**Manganese Life Cycle Assessment**

This fact sheet summarises a project to undertake a Life Cycle Assessment (LCA) aimed at measuring the overall environmental performance of the global manganese alloy industry. LCA is a comprehensive and internationally recognised tool that is used to quantify the environmental impacts associated with a product or process by modelling the complete production chain.

1. **Introduction**

IMnI has launched a Manganese Sustainability Programme which is designed to achieve a shared understanding of sustainability in the industry, improve sustainability of the manganese industry through IMnI activities, and to ensure that the industry follows responsible business practices. The manganese Life Cycle Assessment (LCA) project is an important step towards achieving these objectives.

It is intended that the manganese LCA will both promote external industry communication and improve internal environmental and cost performance. This will be achieved by:

- Generating comprehensive, accurate and globally representative process and environmental data,
- Providing a scientific basis for communicating the impacts of the manganese industry to external stakeholders,
- Sharing of best practices on environmental management within the industry,
- Providing a global industry benchmark with which to compare and identify areas of environmental risk, and
- Highlighting cost saving opportunities within the manganese value chain.

2. **Background**

Life Cycle Assessment (LCA) is a technique for modelling the interactions between a product and the environment from "cradle to grave" or "cradle to gate" (partial life cycle). It assesses the impacts associated with all stages of a production process from raw materials extraction through processing, manufacture, distribution, use, repair and ultimately disposal (including recycling). The LCA methodology (standardised under ISO 14040) follows five key stages:

1. Planning – statement of objectives, product definition (including alternatives), selection of system boundaries, environmental parameters, evaluation methods and strategy for data collection.
2. Screening – preliminary execution of the LCA and adjustment of plan.
3. Data Collection and Treatment – undertaking measurements and calculations, compilation of the "inventory table".
4. Evaluation – classification of the inventory table into impact categories, impact assessments, normalization and weighting.
5. Interpretation – sensitivity, uncertainty and feasibility analysis.

3. **The Manganese LCA Project**

The manganese LCA Project is a ‘cradle-to-gate’ study of manganese alloy production including mining of manganese ore, sintering and smelting of the ore and associated off-site upstream/ downstream processes such as consumables production, transportation and power production. The production of high carbon ferro-manganese (HC FeMn), refined low-medium carbon ferro-manganese (Ref. FeMn) and silicon-manganese (SiMn) are analyzed independently. The study quantifies environmental impacts using a comprehensive set of pre-defined LCA impact categories and material/energy flows including:

- Energy Consumption and Global Warming Potential (Carbon Footprint)
- Acidification (Acids deposited to soil and water)
- Photochemical Ozone Creation Potential (Smog)
- Water Use
- Slag and Dust Production (Waste)
The project utilises data from 7 mines and 10 smelters globally. The set of sites participating in the project is intended to be the most representative of the global industry.

Comprehensive and globally representative results on production inputs and environmental data have been compiled, including:

- Air emissions
- Water demand
- Hazardous and non-hazardous waste, and
- Energy demand

The key deliverables of the project will eventually be a global LCA report, which will include globally averaged data (representative of the industry as a whole) and provide a comprehensive model of a ‘typical’ manganese supply chain by process stage, and site LCA benchmark reports, which will allow comparisons with the global data, identify hotspots of impact, and highlight cost and impact reduction opportunities.

The final data and results of the project will be used to:

1. Improve the environmental performance of the industry and individual sites through company-industry benchmarking, identification of environmental hotspots and determination of best practices.
2. Generate a database of accurate environmental data for the industry to respond to issues and inquiries in a factual, accurate and timely manner.
3. Provide a connection to steel and stainless steel LCA data to improve the understanding and completeness of the environmental impacts of the steel supply chain.
4. Communicate the environmental aspects of manganese production to downstream steel producers, governments, key stakeholders and potentially to the general public.

4. Summary

The manganese LCA Project is an unprecedented demonstration of the industry’s commitment towards producing manganese alloy in a sustainable manner. The project will provide a comprehensive and quantitative benchmark of environmental performance, highlight the significance of environmental issues within the industry, and identify process areas to target for continuous industry improvement. Combined, the manganese LCA Project will provide the basis for significant environmental improvement in the manganese industry for years to come.

Further information:
There are more fact sheets in this series: Fact Sheet 1. The derivation of limit values for manganese and its compounds in freshwaters: data availability. Fact Sheet 2. Construction of the biotic ligand models for manganese, Fact Sheet 3. Accounting for bioavailability in assessing potential risks of manganese in freshwaters, and Fact Sheet 4. Assessing the potential terrestrial risks from manganese, and can be found at: http://www.manganese.org.

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