sector is not supported by them. It has resulted in less or no investment in Pakistan for the development of the industry. As there is a smaller number of industries so these industries do not have to compete with each other as they do not have incentives in the supermarket. There are 220 million people and comparatively, only a few hundred industries are making all kinds of products. So, they do not have any competition. It is a huge market and it is a completely unsaturated market. It is a vicious circle because of government policy; there is no investment coming and because of lack of investment there are no industries. Because of the nature of industrial competition, there is not an urge of developing new cutting-edge products, that can compete with each other. As a result, we also see consequences on the academic side. Students are not involved in practical projects."

The Gap Between Industry and Academia

"Industries should involve universities in projects because if they do give universities a chance to collaborate, students will learn about the technicalities in the world of engineering and science. Another problem is you do not have professors or mentors that are experienced in working with the industry and know about the market's demand. They do not know how to optimize their research, how to control finances, and how to control time, so they are not experienced and then all of this is a trickledown effect and it goes to disturb the entire system."

Problems in the sociopolitical system

"I do not blame the students and do not completely blame academia here. They cannot do anything because it is not about their aptitude or belief system, it is more about the economic and socio-political situation. The same students when going abroad, work in top-notch companies and prove themselves to be top engineers and doctors in the world. Even the team that discovered gravitational waves had a Pakistani scientist. It is not a problem with IQ and with ability. It is a problem of a lack of opportunities."

Empathy and Innovation

"Innovation is not discovering or developing something new but improving something that already exists. To innovate something, the first thing you need to recognize is a potential problem in your surroundings and how you can solve it. To empathize, even if somebody has the smallest problem with a product, it means that this product has room for improvement. Instead of being negative, be empathetic towards them."

Conclusive Remarks by Rabia Nusrat:

"In a developing country like Pakistan where it is not possible to have funds to make water infrastructure resilient, companies like PakVitae can ensure a promising future for our water problems. If academia-industry relations improve, engineers and scientists would be able to get real-time exposure to industrial problems and Pakistan would be able to produce more problem-solvers and think tanks in engineering and science."

Scientists are designing sustainableand reusable Jelly Ice Cubes

These plastic free ice cubes are, anti-microbial and prevent cross contamination. Made with 90% water, jelly ice cubes change color depending on temperature, and can be used for 13 hours for cooling purpose.

FIGHTING ENVIRONMENTAL INJUSTICE

• JANUARY 29, 2021

This article is originally published in **Spectra Magazine. [2]**

The original interview has been condensed by Syeda **Rabia Nusrat** and **Fatima Iftikhar**.

Credits: Interview by **Syeda Rabia Nusrat, ideaxme Public Interviewer, UET, Lahore.**

With permission of **ideaXme**, a global podcast, ambassador and mentor programme. **ideaXme** interviews the creators and innovators who shape our world. They speak to all those who move the human story forward!™ **ideaXme Ltd.**

A few years back a mother of two in Flint Michigan, upon finding that one of her children was not growing well, called an environmental engineer to test her home's water supply. The tests revealed elevated levels of lead. This happened right after Flint's water source was switched from the Detroit River and Lake Huron to the Flint River. Without added corrosion inhibitors, Flint's corrosive water caused lead to leach into the water supply network. As of yet, the contaminated water has caused neurotoxicity in 12,000 kids. It has also caused a Legionnaires disease outbreak, killing 12 and affecting another 80 people. Now, after several years of fighting against environmental injustice, the city is planning to replace the lead pipe network in July 2020.

Rabia Nusrat, Ideaxme's Public Interviewer and an environmental engineering senior at the University of Engineering and Technology (UET), Lahore, interviewed Dr. Marc Edwards, an environmental engineer and professor of environmental engineering at the University of Virginia, Tech. He has helped expose the DC and Flint water crisis and continually fought for environmental justice, forcing the EPA to revise its regulations about lead and copper contamination.

Watch the complete interview here:
https://youtu.be/3y09pqirhMo

Fighting Environmental Injustice

"In my first job as a civil and environmental engineer, I worked on a problem with blue water in California. Unfortunately, it was the position of the lawyers who worked for the water utility that it was not our problem to fix. It was caused by corrosive water reacting with consumers' copper pipes. They took this legal position that I believe, in retrospect, was unethical, and ultimately, they lost about 30 million dollars and a major lawsuit. I think my first lesson was if you ever want to be sued and deserve it, let a lawyer tell you how to do your job. But I left their resolve to do better if I shouldn't encounter such scientific and in my opinion, undesirable behavior in the future. And that's kind of what prepared me for exposing government scientific misconduct in Washington DC and Michigan."

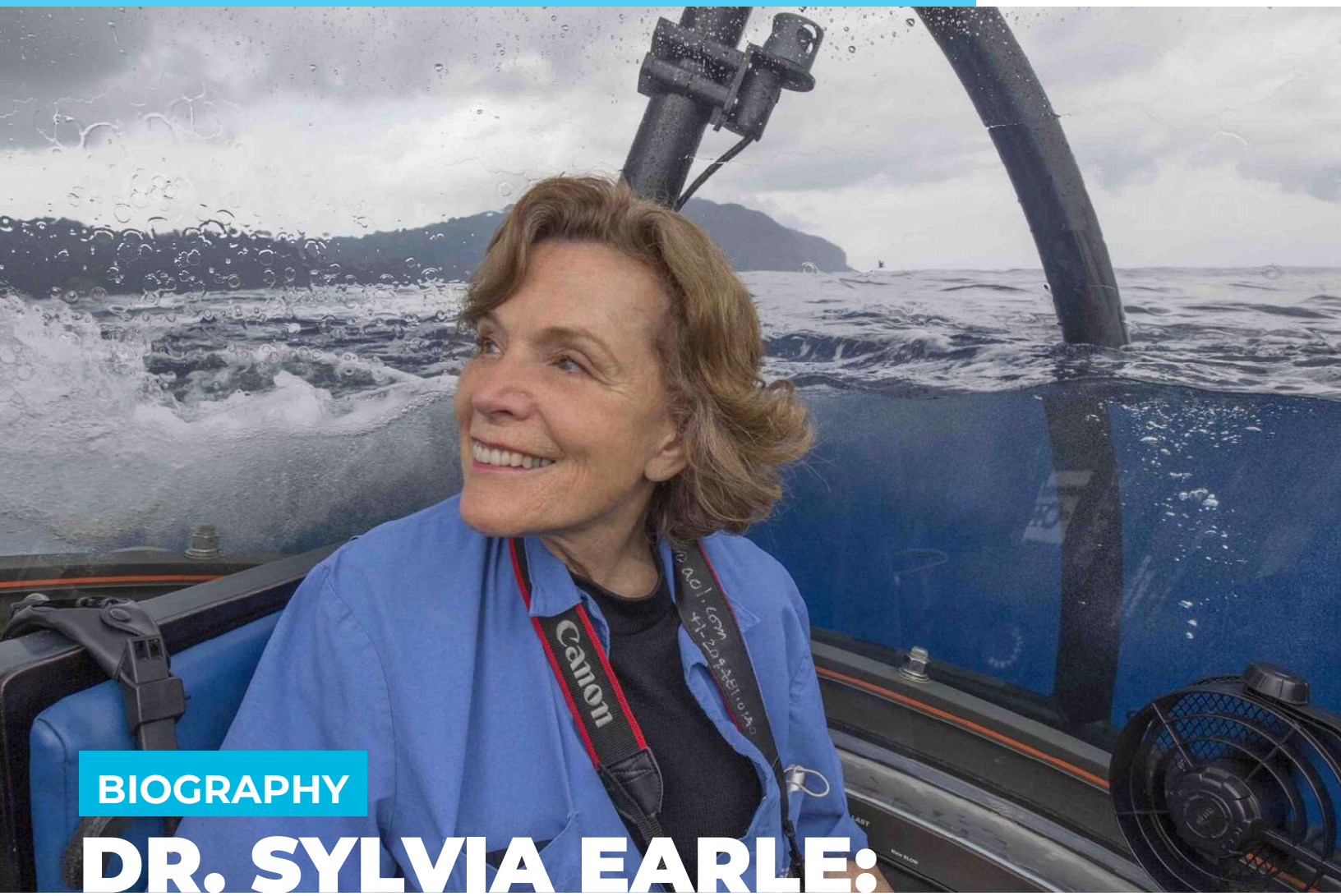
Ethics and Heroism: Saving Public Health

"My message is: be very careful what you learn in your education. Your education can teach you wonderful things, but it also trains you to be a coward, a moral coward. It teaches you how to conform and sometimes how to look the other way and be willfully blind when you are not the good guy or part of a team that's the bad guys. So, I think this is something that we have to be very, very careful about. I often tell students it's the people the world can't change who will change the world and I think that's important. "

"You could wake up someday and find yourself doing something that you would once have abhorred. That is the default condition. It takes a very strong person to remain true to our dreams and aspirations."

Clarion Call for Environmental Engineers

"I think that life has probably never been better than it's been right now. That doesn't mean we can't strive to do better or that we're not in danger of losing it all. Because we're perfectly capable of doing that. I once coined the phrase for what it is that environmental engineers do. It's saving humankind from itself. So, I think that there are a lot of big problems out there that still have to be solved. Of course, the biggest problems are always the human dimension. You really want to meet the enemy. More often than not, it is us. So, you have to start with yourself; you have to aspire to be an ethical, honorable person. It's not so easy in today's world. Cheating is rewarded unfortunately, that's why it works. But, you know, there is such a thing as a just society in the sense that you are able to not be unethical yourself, to be a whistleblower and call out or expose unethical actions that can slightly nudge the moral arc of history."



BIOGRAPHY

DR. SYLVIA EARLE: A HERO FOR THE PLANET

Having spent years in the study of Oceanography and getting considerable appreciation for her work from fellow scientists, Dr. Sylvia Earle came into the public eye through her TED Talk about the oceans. While the 2009 TED Prize proved to be a huge accomplishment in the life of Dr. Earle and her enthusiastic nature motivated the masses to work towards one of her biggest dreams, this scientist's journey has not been easy.

Early Age and Fascination Towards Nature

"Born in 1935 in New Jersey, Dr. DrSylvia Earle had an early interest in nature. She would spend her days in the wild simply exploring the beautiful wonders of it. From insects to plant bodies, young Dr. Earle was fascinated by it all. She lived on a farm, and she had wildlife within walking distance from her house. Her parents never held her back and only encouraged her to learn more about these things. Therefore, she grew up in an environment where being scared of any creature was not taught.

"I was not shown frogs with the attitude 'yuk' but rather my mother would show my brothers and me how beautiful they are and how fascinating it was to look at their gorgeous eyes."

At an early age, Earle and her family shifted to Clearwater, Florida. This allowed Earle to witness the Gulf and its coast's wildlife. These first-hand experiences allowed Dr. Earle to develop a unique understanding and appreciation for all kinds of natures.

Educational Journey and Interest in Marine Life

The educational journey of Dr. Sylvia Earle went relatively smoothly, thanks to her brilliant performance throughout her academic life. She managed to get a scholarship to Florida State University and supported herself by working at college laboratories. She gained considerable experience in the field of oceanography while her studies went side-by-side. Dr. Sylvia got closer to the water after learning about scuba diving and spending her days exploring marine life. This resulted in Earle deciding to study Botany in her future years. She later moved to Duke University for her master's degree and received her Ph.D. from the same institution

Entry into the Practical World

It can be said that the first steps Earle took toward her career were a result of her Ph.D. dissertation. In the 1960s, a marine scientist writing such a detailed account of aquatic plant life was something unheard of, and so granted Dr. Earle was the title of first such scientist with this achievement. As a result of this success and her excellent academic performances throughout her life, Earle worked as a Harvard research fellow in 1967. She then worked as a resident directorship of the Cape Haze Marine Laboratory in Florida.

Managing Work and Private Life

Like many women in the work field, Earle had to carry out two work shifts every day: one at her home and the other at her office.

In 1964, she had to leave behind her children for a six-week expedition in the Indian Ocean. Then, in 1968, she had to travel a hundred feet below the waters of the Bahamas in the submersible Deep Diver while she was four months pregnant! These shocking efforts of Earle for the field of oceanography distinguish her from other scientists. She also did work together with her later husband, and in 1982, she founded Deep Ocean Engineering with him; a company to build an innovative submersible craft that could help explore ocean life at greater depth than normal SCUBA gear. She also served as a chief scientist; a pioneer for being a woman for the National Oceanic and Atmospheric Administration.

ACHIEVMENTS

In 1970, she headed an all-female expedition 50 feet underwater for two weeks. This expedition was under the Tektile II, the sixth mission adaption to the mission Earle had applied for and had faced rejection from. According to Earle, the only reason she was denied the expedition despite her experience underwater being more than others was because the idea of men and women living together underwater was unacceptable at the time.

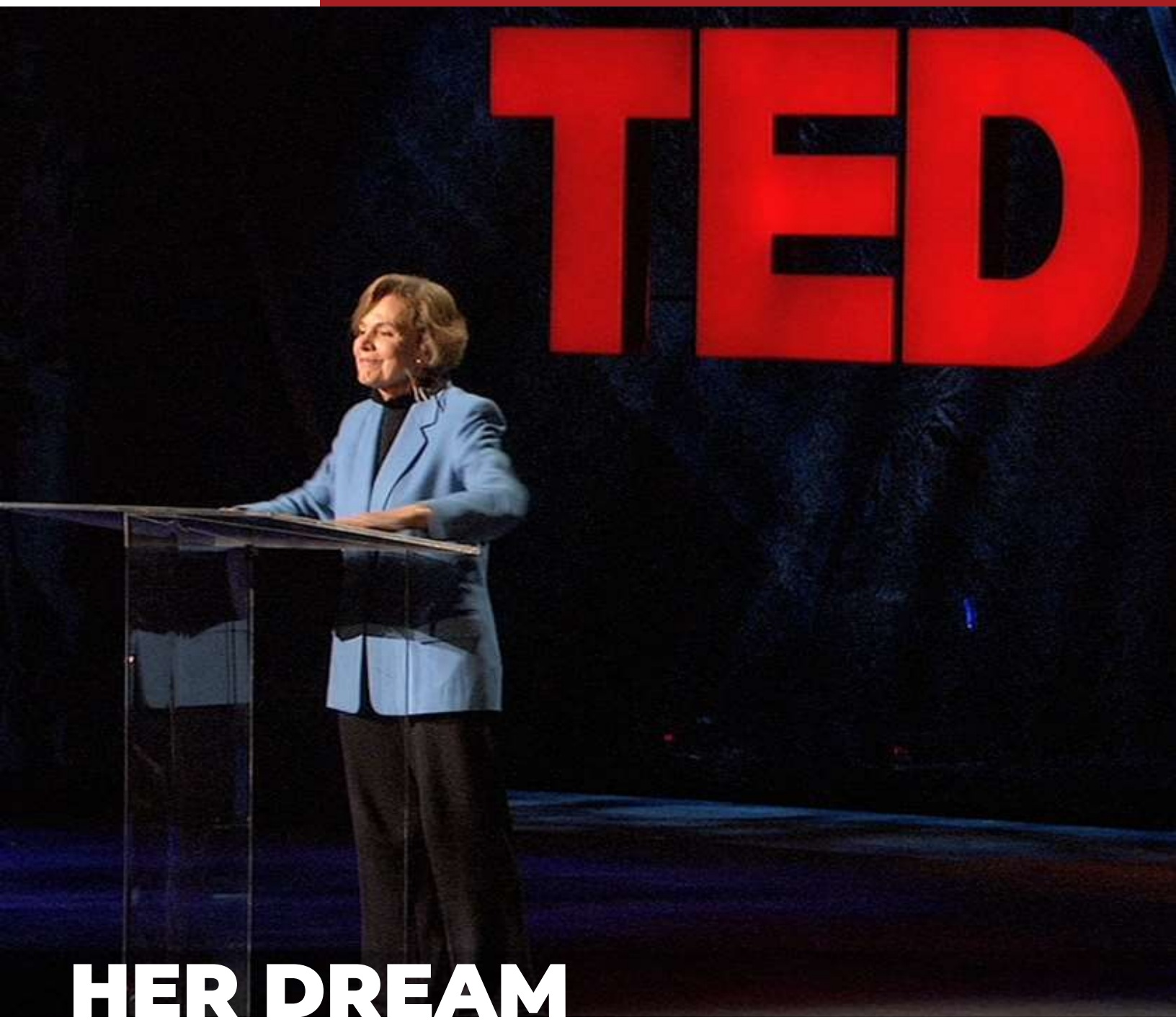
After gaining much recognition from the expedition, Earle moved on to write for National Geographic. Under the National Geographic Society, she led the five-year program of Sustainable Seas Expeditions from 1998 to 2002. She even became a speaker to spread awareness about environmental degradation and other issues surrounding marine life.

> The most valuable thing we extract from the oceans is our existence

Sylvia Earle

All the works of Earle proved to be quite beneficial for the world, and so her awards are not the only achievements of hers, but her work is an achievement in itself. Dr. Earle is also serving as Explorer-in-Residence at the National Geographic Society.

> I hope for your help to explore and protect the wild ocean in ways that will restore health and, in doing, secure hope for mankind. Health to the ocean means health for us.



