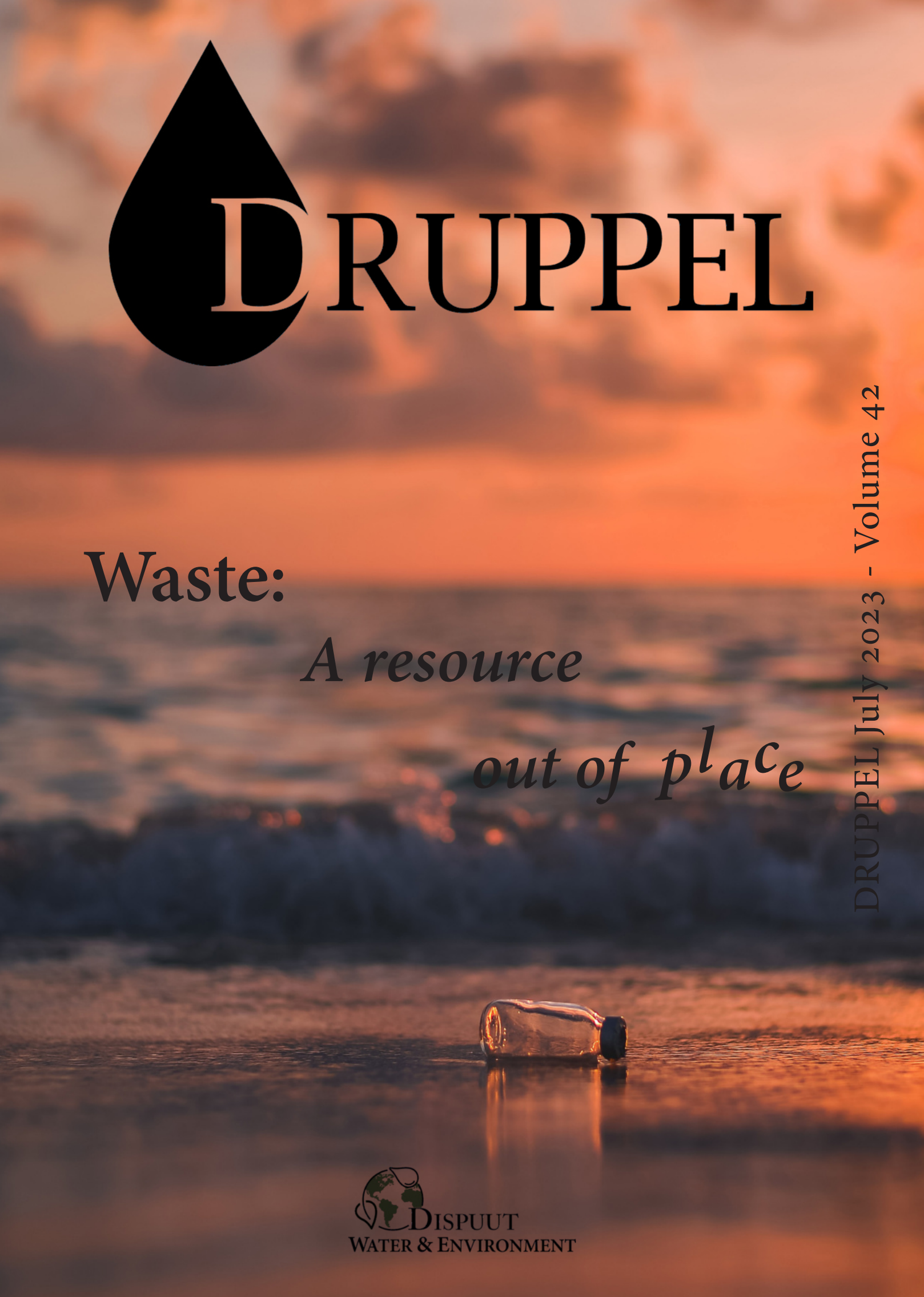
DRUPPEL

Waste:

A resource out of place



DRUPPEL July 2023 - Volume 42

DISPUUT
WATER & ENVIRONMENT

The colophon

June 2023

The Druppel is a magazine of the student society of the master's degree Watermanagement and Environmental Engineering of the TU Delft. The magazine is published two to three times a year.

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The Druppel is distributed to all members and relations of the Dispuut Water & Environment, faculty of Civil Engineering and Geosciences of the TU Delft.

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From the Editors

In September 2022, the TU Delft decided to start a new Master's Programme - MSc Environmental Engineering. The programme has three tracks for students to specialise in - Atmospheric Environmental Engineering, Water Resources Engineering and Resource and Waste Engineering. In this edition we focus on engineering solutions that minimise the depletion of natural material resources and the impact of waste on human health and the environment.

Enjoy!


Sejal Dangi


Ragashree Srinivas


M. Erica Biagini


Sophie Verheugd


Marchien Boonstra

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From the board

Dear Members, Staff, and Partners,

Another quarter has flown by and we are thrilled to share some highlights from (last part of) Q3 and Q4. From fun activities to insightful events, it's been a memorable few months.

We ended Q3 with Dispuut weekend in Almere where 45 of our members joined! Thank you to everyone for making it unforgettable! April was a busy month filled with board games, Easter-, Gala- and Fitterij-themed cookie breaks, lunch lectures, and three brand-new board members!

We kicked off May with a relaxing art event where our members gathered in the Freezone F to unleash their creative potential and showcase their cultural pride. This was followed by the Fitterij where approximately 15 teams competed in a pipe fitting contest ending the day with a fun BBQ. May ended on a high with the Gala, which was held on a boat in Rotterdam. With good food and energetic music, it was indeed a jolly night.

To ensure that the interests of the students from the new Master track, Waste & Resource Engineering, are met, the PR Committee worked tirelessly to organize a Master Business Event catered specifically to these students. Finally, we ended the year with a BBQ and department outing where we showed off our line-dancing abilities.

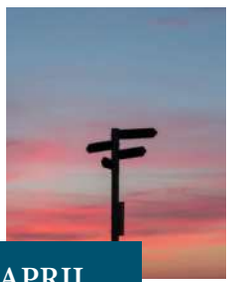
As you can read, our committees have not been sitting still. Great work everyone, and thanks for a memorable Q3 and Q4! A big thank you to our partners too, because all of the above would not have been possible without their support. Don't forget to regularly check our website and the pinboard to stay up to date with all the career opportunities they provide.

Finally, we invite everyone to make the next year equally great. The Dispuut has exciting events lined up, so don't miss out! Also, don't forget that we value everyone's opinion and that we are more than open to hearing about any ideas, problems, or suggestions that you have to keep improving the Dispuut. You are welcome at the Hok at any time! There is also the anonymous suggestion box on the mug shelf outside the Hok.

Board 73
Ine, Jonathan, Sejal, Noor, Dwiva, Erica, and Christine

Events

Recent Events



25th
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25th
Q4 Drinks

APRIL

MAY

2nd
Art Session
12th
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26th
Gala

1st
Master's Business Event
(Resource & Waste)
7th
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Companies

Hoogheemraadschap van Delfland

dunea DUIN & WATER

Deltares

waternet
waterschap amstel gooi en vecht
gemeente amsterdam

ARCADIS Design & Consultancy for natural and built assets

Royal HaskoningDHV
Enhancing Society Together

PAQUES

Evides waterbedrijf

HKV LIJN IN WATER

UNIE VAN WATERSCHAPPEN

Witteveen+Bos

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wln water · onderzoek · advies

Nelen & Schuurmans

ambient

Vewin
Vereniging van waterbedrijven in Nederland

waternet
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gemeente amsterdam

Resource and Waste Engineering at water utility Waternet

By Jan Peter van der Hoek
Chief Innovation Officer Waternet,
Professor Drinking Water Engineering Delft University of Technology

Introduction

Waternet is the water utility of Amsterdam and surroundings. It is responsible for all water related activities: drinking water supply, sewerage, wastewater treatment, surface water management, groundwater management, and control of shipping and inland waterways, including the control of the water quality in the canals of Amsterdam. Topics as Circular Economy and Energy Transition are high on the agenda of Waternet, also on the Research & Innovation agenda. The combination of drinking water treatment and wastewater treatment offers challenging opportunities for Resource and Waste Engineering.

