



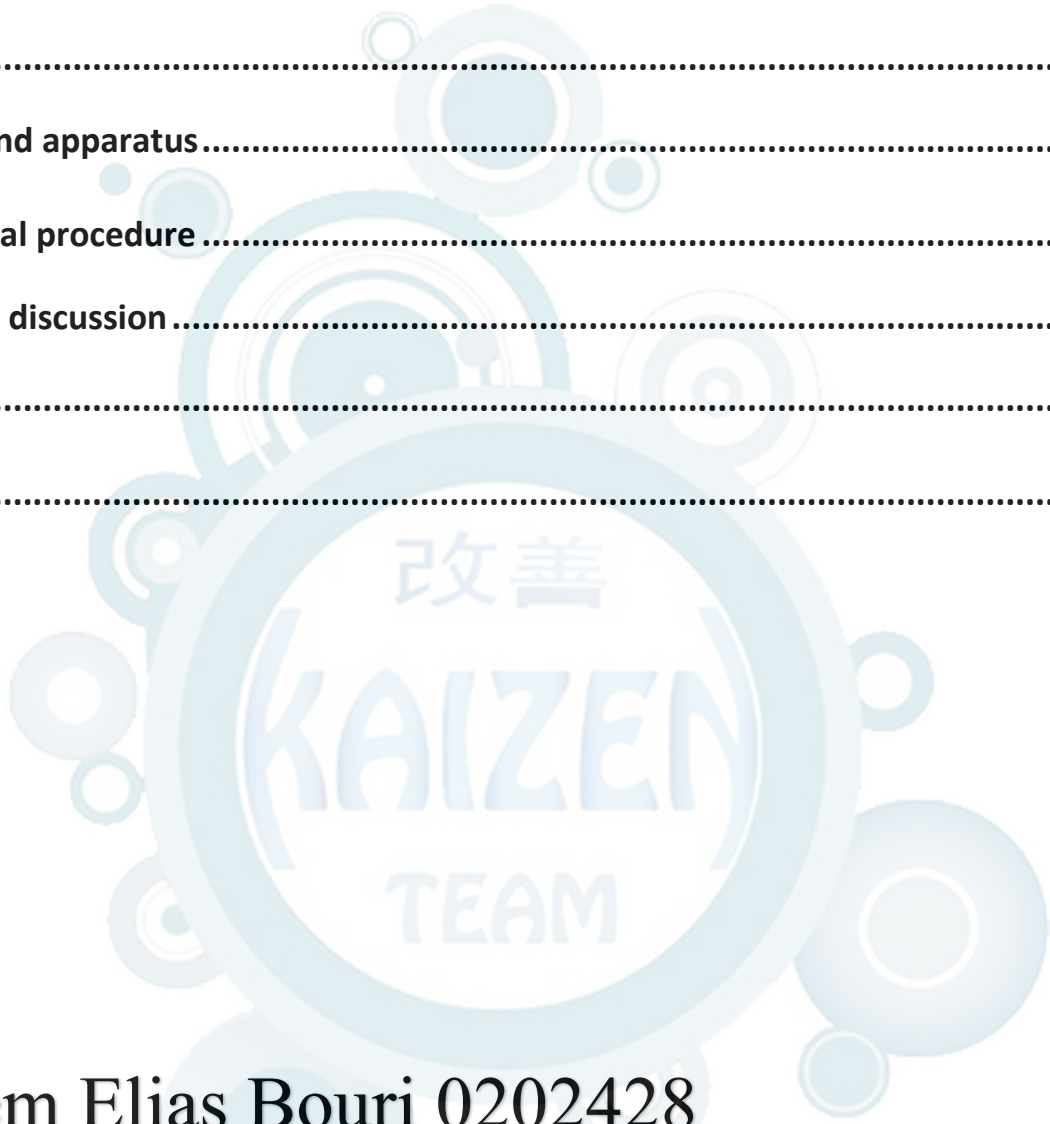
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The surface Hardening by Carburizing and Heat treatment after carburizing

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Safety is a state in which hazards and conditions leading to physical, psychological, or material harm are controlled to preserve the health and well-being of individuals and the community.

