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Modern and New Technologies in Copper Production

Xolov Orif Tolibovich[1], Xamdamova Lola Olimjon kizi[2], Gayratova Gulzoda San'at kizi[3]

[1]Lecturer of the department "TJA and B" (QarMII),
E-mail: orif.xolov71@mail.ru;
[2]1st year student (QarMII
E-mail: lola.xamdamova.97@mail.ru;
[3]Bukhara State University of Philology
And a student of Uzbek language faculty gayratovaguli@gmail.com

Abstract. *Metallurgy is the basic branch of industry in Uzbekistan and other countries. Metallurgy, to some extent, determines the development of the country's economy. Ferrous and non-ferrous metals account for 95% of the volume of construction materials used in industry, and their production consumes about 10-14% of the fuel used in the country, 20-24% of electricity, and 40% of raw materials and mineral resources. Archaeological evidence suggests that the origins of metallurgy date back to antiquity, for example in the southwestern part of Asia Minor, where copper smelting took place between 7,000 and 6,000 BC. About that time, the native metals of mankind: gold, silver, copper, and meteorite iron were known. In later times, as humans learned to mine and process ore, ore processing technologies emerged. Previously, metal products were made by cold processing of metals. Copper and iron are limited in their use because of the difficulty of cold processing. After the invention of the heat treatment of metals, copper products began to spread. The smelting of copper from oxidized ores and the extraction of ingots from it (5 - 4 thousand years BC) led to an increase in copper production.*

Keywords: copper, metallurgy, manufacturing, technology, quality, high results, bronze, ore.

Introduction

The process of processing sulfide copper ores using the methods of primary firing of complex ores and refining of copper dates back to the middle of the 2nd millennium BC (Middle East, Central Europe). Two thousand years ago, bronze (about 90% Cu + 10% Sn) began to be widely used. The prevalence of bronze products is due to the fact that the quality of bronze products (hardness, corrosion resistance, etc.) is higher than that of copper products, as well as the melting temperature of bronze is lower than copper and fills molds better than copper.

The widespread use of bronze marked the beginning of the Bronze Age. Between 3,000 and 2,000 BC, the Caucasus was the major center of copper and bronze. About 2,000 years ago, mankind began to use iron extraction methods. First, iron was used to make iron, and then smelting pots - "Syrodutny Gorn". The stone quarry was loaded with easily recoverable ore and charcoal. The air needed to burn the coal is blown into the furnace from the bottom. During the process, carbon restores iron oxide. The relatively low temperature of the process and the high content of iron slag prevented the carbonization of the metal, resulting in the production of low-carbon iron. The resulting iron accumulates at the bottom of the furnace and is called "kritsa". Once extracted from the furnace, the chrysanthemum was hardened to form a metal, which was used to make articles. The process was less productive, allowing only half of the iron to be extracted from the ore. Iron metallurgy was developing more slowly than copper metallurgy. The main reason for this was the possibility of obtaining copper in molten form at the temperatures reached at that time, and iron in the form of dough-like, low-carbon. Due to the low carbon content, iron was soft and the quality of work tools made of it was lower than that of bronze tools. In order for iron to be widely used, it became necessary to use carbonization and annealing processes, that is, to develop steelmaking processes. As a result of the development of these processes, iron came to the fore among the metals used by mankind 1,000 years ago, and this is the beginning of the Iron Age. At the beginning of our era, iron metallurgy was widespread throughout Europe and Asia.

Main part

For three thousand years, iron metallurgy had not undergone a fundamental change. The process was constantly evolving, and in the middle of the 14th century, small blast furnaces appeared. Over time, the size of blast furnaces, especially the height, increased, and the development of intensive air blowing into the blast furnace resulted in an increase in furnace volume temperature, resulting in accelerated carbonation and recovery of the metal. Instead of cast iron in blast furnaces, it was possible to obtain a high-carbon alloy (cast iron) containing Si and Mn. The reason for the increase in the production of cast iron was the creation in the XIV century of the "crucible" stage, which allowed to convert cast iron into refined iron. In the Krichnyi furnace, pig iron was re-melted, its additives (S, Mn, Si, P) were oxidized with oxygen, and the pig iron was refined. The development of the Krichniy process became the basis for the production of iron in two stages, and now the modern technology of steel production is carried out in two stages.

