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Characteristics of St.37 Steel Materials with Temperature and Time on Heat Treatment Test using Furnace

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Abstract:- Steel St.37 is a widely used metal in industry. Lightweight, corrosion resistant, and good heat conductor cause aluminum is selected to be one of the materials to make a machine component such as alloy wheels, pistons, and other machine components. The high number of aluminum usage in the manufacture industry is inseparable from foundry technology. Quenching test is using Furnace test and cooled with water and SAE 40^{0}C lubricant oil. Testing 1: 2 pcs Stainless steel specimens are heated at 40^{0}C to 800^{0}C temperature obtained 33 minutes result of red color is then blue then cooled with water ash To-brown. Test 2: 2 pcs Stainless steel specimens were heated at a temperature of 600 ^{0}C to 800^{0}C in 5 minutes the result of red-colored blue was then cooled with water from gray to brown. Test 3: 2 pcs Stainless steel specimens were heated at a temperature of 7000C to 8000C, obtained within 2 mins of reddish blue then cooled with water of gray to brown. Testing 4: 2 pcs Stainless steel specimens were heated at temperatures of 40 ^{0}C to 800^{0}C obtained 33 minutes of blue later in color cooled with black material lubricating oil. Testing 5: 2 pcs Stainless steel specimens were heated at a temperature of 600^{0}C to 800^{0}C in 5 minutes the result of blue color was subsequently cooled with lubricating oil obtained from the color of black material. Testing 6: 2 pcs Stainless steel specimens were heated at a temperature of 700^{0}C to 800^{0}C, obtained in minutes of reddish blue later on cooled with lubricating oil obtained by color from black material.

***Keywords**:- Characteristics, Steel St.37, Temperature, Time, Furnace.*

I. INTRODUCTION

The rapid development of the industry at the present time especially the machinery industry also spur the development of basic material manufacturing technology such as steel. Given these conditions, sufficient mechanical properties, so that the lifespan can be increased. To overcome this, engine components are usually treated by heat treatment. St 37 steel equivalent to AISI 1045 with chemical composition 0.5% C, 0.8% Mn, and 0.3% Si, is one of the steels produced for the manufacture of various machining components. the mechanical properties of St 37 steel are subjected to heat treatment process by Carburizing. One of the surface hardening processes is solid carburization, which aims to increase the carbon content (C) coated steel surface to obtain greater hardness of surface hardness from the inside.

The solid carburizing process can result in improved mechanical properties of machining components such as:

1.Increased surface hardness.
2. Increased wear resistance to contact surfaces.

The alloy steel is a steel formed in accordance with the intended purpose for improving the mechanical

properties or the nature of the steel in accordance with the base element of the steel. In alloy steel is divided into 2 types, namely: Low alloy steel (special alloy element <8.0%), High alloy steel (special alloy> 8.0%))

St Steel Characteristics (AISI 1045) St 37 steel is mild steel which is equivalent to AISI 1045, with the chemical composition of Carbon: 0.5%, Manganese: 0.8%, Silicon: 0.3% plus other elements. By hardness ±170 HB and tensile strength 650 -800 N / mm2. Generally St 37 steel can be used directly without heat treatment, unless special use is required.

