the international water association

Health Related Water Microbiology Specialist Group Newsletter

Volume 23 – June 2021

Contents

Message from our Chair

Dear colleagues and friends of the HRWM family!

As I write these lines, the IWA World Water Congress (May 25 - June 4, 2021) is underway, for the first time completely in digital format. Members of our HRWM SG are involved as presenters, chairs and participants. The topics are divided into 6 tracks, of which Track 2 Wastewater treatment & resource recovery and Track 3 Drinking water & potable reuse are particularly interesting. The programme can be found under: https://digital.worldwatercongress.org/programme/.

The technical conditions are excellent, the three pre-recorded presentations per session are discussed in detail during a live panel. One experienced member and one YWP each act as moderators. Despite all these efforts, even the best technology cannot replace personal exchange and social contacts, which we are missing.

For the IWA Leaders Forum, which takes place in the frame of the world congress, it has been announced, that we will learn about new possibilities for IWA SG to hold webinars. This should help us to realise our planned webinar series in September 2021.

The IWA headquarter has decided to hold the next IWA World Water Congress & Exhibition, entitled Water for smart liveable cities, from 11-15 September 2022 in Copenhagen, Denmark.

Link: https://worldwatercongress.org/

Due to this new scheduling the organizing team for our 21st HRWM Symposium, which will be held in Darwin, Australia, has decided in consultation with the HRWM management team, to postpone the symposium to 2023. The exact date has still to be fixed.

Despite this postponement, our HRWM family will remain in touch. The next opportunity will be the following HRWM webinar with the title "COVID-19 and Wastewater-Based Epidemiology: Testing of Wastewater from Buildings like Schools, Offices, student halls and Nursing Homes" (June 17, 2021). It is organized by Jes Clauson-Kaas, Hiro Katayama and Daisuke Sano (for more information see page 6).

This time I would also like to draw special attention to the HRWM website, which is maintained with great dedication by our SG HRWM Secretary Daisuke Sano. We are most grateful for his additional task as webmaster. Link: https://hrwm-watermicro.com/

Enjoy reading the Newsletter, which has been edited in the usual excellent way by Maronel Steyn. Many cordial thanks for that.

We would also like to thank the colleagues who contributed to this newsletter. Please continue to be active and send contributions, we are already collecting for the next one.

I am looking forward to our upcoming HRWM Webinar in June 2021 and the planned webinar series in September 2021, we will keep you informed.

Warm regards
Regina Sommer
HRWM Chair

Integrative MST-QMRA approach to guide water reuse in industrial estate communities in Thailand

- **Article Credit: Dr. Thammanitchpol Denpetkul, Mahidol University, and Dr. Kwanrawee Joy Sirikanchana, Chulabhorn Research Institute, Thailand**

The expansion of industries into rural communities has promoted economic development in communities; however, higher faecal pollution loads from expanded populations in the industrial sector could pose a public health concern. In this study, we examined microbial water quality in industrial and adjacent community areas to investigate microbial impacts on public health during three dry events.

A total of 27 samples from nine sampling sites indicated faecal pollution from mostly human sources, as shown by crAssphage detection (88.9%) and human polyomaviruses detection (92.6%). There were three occurrences of enteric human adenovirus from residential sites. Overall, industrial and residential land use affected the amount of human faecal pollution equally.

For the first time in Thailand, this study integrated the microbial source tracking (MST) and quantitative microbial risk assessment (QMRA) approach to calculate enteric human adenovirus annual infection risks for non-potable water reuse purposes by predicting concentrations from two MST markers: crAssphage and human polyomaviruses. Three water reuse scenarios were selected: 1) toilet flushing to promote the eco-industrial park concept; 2) food crop irrigation; and 3) aquaculture, the last two of which are conducted in the community. All scenarios exceeded the annual infection risk benchmark of 10^{-4} per person per year.

Therefore, suggested pre-treatments include 1) a combination of depth filtration and chlorination for food crop irrigation and aquaculture reuse purposes; and 2) chlorination for toilet flushing. Microbial monitoring in combination with a QMRA could offer opportunities for faecal contamination and risk controls, leading to more efficient water quality management and adequate additional treatments for water reuse.

We would like to extend this research to include more locations, types of water, and reuse purposes, as well as determine the relationship between MST and pathogenic microorganisms in Thailand in order to increase microbial risk assessment accuracy and identify the best treatments for various reuse purposes.

This article is freely available at:

Kongprajug, A., Denpetkul, T., Chyerochana, N., Mongkolsuk, S., & Sirikanchana, K. (2021). Human Fecal Pollution Monitoring and Microbial Risk Assessment for Water Reuse Potential in a Coastal Industrial–Residential Mixed-Use Watershed. Frontiers in Microbiology, 12:647602. doi: 10.3389/fmicb.2021.647602**.**

An industrial estate on the coast of Thailand.

Michigan PCR Network and Wastewater Sphere

- **Article contributed by Andri Taruna**

The early detection of SARS-CoV-2 in wastewater can help identify a new emergence of infection in a community, monitor the level of virus in different areas across the state, monitor virus in facilities with vulnerable populations within a specific sewer shed and provide timely information to inform response plans at state and local levels to curtail transmission and target public health interventions. Michigan Department of Health and Human Service launched a collaborative project between The Michigan Department of Environment, Great Lakes and Energy (EGLE), Michigan State University (MSU), and existing statewide qPCR laboratories network to detect SARS-CoV-2 in wastewater via a standardize method. Dr Joan Rose's lab at MSU, as the lead laboratory, provides training for the local health department and university laboratory staff to monitor wastewater for SARS-CoV-2 using droplet digital (dd)PCR methods and conduct the wastewater surveillance for the wastewater utilities around Michigan State and sewer or manholes around MSU dormitories. In addition, together with the Global Water Pathogen Project (GWPP) and supported by PATH, we are developing the global data center called Wastewater Sphere (SARS public health environmental response), which creates a global database for SARS-CoV-2 wastewater surveillance maps. The data will also be visualized on dynamic/updated maps on a global and country scale with options to zoom in regionally at a spatial level that will protect the anonymity of the facility and enable examination of the spatial and temporal trends of SARS-CoV-2. For further information please visit the GWPP website (https://www.waterpathogens.org/about-w-sphere).

A waterway in the industrial estate.

The research team taking a water sample.