Waternet operates two drinking water production plants and eleven wastewater treatment plants, and serves about 1.3 million customers. In total about 95 million m3/year drinking water is produced and 125 million m3/year wastewater is treated. Drinking water production and wastewater treatment result in specific residues. While they were considered as wastes in the past, nowadays they are considered as valuable residues. Smart engineering solutions give value to these residues and help Waternet to realize the ambitions related to the Circular Economy and Energy Transition.

Known examples, already applied in practice, are struvite recovery from wastewater and calcite recovery from drinking water. Both have ben implemented full-scale in the treatment plants of Waternet. In the WWTP Amsterdam-West about 1000 tons/year struvite is recovered from the sludge by dosing magnesium chloride to the sludge, resulting in the controlled precipitation of struvite, $NH_4MgPO_4.6(H_2O)$. The investment costs were € 4 million, while the savings are € 400,000/year as no clogging in the sludge line takes place due to the controlled precipitation. In both drinking water treatment plants pellet softening is applied: a process to reduce the hardness of the water. By using ground calcite as seeding material, pellets are produced which can be reused in the softening process and also be applied in the industry. The principle of this process is shown in Figure 1.

As mentioned above, the combination of drinking water treatment and wastewater treatment in one water utility offers additional opportunities. Three examples will be discussed to show these opportunities.

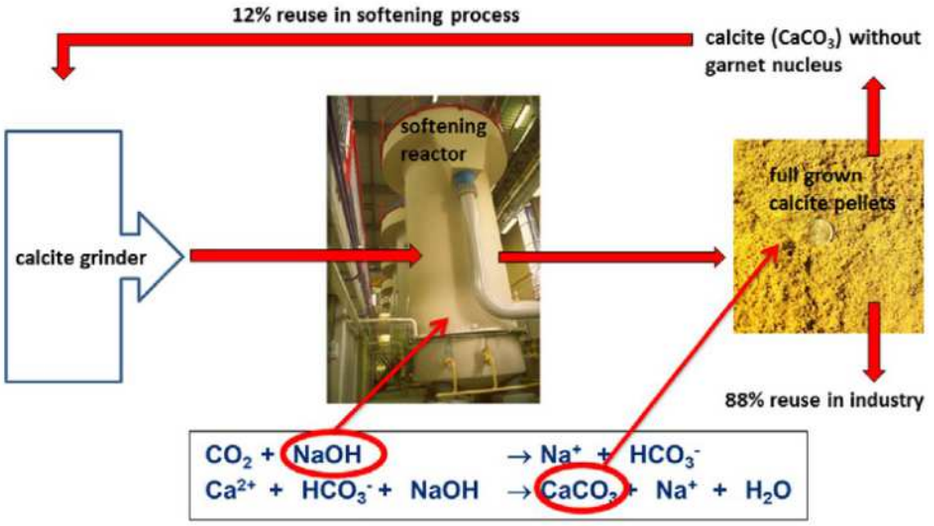

Figure 1: The principle of calcite recovery in drinking water production.

Magnesium from drinking water production used in wastewater treatment for struvite production

Waternet has to increase the drinking water production capacity in the near future due to a growing drinking water demand. One of the possibilities is the use of brackish seepage water in the Horstermeer, a polder near Hilversum. Brackish water results in a low water quality in the polder. One of the options is to "catch" this water (6-8 million m3/year) by interception wells before it reaches the surface water. This brackish water can be used as a source for drinking water production. However, to desalinate this water reverse osmosis (RO) is required. That is where Resource and Waste Engineering comes in. Reverse osmosis results in a concentrate with a relatively high salt content, including magnesium salts. At the same time a magnesium salt, $MgCl_2$, is dosed at WWTP Amsterdam-West in the sludge line for struvite recovery. It may be attractive to recover magnesium salts from the concentrate in the drinking water production process and use it for struvite recovery in the wastewater treatment. Figure 2 shows the principle of this approach. A first study has been done by a MSc student, Divvay Mehta, and he has proven that it is technically feasible by using an ion exchange process to remove magnesium from the RO concentrate. In a next study the financial feasibility and the sustainability will be assessed.

Bio-composite material production from calcite and cellulose

Bio-composite materials are becoming a sustainable alternative on the global market. Bio-composite material can be made from natural ingredients collected from sustainable resources like natural fibres from cellulose from crops or waste paper and glued together with a resin. The use of bio-composite materials will reduce the negative environmental impact compared to the use of composite materials made from polymeric resin and synthetic fibres. Waternet, Delft University of Technology and the Dutch company NPSP work together in the European project Wider Uptake to produce a bio-composite material made from cellulose fibres recovered from wastewater, natural fibres recovered from grass, reeds and aquatic plants collected during surface water management, and calcite (as filler) recovered from drinking water. Once recovered, these raw materials are glued together with different types of resins. The mixed product is moulded using high pressure and temperature into a bio-composite material. A new material like the one described here can have

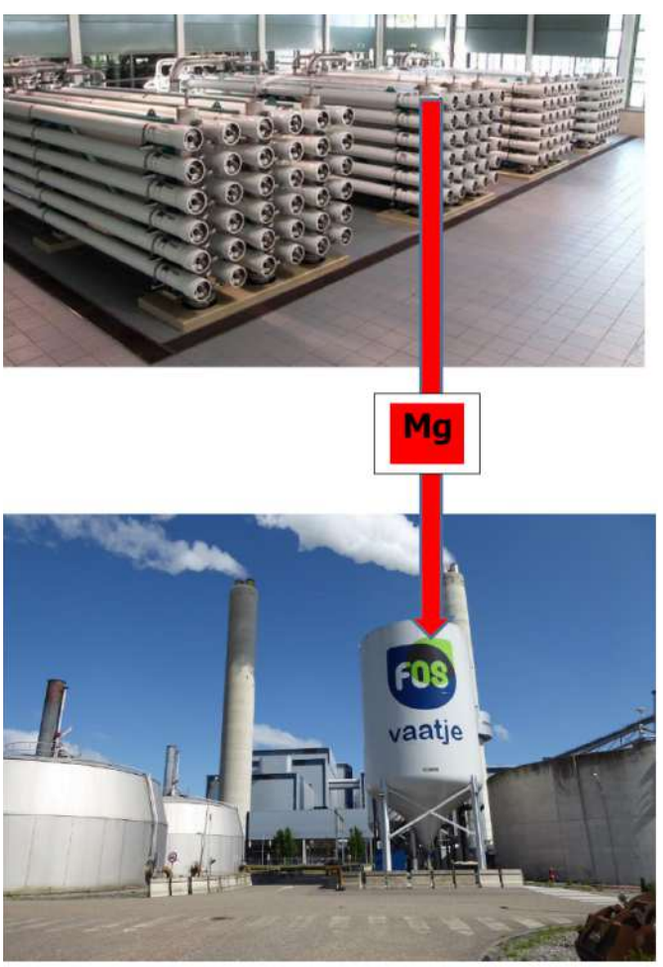

Figure 2: Magnesium recovery from a drinking water production reverse osmosis plant for struvite recovery from wastewater.