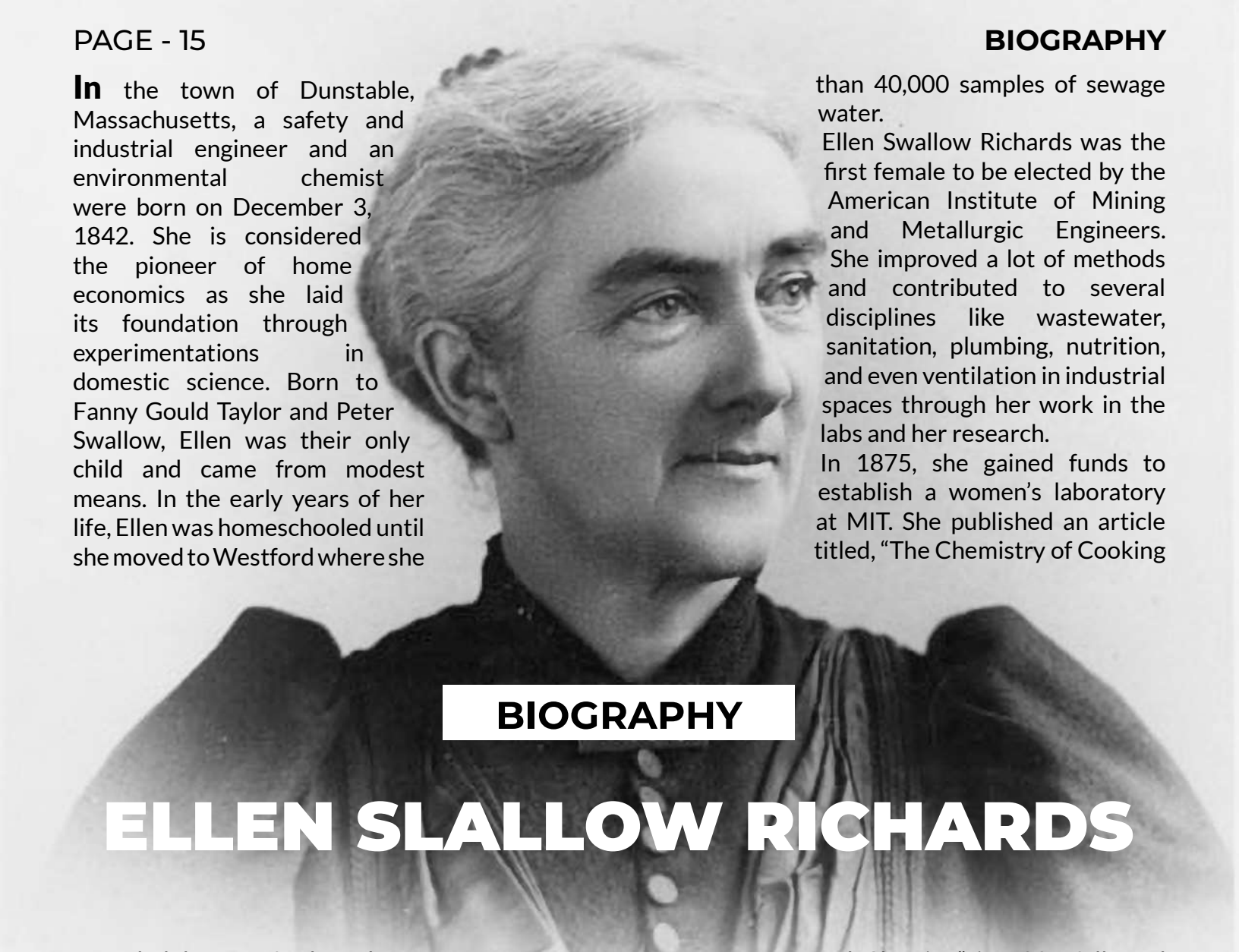
HER DREAM

The TED talk of Dr. Earle gave her its support to launch Mission Blue. Under this mission, she plans to establish marine protected areas across the world. Her dream is to achieve 30 percent of ocean protection by 2030. This dream is being supported by more than two hundred organizations, all motivated by her work. Mission Blue is a significant part of her life as it is evident that a Netflix documentary about her life featured this mission in great detail. Sylvia Earle is 85 years old today, and her dream is to help the ocean bodies remain firm. [3-5]

About Author:

Rija Zaidi is a freshman studying English Literature at Forman Christian College. She is a freelancer as well. Her favorite hobbies are writing short stories and poetry. Zaidi enjoys binging on Big Bang theory and reading classic novels

WOMEN IN
WATER QUALITY



BIOGRAPHY

ELLEN SLALLOW RICHARDS

In the town of Dunstable, Massachusetts, a safety and industrial engineer and an environmental chemist were born on December 3, 1842. She is considered the pioneer of home economics as she laid its foundation through experimentations in domestic science. Born to Fanny Gould Taylor and Peter Swallow, Ellen was their only child and came from modest means. In the early years of her life, Ellen was homeschooled until she moved to Westford where she attended the Westford Academy. Ellen Swallow in 1868, attended Vassar College and graduated with a Master's degree with research on the chemical analysis of iron ore. She was the first female to be accepted by the Massachusetts Institute of Technology (MIT) where she continued her studies and later on taught there as well. . Even though Ellen's first job was as an unpaid chemistry teacher at MIT, she did not give up and became an instructor at her Professor William Nicholas' lab Lawrence Experiment Station in 1884. She became a consulting chemist and later a nutritional expert for US Agricultural Department.

Ellen married Robert H. Richards in June 1875 who was the chairman of MIT's Mining Engineering Department and with his support, Ellen continued to work at MIT

Pioneer of Sanitation Engineering

Ellen S. Richards, best known for her pioneering work in sanitation engineering was also the first professional female chemist. In 1890, her extensive research led to the pathway of establishing the first quality standards of her nation after she analyzed more than 40,000 samples of sewage water.

Ellen Swallow Richards was the first female to be elected by the American Institute of Mining and Metallurgic Engineers. She improved a lot of methods and contributed to several disciplines like wastewater, sanitation, plumbing, nutrition, and even ventilation in industrial spaces through her work in the labs and her research.

In 1875, she gained funds to establish a women's laboratory at MIT. She published an article titled, "The Chemistry of Cooking and Cleaning" in 1881 followed by several articles. Ellen was appointed as a sanitary chemist instructor at MIT and held the position till her death.

In 1890, she launched a kitchen that offered food at a low cost that was scientifically prepared and offered public demonstrations. Even though this kitchen failed, various similar kitchens were launched nationwide, the most famous being the Rumford Kitchen and school lunch programs were accepted all across the country.

Ellen wrote several books and articles in her lifetime and, in

1899 Melvil Dewey organized meetings in Lake Placid that laid the foundation of home economics. She also funded and helped in the launch of the Journal of Home Economics.

In the last decade before her death, Ellen wrote many scientific papers and published 10 books. In 1910, she was appointed at the National Education Association where she supervised the teaching methodology being taught to students of home economics. In the same year, she received an honorary degree of PhD.

Ellen was very ambitious and active that she even presented a paper on the cost of living 4 days before her death. Ellen Swallow Richards passed away on March 30, 1911, after suffering from angina. She is buried in her family cemetery in Maine.

[6-8]

About Author:

Ayerah Asim is pursuing her Master's in Environmental Sciences at Forman Christian College University. In her continuing research, she is working on membrane bioreactors.

Rachel Carson was a 'born ecologist' a talented writer and a scientist. Rachel Louise Carson was born on May 27, 1907, in Springdale, Pennsylvania. She aspired to be a writer from an early age. She studied English major at Pennsylvania College, but destiny led her to change her major to Biology. Her main area of research remained marine biology while studying at the Woods Hole Marine Biological Laboratory. After graduation in 1929, she went on to study MA at Johns Hopkins University and completed her degree in 1932.

Her breakthrough in scientific writing came about at the time when she was hired as a scientist and editor by the United States Bureau of Fisheries in 1936 which later was called the US Fish and Wildlife service. She was promoted to the position of Editor-in-Chief because of her commendable work. She won this role based on her distinction in biology research and writing; she had a fifteen-year-long career with this federal service writing radio scripts and editing feature articles. One of her prominent programs on marine life was known as 'Romance Under the Waters' a series of seven-minute radio programs. Being a conservationist at heart, she always urged through her writing to regulate the force of destruction and focused primarily on the welfare of fish and the fishermen alike. Baltimore Sun and its syndicated papers regularly published her articles.

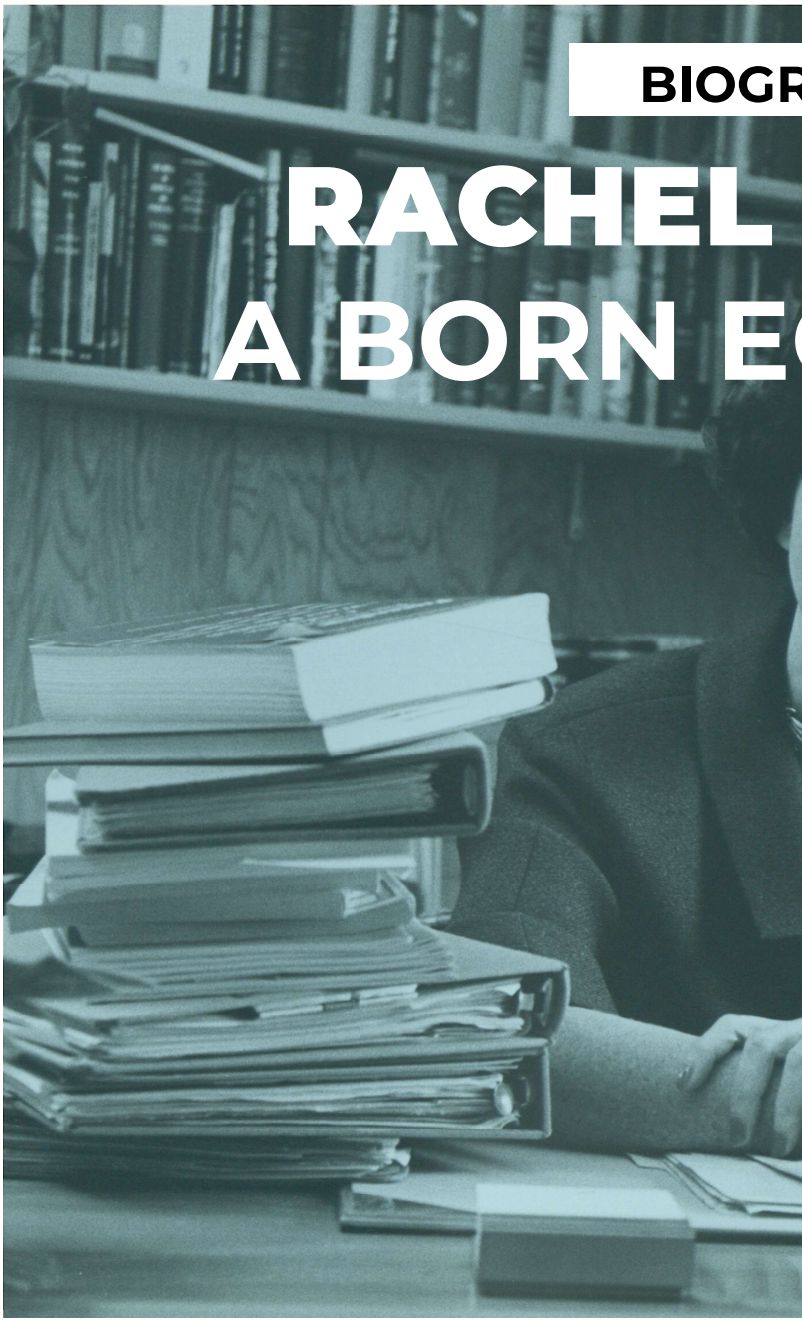
"It is a curious situation that the sea, from which life first arose should now be threatened by the activities of one form of that life. But the sea, though changed in a sinister way, will continue to exist; the threat is rather to life itself."

She wrote an article named 'Undersea' in 1937 for the Atlantic Monthly based on government research which was then turned into a book 'Under the Sea-Wind' in 1941. This book was widely praised because it reflected the experience and hard work of a scientist and its precise transformation through concise words into lyrical pose style writing. Carson continued working for the US Fish and Wildlife Service where she authored various bulletins like 'Conservation in Action' which was devoted to forming a layman's perspective about exploring wildlife and ecology. Another series, 'Food from the Sea' was about the benefits of fish and shellfish in our diet. In 1951, she wrote a book titled The Sea Around Us' which became a national bestseller and even won a National Book Award. This book was translated into 32 different languages. 'The Edge of the Sea' was her third book which was published in 1955.

She wrote state of the art articles

"The more clearly attention on the won the universe about us, have for

– Rachel



we can focus our
ders and realities of
the less taste we shall
destruction.
l Carson

which inspired people to make them appreciate the beauty and wonders of the living world. A few of her books highlighting her vision of nature are 'Help Your Child to Wonder' and 'Our Ever-Changing Shore' published in 1956 and 1957 respectively. Her mantra in these books was to emphasize the reality that humans are a part of nature and what gives them power is their ability to alter nature. [9, 10]

After World War II, there was a massive increase in the use of synthetic chemical pesticides such as DDT (Dichloro-Diphenyl-Trichloroethane). Carson took notice of it and wanted to warn the public about the harmful effects of such chemical pesticides. Therefore, she wrote her book 'Silent Spring' in 1962 to make people realize the impact of their activities on the planetary ecosystems and warn them about the consequences of using harmful chemical pesticides. She received many lawsuit threats from the chemical industry, but she stood to her word. In 1963, she testifies before Congress and made a call for new policies designed to protect nature and human health. Silent Spring was a wake-up call for the Americans to think about the environment and it led to the start of the contemporary environmental movement. She wrote in Silent Spring. [11-13]

"Those who contemplate the beauty of the earth find reserves of strength that will endure as long as life lasts. There is something infinitely healing in the repeated refrains of nature-the assurance that dawn comes after night, and spring after winter. In nature, nothing exists alone."

Two years since her last publication and after a long and tiring battle against breast cancer, Rachel Carson bid farewell to the world on April 14, 1964, at the age of 57. To pay tribute to her work and to honour her memory the Fish and Wildlife Service in 1969, name one of their refugees after Carson as the Rachel Carson National Wildlife Refuge. In 1980, after her death, she was awarded the Presidential Medal of Freedom. In the end, I would like to quote her insightful words about life. She once beautifully said,

'Those who dwell among the beauties and mysteries of the earth are never alone or weary of life.'

About Author:

Nimra Fayyaz is a student of Environmental Sciences at Forman Christian College Lahore. She serves as head of the marketing team at Earthly Perspective Magazine.

BIOGRAPHY

RUTH MYRTLE PATRICK: A NATURE LOVER

"If you'll be a good girl, I'll let you sit on my knee and look through my microscope."

– Ruth's father

The world of microscopes took Ruth to another dimension. She found a world of utter fascination whenever she observed through the ocular lens of the microscope. It was a very proud moment for Ruth when she received her very first microscope. Imagine, a girl getting her first microscope at the age of 7. Such an amazing feeling!!!! Ruth Myrtle Patrick, born on 26th November 1907, in the city of Topeka, Kansas, was a pioneer in **Limnology**. She owed all her success to her father, Frank Patrick, who was a banker and a lawyer by profession, but he was the one who ignited Ruth's interest in naturalistic learnings. This is the reason why even after marrying twice, Ruth always kept her maiden name in her student and professional life.

During her childhood, Ruth's father took Ruth and her sister for walks on Sunday afternoons, where they spent time together observing nature and collecting fascinating materials from woods and streams.

As she grew into a beautiful young lady, her interest in science grew

even more. She started Coker College at the age of 19 in South Carolina. Her summers, during her college years, were spent at ***Cold Spring Harbour Laboratory and Woods Hole Oceanographic Institution***. While, in graduate school, she met Charles Hodge IV, the man she wanted to spend all her life with.

In 1931, she completed her master's degree from the University of Virginia. ***"A Study of the Diatoms of Charlottesville and Vicinity"*** was her thesis title in post-graduation. She further pursued her education in the field of science, specifically Diatoms, and received her doctoral degree in 1934. Her dissertation title in PhD was "***A Taxonomic and Distributional Study of Some Diatoms from Siam and the Federated Malay States".***

As she received her doctorate, she, along with her husband, moved to Philadelphia. In Philadelphia, she started teaching at the Pennsylvania School of Horticulture. In 1933, she volunteered at the Academy of Natural Sciences of Philadelphia, because she got attracted by their diatom collection. In 1937, she became the curator of the ***Leidy Microscopical Collection at the Academy***. In 1947, she founded the Department of Limnology. Later, in 1983, the name of it changed to Patrick Centre for Environmental Research, in her honour.

Ruth spent the summers and autumns of the year 1948 near the streams draining the Conestoga River and studied the relationship of the diatom composition of the stream with the health of the stream. Her study concluded that as pollution increases, biodiversity decreased. This conclusion has been named the **"Patrick Principle"**, by Dr Thomas Lovejoy, and this principle has become the foundation of many environmental assessments being done in the present day.

Thomas Lovejoy, a pioneering conservation scientist, invented the term "biological variety" (1980). He is the founder and president of the Amazon Biodiversity Center, a non-profit organisation, as well as the well-known Biological Dynamics of Forest Fragments Project.

One of their major invention of Ruth was the 'Diatommeter', which she used on different river surveys all around the United States. She was called for help from various industrialists and government agencies to carry out river assessments. Before the Savanna River Nuclear Power Plant was established, Ruth, along with her team, assessed the Savanah River. In 1979, she assessed the radionuclide contamination of the Susquehanna River due to the Three Mile Island accident. According to Ruth, she has studied almost 800 to 900 rivers and streams all over the world.

In the 1970s, she worked as an assistant professor at the University of Pennsylvania. She taught various courses, including limnology, psychology, and pollution biology. She was loved

and respected by all her students, and she became a role model for women, especially those who wanted to pursue careers in the field of science. This led to her winning many awards and laurels.

Ruth had written several books and more than 200 scientific manuscripts. Her famous works included:

The Diatoms of the United States, Rivers of the United States, and Groundwater contamination.

Twenty-five honour doctorate degrees were awarded to her. She won numerous awards and honours, such as the John and Alice Tyler Ecology award in 1975, a gold medal from the Royal Zoological Society of Antwerp in 1978, and the National Medal of Science from President Clinton in 1996.

Recently, the American Society of Limnology and Oceanography celebrated ***"The River Continuum"***, written by Ruth and her fellow researchers, as one of the most cited papers in the field of stream ecology. This multidisciplinary paper-covered watershed science, microbial ecology, hydrology, chemistry, entomology, fish, algal community structure, and computer modelling. Ruth is also the founding member of the Benedict Estuarine Laboratory, Maryland, which today is known as the Patuxent Environmental and Aquatic Research Laboratory.

Ruth had a very consistent relationship with the politics of the country as well. President Johnson took her advice on water pollution and President Reagan took her advice on acid rain pollution. Many governors of Pennsylvania referred to her on the issues of water quality. She was one of the members who developed the Clean Water Act, and she also worked on anti-pollution legislation along with Congress. At both, Federal and State levels, she served as an advisor. She also served as the board member of WWF, Pennsylvania Power and Light Company, and several other organizations.

Ruth had a very welcoming personality. The doors of her home were always opened for her friends and colleagues. After discussing ongoing research, she used to make dinner for everyone who was invited, including many famous scientists such as Robert May, Luna Leopard, George Woodwell, and many more. Her home was a place where intellectual conversations along with great laughter and good food used to take place. Ruth was a bundle of joy, a package full of positive energy, curiousness, dedication, and above all intelligence. Her first husband said, 'marrying Ruth was like being married to the tail of a comet'. She was a very hardworking woman and a very dedicated environmental scientist. She was always working, and it was very difficult for her to take out time for other activities from her busy schedule. Whether it was 8 in the morning or it was 8 in the evening, you could call her anytime for work-related discussions. Instead of blood, the purpose to achieve something big ran in her veins. Her commitment and dedication to work were commendable.

After the death of her first husband in 1985, ten years later, she married Lewis H.VanDusen who was an attorney in Philadelphia. Her second husband died in 2004. She was left with a son, Charles Hodge V, three stepchildren, and three grandchildren. On 23rd September 2013, Ruth left for her eternal voyage at the age of 105.

It'll be safe to say that she lived her life the way she wanted to. Her only aim in life was to leave the world a better place for future generations. She truly enjoyed sharing her knowledge and her experiences with anyone who wanted to learn. She helped to solve world environmental problems and taught people to appreciate nature. She was truly an icon in the world of environmental science.

About Author:

Farah Khalid is a student of environmental sciences at Forman Christian College Lahore, Pakistan

ENGINEERING

AERO ENGINE CRAFT/ CONTRAIL-FREE AERO-ENGINES

A REVOLUTION IN THE AVIATION INDUSTRY

About Author:

This article has been written and condensed by Dr. Sarah Qureshi and Farah Khalid. It has been edited by Engr. Rabia Nusrat & Mansoor Ahmad.

The world is shifting to electric cars to reduce the impact of climate change but no one is talking about the impacts the aviation industry is having on the environment. In such times, Dr. Sarah steps up and finds a way not only to mitigate the impact of water vapors which are the most abundant greenhouse gas caused by the aircraft engines but also produce artificial rain by inventing a unique device that can remove contrails during the operation of aero-engines.

Dr. Sarah Qureshi is the founder and CEO of Islamabad based research and development company named "Aero Engine Craft Pvt. Ltd". Sarah completed her undergraduate from NUST college of engineering and then joined Cranfield University UK. Sarah assisted the inventor with patenting the contrail-free aero-engine during her Ph.D. research. The invention has been granted two international patents and has tremendous potential in bringing about an environmental revolution in the context of aviation. After completing her Ph.D. in jet propulsion systems, she founded her startup and is now working day and night to bring a revolution in the aviation industry.