Applying Quantitative Microbial Risk Assessment and Wastewater-Based Epidemiology to Mass Gathering Risk Control and Communication

- **Article contributed by Michio Murakami [1],*, Masaaki Kitajima [2], Seiya Imoto [3]**

1 Fukushima Medical University; * michio@fmu.ac.jp

2 Hokkaido University

3 The University of Tokyo

Since April 2020, the volunteer researchers, including the authors, have been working together to conduct a solution-focused infection risk analysis for COVID-19 at mass gatherings such as sports events and festivals. The name of the team is MARCO (MAss gathering Risk COntrol and COmmunication). MARCO is a multidisciplinary team of researchers from various fields such as environmental science, risk science, medicine, statistical mathematics, and so on. Researchers are from universities such as the University of Tokyo, Fukushima Medical University, Hokkaido University, and research institutes such as the National Institute of Advanced Industrial Science and Technology, several medical institutions, and companies such as Kao Corporation and NVIDIA Japan. They have been conducting a quantitative microbial risk assessment for spectators and evaluation of the effectiveness of preventive measures at the opening ceremony of the Tokyo Olympics and Paralympics scheduled for July 2021, which was recently published in Microbial Risk Analysis (doi: 10.1016/j.mran.2021.100162).

Furthermore, they also aim to evaluate an effective COVID-19 testing system for athletes and staff, and to propose preventive measures based on wastewater-based epidemiology (WBE) for individual facilities including the Olympic/Paralympic athletes' village. One of the advantages of WBE is that the infection of SARS-CoV-2 variants within a community can be effectively monitored through genetic analysis of SARS-CoV-2 in wastewater. In fact, a research team involving MARCO members has succeeded in identifying variants in wastewater via next-generation sequencing analysis. WBE has been attracting remarkable attention of researchers and practitioners from different disciplines in mass gathering risk control and communication. MARCO is rapidly deepening its solution-focused research and simultaneously advancing social implementation.

A manual for SARS-CoV-2 gene detection from sewage has been issued in Japan

- **Article credit Ryo Honda, Eiji Haramoto, Masaaki Kitajima, Akihiko Hata, Hiroyuki Katayama, and Daisuke Sano**

In March 2021, COVID-19 Task Force (TF) of Japan Society on Water Environment (JSWE) issued a manual for SARS-CoV-2 gene detection from sewage in collaboration with the Japan Institute of Wastewater Engineering and Technology. The detection method needs to be selected based on multiple factors, including accuracy, detection sensitivity, available equipment, consumables costs, manpower, number of samples, etc. This manual describes a sequence of procedures for measuring SARS-CoV-2 gene in sewage, from sample collection and transfer, to process control preparation, virus concentration, RNA extraction, reverse transcription, and quantitative PCR, with their pros and cons. The safety issues during the measurement are also included. This manual emphasizes the importance of process control, because the wastewater quality varies with the time and location and can affect the recovery efficiency of SARS-CoV-2 gene from sewage. The

JSWE COVID-19 TF expects that this manual will serve as a reference guide for local government and private companies which are interested in WBE for COVID-19 in Japan.

If you have any questions, please contact the following people:

Ryo Honda (rhonda@se.kanazawa-u.ac.jp); Daisuke Sano (daisuke.sano.e1@tohoku.ac.jp)

IWA HRWM WEBINAR:

COVID-19: Protecting communities with wastewater-based epidemiology

- **Article contributed by Jes Clauson-Kaas, Hiro Katayama and Daisuke Sano**

An effective early warning tool is of great administrative and social significance to the containment of an epidemic. The progression of infectious diseases can be considerably hampered if early-stage interventions are taken, saving lives as well as minimizing social and economic disruption. As humanity faces COVID-19, one of the biggest global public health crises in recent decades, wastewater-based epidemiology (WBE) has been given high expectations as a promising surveillance tool complement to clinical testing which had been plagued by the turnaround time and limited capacity. Particularly, several recent case reports have highlighted the role WBE may play, not only at the community-level, but also at the facility-level in issuing early warnings to prevent local outbreaks. In Denmark a precondition for opening schools is a nasal swab test twice a week for all pupils. There is hope that this could be replaced by testing the sewage from four case reports were presented to share with interested viewers the basics of the concept, the school three times a week. In this webinar, benefits and critical points, lessons learned from real-life applications, and the unsolved challenges faced by the scientific community.

Data and Time:

13:00-14:30 GMT on June 17th

Coordinators:

Jes Clauson-Kaas, IWA Fellow, Chief Consultant, Greater Copenhagen Water Utility, Denmark

Hiro Katayama, IWA Fellow, IWA HRWM SG Past-Chair, IWA COVID-19 Task Force, The University of Tokyo, Japan

Daisuke Sano, IWA HRWM SG Secretary, Tohoku University, Japan

Presenters:

Dr. Walter Betancourt, University of Arizona, USA

Prof. Tong Zhang, The University of Hong Kong, China

Dr. Xavier Litrico, Group Research and Science at SUEZ, France

Dr. Marlene Hsu, Water Research Australia Limited, Australia

Dr. Daniel Deere, Water Futures Pty Ltd, Australia

Link: https://iwa-network.org/learn/covid-19-protecting-communities-with-wastewater-based-epidemiology/

Establishing an Automated System for Genomic Analysis of SARS-CoV-2 in Wastewater

-Article Credit: Masaaki Kitajima [1],*, Ryo Iwamoto [2]

1 Hokkaido University; * mkitajima@eng.hokudai.ac.jp

2 Shionogi & Co. Ltd.

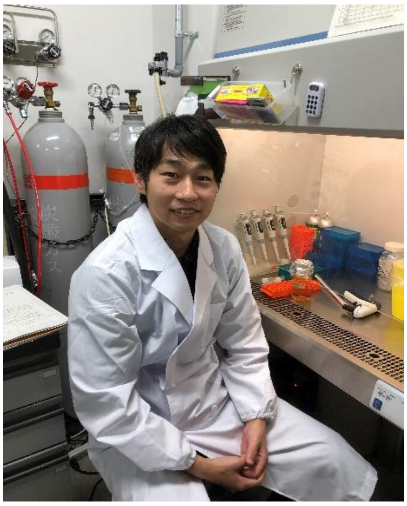
In Japan, there have been fewer reported cases of COVID-19 per capita than in many other countries, and therefore, detection of SARS-CoV-2 in Japanese wastewater has been challenging because of low virus concentrations. Hokkaido University and Shionogi & Co., Ltd. entered into a collaborative research agreement in October 2020 to develop a virus detection method with increased sensitivity. As a result of the collaborative research, we have successfully developed a highly sensitive method for SARS-CoV-2 detection in wastewater. Our next step is the societal implementation of wastewater-based epidemiology to monitor COVID-19, which requires the establishment of a high-throughput analysis system of the collected wastewater samples. For this purpose, Hokkaido University and Shionogi started collaboration with Robotic Biology Institute, Inc. (RBI), iLAC Co., Ltd. RBI has the technology for automated SARS-CoV-2 detection/quantification and library preparation for next-generation sequencing (NGS) analysis using LabDroid "Maholo", a versatile humanoid robot made in Japan; iLAC is capable of elucidating genomic information (e.g., viral genome mutations) based on massive NGS analysis. In order to validate the automated system for genomic analysis of SARS-CoV-2 in wastewater, the project team has started large-scale wastewater surveillance based on the cooperation of sample collection by Osaka Prefecture. The analysis service is scheduled to launch in May 2021.