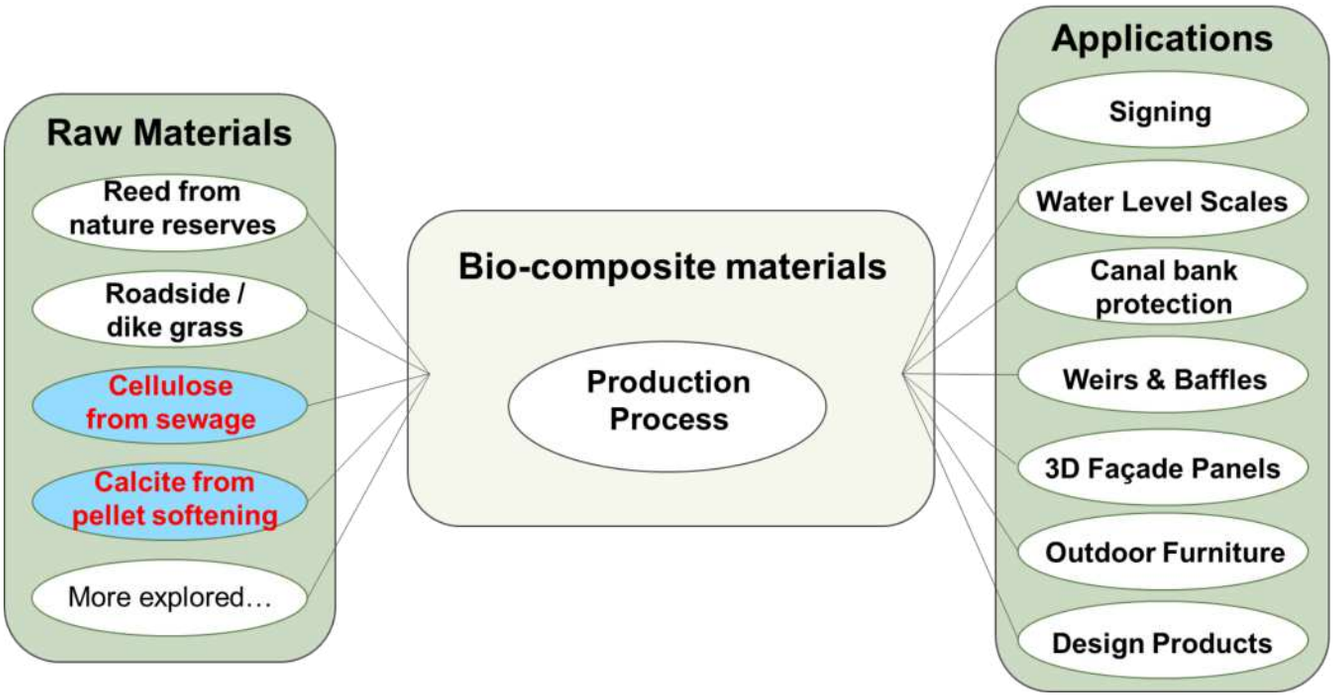

Figure 3: From water treatment and water management residuals to bio-composite material application.

multiple applications such as building construction elements for riverbank protection, creating nautical signs or elements for building facades. Figure 3 shows the process scheme from raw materials to applications. Two PhD students of Delft University of Technology, Anurag Bhambhani and Arianna Nativo, and a postdoc student, Oriana Jovanovic, are involved in this project. They focus on chemical and microbial risk assessment, and circularity and sustainability assessment of bio-composite material production. It is a nice example of combining residues from drinking water treatment, wastewater treatment and surface water management into a high value product.

Using WWTP effluent as source for drinking water production: the Ultimate Water Factory

Recently the RIVM (National Institute for Public Health and the Environment) published the report "Water availability for drinking water production up to 20230: difficulties and solutions". Dutch demand for drinking water is expected to be substantially higher in 2030 than in 2020. Reasons for this include a growing economy and expanding population. Climate change (with warm summers) will push demand for drinking water up even as availability goes down. It is estimated that 100 million m^3 more drinking water will be needed in 2030 relative to 2020.

At the same time a new European Urban Wastewater Treatment Directive will come into force. According to that directive the standards for nitrogen and phosphorous in the wastewater effluent will be tightened, while new standards will be introduced for pharmaceuticals and organic micropollutants in the treated wastewater.

That is where Resource and Waste Engineering comes in. On the one hand we need new sources for drinking water production, and on the other hand we have to treat wastewater to a higher effluent quality. Is it possible to use the high quality WWTP effluent as (additional) source for drinking water production? In March this year a consortium of regional water authorities, drinking water utilities and research institutes (KWR Water Research Institute and STOWA) has been established to assess and evaluate this new possibility: "The Ultimate Water Factory". Waternet is a partner in this consortium. We know that technically it is feasible: in Windhoek, Namibia, wastewater has already been used as source for drinking water production since 1968, and in Singapore the NEWater process was launched in 2003. It recycles the treated used water into ultra-clean, high-grade reclaimed water, cushioning the water supply against dry weather and moving Singapore towards sustainability. But what about the acceptance by the customers in the Netherlands? And does it comply with the Dutch drinking water regulations? And does it have effects on the water system as the effluent is not discharged to the surface water but directly reclaimed for drinking water? And what about the economic feasibility? Challenging questions that have to be answered the coming years!

Conclusions

Resource and Waste Engineering is vital for water utilities to contribute to Circular Economy and Energy Transition ambitions. Water management and water technology offer a lot of possibilities. Waternet already implemented some possibilities, and carries out research, in collaboration with Delft University of Technology, to find new and innovative solutions.

Building a Resilient Future

Protecting Nature and Empowering Generations

Around the world, we're feeling the effects of climate change, rapid urbanization, loss of biodiversity. The rate at which we're seeing large-scale, unforeseen events such as floods and wildfires, is becoming more frequent. We need to help our cities and communities. To create healthier lives, thriving nature a more resilient future. We are here to protect our natural environment and water resources, while powering our world for future generations. Managing water resources in a sustainable way by offering complete services throughout the entire water cycle, from water supply to water resource planning, treatment, and systems optimization. We help create intelligent water networks and advanced asset management strategies, as well as advising on water re-use and desalination for both public and private clients.

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Together, we can create a legacy

The Journey of Waste: Understanding Landfills by the CURE Project

By Liang Wang (L.Wang-10@tudelft.nl), Nathali Meza (P.N.MezaRamos@tudelft.nl), Cristhian Andrade (c.f.andradecorona@tudelft.nl).*

*All authors contribuited equally

Picture your birthday celebration, complete with cake, drinks, balloons, confetti, and gifts, all organized by your best friend. The day after, you tidy up and dispose of the waste in the appropriate containers. This waste, collected by a waste truck, eventually ends up in waste management facilities, with a significant portion finding its way to a landfill. Currently, this is the case in many parts of the world, and it was the same picture in the Netherlands until 1996; after that year Dutch legislation strengthen recycling and incineration as major practices to handle the waste.

But what is a landfill? A landfill is like an engineering hill, it looks like a green and beautiful hill outside, but inside there is waste degrading until it is stable. The landfill has engineering considerations to protect the environment and it can occupy big areas. Imagine 40 central stations of Delft, well, that can perfectly be the area of a landfill.

Waste generated at home if not recycled or incinerated often

embarks on a journey lasting longer than our lifetimes. For instance, plastics can take several hundred years to degrade, and the amount of waste produced each year is staggering. In the United States alone, over 200 million tonnes of waste were generated in 2013. When extrapolated globally, this number increases to over 800 million tonnes of municipal solid waste generated annually. Population and consumption are increasing worldwide, and consequently waste production.

