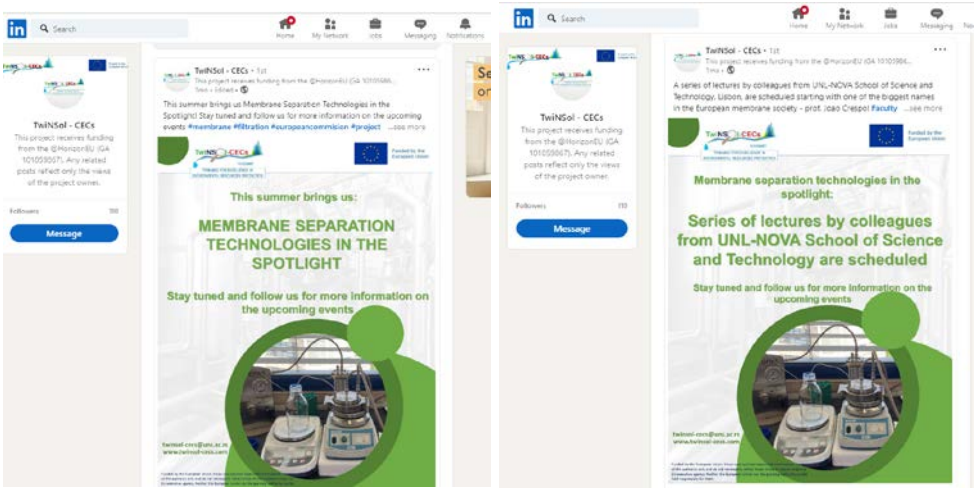
REPORT

Series of trainings "MEMBRANE SEPARATION TECHNOLOGIES IN THE SPOTLIGHT"
University of Novi Sad, Faculty of Technology Novi Sad (TFNS)
August – October 2023

Within TwiNSol-CECs project and Work Package 3 "Reinforcing research knowledge and skills of TFNS", a series of trainings with membrane processes in focus was created by Prof. Joao Crespo, a leader of the project team from the partner institution NOVA University of Lisbon (UNL), who is a Professor of Chemical Engineering at the Faculty of Sciences and Technology, UNL, Head of the Laboratory of Membrane Processes and Dean of ITQB NOVA - Instituto de Tecnologia Química e Biológica António Xavier, UNL. The series of trainings is planned as a combination of online and onsite lectures on different topics within the domain of membrane separation processes, according to the ones originally planned by the project proposal, e.g. membrane processes for the removal of organic contaminants from water, process monitoring, automation and advanced control, data acquisition and data analysis. The series of training was named "Membrane Separation Technologies in the Spotlight" and it was announced on the project website and the project social media profiles (Figure 1); invitation emails to all teaching staff of TFNS, as well as to those from the University of Novi Sad, known for the research interest within the domain of membrane separation technologies, were also sent. Membrane separation technology could be regarded as the one of the main research domains of TwiNSol-CECs project, besides the advanced analytics on Contaminants of Emerging Concern (CECs) and the biomaterials for CECs removal. The first two lectures were held online, followed by the 2-day onsite training at TFNS with two visiting researchers from UNL, who gave both theoretical and practical sessions. The report on each of these three events follows.