Before starting the experiment in laboratory, we must follow safety rules:

1. Put on protective clothing like lab coat, a pair of safety glasses and a pair of disposable gloves.
2. Do not hold a workpiece by hand. Use tongs instead because of high temperature degrees.
3. Stay away of the oven and deal carefully with it.
4. Do not taste or sniff chemicals.
5. Rings and jewellery must not be worn.
6. Long and loose hair must be contained.
7. Close fitting / protective clothing must be worn.

Objectives

To provide the student with knowledge about surface or case Hardening of low carbon steel by Carburizing and studying the mechanical properties after using this process, So in this experiment we will be hardening the surface of steel (carburizing it), then using Rockwell method of hardness measurement we determine the hardness of the surface with distances from the specimen's center to its edge.

MATERIALS :

- Specimen 0.15% carbon steel
- Carbon (Charcoal)
- stainless steel box
- Clay
- water

APPARATUS :

- Rockwell device
- Oven
- Timing Equipment

Materials and Apparatus

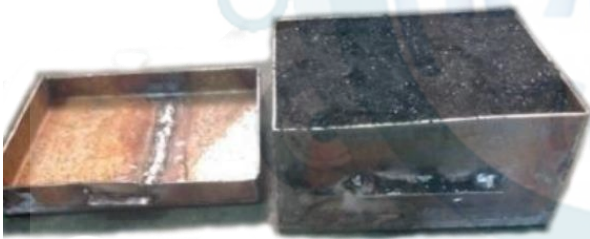


Experimental procedure

- 1) We filled the metal box with black coal called carbon powder.



- 2) We buried the specimen, which was a low carbon steel with a 15% carbon, inside the carbon powder, we added energizer, we covered it with mud to maintain the gases throughout the carburizing process and then we closed the metal box with a metal lid.



- 3) we put it in the oven at 950 degrees for 2 hours.



- 4) After the specimen is taken out the oven, a case hardening process is implemented by using another oven at 780 degrees for 30 minutes. After 30 minutes in the oven, the specimen should be cooled down using {oil} or {water}.

- 5) After it's cooled down, the specimen was cut in the middle into two halves. The first half is going to have a microscopic examination and the other half is going to be used to take hardness measurements using the Rockwell C-scale (HRC). We used the Rockwell C-scale because it is a hard metal.



- 6) To take the hardness readings, we set the Rockwell device on 150kN force, the indenter (diamond coin) at 12 mm. We put the specimen in the device, and we set a timer of 15 seconds for 3 rotations. Once the time is up, we take the readings off the edges then we add 2mm and take it from the middle, in the next round we add 4 mm, and we take the reading from the middle and so on. The readings are maximum at the edges.

• The readings obtained were:

- At 0 mm, the HRC was 58
- At 2 mm, the HRC was 55
- At 4 mm, the HRC was 53
- At 6 mm, the HRC was 51

