1. What Is Steel

There have been various definitions as to what steel is, but it can be generally defined as a material that consists mainly of iron, with a carbon content of less than 2%. Other elements may also be present, but of all the alloy elements, carbon has the most distinct effect on the steel properties.

1.1. Carbon

Pure iron has neither the strength, nor the hardness required for most applications, but when combined with small amounts of carbon, it becomes steel. Changing the carbon content and adding other elements affects the steel properties. If the amount of added alloy elements exceeds 0.5%, the material is called alloy steel. With the present alloy elements below 0.5%, the material is called non-alloy steel.

Carbon also plays an important role during steel making. Its content depends on the production process, but usually excess carbon has to be removed during the liquid phase.

1.2. Diverse Product

Steel is thus a collective noun for a product that varies according to methods of production, shape, dimensions, chemical composition, properties and applications. The chemical properties and the mechanical properties are specified in standards and various steel grades are produced via different production processes. The broad range of properties that can be implemented, the many forms, in which steel is supplied, together with its ability to be easily recycled, make this product suitable for the most diverse fields of application.

Besides the quality of the final product, other aspects such as cost price, energy saving and a low environmental aspect are equally important.

1.3. Stages of Steel Production

Steel is produced in integrated steel works which comprise all production units needed to convert the raw materials into the final product. Steel works are divided into “hot” sections and “cold” sections.

The following two subchapters include many – as yet - unfamiliar words which will be dealt with in a greater detail in the follow up chapters.

1.3.1. Hot Section

Hot sections that start with raw materials and produce hot rolled coils include the following stages:

- Preparation of the raw materials – iron ore and coal
- Production of pig iron in the blast furnace
- Desulphurization of the pig iron and transport to the steel plant
- Converting the pig iron into steel in the converter
- Ladle metallurgy: degassing for certain steel grades, alloying and temperature adjustment
- Continuous slab casting
- Slab inspection and slab scarfing where necessary
- Reheating of the slabs and subsequent hot rolling

A hot rolled coil can be used either as a semi-finished product or as a final product. Hot rolled material is used as such for construction, making pipes, etc. but it can also be undergo further processing in the cold rolling section or a coating line. Hot rolled coated products are used mainly for applications in the building industry. Cold rolled final products are used in car bodies, domestic appliances, packaging, etc.

1.3.2. Cold Section

Cold section of integrated steel works generally consists of the following stages:

- Pickling and cold rolling
- Continuous or batch annealing to attain the required mechanical properties
- Skin pass milling to generate roughness, improve flatness and optimize the mechanical properties
- Metallic and / or organic coating if required
- Inspection and packaging

In the case of thermal or hot dip galvanizing, the last four stages are combined in the coating line.

As a result of economic and ecological developments, more stringent criteria regarding thickness and flatness tolerance as well as surface quality demand new technology with highly automated equipment and built-in control systems.

1.4. Primary and Secondary Steel Making

Integrated steel works include a blast furnace and a converter to produce liquid steel. This is also called blast furnace steel making or primary steel making. In addition to iron ore, about 20% scrap iron is also used in this process. The energy required to melt this iron is provided by fossil fuels. Before the raw materials (iron ore and coal) are suitable for use in the blast furnace, they have to undergo intensive preparation.

Electric furnaces on the other hand are charged with 100% scrap iron or with iron ore or direct reduced iron (DRI). These materials melt by putting in large amounts of electrical energy by means of an electric arc. Hence their name: Electric Arc Furnace (EAF) also called secondary steel making. Steel production in electric furnaces no longer requires intensive preparation of raw material. Because the charges of an electric furnace are smaller, they can meet the demand more flexibly. But the process also has its limitations: quality and price of scrap metal are of overriding importance. Besides, some elements present in the scrap metal are retained in the liquid steel.

1.5. Mini Mill

Because of the huge investment entailed in building a new steel works, new technologies that require less capital have been developed. The mini mill is one of these. These are compact steel works using electric furnaces and thin slab casters. This greatly simplifies downstream processing in that a simple hot rolling treatment usually suffices to produce the final product.

A further simplification of this process could be achieved by casting the slabs directly in the thickness required for the final product, bypassing thus the rolling stage completely. This process is called strip casting.

Mini mill applications tend to be used for production of rather simpler grades due to possible quality problems such as surface defects.

Points to remember:

- Steel is an alloy that consists mostly of iron and has a carbon content of fewer than 2 % by weight, depending on the grade.

- Carbon plays a very important role during steel making. It is the most common alloying material for iron, but various other alloying elements are also used.

- Integrated steel works are divided into a “hot” section and a “cold” section.

- Primary steel making uses blast furnace and converter.

- Secondary steel making uses electric furnace.

- Mini mill requires less capital, but is mostly used for simpler steel grades

Glossary:

English	Czech
Alloy	Slitina
Alloy elements	Legující prvky
Alloy steel	Legovaná ocel
Annealing	Žíhání
Blast furnace	Vysoká pec
Carbon	Uhlík
Casting	Odlévání
Coil	Svitek
Cold rolled	Válcováno za studena
Continuous casting	Kontilití
Degassing	Odplynování
Hot dip galvanizing	Žárové zinkování
Hot rolled	Válcováno za tepla
Charge	Vsázka
Ladle	Pánev
Mini mill	Mini huť
Pickling	Moření
Pig Iron	Surové železo
Scarfing	Čištění plamenem
Scrap metal	Kovový šrot
Skin pass	Válcovat povrchově za studena
Slab	Brama
Slag	Struska
Steel grade	Jakost oceli