

In this issue...

- BioNexGen ID 1
- Editorial 1
- Three years of BioNexGen: Summary 2
- Impressions of BioNexGen Partners 3
- 4th nano4water Workshop 4
- NanoMemWater Final Conference 5
- 2nd WATERBIOTECH Conference 6

BioNexGen ID

Title

Development of the Next **Generation** membrane **Bioreactor** system

Programme

Seventh Framework Programme, Collaborative Project

Duration

01/09/2010-28/02/2014

Main objective

BioNexGen is developing a new class of functional low fouling membranes for membrane bioreactor technology with high water flux and high rejection of organic matter with low molecular weight

Partner countries

Egypt, Germany, Greece, Italy, Tunisia, Turkey, UK

Editorial

Dear Readers,

Welcome to the sixth and final issue of our **BioNexGen** newsletter! In this issue we will inform you about activities where our consortium was involved in during the past months. First of all, we will present you a summary of the main achievements of **BioNexGen**. We have also asked our project partners to share their experiences they have made within the project with you.

In this issue we will also make you aware of interesting upcoming events such as the 4th nano4water workshop. After that, we will give you an overview of the **BioNexGen** Final Conference NANOMEM-WATER, which took place in October 2013. We would as well like to present you an article of the WATERBIOTECH Conference in Marrakech (Morocco).

Moreover we warmly invite you to also regularly consult our project website under www.bionexgen.eu in order to be updated on the latest developments.

Yours sincerely,
BioNexGen consortium

BioNexGen Partners

The project is carried out by **7 European, 1 Turkish and 3 MENA partners**, namely two partners from North Africa and one from the Middle East.

The consortium has been carefully selected to ensure a multidisciplinary approach which is necessary to realise this innovative concept. It consists of academic and industrial partners and of technology transfer institutions.

Technology transfer: Coordinator, Karlsruhe University of Applied Sciences (Germany), Steinbeis-Europa-Zentrum (Germany)

Membrane's development: Institute on Membrane Technology at Italian National Research Council (Italy), Foundation for Research and Technology, Hellas (Greece), Izmir Institute of Technology (Turkey), Swansea University (UK), as well as Microdyn Nadir (Germany) and Nanothinx (Greece), as European leaders in innovative MBR membrane technology and carbon nanotubes' manufacturing

Demonstration and field test activities: Centre de Biotechnologie de Sfax (Tunisia), Central Metallurgical Research and Development Institute (Egypt)

Three years of BioNexGen - Improved Membranes for Wastewater Treatment: Our main achievements

Since water scarcity is a growing problem particularly in the Northern African countries the use of alternative water resources will be more important in near future. In this context reuse of treated wastewater offers a viable option to reduce fresh-water consumption. In general Membrane Bioreactor Technology (MBR) is widely regarded as an effective tool for industrial water treatment and water reuse due to its high product water quality and low footprint.

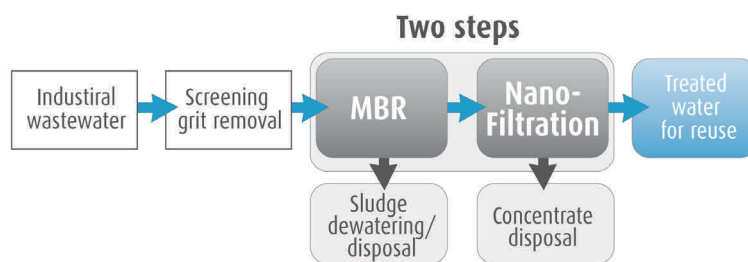
However, membrane fouling is regarded as main issue for further marketing of this technique.

Therefore **BioNexGen** aimed at developing novel functionalized low-fouling membranes for membrane bioreactors (MBRs) in wastewater treatment.

