

Newsletter No 2

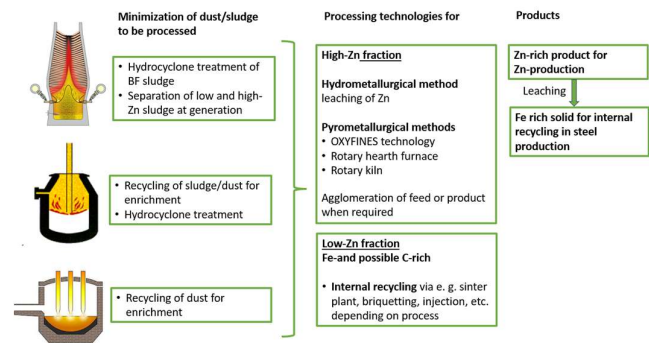
The steel industry contributes to the global economy but also generates significant amounts of emissions and residues. Residues are valorised by internal recycling or external use, but there are still significant carbon and iron units that cannot be recycled because the zinc content in the dust and sludge is too high, but too to be sent to zinc producers. The removal of zinc is important for recycling these residues in steelmaking processes, as zinc creates various problems in steel plants and therefore causes both raw materials losses and additional costs for preparing safe deposits and conducting landfilling. An efficient and economically feasible method for removal of zinc and to generate an iron-rich residue for recycling within the production cycle is not yet available.

The objective of ZincVal (RFCS-02-2022-RPJ, 10111263) is to develop technologies securing high raw material efficiency by extracting more from existing raw material streams through developing technologies enabling the reuse of low-zinc residues produced in the present and future steelmaking routes. At the same time, the costs of landfilling and the use of new land areas can be avoided. The project objectives are relevant to EU circular economy goals and steel industry decarbonization, focusing on multiple technological routes for residue treatment.

The technical routes involve hydrocyclone separation, pyrometallurgical routes (OXYFINES technology, Rotary heart furnace and Rotary kiln), recycling of EAF dust and hydrometallurgical methods as leaching of enriched dust.

Project concept

- ▶ Physical, chemical and mineralogical characterization of residues samples from steel production for selection of treatment method
- ▶ Development of technologies, with relatively low starting TRL, for separation and treatment of low-zinc residues from steel plants
- ▶ Evaluate Zn-rich and Fe-rich fractions for industrial use
- ▶ Design the most sustainable recycling routes for different residues regarding environmental impact, energy consumption and CO₂ emissions, as well as cost-effectiveness.



Consortium

The consortium of seven partners from four EU countries demonstrates strong participation of industrial steel sectors by including three steelmakers: two integrated and one EAF steel plant, three metallurgical research institutes and a technology provider

- ▶ Acciaierie d'Italia, Italy
- ▶ Centre de Recherches Métallurgiques, Belgium
- ▶ Linde, Sweden
- ▶ ORI Martin, Italy
- ▶ RINA Consulting Centro Sviluppo Materiali, Italy
- ▶ Swerim, Sweden
- ▶ Tata Steel Nederland Technology, Netherlands



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Activities

RFCS ZincVal Project Consortium Meeting

A ZincVal consortium meeting was successfully held on 4 November in IJmuiden, hosted by Tata Steel. The meeting took place in a hybrid format, with about half of the partners joining on site and the other half participating online. This setup enabled broad participation to review the latest project progress, exchange technical insights, and plan the next steps of the technical work. The meeting was highly productive, marked by lively discussions and strengthened cooperation among the partners. The consortium encourages even more collaboration as the project moves into its next phase, ensuring alignment and maximized impact across all work packages.

A highlight of the day was a guided tour of the HIsarna pilot plant, where participants had the opportunity to explore the innovative smelting technology on IJmuiden site and gain first-hand insight into its potential for future industrial and environmental advancements.