Related links:

Establishing an automated system for the analysis of SARS-CoV-2 in wastewater:
https://www.global.hokudai.ac.jp/blog/establishing-an-automated-system-for-the-analysis-of-sars-cov-2-in-wastewater/

Wastewater surveillance to monitor COVID-19 starts in Osaka Prefecture
https://www.global.hokudai.ac.jp/blog/wastewater-surveillance-to-monitor-covid-19-starts-in-osaka-prefecture/

Maasaki Kitajima



Ryo Iwamoto

Getting to know the YWP Chapter from Japan (Japan-YWP)

Article credit: Asami Nagao, Vice-Chair of Japan-YWP, and committee members.

The YWP Country Chapter was established in March 2010 with the support of IWA Japan National Committee, Japan Society on Water Environment (JSWE), and Japan Water Works Association (JWWA). We aim to develop a national and international network for young water professionals to actively engage and allowing them to be empowered to contribute to various solutions. We have held symposiums and workshops to create opportunities to have discussions with young water professionals in different water sectors and share the various knowledge. The Japan-YWP Country Chapter consists of 26 steering committee members, with over 503 registered members since January 2021.

Three online events have been held in 2020. The first one, entitled: "First step of Water sector", aimed to introduce interesting points of the water sector for students and young workers of the water sector. Another one was "What can we learn from sewage". The detection method of the COVID-19 virus from sewage was a hot topic and we wanted to know what information we can get from sewage, not only the virus but also medicines and microbes. The last event was "Treasure on sewage". Sewer resources (e.g. nitrogen, phosphorus) are able to be used for agriculture but they are not widely used, so we introduced some success cases in Japan where local governments and farmers are united. This year, YWP- Japan already held two online events and are planning other new events.

Some of our recent years' activities include: In 2018, IWA WWCC was held in Tokyo and Japan-YWP organized a workshop "Post SDGs Future Vision Call". The participants talked about Future Vision as for post SDGs with long-term perspective and discussed what social systems and technologies should be developed. The same night, we gathered with international YWPs to get to know one another. In 2019, we established a working group "water related SDGs". We discussed not only targets in Goal 6 but all 169 targets and how it relates to water to achieve the goals. Finally, we published a report which introduces how to utilize the SDGs in the water sector.

"Water" is related to many sectors, and the water sector has various categories like water supply, sewage, water environment, macro and micro. It is a big advantage to get an opportunity to interact with YWPs who have different backgrounds and to motivate and inspire each other. Throughout the COVID-19 pandemic, we have been exploring what Japan-YWP can provide online, and our immediate goal is to increase international collaboration and activities. If you are interested in Japan-YWP, please contact us! (japanywp@gmail.com)

Workshop in 2018 IWA WWCC

Online event in

Call for papers

Journal: International Journal of Molecular Sciences

Special Issue: Multiomic approaches in the microbiome and microbial ecology of health and disease

Submission Deadline: 6-8 Months

Advances in microbiome research have provided insights into microbial taxonomic membership and microbial ecology in health and various disease phenotypes. The field has also benefited from the application of other 'omics including meta-(transcriptomics), meta-(proteomics) and metabolomics for the characterization of transcriptional and translational activities within microbial communities. Most microbiome studies, thus far, have applied a single-omics approach, and few have shown the utility of combining various 'omics datasets to understand microbial membership and function. Challenges exist for multiomics data generation, integration, normalization, database selection, data storage and dissemination.

The Special Issue welcomes studies of the microbiome as well as the microbial ecology of health and disease using multiomics approaches. Sample types may include, but are not limited to those originating from human, animal or environment (e.g., built, soil, water and wastewater). Articles describing one or several of the mentioned challenges in the field of multiomics are also welcomed.

In order to be considered for inclusion in this Special Issue, please send an email message to both Co-Editors including a short abstract (250 words) and a list of the possible co-authors of the paper, as well as a list of 5 keywords that describe the content of the manuscript.

Keywords:

Health and disease; Meta-transcriptomics; Meta-proteomics; Metabolomics; microbiome; Multiomics; Viromics

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Interests: Environmental microbiology, microbial ecology, indicators of fecal contamination, ancient microbiomes and viromes, virology

Examples can be found at:

https://www.mdpi.com/journal/ijms/special_issues/pre-mRNA_splicing
https://www.mdpi.com/journal/ijms/special_issues/Transcription_Factors_Environmental

(Please read the "Special Issue Information" and "Keywords" sections).

Sewage as element of the surveillance pyramid of COVID-19

Article credit: Gertjan Medema, Leo Heijnen, Goffe Elsinga, Jeroen Langeveld, Remy Schilperoort, Johan Post, Miranda de Graaf, Evelien de Schepper, Ewout Fanoy, Olaf Duin, Nick Ivens, Mariska Ronteltap, Imke Leenen, Bert Palsma, Marion Koopmans.

The current coronavirus pandemic is a major challenge for society. Surveillance is crucial to know where the virus is circulating and what the effects of lock-down measures are. Our first experiences in the spring of 2020 showed that SARS-CoV-2 RNA can be detected in domestic wastewater. A large proportion of people with a SARS coronavirus infection (COVID-19) also shed virus via their stool. In some cities, the virus was already detectable in the wastewater before the first patients were diagnosed.

We are conducting a research project in the area of the city of Rotterdam in the Netherlands. Our research question is the added value of sewage surveillance and whether the trends of SARS-CoV-2 RNA in sewage reflect the trends in COVID-19 infections in the district where the sewage water comes from. This is done by linking data underground (sewage) to data above ground (positive tests, number of hospitalized patients etc). We collect data from various sources to compare which combination of data provides the most reliable information about the extent of the pandemic, the circulation of the coronavirus and the new coronavirus variants in the city.

The research consists of the following components:

- Investigation of the presence of SARS-CoV-2 in the stool of COVID-19 patients. This is done through general practices and aims to find out how often and much people with COVID-19 also shed virus via their stools.
- Research into the types of complaints that bring people to the General Practitioner (GP), via medical registrations in GP practices (syndromic surveillance).
- 'Testing streets' of the Municipal Public Health Service (GGD).
- Measurements of SARS-CoV-2 in sewage from a number of Rotterdam neighbourhoods, geographically matched with the other surveillance data.
- Comparing the genetic makeup of viruses in sewage and patients.

To collect and analyse data on each of the components, Erasmus MC, GGD, GP practices and RIVM work closely with KWR Water Research Institute, Water Boards, Foundation for Applied Research on Water Management (STOWA), Partners4UrbanWater and Royal Haskoning DHV (RHDHV). This short popular article aims to provide an overview of the status of the project.

