THE FRAMEWORK PROGRAMME FOR RESEARCH AND INNOVATION
HORIZON 2020

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Upcoming Events

- **International Energy Conversion Engineering Conference, Indianapolis, Indiana USA, August 19–22, 2019** ***https://propulsionenergy.aiaa.org/IECEC/***
- **20th International Sol-Gel Conference, St. Petersburg, Russia, August 25-30, 2019** ***http://solgel2019.ifmo.ru/***
- **12th European Congress of Chemical Engineering, Florence, Italy, September 15-19, 2019** ***http://www.aidic.it/ecce12/index.php***
- **European Coatings Fire Forum 2019, Madrid, Spain, November 06-07, 2019** ***https://www.european-coatings.com/Events/European-Coatings-Fire-Forum-2019***
- **4th International Conference on Desalination using Membrane Technology Perth, Australia, December 01–04, 2019** ***https://www.elsevier.com/desalination-using- membrane-conference***
- **6th World Congress on Smart Materials and Polymer Technology, Dubai, UAE, December 16–17, 2019** ***https://smart.materialsconferences.com***
- **ICCG13 - International Conference on Coatings on Glass and Plastics, Braunschweig, Germany, March 23-26, 2020** ***https://iccg.eu***

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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SIX MONTHLY NEWSLETTER

MATChING

Project Updates

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

- WP3 Low-T geothermal case: lab tests with coatings for geothermal brine were completed (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 are being 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. The module is towards the end of the testing period and very promising results are being collected;
- 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. Installation of a pilot condenser at a production site has been completed for testing the most promising coatings.
- WP6 - Technologies for water treatment: all the technologies under investigation have been already tested at lab scale with promising results. All pilots are operating. So far, successful results were achieved with capacitive deionization and Vortex technology at Engie's test site and with membrane distillation at As Pontes Power Station. Tests at Torrevaldaliga still ongoing.

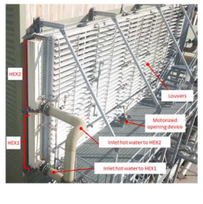
In this issue

Welcome to the 5th edition of MATChING Newsletter

Since our last Newsletter in November 2018, there were several developments in the project : at this moment all the pilots have been commissioned and some were already closed. This edition will summarize some of them. Partners' updates have been added by EGP for the Nuova San Martino demonstration of hybrid cooling; by ENEL for the long run test on membrane treatment of FGD wastewater. Technology focuses will describe membrane condenser configuration from ITM. Update on past and future workshops is included.

PARTNER : EGP

The application of hybrid cooling tower in high temperature geothermal power plant (WP4) is going to complete the DEMO tests at N.va San Martino power plant (Monterotondo Marittimo, Italy) owned and operated by EGP. After an initial validation phase where the behavior of innovative materials was investigated at pilot scale, one of six cells of the cooling tower was retrofitted by SPIG and operated for more than 6 months by EGP; in the retrofitting works, the existing filling pack was replaced with an innovative one and 4 air water finned tubes heat exchangers were added at the roof.



The 3-D shaped wet filling pack increases the contact surface between the air and water increasing the specific heat exchange capability. The surface heat exchangers varies the thermodynamic state of outlet air avoiding the achievement of dew point thus eliminating the typical visible plume from the stack.

The main results after 6 months of operations is the reduction of evaporation rate up to 10% without clogging and fouling phenomena.

MATERIALS &TECHNOLOGIES FOR PERFORMANCE IMPROVEMENTSOF COOLING SYSTEMS IN POWER PLANTS

INDUSTRIAL VORTEX GENERATOR (IGV) TECHNOLOGY

The IVG (Industrial Vortex Generator) design enables a consistent and low energy method to achieve physical water treatment (PWT) water treatment in a variety of end use applications.

The IVG technology is provided by Pathema. The module is composed by the following elements:

Pre-former: Inlet of the vortex generator provides smooth outward direction of the flow through toroidal motion toward a set of well-defined channels.

Channels: The fluid is directed through a set of channels, each with vortex-forming geometry. Each channel delivers a very high velocity stream of vortex flow tangentially into a vortex chamber

Vortex chamber: Vortices from the channels form a strong and stable vortex flow

Causing a strongly reduced pressure along the vortex axis with a very low central pressure There is very high pressure at the periphery and almost vacuum in the center.

Micro-bubbles that are present migrate towards the center where the lowest pressure is and accelerated due to the pressure gradient. The bubbles expand and combine in the center with a very low pressure. The strong hydrodynamic force creates cavitation changing the water balance and affects the calcium crystals in the water.

In the framework of MATChING project, the application of Industrial Vortex Generator (IVG) technology is evaluated and demonstrated. It is a novel technology that enables chemical free conditioning of cooling towers. The evaluation was made in two steps, a first evaluation in laboratory and a second step coupling IVG with a pilot installation able to simulate a cooling tower process.

Demonstration of Membrane treatment of w-FGD wastewater

Demo tests on going at the Torrevaldaliga Nord Power Plant (ENEL)

After the promising results achieved by ITM with the lab test on real water samples coming from the Torrevaldaliga Nord wet-FGD wastewater treatment plant. ENEL, supported by ITM, started the design and realization of a demonstration pilot plant to perform test directly on site.

