InSGeP

Investigations of Slags from Next Generation Steel Making Processes

Deliverable 1.1

Comprehensive overview

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Abstract

Complying with the EU Green Deal, the RFCS objectives and Horizon Europe's Missions to move towards Net Zero Emission by 2050 with a zero-pollution ambition, it is essential to make sure that while introducing breakthrough technologies to produce green steel, the whole circular concept is kept in place, especially with respect to recycling of by-products, such as slag. Next generation iron and steelmaking process to decrease CO_2 by using direct reduced iron (DRI) with varying reduction degrees, hot briquetted iron (HBI), hydrogen plasma smelting reduction (HPSR) or by operating electrical smelters for low-grade ores will result in increase of EAF and other slags with different properties. This requires the understanding of the possibility to valorize future slags in the present value chain and define innovative applications to assure smooth transition process without disruption to the steel industry as well as other sectors (such as road construction or cement) who currently rely on slag as raw material for their processes.

To understand and move forward the transition of the steel industry, five steelworks, six RTOs and two suppliers will investigate slags resulting from next generation steelmaking in Europe in InSGeP project. The project will rely on the limited amount of currently produced slags from next generation steel production in Europe as well as on laboratory, pilot scale and industrial scale tests that will be performed based on the needs of the involved partners. The slags will be evaluated based on chemical, mineral, environmental and physical properties and will be treated with different cooling and granulation methods to produce physical characteristics needed for different applications and environmentally compatible products. Use of the slags in applications such as road construction, cement/concrete, liming material, or 3D printing will be tested. The InSGeP project will create guidelines for the use of slags from next generation steelmaking.

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List of abbreviations and acronyms

DRI	direct reduced iron
EAF	electric arc furnace
HBI	hot briquetted iron
HPSR	hydrogen plasma smelting reduction

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1 Introduction

Europe is ongoing a transformation in the steel making process to reduce CO_2 emissions while keeping the goal of zero waste. Different types of next generation iron and steelmaking process to decrease CO_2 will be put into practice such as direct reduced iron (DRI) with varying metallization degrees, hot briquetted iron (HBI), or low-grade fine ores in a hydrogen plasma smelting reduction (HPSR) which will result in increase of electric furnace (EAF) slag, smelter slag and other slags with different properties (**Figure 1**). This requires the understanding of the possibility to valorize future slags in the present value chain and define innovative applications to assure smooth transition process without disruption to the steel industry as well as other sectors (such as road construction or cement) who currently rely on slag as raw material for their processes. To understand and move forward the transition of the steel industry, InSGeP project is investigating slags resulting from next generation steelmaking in Europe. The project relies on the limited amount of currently produced slags from next generation steel production in Europe and abroad as well as on laboratory, pilot scale and industrial scale tests that will be performed based on the needs of the involved partners.

Deliverable 1.1 “Comprehensive overview” describes the state-of-the-art of the transformation of the steel industry with respect to slag as well as how the InSGeP project will go beyond state-of-the-art.

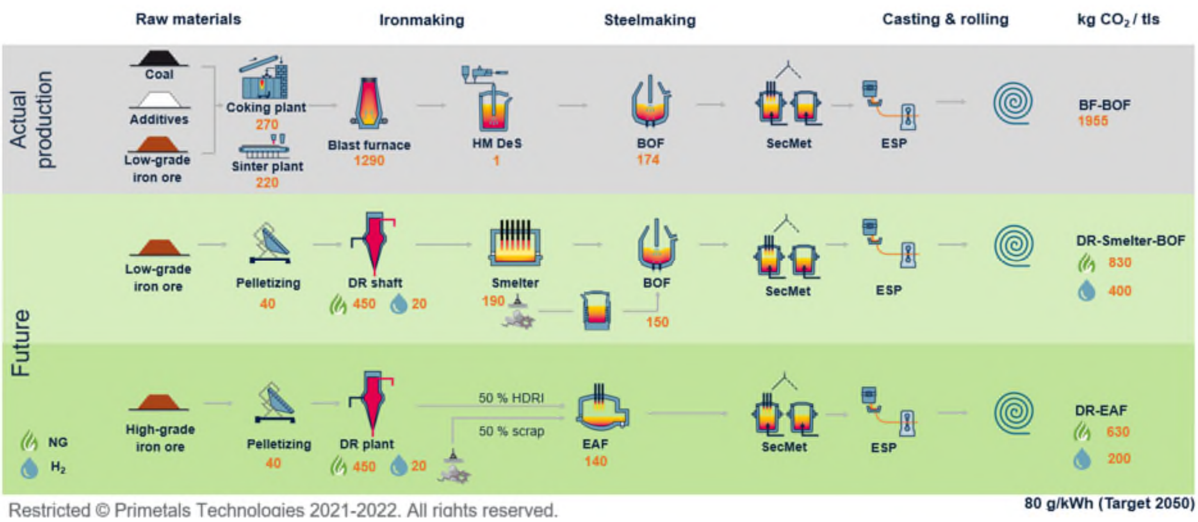

Figure 1: Actual and future production of steel in Europe (©Primetals Technologies 2021 – 2022)