Results and discussion

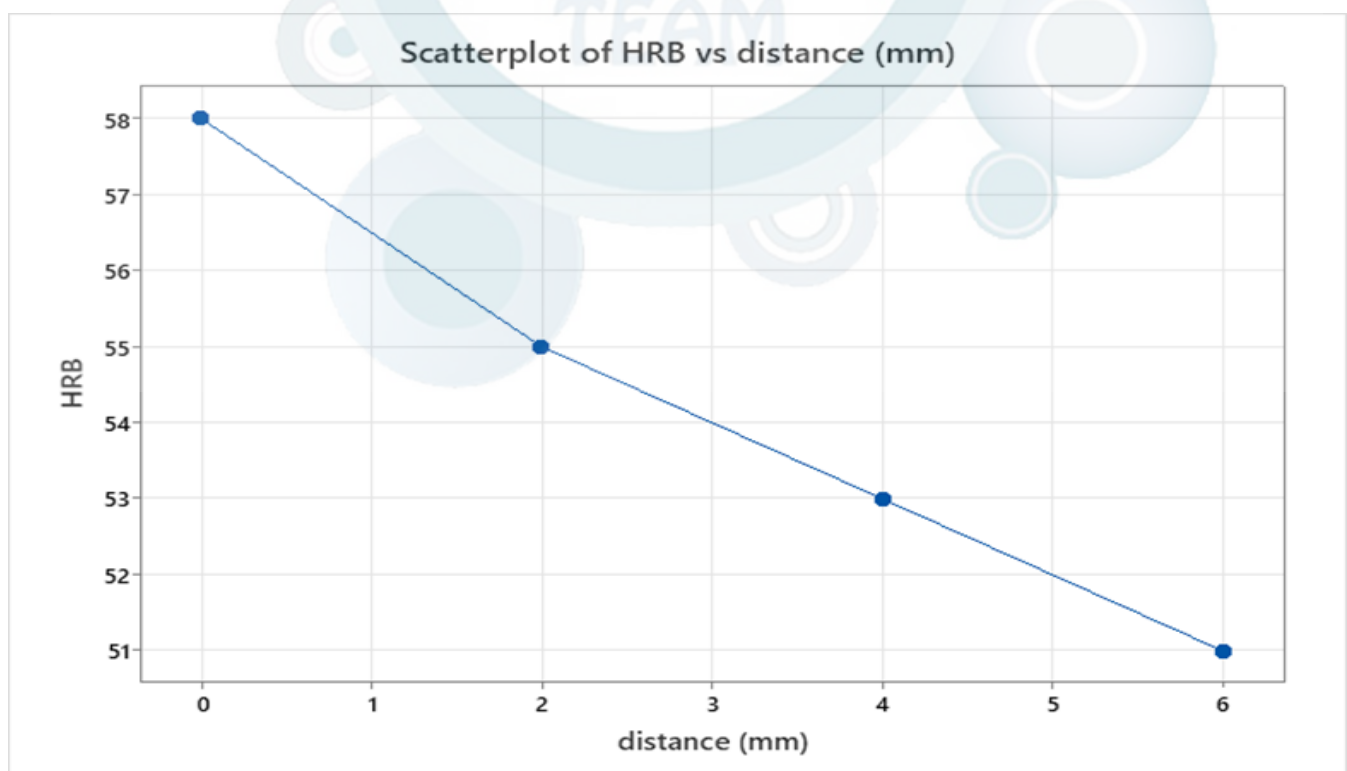
- ❖ In the beginning, we took a sample of stainless steel and put it in the box that contains the carbon steel powder, then put the clay on top of it and cover it with the special lid, then we put this box in the oven at 950 degrees Celsius for two hours.
- ❖ During this period, carbon monoxide should be developed by the presence of solid carbon Oxygen in trapped air:

$$2c + O_2 \longrightarrow 2CO$$
 On the surface of the workpiece, carbon monoxide releases carbon atoms:

$$2CO \longrightarrow CO_2 + C$$
 The released carbon atoms are dissolved interstitially on the surface of the steel.
- ❖ Then we turned off the oven, and then took out the oven sample from the box and put it in another oven at 780 degrees Celsius for 0.5 hours, then we cool it by water or oil, then we go to the hardening test experiment - Rockwell test -.

As a result, it seems to us that as we move towards the middle of the sample, the hardness decreases, and that the highest hardness value is at the edge of the sample.

Distance(mm)	0	2	4	6
HRC	58	55	53	51



Conclusion

In this experiment we used the (pack carburizing) on a low carbon steel with suitable core properties, thus our steel has become harder and more resistant to corrosion (wear resistant surface).

References

❖ References

- YouTube videos
- The manual
- Notes during the lab
- Wikipedia

❖ Technology

- Word