Development of a Low CO2 Iron and Steelmaking Integrated Process Route for a Sustainable European Steel Industry

Results in Brief

Revolutionary low-carbon footprint iron production technology

Carbon capture and storage (CCS) is one option to making iron making eco-friendlier. An EU-funded project developed a revolutionary iron making process that emits 50% less CO2 without using CCS technology.

The European steel and iron industry annually emit about 160 million tonnes of CO2 and are responsible for 8% of all emissions covered by the Emission Trading System. This relatively high proportion reflects the emission-intensive nature of iron and steel production. It is primarily attributed to the smelting of iron ores in blast furnaces to produce molten steel. More specifically, blast furnaces use coking coal as both the reduction agent and the source of heat energy for producing around 70% of currently available primary steel.

HIsarna: Pivotal for a low-carbon and circular economy

HIsarna is one of the most promising recent developments in reducing CO2
emissions from the steel industry. Until now, HIsarna alone has shown it can reduce energy use and carbon emissions by at least 20%. When combined with CCS, CO2 emissions from steelmaking can be reduced further.

The process consists of a reactor into which iron ore is injected at the top. The ore is liquefied in a high-temperature cyclone and drips to the bottom of the reactor. When powdered coal is injected into the reactor, it combines with the molten ore to produce liquid hot metal and concentrated CO2. The technology reduces specific CO2 emissions and energy consumption through a number of ways including the use of iron ore and pulverised coal without having to pre-process the raw materials in separate coke, sinter or pellet factories.

HIsarna also plays a pivotal role in the future recycling ambitions of the circular economy. It provides the ability to combine primary steelmaking with recycling of up to 50% steel scrap, which is twice the present theoretical maximum of the blast furnace – basic oxygen steel plant route. It also allows the recovery of zinc from coated steel scrap.

Sustainable iron/steel production

Tata Steel has been testing this ground-breaking process at its IJmuiden steelworks in the Netherlands. With EU funding of the LoCO2Fe project, Tata Steel demonstrated that more than 50% CO2 emission reduction is possible with HIsarna technology without the use of CCS.

The key components of the process were the use of steel scrap in the HIsarna reactor and replacing part of the coal for sustainable biomass. “Results showed that up to 53% of material added to the process can be made of scrap steel, reducing the requirement for raw materials compared to the blast furnace process. In addition, more than 40% of granular coal was replaced by sustainable biomass,” notes project manager Johan van Boggelen.

As the HIsarna installation produces highly concentrated CO2, it is ideally suited for CCS, without the need for a costly gas separation stage. Combining HIsarna with CCS solutions could lead to a total CO2 saving of at least 80% from the iron/steel production process. And in theory ironmaking without emissions should be possible. “Through LoCO2Fe, the HIsarna technology made a huge leap forward, becoming an iron making process that is in line with the European climate change agenda. LoCO2Fe demonstrated that iron making technology with significantly reduced emissions is possible,” concludes van Boggelen.

Keywords
LoCO2Fe, CO2, Hlsarna, carbon capture and storage (CCS), iron making, steel production, Tata Steel, circular economy

**Project Information**

LoCO2Fe

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