Structure and Properties of Materials - MSE230

Project D1

Title: Steel

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Abstract

The manufacture of reliable products is tied to material selection. The examination of the chemical components, electrical and electronic devices and structural components is any material used in manufacture of products whether automotive, home appliances or manufacturing machines is pivotal. This project aims to analyse steel as one on the widely used material in engineering by discussing its chemical composition, chemical structure and related features and steel related standards such as the ASTM.

Introduction

The Steel considered as most important engineering and construction material. It can be recycling many times without losing any of its properties. It has a large strength; it comparatively needs small amount energy to be produced. decades ago, the steel industry had huge efforts to reduce environmental pollution. Nowadays, one tonne of steel is produced just 40% of the energy that been in the sixties. Also, the dust emissions have been changed to smaller amount.

Figure 1 steel

Chemical Compositions, structure and related properties of Steel

Steel is an alloy of iron and a number of elements that include carbon. The elements that make up steel can be added intentionally to make steel have certain features and properties while others are accidentally present as impurities during its extraction [2, 3]. There are numerous steel alloys making their categorization very complex. Varies governing bodies however present different directions of categorization of steel alloys. Steel alloys are however generally classifying as Electrical Steel, Plain Carbon Steel, High Alloy Steel

(Stainless Steel and Tool Steel), Ultra Low Carbon (ULC) Steel, Alloy Steel, and High Strength Low Alloy (HSLA) Steel.

Common element that are used for alloying in steel include; Carbon, Manganese, Phosphorous, Sulphur, Silicon, Copper, Nickel, Chromium, Molybdenum, Vanadium, Columbium (Niobium), Titanium, Aluminium, Nitrogen, Boron, Tin, Calcium. These alloying elements serve different but specific purposes in steel. Carbon is the core alloy in steel and its major hardening steel (3). The strength and hardness of Steel increases with increase in the amount of Carbon. Ductility, toughness and weldability on the other hand decrease with increase in carbon content in steel. Plain carbon steel grade has up to 0.95 percent Carbon, HSLA has 0.002 percent, ULC Steel has Carbon between 0.002-0.007 percent and HSLA Steel has up to 0.13 percent. Manganese is an element that is in all commercial Steel and serves the same purpose as Carbon (to increase hardness and strength) but in a lesser degree. Basically, added elements affect Steel strength, hardness, toughness, weldability, ductility and tensile strength. While most of these elements are added to Steel some exist as residuals in Steel and they include Copper, Nickel, Chromium, Molybdenum and Tin. A very important alloying element is Aluminium which is used as primary deoxidising agent in the making of steel. This is means that Aluminium reacts with oxygen in steel to form aluminium oxides that can easily float on slag. Additionally, it acts as a grain refiner when it combines with Nitrogen during hot rolling to form aluminium-nitride precipitate (2).

Extraction of steel

Steel is made from majorly Iron and its extraction involves extraction of Iron. The Iron is then heated and melted in either a blast furnace or an arc electric arc furnace to

remove residual elements and impurities and add carbon and other alloying elements. The electric arc furnace is used to produce good quality steel that is alloyed with the alloying elements discussed above. The blast furnace produces steel by blowing air through Iron that is melted to oxidize it and remove impurities. In the initial stage, Iron ore, limestone and coke are fed into the furnace from the top and continually descents as the furnace becomes hotter and hotter. In the upper part of the furnace, burning coke produces oxygen while at the bottom part of the furnace limestone is products and it reacts with ore impurities and coke to form slag. As temperatures rise to 3000F the slag floats allowing for its removal via a slag notch. The molten steel that is free of impurities is removed from the bottom of the furnace via a tap hole.

