MEASUREMENTS OF STRESS-STRAIN BEHAVIOUR VS. CHEMICAL COMPOSITION OF IRON PRODUCED AT KURUM INTERNATIONAL

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ABSTRACT

The formation of the structures of steel is a complex process that is conditioned by multiple factors. Recognizing that the starting point for forming the structure that the steel inherits in room temperature is austenite structure (this is the most typical case, but not the only), we can construct a scheme of major transformations that undergoing this structure. The purpose of this study is to examine the physio-chemical-mechanical properties of iron produced by the company Kurum International and suggest improvements where they are needed.

***Keywords*:** *Steel, Iron, Tensile strength, Volumetric defect*

INTRODUCTION

Despite the tremendous diversification of materials in human use over the last fifty years and the increasing weight of light alloys, advanced ceramics, plastics, composites, etc., the role of steel in the industrial development of a country is not considered to be overcome, on the contrary, it remains an irreplaceable material for a variety of applications, from the most important in the fields of mechanics, construction, transport, energy. Without being drawn, even, by an infinity of "small" applications without which our daily life would not be conceived, as many years ago, even today, when evaluating the economic indicators of a country, the volume of production and use of steel, is considered one of the most significant for the level of its industrialization [1, 2].

How is it that this old material retains its role as a leader in this modern world, which brings new materials to market daily? The reason must first be sought in the extremely wide range of properties and combinations thereof that steel can realize (conceived as a class of materials and not as an individual), that is, in its flexibility to adapt to the demands of the most diverse, and in this respect still and to this day it has not been surpassed by any other material. Of course also aspects of cost, availability, tradition, etc., go in favor of the widespread use of steel. But in our treatment we will develop arguments relating to the first reason, namely the diversity of properties of this material. The diversity of properties is based on the variability of internal construction parameters, which is often summed up by the term microstructure. Steel is an iron-based metal alloy, or, in other words, an iron alloy with other elements. The fact that steel is often called the iron-carbon bond is explained by the special role of this element in the process of steel production and in the formation of its microstructures. But not with the fact that he is the only or main connecting element. There are even special steels, in which the carbon content and impact is negligible, compared to other bonding elements. From the above, it is natural to look for the reason for the diversity of properties of steel first in its basic element, namely iron.

The purpose of this study is to examine the physico-chemical-mechanical properties of iron produced by Kurum International and to suggest improvements when needed.

MATERIAL AND METHODS

Objectives of the study:

1. Physical experiments

Carry out ten experiments to measure the tensile strength of iron with different sections produced by Kurum International.

2. Chemical composition

Measure the chemical composition of the samples obtained from the production of the company plant.

Study Methods:

1. Theoretical methods

This study has utilized the current knowledge provided by the existing literature in the field of mechanical metallurgy. This knowledge, have served as a guide in the development and successful conclusion of the study. A more detailed overview of references to this topic can be found in the Bibliography section at the end of the article.

2. Experimental methods

In order to achieve the objectives of the study, ten physical experiments were conducted using the methods of cold tension tests and ten chemical experiments at the certified laboratories of the company Kurum over a period of several months. Various samples of iron produced at the company's plant were randomly selected for these experiments.

3. Good Practices

For the successful realization of the study, a number of good international practices implemented for similar or identical purposes by agents with valuable and helpful experience have been used. Detailed and dedicated explanations of these practices are not included in the study because they are not included in the scope of study and do not add value to the argumentation of the scientific degree of the applied methods.

The experimental part

1. Chemical composition of samples

The chemical composition of the samples was taken from the measurements carried out in the chemical laboratory of Kurum International by the company itself [3].