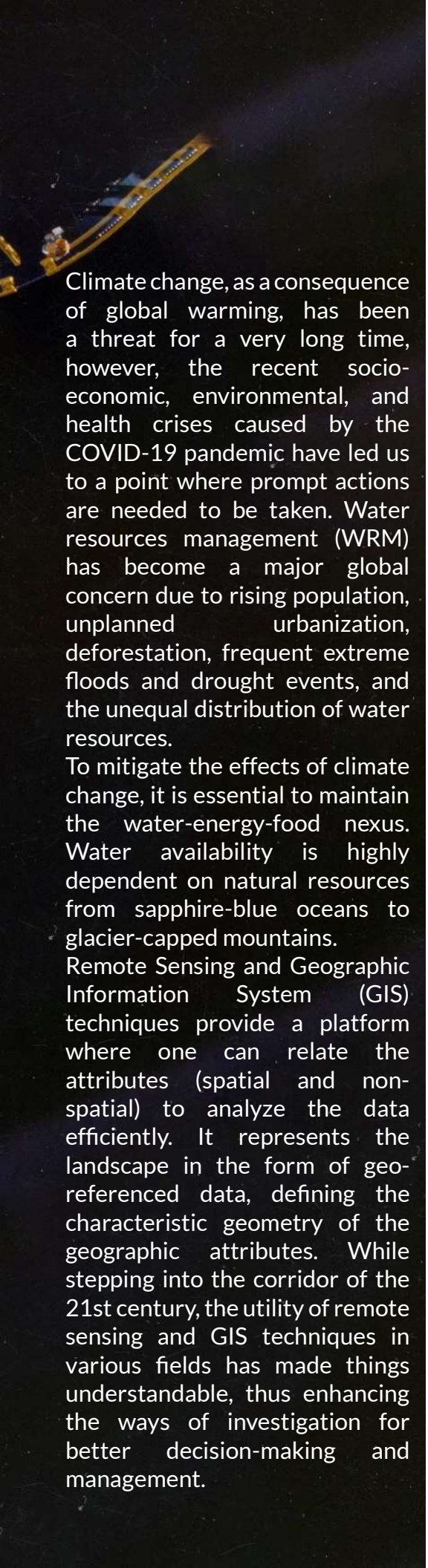
She has invented multiple technologies at Aero Engine Craft Pvt. Ltd that includes a QE6 twin-cylinder transfer piston engine that can be used in small-scale vehicles from loader vehicles to mini-buses. Along with Mr. Masood Latif Qureshi, she has also developed the test rigs and rotary engines. Above all these achievements comes her distinction, that is the invention of contrail-free aircraft engines. These engines can create artificial rain and reduce the bad impacts of aircraft engine emissions. The emissions of an aircraft contain water in vapor form, and it forms the contrails that are visible from the ground. These contrails not only wastewater but also take part in climate change and global warming. The device Dr. Sarah proposed can store the water vapors from emissions (making the engine contrail-free) and then release them in the lower atmosphere in the form of artificial rain. This is an absolute marvel of engineering, and she believes that it has great business potential too.

Her work has been featured at multiple national and international forums. She has been included in the top 100 professionals in aerospace & aviation to follow on LinkedIn in 2021, she is also working as an ambassador for Solar Impulse for its program of finding 1000 green solutions, her work has been featured in Dubai Expo 2020 in Pakistan pavilion and she is also working as a visiting fellow at Cranfield University.

Apart from her endeavors in aviation & aerospace, she is very active in supporting, guiding, and mentoring the youth in their startups and innovation endeavors. She recently participated in the National Idea Bank Competition as a mentor and a judge.

ENGINEERING

REMOTE SENSING AND GIS FOR WATER RESOURCE MANAGEMENT



Climate change, as a consequence of global warming, has been a threat for a very long time, however, the recent socio-economic, environmental, and health crises caused by the COVID-19 pandemic have led us to a point where prompt actions are needed to be taken. Water resources management (WRM) has become a major global concern due to rising population, unplanned urbanization, deforestation, frequent extreme floods and drought events, and the unequal distribution of water resources.

To mitigate the effects of climate change, it is essential to maintain the water-energy-food nexus. Water availability is highly dependent on natural resources from sapphire-blue oceans to glacier-capped mountains.

Remote Sensing and Geographic Information System (GIS) techniques provide a platform where one can relate the attributes (spatial and non-spatial) to analyze the data efficiently. It represents the landscape in the form of geo-referenced data, defining the characteristic geometry of the geographic attributes. While stepping into the corridor of the 21st century, the utility of remote sensing and GIS techniques in various fields has made things understandable, thus enhancing the ways of investigation for better decision-making and management.

For a long time, extrapolation of data of hydrological processes was performed manually; which included hydrographs and other manual hydrological charts. Technological advancements have made people adopt and maintain new soft structures. Now, the modelers can simulate the river runoff and its pattern around the globe with the help of GIS data structures using a "spatial hydrological model".

Integrating Satellite Remote Sensing and GIS with hydro-climatology provides an appropriate tool for managing large and complex databases and provides a digital depiction of catchment features for the modeling approach. It is a supportive tool to attain higher accuracy from hydrological models, thus giving reliable outcomes for betterment.

Many researchers and scientists have assessed the capabilities of satellite-based products, such as Global Climate Models or Regional Climate Models. These datasets include weather parameters like precipitation, temperature, wind speed, and humidity at a coarse to fine spatiotemporal resolution compared to gauge observations on both, pixel, and basin scales globally.

The main element of the terrestrial hydrological cycle is the generation of river discharge and the movement of water, which flows in the river channels. The prime zone that hosts this process is the river catchment, watershed, or basin. The hydrological response of watersheds to precipitation events depends on the mechanisms of runoff generation.

As the climate and land-use change, the movement of water (on the surface & underground) is also affected. It also increases the risks of extreme events like flash floods. In such hydrological zones, various spatial differences in vegetation, topography, soil properties, geology, land use/land cover, and meteorological conditions are observed and can be well understood even on a small scale.

Thus, the heterogeneity in land cover and land use surface may be affected and strengthened by anthropogenic activities that can have an impact on the characteristics of natural landscapes. Therefore, it is important not only to consider the prime processes occurring, but also the terrestrial ones capturing the relevant factors that govern the runoff generation scenarios, and providing a chance to represent the land surface heterogeneity to describe the hydrological cycle.

Pakistan comes in the Hindukush Karakoram Himalaya (HKH) region.The region is well known as the "Water Tower of Asia", and the "Third Pole", as it hosts snow and glacier-capped peaks. Pakistan is a developing country that has been affected by climate change. According to Germanwatch, a German think-tank advocating for the prevention of climate change impacts has ranked Pakistan as the seventh nation most affected by events related to climate change (Climate Risk Index 2018 report). Hence, the use of data and integration technologies to increase precision in the prediction of events can help us plan to manage the problem beforehand.

[14-16]

SCIENCE

SMOG: CAUSES, FORMATION, EFFECTS AND PREVENTIONS

In recent days, photochemical smog is a serious problem, especially in urban areas. The terminology refers to a mixture of hazardous gaseous emissions and fog. It is usually seen as yellowish or blackish fog, which suspends in the atmosphere or forms a ceiling in the air due to inversion. It happens when fume, emissions, and particulates (nitrogen and sulfur oxides and volatile organic compounds) react in the presence of sunlight to form ground-level ozone. The emissions of harmful gases from vehicles and industries, as well as the combustion of wood and coal – together with the buildup of certain weather conditions, are the main causal agents of smog.

The gaseous emissions such as carbon monoxide from vehicles are the main elements that form smog, when acted upon by the sun's ultraviolet light, together with particulate matter and volatile organic compounds. Dense urban areas suffer more from the smog because of huge traffic, industries, and the combustion of different types of fuel. Smog has serious damaging effects on people, plants, and animals. Below are a few causes, effects, and solutions to mitigate photochemical smog.

Smog is a type of air pollutant. The word "smog" was coined in the early 20th century as a portmanteau of the words smoke and fog, to refer to smoky fog, its opacity, and odor. This kind of visible air pollution is composed of nitrogen oxides, sulfur oxides, ozone, smoke, or

particulates among others (less visible pollutants include carbon monoxide, CFCs, and radioactive sources). Human-made smog is derived from coal emissions, vehicular emissions, industrial emissions, forest and agricultural fires, and photochemical reactions of these emissions.

Smog-forming pollutants from numerous point and non-point sources such as factories, consumer products, or vehicles are the typical causative factors of photochemical smog. In most urban areas, more than 50% of smog is formed as a consequence of vehicular emissions. Mostly, the occurrences of smog are associated with the relationship between weather patterns and heavy motor vehicle traffic, industrial and other consumer product emissions. Consumer products include solvents, paints, plastic packaging, and sprays.

Smog is of two types: photochemical smog – commonly formed in urban areas and originates from elevated levels of hydrocarbon burning and nitrogen oxides in the presence of sunlight, and sulfur smog – formed when there is an increased level of sulfur oxides in the atmosphere.
Smog-forming pollutants from numerous sources such as factories, consumer products, or vehicles are the typical causative factors of photochemical smog. In most urban areas, more than 50% of smog is formed as a consequence of vehicular emissions. Mostly, the occurrences of smog are associated with the relationship between weather patterns and heavy motor vehicle traffic, industrial and other consumer product emissions. Consumer products include solvents, paints, plastic packaging, and sprays.

The use of coal as fuel in heating, or power production plants, discharges high concentrations of sulfur oxides into the atmosphere. The effects are worsened by high levels of suspended particulate matter and dampness in the air. For instance, coal-induced smog has been widely experienced in London up to the Middle Ages of the 20th century, which is termed “London Smog”. In China, Harbin, coal-induced smog contributed to the closure of roads, schools, and airports in the autumn of 2013.
The emission of harmful gases like carbon monoxide (CO), from fuel combustion in automobiles, are the chief contributors to smog formation. Industries equally emit scores of gaseous emissions and fumes which leads to smog

formation.

The primary precursors are oxides of nitrogen, volatile organic compounds, carbon monoxide, fumes, and sulfur oxides. These compounds react with moisture, heat, sunlight, and ammonia among other compounds, to form the toxic vapors, suspended particulates, and ground-level ozone, that make up smog.

Photochemical smog can also be a consequence of natural causes, for instance: volcanic eruptions. Volcanic eruption discharges high concentrations of sulfur dioxide and particulate matter in the air – the two primary constituents for smog formation. Radiocarbon amounts of some specific plant lives are believed to cause smog in a few locations. For instance, the Los Angeles creosote bush is linked to smog occurrences in the area.

Smog is harmful to humans, animals, plants, and nature as a whole. Many people's deaths were recorded, notably, those relating to bronchial infections. Heavy smog also blocks the sunlight from reaching the earth. This unavailability of sunlight causes vitamin D deficiency, leading to issues like rickets. When a city or town gets covered in smog, the effects are felt immediately. Smog can be responsible for any ailment, from minor pains to deadly pulmonary diseases such as lung cancer. Smog is well known for irritating the eye. It may also result in inflammation in the tissues of the lungs, giving rise to pain in the chest. Other issues or illnesses such as colds and pneumonia can also be caused by smog. The human body faces great difficulty in defending itself against the harmful effects of smog.

Minor exposure to smog can lead to greater threats of asthma attacks; people suffering from asthma problems must avoid exposure. Smog also causes premature deaths and affects densely populated areas, where it builds up to dangerous levels. The highly affected include the elderly, kids, and those with cardiac and respiratory complications.

The ground-level ozone present in the smog also inhibits plant growth and causes immense damage to plants. Crops, vegetables like soybeans, wheat, tomatoes, peanuts, and cotton, are subject to infection when they are exposed to smog. The smog results in mortifying impacts on the environment by killing innumerable animal species and green life, and it takes time to adapt to breathing and surviving in such toxic environments.

Smog is an emerging problem, especially due to the fast modernization or industrialization, as the hazardous chemicals involved in smog formation are highly reactive to the elements present in the atmosphere. Smoke and sulfur dioxide pollution in urban areas is now at considerably lower levels than in the past, as a result of the law passed to control emissions, and due to cleaner emission technology.

- Vehicle Exhaust Fumes
- Fossil Fuel-Based Power Plants
- Exhaust from Industrial Plants and Factories
- Construction and Agricultural Activities
- Natural Causes
- Household Activities

Possible solutions to mitigate and control smog

- Drive less. Walk, ride a bike, and use public transportation whenever possible.
- Take care of cars. Getting regular tune-ups, changing the oil on schedule, and inflating tires to the proper level, can improve gas mileage and reduce emissions.
- Fueling up vehicles during the cooler hours of the day— at night or early in the morning. This prevents gas fumes from heating up and producing ozone.
- Avoid products that release high levels of Volatile Organic Compounds (VOCs). For example, use low-VOC paints.
- Avoid gas-powered yard equipment, like lawnmowers. Use electric appliances instead.
- Better to develop some ecofriendly, green, cheap, and renewable energy sources exploiting sunlight and water through photochemical, photo-electrochemical, and electrochemical water splitting.
-

Strategies other countries are adopting to control the smog problem

PARIS

Paris bans cars in many historic central districts on weekends, imposes odd-even bans on vehicles, makes public transport free during major pollution events, and encourages car-and bike-sharing programs. A long section of the right bank of the River Seine is now car-free, and a monthly ban on cars has come into force along the Champs-Elysées.

DELHI

Reports that pollution levels in Delhi matched those in Beijing spurred the city to ban all new large diesel cars and SUVs with engines of more than 2,000CC and to phase out tens of thousands of diesel taxis. The city has experimented with alternately banning cars with odd and even number plates and is now encouraging Uber-style minibusses on demand. Other cities considering diesel bans are Dublin and Brussels.

THE NETHERLANDS

Politicians want to ban the sale of all petrol and diesel cars from 2025, allowing only electric or hydrogen vehicles. The proposed law would allow anyone who already owns a petrol or diesel car to continue using it. Most cities encourage bicycle use.

FREIBURG

Freiburg in Germany has 500km of bike routes, tramways, and a cheap and efficient public transport system. One suburb, Vauban, forbids people to park near their homes and makes car-owners pay €18,000 for a space on the edge of town. In return for living without a car, people are offered cheaper housing, free public transport, and plentiful bicycle spaces.

Conclusively, SOx, COx, and NOx released from the burning of fuels in automobiles and power generation houses are major causes of air pollution. The scientific community is paying heed to the development of eco-friendly energy sources which can fulfill the energy needs and combat air pollution to make the world a better place to live and thrive!

TECHNOLOGY

ELECTRIC VEHICLES: A STEP TO BETTER FUTURE

According to Pierre Kochel, 35% of cars all around the globe would be running on electricity by the end of the year 2040. It has become really important to know whether the climate of the world would be affected positively or negatively by the increase in the number of electric vehicles.

Firstly, we need to know the type of electric vehicles that exist. There are mainly three types of electric vehicles, which are:

- Hybrid Electric Vehicles
- Plug-In Hybrid Electric Vehicles
- All-Electric Vehicles

The following figure shows the types of electric vehicles in comparison to conventional fuel-based vehicles. The advantages and the disadvantages are also mentioned in the figure

One of the long-term temperature goals of the Paris Agreement is to not let the average global temperatures rise above 1.5 – 2 degrees Celsius (Paris Agreement, 2016). Electric vehicles play an important role in it as they do not emit greenhouse gases which are responsible for global warming. So, out of the many reasons, the most important and convincing reason for the progress of electric vehicles is their ability to possibly decrease the amount of global greenhouse gas emissions in comparison to the fuel-based conventional vehicles. Another reason which could contribute to the growth of electric cars will be the production of less costly yet higher energy density batteries, which could boost the electric system of the cars. If we only look at the positive aspects of electric vehicles, we could say that the

About Author:

Farah Khalid is an Environmental Scientist who recently completed her post-graduate studies at Forman Christian College (A Chartered University). She made a significant new contribution to the field of wastewater treatment by stepping into the world of bacterial communication on membrane surfaces.

global climate will be much better, but we cannot run away from reality.

Even though electric cars do not directly emit greenhouse gases, since they run on electricity, we need to make sure what exactly is the source of electricity. In many parts of the world, electricity is still being produced via fossil fuels such as coal. The following figure shows how much each source generated electricity annually [See Figure 2]. The figure indicates that the major source of electricity is coal. More than 8000 Tera Watt-hour (TWh) of electricity is being produced by fossil fuels per year.

As per the graph, it can be seen that the use of coal for electricity production reached its zenith in 2014. It has then started to decrease because some countries have started focusing on the use of environmentally friendly energy sources, which do not emit or emit comparatively fewer greenhouse gases.

Moreover, there are some production companies of electric cars such as 'Nissan', which are going with the slogan of 'Zero Emission Vehicle' for one of their car models. By this slogan, they are giving us an impression that no greenhouse gases emanate from this model of the car. But the question which arises here is whether the factories or the production houses where these electric vehicles are being produced, how environmentally friendly are they. There have been many studies conducted regarding this, but no conclusion has yet been made.

The website 'Carbon Brief – Clear on Climate' talks about the impacts of electric cars on the climate. According to the website, in comparison to non-electric vehicles, electric vehicles emanate fewer emissions over their life period. On the other hand, in countries where coal is used as the main fuel, the electric vehicles are of not much importance, and they may cause a similar number of emissions as fuel-based cars. There is some ambiguity attached to the production of batteries that are used in electric vehicles. With the decrease in the prices of batteries, the companies would start using larger batteries which will give greater mileage. They could harm the environment, because they have significant impacts during their disposal stage since they contain metals such as lithium, lead, nickel, etc.

Also, it is quite difficult to draw a comparison between electric cars and fuel-based one. The following factors should be taken into consideration while comparing the two:

- Vehicle's size
- Accurate measurements of fuel economy
- Way of calculating emissions.
- Driving patterns
- Weather
-

To conclude, I think we should look at both sides of the coin. Electric vehicles should be promoted, and their growth should be accelerated in those countries in which renewable sources of energy are being used, and not fossil fuels. If everyone in those countries begins to drive electric cars, it could be beneficial for the climate. Whereas, in countries like Pakistan in which electricity is not even enough for daily purposes, the use of electric cars should not be encouraged. In my opinion, even if everybody starts to drive an electric car, it will not lead to a better global climate, because the emissions caused during the production of electricity would cancel out the positive effect of the electric vehicles.