2 State-of-the-art

The state-of-the-art process routes for steel production are, on the one hand the combination of blast furnace (BF) and basic oxygen furnace (BOF) and on the other hand, electric arc furnace (EAF), using scrap or coupled with direct reduction (DR). **Figure 2** illustrates the relation between available iron ore quality and current as well as future steelmaking routes, respectively.

As shown in **Figure 2**: , BF-BOF route will still exist within the next 1 – 2 decades to process low- and medium grade ores (Fe content < 62 wt.%), in parallel to the scrap-EAF and DR-EAF route and its combinations, which requires high-grade ores (Fe content > 65 wt.%)[1]. To reach the goal of climate neutrality (zero net CO_2-emissions) by 2050 according to the EU Green Deal and the “Fit for 55 package”[2], the BF-BOF route will be progressively replaced due to its high CO_2 emission (1800 kg/t crude steel even in best cases).

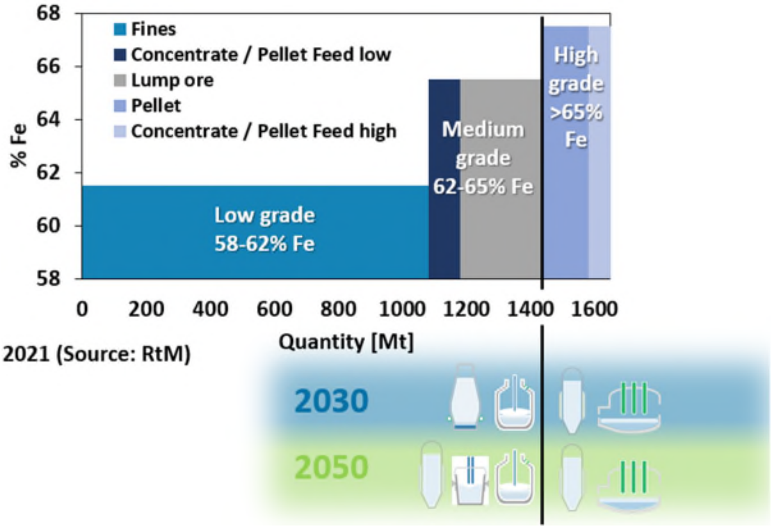

Figure 2: Worldwide iron ore qualities (upper part) and expected steelmaking routes depending on the available ore qualities (lower part)

With the mandate to decarbonize the European steel sector, new process technologies are developed to significantly reduce CO_2 emissions and transition phases are ongoing to change the steelmaking process by implementing next generation iron and steelmaking routes. Most of these technologies have in common that hydrogen is the (main) reducing agent. For high-grade ores, the only change is the replacement of natural gas with hydrogen as the reducing agent during the DR process. For medium grade ores, the BF should be replaced with a combination of DR and a Smelter (electrically heated reactor that produces a hot metal like product that can be further treated in a BOF). A second alternative to the BF/BOF route is the hydrogen plasma smelting reduction (HPSR), where steel is produced directly out of fine iron ores in just a single process step using ionized hydrogen (H^+ ions) in plasma state. Iron ores electrolysis could be a long-term way to produce steel.

As slag production is an integral part of steelmaking, the sustainable recycling or utilization of slag is a major key to fulfilling circular economy goal and reduction of CO_2 emissions instead of landfilling the slag. With the transition to next generation steelmaking most of the steel will be made in an EAF or an

[1] De Maré, Carl. "Why Both Hydrogen and Carbon Are Key for Net-Zero Steelmaking." *IRON & STEEL TECHNOLOGY* 1 (2021)
[2] Europe. Com.: 'Fit for 55' - delivering EU's 2030 climate target on way to climate neutrality, COM(2021) 550, 2021

electrical smelter using larger quantity of pre-reduced iron in the burden which increases the urgency to find suitable solutions for the resulting slag utilization as well as to replace the BF/BOF slag which currently is a product used by different industries (e.g., cement or road construction). As the next generation steel production in Europe is in its first stages fundamental research is needed to understand the changes that are coming and prepare for solutions that will be needed with respect to slag, which is a major by-product of steel production.