Round Robin analysis

Material characterization activities of ZincVal are now almost finalized. The consortium has successfully launched and completed the Round Robin analyses of BF, BOF, and EAF dust samples provided by three participating steel companies (Tata Steel IJmuiden, ADI and ORI MARTIN). Partner laboratories (Tata Steel, ADI, and RINA CSM) carried out self-standardized chemical and mineralogical characterizations. The results have been compared and jointly evaluated. The analytical protocols will now be further assessed to support methodology assessments, and to strengthen the technical foundation for the project's upcoming activities.

Preparation for trials with different process technologies

Further activities for experimentally evaluating valorisation of dust and sludge with different process technologies are ongoing such as following.

CRM & Tata Steel Together Advance Dual Kiln Technology for Metal Recovery

Tata Steel Netherlands has developed an innovative Dual Kiln Technology aimed at removing harmful elements from metallurgical residues while enabling the recovery of high-grade zinc. The process operates in a 2-stage kiln process under reducing conditions, allowing effective separation of lead and cadmium from zinc and producing ferrous residues with high metallization levels. These (partially) metallized residues can be directly

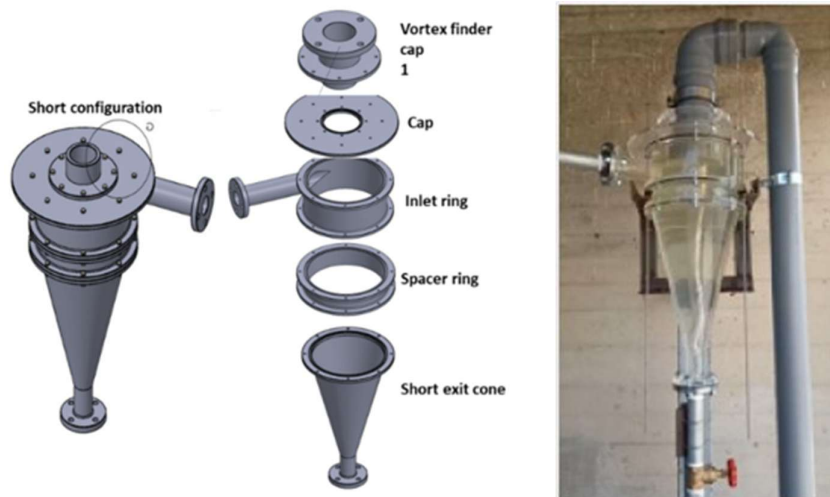
charged into a blast furnace (BF) or a smelter, supporting improved resource efficiency and circularity in steelmaking operations.

As part of the technology's validation, critical parameters including lead and zinc separation efficiency and iron metallization will be systematically evaluated at CRM. The testing program will progress from laboratory-scale trials to pilot-scale kiln demonstrations, providing key data on process performance and scalability. The initiative underscores Tata Steel and CRM's commitment to sustainable metallurgy through enhanced recovery of valuable metals and reduced environmental impact. A revamping of the CRM Group's rotary kiln, including partial electrification of the kiln and better dust capture, is currently underway to enable future testing.



Hydrocyclone

Hydrocyclone units are used to separate particles dispersed in a fluid through physical phenomena, and their efficiency depends on the configuration and operating conditions. Efficiency is defined as “the separation of a fraction of particles of a given size due to the force generated by the rotating flow inside the cyclone.” Within the ZincVal project, RINA CSM is responsible for designing a hydrocyclone model using CFD. Experimental data available in the literature, useful for validating a reliable CFD model, and the characterization obtained from the first phase of material analysis are the inputs for the design. RINA CSM has built a modular physical model based on indications from the initial CFD design phase to experimentally study how the swirling flow induced in the cyclone unit affects material separation. Thanks to its modularity, the effect of vessel geometry on particle separation and all related geometric parameters is investigated, along with flow rates and the outflow exit angle. The physical model was built in Perspex to identify the most effective configuration and operating conditions. The experimental campaign in progress, defined together with ADI, aims to test between 30 and 50 kg of sludge and analyze the different fractions obtained in terms of grain size distribution, chemical composition (including Zn content by XRF), and phases present by XRD.