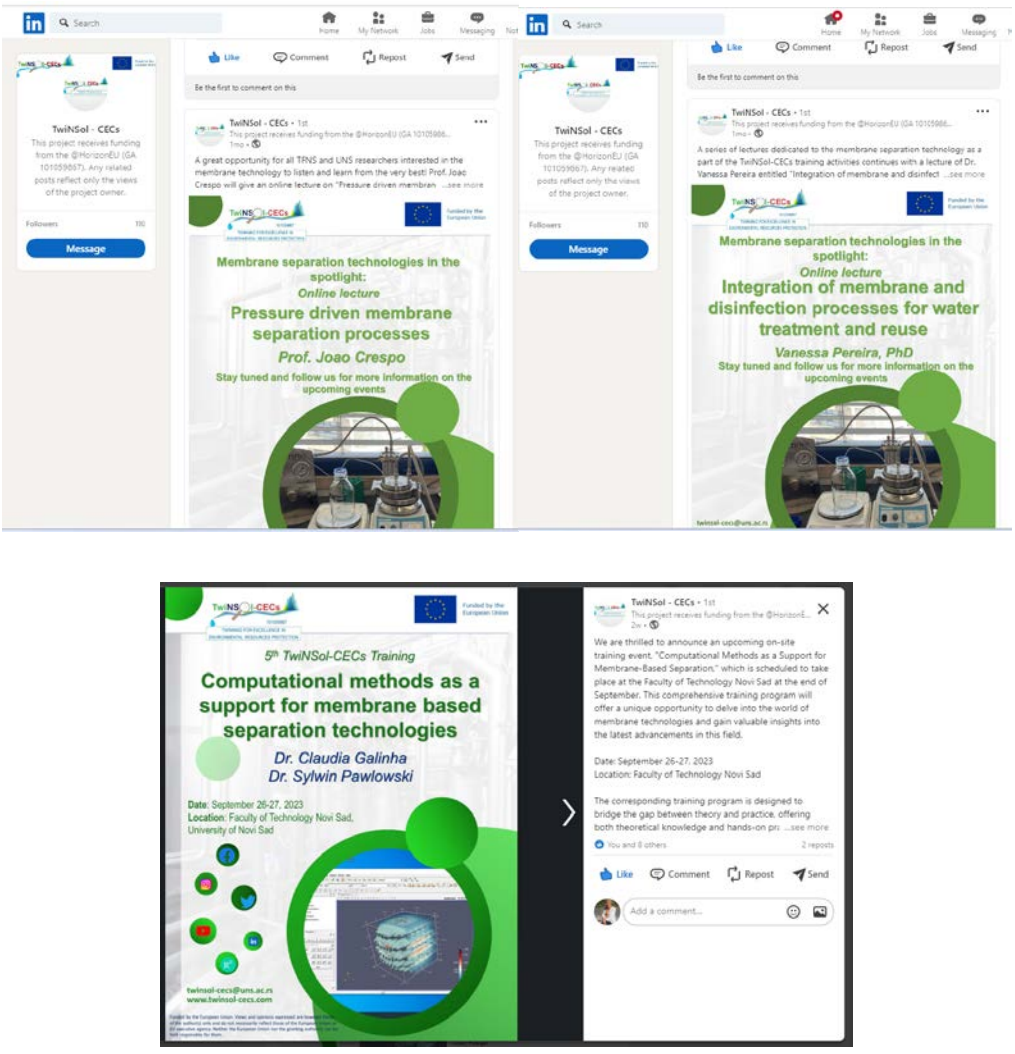


Figure 1. Announcements of the series of trainings on membrane separation technology on the LinkedIn project account

Online lecture 1

Principles of Pressure Driven Membrane Processes
by Prof. Joao Crespo

August 25, 2023

The first lecture within a series on membrane processes under the title "Principles of Pressure Driven Membrane Processes" was held online by Prof. Joao Crespo on August 25, 2023, 13.00 – 14.10 h CET. The lecture was opened and moderated by Dr. Nikola Maravić, the project communication coordinator and a member of the membrane technology team from TFNS. Prof. Nataša Đurišić-Mladenović, the project coordinator, has welcomed all participants, presenting briefly the starting series of trainings as one activity among the work plan of the TwiNSol-CECs project (Figure 3). Subsequently, Prof. Zita Šereš, head of the membrane technology group from TNFS, introduced Prof. Joao Crespo, highlighting the most important parts from his biography with special empahsis on his prestigeous background in membrane processes (Figure 2).

In his lecture, Prof. Joao Crespo has presented main principles regarding pressure driven processes in a time frame of 50 minutes. The participants had an opportunity to hear more about different techniques of managing membrane separation processes. Furthermore, specific problems and solutions in the area of membrane structure, membrane permeance and membrane flux decay were addressed and discussed (Figure 3); industrial scale application and technology were discussed with a presentation of large-scale membrane reactors. At the end of a lecture, Prof. Joao Crespo raised most important questions to be answered in terms of successful application of pressure driven membrane processes.

Afterwards, discussion section was opened, and several participants asked questions and gave comments. Discussion section lasted for 20 minutes.

Total number of participants who joined and listened to the lecture was 23 (Figure 4).

The online lecture was recorded and published on TwiNSol-CECs YouTube channel: https://www.youtube.com/watch?v=-a0aaP78pc4&t=1620s

Participants were informed that the lecture would be recorded and published as well as the screenshot of all participants.

