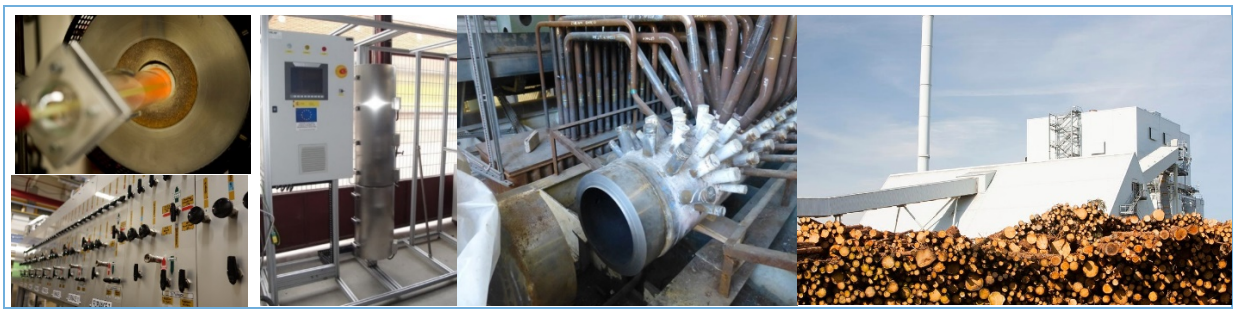

Lowering Costs by Improving Efficiencies in Biomass Fuelled Boilers: New Materials and Coatings to Reduce Corrosion

Edition: June 2021

Dear Readers,

Every 4 months a newsletter will be shared with all stakeholders and the scientific community that are involved and or interested in the field of bioenergy, including plant developers, plant operators, technology suppliers, as well as governmental bodies. Furthermore, members from the public who are interested in one or more of the topics related to BELENUS, such as bioenergy and materials engineering, will also gain from our quaternary newsletters.

These newsletters will cover project progress, special topics, news, relevant impacts, and information and where to meet us in person at important events. In this edition of the newsletter, you will learn about BELENUS in general and advances on the project.

The best is yet to come! Enjoy reading!

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 815147.

Special Topic: Exposure of trial tubes within the steam circuits under real-plant conditions.

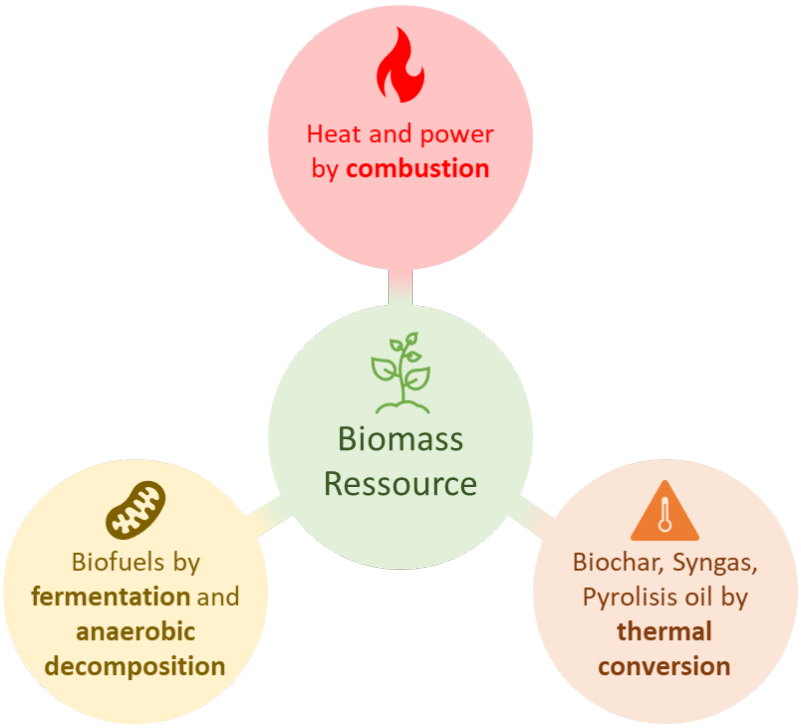
Partners involved

VAL, France
INTA, Spain
TEandM, Portugal
SMT, Sweden
UNIPER, United Kingdom
CHAL, Sweden
EIFER, Germany
EDF, France
UCM, Spain

Importance of the topic

Increased renewable energy demands have driven the development of energy conversion technologies with high efficiency and low environmental impact. Indeed, biomass-fired power plants rise as a high potential solution, with its flexibility in various sectors, and have proven its use producing over 96% of all renewable heat in the past 18 years and generating 637 TWh of electricity in 2018.

