STEEL PRODUCTION AND ITS ROLE IN MECHANICAL ENGINEERING.

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Abstract: Deep cutting is also achieved by expanding the cutting and technological properties of steel through the addition of cobalt (Co), molybdenum (Mo), and increasing the amount of vanadium. Steels P18F2K5 (cobalt-coated), P9K5, P9K10, and P10FK5 are considered highly heat-resistant and are recommended for heat-resistant austenitic steels and hardened steels.

Keywords: Metal, mechanical engineering, steel, casting, tool steel, high-speed steel.

Introduction: To prevent the Republic of Uzbekistan from being included in the list of least developed countries, it is necessary to bring the quality of machine-building products manufactured in our country to world standards. To meet this requirement, it is essential to use modern technological equipment employed in local enterprises. This is because the design of today's machine-building products is becoming increasingly complex, production capacities are changing frequently, and the production time for new products is shortening. Modern mechanical engineering is one of the main consumers of metals in our country. Parts for machines and equipment are produced in the fields of mechanical engineering, shipbuilding, electronics, and radio engineering.

Metal materials are mainly divided into two groups: ferrous metals and non-ferrous metals. Ferrous metals include iron and its compounds (e.g., cast iron, steel, ferroalloys). Steel and its alloys, used as the primary material in mechanical engineering, hold a special place among metals. More than 90% of the world's metal usage consists of iron and its alloys. The reason for this is that ferrous metals possess important physical and mechanical properties, while iron ore is abundant in nature and steel production is inexpensive and straightforward. The use of such materials extends the service life of machine and assembly line parts and components, conserves metals, reduces processing costs, and decreases labor expenses. Rational selection of materials and improvement of technological processes for their processing ensure the reliability of structures, reduce production costs, and increase productivity.

Historical foundations and industrial development: The parts of any machine and mechanism are subjected to various stresses during operation and function in different environments. Therefore, for reliable operation throughout the specified service life, materials with complex properties determined by the component designer must be selected.

According to archaeological data, metal materials - gold, silver, copper, and meteoritic iron - were used by humans approximately six to seven thousand years ago. However, iron obtained from iron ore was discovered accidentally. Later, iron began to be obtained purified from carbonic acid (carbonate iron). Iron was initially smelted in furnaces and was called "krits." Over the centuries, technologies for steel production based on blast furnaces were

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developed. However, due to the structural limitations of blast furnaces, large-scale steel production was restricted.

As a result of long-term scientific research, it became possible to produce steel in blast furnaces. In 1780, the Puddling process was invented, followed by the Bessemer process in 1854, the Thomas process in 1856, and the Martin process in 1864 for steel production. In the second half of the 19th century, along with the increasing demand for metals and their alloys, rapid developments aimed at improving their production properties were carried out.

Tasks within the framework of the Strategy of the Republic of Uzbekistan

The Decree of the President of the Republic of Uzbekistan "On the Strategy for the Further Development of the Republic of Uzbekistan for 2017-2021" defines five priority areas for the country's development, in which accelerating technical progress through the creation of new technologies, advanced technological processes, and materials is identified as a crucial task. In the next 5 years, it is planned to increase the production volume of the machine-building and metalworking industry by 50-55%, and labor productivity by 40-45%.

Within the framework of these goals, it is planned to improve the quality and variety of metal products, produce new building materials, metal powder coatings and products, develop new polymer and composite materials with the necessary properties, introduce low-waste or waste-free technological processes, and apply processing methods that significantly enhance the properties of metals. These measures, in conjunction with other sectors of the national economy, will serve to boost the technical and economic potential of Uzbekistan.

Steel production technology and chemical processes:

According to statistics, in our country, 12-15 million tons of metal are subjected to corrosion and become unusable annually, while 7-8 million tons of metal are lost during mechanical processing. If these resources were used wisely, millions of tons of metal could be saved.

Modern metallurgical complexes consist of large and complex systems, which include ore beneficiation plants, coke production batteries, furnaces with constant air supply, boiler houses, rolling mills, and other equipment.

Steel is the primary construction material: it is thin, malleable, has high shear strength and mobility in liquids. Additionally, steel is easily welded and cut, therefore the demand for it in mechanical engineering is growing. Steel is typically produced in oxygen converters or electric furnaces. With the help of oxygen, foreign matter in the ore is oxidized; however, the presence of excess oxygen in the steel negatively affects its mechanical and technological properties. Therefore, it is crucial to remove iron oxides (FeO) from steel. For this purpose, a certain amount of ferromanganese, ferrosilicon, or aluminum powder is added to the steel bath.

Depending on the degree of iron oxidation, steel is classified into the following types:

- Fully refined steel
- Killed steel
- Semi-killed steel
- To obtain fully refined steel, oxygen is first bound using ferromanganese, then further deep purification is carried out with ferrosilicon and aluminum.

To produce killed steel, it is first treated with ferromanganese in the furnace, then processed with carbon in the mold. The gases released during this process (for example, CO) partially remain in the metal, resulting in lower quality.

Semi-killed steel is obtained by adding some ferromanganese, ferrosilicon, and sometimes aluminum. Such steels are widely used in industry. In general, 55% of the produced steels are fully refined, 40% are killed, and 5% are semi-killed.

Alloys and alloying elements: To obtain high-quality steel, a certain amount of pure metals or ferroalloys (e.g., ferrochrome, ferrotitanium) is added. This enhances the physical and chemical properties of steel. For example, vanadium is a strong carbide-forming element that slows down grain growth in steel at high temperatures, protecting it from overheating. This increases the strength of steel and provides secondary hardness. As the chromium content increases, the amount of residual austenite in steel also increases. Any high-alloy steel consists of martensite, residual austenite, and complex carbides. Such steels require special heat treatment - namely, "tempering." For example, R9 grade steel is tempered 2-3 times at a temperature of 560 °C, while R18 steel is tempered for one hour at a temperature of 580 °C.

Conclusion: In practice, many knives are hardened to martensite structure, which is carried out at a slower rate than carbon steel. High-alloy and high-carbon steels are stronger, but hardening is slower. At As1 temperature, austenite particles play an important role in the transformation into pearlite particles. Alloyed steel is denser and heavier than carbon steel. The higher the degree of alloy, the greater the depth of hardening. High-speed steels are considered one of the most important materials in toolmaking. High-speed steels based on tungsten do not lose their properties even at high temperatures, since tungsten retains the strength of the steel at high temperatures. Vanadium is a strong carbide-forming element that causes the formation of solid carbides. It slows down the growth of particles at high temperatures, which reduces the overheating of steel. Under the influence of heat, the strength of steel increases, and hardness remains even after tempering. When vanadium steels are tempered, the residual austenite in it completely or almost completely transforms into martensite, which slightly increases the hardness of the steel. Carbon is the main element in steel, which provides high hardness. If the chromium content exceeds the norm, the residual austenite content in the steel increases significantly. Any alloy steel contains martensite, residual austenite, and complex carbides. Tools made from such steels require special processing, and R9 steels are tempered 2-3 times at 560°C, while R18 steels are tempered for one hour at 580°C.

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