Most waste is recycled, incinerated, or landfilled, with the latter being the most common destination in many countries. Over time, when waste degrades, landfills produce harmful substances such as methane (a strong greenhouse gas) and leachate (landfill wastewater that can be contaminated). Conventional landfills are not a sustainable solution and present challenges like limited storage and long-term environmental impacts.

To protect human health and the environment, landfill aftercare is essential. Landfill operators implement measures to decrease landfill emissions and ensure compliance with regulations. The common approach in most parts of the world is to isolate the waste through the use of bottom liners and surface sealings. However, these artificial constructions have a limited lifespan and need to be periodically replaced to ensure continued protection. In The Netherlands, the standard practice for landfill aftercare involves covering the landfill with a surface sealing, which must be periodically renewed to prevent the leaching of pollutants. Current legislation on landfill aftercare does not specify when this monitoring can end, placing the burden of cost and environmental damage on future generations. This approach is not sustainable and falls short of meeting sustainability definitions.

By reducing the need for landfill aftercare, it may be possible to lower maintenance costs and enable the reuse of land for other purposes. However, aftercare can only be reduced if we can guarantee that the current and long-term emissions are negligible and pose no environmental risks. Proper landfill stabilization techniques can make the landfill an environmentally friendly structure that can be used for other purposes. In addition to the physical stabilization measures, predictive models should be used to assess the feasibility of reducing aftercare requirements.

Aeration and leachate recirculation are techniques that can help to mitigate conventional landfill-related problems. These methods introduce air and recirculate leachate within the landfill (Figure 1), accelerating waste degradation and thereby emissions via the gas and leachate, which can then be collected and treated, leading to a stabilized waste body within a much shorter time. Oxygen within the air speeds up biochemical reactions, and some pollutants can be flushed out or be further degraded by microorganisms when leachate recirculates in the landfill.

The CURE project (Coupled multi-process research to reduce landfill emissions) is a collaboration between academic institutions such as TU Delft, Wageningen University, University of Southampton, University of Delaware, TU Dresden, and industry partners like the Dutch landfill operators Afvalzorg and Attero. The project aims to identify, describe and predict the emission of pollutants into the environment. By this, it would be possible to know when it is safe to reduce aftercare and ensure that people and natural resources are safeguarded from landfill pollutants. The project researches three full-scale landfills, two of them under aeration and one under leachate recirculation. The goal is to understand the effects of aeration and leachate recirculation on the biological, chemical, and physical processes in landfills through field measurements, laboratory experiments, and modeling. Then, the environmental risks from such sites can be better understood, predicted, and managed.

Fieldwork entails measuring and characterizing landfill gas, leachate, and temperature, with sensors installed to automatically record data like gas flow and composition and leachate flow rates. GPS measurements and drone-based LiDAR (Light Detection and Ranging) surveys detect surface settlement. Electrical Resistivity Tomography (ERT)

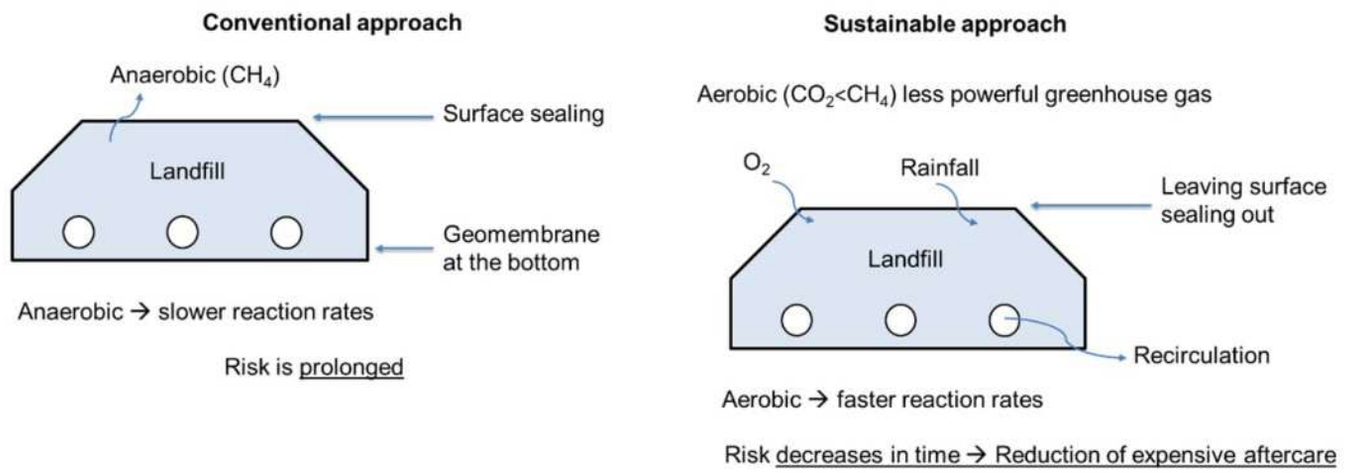


Figure 1: Conventional versus sustainable landfill management approach. The image shows that leaving the membrane out at the top allows oxygen and rainfall to percolate into the waste material. Also, leachate can recirculate from the bottom (drains collection system) to the top. In the conventional approach the surface sealing prevents the input of fluids.

Figure 2: PhD students of the CURE project at TU Delft (Left: Liang Wang, Center: Nathali Meza, Right: Cristhian Andrade).

and fibreoptics for Distributed Temperature Sensing (DTS) allow for the monitoring of moisture and temperature in the waste subsurface.

Laboratory experiments simulate landfill behavior on a smaller scale to examine various waste stabilization approaches. For example, it is possible to perform gas production tests or analyze waste behavior under different boundary conditions. These experiments and field data are used in models to calibrate model parameters, and ultimately, to better understand landfill changes resulting from in-situ stabilization, such as consolidation, fluid transport properties, or the behavior of pollutants such as ammonium and the future emission potential.

The CURE project offers potential applications for sustainable landfill management. The sustainable landfill concept can be applied worldwide to both existing and new landfill designs. It can be adapted for different countries and landfill conditions, offering environmental benefits like reduced greenhouse gas emissions, pollution prevention, and repurposing stabilized landfills for community use, such as cycling tracks and other amenity areas.

Figure 3: An ERT (Electrical resistivity tomography) experiment to quantify landfill water content.

Waste treatment is a complex process involving multiple stakeholders and physical and biochemical processes. While proper waste disposal is essential, there are other ways to address the issue of waste generation. Recycling is undoubtedly an excellent strategy to reduce waste and promote a more sustainable future. However, consuming less, especially when it comes to disposables, is even more critical. This advice applies universally, regardless of where you are on the planet or what level of waste management you are subjected to. So, the next time you dispose of your trash in the bin, it is better to think twice. You can ask yourself if it is worth producing that waste. Because it might be there forever, keeping future generations busy with and paying for the consequences of its disposal!

Figure 4: Landfill under aeration. Source: Afvalzorg.

The Nuclear Waste Condrum: Interview with Prof. Philip Vardon

Interviewed by M. Erica Biagini & Ragashree Srinivas, March 2023

"Regardless of whether you are for or against nuclear power, and no matter what you think of nuclear weapons, the radioactive waste is already here, and we have to deal with it."- Gerald S. Frankel, materials scientist, Ohio State University. Nuclear energy is seen as a lucrative alternative for energy production. However, dealing with the radioactive waste it generates is still a challenge. Currently research is directed towards finding sustainable and safe ways of storing these wastes. Let's dive into it with Philip Vardon, Professor at Geoscience and Engineering Department of TU Delft and his thoughts on sustainable radioactive waste management.