3 InSGeP project beyond state-of-the-art

With the European Green Deal[3] objectives to fight climate change and move towards climate neutrality by 2050 with a zero-pollution ambition for a toxic-free environment it is essential to make sure that while introducing breakthrough technologies to produce green steel, the whole circular concept is kept in place, especially with respect to recycling or utilization of by-products such as slag.

The InSGeP project aims to understand the potential impact of next generation steel production on resulting slag. The project will investigate the production of steel with direct reduced iron (DRI), hot briquetted iron (HBI) and its combination with scrap in EAF or smelter or HPSR and the quality of resulting slag as well as recycling or utilization routes that the slag can have.

In particular, the project will investigate and characterize slag from next generation steel production in Europe and outside Europe as the production of steel with next generation technologies is currently extremely limited in Europe. In addition, slag will be produced in laboratory, pilot and at industrial scale with different DRI, HBI or fine iron ores qualities and percentages to determine utilization routes. This will create invaluable information and experience for EU steelworks who are not yet using next-generation steelmaking processes to transition soon.

The aims of the InSGeP project are in line with the objectives of the latest (2011 – 2017) Monitoring and Assessment of the RFCS Research Program[4] report by replacing natural resources with slag: i) to cut greenhouse gas emissions, ii) to make sustainable use of resources and iii) to develop new competitive, high-performance products by saving natural resources. The project answers Article 10 “conservation of resources, protection of the environment and circular economy” objectives of the RFCS Research Program for the Steel sector.

As the production of steel with next generation technologies (high % of DRI/HBI in the EAF charge, smelter, HPRS) is currently limited in Europe and additionally, the starting TRL of the InSGeP project is 1 – 2 with the aim to end the project with TRL 4. The basic understanding of the slag and its utilization route potential will enable the steel industry a smoother transition in the upcoming years without affecting the production of the steel making (higher environmental impact and reduced value of by-products) as well as other sectors currently relying on slag as input material.

3.1 Solutions proposed in the project

InSGeP project is an essential start to understand how the next generation steelmaking will affect slag production in Europe and to create a roadmap to see how the slag can be recycled or created into a product that can be used in other sectors. With the transformation of the steelwork, it is essential to not only ensure that the steel quality meets the standards, but also that by-products, especially slag, the most

[3] European Commission (2019) *The European Green Deal*, Brussels

[4] European Commission, Directorate-General for Research and Innovation, Research Fund for Coal and Steel : monitoring and assessment report (2011-2017), Publications Office, 2020, https://data.europa.eu/doi/10.2777/496811

important by-product by volume, will have a place in the future economy and will not be landfilled.

To understand the landscape of next generation steelmaking in Europe which is currently taking place or the future direction it is important to gather information from relevant parties. In the InSGeP project five steelworks (ORI MARTIN, VOESTSALPINE, SAARSTAHL, ArcelorMittal and SIDENOR), six RTOs (FEhS, RINA, K1-MET, SSSA, CRM and BFI) and 2 suppliers (TENOVA and PRIMETALS) who represent a large part of European slag knowledge will come together to share knowledge and create a fuller understanding how to include slag utilization as an essential aspect of the decarbonization transformation of steelmaking.

By bringing together partners from various parts of Europe (Austria, Belgium, France, Germany, Italy, and Spain) with additional international presence, the experience and needs can be better assessed. With the different emerging technologies and processes that might be better suitable for different steelworks, it is important to gather this information to provide a guide map of the possibilities to disseminate knowledge which is essential to help achieve decarbonization in Europe.

To ensure thorough understanding of the slag that will result from next generation steel production, at least 15 slag samples will be collected from European next generation steel production that is already taking place as well as from around the world when possible. Because currently next generation steel production is not widely implemented, it is necessary in addition to produce slag samples in the project to understand the different slags that might result in the future when the new steelmaking techniques will be implemented. Slag samples will be created in laboratory and industrial tests for the project with different percent of DRI/HBI/HPSR, which will be analyzed and used to assess utilization paths. In order to cover different scenarios and possibilities for different steelworks (with respect to their future needs), project partners will conduct laboratory, pilot and industrial tests with different input, percent of input, techniques, and steel type. The criteria will reflect individual steelwork transformation strategy into decarbonization of their plant. The samples that will be created in the project based on their characteristics and amount will be treated with different cooling and granulation techniques to modify the slag to meet regulatory requirements as well as analyzed for utilization routes.