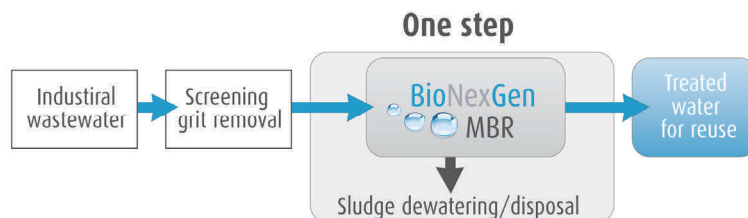
Our scientific work on developing novel anti-fouling membranes for membrane bioreactors offers promising routes for future applications in a variety of industrial sectors. In this regard novel hydrophilic and antimicrobial coatings based on polymerizable bicontinuous microemulsions as well as layer-by-layer techniques have been developed. In addition incorporation of a variety of nanoparticles (e.g. carbon nanotubes) in these coatings have been studied as well. The major advantage is that these coatings can be casted on commercially available membranes in order to enhance their performances.

We successfully involved many Bachelor, Master and PhD students in our collaborative research work. In total four students completed their PhD work within **BioNexGen**, namely: Francesco Galliano, ITM-CNR, Italy, Ines Friha, CBS, Tunisia, Shamim Deowan, HSKA, Germany and John Anastasopoulos, ICE-HT/FORTH, Greece. Dimitra Sklavounaki, ICE-HT/FORTH, Greece completed her Master.

Membrane bioreactor process combined with nanofiltration



BioNexGen approach



Besides research we also organized two workshops: 8-9 March, 2012 at CBS, Tunisia, 15-17 May, 2013 at ITM, Italy and a final Conference 8-10 October 2013 on “Application of nanotechnology in membranes for water treatment” in Izmir, Turkey. Besides a multitude of interesting contributions from interna-

tionally renowned scientist this conference was also **BioNexGen** showcase presenting a variety of project findings.

However, the **BioNexGen** project not only offered excellent technical work but also gave rise to cultural exchange on a personal level during our regular meetings with a variety of European and MENA countries what we enjoyed very much.

Since **BioNexGen** is drawing to a close and this is consequently the final newsletter. I would like to thank all partners for their excellent contributions to this successful project.



Three years of BioNexGen: Impressions from our project partners

Three years of joint and interdisciplinary research are laying behind our **BioNexGen** project partners. Three years of challenges and achievements and many new experiences for everyone of them. Within the final steps of **BioNexGen**, currently taking place, we asked our project partners about their major achievements, positive impacts and various lessons learnt.

Deeper technical knowledge in a cutting edge research project, valuable multicultural experience and a new level of team work have been the biggest impact for the coordinator of **BioNexGen**, Prof. Dr. Jan Hoinkis and his team mate Dr. Shamim Dewan from University of Applied Sciences, Karlsruhe (HSKA, Germany). To Shamim Dewan the project offered the possibility to pursue his PhD in chemical engineering. The team of HSKA also has improved their skills on how to develop a concept and materialise it.

According to Prof. Dr. Sacide Alsoy Altinkaya of Izmir Institute of technology (IZTECH, Turkey), **BioNexGen** has provided her and her team a great opportunity to apply their expertise in developing water treatment membranes, in addition, they benefitted from the criticisms of the industrial partner. The project also helped them to advance their knowledge in surface modification and characterization of the membranes. Convincing Prof. Altinkaya on the ability of extending knowledge to further areas, **BioNexGen** motivated her to involve in new multinational collaborations within EU funded projects..

This project was a great experience for Dr. George Voyiatzis and his teammates from Foundation for Research and Technology, Hellas (FORTH, Greece). **BioNexGen** has been a milestone as it was their first project dealing with membranes for wastewater treatment. They have designed and accomplished a way to transform an existing ultra-filtration membrane into a new class of functional membranes based on the embedment of CNTs in its thin selective layer.

Research conducted during **BioNexGen** opened the chance to directly get in contact with MBR technology. They were intrigued to learn about the latest membrane development techniques and membrane manufacturing technology in order to prepare CNTs properly functionalized with ultimate purpose to enhance their embedment in polymer membranes.

The principal researchers from Institute on Membrane Technology of the National Italian Research Council (CNR-ITM, Italy) are Dr. Giorgio De Luca (modelling/theoretical approach) and Dr. Alberto Figoli (membrane development and application).