2. Physical properties [1, 2]

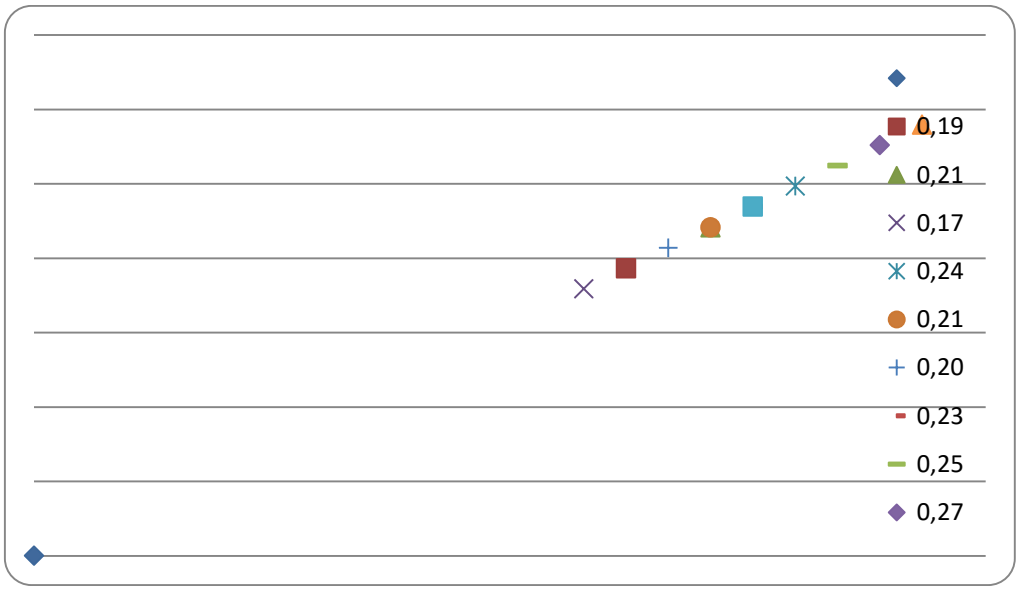

Figure 1 Correlation σ – ε for the sample φ = 12 mm

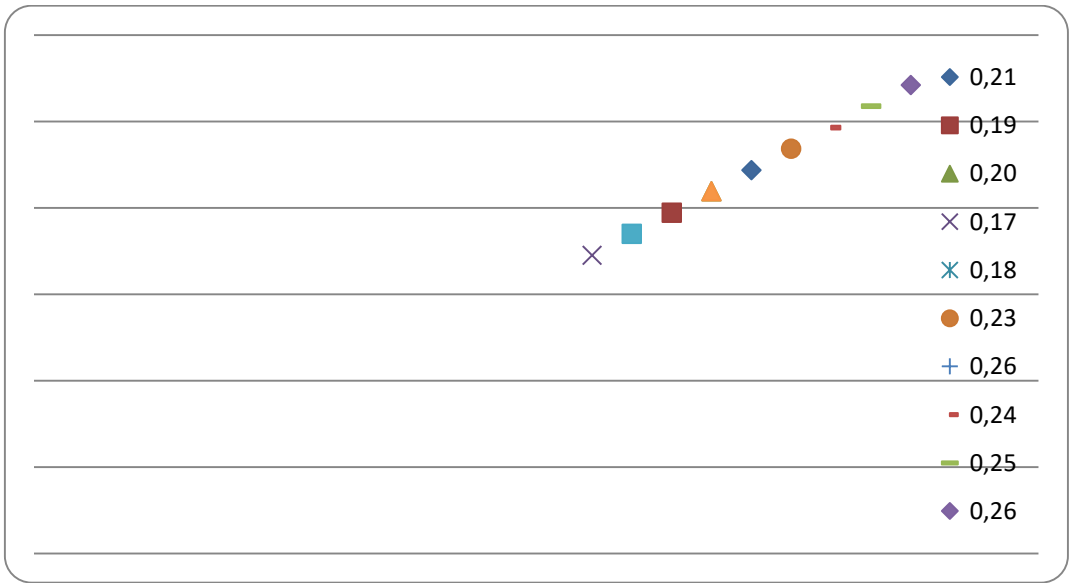

Figure 2 Correlation σ – ε for the sample φ = 14 mm

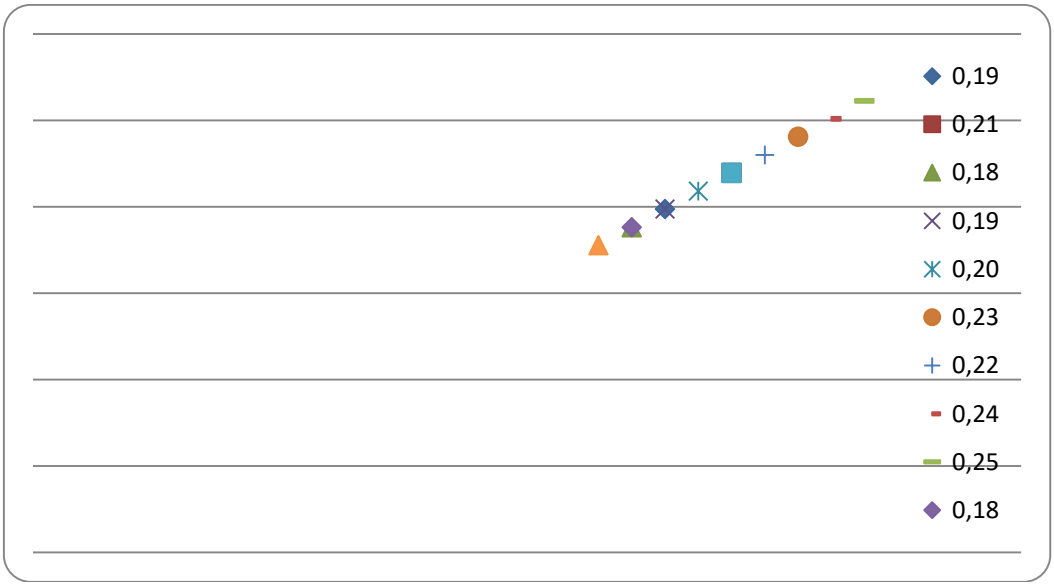

Figure 3 Correlation σ – ε for the sample φ = 16 mm

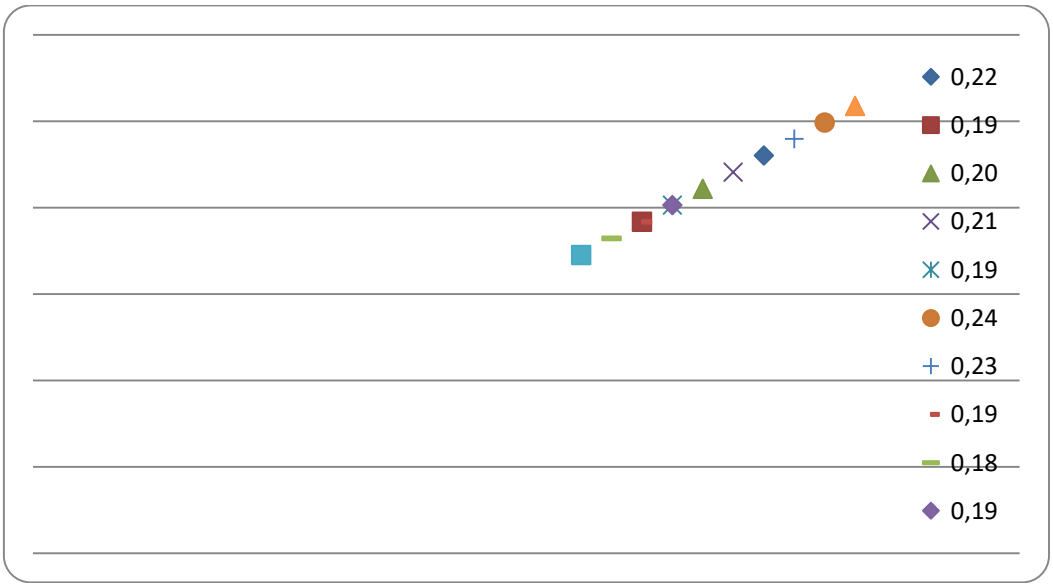

Figure 4 Correlation σ – ε for the sample φ = 20 mm

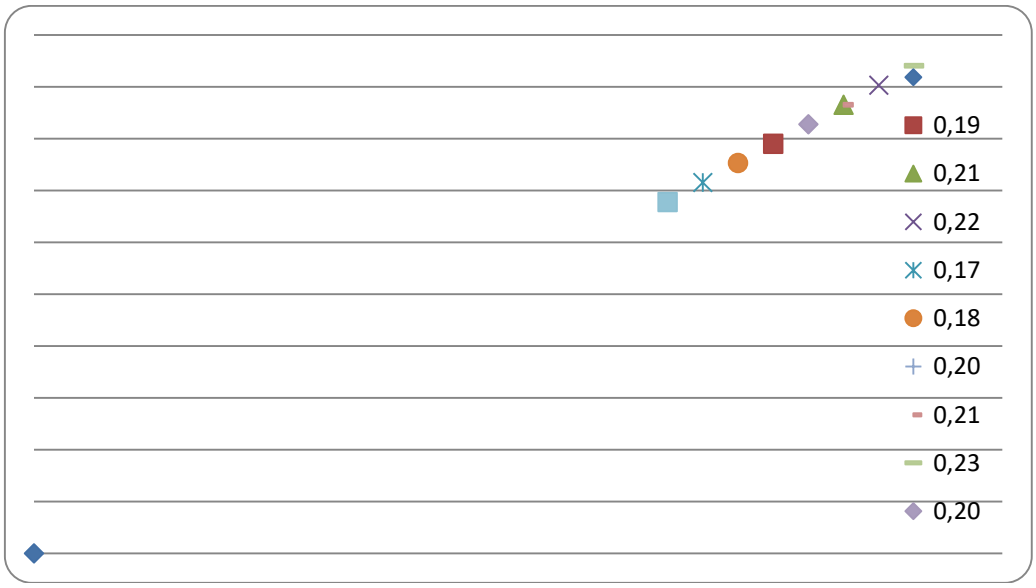

Figure 5 Correlation σ – ε for the sample φ = 25 mm

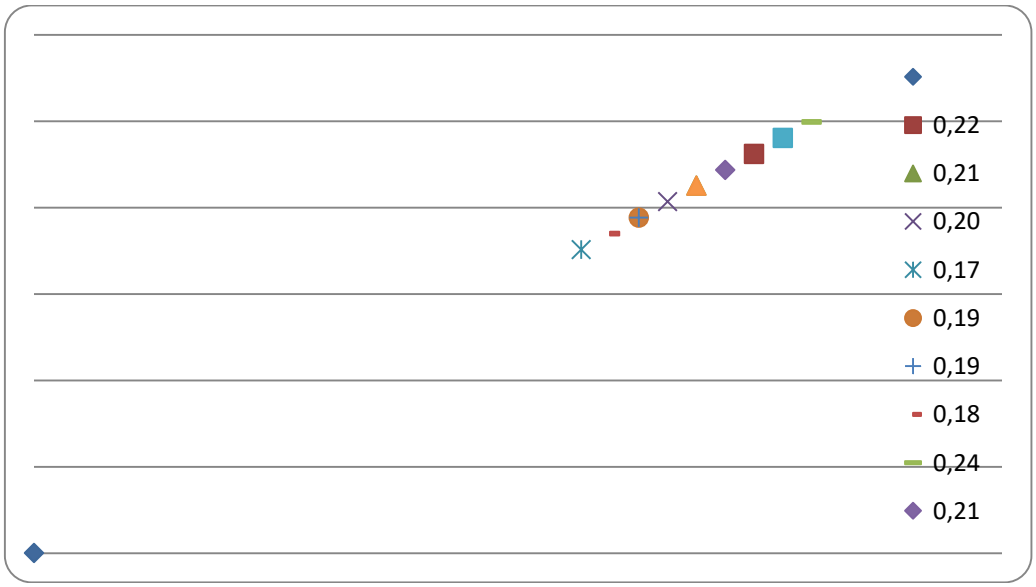

Figure 6 Correlation σ – ε for the sample φ = 32 mm

RESULTS AND DISCUSSIONS

The value of the tensile strength in the samples from many tests are not always the same for the same type of connection, i.e. it is a subject of uncertainty. Even the stresses acting on the mechanical mechanism may turn out to be greater than predicted.

Uncertainty in tension determination depends on:

1. the sensitivity and accuracy of the machine used to perform the tension test