Stool testing

In order to be able to relate the amount of virus in the sewage water to the number of people who have a coronavirus infection, it is important to know how many virus particles someone excrete in the stool when they are infected with SARS-CoV-2. We asked patients who have a positive SARS-CoV-2 test to fill in a questionnaire and submit a jar of faeces. We then tested the stool to determine how many virus particles it contains. We also looked at the genetic information of these viruses to determine whether they are comparable to the viruses found in sewage water.

Thanks to the efforts of the GP practices and the department of GP medicine, the stools of more than 140 people have already been tested and a questionnaire received. This shows that 55% of people were positive for SARS-CoV-2 in their stools, sometimes more than two weeks after becoming ill (Figure 1). Of the patients enrolled in the study, 45% had diarrhoea or nausea. 52% of this subgroup had coronavirus in the stool. The first reports of the British variant (B1.1.7) came in December 2020. A large proportion of infections in the Netherlands are now caused by this variant.

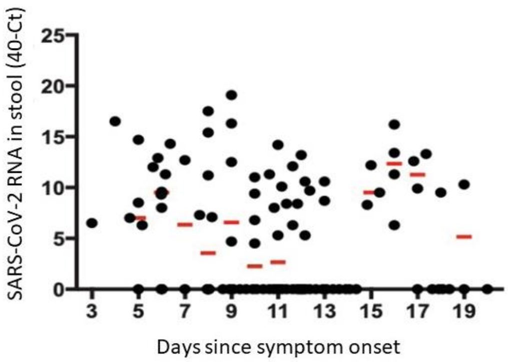

Figure 1 - Amounts of virus in the stool of COVID-19 patients. The dots indicate the mean amount of virus per patient and mean amounts per time point are shown in red.

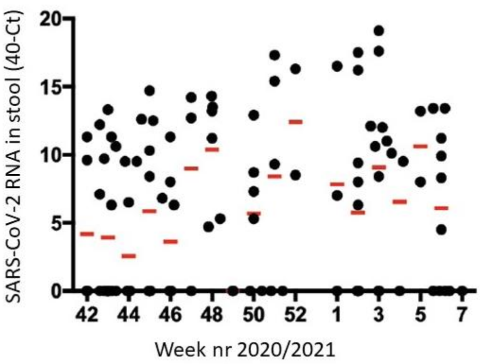

Figure 2 - Amounts of virus in the stool per week number; Week 42, 2020 to Week 7, 2021. The dots indicate the amount of virus per patient and average amounts per week; numbers are shown in red.

Syndromic surveillance

To determine whether an increase in the number of SARS-CoV-2 positive people in a neighbourhood results in an increase in patients contacting the GP because of respiratory complaints, we monitor the clinical registration of GP practices. We do this via the Rijnmond Healthy database (IPCI) of the Department of General Practice and the Department of Medical Informatics. This database contains all healthcare data that the general practitioner records as standard practice. The data are sent to the research database without the persons being traceable. We have submitted our research to the Supervisory Board of the Rijnmond Healthy database and have received permission to work with this data. The extraction of the data for the whole of 2020 has already been done. The data can now be further analysed.

Clinical testing: drive-through test lanes

In the Netherlands, people with respiratory complaints are now readily tested for the SARS-CoV-2. The nose / throat swabs are collected by the GGD (Public Health Service) and tested in virological laboratories (including Erasmus MC). We monitor the number of SARS-CoV-2 positive tests for the neighbourhoods where we also test the sewage. By comparing this data from the test lanes with sewage measurements, we can validate whether sewage surveillance can be a sensitive instrument for detecting SARS-CoV-2 outbreaks. For a number of clinical isolates, we will determine the genetic information to investigate whether they are comparable to the SARS-CoV-2 RNA that we find in the sewage water.

For all 8 neighbourhoods, the number of positive tests in the GGD test streets per week per 10,000 inhabitants is shown (Figure 3). The three areas in which the GP practices participate are Ommoord, Rotterdam South (Katendrecht, Kop van Zuid, Afrikaanderwijk, Zuidplein, Tarwewijk, Bloemhof, Hillesluis), and Rozenburg.

