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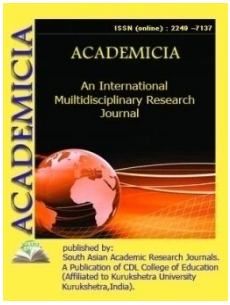

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QUALITY IMPROVEMENT OF THE STEEL MELTING TECHNOLOGY IN AN ELECTRIC ARC FURNACE

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ABSTRACT

This article is focused on the processes in the second step which is about melting the raw materials and achieving the desired chemical analysis and temperature of the steel required for the third step in steel production – Casting and Solidification. The temperature of the electrodes (mainly the cathode) reaches 2700-3300˚C.Ionization occurs due to the high temperature of the arc. That's way, good electrical conductivity occurs between the electrode. After the liquefaction process was completed at the specified time and the furnace temperature was sufficient after the metal was liquefied, a certain amount of aluminum alloy was added to the furnace to improve the fluidity of the liquid metal, and the liquid metal sand was poured into a clay mold.

KEYWORDS: *Electric Arc Furnace (EAF), Ferroalloy, Slag, Coke, Flux, Electrode, Liquefaction, Melting.*

INTRODUCTION

Cast steel is melted in two types of furnaces:

- Electric arc (acid and basic)
- Electric induction (acid, basic, or neutral)

Some open-hearth and crucible furnaces do exist in the worldwide industry butthese are obsolete methods of steelmaking.[1,2].

The choice of furnace and melting practice depends on many variables, including:

- The plant capacity or tonnage required
- The size of the castings
- The intricacy of the castings
- The type of steel to be produced, i.e., whether plain or alloyed, high or low
- carbon, etc.
- The raw materials available and prices thereof
- Power costs
- The amount of capital to be invested
- Previous experience

Although the steel production with the electric arc furnace (EAF) has grown significantly in recent years, the approach of the steelmakers has changed influenced both by the increased competition in the market and by a more diffused and deep knowledge of the steelmaking route and related technologies.

Steel and ferroalloy production in electric arc furnaces is widespread in the world and is part of a technological process that operates on the basis of environmentally clear material and material savings that meet the requirements of today's world. In modern industry, an iron alloy is steel, construction, machine-building, and other specialties, in construction and high-strength, corrosion-resistant stainless steels, instrumentation steel, and working under pressure. Steel with spherical bearings and springs, steel with special properties are widely used.

The steel industry is a fundamental part of the base industry structure in Europe and worldwide as well.[3-7].

The total production of steel in the world is currently about 970 kton, of which about 160 kt on is produced in the European Union and about 6 kton in Sweden

The production of steel can be divided into several steps:

· Raw material pre-processing (iron ore, steel scrap, coal, slag formers)

· Process metallurgy (melting of raw materials, modification of melt chemistry)

· Casting and solidification (continuous casting, ingot casting, molding, drawing)

· Hot and cold forming (hot and cold rolling, pressing)

· Mechanical processing (cutting, turning, milling)

There is 0.02-0.6 % carbon in structural steel. The general requirements for this type of steel are strength, plasticity, and good technological properties [8-11].

MAIN PART

Today, a number of production problems of Uzmetkombinat, one of the leading enterprises in Uzbekistan, have been researched and analyzed in different ways. Professors and researchers of the Department of "Foundry Technology" of Tashkent State Technical University conducted research to reduce the percentage of slag released during the liquefaction of steel 45 in the electric arc furnace in the laboratory under the department. The slag of 2 different weights was introduced into the furnace and liquefied at different time intervals. The following must be taken into account during liquefaction.

Chemical composition of steel 45 (GOST 1050-88)