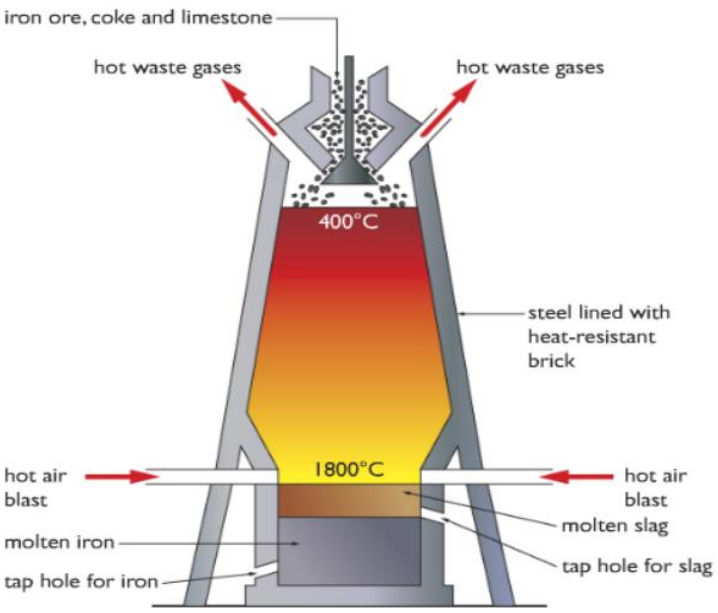

Figure 2 extractions of steel

Standards for steel

The American Society for Testing and Materials (ASTM) has laid down steel standards to evaluate, classify, specify, chemical, metallurgical and mechanical elements of

steel (ASTM Handbook, 2002). These standards are used production of industrial parts, mechanical components, and construction elements, as well as all their related accessories. To mention a few the ASTM has developed standards on architectural metal fence systems, steel bars, Chain link fence and wire accessories, machinery and piping systems, steel sheet specifications, stainless and alloy steel tubular products, steel plates for pressure vessels and boilers among others (ASTM Handbook, 2002).

Steel is widely used material in the making of satellite systems, commercial transport aircraft, military aircrafts, building and construction (sheets, poles, roofing, fences), making of home appliances such refrigerators, sinks, ovens, and televisions. Its strength, weldability and recyclability make it a desirable commercial material.

#	STANDARD	STANDARD NUMBER	LAST VERSION	DESCRIPTION	ICS NUMBER	STATUS / REPLACED BY	MATERIALS
1	**EN**	**EN 10025**	**1993**	Hot rolled products of non-alloy structural steels; technical delivery conditions	77.140.10	Replaced by EN 10025-1:2004; EN 10025-2:2004	60
2	EN	EN 10025-1	2004	Hot rolled products of structural steels - Part 1: General technical delivery conditions	77.140.10; 77.140.50		0
3	**EN**	**EN 10025-2**	**2004**	Hot rolled products of structural steels - Part 2: Technical delivery conditions for non-alloy structural steels	77.140.10; 77.140.45; 77.140.50		30
4	**EN**	**EN 10025-3**	**2004**	Hot rolled products of structural steels - Part 3: Technical delivery conditions for normalized/normalized rolled weldable fine grain structural steels	77.140.10; 77.140.50		16
5	**EN**	**EN 10025-4**	**2004**	Hot rolled products of structural steels - Part 4: Technical delivery conditions for thermomechanical rolled weldable fine grain structural steels	77.140.50; 77.140.10		16
6	**EN**	**EN 10025-5**	**2004**	Hot rolled products of structural steels - Part 5: Technical delivery conditions for structural steels with improved atmospheric corrosion resistance	77.140.10; 77.140.50		14
7	**EN**	**EN 10025-6**	**2004**	Hot rolled products of structural steels - Part 6: Technical delivery conditions for flat products of high yield strength structural steels in the quenched and tempered condition	77.140.50; 77.140.10		40
1							

Figure 3 standards of steel

References

1. Handbook of comparative world steel standards. ASTM. Bringas, J. E. (2002). [Accessed: April 5, 2021]
2. "Difference between low alloy steel & high alloy steel," Amardeep Steel Centre Blog, Dec. 27, 2017. [Online Accessed: April 5, 2021]
3. "The Alloy Steel Manufacturing Process," Sciencing, Apr. 25, 2017. Available: https://sciencing.com/alloy-steel-manufacturing-process-7267414.html. [Online Accessed: April 5, 2021]
4. Worldsteel. (n.d.). Retrieved April 08, 2021, from https://www.worldsteel.org/about-steel.html