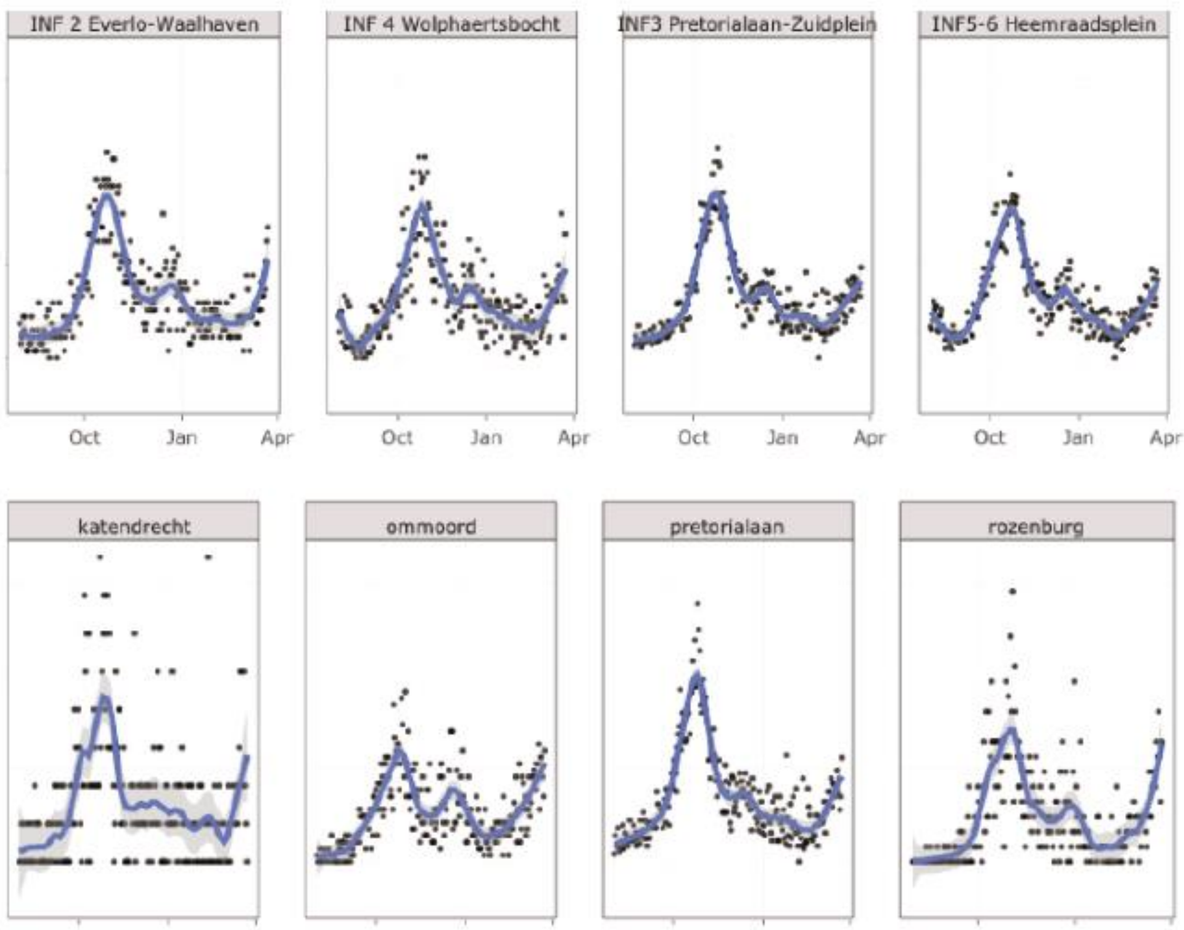

Figure 3 – Time trends in reported SARS-CoV-2 cases per 10,000 inhabitants in the 8 city neighbourhoods.

The GGD has now tested 188,346 people in the neighbourhoods that are monitored within the project, of which 30,271 were positive for SARS-CoV-2. In October there was a clear peak in the number of coronavirus infections in Rotterdam. Seen for the Netherlands as a whole, there was still a peak in

December, but it was relatively small for Rotterdam. Erasmus MC has determined the genetic characteristics of the virus present in more than 1,300 SARS-CoV-2 tests from Rotterdam. This will be determined for many more samples in the coming months.

Sewage surveillance

Sewage surveillance is a simple and fast way to monitor the circulation of SARS-CoV-2 in an entire city or district. We mainly investigate how sewage water surveillance has added value compared to other methods of surveillance (such as GGD test streets). The validation of the sewage water surveillance on the basis of "above-ground" data requires a good geographical overlap between the sewage water measurements and the GP areas. In the Rotterdam-Rijnmond region, we have selected a number of neighbourhoods with a good overlap between the sewerage system and general practices. In addition, we measure the sewage as it arrives at the Dokhaven sewage treatment plant from various districts and can link it anonymously to the GGD test data from those districts. The selected research locations are 3 sewage pumping stations (RG) where the sewage water from districts is collected to be pumped to the sewage treatment plant (RG Ommoord, RG Katendrecht and RG Pretorialaan) and 2 sewage treatment plants (RWZI Rozenburg and RWZI Dokhaven). At WWTP Dokhaven, 4 sewage pipes come in from different parts of the city, which are sampled separately (see Figure 4).

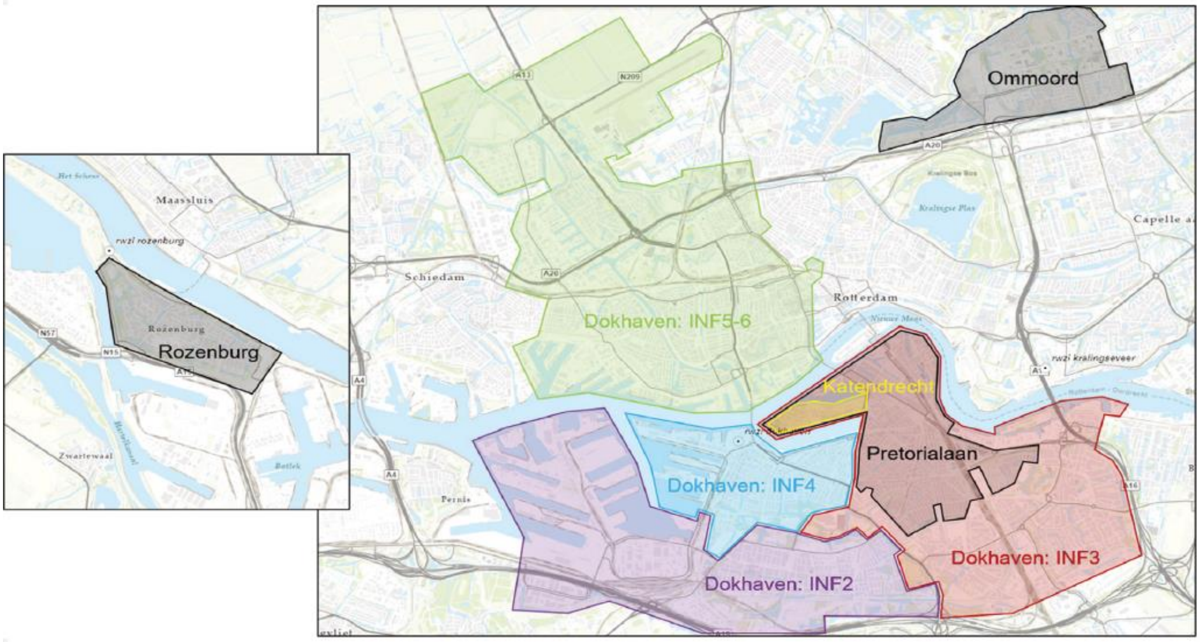

Figure 4 - Sample collection locations. The research areas around WWTP Dokhaven are indicated in colour.

This set-up makes it possible to investigate to what extent sewage water surveillance is a good representation of the number of cases in a neighbourhood. Sampling cabinets have been placed at the sewage sampling locations since the summer of 2020.

In the sewers we have seen the second wave rise, slowly fall and in the last weeks we have seen an increase again. We correct the measured concentrations for the influx of rainwater, industrial water and other water that does not come from households and therefore domestic waste water. The complete set of measurement results is included in Figure 5, in which the SARS-CoV-2 measurements are expressed as the number of SARS-CoV-2-N2 gene copies per ml of domestic waste water. The applied standardization method uses accurately measured daily volumes of sewage water with the conductivity of the sewage sample as an independent control measurement. Thanks to this method, days on which the sample is not representative of the population, for example because less wastewater has been discharged due to a pumping failure, are filtered out. This ensures a high quality of the measurement series.

During the study, we have been analysing the relationship between sewer data and GGD test results every two weeks since October. This analysis showed that in the period September-October 2020, the sewer measurements were approximately 6 days ahead of the GGD test results. As time progressed and the GGD testing capacity was expanded, it turned out that sewage was only about 1 day ahead. The data from the source and contact research also showed that people come to the test street more quickly. Just after the summer it took an average of 6 days from the first symptoms to the test result, in December it was about 11/2 days. When we corrected the GGD test street data to the first day of illness, we saw a strong overlap with the sewer data, especially in the increase of SARS-CoV-2 in September and October, see Figure 6.