- *Hardening Process*

The hardening process is performed on the metal, in order for the metal to gain higher hardness. Hardening is one of the processes of heat treatment, in which the steel is heated to a certain temperature above critical temperature (Ae3) and then held for a long time [1]. Then dipped into water, oil or water of saline solution depends on the type of steel. For Hypoeutektoid heating steel is done at 300C -500C above the Ae3 line on this steel itsmicron structure is Ferrite + Pearlite transformed into Austenite structure. While the Hypereutectoid steel when heated at a temperature of 300C -500C above the Ae1 line, the structure of Pearlite. In Figure 2.1.a cooling diagram for Hypoeutectoid steel is shown, and from the cooling diagram it can be seen the effect of the cooling rate and the microstructure formed by the variation of the cooling rate which are given. Basically the isothermal cooling diagram may change its location according to the composition of the carbon. The larger the carbon composition the curve's nose will move away from the Y axis, and the more it gives the material the opportunity to transform perfectly to the expected structure, such as the structure Marten site, which in the IT diagram for Hypoeutectoid carbon steel, is very narrow in time to form a Martensite structure in its rapid cooling process. Occurrence of Surface Layer HardeningThe process of hardening the surface layer of steel is carried out by saturating the steel surface with carbon or with otherelements . At that time the steel absorbs the saturated element sochange the carbon content that occurs on the steel surface[6,7]. Deeper penetration will depend on the ability of this element to form a solid solution with steel. The elements to be done in the industry at the moment for surface coating hardening are carbon, nitrogen, silicon and aluminum that can formsolid solution. Rising temperatures in the coating harden affect the steel structure in reverse. At hightemperatures the steel structure on the inside is damaged. In the treatment of surface coating hardening at high temperatures gives a large difference in the carbon distribution in the diffusion layer. As the temperature rises not only the speed of diffusion of the rising steel elements, but also the velocity of this element [2,3]t is transferred from the surrounding medium to the steel surface rising faster.In other words, the number of atoms absorbed on the surface of the object is greaterthan that can diffuse into the steel, so that very high atomic concentrations lead to chemical alloys (carbides, nitrides, etc.) that cause fragility of the surface layer. Carburizing (Carburizing)Carburizing is the process of enriching the workpiece layer with carbon through thermochemical treatment. Generally applied to the type of steel containing levels of 0.2% C or lower again. Carburizing treatment of steel can improve the mechanical properties of steel as it improves wear resistance because the surface of the workpiece is high[4,5].