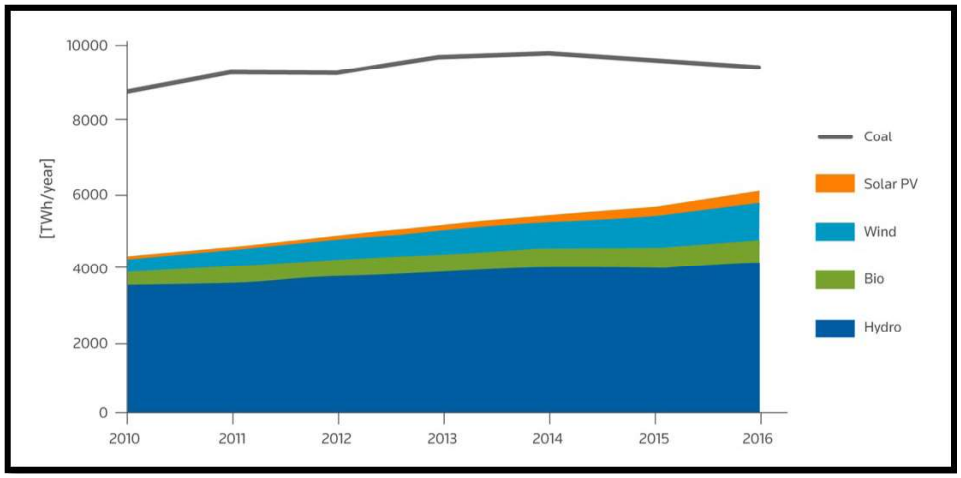
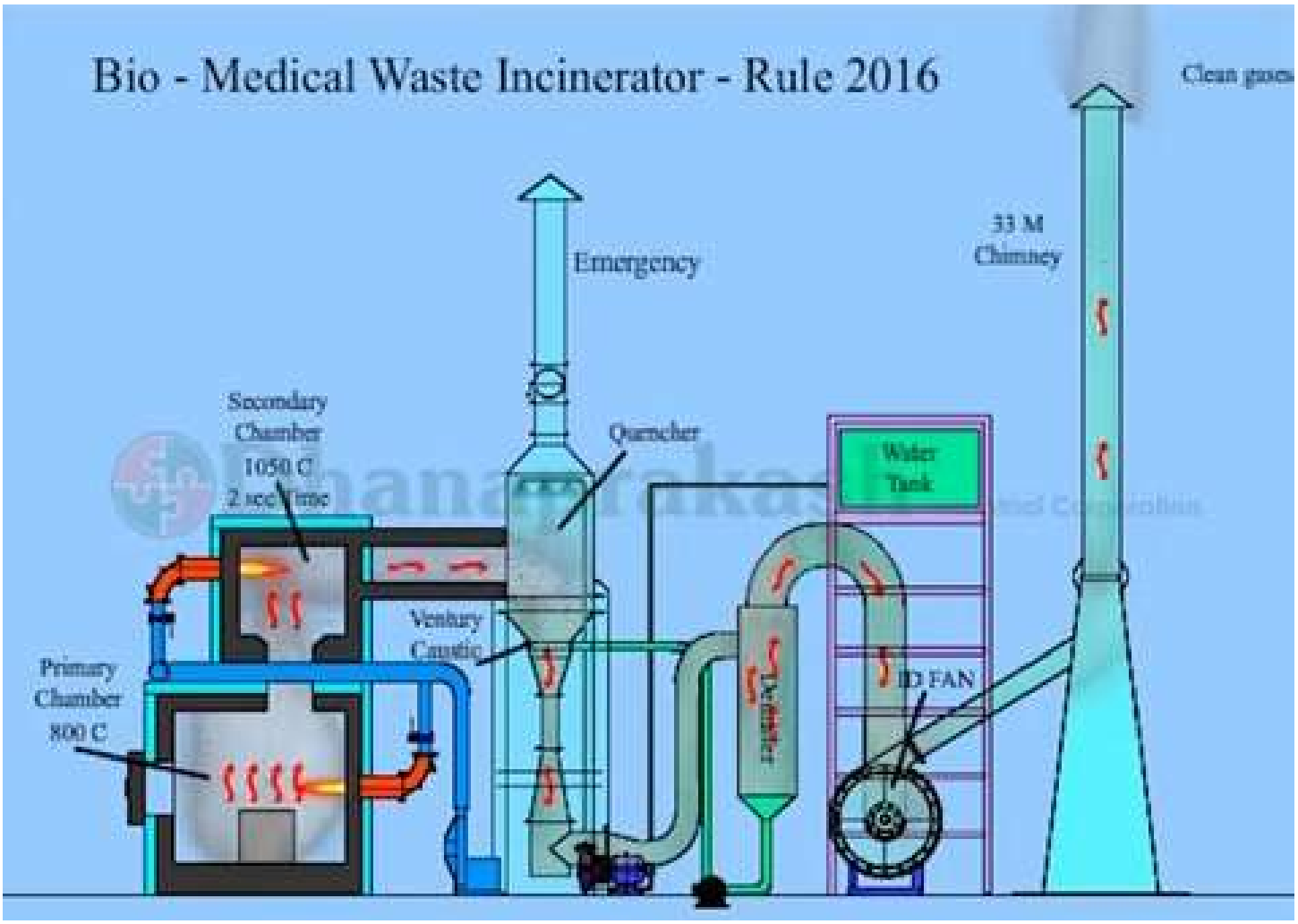


Figure: Electricity generation by each source in TWh/year, Source: IEA, World Energy Outlook, published 2011-2017.

ENGINEERING

ENVIRONMENTAL IMPACTS OF INCINERATION OF HOSPITAL WASTE



In many underdeveloped countries, incineration of harmful waste is a general method of hospital waste management. Although it has the advantage of killing microorganisms and decreasing unwanted material by burning them, however, it harms the environment as burning causes the release of harmful toxins in the environment.

Burning of hospital waste generates persistent organic pollutants (pollute air), dioxins, polycyclic aromatic hydrocarbons (PAHs) and much of other harmful compounds which are carcinogenic in nature. Hospital waste incineration is famous for its bad impacts on the environment as it does not completely deteriorate the litter, but it gives out heavy metals as ash. Thirteen of the investigated plants were built between 1994 and 1997 in Poland, in which polychlorinated dibenzodioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) were present as ash bottom due to the burning of waste of the hospitals, and eight of them shown low PCDDs/Fs concentration in stack gases, below 0.1 ng-TEQ/m3n .

Heavy metal ions for example, chromium, lead zinc, mercury, arsenic, and many others and organic compounds e.g., dioxins, benzene, PCBs are precarious, if these are not destroyed properly, they can severely pollute the environment and can consequently cause chronic diseases like acute respiratory syndromes, gastrointestinal abnormalities, and other carcinogenic and death-dealing diseases. Therefore, it is

mandatory to disclose some facile and technological approaches to replace existing methods.

In this pursuit, developed countries, i.e., United States, Germany, Netherlands have started other techniques like using autoclave, microwave, and recycling methods instead of incineration to avoid the bad effects of burning on human health and their surrounding environment. However, these sophisticated methods cannot be employed on a commercial scale in underdeveloped countries. Because many hospitals in developing countries have financial issues and they cannot use high-cost methods to dispose of their waste. Autoclaving methods, microwave disinfection, superheated steams are few methods which must be used for the waste management in healthcare centres and hospitals instead of incineration to avoid its deleterious impacts on environment. Steam sterilization (autoclaving) is the most widely used method for sterilization and is considered the most robust and cost-effective method for sterilization of medical devices. The effectiveness of steam sterilization can be measured using biological indicators. Microwave based disinfection system which suits for this purpose, not only ensures complete disinfection of waste but is also a cost-effective, resource efficient and environment friendly method. The efficacy of an on-site superheated water and steam macerating system evaluated for its ability to process infectious and perceived hospital and laboratory waste into municipal waste as a source for fuel or recycling at a lower cost than traditional medical waste handling systems in super heating technique in which waste of hospital is soaked with water at the temperature of 275 degree.

Polychlorinated dibenzo-p-dioxins and dibenzofurans (PCDD/F) are released in air because of hospital waste burning in incinerators. For last two decades, incinerations are being studied with much concern and they have attracted the attention of scientist's Clinical solid waste is a major issue in developing countries and its management is very much important to avoid diseases caused by environmental pollution. The study was done at a hospital in Ghana with a capacity of 2000 beds. The average waste was 0·5 and 2·0 kg/bed/day which produced 0.33 million tons of clinical litter every week. The hospital uses an in-built drier that dries waste very fast and a chamber that burns the whole waste in a minimum time of 3 hours. In Nigeria, medical waste gets no special attention and care which it must get, these wastes are still mixed with household wastes and then disposed of .

In hospital we found non-hazardous as well as hazardous waste 75-90 % generated waste is hazardous, 10-25% of hospital waste is hazardous. Non-hazardous waste consists of food scarps, peels of fruits, paper material etc. It is also called as non-risk waste. Hazardous waste contains sharp waste (hypodermic needles etc), Chemical waste (reagents, solvents etc), Pathological waste (human organs, tissues etc), and Infectious waste (e.g., blood and body fluids).

There are different sources of health care and therapeutic wastes like dispensary, outpatient departments, dialyzes center, blood banks, ICU, etc. Health care waste (therapeutic wastes) is a by-product of health care that includes sharps, non-sharp blood contaminated items, blood, body parts and tissues, chemicals, pharmaceuticals, and radioactive materials. Laboratory and other researching departments are also sources of therapeutic wastes. Treatment and dumping of therapeutic waste decrease danger and threats, fitness threats which are caused by emission of hazardous contaminants into our surrounding environment by these treating or disposing processes.

There are some objectives of incineration.

1. To manage the hospital waste effectively and efficiently.
2. To estimate the total emission of the gases, particulate matters dioxins, other metal ions in accordance with the waste to be burnt.
3. To calculate the standard of atmospheric discharge
4. To precisely define the methods of management of health care centres wastes.

However, it is quite evident that it is not an environmentally friendly method but to have an immediate solution to the problem it is preferred mostly.

There are some ways to dispose of medical waste given below:

1: Landfills make clean water dirty if they are not constructed in the proper manners. Risks may increase if these are not designed properly and safely.

2: Incineration has been

practiced in the whole world in different countries, but it is an improper technique and unfit and inappropriate as it releases or ejects harmful pollutants in the air and make the environment unpleasant and causes many diseases when a person breath in harmful polluted air and it also releases ashes. Incinerated materials have chlorine which can produce and emits dioxins and furans, which are fatal carcinogens and cause very bad health effects even death. Heavy materials like metal ions (lead, mercury, cadmium etc) are likely used to disperse toxic metals in the surrounding areas to cause bad health of humans. Dioxins and furans are harmful. Those materials having chlorine, or the metal ions should never be burnt in an incinerator.

Occupational health and safety mostly related to caretaker and laundry workers, doorkeepers, nurses, emergency therapeutic personnel, and decline workers so they must provide with good safety measures. Injuries caused from sharps instruments and exposure to dangerous chemical litter which is also cause health deterioration to employees in those organization which producing bio-therapeutic waste. Proper management of litter and debris can solve problems.

There are some disadvantages of Incineration:

1. One of the main disadvantages of the incineration process is that it emits harmful and disease-causing pollutants directly or indirectly
2. A huge amount of dioxin and furan quantity in the atmosphere are detected after this process
3. This treatment is inappropriate for therapeutic litter.

There are some alternatives of incineration which are safe and appropriate methods used by developed countries for the management of therapeutic waste materials are:

Autoclaving: Autoclaving is a process of low heat in which steam is produced and brought directly into contact and blended with waste in an appropriate and controlled manner and for maximum duration to sterilize the therapeutic waste. The system must be in horizontal type because autoclave horizontal is low-cost options for general sterilization ideal tool for Laboratories, Hospitals, Nursing Homes, and Agricultural R&D labs etc, Pharmaceutical, Food & Beverage Industries and Institutions. Autoclave designed carefully for the analysis of medical debris for safety and easiness. Pre-vacuum system must be used and preferred in place of gravity system for better and positive outcomes. It must have tamper-proof control panel with efficient display and recording devices for critical parameters such as time, temperature, pressure, date, and batch number etc.

The heating effects of electromagnetic radiations causes microbes to become inactive; this will show a spectrum of frequencies between 300 and 300,000 MHz Microwave heating is the phenomenon of an inter-molecular heating. The waste material is heated very much in the existence of steam. This process is similar to autoclaving method the difference is that the waste is putted indirectly to heat by giving steam in the outer site. During the process, the litter is continuously collapsed in a compartment like chamber.

In conclusion we can say Incineration is the phenomenon of burning waste in a chamber at a very high temperature. This process has many drawbacks like it is not eco-friendly, as it releases harmful and dangerous matter like PM, POPs, dioxins, benzene, etc. in the air when it is burnt. Underdeveloped countries use this method to get rid of waste and to disinfect waste so germs or bacteria in it cannot harm human health. However, to avoid environmental issues, some alternative methods such as autoclaving, microwaving, super-heating techniques must be used. Human protection and well-being is of much importance so, that techniques should be used which are not harmful to human beings. Those techniques must be avoided which cause adverse effect on environment and on humans.

[17-37]

About Authors:

Mahmoona Ashraf is a student of environmental science at the University of Punjab

Muneeba Hameed is a student of environmental science at Bahauddin Zakariya University.

SpinLaunch Goes Green

"Launching rockets into space with the highest cadence and lowest environmental and economic cost sounds crazy, right?"

Spin Launch had its first test flight in late October and verified its suborbital accelerator. It uses kinetic energy as its primary method to get off the ground, with the help of a vacuum-sealed centrifuge, which spins the rocket up to 5000 mph before releasing it into space.

Imagine you could travel across the country by spending zilch on fuel. How tremendous that would be? Read the article given in the link below to know the pros and cons of electric cars and their effects on the global climate.

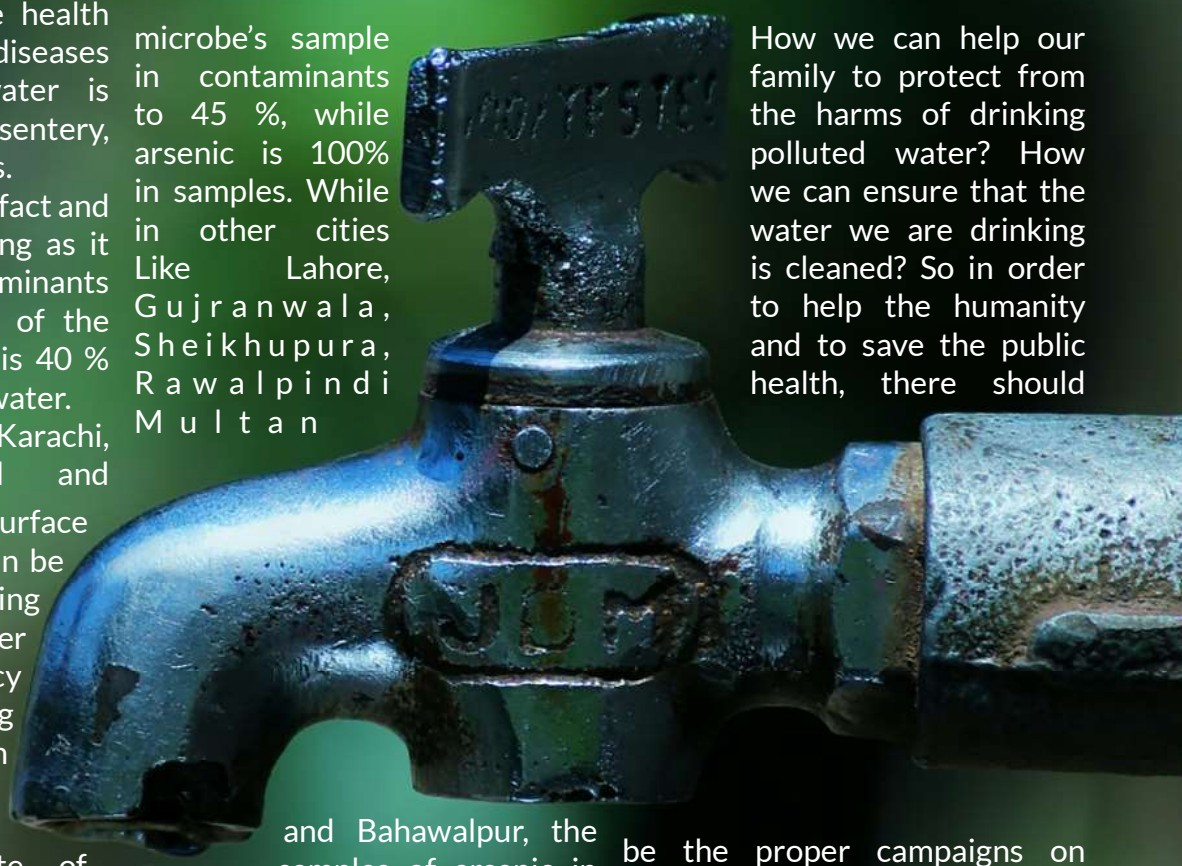
KNOW YOUR TAP WATER!!

"Water is the driving force of all nature". It is very difficult for the creatures on earth to live without it. But the water pollution is growing day by day. In Pakistan due to many reason water is being polluted and effects the health of peoples. The industrial waste such as lead and arsenic has caused a lot of the health problems. The major diseases caused by polluted water is Diarrhea, Polio, Dysentery, Hepatitis A and Giardiasis.

In the recent times, some fact and figures are very disturbing as it shows, these water contaminants are responsible of 30% of the diseases and death rate is 40 % due to drinking polluted water.

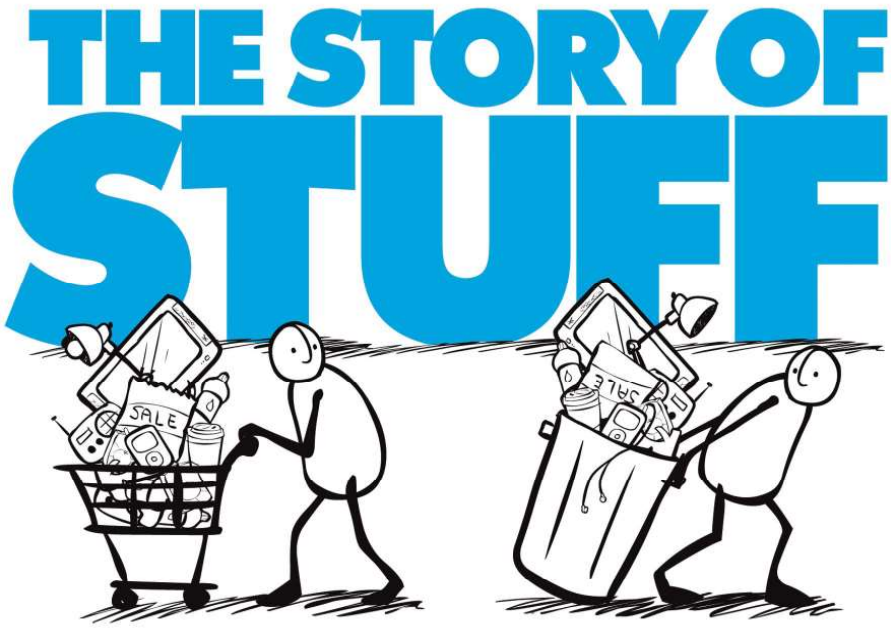
Metropolitan cities Like Karachi, Hyderabad, Islamabad and Rawalpindi are using surface water. Water quantity can be determined by measuring from which source water is coming, the efficiency of process, filtering water and chlorination of water. The major reason for the water contamination is waste of Textile and the Tanning industry i.e. improper way of disposing the waste and toxic materials. The second major reason is the imperfections in the sewage system. Due to handling these waste reluctantly, it caused the surface water polluted.

Many cities in Punjab are creating the poison like arsenic, which not only polluted the water to danger water but also effected the lives of human beings as well as animals. For example, if we consider the Kasur, a city in Punjab, Pakistan, it is most polluted region having microbe's sample in contaminants to 45 %, while arsenic is 100% in samples. While in other cities Like Lahore, Gujranwala, Sheikhupura, Rawalpindi Multan and Bahawalpur, the samples of arsenic in water reached up to unsafe level. Meanwhile, Faisalabad which is known as industrial city in Pakistan, has also inadequate water treatment facilities. There are also samples of microbiological contaminants in water. In most of the rural areas in Pakistan, about 70% of the peoples are facing polluted water problem. The cattle dung, municipal waste is the reason for this contaminations.



Now the question rises, how we can help our community in drinking safe water? How we can help our family to protect from the harms of drinking polluted water? How we can ensure that the water we are drinking is cleaned? So in order to help the humanity and to save the public health, there should be the proper campaigns on drinking clean water. The people should have to seek knowledge of disposing the waste correctly in order to save the water from contamination. There should be the proper channel that guides the people about the problem and its solution.