3.2 DRI and HBI

Directly reduced iron is produced by using H_2 instead of carbon reductant (e.g., coke) to reduce iron ore pellets to DRI or sponge iron in a shaft furnace. The DRI can be charged into an EAF for further processing. The DRI can be used at different amounts in combination with different scrap options or 100 % of DRI can be charged into the EAF. Hot briquetted iron is a high quality DRI which can be also charged into a blast furnace. If production of DRI and HBI is made with green energy the primary steelmaking route will have reduced carbon use or become carbon neutral[5].

3.2.1 Production of laboratory scale samples

The detailed properties and the EAF melting behavior of H_2-based DRI from lower quality iron carriers are still unknown since this type of DRI is not commercially available. Due to this reason, several DRI samples made from different lower quality iron carriers by use of different natural-gas- and H_2-based reduction gas mixtures will be produced in laboratory vertical tube furnaces. The self-produced DRI samples will be molten in laboratory crucible furnaces to take primary slag samples for further chemical-mineralogical analysis (RFA, XRD, Raman spectrometry) and to assess the melting (time) behavior by camera recordings, when the DRI is charged to an initial steel bath. The aim is to compare the properties and melting behavior of the different DRI types to feed the economic evaluation for DRI/HBI melting and slag modification practices in the EAF. Data on the mineralogic composition will help to determine the usability for slag application in road construction or for cement utilization. The comparison and alignment of XRD and Raman data shall lead to a simplified method for future mineralogic slag analyses.

3.2.2 Production of pilot scale samples

Two samples of slags will be produced within a 6 t AC EAF. These melts will be made of different DRI to scrap ratio or with different DRI quality based on the outcome of previous tasks. It is possible to gradually increase the slag basicity during the trial to estimate EAF slag composition deriving from flat steel production. The obtained slag can be used for further investigation (characteristics for civil engineering or wet granulation for cement industry)

Two additional samples of ~ 100 kg each will be produced in a 1 t DC pilot furnace with 100 % DRI burden with different carbon content. Slag chemistry will be tuned thanks to additions and steel and slags samples will be taken at various stages of the smelting and refining. These pilot tests are important to confirm the outcome of data analysis and allow orientating and adjusting the industrial trials.

A pilot 1 ton DC furnace (**Figure 3**) to produce slag samples will also be used. This research furnace is equipped with two electrodes which could be inclined to initiate the arc and start melting on insufficiently metalized materials. Also, depending on the regulation mode, the furnace could be operated in DC EAF mode, arcing between electrodes and burden, or in smelter (SAF: Submerged Arc Furnace) mode with electrodes immersed into material, higher slag ratio and addition of carbon. At this end, blast furnace (high) quality pellets will be reduced to DRI state in large scale laboratory reactors and melted with carbon bearing material and slag formers (lime and dolo-lime). Two pellets quality obtained from different ores will be tested.

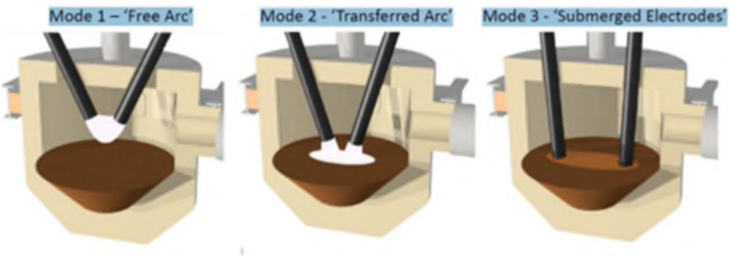

Figure 3: 1 ton pilot furnace which will be used in either EAF or SAF mode

3.2.3 Production of industrial scale samples

Three industrial trials will be performed at different steel producers in Germany, Italy, and Spain to create slag samples with DRI or HBI.

Industrial tests with scrap and DRI in different heats will be performed. Slag samples will be collected with 100 % scrap melting, as specific reference situation. Test heats with maximum DRI amount of 30 % will be carried out and corresponding samples will be collected. These samples will be analyzed by chemical and mineralogical composition and compared with samples produced in laboratory tests.