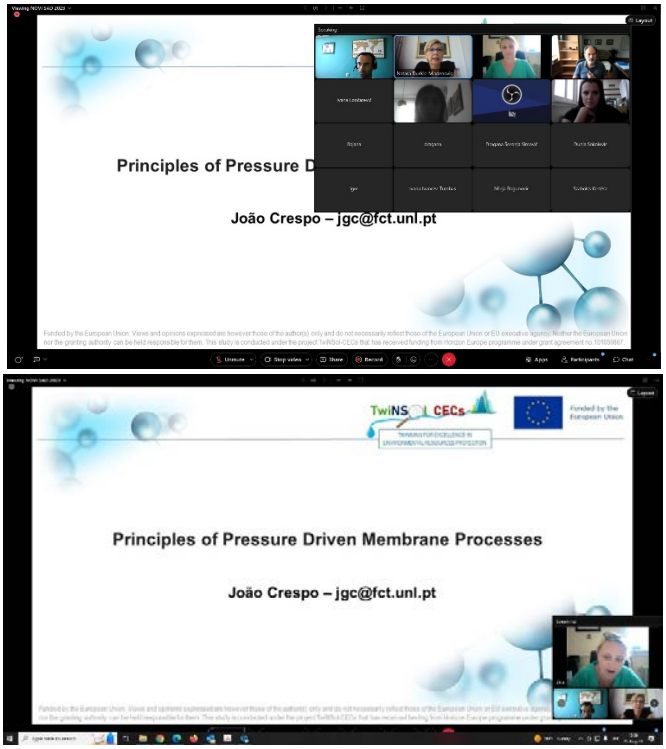


Figure 2. Welcome speach of Prof. Nataša Đurišić-Mladenović and introduction of Prof. Joao Crespo by Prof. Zita Šereš

