DEVELOPMENT OF TECHNOLOGY FOR OBTAINING QUALITY CASTINGS FROM STEEL ALLOYS

Saidmakhamadov Nosir[1]	PhD candidate [1,4]Tashkent state technical university, University street
Docent Abdullaev Kamol[2]	, Tashkent, Uzbekistan [2]Namangan engineering – construction institute, Islam Karimov street 12, Namangan, Uzbekistan
Teacher Abdullayev Bahodirjon[3]	[3]Andijan Machine – Building Institute, Bobur Shox Avenue 56, Andizhan, Uzbekistan
Master degree Khasanov Akhrorjon[4]	[1,4]Tashkent state technical university, University street

ABSTRACT

In this paper, two different types of charge are liquefied in an electric arc furnace to liquefy 65 G steel and their structures are compared. In addition, the technology of out – of – furnace processing of liquid alloys has been developed to obtain high – quality castings.

Keywords: Ferrous metals, steel, carbon monoxide, chromium, nickel, molybdenum, tungsten, copper, niobium, vanadium

Introduction

Ferrous metals and steel in general are very important in the national economy. There is no industry in the economy that does not use ferrous metals. The level of economic power of any country is determined primarily by the amount of steel that can be melted. Without steel, mining, oil and gas, machinery, transportation, and even agriculture will not develop [1].

Iron was known in ancient Egypt. There, iron was found in pure form (meteorite iron) and was considered equal to gold. Open pit mining has led to the rapid development of the industry. It's a huge contribution to human development. This method is called natural air spraying. Because ordinary unheated air was used here. The essence of this process is that pistachio coal and iron ore are placed in a stone furnace, and the air needed for combustion is sent from the bottom of the furnace. Combustion gas CO (carbon monoxide) recovers iron. The burnt ore was hammered out of the slag. Such air-purified iron was not homogeneous. Over time, this method improved, and after firing at high temperatures, the iron ore began to turn into liquid cast iron [2 – 3].

Additional factors in steelmaking have led to the expansion of the chemical industry, machinery, oil and gas, and other industries. The alloying of steel with other metals has led to the development of scientific technologies for the production of new structural materials. In particular, the production of stainless steel has grown rapidly [4 – 5].

Methods of obtaining steel in industrial quantities are called steel metallurgy.

An alloy of iron that deforms with carbon and other elements is called steel. Steel contains carbon, manganese, silicon, sulfur, and phosphorus.

Special alloys are added to the metal to obtain steel: chromium, nickel, molybdenum, tungsten, copper, niobium, vanadium, etc., as well as large amounts of manganese and silicon [6 – 7].

The development of modern metallurgical technology is characterized by the extraction of high quality metal from smelting furnaces using an auxiliary unit or a specially equipped bucket. The role of smelting furnaces is mainly in obtaining a liquid cast product with a specific composition and temperature. Recently, there has been a significant difference in the technology of obtaining high-quality steel in large converter, open – hearth, induction or electric arc furnaces, especially if the oxidation of additives in these furnaces is carried out by spraying the bath with oxygen [8 – 10].

Some plants in various developed countries are developing new furnace designs to improve the quality of liquid steel.

Materials And Methods

Today in the shop "Casting – Mechanics" of JSC "UzMetkombinat" was analyzed the problems encountered in the process of casting castings from steel alloys for trolleys in sand – clay molds and their causes.

First, a basic 2.5 – ton electric arc furnace was selected. After checking that the furnace linings were in good condition, first small and then large shale materials were loaded into the furnace. As soon as the alloy began to liquefy, 3% limestone ($CaCO_3$) and ferrous alloys FeSi 65 and FeMn 90 were added to the furnace as flux, depending on the weight of the alloy.

The recommended chemical compositions for 65G steel are given in table 1

Table 1

Chemical composition of 65G steels

Brands	C	Si	Mn	Ni	S	P	Cr	Cu	Fe
65G (sample 1)	0,62 – 0,7	0,17 – 0,37	0,9 – 1,2	to 0,25	to 0,035	to 0,035	to 0,25	to 0,2	97
65G (sample 2)	0,65 – 0,8	0,27 – 0,47	0,9 – 1,5	to 0,25	to 0,035	to 0,035	to 0,25	to 0,2	97

When the alloy was completely liquefied, the liquid alloy was stirred and sampled three times to check the chemical composition of the alloy. As a result of the inspection, FeO (iron oxide) was added to the furnace due to the increased carbon content of the alloy.

Before loading the liquid alloy into the bucket, the bucket was heated to a temperature of 800 – 850^0 C for 45 – 50 minutes. The main purpose of heating is to keep the bucket from overheating due to the fact that the liquid alloy does not scatter when poured and the liquid alloy is oxidized.

In order to reduce gas pores and mirrors in the liquid alloy, to develop and process the liquefaction regime of alloys, to obtain high – quality castings, several methods of out – of – furnace treatment of liquid metal are considered. After cleaning the alloy from gaseous pores and mirrors, the alloy was poured into a sand – clay mold slightly larger than the size of the drawing.

Results

Development of high-quality castings from 65G steel alloys and the reduction of gas pores and mirrors, the mode of liquefaction of alloys and their processing technology.

The liquid alloy was treated with inert gases outside the furnace, purified on the basis of the dynamics of the change of gases and mirrors in the liquid alloy, and poured into a sand – clay mold.

The composition of the alloys was determined in the laboratory on the equipment “SPEKTROLAB – 10 M” and the following chemical composition was obtained. Table 2 shows the chemical composition of 65G steel (sample 1) and 65G steel (sample 2).