TABLE 1

C, %	Si,%	Mn,%	Cr, % no more than
0.42÷0.50	0.17÷0.37	0.50÷0.80	0.25

Mechanical properties of steel 45

TABLE 1.1

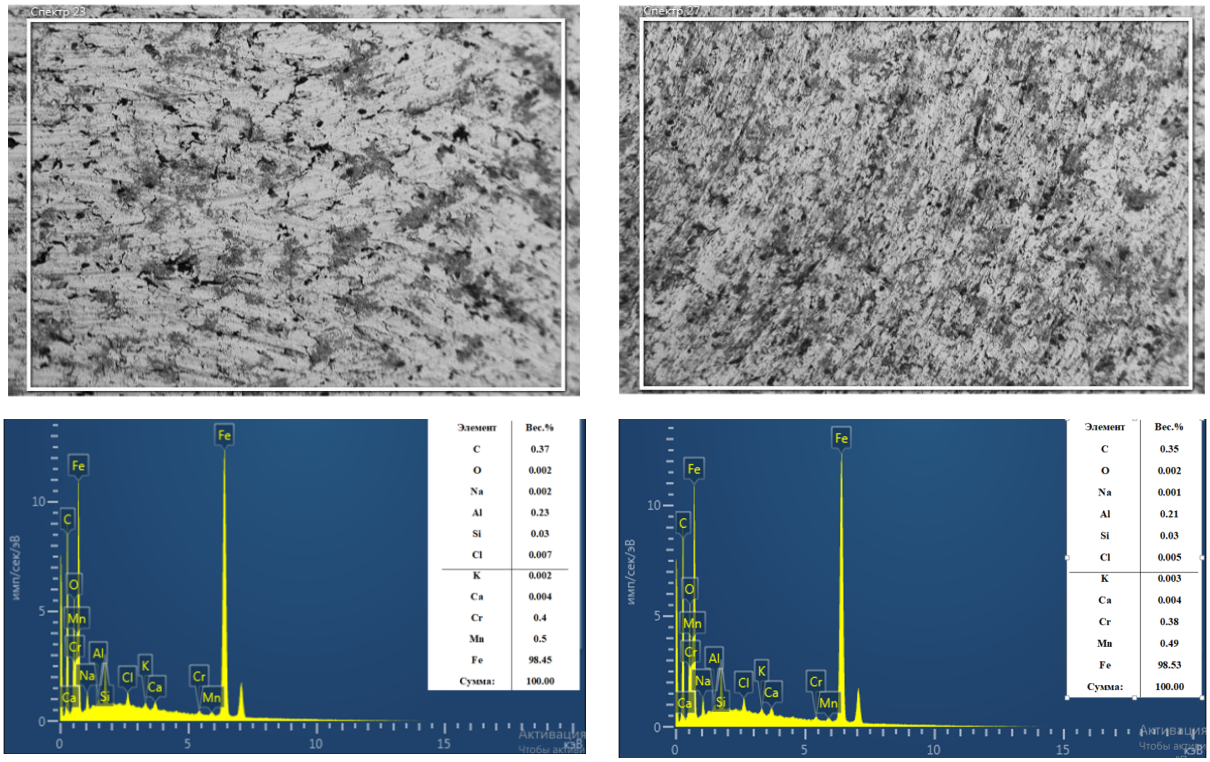
σ_T, N/mm^2	σ_V, N/mm^2	δ, %	Ψ, %	HB
355	600	16	40	229

Different slag compositions in the research process

TABLE 2

S/n	Charcoal composition	Weight, (Research I), gm	Weight, (Research II),gm	Overall melting time, (research),min	Overall melting time, (Research II), min
1.	Steel 45	1224	1224	205	180
2.	Coke	200	71		
3.	ANF-6 flux	122	65		

a) b)



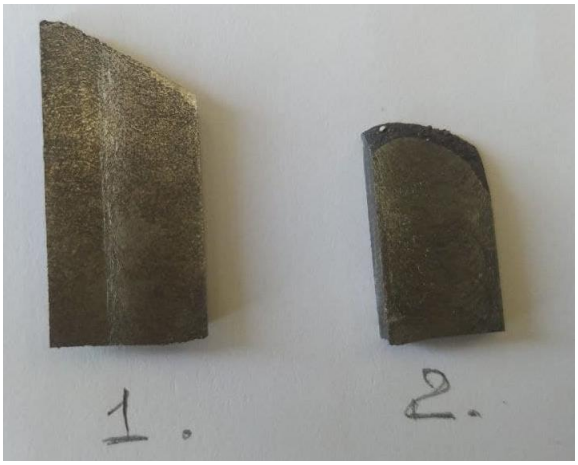
SEM micrographs of experimental tell specimens