Combined Heat and Power plants (CHP) also referred to as cogeneration facilities produce both heat and electricity with an average conversion efficiency of 30%. Moreover, biomass coming from industrial wastes, forests, crops, or algae present the greatest energy resource with plenty of applications and helps developing a circular economy.



Nevertheless, fireside corrosion o superheaters, mainly due to potassium chloride (KCl), hydrogen chloride (HCl), and sulphur dioxide (SO_2) limit the production of biomass-based energy and the behaviour of high-temperature alloys must have a high properties to stand against the combustion process. That is what the BELENUS project stands for, aiming to find new solutions for corrosion-resistant alloys.

Current state of the art

Supporting the strong added value of biomass power plants in the renewable energy market, an enhancement of its structural properties is investigated by the BELENUS project, with the research and development of new alloys and coatings standing against high temperature combustion and aggressive gases. Indeed, feedstocks can be composed of eucalyptus, industrial wood waste, bagasse, wheat straw, rice husk or municipal solid waste which differs in compositions and the

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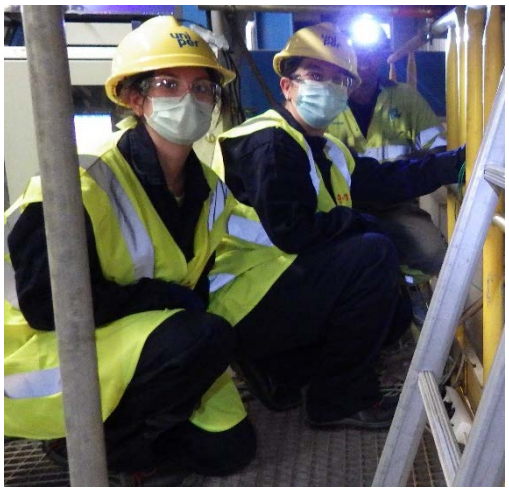
resulted products formed by their combustion is uncertain and not homogeneous at long exposures.

Biomass thermochemical conversion release potassium into flue gas at high temperatures forming aerosols, which can be adsorbed at the heat exchanger surfaces leading to corrosion. Phase transformation of the alloys at the interface are playing the major role and research has been conducted to enhance their properties by depositing several coatings. Therefore, some results already showed the importance of some elements such as nickel or chromium in the coating, improving its resistance. Nevertheless, some elements don't have good behavior with all types of salt and a focus is made on their dissolution properties when in contact with different ashes. For example, protective scales can be dissolved by potassium chloride to form potassium chromate or sulphation reactions can release chloride gas leading to unprotective active oxidation. Moreover, chromium volatilization occurs in a chlorine environment. Thus, the solutions proposed are to use Ni-based superalloys or ferritic-martensitic alloys with coatings and to find a balance between the formation of protective phase changes leading to low-active layers, and the dangerous diffusion and dissolution of elements in gases environment.

Advances on the project

Testing of alloys have already started the installation of trial tubes for exposures to be conducted in the Blackburn Meadows and Steven's Croft boilers. UNIPER has available several corrosion probe logger controllers and originally planned to use them to make corrosion probe exposures in the Blackburn Meadows wood fired boiler. Following the withdrawal of DBL from the project, the controllers are also planned to be deployed at Steven's Croft with corrosion probe exposures to be also undertaken at this site. A length of Fe-Ni-Cr stainless steel has also been sourced to enable the planned in plant corrosion trials to be conducted in the final superheater of the Steven's Croft boiler. The tube was split into two sections with one part sent to SMT-Kanthal and, subsequently TEandM for application of trial coatings, and the second part sent to INTA for application of a range of diffusion or hybrid coatings. There are two types of potential coatings with different compositions aiming to stand against high-temperature corrosion, which are laser cladding and HVOF (High Velocity Oxygen Fuel). Furthermore, the variation of the coating thickness will be evaluated and optimized to fit our goals of cost reduction.

Validation, testing and monitoring in a plant – Perspectives of BELENUS



To validate the coatings technologies, sections of tubes and pipes will be coated with the best performing material systems. In parallel, air-cooled corrosion probes of the selected systems will be inserted into the hot gas path of operating biomass boilers for extended periods (>3000 h). These probes are relatively easy to install and remove and typically have 10-20 interlocking samples, which can be formed from coated and uncoated samples. Thermocouples positioned along with the probes record surface metal temperatures and allow a degree of temperature control. It is therefore possible to have a range of temperatures along with the probe and importantly the ability to have samples exposed at higher temperatures than the plant final steam temperature. Fuel, ash, and flue gas samples will be gathered and analysed to evaluate biomass quality and correlate with the observed corrosion behaviour.

