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## Upcoming Events

- **Heat Exchanger Fouling and Cleaning XII – 2017, June 11-16, 2017, Madrid, Spain**  
<http://www.heatexchanger-fouling.com/index.htm>
- **International Water Association Conference, July 18-20, 2017, Bath, UK**  
<http://efficient2017.com/>
- **2017 International Congress on Membranes and Membrane Processes, ICOM 2017, San Francisco (U.S.A.), July 29-Aug. 04, 2017**  
<http://www.icom2017.org/>
- **10th World Congress of Chemical Engineering (WCCE10), October 01-05, 2017, Barcelona, Spain**  
<http://www.wcce10.org>
- **IAHR Industrial Cooling Tower Conference 2017 2016, October 18-19, 2017, Lyon Marriott Hôtel Cité Internationale, France**  
<http://www.iahr-ictc2017.com/>
- **ECOMONDO - the green technologies expo, GREEN & CIRCULAR ECONOMY November 07-10 2017, Rimini, Italy**  
<http://www.ecomondo.com>

## Partners



## Subscribe to our Newsletter or Join our Stakeholders' Community

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](mailto:matching-communication-team@enel.com)



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MATChING

## Project Updates

Here is a summary, at WP level, of the most relevant progress:

- WP3 Low-T geothermal case: Just completed the experiments in laboratory with coatings for geothermal brine with promising results (12 coatings for AISI 316L and 9 coatings for P265G). Five of them have been selected for the testing at Balmatt site where they will work with the real geothermal brine. Installation of the facility at Balmatt is foreseen at the end of 2017.
- WP4 - High T geothermal case: The first set of material solutions for CT dry modules have been exposed for two months (mock up test) in by-pass configuration in Nuova San Martino Cooling Tower;
- WP5 - Steam Condenser materials: Laboratory test almost completed for both the steam side and cooling water side coatings/materials with interesting results. Performance test just started at Thyco Facility for steam side materials
- WP6 - Technologies for water treatment: almost all the technologies under investigation have been already tested at lab scale with promising results. Test with membrane distillation for CT blowdown recovery are on going at MERADES pilot plant and will start soon in As Pontes Power Station.



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## Welcome to the 2nd edition of MATChING Newsletter

## SUMMARY OF THE EDITION

After the first year of the project we have made a lot of progress in all the Project activities. Laboratory test are completed for almost all the technologies under investigation and we are now ready for the next phase! In this edition we have made a focus on two technologies:

- Antibiofouling Coatings;
- Membrane Distillation

The first technology is developed by many Partners inside the Consortium: MateriaNova, DTI and Ionics as experts in material science and developers of the technology itself, INTEGASA as steam condenser manufacturer and finally EDF, Endesa and Enel as end-users. So far most of the laboratory investigations on selected coatings have been performed by both MateriaNova and DTI showing promising results (see MateriaNova article). In parallel some industrial prevalidation test have been run in Endesa Litoral Power plant where 15 samples have been immersed for a couple of months in a raceway reactor containing a liquid composed by a concentration of 0,9 gr/l of *Nannochloropsis gaditana* (seawater microalgae) in continuous motion (flow rate 2 m/s). Next steps is now the demonstration at PERICLES EDF facility first and

finally in Endesa As Pontes pilot condenser.

The second technology is investigated by research Partners such us VITO and ITM, a producer of MD modules like AQUASTILL and Enel, Endesa, ENGIE as end-user of the technology. Up to now it has been investigated in laboratory by VITO and ITM, respectively for the recovery of CT blowdown and FGD wastewater, and it is now coupled with ENGIE MERADES pilot cooling tower for a 3 months experimentation (see the related article). Next steps here are the demonstration in As Pontes test rig (one year demonstration) and on the FGD pilot facility coupled with UF/RO. All the findings from the first 18 months of the project will be presented and discussed in detail during the next MATChING workshop that will be held on October 19 in LYON together with the [IAHR Industrial Cooling Tower Conference 2017](#).