Not everyone who carries the virus goes to the GGD test lanes or GP, but everyone does go to the toilet. At the end of 2020, the GGD had indications that relatively few people from a specific city neighbourhood came to the test lanes. The measured concentrations in this neighbourhood's sewer also indicated that there was more virus circulation among the population. The GGD then decided to expand the test facilities in this neighbourhood with test buses.

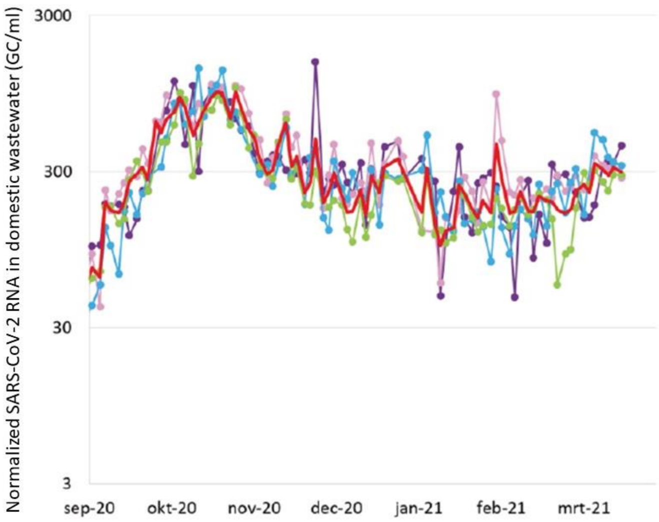

Figure 5 - Normalized concentrations of COVID-19 in sewage water in the city districts (line colours correspond to colour areas in Figure 4).

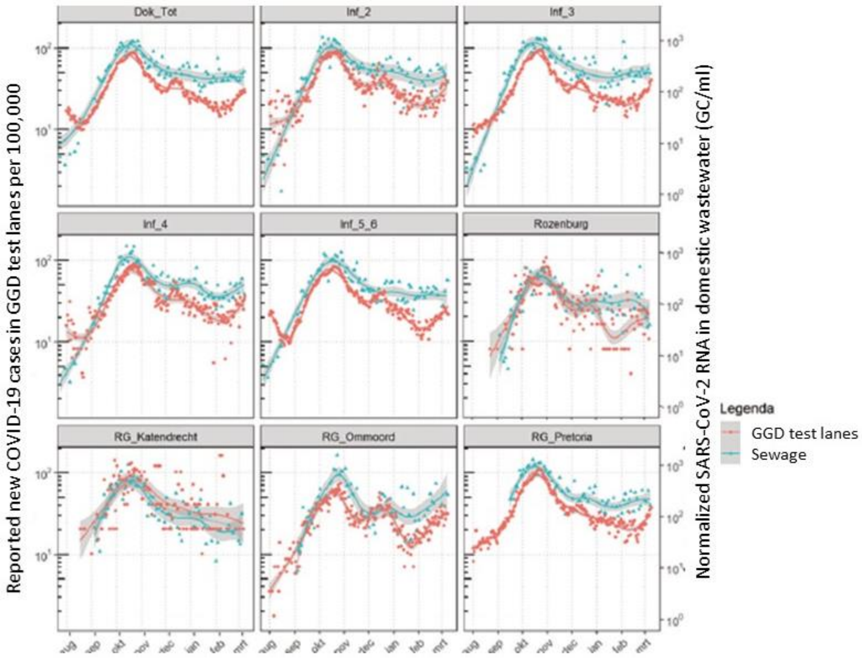

Figure 6 - Trends in normalized SARS-CoV-2 measurements in sewage and GGD positive tests, corrected for the first day of illness.

The high correlation between sewer data and GGD data (Figure 6) makes it possible to draw up fairly reliable models with which the number of positive tests can be calculated on the basis of sewer data. An example of this is included in Figure 7.

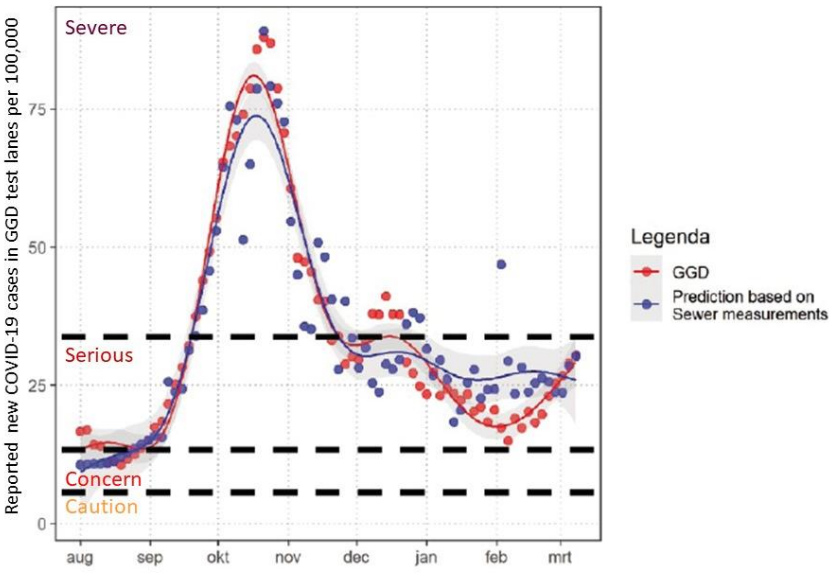

Figure 7 - Calculated number of positive tests based on sewerage measurement compared to the reported number of positive tests.

The calculated number of positive tests corresponds well with the number of positive tests registered by the GGD. In the figure a comparison has also been made with the signal values from the Dutch national corona dashboard based on the number of positive tests, but scaled to the size of the underlying area. With a calculation model based on sewer measurements, the same signal value is determined as follows from the GGD tests. An interesting period in the data is the end of December 2020. During that period, the number of tests increased (people possibly wanted to celebrate Christmas safely with family) and with it the number of positive tests, but the percentage of positive tests dropped sharply. In those same weeks, sewage showed very little increase, indicating that the "Christmas Peak" in this area was likely the result of higher numbers of tests. This makes it clear that when interpreting GGD tests, willingness to test must always be taken into account, while sewer measurements do not depend on this willingness to test. This, once again, demonstrates the power of sewer measurements.

Sequencing

To investigate whether the viruses in the sewage water are comparable to those of COVID-19 patients in Rotterdam, we compared the genetic characteristics of SARS-CoV-2 in 120 sewage samples with those of 1,300 patients. We also investigated whether the new corona variants are present in the sewage water. We find a similar diversity of viruses in the sewage as in the patients. This again shows that the sewage is a good representation of what is happening above ground. It was also possible to detect the British variant (and other variants) in the sewage. We do this by examining a number of signature mutations that are different between the original SARS-CoV-2 and that of the British variant.