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Furthermore, a corrosion monitoring system for the fireside walls and tubes will be also developed, since under these aggressive conditions, the material systems need to be monitored to have the appropriate information in real time, facilitating the maintenance and operation of the plant. A new system, based on previous experiences at UCM, will be designed and tested in the laboratory to achieve reliable and comprehensive measurements up to 5000 hours. The corrosion sensors are based on the electrical field originated in the solid electrolyte formed on the oxide scale on materials and coatings.
Finally, the data from the corrosion monitoring system developed will be compared to the corrosion probe data.

Sectorial Breaking News

Date	Headline	Source
4th March 2021	*Schlumberger, Chevron plan bioenergy and carbon capture project*	Renewables Now
23th March 2021	*Miscanthus biomass heat project in Moldova officially launched*	Bioenergy Insight
9th April 2021	*Construction underway on 112 MW biomass plant in Japan*	Bioenergy Insight
30th April 2021	*ReEnergy, Ember to form bioenergy platform joint venture*	Biomass Magazine
5th May 2021	*Canada funds 8 bioenergy projects*	Biomass Magazine
7th May 2021	*Drax to build three new pellet plants in Arkansas*	Bioenergy Insight
27th May 2021	*Koehler Group to convert Oberkirch coal-fired plant to biomass*	Bioenergy Insight
8th June 2021	*Greenleaf Power secures $36m biomass project funding*	Bioenergy Insight
21th June 2021	*Germany allocates roughly 83 MW in CHP tenders*	Renewables Now

Remarkable Upcoming Events.

1. *EXPOBIOMASA. AVEBIOM, Spanish Association of Energy Valorization of Biomass*

AVEBIOM, organizer of EXPOBIOMASA, is the union of the main actors of the bioenergy sector that cover the entire biomass value chain. It was set up in 2004 with the aim of promoting the development of the bioenergy sector in Spain.

One of the main actions of the association to fulfill its purpose is the holding of EXPOBIOMASA, a professional fair for the biomass sector. It began in 2006, and on this occasion the twelfth edition is celebrated, consolidated as the reference fair in southern Europe and for Latin America.

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Expobiomasa is a unique fair where visitors and exhibitors get more contacts in three days than in a whole year. It is a professional fair, in which three of each 4 visitors were already engaged or involved in projects related to biomass, and the rest comes to find products and services to join.
DATES: 21, 22 and 23 for September.

SCHEDULE: 09: 30h. - 18: 30h.

ENCLOSURE: Fair of Valladolid. Avda. Ramón Pradera, 3. Valladolid. Spain.

2. *Bio360 Expo European Biomass to Power Conference*

Following the success of our previous conference in Helsinki, Finland which gathered over 100 senior level attendees, we are delighted to be hosting the 10th edition of our European Biomass to Power 2021 on the 17th & 18th November in Manchester, UK.

This two-day event will bring together key industry stakeholders to join our forum discussions and excellent networking, including senior representatives from Power Companies, Biomass Producers, Biomass Traders & Distribution Companies, Trade Associations, Renewable Energy Consultancies, EPC Contractors and OEMs, Regional & National Governments and Regulatory & Research Bodies.

During the afternoon of Tuesday, 16th November 2021, a day prior to the conference, a limited number of conference delegates will receive a unique opportunity to join an exclusive site visit of Drax Power Station in Selby, North Yorkshire and gain insight into every aspect of electricity generation ongoing upgrades to the latest biomass technology.

3. *IEA Bioenergy conference 2021*

The IEA Roadmap 'Net Zero Emissions by 2050' recognizes bioenergy as an important option, representing 18% of total energy supply in 2050, and playing a major role to reach carbon neutrality of the global energy system, either through the direct replacement of fossil fuels, or to offset emissions indirectly through the combined use of bioenergy with carbon capture and storage/utilisation. An increasing role of biomass/biofuels would be needed in industry, transport as well as heat and power production. The conference sessions will consider latest developments and prospects of biomass/bioenergy in different sectors, as well as sustainable feedstock mobilisation and the role of biomass in a circular bio-economy.

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Stay in contact with us. Visit our website.

BELENUS website www.BELENUS-project.eu is available since the early beginning of the project. It is the relevant source to show the scope and objectives of the project up and outstanding results. Find out more interesting information about the project and the impact of the results achieved, including all dissemination activities carried out.

If you have any questions feel free to drop us a line at *contact@BELENUS-project.eu* and remember you can follow us on *LinkedIn* .

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