Operational trials at the 90 t EAF will be performed using a scrap charge with different partitions (up to 20 %) of commercial HBI. Trials for slag conditioning will be performed towards slag usability for road construction or to obtain a defined glass content for a potential use for cement utilization. This treatment also includes the destruction of the slag foam. Slag conditioning will be performed in the slag pot during tapping by use of a pneumatic feeder for selected additives. Aim of the slag conditioning is to achieve best slag properties for the road construction and cement sector in the most economical way by a balanced use of selected primary or secondary additives. In all cases, operational slag samples with defined and reproducible cooling will be taken from the different heats for chemical-mineralogical analysis as described above (RFA, XRD, Raman spectrometry) and for leaching tests.

Industrial heats at the 150-ton capacity in EAF will be performed. Commercial HBI will be used (up to 15 %) in combination with different scrap mixes for different special steel grades with specific requirements. Slag samples will be collected to be analyzed and submitted to cooling tests (with and without granulation).

3.3 Smelting of low-grade iron ores

For the smelting of low-grade iron ores, the smelter (alternating electric smelting furnace) could be the missing link in future steelmaking between the direct reduction process and existing BOFs of integrated plants on their transformation path to a decarbonized steel production. The smelter technology is based on the already existing SAF (Submerged Arc Furnace). The SAF has been used in the non-ferrous sector to produce e.g., ferrochromium, -zinc, or -manganese.

Ores with an iron content below 64 – 65 % (low- and medium-grades) cannot be treated economically in the EAF. The slag volume would be too high leading to a decreased productivity. The following **Figure 4** shows a schematic view of the smelter process.

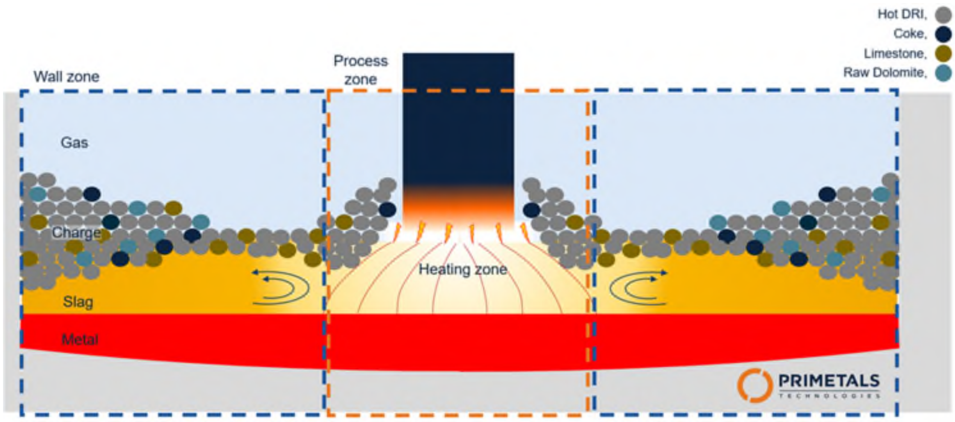

Figure 4: Schematic view of the smelter process (copyright Primetals Technologies)

After a pre-reduction step (not shown in **Figure 4**), the low- and medium-grade DRI need to be molten in a smelter. In the smelter, the pre-reduced DRI is charged, and coke is added for reduction and carburization, which results in a hot metal like product, that is tapped from the reactor and then further treated in the BOF (apart from that, also the use in an EAF is possible) to produce crude steel. Important thermodynamic and metallurgical phenomena occur during the smelter operation including dissolution of the reducing agents, final reduction of the DRI to hot metal, slag formation, and heat transfer and losses. One main advantage of the smelter is its flexibility in terms of input materials (beside DRI, also scrap, or other iron containing circulating materials or residue streams up to ~ 20 % can be used) and its ability to produce hot metal with different carbon contents like hot metal from the BF. Iron produced in the smelter therefore allows existing integrated steel mills to substitute CO_2 intensive hot metal from the BF. The slags of the smelter are expected to have a basicity (B2; CaO/SiO_2) between 0.9 – 1.2, like BF slag. Within InSGeP, two types of smelters slags will be produced.

3.3.1 Production of pilot scale samples

Feed mixture of Low Reduced Iron (LRI, 75 – 92 % metallization degree) will be produced and EAF slag to produce four smelter slag samples. EAF slag addition will be in the range of 0 – 100 kg per ton hot metal produced.

Another important pathway of future smelter operation is aiming at the sole use of DRI preferably produced from low-grade ores. Smelter slag samples will be created without EAF slag additions. Both smelter operation modes (LRI + EAF slag and DRI respectively) will have similar slag chemistry to BF slag to allow a utilization in cement industry. Potential application fields of the smelter slags as secondary resource will be evaluated.