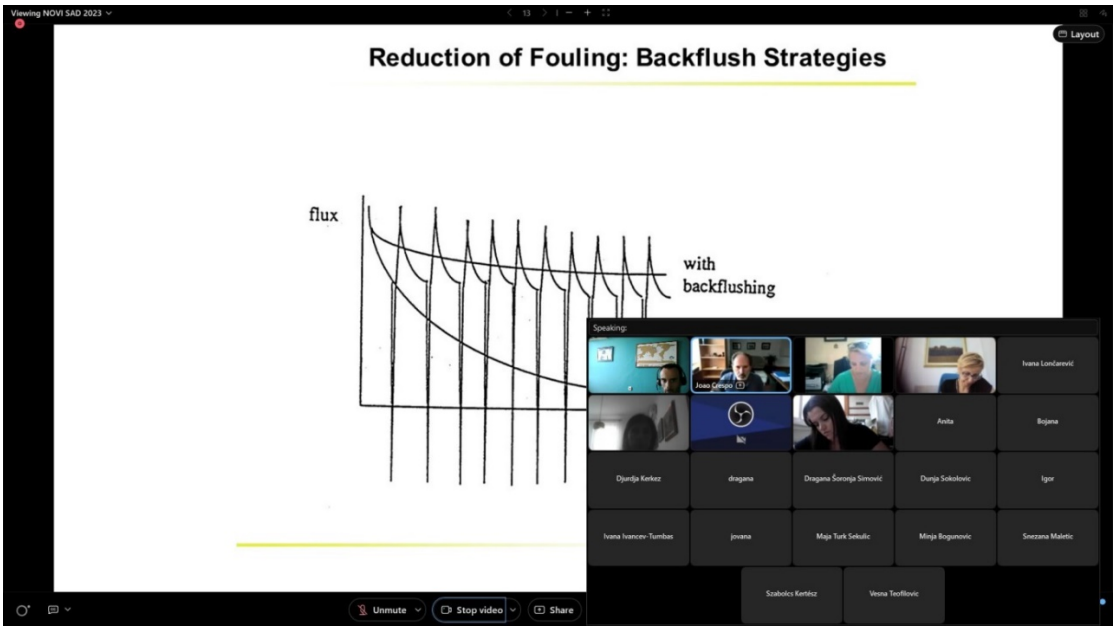


Figure 3. One of the slides during the presentation of Prof. Joao Crespo

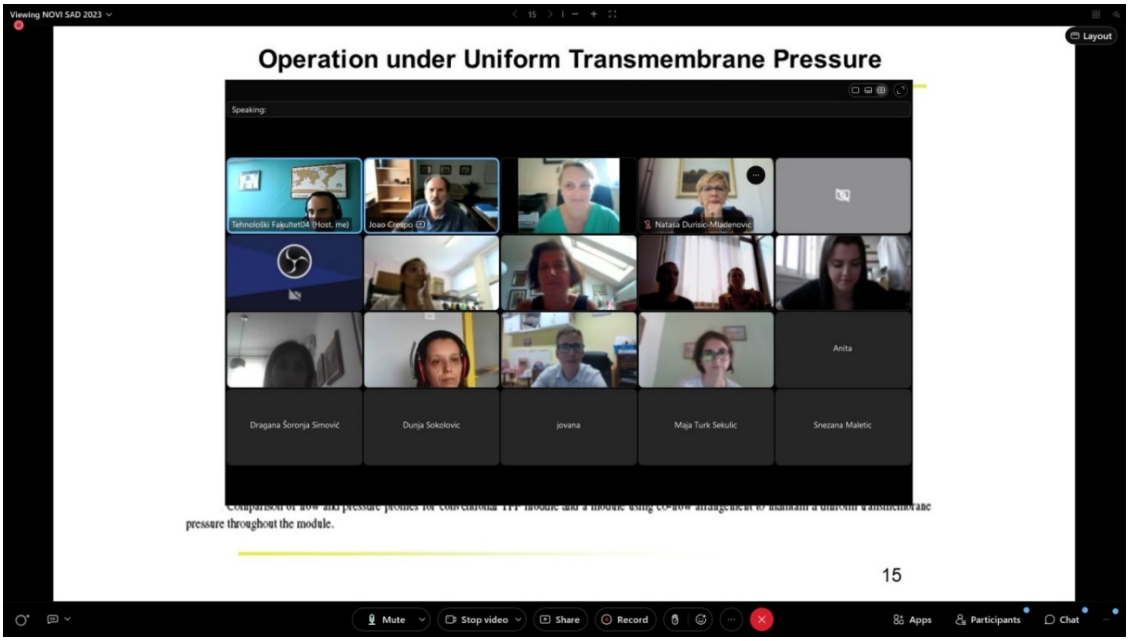


Figure 4. Joint screenshot of the participants

Online lecture 2

Integration of membrane and disinfection processes for water treatment and reuse

by Dr. Vanessa Pereira

September 5, 2023

The second online lecture within the series “Membrane Separation Technologies in Spotlight” entitled "Integration of membrane and disinfection processes for water treatment and reuse " was held by Dr. Vanessa Pereira from iBET, on September 5, 2023 13.00 – 14.10 h CET.

The lecture was opened and moderated by Dr. Nikola Maravić, the project communication coordinator and a member of the membrane technology team from TFNS. Prof. Nataša Đurišić-Mladenović, the project coordinator, has welcomed all participants and presented most important remarks regarding TwiNSol-CECs project (Figure 5). Subsequently, Prof. Zita Šereš, head of the membrane technology group from TNFS, introduced Dr. Vanessa Pereira and highlighted the most important parts from Dr. Vanessa Pereira biography.

In her 45 min presentation Dr. Vanessa Pereira highlighted modern problems with surface water quality, wastewater reuse and the complexity of the applied treatments (Figure 6). Furthermore, a detailed insight into the membrane processes coupled with different non-membrane treatments to meet specific qualitative demands for water reuse was given. Specific attention was paid to the UV light treatment of both permeate and retentate obtained after nanofiltration of wastewater effluents in order to remove/degrade different pharmaceuticals. Dr. Pereira also presented the latest results of the study in which she was involved within the field of pharmaceutically active compounds removal from water samples.

After the presentation, 25 minutes of discussion took place. Several researchers engaged in discussion with their questions and comments of the presented material.

Total number of participants who joined and listened to the lecture was 19 (Figure 7).

Participants were invited to turn on the camera if they agree to be a part of the joint screenshot for the purpose of the event report publication.