About Prof. Dr. Philip Vardon

Phil is a Professor in the Section of Geo-Engineering and the Department of Geoscience and Engineering. He leads the department theme in Geothermal Science and Engineering. His research is into complex coupled processes in the subsurface and focuses on the impacts on geomaterials of various processes including heat, moisture and contaminant movement, including practical applications such as geothermal energy, slope stability and radioactive waste disposal.

How does the Netherlands deal with radioactive waste?

The waste is currently stored in interim storage in Zeeland and is managed by a company called Covra NV. They collect and store different types of radioactive waste in different ways. There is a warehouse where they store the low-level radioactive waste and high-level waste is stored underground or overground in concrete bunkers. One of the key things in radioactive waste management is to keep the high-level radioactive waste cool. In the Netherlands, a passive system is used. Currently, we produce only small quantities of waste, but of course if we start generating energy from new nuclear plants then we will have higher waste quantities. After some time, when a sufficient amount of waste is collected, and the heat production from the high-level waste is lower, the plan is to dispose of radioactive waste is the subsurface. The plan is that the waste is buried around 500m underground, such that it is isolated from the biosphere. The subsurface disposal will be carefully designed, with both a natural geological barrier and a multi-component engineered barrier. Funding is collected for such a facility, based on the production of energy. It is currently planned to build a repository in 2130. Yes 2130, not 2030 which means the waste will have a significant cooling period.

Does the Netherlands have any nuclear energy plants?

We have one in Borssele, in Zeeland. Unsurprisingly enough,

this is close to the waste storage facility. This is helpful because it cuts down on the transportation time. We also have two research reactors: one in Delft and another one in Petton which is located north of Amsterdam. There are also plans to build new nuclear power stations.

What do you expect would be a realistic scenario for radioactive waste storage since you mention plans for new plants are in the works?

We make radioactive wastes from all sorts of uses, including medical applications, although power stations contribute the major part. All of this waste needs to be collected and is sent to either temporary storage or permanent disposal facilities. If we make new power stations, we would definitely need to expand current plans. It can mean that we have much more waste stored temporarily which is not ideal. We also have a moral responsibility to deal with waste generated when we have benefited from the resource, and not pass this problem onto future generations. This is also built into the new European Taxonomy on climate friendly energy activities where you see that they want to include nuclear energy under certain conditions, given that it can contribute low carbon energy. However, it is also included that there must be repositories operating much, much earlier, i.e., by 2050. This is good because then you are not passing problems on to future generations.

We regularly see arguments for a good location of a radioactive waste disposal site. A good location is not just about geology, right? It is also about people. How do you optimise between the two?

A radioactive waste disposal site needs to ensure safety; however, the good news is that the geology across a large amount of the country can provide this. A radioactive waste disposal site can bring in a lot of jobs, but you will have radioactive waste being transported into your location. Often what you see is that waste disposal sites in different countries are chosen to be close to existing power stations because of two reasons. One is that the communities are used to nuclear technologies, and they are comfortable with how systems work that can protect from radioactivity. The second is that by transporting your waste a lower distance there is a much lower risk. So both geological and social aspects play a vital role in site selection.

What is the difference in amount of waste produced from nuclear plants and coal fired plants?

If you look at how much waste a coal fired or gas fired power station makes in terms of carbon dioxide and ash (in the case of coal power) it is enormous in comparison to nuclear power. However, the toxicity and impact of the waste is different. For instance, a nuclear plant will produce equivalent to a mobile phone size amount of uranium waste to provide enough power for your entire lifetime. But you wouldn't necessarily want to stand close to it, right, as it is highly radioactive? Whereas if you had a pile of ash from a coal fired power station, it would be okay. Nuclear plants produce a very concentrated waste product which requires very little area to dispose it but it lasts in a potentially damaging way for a very long time whereas ash is not as damaging. There is a difference with the amount of effort, expense and resources you need to dispose of radioactive waste when compared to the same amount of waste from coal fired plants.

What was your motivation behind pursuing this topic?

I was drawn to this topic because it has challenges, uncertainties and many unknowns. You have these very long-time scales and it is actually very hard to really validate what's going on. You have to make predictions and find different ways to see whether the predictions make sense - for example conduct big experiments which leads to generation of a lot of data. Then you do numerical simulation, see if you understand it. And you have to look at what happens hundreds of years or thousands of years in the future. Which is very interesting to me!

Do you have any anecdotes on some of your very exciting research experiences?

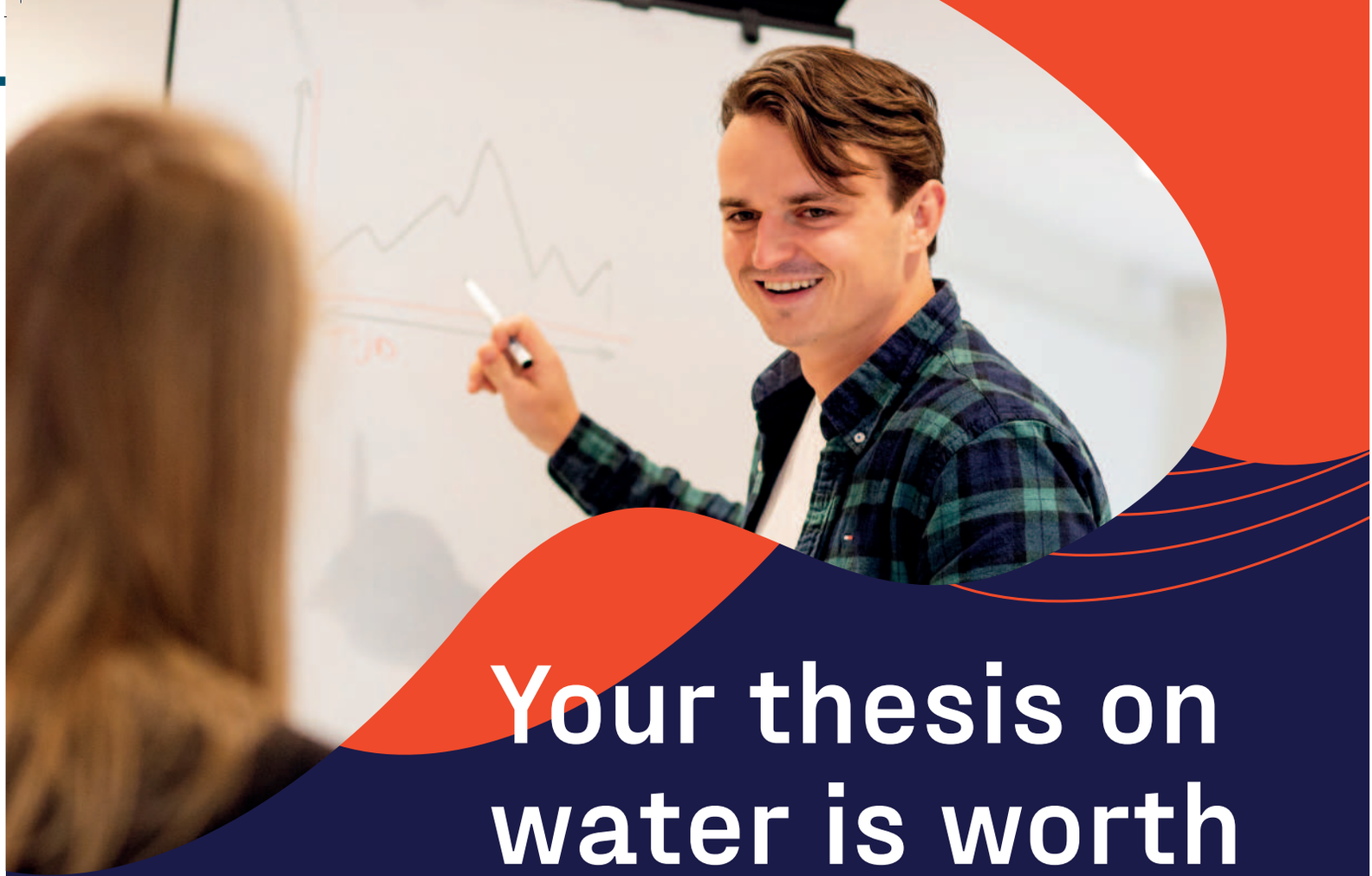
Last spring, we installed a 500 meters deep monitoring well and also tried to collect samples relevant for geothermal energy. As an academic, I often sit in my office and do numerical simulations, small scale things. So, actually being involved in real full-scale projects with drilling rigs, with on-ground things like that is quite exciting. It's amazing.