Finally we would like to give our welcome to DOW and SUEZ that have recently joined the MATChING stakeholders' Community.



MATERIALS & TECHNOLOGIES FOR PERFORMANCE IMPROVEMENTS OF COOLING SYSTEMS IN POWER PLANTS

## Anti-biofouling Coatings

It is well known that biofouling is one of the factors that heavily affects the heat transfer performances of steam condensers being responsible of more than 30% of the overall heat transfer resistance. The formation of a biofilm is a complex process that consists of several different stages. It is generally accepted that the first stage happens already within minutes of contact between a surface and the medium to which it is exposed. In this context the surface energy plays an important role in that the bacteria have to attach to the surface. The use of specific coatings that modify the surface energy of condenser materials can thus contrast this phenomenon. Commercial coatings producers follows different strategies to combat fouling. Some of these coatings prevent the settlement of biofouling using biocides (anti-fouling coatings). Some others do not prevent the formation of biofilm, but form a smooth and not sticky surface making difficult for fouling organism to adhere (fouling release coatings). The latter are today widely used on merchant ships and ferries. However their application to steam condenser would require the following additional functionalities: low thickness (<10 µm); possibility to apply them inside the condenser tube bundles, efficiency at a flow around 2 m/s. That's exactly the job for MATCHING!

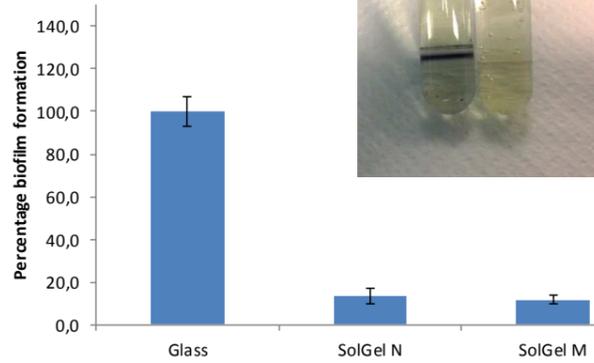


Figure 1 : Results of biofilm adhesion on coatings, observation of vials (upper part) and spectroscopy measurement (bottom part)

Materia Nova produces Sol-Gel coatings containing agents that either change the surface energy, the topography or that limit the adsorption of the bacteria to the surface. In the latter case a direct contact biocidal effect likely also plays a role. Biofilm formation is known to be sensitive, among others, to amine groups and hydrophobic surfaces. To minimize the biofilm formation, Materia Nova develops 2 types of coatings based on sol-gel technology:

- one based on peptoid precursors mimicking anti-fouling peptide natural effect with amine functionalities and hydrophobic groups;
- one based on long alkyl chain precursors creating a porous structuration limiting the adhesion of biofilm.

Coatings prepared from those two strategies have been applied on glass and metal for biofilm development and adhesion tests and two main results were observed for now. Interestingly, coatings based on the sol-gel process in presence of peptoids have been successfully obtained on glass and stainless steel. The presence of small amount of peptoids leads to reduced biofilm formation in comparison to commercial sol-gel. Nevertheless, the porous structuration obtained with alkyl chains have allowed to limit greatly the adhesion of films. Figure 1 (upper part) is an image comparing vials untreated and with porous sol-gel. The second (N1) does not present a dark ring corresponding to the biofilm formation on the surface.

Figure 1 (bottom part) represents the quantification of this adhesion measured with UV-vis spectroscopy. Sol-gel N and M correspond to structured coatings, the adhesion of biofilm on their surface is more than 5 times lower than the reference. Incorporation of peptoids in the sol gel still needs to be optimized to improve the anti-fouling effect. However the currently developed coating appears to have a strong biocide effect. Thus, the combination of both strategies can lead to surfaces matching effects from hydrophobic alkyls and peptoids molecules and represents the next step of the work.