In addition to iron, in ancient times, Au, Ag, Cu, Sn, Pb, Hg were mined and used. The production of other non-ferrous metals has developed in recent centuries (in some cases in 10 years). Modern metallurgy, as a set of basic technological processes for the production of metals and alloys, includes:

- preparation for ore mining and extraction of metals from it (including enrichment processes);
- Extraction and refining of metals (pyrometallurgical, hydrometallurgical and electrolytic processes);
- production of various products with the help of metal powder;
- sandblasting processes of metals and alloys;
- processes of metal processing under pressure;
- processes of thermal and chemical-thermal treatment of metals, etc.

Other industries are closely related to metallurgy, such as the coke industry, the refractory materials industry, and other industries. Preparation for the extraction of metals from ores begins with the process of crushing, grinding, grinding and sorting. The next processing step is enrichment. The industry uses the widest range of flotation, gravity, magnetic and electrical methods. After enrichment, the products are usually dried or baked. Typically, the final stage of ore preparation involves the averaging of the raw material, mixing of the raw material, as well as agglomeration, briquetting and sanding.

Most properties of metals are characterized by the presence of free electrons in the metal structure. In addition to the neutral atoms, the metal structure contains ionized atoms, which means that they do not have a certain amount of electrons. All metal atoms have the same ionization capacity, and the transfer of electrons from ionized atoms to neutral atoms can take place without energy consumption. As a result, a continuous electron exchange process takes place in the metal grid. At this point, there will be a certain amount of free electrons that do not belong to any of the known atoms at that time. The smaller size of the electrons than the atoms allows them to move freely throughout the metal grid. The presence of free electrons in a metal lattice determines the properties of the metal. Elements that tend to donate electrons are called metals, unlike metalloids that try to attract electrons as a result of a reaction in electrochemistry. As mentioned above, one of the important properties that determine the state of metallicity is their crystalline structure. The strength of a metal bond explains many of the physical and mechanical properties of the metal.

One of the leading branches of non-ferrous metallurgy is the copper industry. Copper production is constantly increasing and at the same time copper production technology is constantly improving. In the future, it is possible to increase the volume of copper production by attracting new types of raw materials for metallurgical processing, increasing the complexity of its use and the widespread use of modern technologies and equipment. Norilsk, Jezkazgan, Balkhash and Almalyk mining and metallurgical plants operate in the CIS on the basis of many large copper ore reserves. Pyro- and hydrometallurgical methods are used to process metallic copper and to process various types of copper-containing raw materials.

85% of the copper produced in the world is obtained by pyrometallurgical methods. Hydrometallurgical methods are mainly used in countries with hot climates, as it is possible to carry out the process on open equipment without building large production facilities there. In the CIS countries, the share of copper produced by hydrometallurgical methods is less than 1%. Pyrometallurgical technology involves the processing of raw materials (ore and concentrate) into crude copper, which is then refined.

An analysis of the composition of copper ore and concentrates processed using pyrometallurgical technologies shows that the raw material consists mainly of copper and iron sulfides and loose ore minerals. It is clear that the ultimate goal of copper pyrometallurgy (production of crude copper) can be achieved by the transfer of iron, sulfur and waste ores to the relevant products of the technology. When using pyrometallurgical processes, it is necessary to take into account the complexity of the processed raw material, because it is necessary to separate as much as possible all the precious elements along with copper. can work.

The most common technologies for obtaining refined copper in recent years include the following binding metallurgical processes: smelting, matte conversion, flame and electrolytic refining. In some cases, the sulfide raw material is burned in the first oxidative firing method before melting into matte.

Steel smelting is the main technological process of processing sulfide copper ore and concentrates.

There are many types of smelting of copper ore and concentrates into matte, which differ from each other in technological properties and equipment.

To date, in the copper industry, the methods of smelting sulfide-containing raw materials up to copper matte, smelting in smelting furnaces, smelting in electric (rudothermal) furnaces are used. Some copper mines also use smelting in tower furnaces, one of the oldest methods of processing copper ore.

Due to the fact that the above-mentioned methods of smelting often do not meet the requirements of modern metallurgical processes, today the development of technologies for processing sulfide copper raw materials is moving towards the use of autogenous processes, which are technologically perfect and economical.

Autogenous processes are based on the use of heat generated by the combustion of sulfide minerals, which is why the use of autogenous processes in copper metallurgy has great economic benefits. In particular, in copper metallurgy, the use of autogenous processes allows to carry out the processes of annealing, smelting and partial conversion in one technological cycle or in one machine. The use of autogenous processes also allows to increase the level of integrated use of recycled raw materials, without the need for additional fuel from the outside.

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