December 2024

GreenHeatEAF newsletter #3

Gradual integration of renewable non-fossil energy sources and modular heating technologies in EAF for progressive CO_2 decrease

The project falls under the funding programme of Horizon Europe – Clean Steel Partnership.

The call topic is related to modular and hybrid heating technologies in steel production.

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The year 2024 has come to its end and it is time to celebrate the arrival of the New Year!

This year was dense of activities for the GreenHeatEAF consortium, that also successfully faced its first review meeting. 2024 was also a difficult year for the European steel sector, which faces a tough economic crisis. Nonetheless, many different activities were put in place to demonstrate the integration of non-fossil fuels and renewable C-sources in Electric Arc Furnace (EAF) processes to decrease CO_2 emissions and dependence from fossil energy and C-sources markets by combining pilot, on field and simulation investigations.

Our great 2024

Many different activities have been carried out during 2024, and a very short overview is here provided.

A pilot installation to test Hydrogen-Enhanced Combustion (HEC) with standard EAF burners was set up at the facilities of BetriebsForschungsInstitut (BFI), and first trials with a scaled down and manufactured model burner were performed for following combustion tests. Demo trials of hydrogen use as energy source in the Electric Arc Furnace (EAF) with LINDE's Cojet burners for different iron carriers and charging methods were done in SWERIM's EAF pilot furnace (see Figure 1.a) with hydrogen produced by high pressure alkaline electrolyser.

The CFD simulation models to investigate and optimize HEC with standard burner and EAF-heating with HEC as well as HEC effects on EAF processes and off-gas conditions were set up and first calculations conducted.

A new solution to monitor gas heat through an adapted Acoustic Gas Measurement system and relevant process data was developed and is now being installed.

Tests on slag modification in slag pot to adjust chemistry and obtain slag suitable for cement industry were done on the conducted DRI- and scrap feeding trials. Additionally, the test bed for heat recovery from EAF off-gas was planned and the preparation started.

Based on previous analyses of different renewable C-sources, materials were selected for industrial trials at EAF. The tests session to partially replace anthracite and foaming coal with biochar and plastics, respectively, was completed at the industrial EAF of SIDENOR (see Figure 1.b).

"GreenHeatEAF contributes to gradual replacement of fossil fuels and fossil carbon materials with non-fossil gases and renewable C-sources. Therefore, GreenHeatEAF contributes to lowering NG, anthracite and coal exploitation, by decreasing GHG emissions through the use of sustainable gases (i.e., green Hydrogen, preferably internally produced) and materials (zero-impacting biomass)."

(a) (b)

Figure 1. a) Field trials at SWERIM' EA ; b) experiments with non-fossil C-bearing materials (tires) at SIDENOR's EAF.

Using industrial and literature data, Scuola Superiore Sant'Anna (SSSA) adapted an existing Aspen Plus EAF model to consider injection of alternative C-sources and use of NG/H_2 blends in burners and developed sensitivity and scenario analyses. SSSA also developed models of two biomass upgrading processes, i.e. pyrolysis and torrefaction.

BFI applied an existing dynamic EAF model to SIDENOR's data and adapted it to CELSA's Consteel EAF. SWERIM extended an in-house steady state mass and heat balance EAF model in ReMIND to the use cases of HŐGANAS, CELSA, SSAB.

Dissemination activities

The GreenHeatEAF Consortium is committed to disseminate project results and ensure industrial interest and commitment towards them throughout the European steel community. To this aim, several presentations were held in important international scientific conferences, such as the 18th Society and Materials Conference (SAM18), the 13th European Electric Steelmaking Conference (EEC 2024), the 9th European Coke and Ironmaking Congress (ECIC 2024), and the 2024 Annual Dissemination event organized by the European Steel Technology Platform (ESTEP) in Linz at the end of October (see Figure 2).

Figure 2. Presentations held by partners of the project within relevant scientific events.

Moreover, 3 papers were published in open access mode in relevant Scientific Journals to describe some preliminary results of the project and are now available to the wide public. You can download them from the following links

https://www.mattech-journal.org/articles/mattech/pdf/2024/05/mt20240027.pdf

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