The higher authorities should have to collaborate with Consultants so they can provide basic knowledge to people in live sessions in order to help them in selecting the right source of drinking water.



LIFE CYCLE ASSESSMENT

Life cycle assessment is the study of the cradle-to-grave story of products. It covers the environmental and societal impact of individual processes, from the resource extraction and manufacturing of the product to its disposal. The Story of the Stuff is a project that is focused on awarding the masses about the background of the products that we use. For example, if we talk about the manufacturing of plastic bottles; we know that plastic is made up of hydrocarbons derived from crude oil, and the manufacturing itself is energy-intensive. Hence, manufacturing plastic bottles is not a sustainable option. One of the famous water bottling brands published in one of its reports that "bottled water is the most environmentally responsible consumer product in the world."

If we see the story behind the manufacturing of plastic bottles; it is not an environmentally responsible process in the first stage, and the disposal of plastic bottles is another problem. Only 29.1% of plastic bottles can be recycled, mostly downcycled, and the rest go to waste. Hence, it is useless to call bottled water an environmentally responsible consumer product.

Whenever you want to sell something, you scare people of the problem. This is the trick that a multi-billion-dollar industry played. To sell bottled water, industrialists scared people about the unreliability of tap water. Then again, bottled water is also tap water!

This story also tells us why societies that are based on consumerism are unhappier than those that invest money in good health care, sustainable business, and good education. It emphasizes that several toxic chemicals are used in the products. Hence, this factor should also be kept in mind while buying them.

Similarly, there are several other examples of unsustainable businesses that are the epitome of failure. From a bird's-eye view, to think sustainably, sustainability should be at the very heart of businesses. Since we have only one planet, and most of the resources are not renewable like zinc, coal, and water, life cycle assessment allows us to rethink our choices about the products based on their environmental impacts.

For instance, for better health care and a sustainable society, it is crucial to shift our focus from a linear economy to a circular economy for a happy and livable planet, since the cost of environmental damages outweighs the profit gained from unsustainable consumerism.

About Authors:

This article has been written by Rabia Nusrat and edited by Alizah Memon

SCIENCE

PAKISTAN'S FLOATING WETLANDS: LOW-COST REMEDY FOR WASTEWATER

A team of scientists in Pakistan has developed low-cost vegetative mats, which have shown promising results for the treatment of domestic wastewater, factory effluent streams, and even pools filled with hydrocarbons and heavy metals. The mats float in polluted reservoirs and continuously clean wastewater through local plants and vegetation – dubbed floating treatment wetlands (FTWs). This technology is developed by Dr. Afzal and his team at the National Institute for Biotechnology and Genetic Engineering (NIBGE), Faisalabad, under the umbrella of the Pakistan Atomic Energy Commission (PEAC). Dr. Jochen A. Müller and Dr. Muhammad Arslan were also collaborators from Helmholtz Centre for Environmental Research in Germany.

For the first time in Pakistan, full-scale FTWs were installed for almost six years at WSPs (waste stabilization ponds) near Faisalabad. These ponds were filled with 60% sewage from homes, while 40% of wastewater poured from various industries including tanneries, chemical, and textile factories. Wastewater from both homes and industries turned the ponds into an ideal testbed to check the importance of floating green patches.

COD (chemical oxygen demand) reveals the amount of both biodegradable and non-biodegradable substances present in water/ wastewater, whereas BOD (biological oxygen demand) tells the level of only biodegradable matter present in the water/wastewater. So, high COD and BOD values indicate the presence of a high concentration of pollutants/chemicals in the wastewater and lower values indicate that the water is comparatively clean.

The wonders of eco-friendly mats were observed in the second year and after three years, almost all water quality indicators were improved. Positive effects were noted in three categories: physicochemical(reduction in total dissolved solids, oil and grease, and sulfates) microbiological (coliform and fecal coliform), and heavy metals (cadmium, chromium, nickel, etc).

The wetland systems treated 79% of COD, 88% of BOD, and 65% of total dissolved solids (TDS). The locally developed, floating mat is 500 times less expensive compared to commercially available solutions. For almost six years, few green mats treated some 57,947,400 cubic meters of filthy water – which can fill more than 31000 Olympic size swimming pools – treating the water at the cost of a few paise per cubic meter! The data assessment shows that all wetlands will be further viable for a total period of 15 years.

The Blue Water Crisis:

Clean and blue water thirst is increasing in Pakistan. According to the International Monetary Fund (IMF), Pakistan is the third-most affected country with an acute water shortage. The World Economic Report also highlighted that water scarcity is one of the major threats to Pakistan's economic stability. Moreover, the Pakistan Council of Research in Water Resources (PCRWR) has warned that Pakistan may run out of sufficient usable water by 2025. Apart from the extensive use of water, the discharge of wastewater into the environment is the main reason for the depletion of clean water resources in the country.

The toxins and pathogens in the wastewater not only pollute the soil but also pollute freshwater resources, hence depleting resources available for human consumption. In Pakistan, the masses are forced to drink unsafe water. According to an estimate, unsafe water contributes to 80% of diseases and 40% of deaths in the country. In this scenario, floating wetlands are a practical, low cost and eco-friendly solution to this growing problem. These green systems are easy to use without any electricity and chemical input.

Pakistan is among the top five countries that account for almost 90% of farmland across the globe irrigated by sewage water. The findings were published in the Environmental Research Letters Journal in July 2017. The bad news is that vegetables and fruits grown with this water contain heavy metals, pathogenic bacteria, and worms – all hazardous to human health. "Wastewater is rich in nutrients, and it boosts yield, but it also contains traces of heavy metal which is harmful to human health as well as soil used for agricultural purposes," says Rafiul Haq, an ecologist and former consultant to the International Union for Conservation Nature Pakistan chapter.

In 2013, a study conducted in Sialkot and Wazirabad districts found higher levels of heavy metals in crops irrigated by wastewater, compared to that of supplied water from tube wells. The study conducted by Environmental Biology and Ecotoxicology Laboratory at the Quaid-e-Azam University compared coriander, okra, onion, garlic, capsicum, carrot, brinjal, spinach, mint, radish, tomato, and wheat crops irrigated by contaminated water from Nullah Aik and Palkhu streams, and tube well water. Metals like cadmium, lead, and chromium in affected crops, especially in leafy vegetables, were found to be

far above the permissible limits. "Cadmium causes kidney and lung damage. It also weakens bones, causing frequent fractures in both children and adults," says Dr. Zafar Ahmed Fatmi, a professor of Community Health Sciences at Aga Khan University, Karachi. "Nickel, another metal frequently found in wastewater, has systemic immunologic, neurologic, reproductive, and developmental effects on the human body" added Fatmi.

In this scenario, Pakistan urgently needs environmentally friendly solutions to clean sewage pools and FTWs could be very helpful in this challenge. It is important to mention that Faisalabad ponds also irrigate some 70% of farmland in surrounding areas. Dr. Afzal and his team designed and fabricated the floating mats, using aluminum frames on the edges, and polyethylene insulation rolls inside to develop FTWs. Then, four local plants – Common reed (Phragmites australis), Southern Cattail (Typha domingensis), Kallar grass (Leptochloa fusca), and Para grass (Brachiaria mutica) – were set in a hydroponics system as all plant's roots were dipped in sewage water. However, roses and other flowering plants were also grown on the edges to add beauty to the green mats. All the plants belong to the grass family and are well known for the biological treatment of wastewater Reference.

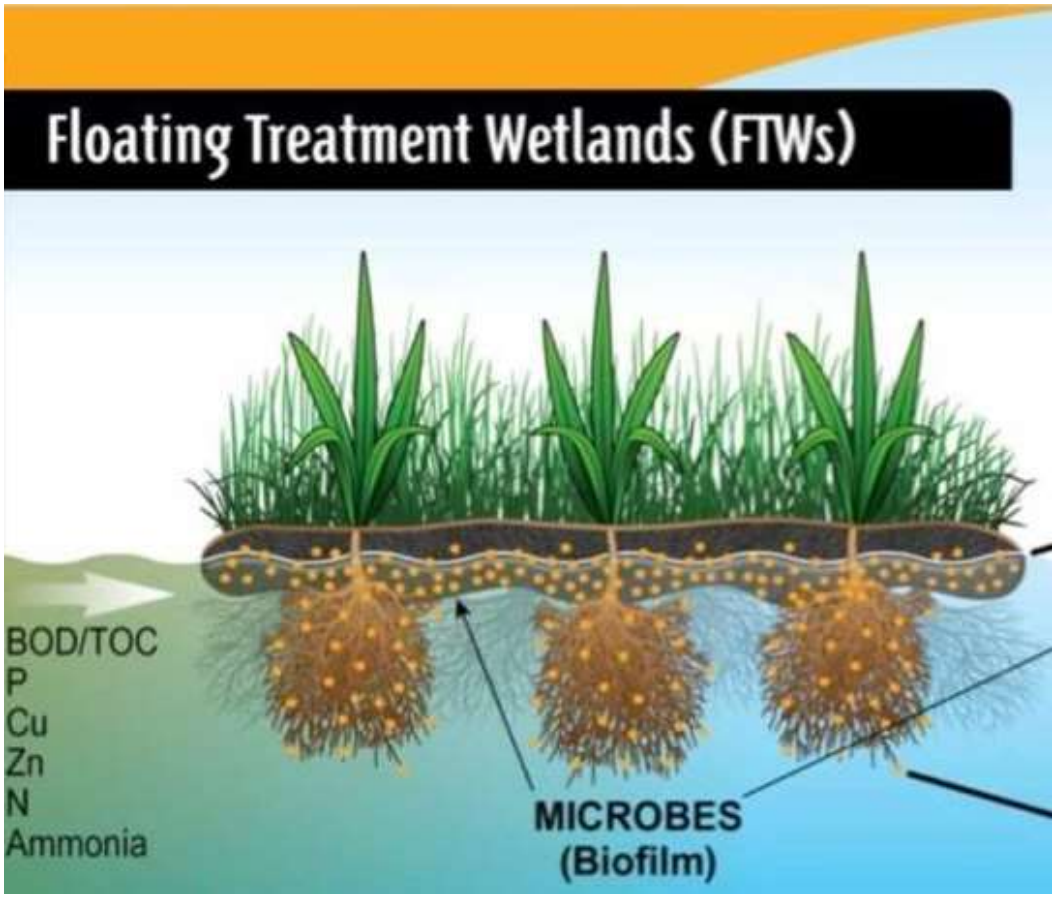
The Hydrocarbon Pit

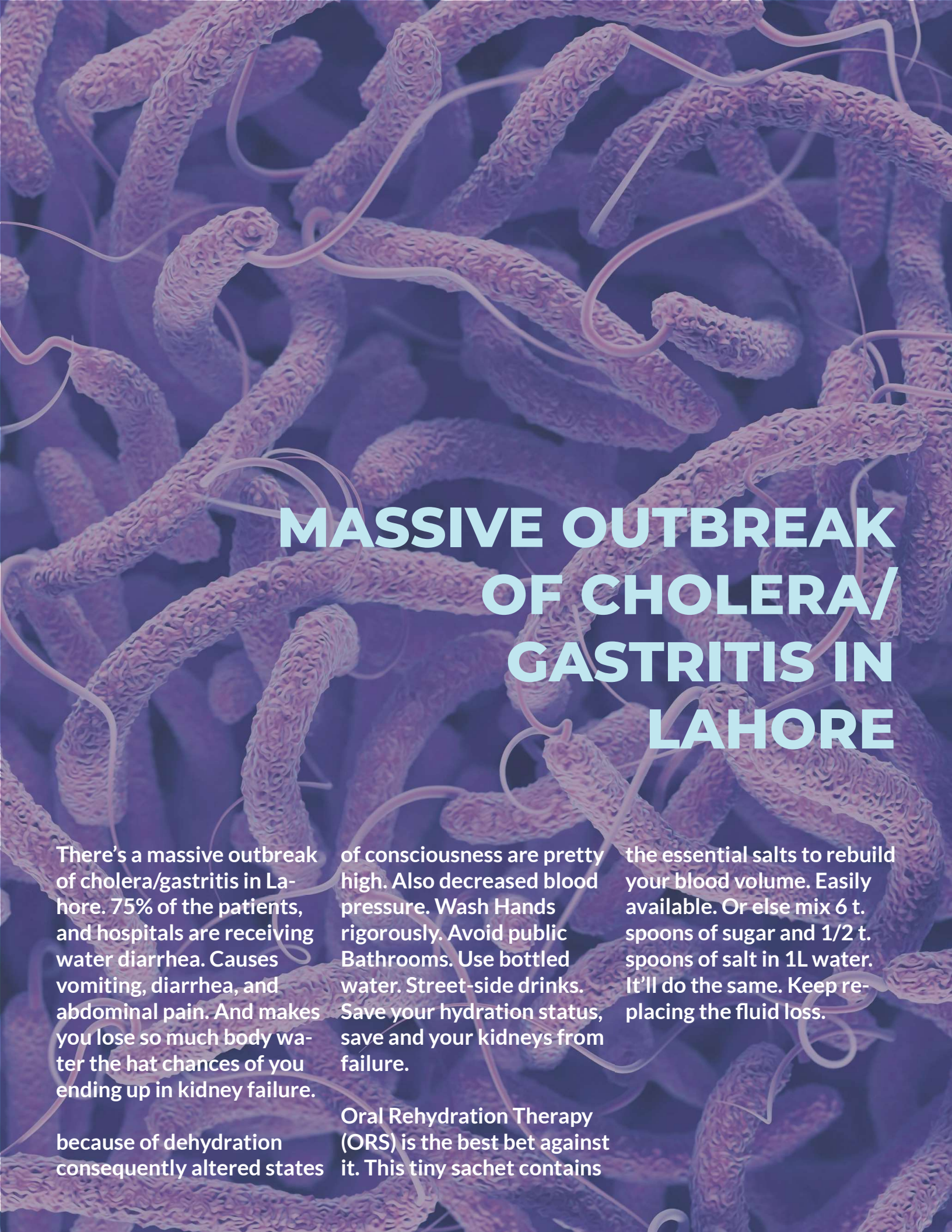
The team also tested wetlands of the same plants in a pit full of heavy metals and toxic hydrocarbons at Rajian district, Chakwal, which had emerged because of oil and gas exploration. Collectively, all the floating wetlands reduced COD, BOD, TDS, hydrocarbon content, and heavy metals by 97.4%, 98.9%, 82.4%, 99.1%, and 80%, respectively, within 18 months. Almost all the plants survived in a toxic environment and even showed fast growth. Scientists also observed birds and fishes near the FTWs, which is a plus point for biodiversity and ecology. The amazing success of environmentally friendly wetlands needs further work, and a web of wetlands can clean sewage reservoirs from Gilgit to Baluchistan. The floating treatment wetlands consist of locally available plants and grasses and pave the way to clean even larger reservoirs of polluted waters. [38]

About Authors:

Suhail Yusuf is a science journalist and documentary producer based in Karachi, Pakistan.

The article has been edited by Rabia Nusrat, Anam Riaz, and Alizah Gul Memon.





MASSIVE OUTBREAK OF CHOLERA/ GASTRITIS IN LAHORE

There's a massive outbreak of cholera/gastritis in Lahore. 75% of the patients, and hospitals are receiving water diarrhea. Causes vomiting, diarrhea, and abdominal pain. And makes you lose so much body water the hat chances of you ending up in kidney failure.

because of dehydration consequently altered states of consciousness are pretty high. Also decreased blood pressure. Wash Hands rigorously. Avoid public Bathrooms. Use bottled water. Street-side drinks. Save your hydration status, save and your kidneys from failure.

Oral Rehydration Therapy (ORS) is the best bet against it. This tiny sachet contains the essential salts to rebuild your blood volume. Easily available. Or else mix 6 t. spoons of sugar and 1/2 t. spoons of salt in 1L water. It'll do the same. Keep replacing the fluid loss.

SCIENCE

MITIGATING THE OUTBREAK USING WASTEWATER-BASED EPIDEMIOLOGY

In times when making it out alive is based on luck, getting tested for coronavirus has become an essential tool to save lives. The unavailability of enough kits and inefficacy of swab tests has made the prospects of living grimmer. If someone's test result is negative, it does not always mean the absence of infection in the body.

Proactive approaches of testing for Covid-19 in communities can prove to be an effective way to address the problem. Examining the presence of Covid-19 in wastewater is a promising way to forecast future surges. In order to make this method a success and to determine potential environmental transmission routes, it is imperative to know the active time of coronavirus in water and wastewater. In tap water, coronavirus can survive up to 10 and 100 days at 23°C and 4°C respectively. Similarly, according to published research, coronavirus persists in wastewater for two to four days at 23°C.

Detecting problems in a locality via wastewater is not a thing of the future. Wastewater-based epidemiology has been used for many years to determine the activities of inhabitants, including use of illicit drugs within the community by collecting quantitative and qualitative data of contaminants. This technique was first proposed in 2001 and applied in 2005. The future applications of this tool of surveillance can also be to monitor diet habits, disease patterns and exposure to environmental

and food contaminants in neighbourhoods.

"Wastewater-based epidemiology (WBE) is innovative and promising approach which enables information about exposure to external agents and disease in defined population groups to be retrieved from wastewater via the analysis of human metabolic excretion products (called as biomarkers)."

In these uncertain times, it is imperative to have timely and targeted testing for coronavirus to know when it is safe to re-open communities. For this, wastewater-based epidemiology (WBE) is now being applied to detect coronavirus in communities. This method is cost-effective and ensures the early detection of the virus as compared to individual testing. Individual or diagnostic testing is not only fickle, but also it does not warn us about the future surges of the epidemic. Furthermore, not everyone can get tested for coronavirus; some cannot afford it, and some choose not to get tested. Wastewater-based epidemiology (WBE) detection is based on enumerating the virus RNA (ribonucleic acid) in sewage and performing mass balance approach on virus shedding using population and sewage flow rate. While this holistic job of detection can predict the number of patients, it cannot tell the individual identity of the patient.

Using this method, it has become feasible to know the number of coronavirus cases in a locality. According to reports, coronavirus was found to be in sewage of Spain and Italy, before the first case was prevailed in China. Scientists claim that when the virus was detected last year, it was less contagious but mutated into a more harmful form afterwards. This could be the reason that it took so long to detect coronavirus in Europe. Globally, it is now becoming the new normal to test for the virus in wastewater as researchers in Netherlands, Australia, France, Sweden, and USA have confirmed the presence of the virus in wastewater.

Inspired by the potential of this research, MIT alumni Mariana Matus launched BIBOT Analytics. This start-up is working hard to make wastewater treatment facilities as public health observatories. Here, wastewater samples are pasteurized at 60°C for sixty minutes to make the sample safe for handling. BIBOT is working with 400 wastewater facilities across the Unites States of America to help update the healthcare database system.

Even though, there is no question on the authenticity of this tool of surveillance, still, there are challenges in this area. True quantitative assessment of coronavirus patients is ambitious because there are a number of factors involved and there is variability in these factors. One of the factors is the uncertainty in virus shedding rates between people at different stages of infection. Other factors include the time of persistence of viral RNA in wastewater and flow variations of sewage.

Despite being a useful tool for the management of Covid-19 in communities, sewage may be a route of transmission of Covid-19 in people. Coronavirus can survive in different media with varying life spans. This information is critical because of the airborne transmission of the virus; it poses a serious question of infection due to wastewater aerosols. Right now, there is no inclusive data that declares this as a substantial health risk. However, there are several routes of transmission that are possible, which include environmental surfaces, aerosols, and faecal-oral route. Respiratory route is well-known but credibility of other routes of transmission is still a question in research.