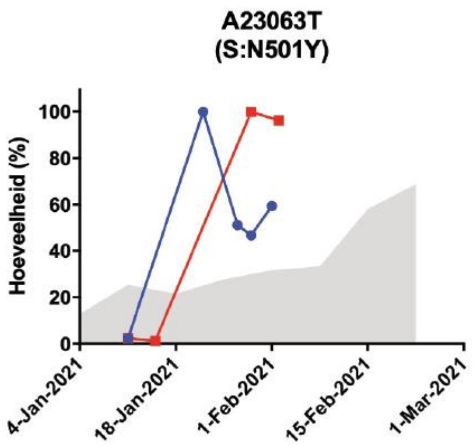

Figure 8 – N501Y signature mutation in patients (gray) and in wastewater (blue and red).

In Figure 8 we see the presence of one of these mutations in sewage water from Rotterdam and Bergschenhoek compared to the number of patients infected with a coronavirus with the same mutation. It is important to realize that we can say that we have found the mutation in the sewage water, but with this technique we cannot say exactly how much of this variant virus is in the sewage water. To make this possible, a different technique is now being developed.

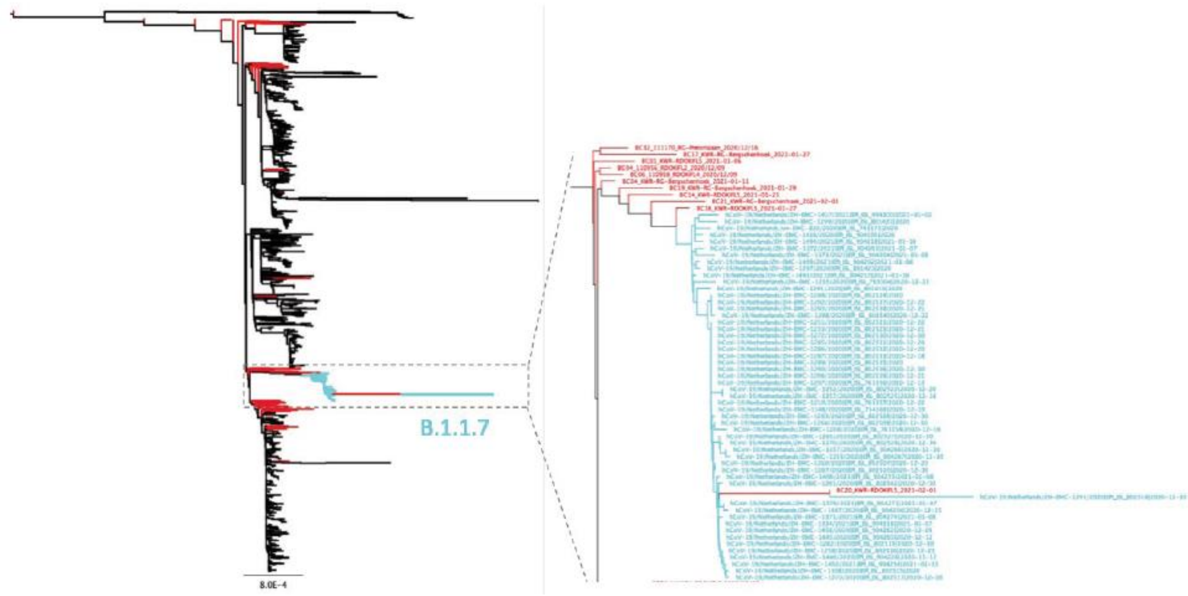

Figure 9 - Sequences of SARS-CoV-2 coronaviruses isolated from sewage (red) and patients (black and turquoise) displayed in a phylogenetic tree.

Figure 9 shows a phylogenetic tree with all viruses found in COVID-19 patients (black and turquoise) and in sewage water (red) in Rotterdam. If viruses are genetically similar you can find them together in the tree, if they differ more from each other they are further apart in the tree. The above analyses have also shown that sewage often contains combinations of different coronavirus variants. So, sewer surveillance can also offer added value for early detection of, for example, new virus variants.

This research was conducted by a consortium consisting of: Erasmus MC, Rotterdam (Dept. Viroscience, Huisartsengeneeskunde, Medische informatica, Medische Microbiologie en infectieziekten), GP practices of Rijnmond Gezond, GGD-Rotterdam Rijnmond, RIVM Center Epidemiology and Infectious Disease Surveillance, KWR Water Research Institute, STOWA, Waterschap Hollandse Delta, Hoogheemraadschap van Schieland en de Krimpenerwaard, Hoogheemraadschap van Delfland, Partners4UrbanWater, Royal Haskoning DHV.

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News from IWA Headquarters

The best 8 scientific posters from IWA's Digital Congress

The poster prize winners have been announced in a plenary session during the second week of the Digital World Water Congress, which took place between 24 May – 4 June 2021. The sessions, presentations and posters were organised in six overarching themes covering the full water cycle.

IWA Membership Awards winners announced at Digital Congress

The winners of the IWA Membership Awards have been announced by IWA President Tom Mollenkopf, during a plenary session on Tuesday 1 June to mark the beginning of the second week of the Digital World Water Congress.

Four inspiring water leaders win prestigious IWA Awards

Inspirational academic Marcos von Sperling has won the acclaimed IWA Global Water Award, during a presentation at IWA's Digital World Water Congress. The award recognises an innovative leader who has made a significant contribution to a world in which water is wisely managed.

IWA Annual Report 2019-2020

IWA 2019-2020: Vibrant and Evolving. This past year is one which IWA can look back on and see excellent and important progress for our Association. There have certainly been positive developments in our sector – whose essential role has been further underlined by the Covid-19 pandemic.

Australian water industry expert becomes IWA President

Leading water consultant Tom Mollenkopf has today become the new President of the International Water Association, taking office following his election in Lisbon, Portugal back in October 2019. Mr. Mollenkopf, who trained as a lawyer and holds an MBA, has been a substantive and well-regarded figure in the water sector for the past 20 years.

Water experts become IWA Vice Presidents

Renowned academic Enrique Cabrera has been elected as the new Senior Vice President of the International Water Association. Professor Cabrera has over 20 years of experience in the field of urban water management. Hamanth Kasan has also been elected as IWA Vice President. Mr. Kasan is general manager of Rand Water in South Africa.