Figure 5. Brief intro on TwiNSol-CECs within a welcome speach of Prof. Nataša Đurišić-Mladenović

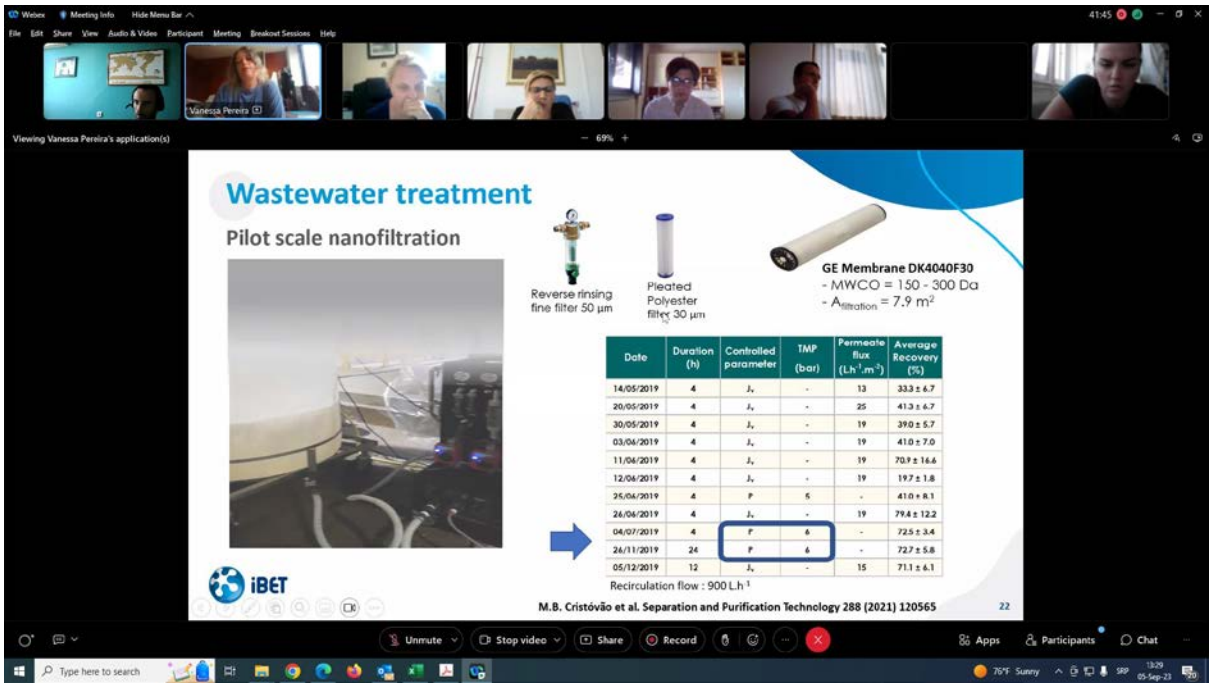


Figure 6. One of the slides during the presentation of Dr. Vanessa Pereira

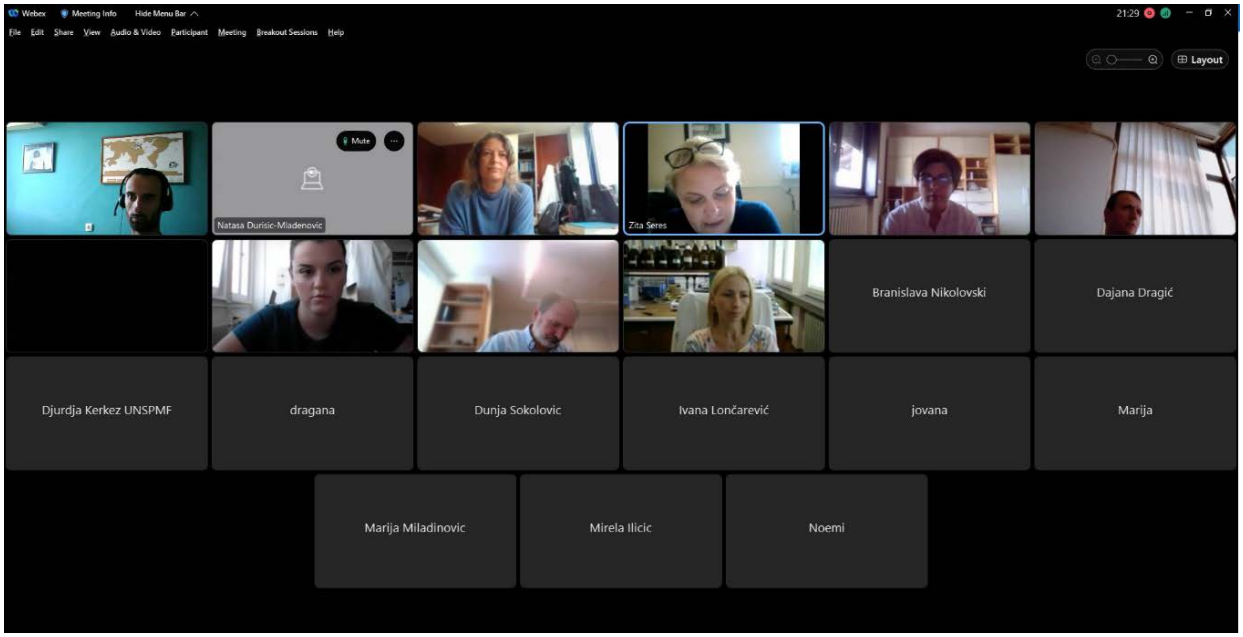


Figure 7. Joint screenshot of all participants

5th TwiNSol-CECs Training
"Computational methods as a support for membrane based separation technologies"
University of Novi Sad, Faculty of Technology Novi Sad
September 26-27, 2023

Within a series of trainings "Membrane Separation Technologies in Spotlight", onsite training "Computational methods as a support for membrane based separation technologies" was organized as a two-day event on September 26-27, 2023, at TFNS. It is the fifth onsite training organized within the TwiNSol-CECs project, the second one held at TFNS (two were organized at CSIC and two at UNL). The 5th Training was organized as a combination of theoretical sessions on the first day and practical lessons during the second day. The aim of the Training was to transfer specific knowledge from researchers from the partner institution UNL, which could be regarded as one of the EU top leading research institution within the domain of membrane separation processes, to TFNS researchers and others interested in membrane processes coming from different institutions. Dr. Claudia Galinha and Dr. Sylwin Pawlowski, from UNL, with prestigious knowledge and expertise in the field of membrane separation processes, particularly in electrospinning, 3D printing, computational fluid dynamics, 2D fluorescence and PCA analysis, held a series of lessons on the topic. The program of the training is attached to the report.

The Training began with Prof. Zita Šereš welcoming all the participants to the Training (Figure 8). Afterwards, Prof. Nataša Đurišić-Mladenović has presented the importance of membrane processes for the research conducting within TwiNSol-CECs project (Figure 8).