2. the change in the chemical composition of the metal bond within a range of tolerances, changes provided by all technical norms and by the temperature variability for the same thermal or thermo-mechanical treatment that the sample undergoes when under test.

3. inhomogeneity of the composition inside the mechanical mechanism, especially if it is large in size.

4. the possible presence in the sample of volumetric defects not previously predicted, such as bubbles, metal impurities and microcracks.

Even in cases when the composition of chemical elements is almost within the required standards, we see that the tensile strength is still below the required values, especially for samples with smaller section. This is because during the lamination process the products undergo a lamination process which is conditioned by the speed of this process and the coolants used; in this case the water must have uniform pressure, which although the company has tried to improve, again at this stage has not fully achieved.

In terms of custom iron production, the company has managed to meet the standards, especially in the production of larger section bars. The terms of the contract references may be technically sufficient to prevent omissions in this regard.

The company KURUM International is recommended to:

- Improve the production line of iron for construction, as here are noticed even the biggest defects, especially in the samples with small section. Fulfilling this recommendation makes it necessary to implement a serious investment plan that respects the standards.

- The tensile strength in some cases decreases from its values compared to international standards and those of the company due to the use by the company of various scrap and the lack of constituent elements such as C, Mn, Si etc. at the required standard levels. The company should not use different scrap with unsafe and uncontrolled composition. The chemical composition of the scrap should not be taken for granted and control procedures should be put into practice.

- Based on the above findings, the metal material should be reinforced, ie the modulus of elasticity should be increased. On the other hand, this is accompanied by loss of workability and plasticity of the sample, so the desired reinforcement, above all, when such properties do not result in much damage.

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