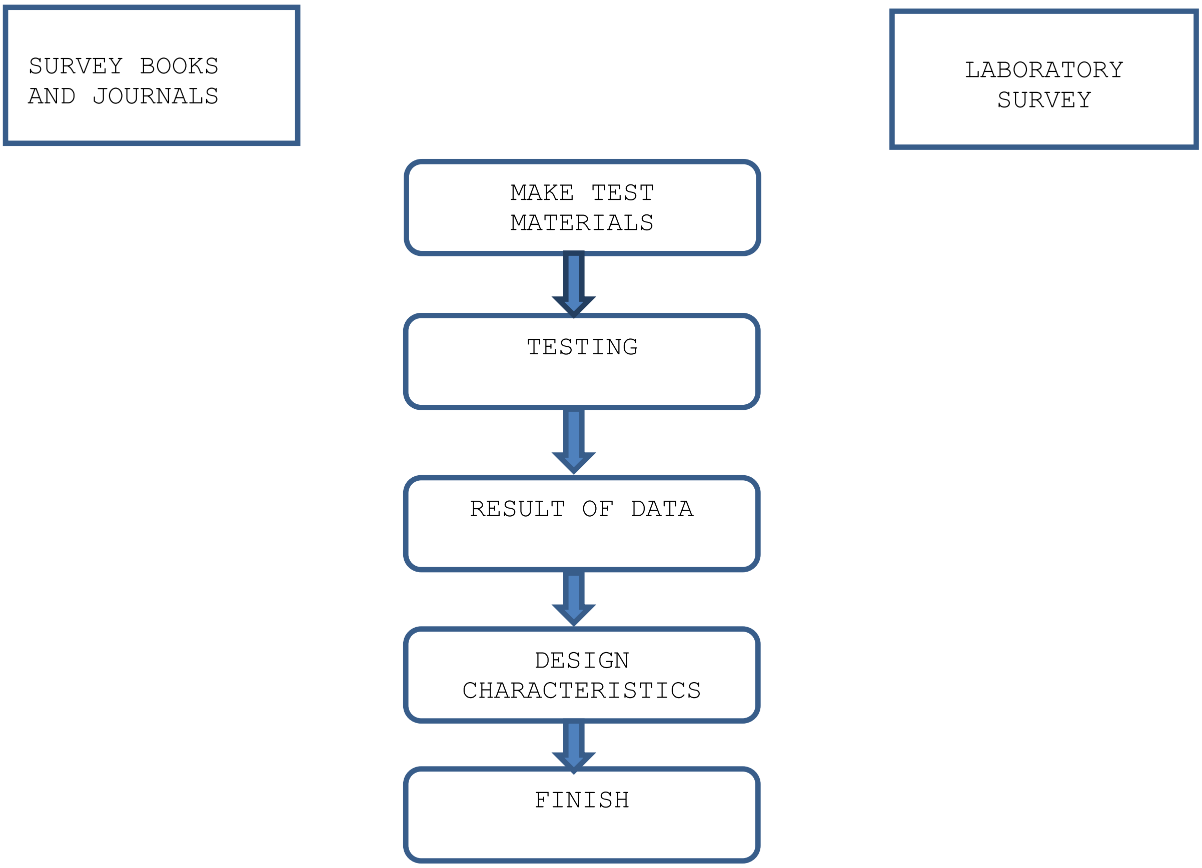
- *carburizing process*

In a solid carburizing process, the carbon content in the surface layer of the object should be between 0.8% - 0.9%, in other cases not more than 1% carbon content, higher than 1% undesirable, because with relatively high levels of carbon the surface layer vulnerable due to the formation of cementite tissue[1,2]. The placement of the object requires attention to ensure that the mixture used is sufficient to give the required carbon, where the surface of the component is separated by the carbarization mixture and there is no component tangent to the side of the box . The distance between the components of the carburized material is not less than 20 mm to 25 mm the same as the box wall. After the income is complete and the carburization medium is lowcompacted, the box is closed and all open parts are sealed with clay or clay. This is to prevent air penetration into the box or the carburization medium will burn during heating and the object will oxidize. The box is then fed into the heating kitchen and heated to a temperature of 860^0C to 920^0C. The temperature is held at carburization temperature for several hours to get the desired coating.

II. RESEARCH METHODS

This research was conducted in February 2018 at the Basic Physics Laboratory Laboratory Faculty of Engineering Mechanical Engineering Study Program University of Harapan Medan, as for the procedure Implementation of research as below:

A. Flow Diagram



A. Materials Offering Machine

Fig 1:- Finishing

B. Heat Treatment

Fig 2:- Furnace

C. Profil Materials

Fig 3:- Profil Materials

D. Test Item Size

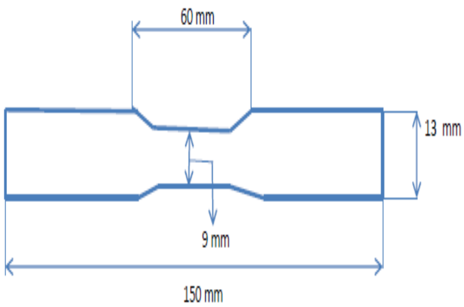


Fig 4:- Test Item Size

III. RESULT AND DISCUSSION

Material made specimen as much as 6 pcs and done Quenching test. Quenching test is using Furnace test and cooled with water and SAE 40 lubricant oil. Testing 1: 2 pcs Stainless steel specimens are heated at 40^0C to 800^0C temperature obtained 33 minutes result of red color is then blue then cooled with water ash To-brown. Test 2: 2 pcs Stainless steel specimens were heated at a temperature of 600^0C to 800^0C in 5 minutes the result of red-colored blue was then cooled with water from gray to brown. Test 3: 2 pcs Stainless steel specimens were heated at a temperature of 700^0C to 800^0C, obtained within 2 mins of reddish blue then cooled with water of gray to brown. Testing 4: 2 pcs Stainless steel specimens were heated at temperatures of 40^0C to 800 ^{0}C obtained 33 minutes of blue later in color cooled with black material lubricating oil. Testing 5: 2 pcs Stainless steel specimens were heated at a temperature of 600^0C to 800^0C in 5 minutes the result of blue color was subsequently cooled with lubricating oil obtained from the color of black material. Testing 6: 2 pcs Stainless steel specimens were heated at a temperature of 700^0C to 800^0C, obtained in minutes of reddish blue later on cooled with lubricating oil obtained by color from black material.