Table 2

Chemical composition of 65G steels

Brands	C	Si	Mn	Ni	S	P	Cr	Cu	Fe
65G (sample 1)	0,68	0,23	0,9	0,22	0,034	0,032	0,21	0,2	97
65G (sample 2)	0,68	0,37	1,0	0,24	0,032	0,033	0,24	0,18	97

The cast samples were magnified x500 times using a CEM Zeiss EVO MA 10 scanning electron microscope and compared with each other.

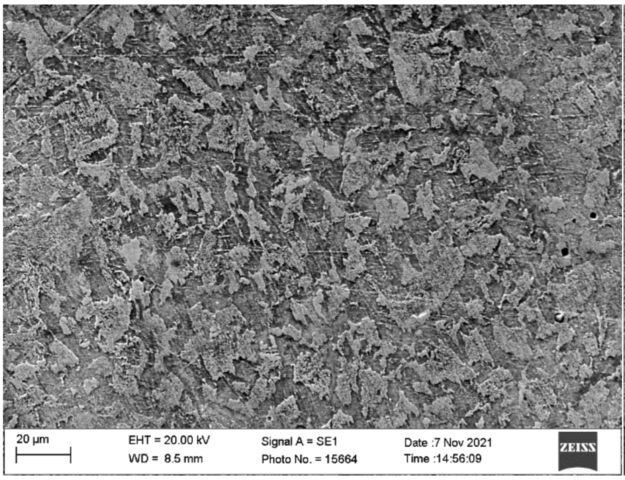

Figure 1. CEM Zeiss EVO MA 10 scanning electron microscope based on 65G (sample 1) alloy x500 was seen

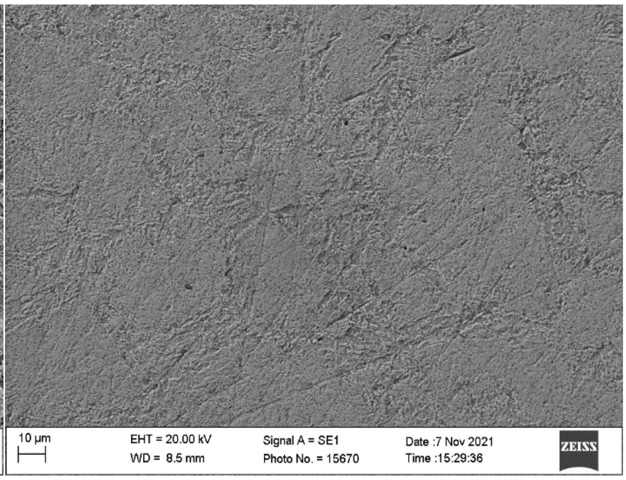

Figure 2. Based on the CEM Zeiss EVO MA 10 scanning electron microscope, a 65G (sample 2) alloy x500 was seen

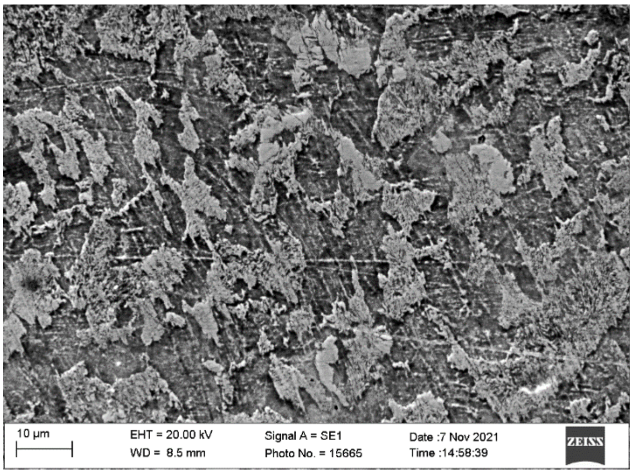

Figure 3 CEM Zeiss EVO MA 10 scanning electron microscope based on 65G (sample 1) alloy x1000 was seen

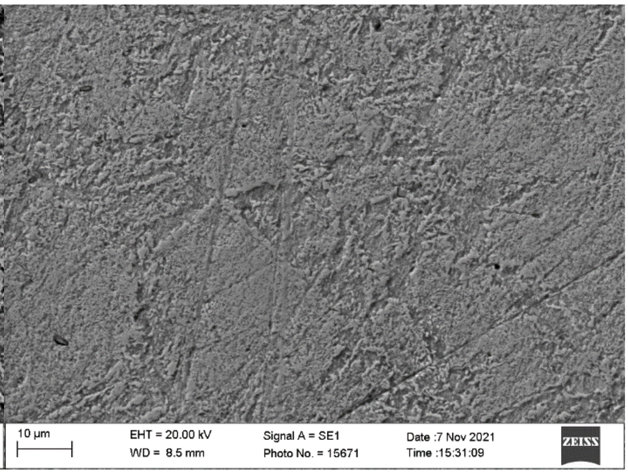

Figure 4 CEM Zeiss EVO MA 10 scanning electron microscope based on 65G (sample 2) alloy x1000 was seen

From the microstructure obtained, it can be seen that the structure of the second sample of 65G is smaller than that of the first sample of 65G. This, in turn, indicates the strengthening of the casting product. In addition, due to the fact that both samples were treated with inert gases in addition to the furnace, the gas pores were reduced by 70 – 80% from the addition of mirrors, resulting in high – quality castings.

Conclusion

Based on the obtained results, the technology of production of high-quality castings on the basis of the developed batch composition, out – of – furnace processing technology was established.

A technology has been developed to reduce the amount of gas pores in 65G alloy castings by 70 – 80% and mirror additions by 60 – 70%. As a result, the technology has been developed to increase the mechanical properties of castings by 16 – 18%, increase service life by 1.5 – 1.7 times.

The technology of out – of – furnace processing of liquid alloys has been developed, and high – quality castings have been obtained.

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