3.4 Hydrogen Plasma Smelting Reduction

Another potential breakthrough technology for decarbonized steel production also mentioned in relevant roadmaps for the steel industry[5] is the Hydrogen Plasma Smelting Reduction (HPSR) process. **Figure 5** shows the concept of the HPSR reactor (left-hand-side).

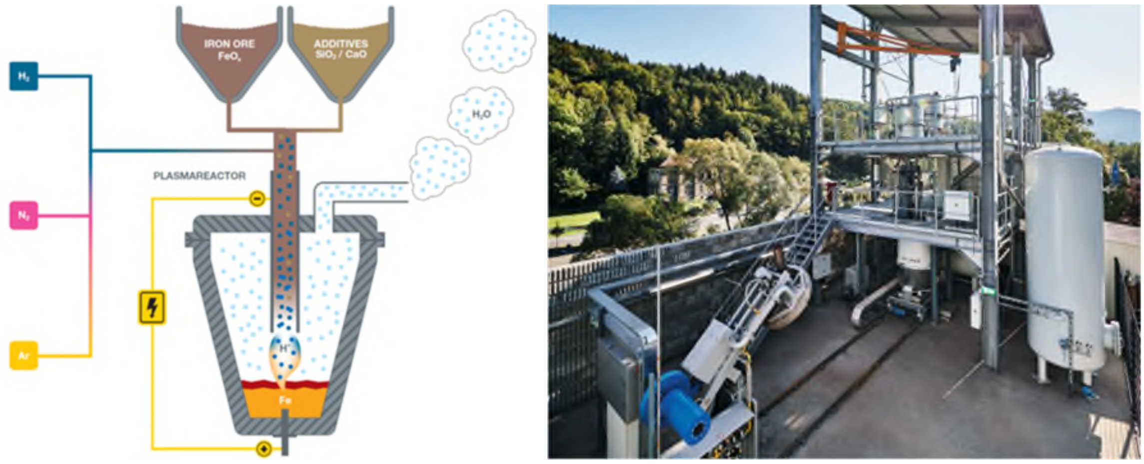

Figure 5: HPSR reactor concept (left) and pilot plant (right)

It is a one-step process to convert iron ore to an alloyed iron (carbon-free). The HPSR process works on the principle of a transferred arc. A hollow graphite electrode is used as cathode. Both the process gas (mixture of H_2 and N_2 or Argon), the fine ore as well as additives, such as SiO_2 or CaO, are introduced through this electrode. The metal bath or the bottom of the reactor works as an anode. Process monitoring, or the progress of the reaction, is determined by measuring the exhaust gas composition during the operation using a mass spectrometer. In the reactor, iron oxide is melted and reduced at extremely hot temperatures with the help of ionized H_2 (H^+-ions, H_2 plasma). Due to fine ore, no upstream agglomeration of the material is needed. The consumed H_2 leaves the reactor as water vapor mixed with unused process gas (H_2/Ar/N_2). Recent studies addressed the behavior of nonferrous tramp elements in iron ore as well as with thermodynamic and kinetic aspects of plasma melt reduction[6,7,8].

The HPSR process slag is expected to have a low basicity B2 between 1 and 2, i.e., somewhere between a BF and a BOF slag. For an economic operation of the process, the FeO content in the final slag should be at least 5 %. The slag composition strongly depends on the quantities of additives (SiO_2, CaO or MgO) according to the properties of the feed ore material and the target sulphur and phosphorous contents of the produced crude steel. Exemplarily, in case of higher phosphorous content in the ore, phosphorous embedding in the process slag is required. To make this possible without reaching the C_2S area, reduction degree must be limited, with at least 5 % FeO in the final slag. At lower temperatures, the setting of phosphorus can take place in a CaO-rich slag, which partially precipitates as mixed C_2S crystals. **Figure 6** shows how the final HPSR slag composition can be reached. Only the low FeO content is fixed (final composition marked with 2, 5 or 6 in **Figure 6**).

