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MEC299

**THE EFFECTS OF NORMALIZING
AND ANNEALING ON THE
MICROSTRUCTURE OF STAINLESS
STEEL**

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ABSTRACT

The effects of heat treatment on the microstructure of stainless steel has been studied. Normalizing and annealing are the main process of heat treatment were used for the experimental work. The stainless steel was cut into 5 mm thick slices and analyzed using spectrometry. Stainless steel plate was heat treated in the same medium and various temperature and holding period in a furnace. Stainless steel is employed in many different things, such trains, machines, and aero planes. Only big industries employ stainless steel, while it can also be used in non-major industries like watch production, which requires micro-sized components.

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CHAPTER 1

INTRODUCTION

1.1 Research Background

In order to create a certain microstructure and acquire the necessary mechanical properties, such as hardness, yield strength, percent elongation, and Young's modulus, a particular metal is subjected to heat treatment, which combines heating and cooling. Steels' microstructures have a close relationship with their mechanical properties. It is an essential step, especially when creating tools and machine parts. Heat treatment, which encompasses annealing, normalizing, hardening, and tempering, is the most crucial method that is routinely used to change the microstructure and mechanical properties of engineering materials, particularly steels.

The heat treatment that is most frequently used to soften metal is annealing. During the annealing procedure, an excessive temperature is applied to a metal in order to transform the material's structure into austenite. Once at ambient temperature, the metal will then progressively cool [1]. This type of heat treatment is intended to boost softness, machinability, and formability while reducing internal stress and improving grain structure.

A metal or alloy is subjected to heat treatment, which involves carefully controlling heating and cooling, to achieve the required physical and mechanical properties, such as hardness, flexibility, toughness, ultimate tensile strength, yield strength, and the percentage of elongation. Common heat treatments used to modify the microstructure and desired mechanical properties include annealing, normalizing, hardening, and tempering [2]. The heat treatment process seeks to increase the material's strength and machinability as well as its flexibility, toughness, strength, and hardness[3].

During normalizing, metal is heated to the austenite temperature range and then allowed to cool in the open air. The objective of this treatment is to produce a pearlite-dominated matrix. In comparison to the receiving state, it frequently exhibits greater strength and hardness. The metal's strength and hardness will increase due to the fine grain structure [4]. Grain refinement is another usage for it.

1.2 Problem Statement

The investigation of heat-treatment issues involves a variety of steps. In reality, given the myriad of elements that affect heat-treatment issues, that statement might not be entirely accurate. The heat-treatment process does not always result in problems; problems might also arise before heat treatment. Some of the contributing factors that could cause a problem during the heat-treatment operation include the type of steel used, the mechanical design, the machining, and the heat treatment procedures. As a result, the stainless steel plate will undergo a heat treatment, annealing, and normalizing process as part of the experiment.

1.3 Research Question

- 1) What changes in microstructure occur as a result of heat treatment?
- 2) What variables cause the mechanical characteristics of stainless steel to alter as a result of heat treatment?
- 3) What equipment will be required to carry out this experiment?
- 4) What was the microstructure of the stainless steel before it was heat treated?
- 5) What role does heat treatment play in the mechanical characteristics of stainless steel?

1.4 Objectives

The main objectives for this project are:

- a) To perform the experiment of heat treatment of normalizing and annealing for stainless steel.
- b) To analyze the microstructure of stainless steel plate using the optical microstructure.