## Anti Bio-fouling Coatings

Preliminary Results available at MATERIANOVA



## MATCHING Announces the next workshop in LYON October 18-19 2017

*Improving the performance of cooling systems in PP: an update of the first 18 months of the project*

MATCHING Consortium is happy to announce the 2017 workshop that is being held in Lyon under the auspices of the [IAHR Industrial Cooling Tower Conference 2017](#)

The purpose of the workshop is to share the most relevant results of the first 18 months of the Project and to engage an open discussion with the Stakeholders on the current and future scenarios related to water availability and cost for electricity production in Europe and abroad.

Workshop will last one day (October 19). A site visit to the Bugey Power Plant, one of the MATCHING demonstration sites, will be organized the day before. The members of MATCHING Users' group can

choose to attend only the MATCHING workshop (open) or take the opportunity to attend both the workshop and the IAHR Conference.

### About Bugey Power Plant

Bugey is a nuclear Power Plant located on the Rhone river, upstream to the city of Lyon. Four nuclear units of 900 MWe are in operation. The site hosts the MISTRAL loop of 25 MWth for the qualification of cooling fills performances tests in real operating conditions. Within the MATCHING project, the objective of the tests is to create and use the actual steam/air conditions downstream to the cooling fills

section as an input for membranes water recovery characterization(WP6).

### Venue

The workshop will be held at the Hotel Marriott Lyon Cité Internationale, located near the Parc de la Tête d'Or, the biggest park in Lyon. The hotel is easily accessible through trunk road and public transports (tramway, bus...).

### Agenda

Agenda of the event is under definition. Check the most updated information on [www.matching-project.eu](http://www.matching-project.eu); Info on IAHR conference available on: [www.iahr-ictc2017.com](http://www.iahr-ictc2017.com);

## Engie lab and VITO started the experiment in Merades

The first pilot testing for the WP6 (Water treatment and recovery) has started on Monday 24th April 2017 on Linkebeek site (Belgium) in partnership with VITO. MERADES has been coupled to the membrane distillation (MD) and the establishment of the reference case is ongoing. The tests are planned for 3 months.

### MERADES Pilot Cooling Tower



VITO Membrane distillation pilot with Aquastill membrane modules

MERADES is a pilot testing facility located on ENGIE Lab site, Linkebeek. This pilot is made of two circuits in parallel simulating semi-open cooling circuits. The facility is coupled with the VITO MD pilot. MD is a thermally driven separation process, where evaporation is induced by a vapour pressure gradient, over a hydrophobic membrane.

In the test configuration, one cooling circuit is operated with conventional treatment (acid injection) and the other circuit is recovering the blowdown treated in the MD pilot. The pilot testing will allow the technical validation of the treatment technology, the assessment of the water savings as well as the potential for chemicals savings.

For more information.

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## MEMBRANE DISTILLATION

Membrane Distillation (MD) is a thermal membrane operation investigated worldwide as a potential low cost and energy saving alternative to conventional separation processes such as distillation and reverse osmosis (RO). In MD, a heated, aqueous feed solution is brought into contact with one side (feed side) of a hydrophobic, microporous membrane. The hydrophobic nature of the membrane prevents penetration of the aqueous solution into the pores, resulting in a vapour-liquid interface at each pore entrance. Here, volatile compounds evaporate, diffuse and/or convect across the membrane pores, and are condensed on the opposite side (permeate side) of the system. The driving force of the process is linked to the vapour pressure gradient between the two membrane sides. MD allows the separation of volatile components from solutions. If the solutions contains non-volatiles components, it is possible to remove solvent by concentrating the solutions. The main benefits of MD are (1) the theoretically complete rejection of non-volatile solutes, (2) the relatively low operating temperature and membrane-fouling problem, (3) the low operating pressure, (4) the minimized concentration polarization phenomena. The latter allows utilizing MD for desalted water production from high concentrated streams with which RO cannot operate due to the osmotic phenomena.