THE FRAMEWORK PROGRAMME FOR RESEARCH AND INNOVATION
HORIZON 2020

Project undertaken with the financial support of the European Commission.
Grant Agreement Number: 686031

COORDINATOR CONTACT

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Upcoming Events

- **ECOMONDO - the green technologies expo, 08-11 November 2016, Rimini, Italy**
  http://www.ecomondo.com
- **9th International Membrane Science and Technology Conference, IMSTEC 2016, 05-08 December 2016, Adelaide, Australia**
  http://www.imstec.com.au/
- **IWA Specialist Conference on Water Efficiency, 21-23 Mar 2017, Tel Aviv, Israel**
  http://www.iwa-network.org/all-events/page/2/
- **ICPEAM 2017: 19th International Conference on Process Engineering and Advanced Materials, 26-27 Mar 2017, Madrid, Spain**
  https://www.waset.org/conference/2017/03/madrid/ICPEAM
- **European Coatings Show Conference, 03-04 April 2017, Nürnberg, Germany**
  http://www.european-coatings.com/Events/European-Coatings-Show-Conference-2017

Partners

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Interested in MATChING progress? Subscribe to our newsletter or ask to join our stakeholders' community. Joining the stakeholder community is a non-binding complimentary and voluntary basis.

For further information contact: **matching-communication-team@enel.com**

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ISSUE 01 November 2016

SIX MONTHLY NEWSLETTER

MATChING

this issue

Project Updates

After the first six months:

- Methodologies on how to carry out the laboratory/pilot activities have been established and are summarized in two Deliverables D2.1 *"First Key Performance and success indicators"* and D2.3 "*Standard for common water testing conditions*". Visit our website for download;
- Laboratory test on materials for low T geothermal source are ongoing at the Danish Technological Institute and AIMEN laboratories (WP3);
- SPIG engineering activities for EGP - Nuova San Martino Hybrid CT are proceeding with the new filling that will be installed by mid April 2017. The first set of solutions for dry modules (base materials + coatings) will be installed in a dry module mock up in the beginning of 2017 (WP4).
- Laboratory test on coatings and surface preparation to promote dropwise condensation and anti-fouling behavior are on going at the Danish Technological Institute, AIMEN and MateriaNova laboratories (WP5);
- Test with MCDI (Membrane capacitive Deionization) and MD (Membrane Distillation) are running at VITO laboratories. Test with Vortex Unit will start soon;
- Test with Membrane Distillation, Pressure Driven membranes and Membrane Condenser are running at ITM Laboratories (WP6).

Welcome to the First edition of MATChING Newsletter

SUMMARY OF THE EDITION

MATChING consortium is very happy to launch this first edition of MATChING Newsletter. Six newsletters, one every six months, will keep you updated with the main achievements and events going on in the Project. In each edition, you will always find a couple of articles providing an insight on some of the technologies we are developing. These articles will also describe the activities we are performing to make a progress toward the current state of the art. In this edition, the focus is on:

Drop-Wise Condensation *for increasing condenser heat transfer efficiency* - what is it, which are the potential advantages and why it is not yet implemented?

Membrane Capacitive Deionization *for water treatment* – which is the principle of operation and why it is competitive towards pressure-driven membranes?

Each edition will also include sections dedicated to "Partners Update" to have a closer look on the Partner's role and activity within the Project. In this First Edition:

The Danish technological Institute (DTI) is working together with MateriaNova, Aimen and Ionics on the development and testing of the coatings for dropwise condensation;

VITO has just completed its laboratory test with Membrane Capacitive Deionization as part of its work under the Work Package 6 - "Water Treatment and Recovery".

We are also pleased to inform you on the first project workshop that took place on September 21 at the EDF Chatou Laboratories. The objective of the workshop was to put together Project Partners and Members of the Stakeholders Group with the aim to share the results of the first six months of the project, in particular those related to the definition of technical and global Key Performance and Success Indicators.