Figure 8. Prof. Zita Šereš welcomes the participants of the 5th TwiNSol-CECs training (left) and Prof. Nataša Đurišić-Mladenović presents the importance of membrane processes in TwiNSol-CECs project (right)

The first 45 minute lecture was held by Dr. Claudia Galinha on the topic "2D fluorescence for monitoring and characterization of membranes", where she explained the main procedures used in determining 2D fluorescence, followed by several examples from previously conducted studies (Figure 9). Next session was held by Dr. Sylwin Pawlowski, when he discussed new techniques and devices used for membrane development, more specifically use of electrospinning and 3D printing in membrane development (Figure 9). Afterwards, during a short coffee break, participants discussed previosly presented topics with Dr. Claudia Galinha and Dr. Sylwin Pawlowski.

Second series of theoretical lectures was based on data analysis and modeling, presented by Dr. Claudia Galinha, and computational fluid dynamics, presented by Dr. Sylwin Pawlowski. Dr. Claudia Galinha presented principles of PCA analysis, as well as examples used in spectroscopic data analysis for inspection of the membrane surface status. Dr. Sylwin Pawlowski made a theoretical introduction into computational fluid dynamics, where he prepared the participants for the practical lessons scheduled for the next day.

Figure 9. Theoretical lessons held by Dr. Sylwin Pawlowski (left) and Dr. Claudia Galinha (right) on September 26, 2023

On the second day of the Training, a series of practical lessions was held for participants in a computer room of TFNS (Figures 10 and 11). Dr. Sylwin Pawlowski has held three practical sessions on computational fluid dynamics, where participants used BlueCFD program to better understand fluid dynamics in different systems. Dr. Claudia Galinha held a practical session on data analysis, more specifically PCA analysis and multivariate regression. Participants used program MathLab to accomplish data analysis of previously given experimental data.