And then are there any Hobbies that help you to destress something?

I have a six-year-old child that takes up quite some time, but then I do a variety of sports. I do some running, cycling, play squash, and attempt to keep age from catching up with me.

What advice do you have for the students?

Don't worry too much about where your future career is going. Do something interesting. There's plenty of jobs and plenty of interesting things to do, so follow what you find interesting. University is a great time to try things, to make mistakes, and to get into one subject that you like. You don't have to take everything too seriously. Not just in your study, but in life as well.



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Hoogheemraadschap van Delfland

How did we do? Interview with Vayia Kladou

Interviewed by Sejal Dangi, March 2023

What would life be if we had no courage to attempt anything new? We interviewed Vayia Kladou, one of the students who joined the Waste and Resources Track of the program to echo the sentiments of the batch and how she hopes to implement the learnings from the program to build a better, greener, and more sustainable future.

Tell us something about your background and why did you decide to join TU Delft?

When I was studying back in Greece, I was trying for Erasmus but it did not happen. I also did a Master's in Greece in Trasnportation but I wanted to see another educational system since I spent approximately 6 years at the same university. I started searching for universities and a lot of people I knew mentioned TU Delft. I knew I wanted to do Environmental Engineering but I did not still decide which university. I applied to multiple universities but eventually decided to come here because it was well ranked and I read about the multidisciplinary research that they conduct here and I was attracted to it. Apart from this, I also believed that the Netherlands would be very close to Greek culture compared to other countries. I also decided that I wanted to pursue the Waste Track because I had completed an internship previously and the track seemed attractive to me.

What were your expectations before you started the master? Is the course living up to those expectations?

In general, I had a broad expectation that I would learn about waste technologies and engineering in treatment plants. I was expecting more in depth knowledge about how processes actually work. I think they are trying to make a level playing field and trying to tell us about the different paths you can pursue as a Resource Engineer and this is good for someone who does not know what they really want to do. However, I do prefer more focused knowledge with practical applications instead of only theoretical knowledge. It is still a little bit vague for us how we would apply this theory to solve real world problems.

How has it been in the Netherlands so far for you?

When I came here, the first 2 months were very difficult since I did not have family and friends here with me. I had to take every decision by myself and it was difficult! When I went back home during Christmas, it was super nice. I like the organisation here, it is so efficient and organised. Apart from this, the university is also very structured in general and they don't disappoint you when something bad happens. They always try to support you in solving problems you might have. I love the biking culture and the country is beautiful. As the time has gone by, I have adjusted and I am much less stressed now.

What do you think the university could have done for you as an international to make the experience better for you?

Not sure if I have something specific. Perhaps the MUDE course was a bit of over work for several internationals but I could manage it. I think the idea of trying to level the playing field is very difficult since we come from such a variety of backgrounds. For example, I might spend 3-4 hours more on MUDE compared to the students who studied here which is something that should also be taken into account when the courses are designed. However, overall I am able to cope with the coursework.

Can you name one experience that stands out the most to you?

I am sharing a house with 7 other people, that's something new for me, haha. With respect to the university, I really appreciate that the university involves companies and real world cases into the curriculum design, this is something that was definitely lacking back in my university at Greece.

What's your favourite place in Delft?

I love the Delftse Hout, especially in the summer!

Evides Waterbedrijf levert 24 uur per dag, 365 dagen per jaar, veilig en schoon drinkwater aan 2,5 miljoen consumenten en bedrijven

Management Traineeship

Met een technische hbo- of wo-opleiding kun je bij ons kiezen voor een Management Traineeship. We praten dan over een intensief leertraject van drie jaar, waarin we je meevoeren langs verschillende multidisciplinaire, (inter)nationale projecten.

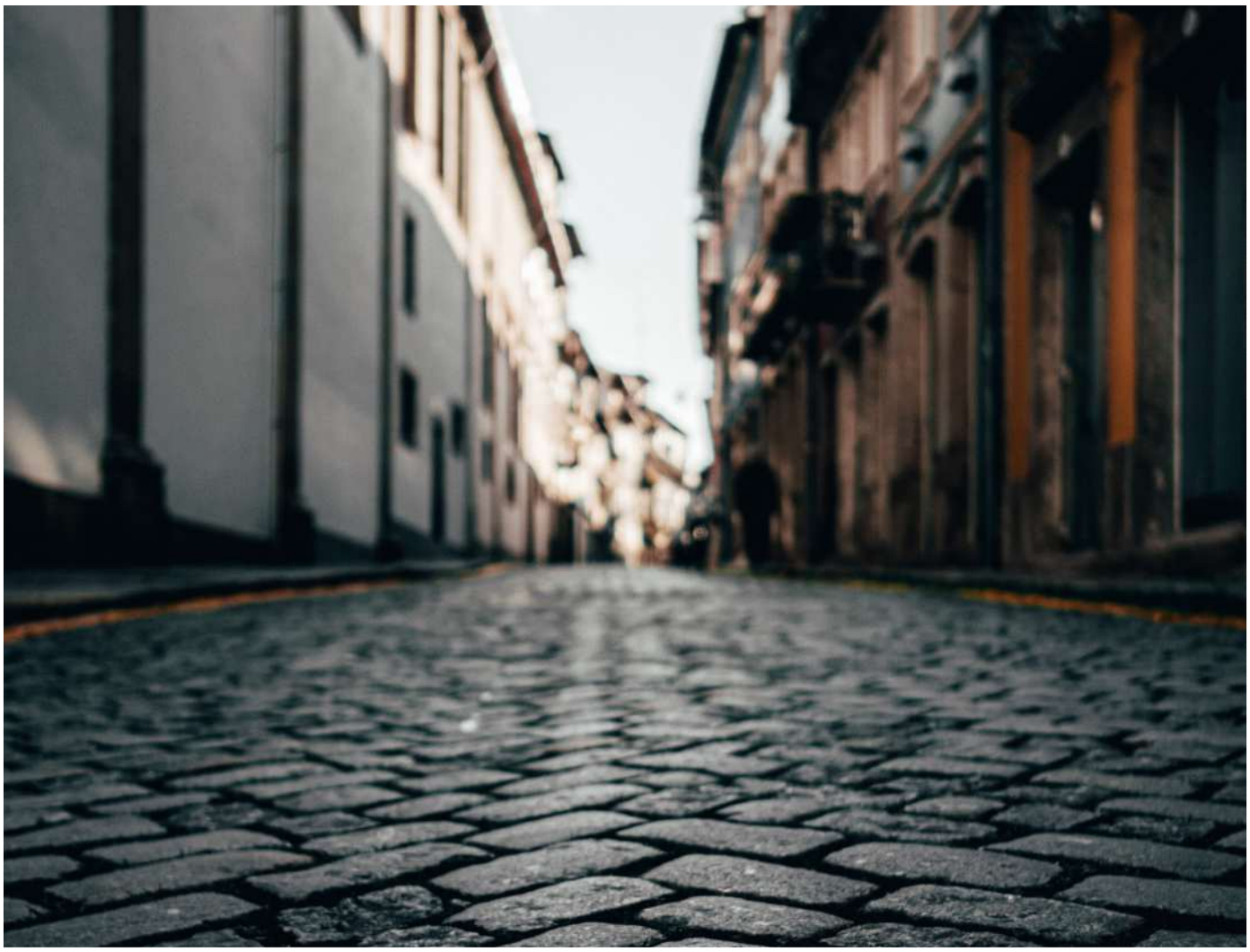
In deze 3 jaar zal je 6 opdrachten uitvoeren binnen onze organisatie. Denk bijvoorbeeld aan onderzoek op het gebied van waterkwaliteit, het realiseren van een nieuwe (transport)leiding of zelfs meewerken aan ontwikkelingsprojecten in derde wereld landen.