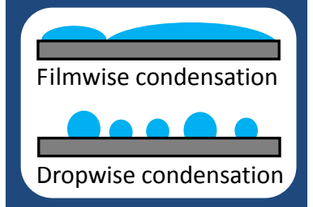
This work resulted in a Project Deliverable (Deliverable D2.1 – First Key Performance and success Indicators") that can be downloaded from the Project Website.

Finally give a look to our section dedicated to the events. Next MATChING General Assembly is foreseen on March 7-9, 2017 on Bruxelles. As the analogous section on the website is regularly updated we invite you to visit it.

MATERIALS &TECHNOLOGIES FOR PERFORMANCE IMPROVEMENTSOF COOLING SYSTEMS IN POWER PLANTS

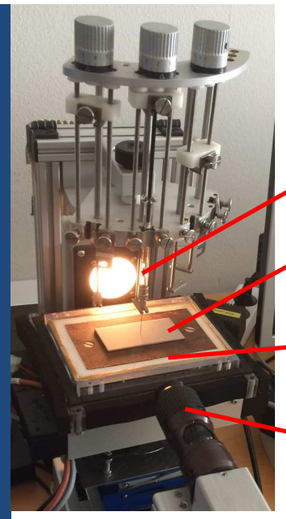
CONDENSATION in power plants

In a thermal power plant, steam drives a turbine and condenses thereafter on the tube surface of a water-cooled condenser. On standard metal tubes, the condensed water forms drops that cover practically the complete surface, forming in some cases actually a continuous water film (filmwise condensation). The water layer acts as heat transfer barrier. Laboratory tests have shown that hydrophobic surfaces increase the heat transfer by providing condensation of distinct drops with free surface in between (dropwise condensation).



As water continuously condenses, drops slide down and grow by coalescing with all other drops in theirs path. These drops leave a wet trail on metal surfaces, but an initially dry trail on hydrophobic surfaces until new condensation starts.

Condensation on vertical plates. Top: bare aluminum (partly filmwise) Bottom: hydrophobic coating (dropwise)



Modified drop shape analysis to measure contact angles under condensation

Syringe to apply water drops or to withdraw water from drops

Sample

Cooling plate (+1°C) to induce condensation

Camera + computer to evaluate contact angles

DTI - Dropwise condensation

DTI has successfully set up lab-scale tests to investigate performance and durability of coatings to increase condensation on surface condensers

The Danish Technological Institute (DTI) will develop coatings that provide dropwise condensation on steam condensers to improve the condenser's efficiency and allow to save cooling water.

Wetting and drainage performance can be predicted by advancing and receding contact angle measurements. In a power plant context, the surfaces will be permanently in contact with water which can already render the surfaces' initial properties. DTI has therefore developed a test set-up to measure receding water contact angles under condensation by combining a cooling plate with a common drop shape analysis (see illustration above).

However, the main challenge is not expected to be the coatings initial properties, but the durability, as it is known that contact with water may degrade hydrophobicity. While a vast amount of hydrophobic surfaces has been published, hardly any data exist on their long-term stability. DTI will expose surfaces for month or years in a condensation chamber that was constructed specifically for the project to generate durability data and identify the most promising solutions.

A variety of different coatings and surface treatments by DTI, MateriaNova and AIMEN will be investigated. DTI's focus will, due to promising previous attmpts, be on organic-inorganic hybrid coatings with a thickness below 10 µm to allow a good heat transfer through the coatings.

First workshop on KPI and Success Indicators Indicators

The first workshop of the project on Key Performance and Success Indicators took place on September 21, 2016 at the headquarter of EDF Research Center in Chatou (close to Paris). Around 45 people attended the workshop. Partners shared with the group of Stakeholders the results of the first six months of the project, in particular those related to the definition of Key Performance and Success Indicators. **KPIs** have been defined **at technology level** to characterize MATChING technologies and to allow comparison with benchmarked commercial solutions (state of the art). Examples of such KPIs are: electrical consumption, heat transfer coefficient, fouling, corrosion...

Relevance of KPI was determined using the SMART criteria where the letters stand for Specific, Measurable, Attainable, Relevant, Time-bound.

