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Upcoming Events

- **Conference on Coatings on Glass and Plastics- ICCG 12, Würzburg, Germany June 11-15, 2018**  
[http:// www.iccg12.de](http://www.iccg12.de)
- **32<sup>nd</sup> International Conference on Surface Modification Technologie, SMT32, San Sebastian; Spain, June 27 - 29, 2018**  
<http:// www.smt32.org>
- **Euromembrane 2018, Valencia, Spain, July 9-13, 2018**  
<http:// www.euromembrane2018.org>
- **Sol-gel 2018, Saint-Petersburg, Russia, August 27-31, 2018**  
<http:// www.sol-gel2018.ru>
- **Eurocorr 2018, Krakow, Poland, September 9-13, 2018**  
<http://eurocorr.org/EUROCRR+2018.html>
- **2018 Eurovent Summit, Sevilla, Spain, September 25-28, 2018**  
<http:// www.eurovent-summit.eu>
- **ECOMONDO - the green technologies expo, Rimini, Italy, November 6-9, 2018**  
<http://www.ecomondo.com>

Partners



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For further information contact: [matching-communication-team@enel.com](mailto:matching-communication-team@enel.com)



ISSUE

03

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SIX MONTHLY NEWSLETTER

MATChING

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Project Updates

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

- WP3 Low-T geothermal case: already completed the experiments in laboratory with coatings for geothermal brine with promising results (12 coatings for AISI 316L and 9 coatings for P265G). Six of them have been selected (2 on stainless steel and 4 on carbon steel) and will be tested at Balmatt site where they will work with the real geothermal brine.
- WP4 - High T geothermal case: The hybrid (wet/dry) module was designed and supplied to Nuova San Martino plant. Start-up/ commissioning of the module is on-going;
- WP5 - Steam Condenser materials: Tests on antifouling materials and stainless steel with biocide properties completed at Pericles facility. Performance test concluded at Thryco Facility for steam side hydrophobic coatings.
- 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 concluded at MERADES pilot plant and on-going at As Pontes Power Station.

Welcome of the new MATChING Coordinator

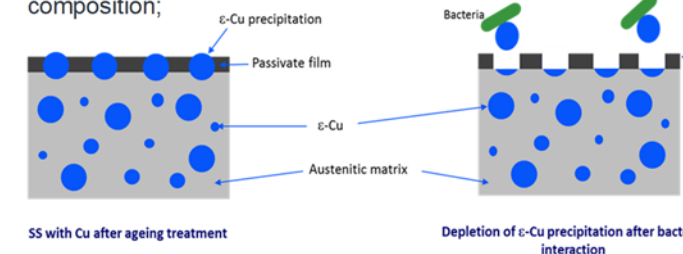
In March 2018 a new Project Coordinator has been nominated: Daniela Galla, from ENEL Produzione SpA.

After one year since last edition, we want to summarize the most relevant updates and results of the MATChING project.

The Partners contributions to this third Newsletter are coming from: AIMEN, EDF, Pathema, ITM.

PARTNER UPDATE: AIMEN

AIMEN has designed at laboratory scale a specific heat treatment for applying on a Cu-containing AISI 304 stainless steel to enhance its antibacterial effectiveness. Three main parameters are considered to evaluate the antibacterial properties: 1) the amount of antibacterial element added in the steel alloy composition;



to the formation of a Cu-rich phase precipitated in the passivated film and the release of Cu<sup>2+</sup> ions into the bacteria solution. The Cu<sup>2+</sup> ions gradually inhibit the cells growth and can kill bacteria by destroying their cell walls and cell membranes. The results, published in Deliverable 5.3, are expressed as

Schematic illustration of  
a) Cu precipitation on 304 Stainless Steel specimen after the heat treatment and  
b) depletion of Cu after bacteria interaction and formation of a discontinuous passivated film.

2) the amount of antibacterial element precipitated upon the passivated film during the heat treatment; and 3) the temperature and duration of ageing treatment. The antimicrobial characteristics of stainless steel can be improved by the addition of Cu due

Antibacterial Rate (AR) in %, reaching values up to 99.9% for a 3.2%Cu- 304 stainless steel type.



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



## STEAM CONDENSER PERFORMANCES

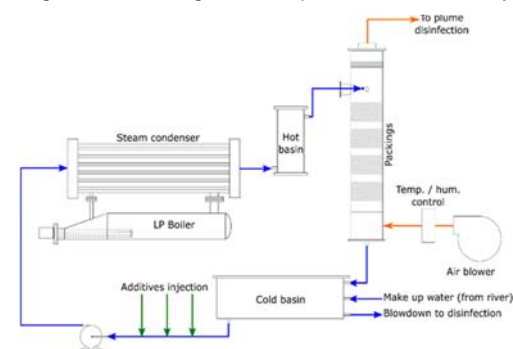
The steam condenser performances can be improved increasing, at the same time, heat transfer rate and condenser robustness. For reaching this aim, investigation and validation of condenser tubes external and internal coatings in combination with other technical solutions are carried on.

Different material solutions are investigated, acting on the steam side, to promote drop-wise condensation, and on the cooling water side, to contrast biofouling phenomenon. All the thermal and nuclear power plants are potential application cases for the technologies developed. Heat transfer characterization of coated and/or laser based textured tubes are performed at EDF on TRHyCo facility to demonstrate the expected improvement of the global heat transfer coefficient. Using the EDF PERICLES facility, several SS solutions are analyzed and validated.