No	Materials	Number of Materials	Temperatur (^{0}C)	Results Time after heating (minutes)	Results of Material Color after Water cooled	Material Color Result after cooled with SAE oil .40
1	Steel St.37	2	40 - 800	33	Brownish brown	Black
2	Steel St.37	2	600 - 800	5	Brownish brown	Black
3	Steel St.37	2	700 - 800	3	Brownish brown	Black
4	Steel St.37	2	40 - 800	33	Brownish brown	Black
5	Steel St.37	2	600 - 800	5	Brownish brown	Black
6	Steel St.37	2	700 - 800	2	Brownish brown	Black

Table 1. The results of the implementation of the research can be explained in the table below:

A. Characteristics Steel St.37 .

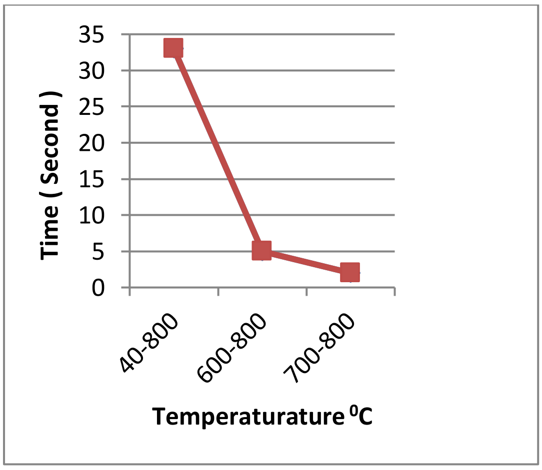


Fig 5:- Characteristics Graffics

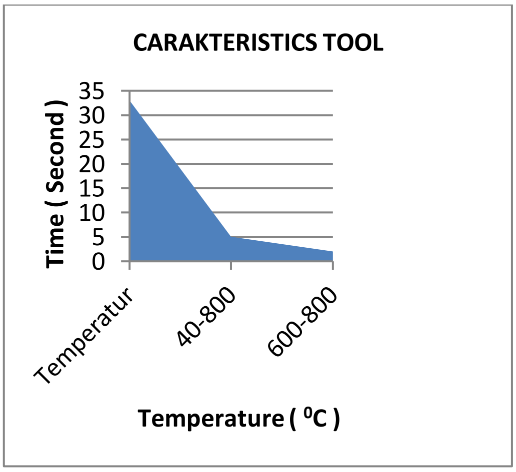


Fig 6:- Characteristics Tool

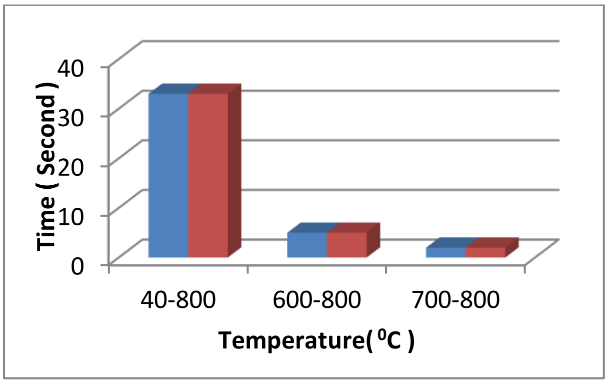


Fig 7:- Characteristics

IV. CONCLUSION

- Testing 1: 2 pcs Stainless steel specimens heated at temperatures from 400C to 8000C obtained time 33. minute result of red color of blue then cooled with water ash-gray to brown.
- Test 2: 2 pcs Stainless steel specimens were heated at 6000C to 8000C at 5. . minute result of red color of blue then cooled with water ash-gray to brown.
- Testing 3: 2 pcs Stainless steel specimens were heated at 7000C to 8000C temperatures obtained within 2 mins of abrupt red color then cooled with water of gray to brown.
- Testing 4: 2 pcs Stainless steel specimens heated at temperatures of 400C to 8000C obtained 33 minutes of red light blue then cooled with lubricating oil color results in black material. Testing 5: 2 pcs Stainless steel specimens were heated at temperatures of 6000C to 8000C in 5 minutes the results of blue tones were then cooled with lubricating oil obtained from black material.
- Testing 6: 2 pcs Stainless steel specimens were heated at 7000C to 8000C temperatures in minutes of reddish blue results then cooled with lubricating oil obtained by color from black material.

V. SUGGESTION

- To carry out the work of heating in the furnace should require a larger furnace equipment, so that the implementation can be examined freely.
- The material under test should be finished first so that the desired result can be good.
- In Making the characteristics of the micro shopexel should be observed as well as possible.

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