OXYFINES Technology

OXYFINES Technology, developed by Linde Gas, is suitable for recovery and refining of zinc (Zn) containing dust and sludge generating usable products. Zn separation rate of up to 97% was achieved during successful pilot scale trials with blast furnace sludge (BFS) which were carried out at Swerim in a previous project. The OXYFINES burner is fed with BFS, and additional heat is supplied via an oxygen burner. The Zn oxides in BFS are reduced by carbon contained in the feed, evaporated, and collected in the off-gas dust. If the dust reaches a zinc content of >30% it can be a desired material for use as direct feed to in zinc production. Iron remains in the melted residue collected at the bottom of the furnace and can be re-used as feed at steel plants.

The OXYFINES campaign will take place at Swerim in February 2026 with a focus on Zn removal from the product and Zn enrichment in the dust. OXYFINES Technology could also be applicable using dry dust and will be tested during the campaign.

Positioning and retrofitting of the reactor and enhancement have been made as rebuilding of the off-gas elbow and draft. Investigation of the material as well as design of experiments is ongoing in cooperation with Linde Gas. Samples will be shared with Tata steel for investigation in leaching experiments for upgrading the products.

Look out for the first results from the trials in the next newsletter!



Agglomeration of EAF dust and biochar

Rina CSM and Ori Martin have started designing recipes and methods to produce agglomerates of EAF dust to be recycled back into the electric arc furnace, with the aim of achieving zinc contents above the threshold set by zinc refining plants. Normally, electric arc furnace dust (EAF dust) is stored and then sold to an industrial partner for metal extraction. The minimum zinc value generally accepted is around 20%. The research idea is to reintroduce a portion of this dust into the electric arc furnace after proper management, to enrich the amount of Zn present through briquetting, by mixing EAF dust with a carbon-containing reducing agent to compensate for the presence of iron oxides. To minimize CO₂ emissions, a renewable reducing agent such as biochar will be used in the agglomerates. Mechanical tests on the briquettes using the drop test will be carried out to evaluate the best recipe. As for melting yield, pilot plant tests will be performed, including tests with a metallic bath. Initial tests conducted on a laboratory scale have provided encouraging results and important indications.



Events

Steel-master 25 workshop RINA

May 19, 2025, in Dalmine, Italy **Damiano Capobianco**, RINA CSM, presented “Treatment for valorization of Zn containing residues in dust and sludge: Hydrocyclone treatment” at the workshop: The role of slags and other by-products within circular economy in the steel industry.

Link to www.zincval.eu/news ▶



Recycling and Resource Day

The online webinar Recycling and Resource Day 2025 were hosted by Swerim and Jernkontoret (Swedish iron and steel producers' association) on September 26. **Alessandro Vecchio** from Acciaierie d'Italia held a presentation about the project called “Selection, through complete characterisation, of steelmaking residues for different zinc removal processes and their best recycling”.

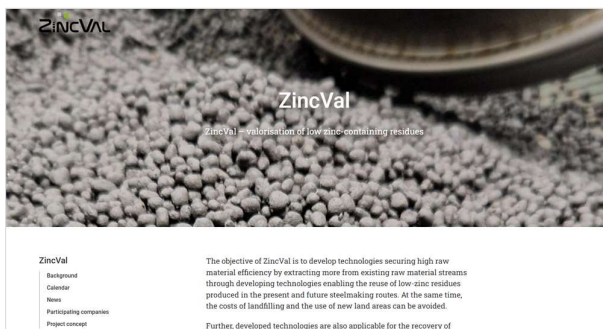
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Upcoming events

You will find upcoming events, where you will have the opportunity to meet team members of the ZincVal project, on our web page.

[Calendar](#) ▶



Check in the ZincVal project website!

For further information, visit our project website, www.zincval.eu, where information and news will be published continuously.