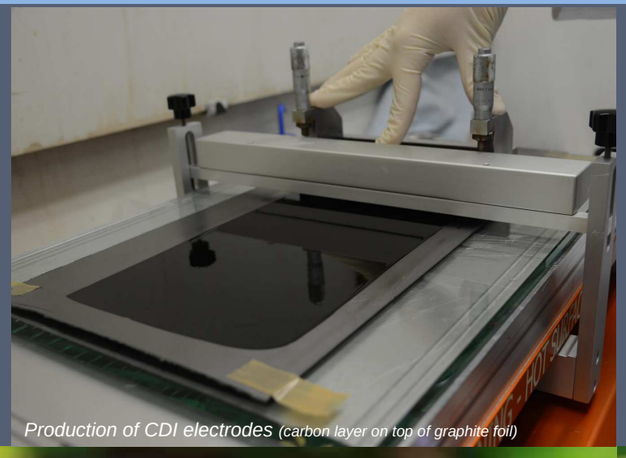
The outcomes are summarized in the Deliverable D2.1 ”Definition of Key Performance and Success Indicators” downloadable in the project website. Two panel discussions have been organized: the first one was on ”The use of membranes for water treatment in the electric sector” while the second one was on “the use of coatings in heat transfer equipment”. In the afternoon session an overview of the regulatory context in European Union and United States has been given respectively by Remi Bussac, policy advisor of EDF and member of Eurelectric working group, and Jeffrey Preece, water research manager at EPRI.

New BAT associated emission limits for discharge water have been discussed following the 2016 version of LCP BREF in Europe and the new EPA (2015) Guidelines in United States. In both the cases it has been highlighted that the regulatory framework for water is complex as in addition to the Industrial Emission Directive (In Europe) many other Directives should be taken into account.

MATChING Consortium would like to warmly thank all the partcipants for their precious feedback and professional contribution.

VITO – Capacitive removal of hardness and salinity

VITO will develop a CDI module capable of removing hardness and salinity from the intake water of cooling towers. Feasibility and performance of the CDI process will be evaluated on labscale for different feed waters: river water, brackish water treated municipal waste water, with different levels of hardness levels and salinity.



Production of CDI electrodes (carbon layer on top of graphite foil)

VITO will start off with a comprehensive study to determine the operational window of CDI in relation to the feed water quality. Based on these results, more precise values for the process parameters can be chosen for optimal removal of targeted components (hardness, salts). Tests on real water samples will fine-tune the initial study.

After conducting the lab experiments on the real streams, enough information will be available to make a sound selection of the CDI-components: membranes, spacers and electrode material will be chosen to match the characteristics of the feed water. Now the construction phase can start and give rise to an actual demo CDI-module.

VITO will build a CDI unit and test it together with the MERADES pilot at the Laborelec demo-site. This CDI pilot unit will consist of one industrial-sized module with a through-put of 100l/h. We will evaluate the desalination, hardness removal,; resistance to fouling, energy consumption and effects on the performance of the cooling towers.

CDI TECHNOLOGY

Capacitive deionization (CDI) has emerged over the past years as an energy and cost efficient technology for the desalination of water with low to moderate content of inorganic salts e.g. for domestic water softening or cooling tower make-up water treatment.

In CDI, water is passed between pairs of carbon electrodes with very high surface areas. The electrodes are polarized to attract and reversibly store ions at their surface, thereby removing these ions from the influent. The ions are stored in the electrical double layer (EDL) at the surface of the carbon electrode material. When saturation is reached, the potential is reversed, releasing the ions from the EDL into the central spacer channel, forming a more concentrated stream. As such the CDI process is discontinuous by nature, as e.g. ion-exchange resin technology. Continuous operation can be achieved by duplicating. In water containing multiple ions, it is possible to selectively remove e.g. multivalent ions (such as Ca^{2+}, Mg^{2+}, SO_4^{2-}) by optimizing the different process parameters: cell voltage, current and hydraulic retention time. This creates a possibility for CDI to remove hardness from aqueous streams in a very energy efficient way and without the use of chemicals.