Wastewater-based epidemiology (WBE) for coronavirus is showing a promising future in handling the situation of the pandemic across globe. As the world is trying to reopen, academic institutions are looking forward to collecting data of virus transmission from student apartments' sewage. This will help them in controlling the situation by devising plans intermittently according to the existing condition of pandemic. Advancements are happening at a fast pace and in order to estimate the exact population size and to discover new methods of biomarker extraction, research has to be conducted to improve the outcomes of this surveillance tool.

Originally Published by Strafasia. [39]

About Authors:

This article has been written and edited by Rabia Nusrat.

SCIENCE

WATER: AN EXTREMELY VALUABLE AND SCARCE RESOURCE

Made up of 70 percent water, humans are biologically dependent on water for survival. You can survive a month without food if the water is available, but you cannot spend more than three days without water. Well, as interesting as it sounds, it throws light on the importance of water for humans. Water is used by our bodies to carry out different activities. It is used to remove toxins and other harmful substances from the body. It also helps perform homeostasis which is maintaining a constant body temperature of a person. It also boosts energy in the body by allowing the assimilation of minerals and other useful substances.

Despite it being a basic necessity for humans, it is considered a leisure item in many third-world countries. Developing countries experience a water shortage daily and often fail to provide their residents with clean drinking water. People have to rely on contaminated water for survival. This results in a number of different diseases.

As mentioned above, people are not able to get access to clean drinking water. The question that arises here is what type of water is considered to be clean to be drinkable. According to the World Health Organization, water should be both odorless and tasteless. This means that if one's taste and smell senses are being activated while drinking water, one needs to reconsider its purity. While certain chemicals and minerals are added to the water to improve its overall quality, their constituents should not be to such an extreme that they start giving off a great odor and color.

If the quality of water is compromised in any way by

the people, they will have to pay for it themselves. Bad quality water results in smelling breaths, something that can get hard to get rid of. Apart from this, contaminated water can result in a severe stomachache. This happens due to many reasons. One of the reasons might be that the person drank tap water, which is untreated. This unprocessed water can cause viral gastroenteritis that results in the inflammation of your intestines and stomach. In addition to this, if arsenic is a part of your water, it can be quite toxic causing headaches, diarrhea, and vomiting. In extreme cases, it can even result in death.

Drinking plain water(deionized or water from RO plants) might not be as healthy as drinking mineralized water. These minerals are essential for the growth and development of the body. Adding magnesium and potassium can help improve the blood circulation of your body. Apart from this, adding calcium to the water can improve bones' strength and regulate the rate of the heartbeat.

While we add different minerals to our water for it to become more healthy, people have also started to drink water with the addition of Espagol or ORS. The reason behind the increased consumption of Espagol and ORS is that people have become sick of drinking RO water. Water filtered by reverse osmosis does not have enough minerals to fulfill our body's needs consequently resulting in fatal diseases. Hence the use of ORS enhance the taste of the water and also help to cure different diseases that the person might be suffering from. For example, adding espagol to water can help fight against diarrhea and constipation. These are effective methods suggested by the doctors. ORS is used to counter dehydration in people who find drinking plain water a difficult task.

On average, a person is recommended to drink 2.7-3.7 liters of water daily. According to health experts, 8-ounce glasses of water are recommendable which is commonly known as the 8×8 rule. People usually follow it when they start drinking water as a daily habit because it is quite easy to remember. However, this number varies from person to person based on their body and external environment.

To calculate the right amount of water needed by your body, you should multiply your weight by 2/3. This provides an answer in ounces, which can later be converted into liters for ease. While this gives an average amount of water needed, you

need to add additional amounts of water based on the physical activities that you carry out. For example, if you exercise for 30 minutes daily, you will need to add 12 ounces of water. Other factors like pregnancy or breastfeeding also result in different needs for water consumption.

Sometimes, the water intake has to be regulated to save the person from major illnesses. For example, if a person has an electrolyte imbalance, which is causing a low blood sodium level, then it is recommended to restrict the amount of water being consumed.

The pH is the power of hydrogen, which determines the acidity and basicity of a substance. In water, a pH higher than 7 is considered to be alkaline, and below 7 is acidic. However, this value changes with the addition of different materials in the water. For example, an addition of carbon dioxide, after being exposed to it in the environment, can cause a drop in pH. This, now acidic, water can contain several harmful minerals in itself as it easily corroded them in the metal pipes, etc. On the other hand, a higher pH, let's say 8.5, can make the water be considered 'hard' water. While this does not have any health risks, it still poses certain issues like deposition on utensils or the formation of insoluble precipitation on clothing.

Being environmental engineers and scientists altruism has been the main drive for checking the water for its feasibility for drinking purposes. After checking the pH, conductivity, and TDS of the five most commonly available brands following results were obtained.

pH, Conductivity, and TDS of different drinking water brands in Pakistan

	pH	CONDUCTIVITY	TDS
A	8.4	430	210
B	8.2	280	130
C	8.1	180	80
D	7.7	480	230
E	7.6	420	200

Source: Lab experiment results by Earthly Perspective(Rabia Nusrat; Environmental Engineer)

TDS is the most important parameter to be checked in the treated water to see either water is going to serve our health or not. There are several sources of TDS in water but minerals in water are the concern here which we are calling TDS here. According to the World Health Organization, RO water should not be used for drinking water as it is detrimental to health. Demineralized water causes an electrolyte imbalance in the body. So, there should be an adequate amount of minerals present in water for its adequate intake. Several studies prove that higher quantities of magnesium in water results in a low risk of death from cardiovascular disease(CVD). According to World Health Organization if the TDS in water is less than the range of 50-250ppm then it lacks essential minerals required by our body hence should not be considered palatable and need remineralization.

Water is one of the most significant resources of our planet Earth. Its intake should not be compromised and its quality should be maintained. Hopefully, the test results presented in the article as well as the other information provided help you select the right drinking water! [40-43]

About Authors:

This article is written and edited by Rija Zaidi and Rabia Nusrat.

NBP SIGNS AN AGREEMENT WITH EVERYWATER

At Every water Shayan, Sohail, Sarwar, Usama Tanweer, and Arslan Ahmed have invented ERM (Esoteric Resistive Membranes) which can solve half of the problems of flux reduction in membranes! Team Earthly Perspective congratulates Every Water on its outstanding achievement!

SCIENCE

WATER POLLUTION

What Does Pollution Mean?

Pollution is the entrance of contaminants or pollutants into the natural environment that may change its entire composition. Pollutants can enter the environment either by anthropogenic or natural means. In both cases, the natural conditions of the environment disturb severely, which ultimately disturbs other environments, as all the natural environments are systematically associated with each other. There are many kinds of pollution, such as air pollution, water pollution, noise pollution, and land pollution. Water pollution is directly linked to the health of humans, and the ecosystem; hence, it is a trending subject of conversation among all administrative and research experts.

What is Water Pollution?

Water pollution occurs when harmful pollutants and contaminants enter water bodies (rivers, streams, lakes, groundwater, seas, and oceans). The main reason for these pollutants might be the illegal dumping of industrial wastes and sewage discharge in water, which contains harmful chemicals, metals, and other biological contaminants.

Earth is the only planet to have liquid water on its surface. About 71% of the earth's surface is covered with water, of which oceans hold about 96% of total water – which is salty and cannot be used, whereas only 2.5% of water (freshwater) can be used for our desired purpose (according to WHO). Water is considered the most important natural resource for the survival of life on the planet. Keeping an eye on this fact, we should eagerly focus on this hot issue of usage versus sustainability.

What Causes pollution in water?

Pollution in water may be caused by many factors – some of which directly affect water bodies, and some indirectly. Unfortunately, many factories and industries are dumping their wastewater, chemicals, and heavy metals majorly in water bodies like seas, oceans, and rivers (Direct Effect).

Another major reason for water pollution is modern farming techniques. Farmers apply nutrients such as phosphorus, nitrogen, and potassium, in the form of chemical fertilizers, manures, and sludge. It causes farms to discharge large quantities of agrochemicals, organic matter, and saline drainage into water bodies(Indirect Effect).

As water is an important resource to sustain human life, unwanted changes in water's natural composition may directly affect the human body. Drinking contaminated and polluted water may adversely affect human health and cause severe diseases

such as typhoid, cholera, hepatitis, diarrhoea, skin cancer, etc.

Types of Pollutants

Physical contaminants primarily impact the physical appearance or other physical properties of water. Examples of physical contaminants are sediments from soil erosion suspended or organic matter that ends in rivers, and streams. Chemical contaminants are elements or compounds. These contaminants may be naturally occurring or man-made. Examples of chemical contaminants include nitrogen, bleach, salts, pesticides, metals, toxins produced by bacteria, and human or animal drugs. Biological contaminants are organisms in the water. They are also referred to as microbes or microbiological contaminants. Examples of biological or microbial contaminants include bacteria, viruses, protozoans, and parasites.

Key Facts about Water Usage

In 2017, 71% of the global population (5.3 billion people) used a safely managed drinking water service – that is, one located on premises available when needed, and free from contamination.

90% of the global population (6.8 billion people) used at least a basic service. Basic service is an improved drinking water source within a round trip of 30 minutes to collect water.

785 million people lack even a basic drinking water service, including 144 million people who are dependent on surface water.

Globally, at least two billion people use a drinking water source contaminated with faeces. Contaminated water can transmit diseases such as diarrhoea, cholera, dysentery, typhoid, and polio. Contaminated drinking water is estimated to cause 485,000 diarrheal deaths globally each year.

By 2025, half of the world's population will be living in water-stressed areas. In the least developed countries, 22% of health care facilities have no water service, 21% no sanitation service, and 22% no waste management service.

Common Ways of Mitigating Water Pollution

Educational and awareness programs should be organized to control water pollution.

It is recommended that there be a proper waste disposal system so that water bodies can be protected against discarded solid waste. These programs increase variability in the availability and distributions of freshwater resource demands.

Majorly groundwater is a major resource for freshwater supplements, particularly drinking water. However, in many cases, these aquifers are being taped at an unsustainable rate or affected by pollution. More attention should be paid to the sustainable management of non-renewable groundwater.

[44,45]

SCIENCE

ENVIRONMENTAL EPIDEMIOLOGY: ITS CLASSIFICATION, PREVENTION, AND CONTROL

Environmental epidemiology is the branch of epidemiology that focuses on how various environmental factors contribute to diseases. These diseases are waterborne, foodborne, or airborne. According to World Health Organization (WHO), 50.4 million deaths occurred worldwide in 2012 out of which 12.6 million deaths were due to unfavorable environmental factors.

Classification of Environmental Determinants:

There are several environmental determinants and every environmental determinant causes several diseases in human beings and animals.

Classification of environmental epidemics:

Generally, environmental-related diseases can be classified as the follows:

- Waterborne diseases
- Airborne diseases
- Foodborne diseases
- Vectorborne diseases

Water-related diseases:

The word "borne" means "carried or transported by the thing specified." Hence, waterborne diseases are the diseases that are transported by water. The most common examples include diarrhea and cholera. The most common cause of diarrhea and cholera include drinking water and food ingestion that contains Campylobacter link, Escherichia coli link (E. coli), Salmonella link, Shigella link, and Vibrio cholera respectively. According to research, more than 5 million people die each year because of water-related diseases alone.

WATERBORNE	**EXAMPLE**
Classical	TYPHOID
Non-classical	INFECTIOUS HEPATITIS
WATER-WASHED DISEASES	
Superficial	TRACHOMA, SCABIES
Intestinal	SHIGELLA DYSENTERY
WATER-BASED	
Water-multiplied percutaneous	BILHARZIASIS
Ingested	GUINEA WORM
WATER-RELATED INSECT VECTORS	
Water biting	GAMBIAN SLEEPING SICKNESS
Water breeding	ONCHOCERCIASIS

Classification of water-related diseases:
Water-related diseases are further classified into four categories and this classification was first done by Bradley in 1972. Following is Bradley's classification of water-related diseases:

Bradley's Classification of water-borne diseases Waterborne diseases:

Waterborne diseases are caused by microorganisms present in drinking water. The most common examples include diarrhea and vomiting. Waterborne diseases are caused by many kinds of bacteria, viruses, protozoa, and parasites the most common types of bacteria that cause diseases are Campylobacter link, Escherichia coli link (E. coli), Salmonella link, and Shigella link.
Water-related diseases are just not simply waterborne diseases and the significance of waterborne diseases cannot be denied. [e.g., Payment et al. (1997) shows that 14% to 40% of gastrointestinal diseases were attributed to the diseases which were caused by consuming tap water meeting North America's microbiological quality requirements. Hence, other water-related diseases are of environmental and epidemiological significance, particularly in developing countries.

Prevention and Control:

Waterborne diseases can be prevented and can be controlled by improved water quality and sanitation. Everyone has a right to clean water and public water supplies should be free from microorganisms causing diseases. Moreover, public awareness should be created about waterborne diseases and in case of contamination in drinking water in underprivileged regions treatment plants should be installed.

Water-washed diseases:

Bradley's classification of water-related diseases introduced a very important category called water-washed diseases. Water-washed diseases are the diseases that are caused by using insufficient quantities of water regardless of its quality for personal and domestic hygiene. According to his study, most waterborne diseases are transmitted by the watershed route and the latter is more epidemiologically harmful when it comes to water-scarce areas typically in developing countries. Moreover, areas where water is available but not used in enough quantities can also become a victim of water-washed diseases.

Prevention and Control:

Improved water quantity, availability, reliability, and hygiene education are the preventions and controls of water-washed diseases.

Water-based diseases:

Water-based diseases can be classified into bacterial, helminthic, and fungal diseases. These diseases include: Bacterial: Leptospirosis Tularemia Legionellosis Helminthic: Schistosomiasis Clonorchis's Fasciolopsiasis Guinea worm infection
Fungal: Pulmonary hemorrhage due to Stachybotrystara infection.

Prevention and Control:

Decrease contact with contaminated water; improve domestic plumbing; public education sanitation; treatment of excreta or wastewater before reuse; public education.

Water-related insect vectors:

These diseases are caused by insects that breed and grow on water examples include Malaria, dengue, yellow fever, etc.

Prevention and Control:

Avoid walking across breeding sites and allow less contact. Destroy those sites having breeding insects such as mosquitoes. Better storm-water management systems and public awareness is the key to preventing such diseases.

Airborne diseases:

Airborne diseases are diseases that can be caught through the air. Several bacteria and viruses are being transferred through the

air from one human to another. Particulate matter and aerosols become the source on which viruses and bacteria can grow and hence can be transferred. Airborne diseases can be caused by poor ventilation or poor air exchange. Airborne diseases cause flu or cold and they include the following symptoms:

- Cough
- Chill
- Muscle pain
- Body aches
- Sneezing\Sore throat
- Stuffy nose
- Sinus pressure
- Sore throat

There is a new addition to airborne diseases of our generation and that is diseases by air pollution. Massive industrialization and poor transportation infrastructure cause a lot of chemicals in the air to react and form hazardous compounds resulting in Los Angeles and London-type smog. Pollution from such sources cause aggravated asthma and many cardiovascular and respiratory illnesses. Is research that the shut down of iron, coke, and steel factory resulted in reduced wheezing among children less than 2 years old. In another study, it has been observed that 24-hour exposure to PM10 resulted in lifetime asthma. Moreover, SO2 exposure in the first year of life resulted in lifetime asthma as well. Community air pollution exposure depends upon
many factors the most important one is the industrial proximity of the residential communities. Community air pollution has been reported to cause asthma, bronchitis, cardiovascular diseases, skin infections, and eye irritation.

Foodborne diseases:

These diseases are transmitted by drinking contaminated food and water. Such diseases are caused by bacterial and viral infections transmitted by microorganisms present in food or water. Climate change and water pollution is going to make the condition even worse. Food systems are complex and there is not a straight relationship between climate change and foodborne diseases. It has been studied that flooding can cause diseases to spread as water from one crop can take the microorganisms to another crop system.

As environmental engineers, we should know how environmental systems can become hazardous to health. Heavy metals accumulation in vegetables and fruits is another problem for the health of people. Lead, cadmium, mercury, and arsenic are the most reported heavy metals consumed by contaminated food.

Food contamination can happen at any stage from process to production by contaminated water, air, and contaminated soil. It can cause severe gastrointestinal, neurological, and immunological symptoms. Contamination in foodstuff is often carcinogenic. Hence, represents a major burden on disability as well as mortality.

Prevention and Control:

Foodborne diseases can only be avoided by preparing the food in hygienic conditions, using clean water, and should use clean air.

Vector-borne diseases:

Vector-borne diseases are diseases that are transmitted by vectors. Vectors can transmit diseases from animals to humans and from humans to humans. Most of them are blood-feeding insects. They suck the blood from an infected host and later inject the blood into another human being hence causing to spread of the diseases.

Vectors have several breeding grounds. They can grow on stagnant water and contaminated water. According to W.H.O, 17% of the infectious diseases are Vector-borne diseases. The most common types of diseases include malaria and dengue fever. Another risk of vector-borne diseases is climate change. As the temperature of the northern region is going to increases vectors will move towards those regions and hence the inhabitants will die as they do not have developed immunity against such infections.

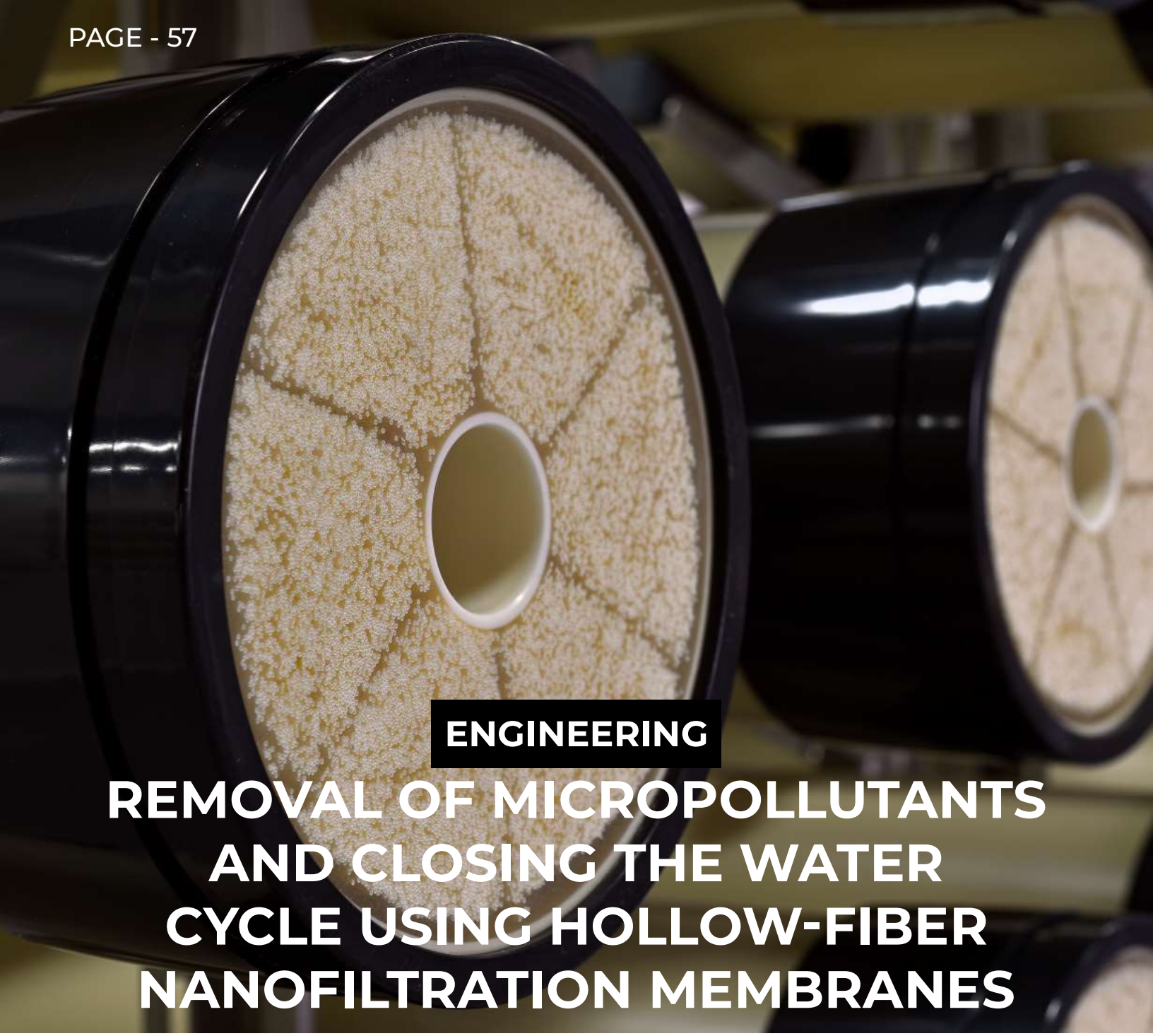
Prevention and Control:

Proper solid waste management, removal of all water stagnant sites, and using nets to protect against exposure to mosquitoes can reduce the risk of these diseases.