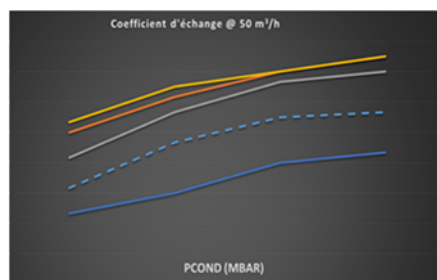


Condenser and water jet test for coating cleanability evaluation

Diagram of a cooling circuit loop of PERICLES facility



PVC coupons, Thryco loop and Heat transfer



In order to characterize the potential of coatings and materials, EDF is operating two experimental programs: 1) on **THRYCO facility**: a series of hydrophobic coatings designed by partners in order to improve the heat transfer performances of condensers. The THRYCO loop is dedicated to a thermal transfer characterization taking account for particular arrangements of horizontal tube bundles including 10 vertical rows. The THRYCO loop operates under realistic operating conditions in terms of pressure (under 100 mbar),

cooling water temperature and velocities. Analysis of the coating performances are derived from global heat transfer measurements and can be done for every particular rows. Currently, five different coated bundles have been tested and compared to the reference non coated tube bundle. On **PERICLES facility**: two series of trials of about 3 months have been performed on 4 loops of recirculating cooling systems in order to evaluate antifouling properties of stainless steels with copper prepared by

AIMEN (WP5.2) and 11 coatings prepared by MATERIA NOVA, IONICS and DTI (WP5.3). Coated coupons have been inserted in different parts of the circuit: internal side of condenser tubes, concrete coupons in the hot and cold basins and PVC sheets in the cooling tower. Trials have been performed with 2 water qualities: raw river water (Seine River) and clean water (osmosis water + 1/10th Seine river Water). Trials have just been completed and analysis of results are ongoing.

## Potential of Coatings and Materials

Preliminary Results available at EDF - Lab Chatou

## BACTERICIDAL STAINLESS STEELS

Biofilms are localized concentrations of micro-organisms attached to a certain substrate. This kind of contamination lead to the formation of deposits, which contribute to fouling, corrosion and scaling, while impacting, both economic and operational, on industrial equipment that uses water for cooling purposes, such as in power generation. Control

of biofilms and macrofouling in industrial systems is an important component of a successful water treatment program. Research on antibacterial materials has increased in last years, resulting in the production of several materials such as antibacterial plastics, antibacterial ceramics, antibacterial clothes, and antibacterial steels. These materials inhibit biofilm formation

or acts at an early stage of the biofouling process providing the release of antimicrobial compounds on a sustainable basis at effective level. A priori, stainless steels do not have any inherent biocidal properties, however several alloying elements have been shown to present bactericidal effects. Among others, mercury (Hg), silver (Ag) and copper (Cu)

have shown potentiality to inhibit biofilm formation. Cu is a relatively inexpensive element and effective as an antimicrobial. Moreover, Cu can stabilize the austenitic structure and make it possible to reduce the nickel (Ni) content in the steel, which leads to a significant economic saving since the price of Ni is relatively high.

## Third General Assembly Meeting, A Coruña, Spain March 21-22, 2018



## Workshop and WP Team Meeting, Lyon October 19-20, 2017



The Third General Assembly Meeting of MATCHING project took place on March 21-22, 2018, in A Coruña, Spain.

The meeting started on March 21<sup>st</sup> with an update of the project status, for each WP. It ended on March 22<sup>nd</sup> with the visit at As Pontes installation, that is a coal - fired power plant that belongs to ENDESA and is located in Coruña (Galicia), in the northwest part of Spain.

In the frame of the project several new test facilities have been or have to be integrated into the power plant:

- 1) a **pilot condenser**, manufactured by Integasa, with the aim to evaluate the performance of different materials through long run tests with the final goal to improve steam condensation efficiency and to reduce fouling in cooling water side;
- 2) **Membrane distillation modules**, provided by Aquastill, for CT blowdown water recovery and reuse.

The 2017 MATCHING workshop and WP TEAM MEETING was held in Lyon under the auspices of the IAHR Industrial Cooling Tower Conference 2017.

The purpose of the workshop was 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. Around 40 people attended the workshop. Workshop was one day (October 19). A site visit to the Bugey Power Plant, one of the MATCHING demonstration sites, was organized the day before.

Two panel discussions have been organized during which it was also highlighted that cost of water in most of the cases is not such that it pushes big investment for avoiding water consumption.

Site-specific constraint, regulation/permits on water abstraction and on wastewater discharge seems to play a major role. Furthermore, it was observed that the issue with water reuse in Cooling Tower operation requires a multi-discipline approach, as there are issues on corrosion, water conditioning, and metallurgy. At this regard, cooperation between different actors is seen as a benefit.

## INDUSTRIAL VORTEX GENERATOR

The Industrial Vortex Generator (IVG) system will degas cooling water and crystallize lime into calcite and aragonite. The crystallized lime will not scale in the system and the degassed water transfers the heat better leading to optimized cooling.

By filtering the cooling water continuously the lime particles and other material is filtered out of the cooling water. UV-C treatment will radiate and eliminate all kind of biological material in the water.

The continuous lightning of the water will lower biological existence to an absolute minimum.

The system is implemented as a independent loop of the cooling tower.

Circulating the buffer water of the Cooling Tower system to continuously treat the water and controlling blowdown. IVG system enables to operate a cooling water system chemical free, prevent lime scaling, corrosion and biological problems.



Lab VPT unit



VPT coupled at MD pilot