PREMA

Energy efficient, primary production of manganese ferroalloys through the application of novel energy systems in the drying and preheating of furnace feed materials

PREMA DEMONSTRATIONS

DLR - experimental solar thermal power plant, Jülich, Germany

Demonstration of hot air production at 800°C 24h/day at Jülich experimental solar tower with thermal storage.

MINTEK Randburg, South Africa

Demonstration of Mn ore heating with hot air (800°C) using a solar thermal plant.

Demonstration of the impact of integrated pretreatment technology and furnace operation with Mn ore preheated at 600°C in a rotary kiln on the electrical energy consumption and CO_2 emissions in a submerged arc furnace.

ERAMET Ideas France

Pilot tests to determine the effect of the use of industrial CO-rich off-gases and their variations on the pretreatment of Mn ore in a custom built continuous shaft furnace placed in the tapping hall and connected to the gas distribution system.

Metso:Outotec Finland & Germany

For the selection of the right pretreating technology (fluidized bed, shaft furnace or rotary kiln), the Mn ore reduction behavior will be analyzed and the optimum operation windows will be determined. The conceptual study will result in first cost estimates.

SINTEF Trondheim, Norway

Pilot tests to demonstrate the effect of pretreated raw materials on energy consumption and CO_2 emission from furnaces for Mn-alloy production.

Effect of untreated and pretreated ore of the same type will be compared by production of Mn alloys in an existing pilot submerged arc furnace. 10 pilot experiments each using around 1 ton of industrial raw materials will be run. Different ores and materials pretreated with different technologies will be investigated.

PREMA AIMS TO ACHIEVE

20% less fossil carbon consumption

PREMA Mn ores pretreatment technologies will provide a higher flexibility in the use of energy sources and allow substitution of coal and electricity with solar energy, bio-carbon and energy containing waste gas streams.

10% less electrical energy used

Pretreatment of Mn ores in a separate unit will allow flexibility in using different energy sources including renewable energy sources.

25% less primary energy used and 15% less CO_2 emissions

Dividing the current operations of Mn alloy production in SAF into two separate units will make the process more energy efficient and thus reduce the overall energy consumption by up to 25% resulting in a 15% reduction of the CO_2 emissions.

30% more potential for reducing energy and carbon consumption utilized

Industrial experience shows that only around 50% of the potential for reduced energy and carbon consumption from reactions during pretreatment are utilized in the furnace in today's operation. The use of waste byproducts such as CO rich off-gas for pretreatment may increase this potential to 80%.

10% lower global Mn ores processing operating costs

Implementation of a flexible scheme in raw materials, including secondary raw materials, process and product quality specifications will ensure competitive production of Mn alloys in Western Europe and South Africa by reducing the operating cost and mitigating the effects of high energy prices.

Project facts

Project acronym:	PreMa
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www.prema-project.eu

@PremaProject PREMA Project

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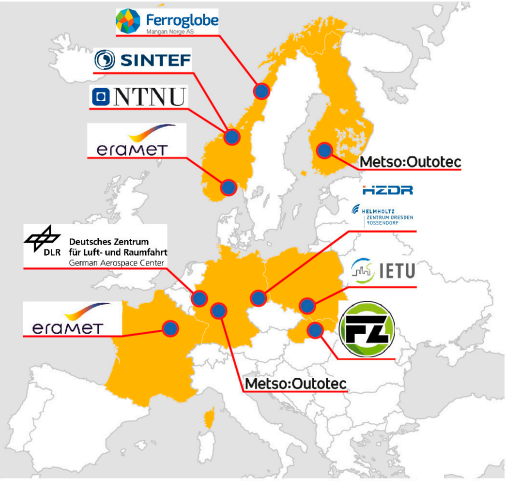

