THE FRAMEWORK PROGRAMME FOR RESEARCH AND INNOVATION
HORIZON 2020

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Upcoming Events

- **SURFCOAT KOREA 2020, The International Surfaces, Coatings and Interfaces Conference, 25 - 27 March 2020 - Incheon/Seoul – Korea -**
  https://www.setcor.org/conferences/SurfCoat-Korea-2020
- **MELPRO 2020, 14–17 APRIL 2020 - PRAGUE, CZECH REPUBLIC -**
  https://www.melpro.cz/
- **16th Coatings Science International 2020, 22 – 26 June, Noordwijk, The Netherlands –**
  https://coatings-science.com/
- **Icom 2020, 12TH International Congress on Membranes and Membrane Processes - 12-17 July 2020 – London, UK –**
  http://www.icom2020.co.uk/
- **CHISA 2020, 24th International Congress of Chemical and Process Engineering - 23-27 AUGUST 2020 - PRAGUE, CZECH REPUBLIC -**
  http://2020.chisa.cz/

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**

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SIX MONTHLY NEWSLETTER

MATChING

Project Updates

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

- WP3 Low-T geothermal case: Six coatings were selected (2 on stainless steel and 4 on carbon steel) and were tested at Balmatt site where they with the real geothermal brine.
- WP4 - High T geothermal case: The hybrid (wet/dry) module in Nuova San Martino plant has successfully completed the testing period and it is now operating contributing to the recovery of water and plume abatement at the site.
- WP5 - Steam Condenser materials: Tests on antifouling materials and stainless steel with biocide properties completed at Pericles facility and 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 but due to unplanned outage of the unit it has not been operated yet.
- WP6 - Technologies for water treatment: all the technologies under investigation have been already tested at lab and pilot scale. Successful results were achieved with most of the technologies (MCDI, IVG, MD). Membrane Condenser was installed at Pericles but still under testing conditions.

In this issue

Welcome to the 6th edition of MATChING Newsletter

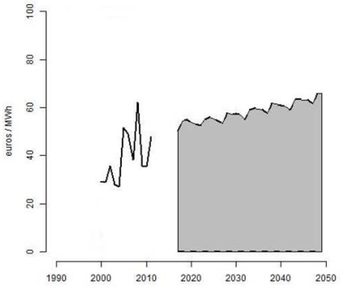
MATChING Project ended on August 31, 2019. In this last Newsletter we will give an overview of the scenarios definition for the techno-economic analysis (TCA) and the results of the TCA applied to water technologies tested during the project. Technology focuses are included from our Partners IONICS and AIMEN together with a summary of dissemination actions throughout the duration of the project.

Partner update: LBE on scenarios definition

Cost-benefit analysis requires the definition of assumptions and scenarios for cooling system, as well as coupling scenarios with water saving technologies taking into account the impact of climate scenarios. It was necessary to establish a methodology, which captures as fully as possible the complexity of the water-energy nexus.

The cost-benefit analysis methodology selected will capture the added value of water saving cooling technologies in years with extreme droughts. Drought risks will reflect the loss of electricity output and related income for power plants, due to the unavailability of the plant during droughts, as low water levels limit water intake and higher water temperature in rivers limit thermal discharges. Implementation of water savings technologies will reduce this risk.

Drought scenarios definition: frequency, impact on electricity production and price have been established based on literature review, supplemented by modelisation and simulation.



	Hard water				Soft water			
	Intake	% reduction versus		Output	Intake	% reduction versus		Output
	m³/h	Current	Ref.	MW/m³	m³/h	Current	Ref.	MW/m³
	(1)	(2)	(3)	(4)	(5)	(2)	(3)	(4)
Current	1262	0%		0.42	1262	0%		0.42
Reference	771	-39%	0%	0.68	581	-56%	0%	0.94
VPT	541	-57%	-30%	0.97	491	-61%	-15%	1.07
MCDI	459	-64%	-40%	1.14	268	-84%	-54%	1.14
MD	442	-65%	-43%	1.18	439	-65%	-25%	1.21

MATERIALS &TECHNOLOGIES FOR PERFORMANCE IMPROVEMENTSOF COOLING SYSTEMS IN POWER PLANTS

Atmospheric Plasma Torch : a silicon oxyde deposition tool

The world of surface treatment has seen a growing interest in the preparation or functionalization by atmospheric plasma torches. In a typical plasma torch, the plasma is created by the passage of an electric current through a gas, between two electrodes and blow outside the nozzle. The gas is typically nitrogen, argon, helium or simply air as for the Matching Project. This technology is very suitable to pretreat any type of substrate. The carbon residues are burned and removed while oxygen functions are embedded at the surface improving the adhesion between the metallic substrate and a subsequent coating.