BioNexGen has provided Giorgio De Luca and his team the opportunity to explore in depth the permselectivity properties of CNTs being able to understand the potential and limits of these new nanostructures and their applicability. They were able to submit the results as papers in international journals. One main achievement of Dr. Figoli and his team was

the possibility to explore practical and theoretical aspects and new scientific fields related to membrane preparation, characterisation and application in water treatment. This led to a patent on PBM novel membrane coating for wastewater treatment (A. Figoli et al., GE2013A000096, filed on field on 27/09/2013). The project not only improved the spirit of collaboration and the exchange of ideas but also helped to stimulate the discussion among the colleagues involved in the project, which in turn contributed to exploit individual and collective skills.

BioNexGen has made an impact on Dr. Sandrine Doretto and Franziska Bergmann of Steinbeis-Europa-Zentrum (SEZ, Germany) as the project helped to deepen their competencies on international project management and cultural exchange. For SEZ, the opportunity to be a partner in **BioNexGen** improved their know-how on the mechanisms of knowledge transfer.



Three years of BioNexGen: Impressions from our project partners II

The incorporation of CNTs in nanoporous membranes and cooperation for the development of mixed-matrix membranes were the major achievements for Theodoros Karachalios and Dr. Katerina Kouravelou of Research and Development of Carbon Nanotubes S.A (Nanothinx - NTX, Greece). With the help of **BioNexGen** they were able to learn about the know-how on the development of the procedure for the infiltration of CNTs in commercial membranes and in the production of mixed-matrix nanoporous membranes.

BioNexGen has helped Gisela Jung and her colleagues from Microdyn-Nadir (M N, Germany) to attain a consolidated know-ledge about the potential of possible modifications to improve MBR-membranes for waste water treatment. For her, it has also been a challenge to estimate the time and costs of the project with such many partners.

For Dr. Daniel Johnson of Swansea University (SU, UK) **BioNexGen** offered the opportunity to

investigate novel polymeric membranes in partnership with international collaborators and to develop colloid probe techniques to assess foulant attachment to membranes. Their technical expertise in membranes systems and fouling have been advanced. Daniel's team profited of **BioNexGen** especially for new international collaboration contacts in the research community. Moreover, SU was able to publish and prepare several research papers.

According to Prof. El-Sayed Ali Abdel-Aal of Central Metallurgical Research and Development Centre (CMRDI, Egypt) this project was a unique chance to fruitfully participate in an international scientific cooperation. His team learnt how to manage big projects with multidisciplinary groups and to commit themselves for achieving common goals and objectives. In **BioNexGen** Prof. El-Sayed Ali Abdel-Aal was able to enhance his knowledge from fundamentals to application.

Upcoming events

April 2014: Fourth Joint nano4water Workshop in Stockholm, Sweden - Call for Papers and Poster Award

During April 23-24, 2014 the fourth Joint Dissemination workshop of the nano4water Cluster will be held in Stockholm, Sweden under the topic "Nano enabled systems and membranes for water treatment". The workshop series aims at bringing together activities and results allowing finding synergies to boost development status and ways into application.

The calls for papers and for posters have been published and are open until February 15th 2014.

The following topics might be addressed:

- ◇ Nanostructured membranes for advanced water purification
- ◇ Nano-catalysts for water purification

- ◇ Molecularly imprinted materials for water cleaning
- ◇ Bioactive nanoparticles as alternative disinfectants
- ◇ Nanosorbents as separation media in water purification
- ◇ Biobased and biomimetic nano membranes for water treatment
- ◇ Membrane bioreactor (MBR) technology

The student posters will be evaluated for the best poster awards.

For further information please visit: <https://nano4water.vito.be/workshops/Pages/4thjointworkshop.aspx>

NANOMEMWATER – BioNexGen Final Conference held from 8th - 10th October 2013 in Izmir, Turkey

BioNexGen final conference, NANOMEMWATER, took place in Izmir, Turkey, from 8th to 10th October 2013. Numerous researchers working in the field of water treatment, membrane technologies and nanotechnology were present. With four keynote lectures held by invited speakers and more than 20 talks, NANOMEMWATER offered a diverse programme and information about latest insights on the “Application of Nanotechnology in Membranes for Water Treatment”.