[5] Focus Roland Berger: The future of steelmaking - How the European steel industry can achieve carbon neutrality, 2020
[6] Naseri Seftejani, M., Schenk, J., Zarl, M., Materials, Vol. 12, paper no., 2019
[7] Zarl, M., Farkas, M., Schenk, J., Metals, Vol. 10, paper no. 1394, 2020
[8] Plaul, J. F., PhD thesis, Montanuniversitaet Leoben, 2005

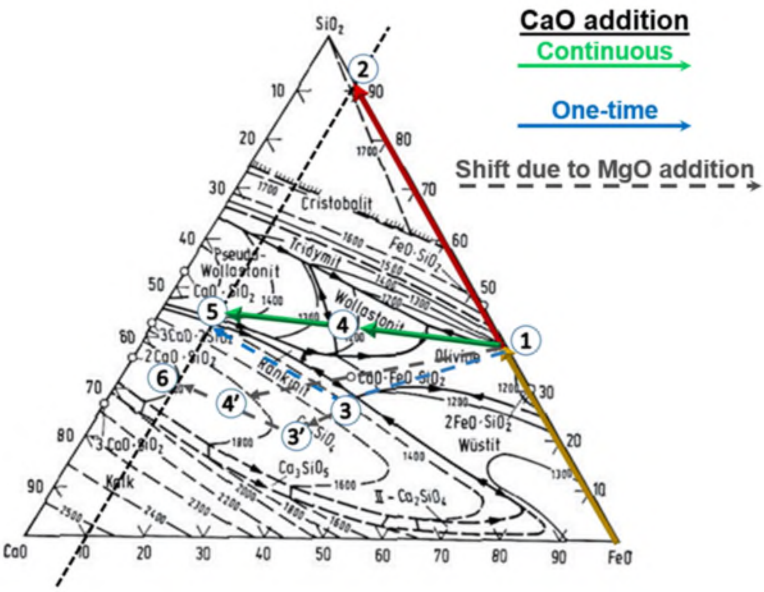

Figure 6: Possible slag paths and final compositions of the HPSR slag; 1 starting point; 2 FeO content in final slag; 3 intermediate process slag for one-time CaO addition; 3', 4' intermediate slags during MgO addition; 4 intermediate process slag for continuous CaO addition; 5 final slag after CaO addition (green arrow denotes continuous addition, blue-dotted arrow denotes a one-time CaO addition); 6 final slag composition after HPSR process with MgO addition

The final slag composition depends, as mentioned before, on the addition of additives (continuous or one-time addition of CaO or modification with MgO) illustrated with differently colored arrows in **Figure 6** and is currently under investigation.

3.4.1 Production of pilot scale samples

A HPSR pilot plant with ~100 kg will be used (see **Figure 5**, right-hand-side) to create samples.

Within InSGeP, HPSR slag will be produced and evaluated in terms of potential application fields as secondary resource. One focus will be on the use of HPSR slag as cement additive by evaluating the latent hydraulic properties via cement prism tests.

3.5 Cooling and granulation

The slag samples obtained or produced during the InSGeP project will further be treated to ensure proper chemical and physical properties of the slag depending on environmental and market requirements, national and European. The slag treatment will include different cooling methods as well as dry and wet slag granulation (with and without modifications) to improve the slag quality. The slag samples will be analyzed for chemical, mineral composition as well as leaching behavior.

The slag properties depend also on the phase composition and structure. Air cooled slags contain crystalline phases like those observed in mineral formed for geological processes and unusual amorphous mass, like volcanic glasses. The higher the basicity and the slower slag cools down; the more crystalline phases dominate. An amorphous material is less soluble than a crystalline material, but to produce a glassy electric arc furnace (EAF) slag with normal basicity is a challenge. The effect of different cooling conditions on the properties of glassy slags with respect to their leaching and volume stability was investigated by Tossavainen et al (2007) [9] and in the RFCS SLACON project. As the use

[9] M. Tossavainen, F. Engstrom, et. al, “Characteristics of steel slag under different cooling conditions”, Waste Management, Vol. 27, Issue 10, 2007, Pages 1335-1344

of next generation steelmaking processes will alter the chemistry of the resulting slag the possibility to form crystalline material from EAF might be possible.

Cooling and granulation modelling and simulations will be done to help understand the changes these techniques have on the slag that will be tested. An added benefit of granulation of slag is it reduces dust emission and eliminates the need for grinding while producing a product that can directly be used in different applications.

Laboratory cooling tests will be conducted without granulation on slag samples to understand the affect different cooling rates have on slag quality, on mineralogy and therefore for leaching and the environmental compatibility. Tammann and muffle furnace in the laboratory will be used for the tests. The slag will be slow (in furnace), moderately (to air atmosphere), and fast cooled (on a copper plate) without granulation.