Atmospheric plasma torches are also very efficient for depositing non-stochiometric compounds using an organic metal precursor. The composition of the film is directly linked to the dissociation degree of the precursor. In the case of MATCHING, the objective being to produce coatings for wettability control, hexamethyl disiloxane (HMDSO) was used as precursor. Thanks to energetic species present in plasma, the HMDSO molecules are decomposed and a SiOx-like layer is deposited on the substrate. Depending on parameters chosen (as power or precursor flow rate) the layer deposited will be more or less organic and lead to a more or less hydrophobic layer.

Different deposition conditions were tested and optimized showing potential interest in thermal exchange efficiency. Focus was put on tuning surface wettability to promote dropwise condensation with low sliding angle. Durability of the layers was improved by combining the coating with a air plasma pretreatment also applied with the torch.

The advantage of plasma torches compared to classical PECVD (under vacuum or controlled atmosphere) is that it can be used directly in the atmosphere without using specific chambers etc. Easily coupled with robotized system or multiplied to coat large parts, this technology can be used to treat any types of parts, and particularly long tubes.

In MATCHING, IONICS and MATERIA NOVA designed a specific application test bench to apply coating on tubes in an automated way. This allows the deposition of a silicon oxide layer on 2.2 meters long tubes (length needed for the pilot systems implemented in the Matching project). However the system can be upscaled to several meters, IONICS being constructor and seller of industrial equipment.

Partner update: VITO on TCA

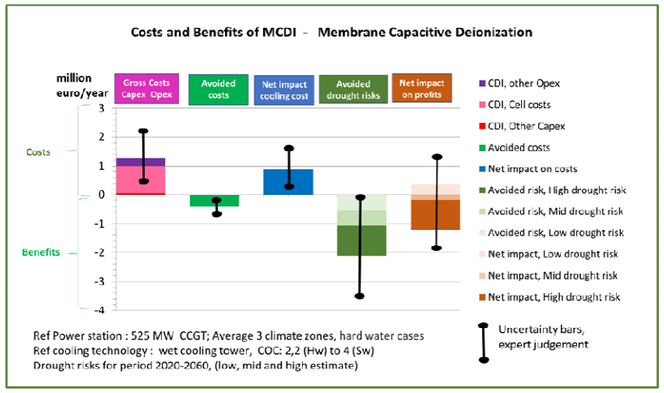
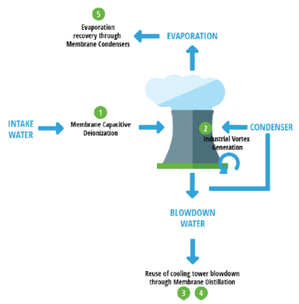


Figure 1 : Cost Benefit of Membrane Capacitive Deionization

Many riverine thermal plants in Europe using wet cooling towers are already or will be at risk for unavailability due to low water levels and/or high water temperatures.

The Matching project assessed in detail 5 technologies to reduce water intake for cooling and tested them both on lab and pilot scale.



For three technologies (Membrane Capacitive Deionization, MCDI; Membrane Distillation, MD; and Industrial Vortex Generator, IVG) a further analysis simulated their application in a new built gas fired power plant in locations with varying climate and water quality. These technologies will reduce water intake of 30% to 66%.

It will increase gross costs for cooling with 10%-75% but will also allow for cost savings (avoided costs for smaller installation and less chemicals) and additional income as drought risks (estimated at 2,5 % of annual income with current practise) can be reduced.

In the project, we have identified the technologies and conditions for which the economic benefits outweigh the costs.