[46-48]

About Authors:

This article has been written and edited by Rabia Nusrat.



ENGINEERING

REMOVAL OF MICROPOLLUTANTS AND CLOSING THE WATER CYCLE USING HOLLOW-FIBER NANOFILTRATION MEMBRANES

Introduction

Nowadays, municipal wastewater contains a variety of residues of household chemicals, body care products, pesticides, and pharmaceuticals such as antibiotics and hormone-like substances. This group of compounds is generally called micropollutants and not all existing conventional wastewater treatment plants based on biological treatment are capable of degrading or removing them. As a result, they are commonly discharged into water bodies, like rivers, and will cause harm to the fauna and flora of these habitats. Moreover, these receiving water bodies will often be used as the source of water for drinking water production plants.

Therefore, there is an urgent need to implement new technologies for the treatment of effluents from conventional wastewater treatment plants. Most technologies applied currently in Europe are based on adsorption (activated carbon) or advanced oxidation processes (AOP) e.g. O3, UV/H2O2. However, it must be taken into account that these methods also have drawbacks: for example, the necessity of saturated activated carbon regeneration or disposal and the formation of by-products in the case of AOP. In this publication, results obtained on real effluent from a conventional wastewater

[illegible] plant wi[illegible]-fiber nanofiltration membranes are presented, including an energy consumption comparison, as well as typical operation costs (OPEX).

Hollow-fiber Nanofiltration Membranes

At the end of the '90s, the first hollow-fiber nanofiltration membranes were firstly developed in The Netherlands by Arie Zwijnenburg from Stork Friesland [49]. These first-generation hollow fiber NF membranes were based upon the well-known interfacial polymerization concept developed by Cadotte and others in the early 70s. The big disadvantages of this concept are the restricted chemical resistance of the selective polyamide top layer and the difficulties in the production process using interfacial polymerization. A new approach to hollow-fiber membranes is based upon the so-called Layer-by-Layer concept. At the RWTH University of Aachen [50] and the University of Twente [51], good results on a lab scale were obtained at the beginning of the 21st century.

Based on these research results, NX Filtration (NX) has developed the next generation hollow-fiber nanofiltration membranes for direct treatment of surface water and biologically treated wastewater. The base material of the membrane is poly-ether-sulphone (PES), which has an outstanding mechanical resistance and generates membranes with very small pore sizes and narrow pore size distribution. The PES base is covered with selective nanolayers created from water-based electrolytes.

The hollow-fiber configuration improves fouling resistance as the flow is not obstructed by the spacers used in spiral-wound elements. Uniquely to nanofiltration processes, the hollow fibers can be backwashed, and NX's innovative membrane chemistry allows for continuous operation and cleaning with strong oxidants such as chlorine and hydrogen peroxide at very high and very low pH. The membranes remove low molecular weight organics, and color caused by natural organic matter (NOM) and remove hardness partially, while allowing a high passage of monovalent ions.[52]

Two types of nanofiltration membranes are available: dNF80 (800 Dalton MWCO) is typically used for NOM (color) removal. The denser dNF40 (400 MWCO) is suitable for micropollutant removal and partial demineralization of water. Both types are available in modules of DN 110 and DN 200 with a membrane area of up to 50 m² and membrane fiber internal diameter of 0.7 mm. Modules are operated in cross-flow mode with a cross-flow velocity of ≤0.5 m/s and maximum transmembrane pressure (TMP) of 6 bar.

Pilot plant and process

For these trials, a pilot plant has been installed at the municipal wastewater treatment plant in Glanerbrug, the Netherlands. This WWTP is based on the conventional 3-step treatment process: primary sedimentation, biological treatment and secondary sedimentation. The final effluent was used as feed water to the pilot plant without any pretreatment other than a 200-micron strainer to remove large particles and coarse material before the membranes.

An overview of membrane specifications is shown in Table 1.

Table 1: Membrane specifications

Parameter Value

Type: dNF40
Membrane material: Modified PES
Module length: 1537 mm
Surface charge: Negative at pH7
Fiber inner diameter: 0.7 mm
Operation: Inside-Out, Cross-flow mode
Est. Bacteria rejection >6 log
Maximum TMP: 6 bar
Typical cross-flow: 0.1-0.5 m/s
Operating pH range: 1 to 14
MWCO: 400 Da

During continuous operation, filtration cycles of one hour were alternated with flush steps and backwashes to control TMP rise. Eventually, chemical cleanings were performed to restore permeability and resume filtration.

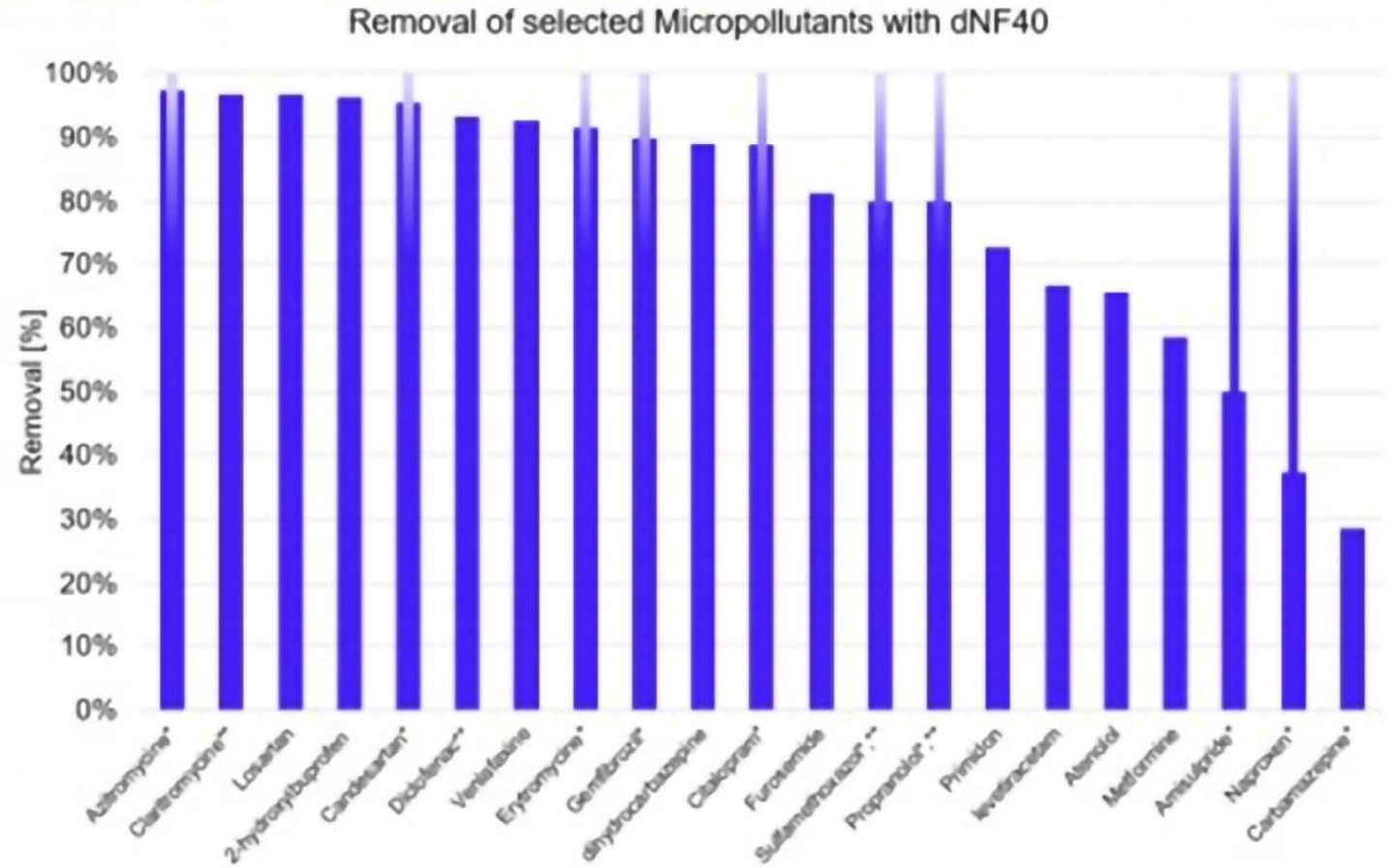
Results

These membranes have been used for this purpose since the very beginning of NX Filtration on several municipal effluent streams, and have demonstrated superior performance compared to competing technologies.

Table 2 shows a summary of the

nx filtration

Earthly Perspective



operational parameters used during the trials: Table 2: Summary of operational parameters

Parameter Unit Value

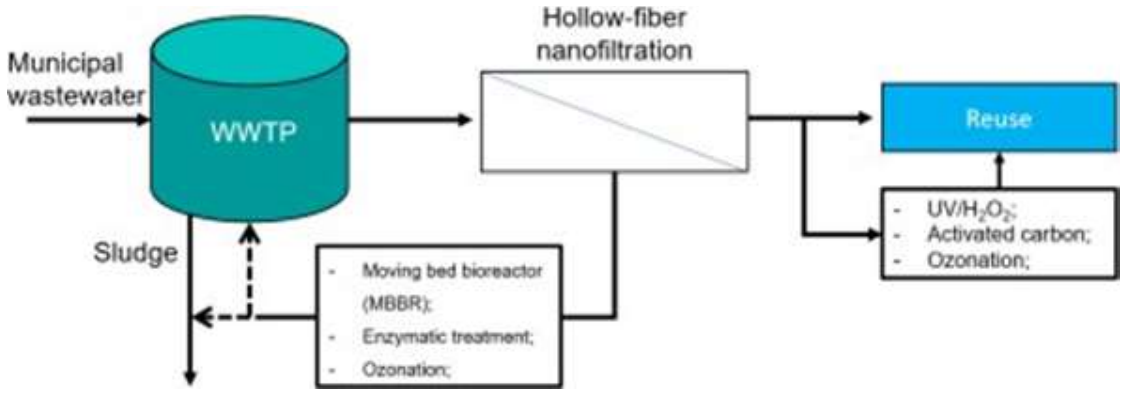
Flux: LMH 20
Recovery %: 80
Cross-flow velocity: 0.5 m/s

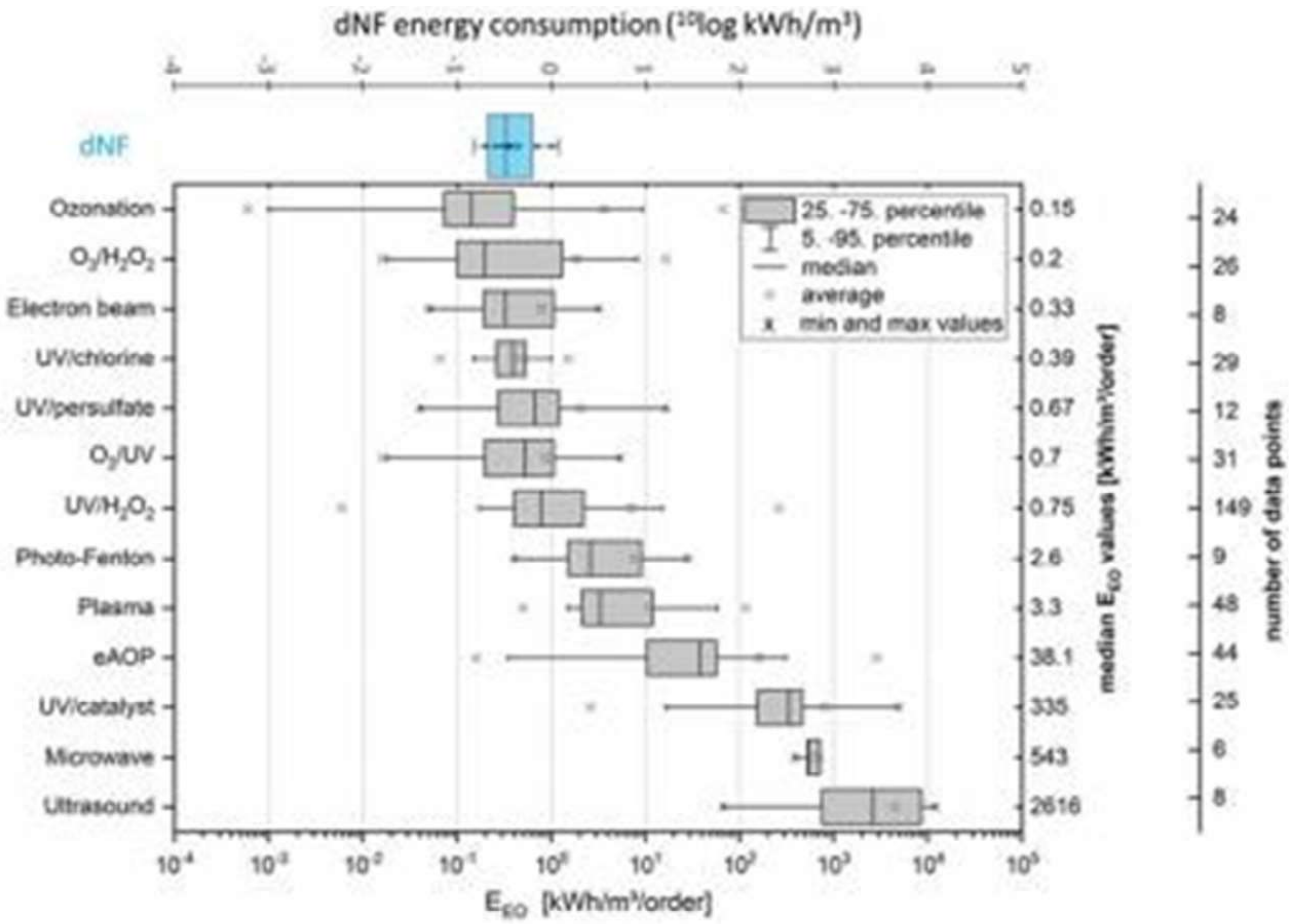
The results shown in Figure 3 were obtained from actual effluent from the wastewater treatment plant in Glanerbrug, NL as part of the MEDUWA project and show the high retention for micropollutants achieved by the dNF40 membranes.

Having in mind that the concentrate stream from any membrane process must receive proper handling and treatment, NX Filtration is simultaneously working on the development of an efficient method to address this issue. As shown in Figure 4, it could be treated with an advanced method to degrade organic matter and either recirculated into the wastewater treatment plant or discharged to a proper destination together with sludge.

Energy demand

In Figure 5, the energy demand of a dNF system is compared with other technologies5 typically used for micropollutant removal in Europe:





Operational costs

The following table presents an OPEX comparison between ozonation + sand filtration, PAC + sand filtration, GAC and a system with dNF40 membranes:

Table 3: operational costs comparison between dNF40 and competing technologies

Ozonation + Sand filtration:
€ 0,18 ± 0,044

PAC + Sand filtration:
€ 0,20 ± 0,044

Granular activated carbon:
€ 0,27 ± 0,044

dNF401: € 0,21 ± 0,03

For this calculation, a system in a single stage feed & bleed array is considered with cross-flow velocities ranging from 0.1 to 0.4 m/s in the different stages.

Conclusion

From the results presented, not only on the removal of micropollutants but also in operational costs, it can be concluded that hollow-fiber nanofiltration membranes can be a realistic alternative for conventional technologies for polishing conventional municipal WWTP effluent commonly used nowadays. The high-quality permeate can be further reused as Removal of micropollutants and closing the water cycle with hollow-fiber nanofiltration membranes process water in some applications and even as potable water (after further conditioning). Thus, hollow-fiber nanofiltration membranes demonstrate a great potential to become a state-of-the-art method for water reuse applications.

Acknowledgement

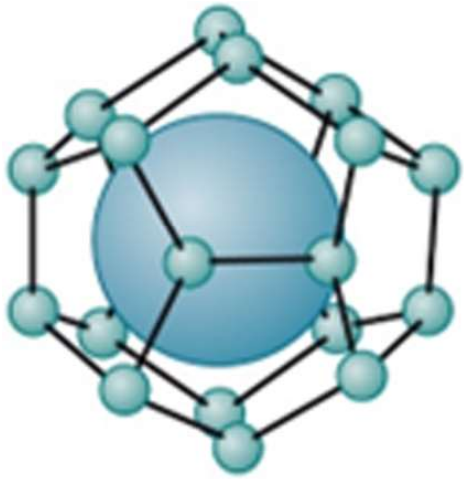
- The developments presented were supported financially in part by the EFRO-project 24Water (PROJ-00386) and the Interreg-project MEDUWA Vechte(e) (14211)

SCIENCE

CLATHRATE – A IMPLICIT ENERGY SOURCE AND A CLIMATE CHANGE CONTRIBUTOR

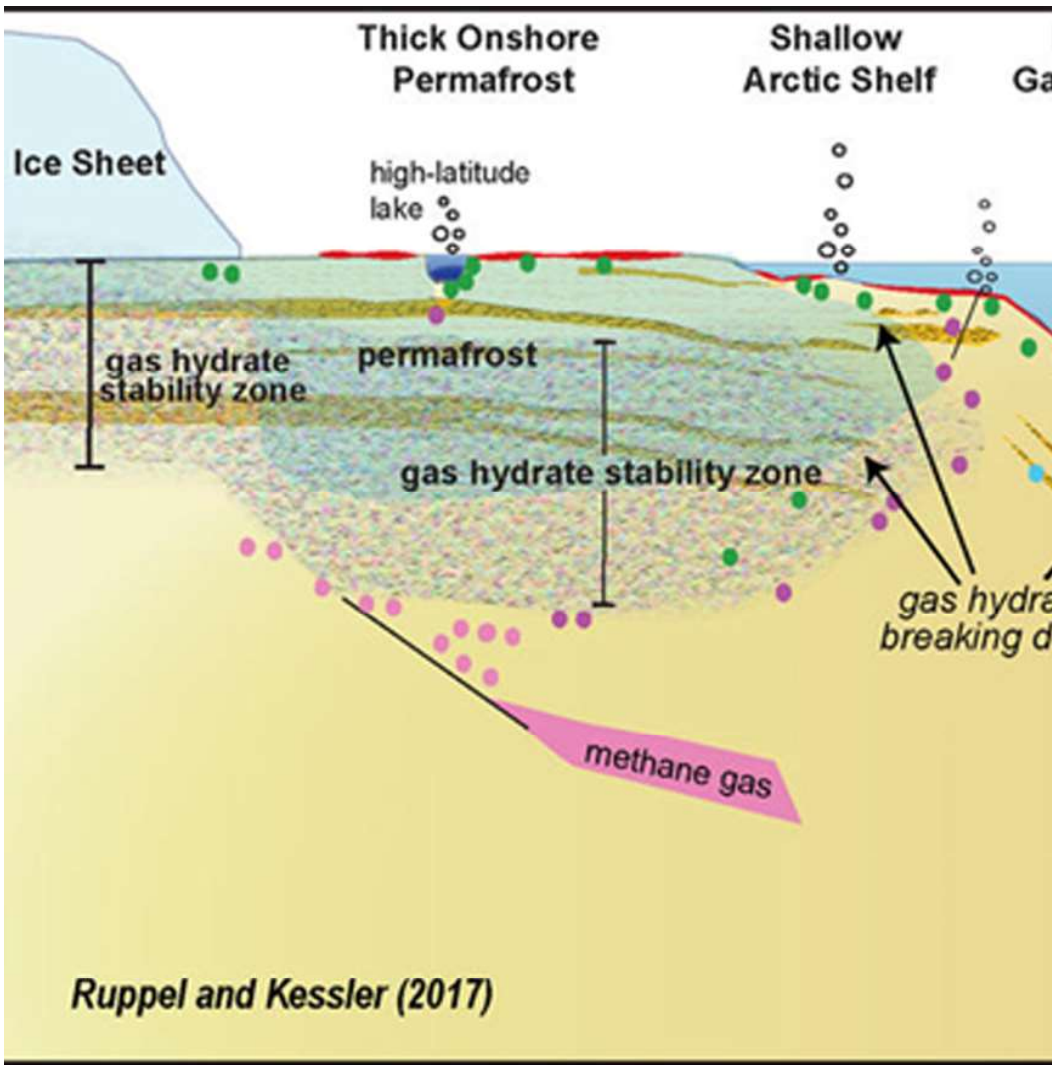
What's a Clathrate?