A pilot granulation facility will be used to conduct dry slag granulation tests. The pilot facility relates to induction furnace for slag melting. The granulation plant is equipped with an air fan of air flow rate of 750 Nm^3/h, with the ability to adjust it. Slag amount for each test will be 2 – 3 kg. The facility is also equipped with water nozzles (positioned after air injection) which can increase the cooling rate, depending on slag type. A sort of hybrid granulation (air cooling with minimum water utilization) can be carried out. The air nozzles can be purposely modified depending on slag specific composition (see **Figure 7**).

Granulation plant side external view and connection with melting furnace | Internal part | Internal part – detail of water injectors

Figure 7: Granulation plant at RINA-CSM

Wet slag granulation tests will be conducted first in smaller quantities (~ 200 g) to allow investigation of modifications and later in medium and larger scale.

Industrial samples will be remelted with and without any modifications. The liquid slags will be cooled by wet granulation. Model slags will be produced by mixing and melting different oxides. The elaboration of model slags allows to focus on specific elements, properties and the contamination of minor elements can be excluded. After evaluation of the modifications (physical or chemical), the best candidates will be remelted and wet granulated will be performed using wet granulation device for further testing like mortar tests. From these tests two slag samples will be chosen for upscaling tests at to test the material according to concrete requirements.

3.6 Slag applications

The slag will be tested for different utilization routes. With respect to regulations gathered, slag samples will be assessed based on composition and leaching behavior to determine utilization routes. When the basic parameters are met slag samples will be further investigated for physical characteristics.

4 Objectives

The following are technical, economic, environmental, and social objectives which the InSGeP project aims to achieve.

Technical objectives	
To understand how the transition of the steel industry with respect to decarbonization will affect slag valorization which is a major and necessary by-product of the steel industry.	Information will be collected about the slag potentially produced in Europe by next generation steel processes by partners who represent steelworks as well as RTOs and technology suppliers who are major players in Europe. Creating a picture of where the steel industry currently is, which will be the impacts with respect to the transformation and the main barriers in relation to valorization of slag from breakthrough technologies.
To understand how the steel production transformation will affect physical and chemical properties of the slag.	Slag that is currently being produced with next generation steel production in Europe as well as outside of Europe will be thoroughly investigated. In addition, slag samples will be specially produced in the project (in laboratory, pilot, and industrial scale) with the steel partners' needs based on their transformation plan to decarbonize their steel production.
To identify process to modify the produced slag to achieve required properties.	Different slag granulation and cooling methods will be investigated to assess options to achieve desired slag properties. This will include modifications to the slag composition based on the needs.
To understand how the produced slag can fit into current slag utilization pathways.	Slag will be investigated with respect to requirements and regulations based on national and European regulations.
Economic objectives	
To create a product from the slag.	By having a product that can be valorized inside or outside of the steel industry the costs of landfilling can be saved as well as additional income gained from the sale of slag. By maintaining or creating new valorization routes conservation and/or creation of new employment opportunities (e.g., more operators are needed for slag treatment than landfilling). Replace the BF/BOF slag which currently is a product used in different industries (e.g., cement or road construction) to maintain/improve the present industrial symbiosis and circular scenario.
To investigate granulation techniques.	Granulation techniques investigated in the project might not only produce slag with better environmental behavior but also reduce the costs of handling and grinding of the slag. In addition, InSGeP will contribute to development of process and technology for dry slag granulation to obtain a raw material to be directly used which will result in sale of these devices.
Environmental objectives	
To reduce impact of steel production on the environment.	By recycling or utilization of slag enormous quantities of materials are not landfilled. In addition, positive effect can be envisioned in the reduction of CO_2 by using the slag as raw material by other sectors.
To decrease the utilization of natural materials.	Slag when properly treated can substitute natural materials extraction and used in variety of sectors (e.g., cement, road

	constriction, agronomy) decreasing the environmental footprint associated with obtaining the otherwise needed natural materials.
Social objectives	
To build community trust.	When the steel industry understands its products and their environmental affects while taking care to minimize harm, society is more likely to accept industrial material to replace natural material.
To interact with stakeholders.	Through dissemination actions, workshops and social media, information about the project activities will be spread and feedback gathered.

InSGeP

Investigations of Slag from Next Generation Steel Making Processes

START DATE | 01-07-2023
PROJECT DURATION | 48 months
TOPIC | RFCS-02-2022-RPJ
BUDGET | 4.5 M€
COORDINATOR | FEhS
CONTACT | info@insgep.eu