A 1 m3/h pilot plant has been realized including a pretreatment section constituted by a softening step, an acidification step and a stripping section to remove hardness (Ca and Mg) and CO2 to mitigate scaling risks.

Pre-treated water is then fed to an Ultra Filtration section and to a Reverse Osmosis section.

The pilot has been designed to achieve up to 75% recovery considering a feed water with a TDS of around 15 mS/cm. Brine produced by the RO section is then treated in a Membrane Distillation unit able to reach an additional 40% recovery in order to achieve a total recovery of around 85%.

Aim of the demonstration is to evaluate the performance and the reliability of membrane processes to be a valid alternati-ve to thermal brine concentrators. Tests are still ongoing but some interesting results have been achieved.

Despite a worsening of the pilot inlet conditions: In fact feed water quality showed a high variability and compositions reached high TDS values (up to 54 mS/cm), the RO pilot achieved recovery in-between 30% and 60 % according to feed quality. Rejection was quite high (92-98%) even if permeate quality would probably require a second RO pass in order to additionally reduce the salinity.

MD tests showed good rejection with industrial water while with the w-FGD waste water the distillate quality was not so good. Probably highly volatile species are going through the membrane. A new membrane with oleophobic properties will be tested in the following weeks.

HYBRID COOLING IN GEOTHERMAL APPLICATION

In high temperature geothermal power plants no fresh water is used as cooling media, but the geothermal fluid itself is exploited in the cooling towers once it has been condensed. The re-injection stream that typically recharges the reservoir is the spent fluid of the cooling process and its amount is about 30% of inlet steam.

Nowadays the standard cooling technology in high temperature geothermal power plants is the wet cooling tower because of low energy penalty and small footprint So far hybrid cooling tower technology has not found application in high temperature geothermal plants due to corrosion and fouling phenomena that can have a high impact on cooling tower performance.

One of the main challenge of MATCHING project has been the effective application of hybrid cooling towers in high temperature geothermal plants in order to enhance th sustainability of the process due to the reduced loss of evaporation thus increasing the re-injection stream. Another important effect of the application of hybrid cooling towers is the removal of the typical plume at the stack reducing the visual impact of the whole plant. all the existing wet filling media was replaced with a 3 dimensional shaped material designed to compact the height of the filling thus reducing the air head loss: 4 heat exchangers were installed under the top floor removing 2 lateral parts of the module.

The heat exchangers were equipped with a combination of base materials and special inner coatings in order to assess corrosion and fouling behavior in real environment. The operation of demo module has switched between wet to hybrid for 6 months ho an average reduction of the evaporated water of about 10% with a small addition energy penalty due to fan consumption.

Final
MATChING Workshop,
Bruxelles, Belgium
June 25-26, 2019

The Final Workshop of MATChING project was held in Bruxelles in June 25-26, 2019.

The purpose of the workshop was to share the most relevant results of the Project and to engage an open discussion with the Stakeholders on the current and future scenarios related to the water availability and to technological measures for improving the performance of cooling systems in power plant, in Europe and abroad.

Final MATChING Workshop and WP Team Meeting, Brussels, June 25-26 2019

i - Some of MATChING Partners at the Final workshop

ii - Roundtable at the MATChING Final workshop

The event was organized by CNR-ITM at Liaison Agency Flanders-Europe on June 25-26, 2019. The goal of the workshop was to strengthen the exchanges and cooperation, and to increase the communication between industry and academics. Representatives from University of Texas at Austin, Water Europe (previously WSSTP), Baltimore Aircoil Company, SUEZ,BLUE- EXPERT BV,Flanders Knowledge Center Water (Vlakwa) were present together with a very large number of MATChING Consortium delegations. Interesting and fruitful speeches were made by experts and professionals focusing on the policy, the progresses, the research activities and pilot demonstrations developed during the project. Moreover, a technical video on MATChING project was projected, showing the application of hybrid cooling tower in high temperature geothermal utility at N.va San Martino power plant.

MEMBRANE CONDENSER

Membrane condenser is an innovative membrane technology that exploits the hydrophobic nature of microporous membranes to promote water vapor condensation and recovery. In details, the waste gaseous stream (e.g., the plume of the cooling tower) at a certain temperature and, in most of the cases, water saturated, is fed to the membrane condenser kept at equal or lower temperature. The water condenses on the surface on the membrane and, once this stream is brought in contact with the retentate side of the microporous membranes, their hydrophobic nature prevents the penetration of the liquid into the pores letting pass the dehydrated gases through the membrane. Therefore, the liquid water is recovered at the retentate side, whereas the other gases at the permeate side of the membrane unit.

Within Matching project, CNR- ITM used a membrane condenser for water and contaminants recovery from synthetic streams (i.e., a saturated air stream with ammonia) simulating the plume of cooling tower. By modeling CNR- ITM predicted the process performance identifying the proper operating conditions for effectively recovering liquid water. In addition, the experiments performed adding NH3 in the feed stream showed the effectiveness of using this unit operation for contaminants control, and the temperature difference between the membrane condenser and the plume resulted the most important parameter driving the concentration of the contaminant in the recovered liquid water.