Total number of participants who joined practical part of the training and listened to the lecture was 20, including two participants from Faculty of Engineering, Szeged, one participant from Faculty of Technology in Leskovac, one participant from Faculty of Sciences in Novi Sad and one participant from Faculty of Technical Sciences in Novi Sad. Other participants that listened to practical lessons

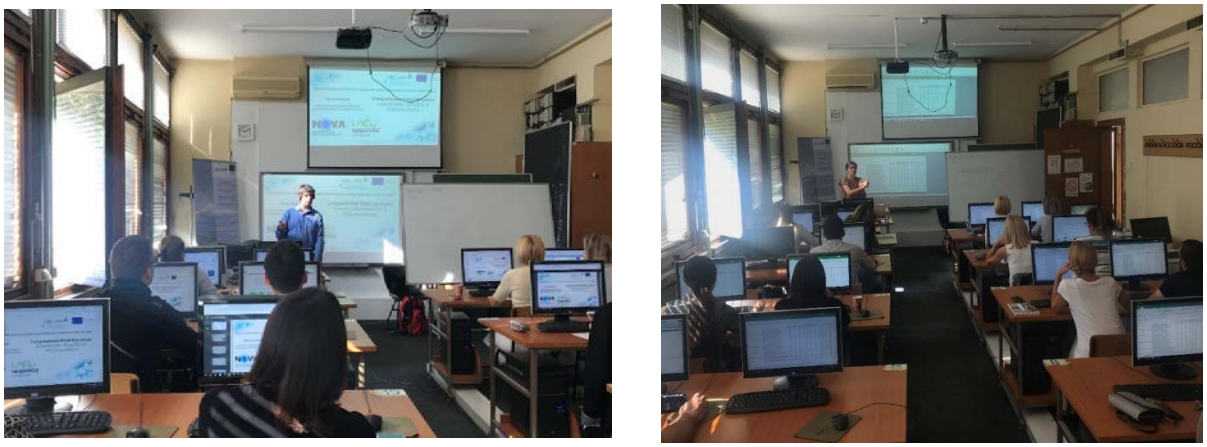


Figure 10. Practical lessons on computational fluid dynamics (CFD) with Dr. Sylwin Pawlowski (left) and on multivariate data analysis with Dr. Claudia Galinha (right)

Figure 11. Participants on practical sessions at 5th TwiNSol-CECs training

5th TwiNSol-CECs Training
"Computational methods as a support for membrane based separation technologies"
University of Novi Sad, Faculty of Technology Novi Sad
September 26-27, 2023
Program

September 26, 2023 Tuesday
Blue Hall, 1st floor

10,00-10,30	Registration of participants
10,30-10,35	Welcome speech, **Prof. Zita Šereš** (TFNS, Novi Sad, Serbia)
10,35-10,45	Membrane processes in TwiNSol-CECs, **Prof. Nataša Đurišić-Mladenović** (TFNS, Novi Sad, Serbia)
10,45-11,30	2D fluorescence for monitoring and characterization of membranes, **Claudia Galinha** (NOVA University, Lisbon, Portugal)
11,35-12,20	New techniques for development of membranes and devices: electrospinning and 3d printing, **Sylwin Pawlowski**, (NOVA University, Lisbon, Portugal)
12,20-12,35	Refreshment and coffee break
12,35-13,20	Data analysis and modeling applied to spectroscopic data, **Claudia Galinha** (NOVA University, Lisbon, Portugal)
13,20-14,05	Computational Fluid Dynamics – Theoretical introduction, **Sylwin Pawlowski**, (NOVA University, Lisbon, Portugal)
14,05-15,00	Lunch

September 27, 2023 Wednesday
Computer Lab no.10, 1st floor

09,30-10,15	Computational Fluid Dynamics – BlueCFD, **Sylwin Pawlowski**, (NOVA University, Lisbon, Portugal)
10,20-11,05	Data analysis (PCA and multivariate regression), **Claudia Galinha** (NOVA University, Lisbon, Portugal)
11,05-11,15	Pause
11,15-12,00	CFD - meshing, numerical schemes, **Sylwin Pawlowski**, (NOVA University, Lisbon, Portugal)
12,05-12,50	CFD - RTD simulations, **Sylwin Pawlowski**, (NOVA University, Lisbon, Portugal)
12,55-14,00	Lunch

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