a) experiment 1 b) experiment 2

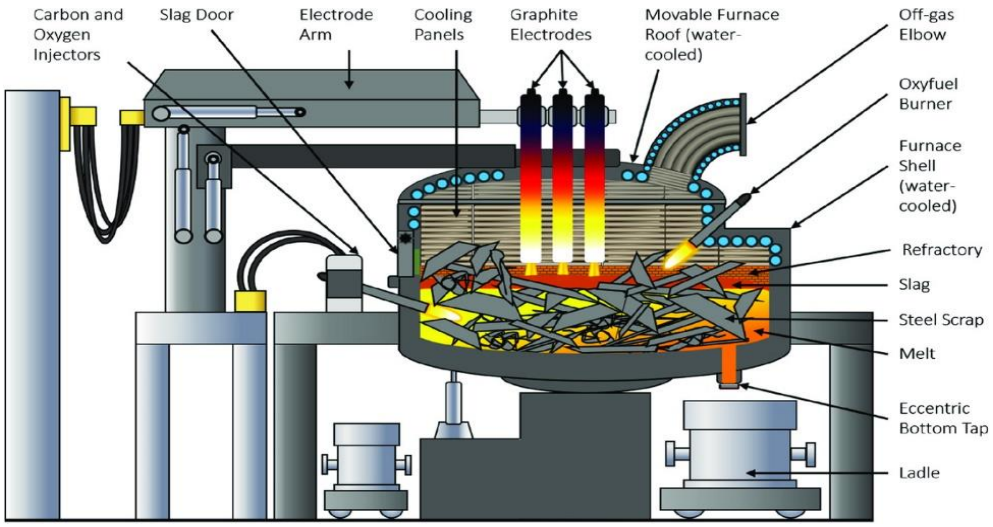
First, a certain amount of coke was added to the furnace, then secondary metal, coke, and flux. Then the oven was electrified. During liquefaction, one graphite electrode connected to an electrical source ignites as they approach each other, and electrons begin to escape from the cathode. When the electrode is moved away from each other, a bright arc is formed between them. The temperature of the electrodes (mainly the cathode) reaches 2700-3300˚C.Ionization occurs due to the high temperature of the arc. That's way, good electrical conductivity occurs between the electrode. The mechanism of movement of the electrode is one of the most responsible mechanisms in electric arc furnaces operating in complex operating conditions. During the melting process, especially during the melting of the mortar, they are constantly in reverse motion. The following is required when moving the electrode: the speed of movement, the minimum (0.02-0.03m/s), and the maximum (0.05-0.08 m/s) when lowering the electrode, to prevent the electrode from breaking freely as a result of unloading and forced lowering rapid movement and at the same time rapid stopping, the absence of deformation in the moving and support parts of the mechanism, as well as in the moving parts between them [12-16].

After the liquefaction process was completed at the specified time and the furnace temperature was sufficient after the metal was liquefied, a certain amount of aluminum alloy was added to the furnace to improve the fluidity of the liquid metal, and the liquid metal sand was poured into a clay mold. This process was performed during both kinds of research. The samples were cooled to room temperature and mechanically treated to improve their surface roughness. The samples

were sent to the laboratory of the Center for High Technologies to determine the chemical composition and analysis of the microstructure.



Steel melting process in an electric arc furnace in the laboratory of the Casting Technology Department



A Review of Mathematical Process Models for the Electric Arc Furnace Process

CONCLUSION

- In the last few years, many efforts have been made by experimenting with alternative melting methods and by improving traditional methods. The results of the research are as follows. Comparing the results of both researches:

- In the first research, the following amount of slag was introduced during the liquefaction of the secondary metal in the electric arc furnace, which mainly resulted in the liquefaction of high-quality steel with a change in the amount of ANF-6 flux in the furnace, as well as 6-8% slag.

- In the electric arc furnace, a flux was introduced into the liquid metal in order to liquefy the secondary metal and produce quality castings. The main purpose of the introduction of flux is to obtain pure quality metal from slag and nonmetallic additives in the slag. To do this, after the furnace was started, secondary charcoal was loaded into the furnace, and ferroalloys FeSi75 and FeMn90 were added to the liquid metal in order to return Fe from FeO.The ANF-6 flux was then introduced and the slag-free sifted St 45 steel was liquefied.

- According to the results of the second study, the work on reducing the transition of metal to slag was 14-18% slag due to the fact that the amount of flux introduced into the slag was lower than in the first study.

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