Tijdens je project heb je je eigen taken en verantwoordelijkheden. De projecten zijn gericht op het realiseren van vooraf geformuleerde doelstellingen binnen de verschillende vakdisciplines.
Afhankelijk van je ontwikkeling en prestaties krijg je steeds meer verantwoordelijkheid binnen de projecten.

Spring in het diepe

Als trainee krijg je de unieke kans om de verschillende aspecten van Evides als waterbedrijf te leren kennen en tegelijkertijd je inhoudelijke en persoonlijke kwaliteiten verder te ontwikkelen. Je wordt in het diepe gegooid, waarbij je altijd kunt terugvallen op een interne coach die samen met jou een persoonlijk ontwikkeltraject ingaat. Daarnaast heb je een groep van nog eens 10 andere management trainees waarmee je kan sparren. Ongekend uitdagend dus!

Interesse in ons management traineeship?
Scan dan onderstaande QR code voor meer informatie:



Circularity and Pavements: Interview with Dr. Aikaterini Varveri

Interviewed by Sejal Dangi & Ragashree Srinivas on 30 March 2023

About Dr. Aikaterini Varveri

Dr. Aikaterini Varveri is an Assistant Professor of Future Pavement Materials in the section of Pavement Engineering at Delft University of Technology. Her research mainly focuses on the areas of advanced characterization and finite element modeling of physicochemical-induced damage processes that affect the durability of (porous) asphalt pavements. She also participates as a work package leader and project manager in national and international research projects (funded by RWS, CEDR, EPSRC, Wetterskip Fryslan, etc) aimed to improve the long-term performance of bituminous materials and asphalt pavements, while minimizing their impact on the environment.

TU Delft introduced a new Master's program in 2022: MSc Environmental Engineering. The new program features three tracks: Atmospheric Environment Engineering, Resource & Waste Engineering, and Water Resources Engineering. While traditionally the Druppel has focussed on water issues, we take a slight detour this year where the second edition focuses on the why, what, and how of Resource and Waste Engineering. The track prepares students to develop engineering solutions that minimize the depletion of natural material resources and the impact of waste on human health and the environment. Dive in to know why Dr. Katerina loves studying the complex dynamics of waste management, why Resource and Waste Engineers are more important than ever now, and how you, as a student at TU Delft, can get involved in making our environments more circular and healthy.

Now that our readers have a little more background, could you tell us how did it all start for you? Why did you decide that you wanted to study environmental engineering/sustainable development? What research questions are you pursuing now?

I always wanted to become an engineer but it was not clear to me which kind of engineer. I was fascinated with the buildings around me, where I grew up. The inspiration came from my uncle. He studied environmental science. When he came to visit us since he had projects around and he used to take me with him. His work was focused on monitoring specific environmental parameters related to water. However, I was also missing - what is the next step? Once you have the data, how do you get to the solution? From here it was clear to me that I wanted to pursue environmental engineering because I wanted to focus on providing solutions. It was a natural choice.

How and why did you decide to study pavement materials? And what do you especially like about TU Delft?

After I graduated as an environmental engineer, I went on to pursue a Master's in hydraulics i.e. hydraulic with respect to the environment. Following this I continued studying sustainable approaches. But when I had to conduct an Environmental Impact Assessment of a construction structure, I realized that if I look at certain pollutants from a long-term perspective, their concentrations increased in time because the material degraded due to the environment. This interaction - not only from material to environment but also from the environment to the material - was very interesting for me. I found that as an environmental engineer, I could also work on the material degradation aspects and try to find solutions that promote sustainability. This is how I went to materials and I went on to pavements by coincidence, honestly. I was working on a highway construction project and I ended up working with pavement materials and that's how everything fell into place! I came to TU Delft as a doctoral student and I wanted to come here mostly because TU Delft was a very reputable institute for engineering. It was a good university for me to start with and after coming here I was more amazed. The environment promotes you to thrive with the various facilities, extraordinary staff, and different cultures, and in general, you have so many opportunities to try different things. The university is welcoming and you can find your own way here because there are so many different options available.

Why did the department decide to offer a separate track for Resources and Waste Engineering?

When we started thinking about the MSc Environmental Engineering program, we started thinking about what are the challenges we are currently facing in the Netherlands, in Europe, and also the world. The track, therefore, focuses on interventions you can make to manage flows and waste streams to promote sustainable development and the protection of the environment. Resources are limited some of which are critical and rare as was also evidenced during the pandemic. Our lifestyles also promote waste generation with increased consumerism and population growth. Since we resorted to single-use plastics for healthcare management during the pandemic, the amount of waste generation increased drastically. However, this also provided opportunities for the development of innovative solutions for efficient waste management.

Talking more in general, things are not going in the right direction on a global scale, and we have to use smart ways to utilize our resources optimally. Apart from this, issues of circularity are closely linked to different spheres in the environment like water, soil, and air, and therefore the introduction of the waste track was considered essential. Several professors at TU Delft are already working on different aspects of waste management but in silos. Introducing the new track also allowed us to bring together different synergies within the different departments to develop interesting projects for students.

One of the vital questions that students consider while deciding to study a subject is job prospects after graduating. What are your thoughts about the relevance of Resource and Waste Engineering to the challenges of the upcoming decades? Any insights on the type of roles can students expect to work in after graduating from this track?

The interest in resource and waste engineering will continue to rise as the population is growing and natural resources get scarcer. We conducted market research before introducing this track and there is definitely demand for Resource engineers. Job prospects in this domain can be very extensive varying from waste management, renewable energy, and waste recycling to environmental management. Depending on the student's interests and their focus areas, they can become circularity experts, waste management specialists (focusing on landfill design and management), sustainability consultants, or traditional engineers who develop solutions for separating waste and developing circular materials. Students can also focus on renewable energy since the program offers them the opportunity to do that with electives and core modules.

Moving onto research possibilities, could you tell us about the research topics the program is currently exploring? Are these projects multi-disciplinary and in collaboration with the industry?

My section works on developing circular materials for pavements for example bio-based materials. We work on utilizing biomass streams or materials that are recycled (but are technically sound) to develop new materials for pavements. Other departments are working on extracting value from waste streams and utilizing this in energy recovery processes. Several colleagues are also working on separation technologies. For example, one team is working on converting waste concrete into its constituents so that you can use these materials back in other applications. Another interesting area of research is soil remediation. There are some topics that also focus on developing frameworks for circular economy which are in collaboration in groups from Construction Management and Engineering. These topics focus on the economics and managerial aspects of waste management. All projects are indeed multidisciplinary in essence.

