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

Edition: October 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, and 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: Erosion-corrosion-resistant materials in biomass power plants

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

The EU aims at decreasing greenhouse gas (GHG) emissions by 40 % by 2030 and increasing the share of renewables to 27 %. Combined heat and power systems (CHP) technologies are well suited for sustainable development projects with their attractive socio-economic and technological aspects. Small scale biomass CHP systems can run on wood industrial residues; however, it is essential that the fuel used is of the highest quality and has a very low moisture content. Indeed, corrosive products coming from its firing present the main issue for the durability of CHP plants.
Medium and large-scale biomass CHP systems tend to utilise steam to drive a turbine, or Organic Rankine Cycle (ORC) that uses a turbine driven by gas which boils at a lower temperature than water. Both are mature technologies with excellent durability and reliability, which call for far less maintenance than is required for gasification CHP.

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 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 composition and the 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 have been conducted to enhance their properties by depositing several coatings. Therefore, some results already showed the importance of some

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elements such as nickel or chromium in the coating, improving its resistance. Nevertheless, some elements don't have a 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 releasing chloride gas leading to unprotective active oxidation. Moreover, chromium volatilization occurs in 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

BELENUS project aims to find new solutions for corrosion-resistant materials in biomass power plants, and this goal can be achieved with a better understanding of corrosion-erosion processes occurring in a real plant. Indeed, in a CHP plant, boilers and tubes must withstand harsh atmospheres in extreme conditions, and thus be faced to prior testing in fired-biomass-simulated environment. Erosion refers to the metal degradation resulting from the mechanical effects of a turbulent fluid. Micro-mechanical deformation/fracture processes lead to particle-induced erosion at the material-fluid interface, etching the surface.
Thus, erosion-corrosion tests were performed on ferritic-martensitic alloys, in simulated atmosphere at lab-scale CHP plant. In parallel, these same materials were tested with several coatings developed by INTA, SMT and TEandM. Moreover, thermogravimetric analysis of the samples was performed during the experiment, along with microstructure analysis. All the crossed results will permit to evaluate the degree of corrosion occurring for each system and quantify the benefice of applying coatings on alloys.

Testing and validation in a plant – Perspectives of BELENUS

Tested alloys and coatings will be compared to choose a system that could be applied in a real CHP plant. Along with that, coatings deposition methods will be evaluated to satisfy techno-economic assessment of BELENUS project and optimize production costs and the materials will be validated considering the acceptability of their life cycle analysis. Finally, a perspective of BELENUS work is to develop an online corrosion monitoring system that will permit to evaluate the lifespan of a plant in at real time.

Sectorial Breaking News

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Date	Headline	Source
June 25, 2021	N. Macedonia's gross electricity output down 14.7% y/y in Apr	Renewables now
June 29, 2021	Investors commit EUR 800m to CIP's next-gen energy transition fund	Renewables now
July 02, 2021	FuelCell Energy completes 1.4-MW biofuel fuel cell facility in California	Renewables now
July 7, 2021	Valmet to build biopower plant in Salzburg	Bioenergy insight
July 22, 2021	Japan's Renova to increase stake in 75-MW biomass plant	Renewables now
Aug 18, 2021	Sweetman Renewables' biomass plans progress in NSW	Bioenergy insight
Aug 25, 2021	24 biomass projects receive share of £4m government funding	Bioenergy insight
Sep 3, 2021	Veolia innovation increases composting recovery for biomass fuel	Bioenergy insight
Sep 24, 2021	11 thermal plants near Delhi directed to co-fire with biomass	Bioenergy insight

Remarkable Upcoming Events.

1. **International Conference on Biomass Technologies and Combustion Systems**

   - January 14-15, 2022
   - Zurich, Switzerland

International Conference on Biomass Technologies and Combustion Systems aims to bring together leading academic scientists, researchers, and research scholars to exchange and share their experiences and research results on all aspects of Biomass Technologies and Combustion Systems. It also provides a premier interdisciplinary platform for researchers, practitioners, and educators to present and discuss the most recent innovations, trends, and concerns as well as practical challenges encountered, and solutions adopted in the fields of Biomass Technologies and Combustion Systems.

2. **International Conference on Energy, Biomass, Waste and Environmental Management**

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- December 13-14, 2021
- Rawa Mazowiecka, Poland

The largest meeting of the domestic biogas industry will be held on December 13 and 14 at CKS Ossa in Poland.
The sixth edition of the largest meeting of the biogas industry in Poland, organized by the Biomass Media Group, will once again bring together representatives of the domestic and European biogas and agri-food sectors, representatives of local government administration and energy market analysts. The two-day conference will gather over 150 professionals from the biogas industry.

3. 12th International Conference on Future Environment and Energy

- January 20-22, 2022
- Tokyo, Japan

2022 12th International Conference on Future Environment and Energy (ICFEE 2022) will be held in Tokyo, Japan during 20-22 January 2022. ICFEE 2022 is sponsored by the Beijing CAS Industrial Energy and Environment Technology Institute (BIEET). It is one of the leading international conferences for presenting novel and fundamental advances in the fields of Future Environment and Energy. It also serves to foster communication among researchers and practitioners working in a wide variety of scientific areas with a common interest in improving Future Environment and Energy related techniques.

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* and *Twitter*

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