The three days-conference started with a poster session on the first evening, followed on the second day by an opening speech of the **BioNexGen** project coordinator Prof. Dr. Jan Hoinkis of the University of Applied Sciences, Karlsruhe (Germany), in which he presented the results of **BioNexGen** research activities. The final conference was complemented by the following guest speakers and their talks:

- ◇ “Membranes with nanostructured porosity” by Suzana Pereira Nunes
- ◇ “Membrane separations of aqueous solutions: from continuum-based models to atomistic simulations” by Anthony Szymzyk
- ◇ “Multi-functional polymer-based membranes” by Mathias Ulbricht

- ◇ “Hybrid water treatment process of tubular ceramic MF and polyethersulfone beads loaded with titanium dioxide photocatalyst” by Jin Yong Park



The audience of more than 50 participants expressed great interest into NANOMEMWATER and the talks presented, resulting in vivid and intensive discussions during and after the conference. It is furthermore planned to publish all talks as conference proceedings in a book. Further information will follow.



The **BioNexGen** final conference NANOMEMWATER was organized by the Turkish project partner IZTECH in close cooperation with the partner SEZ (Germany).

Further information can be found on www.nanomemwater.org

Past events

Second WATERBIOTECH International Conference in Morocco



The 2nd WATERBIOTECH international conference was held in Marrakech (Morocco) from 8th to 10th

January 2014 at the University Cadi Ayyad. Biotechnology for Africa's sustainable water supply: WATERBIOTECH is an EU funded project under the European Framework (FP7).

Researcher from different countries especially from Europe and Africa along with national and regional decision makers, water professionals, scientists actively participated in the conference. All of their discussion and efforts were aim to find a sustainable solution for water management system in northern African countries. Due to the water scarcity and weak water supply and management system, a vulnerable situation was created in many African countries. It causes serious health problems and economic crisis over decades. The main objective of this conference was to exchange ideas and information between international collaborators and funding organizations in order to outline the role of biotechnology solutions of water treatment for a sustainable water supply system in Africa.

The event includes the presentation of scientific papers related to relevant aspects of water management and water supply in Africa as well as discussion panels and workshops. The intention of this conference is to extend this fruitful cooperation to all participants of this event and widely disseminate the results of WATERBIOTECH initiative. The overview on the results and progress in **BioNexGen** project was presented by by the coordinator of **BioNexGen**, Prof. Dr. Jan Hoinkis titled as "Treatment Of Textile Dye

Wastewater By Membrane Bioreactor (MBR) With Commercial and Novel Low- fouling Membranes" the coordinator of the **BioNexGen** project from Karlsruhe University Of Applied Sciences (Germany).The aim of this project was to develop novel functionalized low-fouling membranes for membrane bioreactors (MBRs) in waste water treatment specially for industrial waste water. The presented findings were obtained in a small pilot-scale submerged membrane bioreactor treating model textile dye wastewater (MTDW).

A novel membrane material has been developed as special coating on commercial membranes by the Institute on Membrane Technology (Italy) for treating



this MTDW, which had also been used in the pilot trials for textile wastewater treatment. The next presentation titled as "Novel Hydrophilic And Antifouling Coatings for Membrane Bioreactor (MBR) Application" addressed the development of coating and was delivered by Dr. Francesco Galiano

from the Institute on Membrane Technology (Italy), whose work was carried out within the **BioNexGen** project under the supervision of Dr. Alberto Figoli. The work focused on the preparation, characterization and application of novel hydrophilic coatings on commercial ultrafiltration polyethersulphone (PES) membranes. These membranes were subsequently tested with small MBRs at Karlsruhe University of Applied Sciences, as presented by Prof. Hoinkis in his talk, which focused on pilot results with MBR. Small pilot trials with real wastewater are still ongoing at the Center of Biotechnology (Tunisia). This novel coating can be considered as a promising membrane surface modification technology for potential application in MBR process for wastewater treatment. As result, a joint patent (GE2013A000096) with ITM-CNR, HSKA and UNICAL has been published on 27/09/2013.