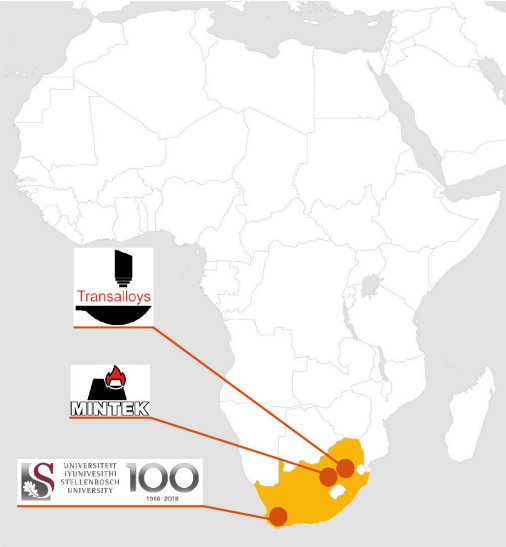

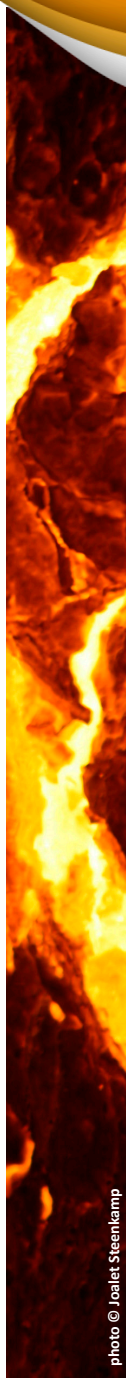

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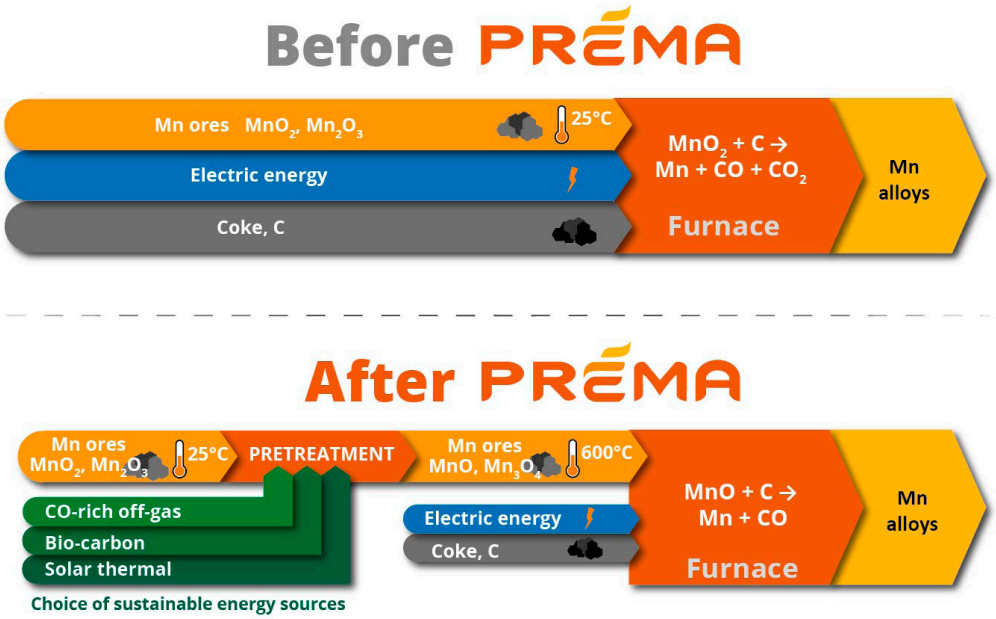
WHAT IS PREMA?

PREMA is a H2020 project aimed at demonstrating an innovative suite of technologies involving utilization of industrial off-gases and solar thermal energy to reduce energy consumption and CO_2 emissions from manganese production as a mean to obtain sustainable production of Mn alloys and steel.

The main concept of PREMA is to increase energy flexibility and the use of sustainable energy sources to reduce the overall energy consumption and CO_2 emissions in Mn alloy production. This will be achieved by dividing the Mn alloy production - today carried out in submerged furnaces (SAF) - into two separate units as illustrated below. A pretreatment unit will be added before the existing furnace. Within the project various pretreatment technologies using different energy sources like: CO-rich industrial off-gas, bio-carbon and solar thermal energy will be developed and demonstrated.



Integration of the novel PREMA pretreatment technologies with the process currently used by smelters will lead to a better flexibility in terms of raw materials leading to a 20% reduction in the consumption of fossil carbon, more energy efficient production processes giving a potential for a 20% reduction in overall energy consumption and a global reduction of operating costs by at least 10%. The ultimate ambition of PREMA is to scale the technology up to use in industrial manganese alloy production both in Europe and South Africa.

PREMA'S ACTION LINES

Action line 1

Pilot testing and engineering of Mn ores pretreatment technology

A screening process of the different available technologies was carried out at laboratory scale by Outotec to identify the most promising ones regarding the Mn-ores used, and the associated CO_2 emission reduction potential, as well as the energy flexibility. After having selected the rotary kiln and the shaft furnace, first pilot tests of pre-heating and pre-reduction were carried out in a rotary kiln at Eramet

Action line 2

Development of a solar thermal technology

Assessment of the critical parameters determining the industrial implementation of Mn ores pretreatment with solar thermal energy. A dust management protocol for ferromanganese smelters utilising mirrored solar collectors have been developed and an economic assessment on the advantages of a re-deployable solar field was completed.

Preliminary testing on the preheating of manganese ores using hot air has shown promising results. The construction of two pilot facilities is currently underway: a solar thermal plant with thermal storage for continuous production of hot air at 800°C in Germany and a solar thermal plant to demonstrate the continuous preheating of manganese ores using hot air at 800°C, in South Africa.

Action line 3

Characteristics of raw materials

Characteristics of Mn-ores have been thoroughly investigated, including mineralogy, chemical composition and size distribution. Series of small-scale experiments have been performed to determine the behaviour of the ores during pretreatment of various conditions, including temperature and gas atmospheres. This data is used as input to selection and design of pretreatment technology

Action line 4

Demonstration of the effect on furnace energy efficiency and CO_2 emissions

The planned demonstration work in PreMa is well on its way. 7 out of the 10 planned pilot trials at SINTEF have now been conducted, which will demonstrate the effect of pretreatment on energy consumption and CO_2-emissions by comparing large-scale experiments with untreated and pretreated Mn-ores.

Integration of pretreatment and furnace operation will be demonstrated at MINTEK. Preparations are now being made, and the trials are planned to be conducted in October 2021.

The use of industrial CO-rich gases in Mn-ore pretreatment will be demonstrated by Eramet Ideas. Design and engineering work required to conduct the trials are in progress.

Action line 5

System integration, environmental impact and business models

A rigorous and detailed simulation model has been successfully developed, and it has been used to simulate varying pretreatment conditions to find optimal operating parameters. LCA-analyses have been performed to evaluate environmental footprints of PreMa process and technology. Both will be continuously updated as more results are generated in the other action lines throughout the project.

Ongoing work for exploitation strategies for the implementation of pretreatment technology at the facilities of the industrial project partners