

Swedish steel industry's effort towards a Closed Steel Eco-Cycle

The Swedish steel industry has developed high quality steel products and energy efficient production processes with low impact on the environment. Until quite recently, the main environmental work has been aimed to resolve specific problems in connection with emissions to air, ground and water. The demands for a sustainable development - from customers, the authorities and public- are in the future leading to a complete assessment, simultaneously focusing on saving of natural resources and energy and at the same time producing products designed for recycling. For manufactures and users of steel, this implies that the producing processes must be changed so that the metals integrated in the raw material can be better utilized than today and the future products can be used in recyclable constructions.

A research program has been completed with the vision – a closed loop manufacture and use of steel in the society.

The focus of the program is

- to increase the iron efficiency by the recycling of scrap metal and to increase the efficiency of the alloys in a steel eco-cycle perspective.
- to effectively economize the use of steel in applications and products

The research program is illustrated in Figure 1. Steel is recirculated and has several lives; the first unit is processed from ore, mainly through the BF-BOF route and then after use in products recirculated and remelted in several new lives. The R&D effort is to minimize the environmental impact of the steel and steel production during this total cycle of subsequent lives. This is a complicated process involving several areas of knowledge.

To cope with this, the planning started with a request to the Swedish universities and institutes, asking them to suggest R&D activities in the area. 15 institutes answered giving a total of 50 suggested projects and a cost of around MSEK 200 (MUSD 29). Then, industrial people made an evaluation. 50 people on a high managerial level and/or expert level in 15 industrial companies evaluated the following parameters on a scale of 1 to 5: new knowledge, environmental value and industrial value. After that, 6 main projects remained. A synthesis resulted in a final R&D program in the magnitude of MSEK 74 (MUSD 11). The program has been financed for the period 2004 – 2008 by MISTRA (The Foundation for Strategic Environmental Research, www.mistra.org) and the Swedish steel industry. A board and a program director have been appointed and research groups are established.

The program is a technology development program with a scientific approach. The scientific efforts required to achieve the goals are substantial and will involve a considerable degree of cooperation between traditionally separate fields of academic research. To deliver a successful outcome, the program involves several Swedish universities and research institutes and networks of international cooperation. It is organized to promote cross-research and cross-learning effects.

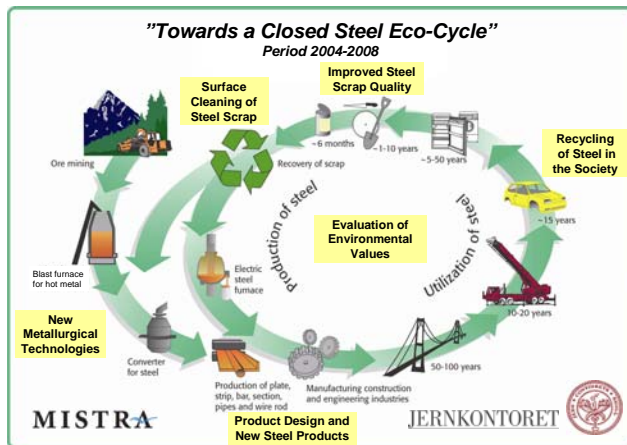


Figure 1 Closed Steel Eco-Cycle (source Jernkontoret)

The program consists of the following projects:

Improved steel scrap quality. New sorting methods are developed, as well as analysis and preparing of scrap in order to increase the yield of the iron and alloys at the re-melting to new steel. Electronic sorting using laser technique for instant sample preparation and analysis of alloys and surface contaminants will be developed. Mapping and development of product streams going through scrap shredders increase the value for melting and gives the basis for a more efficient collection of scrap.

Surface cleaning of steel scrap by pre-heating the scrap to high temperature and in the same process clean the scrap from surface contaminants and metals such as zinc will reduce the energy consumption and the environmental impact. Then the scrap is melted in the metallurgical shop. The outcome of the project is a new technique for combined scrap preheating and surface cleaning of scrap with much less waste gases to clean from undesirable contaminants. Effluents can be removed in a more effective and economic way than by emission from today's steel melting processes.

New Metallurgical technologies will increase the possibilities to maintain the alloying metals in the steel melting and avoid loss of metals to the slag. Retention, recovery and recycling of valuable metals and new slag systems for minimized use of energy, raw materials and environmental impact are parts of the research. Development of a new method to take advantage of the content of vanadium in the iron ore is included in the program. The process can also create a residual slag that is free from accumulating elements and thus can be recirculated into the process.

Product design and new steel products are an important aspect in the steel eco-cycle. The project consists of three parts: optimize the re-use of trace elements as alloy elements in new steel products; improve the production of high-strength steels with energy efficient process routes; improve the technique for weight optimization using high-strength steels in the final product with a resource-economizing use and recycling. The development of steel grades goes very fast and with new methods of construction dematerialization and recycling with high quality can be assured.

Recycling of steel in the society. Presently, the knowledge of the degree of recirculation and the mechanisms are meager. The project aims to increase that knowledge.

Evaluation of environmental values is a main point in the research program. This will be made by evaluation of some of the projects in the program to create environmental evaluation instruments for processes and product development and to give the possibility to describe the environmental assessment in a broad society perspective. Integrated models for decision-making, taking into account both economy and environmental impacts are important parts of the project.