On a more personal note, can you describe for our readers one of your most exciting research experiences?

One of my most exciting research projects was when I worked in a team to develop ultralow noise pavements. This project was very interesting because the drive was completely societal where we tried to study actively what can be done for people living close to the highways and the noise is a source of significant disturbance for them.

From the pavement engineering point of view, we studied how could we minimize the noise by using a secondary material and eventually the idea was to use materials from waste tires. I worked with a big team of people from different sections such as contractors, noise experts, chemists, and Rijkswaterstaat (owners of the highway) since the material should be reliable in different engineering aspects. We came up with a material that produced 10 decibels less noise (which is a lot!) and had durability similar to the material we use on the highways currently. Eventually, we also conducted semi-field testing and it took us 5 years to go from ground zero to testing. The learning curve for me through this project was incredible since it spanned all areas of a project i.e. brainstorming, material development, and testing. Linking this to the coursework of the MSc Environmental Engineering program, students will learn concepts of valorization of waste and new material development which they could apply to work on similar socially-relevant projects.

To end on a lighter note, how do you destress at the end of a day? Any hobbies that you particularly enjoy?

In general, I like anything that I can make with my hands. If I have a raw material and I can create something out of it, then I will enjoy it. I like pottery, cooking, gardening… anything that I can do with my hands, it relaxes me. I sometimes pick up embroidery or knitting when I find the time. It does not matter to me if I finish or not or if I am organized with it but little progress on these activities helps me empty my mind. Yoga also helps me calm me down. I also like reading but if I really have to choose, I would pick something where I create something, haha!

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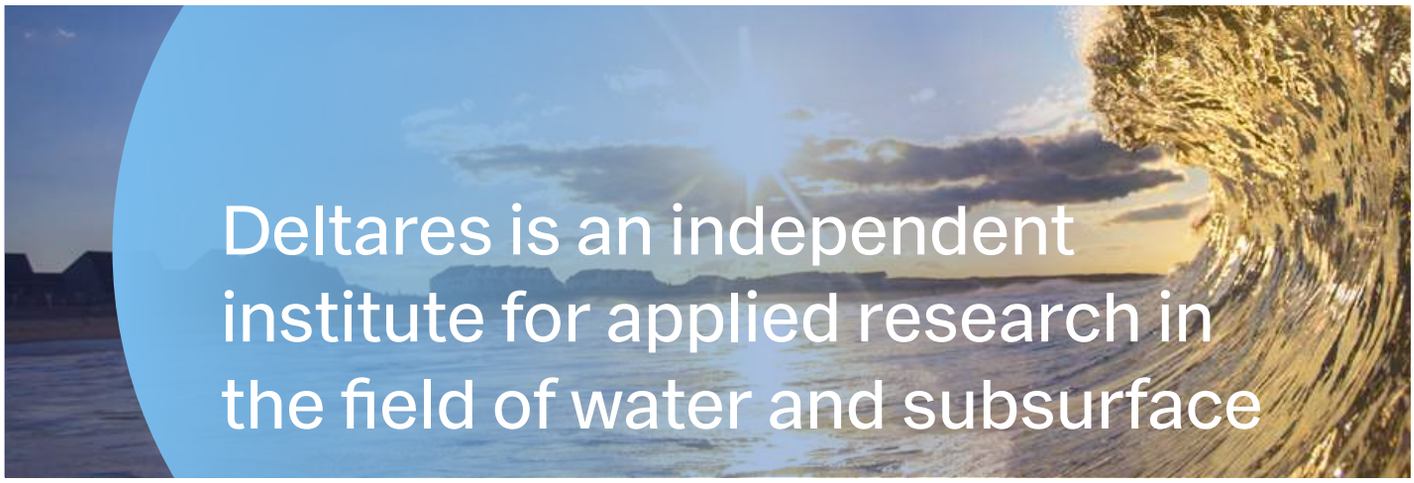

Deltares is an independent institute for applied research in the field of water and subsurface

Throughout the world, we work on smart solutions, innovations and applications for people, environment and society. Our main focus is on deltas, coastal regions and river basins. Managing these densely populated and vulnerable areas is complex, which is why we work closely with governments, businesses, other research institutes and universities at home and abroad. Our motto is Enabling Delta Life. As an applied research institute, the success of Deltares can be measured in the extent to which our expert knowledge can be used in and for society. For Deltares the quality of our expertise and advice comes first.

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Optimising Waste Segregation

An Excursion by the Sustainability Committee of the Dispuut

The sustainability committee organized a very insightful visit to Milieu Service Nederland on March 16th, 2023. Some students from TU Delft's new Master in Environmental Engineering program had the opportunity to experience this 'Waste Tour' and learn more about the working culture of one of the fastest-growing companies in waste management and logistics in the Netherlands.

Milieu Service Nederland, established in 1986, is an enterprising waste partner for business in the Netherlands. They aim to reduce carbon dioxide emissions by helping companies organize their waste collection in the most efficient and sustainable way. The students of the Resource and Waste Engineering Track under the new Master's program had the opportunity to visit their office in Diemen, Netherlands to get a closer look at their facilities and the services they offer.

On arrival, we received a warm welcome from Mr. Marco de Vries, project manager, followed by a grand lunch. Mr. Marco explained the objectives of the company and how they plan to achieve them. He mentioned that consolidating and managing data was one of the toughest jobs at the company and presented us with an example of their current dashboard. The dashboard contained various categories to split data for simplicity. Following this introduction, Marco described the concept of circular procurement. What does this mean? He explained that the method focuses on optimizing the separation and collection of waste to increase the recyclability potential of the waste product. He presented us with various optimization methods, such as color-coding waste bins, enhancing collection and transportation routes, and small-scale composting measures. Once the waste is segregated, it was refreshing to see that it could be recycled into everyday products such as shoes, soaps, and furniture. Marco emphasized the importance of paying attention to the composition of the waste generated by the client.

Overall this trip was a great opportunity for the students to gain a perception of what waste management careers bring in the future. We would like to extend our thanks to Marco de Vries and his entire team at Milieu Service for hosting us.

uut Activities

Fitterij

Pipe Fitting Competition by the Dispuut

Have you ever wondered how a new house is connected to the pressurized drinking water network without interrupting the supply in the system? At this year's Fitterij event on 12th May 2023, 34 participants had the opportunity to try this out for themselves.

The competition consisted of two disciplines: Fitterij and Kraantje drukken. In the Fitterij you participate as a team, one person is the fitter, one is the driller. The driller has to use all his muscle power to drill a hole in a main drinking water pipe that is under pressure. The fitter has to link the main pipe to a tap by connecting several pieces of pipe and connecting parts. The team that connects the tap to the distribution network as quickly as possible and without any leakage wins. Compared to this, the discipline Kraantje drukken sounds relatively simple: an umbrella-shaped fitting piece has to be screwed into a hole in a pressure line to close a leak. But how difficult it is to fight against approximately 3 bar of water pressure quickly became clear to every participant. Those who could not manage to insert the connecting piece into the hole at the first attempt were soaked after only a short time!

Like in the previous years, the event was supported by the company waternet, who helped the participants with a lot of enthusiasm. The fitterij closed with a BBQ and an award ceremony. Thanks to all those who participated and volunteered to help at the event! And to those who couldn't be there this year, you should definitely sign up next year!

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The boardie's then & now!

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