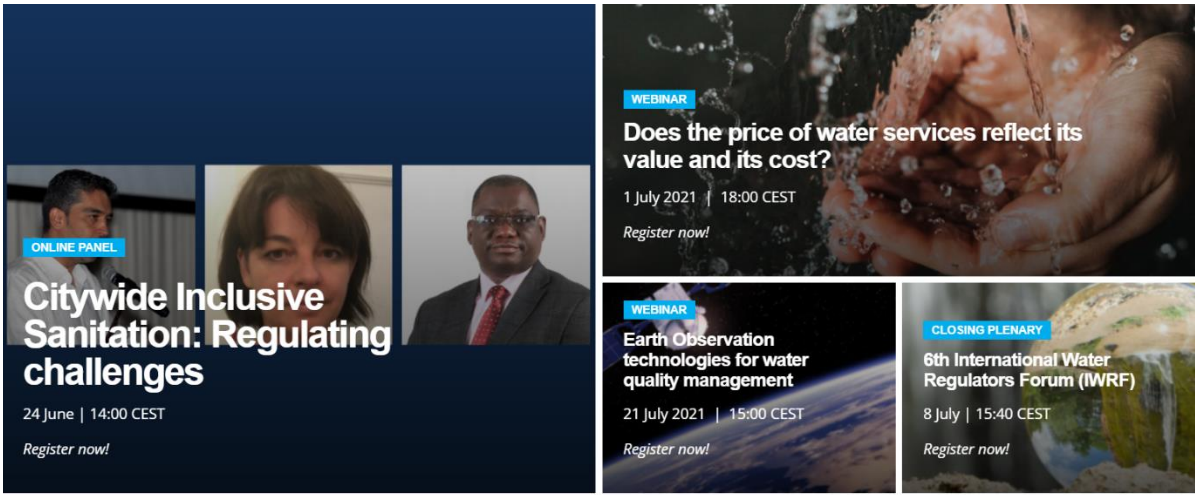
New IWA YWP Chapter in Sweden

A new IWA Young Water Professionals (IWA YWP) Chapter in Sweden was formed on 8 April 2021. This new IWA YWP chapter is open to all water related professionals in Sweden, aged 35 and below, who are IWA members either individually or through their employer.

Guidance on Preparing Water Service Delivery Plans: A manual for small to medium-sized water utilities in Africa and similar settings

This publication is a guideline or how-to manual on preparing water service delivery plans with a focus on small to medium sized organised water utilities having with approximately 5,000 to over 100,000 connections mainly in areas with limited capacity and resources.

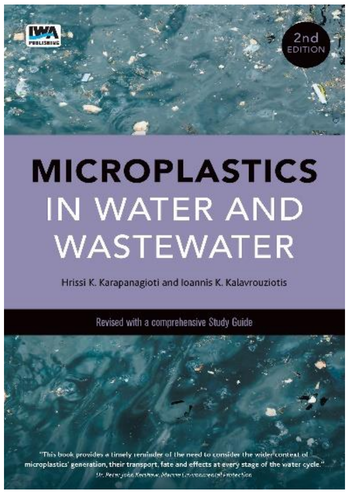
IWA Learn



The place for learning & professional development in the water sector

Professionals in the water sector require continuous development to be able to stay abreast with the changing environment circumstances. No matter in which stage of your career, IWA provides you with guidance and opportunities to build up the competences required to succeed. This includes a set of tools on how to develop your career, as well as opportunity of professional updating, learning, training and networking. To learn more, visit the IWA Learn platform: https://iwa-network.org/iwa-learn/.

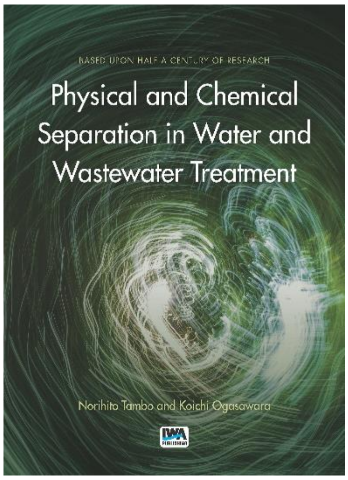
News from IWA Publishing



Microplastics in Water and Wastewater - 2nd Edition
Hrissi Karapanagioti Ioannis K Kalavrouziotis
ISBN: 978178906168
October 2020 • 300 pages • Paperback
IWA Members price: £60.00 / US$ 90.00 / € 75.00
https://www.iwapublishing.com/books/9781789061680/microplastics-water-and-wastewate r-2nd-edition
The book covers in detail the topic of microplastics in water and wastewater. There is a growing interest in the scientific community in microplastics. Most of the studies identified the problems due to microplastics in the marine environment. However, considering that most microplastics are produced on land, similar problems should be encountered in freshwater systems and wastewater treatment plants that at the same time are the sources of marine microplastics.

Environmental Technologies to Treat Sulfur Pollution: Principles and Engineering
Piet Lens
ISBN: 9781789060959
August 2020 • 544 pages • Paperback
IWA Members price: £94.00/ US$ 141.00/ € 118.00
Also available as an Open Access ePDF
https://www.iwapublishing.com/books/9781789060959/environmental-technologies-treat-sulfur-pollution-principles-and-engineering-2nd

This book may serve both as an advanced textbook for undergraduate and graduate students majoring in environmental sciences, technology or engineering as well as a handbook for tertiary educators, researchers, professionals and policymakers who conduct research and practices in the sulfur related fields. It is essential reading for consulting companies when dealing with sulfur related environmental (bio)technologies.



Physical and Chemical Separation in Water and Wastewater Treatment
Norihito Tambo; Koichi Ogasawara
ISBN: 9781789061291
November 2020 • 750 pages • Paperback
IWA Members price: £124.00/ $186.00/ €155.00
https://www.iwapublishing.com/books/9781789061291/physical-and-chemical-separation-water-and-wastewater-treatment
Based upon half a century of research by the authors, Physical and Chemical Separation in Water and Wastewater Treatment addresses the whole water cycle spectrum, from global hydrological cycle, urban-regional metabolic cycle to individual living and production cycle, with respect to quality control technology based on fundamental science and theories. For every treatment process, basic scientific and environmental physical and chemical natures are explained with respect to those of water and its impurities. Health danger and risks for human beings are also covered.

Selected journal papers

A systematic review of microorganisms as indicators of recreational water quality in natural and drinking water systems
José Luis Lugo; Elkyn Rafael Lugo; Mario de la Puente
Journal of Water and Health
https://doi.org/10.2166/wh.2020.179

Editorial: bacterial antibiotic resistance in the water environment
Gary Toranzos; Maronel Steyn; Tasha Santiago-Rodriguez; Daisuke Sano
Journal of Water Policy
https://doi.org/10.2166/wp.2019.160

Association between exposure to drinking water disinfection byproducts and adverse pregnancy outcomes in South Africa
(OPEN ACCESS)
Funanani Mashau, Esper Jacobeth Ncube, Kuku Voyi
Journal of Water and Health
https://doi.org/10.2166/wh.2020.214

Journal of Water & Health: Special Issue

What do we know about antimicrobial resistance in aquatic environments? On the release of an important new Special Issue, Editors of *Journal of Water & Health* tell us more about this crucial topic in water and sanitation. To learn more, read the author blog here: https://www.iwapublishing.com/news/special-issue-water-health-author-blog-post.

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