A Clathrate is an emulsion which is boxed or enclosed. One of the factors of a Clathrate is a crystalline open structure in which the other elements can fit and get trapped. The element which has an open structure is called the host, while the element which gets trapped is called the guest. Thus, Clathrate partake a host- guest relationship. (Vaidya, 2004). The figure below shows the structure of a Clathrate:



Methane Hydrates

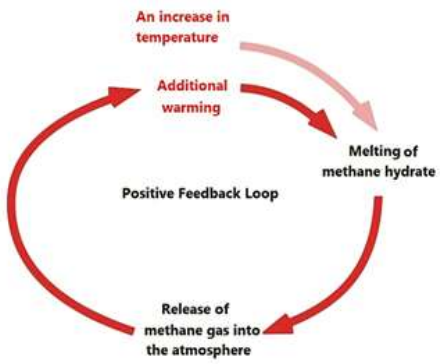
Methane Hydrates, which belong to the group of Clathrate, are white solids just like ice. In methane hydrates, methane motes are trapped in water. The microorganisms that live in the deep layers produce methane by converting the organic substances into methane. These organic substances are the dead plankton that lived long, sank and eventually into sediments. The stability of methane hydrates depends on low temperatures and pressures lesser than 35 bars, thus making the seabed a perfect position for their confirmation. The following figure (See Figure 2) summarizes the locales of methane hydrates and consumption of methane (written in red).

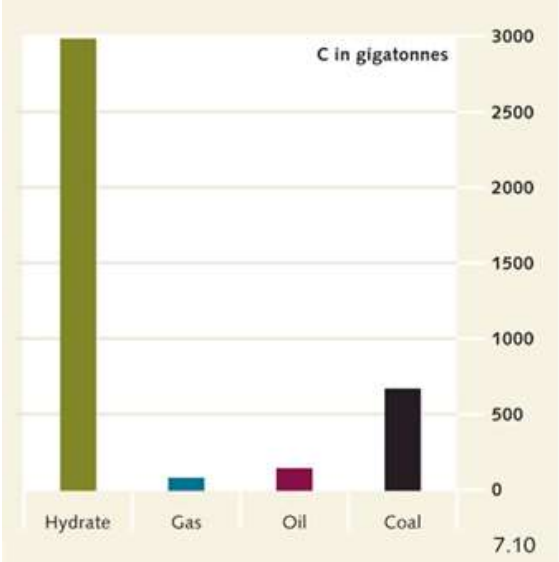


How do they contribute to climate change?

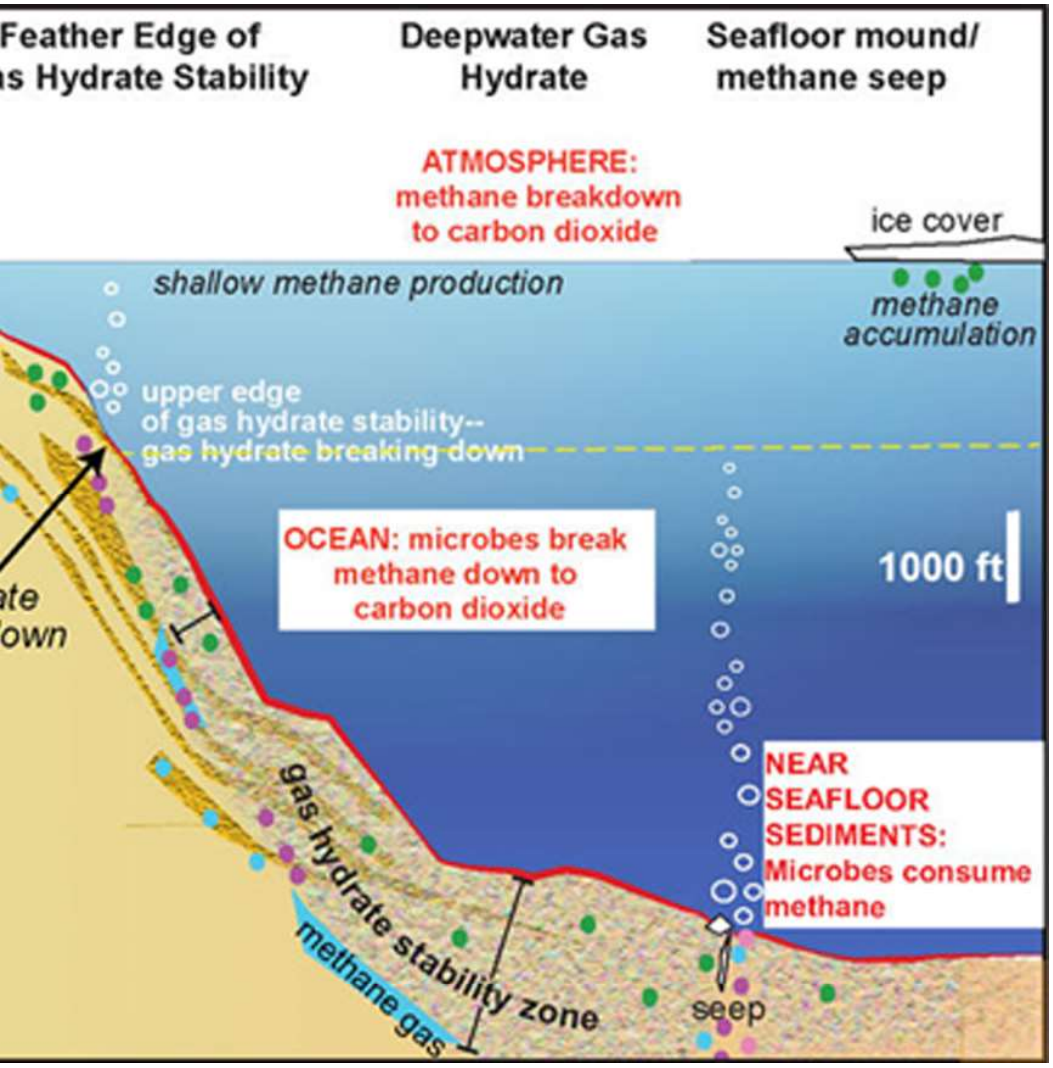
The positive methane feedback explainshowmethanecontributes to climate change. Methane is a potent gas. Methane and other

gases as carbon dioxide increase the atmospheric temperature and affect in global warming. This results in the melting of glaciers, and permafrost getting warmer. When the ocean water gets warmer and permafrost begins to melt, the methane hydrates get in stable and begin to melt. In response to this, methane gas is released which again adds up to the warming, and so the cycle continues. The figure below shows the positive feedback of methane hydrate (see on right)





tonnes (See Figure to the right). Methane hydrates are stable at low temperatures, but as soon as temperature gets increased, in relation to climate change. Carbon dioxide not only adds up to global warming, but it also contributes to the pacification and it reduces the oxygen If we look at geological records, we can see that the breakdown of methane hydrates has significantly contributed to the extreme global warming.



As compared to the carbon that's released annually due to burning, carbon in the form of methane hydrates is 100 to 500 times, which makes it 1000 to 5000 giga they break down. Methane isn't directly released from the ocean, but it's oxidized into carbon dioxide, which itself is a gas. Methane hydrates are important

How do they play a part of implicit energy source?

Methane hydrates are dangerous and can affect the climate. From centuries, people have been using coal and natural gas as an energy source. Methane hydrates is far lesser than the conventional sources of natural gas. The mining of methane hydrates is a operation, but are being made regarding this. It's estimated by scientists that methane mining could be a option in terms of cost at the rate of 50-60 Tonnes per barrel.

Methane hydrates are a representation of a natural gas which has not yet been tapped or we can say exploited. This could be a great energy source. [53]

References

1. . spectra.
2. Dr Marc. spectra.
3. @Plasticwaves03. "The most valuable thing we extract from the oceans is our existence" -Sylvia Earle. 2018 April 11.
4. Sylvia Earle (1935), in Encyclopedia of world biography. 2018, Encyclopedia.com.
5. The Sea. Ocean Conservation Quotes 2021 4/26/2022]; Available from: http://www.seasky.org/quotes/sea-quotes-ocean-conservation.html.
6. Ellen Swallow Richards. [cited 2021; Available from: https://www.engineergirl.org/125397/Ellen-Swallow-Richards.
7. Ellen H. Swallow Richards. 2017; Available from: https://www.sciencehistory.org/historical-profile/ellen-h-swallow-richards.
8. Ellen H. Swallow Richards (1842–1911). Available from: https://www.acs.org/content/acs/en/education/whatischemistry/women-scientists/ellen-h-swallow-richards.html.
9. Rachel Carsen Biography. [cited 2022; Available from: https://www.carsoncenter.uni-muenchen.de/about_rcc/archive/mission/rachel_carson_bio/index.html.
10. Rachel Carson's Silent. Available from: https://www.acs.org/content/acs/en/education/whatischemistry/landmarks/rachel-carson-silent-spring.html.
11. Rachel Carson's Biography. Available from: http://www.rachelcarson.org/Bio.aspx.
12. Debra Michals, P. Rachel Carson. 2015; Available from: https://www.womenshistory.org/education-resources/biographies/rachel-carson.
13. Encyclopaedia, T.E.o. "Rachel Carson". 2022 [cited 2022; Available from: https://www.britannica.com/biography/Rachel-Carson. .
14. David Eckstein, V.K. Global Climate Risk Index 2020. 2019; Available from: https://www.germanwatch.org/en/17307.
15. Masood, M., et al. , "Assessment of Real-Time, Multi-Satellite Precipitation Products under Diverse Climatic and Topographic Conditions." Asia-Pacific Journal of Atmospheric Sciences 2019: p. 1-15.
16. Anjum, M.N., Ding, Y., Shangguan, D., Ijaz, M. W., & Zhang, S. , Evaluation of high-resolution satellite-based real-time and post-real-time precipitation estimates during 2010 extreme flood event in Swat River Basin, Hindukush region. Advances in Meteorology, 2016.
17. Mudgal, D., Ahuja, L., Singh, S. and Prakash, S., Evaluation of corrosion performance of Superni 600 hung in secondary chamber of medical waste incinerator operating at 1050° C. Materials at High Temperatures,. 2017. 1(34): p. 45-52.
18. Caniato, M., Tudor, T. and Vaccari, M., International governance structures for health-care waste management: A systematic review of scientific literature. Journal of environmental management, , 2015. 153: p. 93-107.
19. Organization, W.H., Air quality guidelines for Europe. 2010.
20. Adama, M., Esena, R., Fosu-Mensah, B. and Yirenya-Tawiah, D., Heavy metal contamination of soils around a hospital waste incinerator bottom ash dumps site. Journal of environmental and public health,, 2016.
21. Anamul, H.M., Rahman, J. and Tanvir, M., Zn and Ni of Bottom Ash as a Potential Diffuse Pollutant and their Application as "Fine Aggregate". . Journal of Civil Engineering Research, , 2012. 2(6): p. .64-72.
22. Grochowalski, A., PCDDs and PCDFs concentration in combustion gases and bottom ash from incineration of hospital wastes in Poland. Chemosphere,. 2010. p. 2279-2291.
23. Zhao, L., Zhang, F.S., Chen, M. and Liu, Z, Typical pollutants in bottom ashes from a typical medical waste incinerator. Journal of Hazardous Materials,, 2010. 1-3(173): p. 181-185.
24. Auta, T.I.M.O.T.H.Y.a.M., O.A., Heavy metal concentrations around a hospital incinerator and a municipal dumpsite in Ibadan City, South-West Nigeria. Journal of Applied Sciences and Environmental Management, , 2013. 3(17): p. 419-422.
25. Anastasiadou, K., Christopoulos, K., Mousios, E. and Gidarakos, E., Solidification/stabilization of fly and bottom ash from medical waste incineration facility. Journal of Hazardous Materials,, 2012(207): p. 165-170.
26. Komilis, D., Fouki, A. and Papadopoulos, D, Hazardous medical waste generation rates of different categories of health-care facilities. Waste Management, . 2012. 7(32): p. 1434-1441.
27. Lee, J.Y., Yoo, C., Jun, S.Y., Ahn, C.Y. and Oh, H.M, Comparison of several methods for effective lipid extraction from microalgae. Bioresource technology, , 2010. 1(101): p. S75-S77.
28. Mallett, S.R., Danta, R.C., Benson, J.R., Corey, A.D., Davidner, A.A. and Regla, P, Combination disposal and dispensing apparatus and method. , V.M. LLC, Editor. 2012.

29. *Hossain, M.S., Santhanam, A., Norulaini, N.N. and Omar, A.M., Clinical solid waste management practices and its impact on human health and environment–A review. . Waste management,, 2011. 4(31): p. 754-766.*
30. *Mathur, V., Dwivedi, S., Hassan, M.A. and Misra, R.P, Knowledge, attitude, and practices about biomedical waste management among healthcare personnel: A cross-sectional study. Indian journal of community medicine: official publication of Indian Association of Preventive & Social Medicine, 2011. 2(36): p. 143.*
31. *Abah, S.O.a.O., E.I., Healthcare waste management in Nigeria: A case study.,. Journal of Public health and Epidemiology, 2011. 3(3): p. .99-110.*
32. *Patwary, M.A., O'Hare, W.T. and Sarker, M.H.,, Assessment of occupational and environmental safety associated with medical waste disposal in developing countries: a qualitative approach. . Safety science,, 2011. 8-9(49): p. 1200-1207.*
33. *Babanyara, Y.Y., Ibrahim, D.B., Garba, T., Bogoro, A.G. and Abubakar, M.Y., Poor Medical Waste Management (MWM) practices and its risks to human health and the environment: a literature review., . Int J Environ Ealth Sci Eng, 2013. 7(11): p. 1-8.*
34. *Ferreira, V.a.T., M.R.,, Healthcare waste management practices and risk perceptions: findings from hospitals in the Algarve region, Portugal. , . Waste management,, 2010. 12(30): p. .2657-2663.*
35. *Albuquerque, M., Coutinho, M. and Borrego, C, Long-term monitoring and seasonal analysis of polycyclic aromatic hydrocarbons (PAHs) measured over a decade in the ambient air of Porto, Portugal. . Science of the Total Environment,, 2016(543): p. 439-448.*
36. *Janagi, R., Shah, J. and Maheshwari, D, Scenario of Management of Medical Waste in US and UK: A Review., . Global Trends Pharm. Sci, 2015(6): p. 2328-2339.*
37. *Kitchen, H.J., Vallance, S.R., Kennedy, J.L., Tapia-Ruiz, N., Carassiti, L., Harrison, A., Whittaker, A.G., Drysdale, T.D., Kingman, S.W. and Gregory, D.H., Modern microwave methods in solid-state inorganic materials chemistry: from fundamentals to manufacturing. . Chemical reviews,, 2013. 2(114): p. 1170-1206.*
38. *al., A.e., Floating wetlands for wastewater treatment. Nature sustainability, 2019. 2(9).*
39. *Nusrat, R. Covid-19 & Wastewater: Mitigating the Outbreak Using Wastewater-based Epidemiology. 2020; Available from: https://strafasia.com/covid-19-wastewater-mitigating-the-outbreak-using-wastewater-based-epidemiology/.*
40. *HEALTH RISKS FROM DRINKING DEMINERALISED WATER. National Institute of Public Health.*
41. *Nutrients in Drinking Water, in Water, Sanitation and Health Protection and the Human Environment. 2005, World Health Organization: Geneva.*
42. *Guidelines for Canadian Drinking Water Quality: Guideline Technical Document – Total Dissolved Solids (TDS), H. Department, Editor. 2009, Government of Canada.*
43. *Woodard, J. What is TDS in Water & Why Should You Measure It? 2021; Available from: https://www.freshwatersystems.com/blogs/blog/what-is-tds-in-water-why-should-you-measure-it.*
44. *What is water pollution? ; Available from: https://www.nationalgeographic.org/media/what-water-pollution/.*
45. *Denchak, M. Water Pollution: Everything You Need to Know. 2022; Available from: https://www.nrdc.org/stories/water-pollution-everything-you-need-know.*
46. *Social Determinants of health, WHO, Editor.*
47. *Buteau, S.G., Xiaohuib; Labelle, Remib; Smargiassi, Audrey, Review of the effect of air pollution exposure from industrial point sources on asthma-related effects in childhood. Environmental epidemiology, 2019. 3(6).*
48. *D. D. Mara, R.G.A.F., Water- and Excreta-Related Diseases: Unitary Environmental Classification. Journal of environmental engineering, 1999. 125(4).*
49. *Frank, M.J.W., Frank, M. J. W., Bargeman, G., Zwijnenburg, A., & Wessling, M., Capillary hollow-fiber nanofiltration membranes. Separation and purification technology. 2001. 22(23): p. 499-506.*
50. *de Grooth, J., A tale of two charges: zwitterionic polyelectrolyte multilayer membranes. Enschede: Universiteit Twente. . 2015.*
51. *STOWA, T., Waterschap De Dommel, Costs of removal of micropollutants from effluents of municipal wastewater treatment plants. 2015.*
52. *al., M.e., Evaluation of advanced oxidation processes for water and wastewater treatment — A critical review. Water Research, 2018. 139: p. 118-131.*
53. *Methan Hydrate- A new energy source discovered off andhra coast. Available from: https//www.nationalheraldindia.com/national/methane-hydrate-a-new-energy-source-discovered-off-andhra-coast.*

Earthly Perspective

For the only habitable planet, people and beyond

/ earhtlyperspectivemagazine

/ earthlyperspectivemagazine2020

/ magazineearthly

www.earthlyperspectivemag.org