Figure 1 illustrates that the annualized gross costs for MCDI (hard water cases) amount on average to 1,2 million €. This is for one third compensated thanks to avoided costs (e.g. less chemicals). If we account for the avoided risks, the total benefits will outweigh the costs for plants subject to average drought risk. In addition, the reductions of water abstractions will bring additional benefits to society that are not accounted for.

More information is available from the brochure at the Matching website.

MATChING Workshops overview

The 42 months project MATChING ended on August 31, 2019. The project started formally on 1st March 2016. It had its kick-off on 16-17 March 2016 in Pisa (Italy) and its First workshop on "*Key Performances and Success Indicators for Cooling Systems, Water Treatment Technologies and Materials for Steam Condenser*" on September 21, 2016 at the EDF Campus of the EDF Research Center in Chatou (close to Paris). During the workshop, the colleagues of EDF organized a site visit to some of the facilities used in the project (PERICLES and THRYCO).

The First MATChING General Assembly Meeting was held in Brussels (7-9 March 2017) to discuss the project status update and to plan the activities of the next six months. The third day (9 March) was dedicated to the visit of the Balmatt geothermal drilling site in Mol.

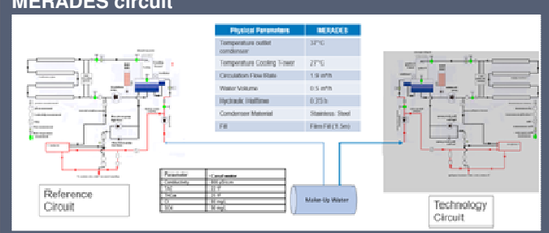
The second MATChING workshop was held in Lyon (FR), on 18-19 October 2017,

Visit in N. San Martino Geothermal site

under the auspices of the IAHR Industrial Cooling Tower Conference 2017. 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. The Third General Assembly Meeting of MATChING project took place on March 21-22, 2018, in A Coruña, Spain. The meeting started on March 21st with an an update of the project status, for each WP; it ended on March 22nd with the site visit at As Pontes installation. The most relevant results of the first 30 months of the MATChING project were presented during the "Water Management in the Power Sector Workshop" (October 2-3, 2018) in Rome, attended by around 50 people. The Third General Assembly Meeting took place in Pisa on March 12-13, 2019. The latter ended with the site visit at N.va San Martino power plant (Monterotondo Marittimo, Italy) owned and operated by EGP. Finally, the Final Workshop of MATChING project was held in Bruxelles on June 25-26, 2019. During the workshop, the participants had the opportunity to attend fascinating and productive speeches on the research activities and pilot demonstrations developed during the project.

Tests performed at MERADES

MERADES circuit



MERADES Pilot Cooling Tower

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 was coupled with different technologies. In the test configuration, one circuit is operated with conventional treatment (acid injection) and the other circuit is used to validate the tested technology.

Membrane Capacitive Deionization (MCDI) was used to desalt intake water,

Membrane Distillation (MD) allowed to recover blowdown water and reuse it as intake water for cooling water circuit and Idustrial Vortex Generator (IVG) treat the recirculation water to avoid scaling in the cooling water circuit. The trial results show that the tested technologies allows a water saving of minimum 20% and an acid consumption reduction. The valuable data collected during the pilot trials have served as input to the cost-benefit analysis.

For more information.

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CORROSION MONITORING BY EIS

A novel probe designed and developed by AIMEN was integrated in the geothermal installations of San Martino and VITO demo sites for in-situ and on-line corrosion monitoring of the piping systems. Electrochemical Impedance Spectroscopy (EIS) was selected as a sophisticated technique to determine the corrosion rate and define the corrosion mechanisms and the scaling degree of pipes by the determination of the Polarization Resistance values (Rp). Rp values combined with standard optical analysis allow at establishing the corrosion resistance of different materials and coatings exposed to the geothermal fluid under specific conditions of pressure and temperature.

Results evidenced that non-destructive EIS technique is a powerful tool to be used to monitor the status of metals and coatings long before any visible damage occurs.

New EIS-based corrosion monitoring system allow at anticipating pipe damages and leakages in the geothermal system and, in consequence, to optimize the operation conditions, the materials selection and to prevent shutdowns and save time and costs of maintenance.