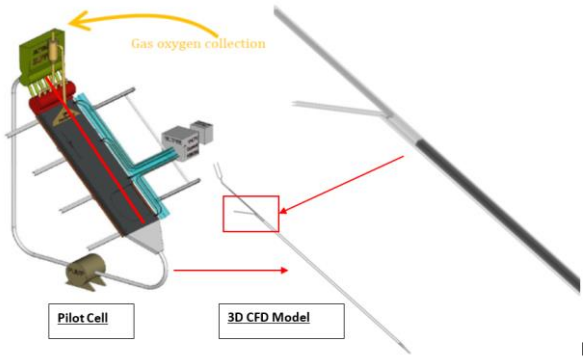
Development of new methodologieS for InDustrial CO2-freE steel pRoduction by electroWINning

October 2020 – Newsletter No. 4

Welcome to this new edition of ΣIDERWIN *e-Newsletter. People registered to the Special Interest Group will receive periodically this email to be informed about the main highlights of the project.*

CFD simulations of the pilot cell confirm the operability of the cell

Workpackage 3 of the ΣIDERWIN project was devoted to the simulation and design of the optimal prototype of the electrolysis cell for Iron production. With that purpose in mind, and before assembling the pilot cell for experiments, many CFD simulations have been performed to assess the efficiency of the cell. Thus, a comprehensive 3D CFD model of this cell has been built as depicted on the figure below:

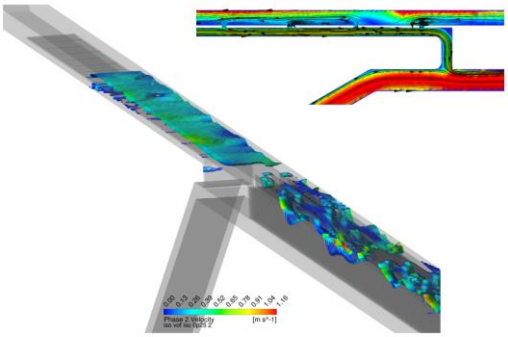


ΣIDERWIN electrolysis pilot cell – 3D CFD model definition

A major issue is to ensure a proper degassing process. Indeed, a large quantity of oxygen is generated close to the anode walls that needs to be properly removed from the cell to avoid a dramatic loss of efficiency.

The cell design has been defined using 3D CFD simulations to be sure that the **generated oxygen gas is properly driven to the cell degassing outlet with no accumulation**, validating SIDERWIN concept.

The figure below depicts some simulation results showing gas pockets colored by velocity in the operating cell.



CFD model results

The final design proposed does not show any gas bubbles accumulating or flowing down to the cathode. This is achieved using specific CFD-designed devices.

The 3D, detailed, full length simulations of the pilot cell have been accomplished and confirm the operatility of the cell.

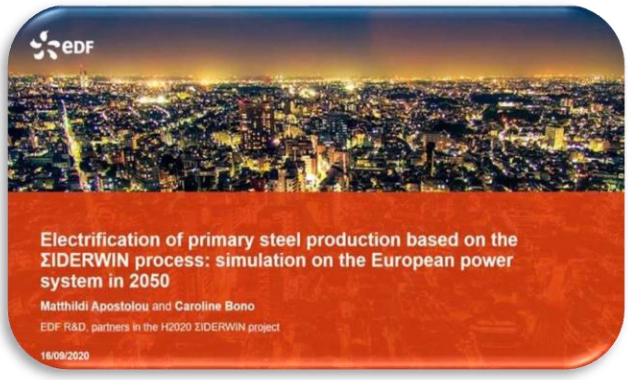
Participation of our partner EDF in the ECEEE conference

The theme of this year's ECEEE virtual conference (14th - 17th September 2020) was the decarbonisation of the Industry. Our colleagues from EDF presented the article «***Electrification of primary steel production based on ΣIDERWIN process: simulation on the European power system in 2050***», valorizing the contribution of ΣIDERWIN in reducing the carbon footprint of steel industries.

The modelling of an electricity mix scenario for 2050 with ΣIDERWIN's electricity demand at a European level, as well as the ΣIDERWIN's Demand Side Response (DSR) flexibility was realized. Different scenarios were studied including scenarios where ΣIDERWIN's demand is satisfied by offshore wind turbines, by 50% offshore – 50% nuclear, and by 100% nuclear power. A detailed technical and economic analysis of DSR was also performed.

The main results of the study are the following:

- ΣIDERWIN should offer a **great flexibility capacity, of up to 39 GW in a European scale**, with great responsiveness and without duration or repeatability constraints.
- **This flexibility represents a real asset for the European Power System**: it could contribute to the **balance of the power system**, by replacing a large part of the peaking OCGT (Open Cycle Gas Turbine) plants. That means:
    - A reduction in CO_2 emissions.
    - Financial gains (higher than the cost of flexibility activation).
- **The deep decarbonation of steel industry enabled by ΣIDERWIN is not jeopardized by the impact on power system:**
    - The European power system is able to meet the additional ΣIDERWIN demand with carbon-free means.
    - Despite a strong increase in electricity demand, the impact on CO_2 emissions of the European power system is very low and depends on the choice of technologies used to meet the additional demand of ΣIDERWIN.
    - In all scenarios studied, the carbon intensity of electricity generation (g/kWh) decreases.
    - The flexibility offered by ΣIDERWIN allows for additional CO_2 savings, by replacing part of the peaking OCGT plants: direct savings in thermal generation but also savings due to OCGT plants not built.



EDF's presentation cover slide and speakers

ΣIDERWIN webinar postponed

Unfortunately, the ΣIDERWIN webinar announced for the **22nd of September 2020** has been finally postponed till the beginning of 2021, due to the delays on the building commissioning because of the exceptional situation of Covid19 pandemic. Soon it will be available in the web and social media the link to register for this interesting event, where the different partners will explain the developments made until date. Stay alert and save the date in your calendar.

ECS Spring Meeting

This year, the Electrochemical Society Spring Meeting that should be held in Montreal in May 2020, was finally cancelled due to Covid19.

Our colleagues from NTNU were going to participate in the event with the paper «***Electrodeoxidation of Iron Oxide in Aqueous NaOH Electrolyte***» published in the proceedings.

This paper summarizes some of the recent results obtained under ongoing studies in the ΣIDERWIN project for the development and optimization of this electrochemical process. Experiments were carried out in NaOH-H_2O (50-50 wt%) electrolyte with a suspension of Fe_2O_3 particles at ~100 °C, using a rotating disk electrode as cathode and different cathode substrates.

Silver was found to be an **excellent substrate for good quality deposits**. It was also demonstrated that, in addition to Fe_2O_3, **bauxite residue** (red mud) from Bayer process may be used as a **raw material** in this process and **iron can successfully be recovered.**

M36 Review Meeting

The next ΣIDERWIN Review Meeting will be held virtually on the **30th of November**.

Wishing that the situation improves and limitations to travel allow all the partners to attend a face- to-face meeting at ArcelorMittal facilities to see the progress of the pilot plant, that continues despite of Covid19 pandemic. Find below some pictures of the new tanks and control systems installed.

ΣIDERWIN pilot plant progressing

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