Fall 2019

**Laboratory 3**

Charpy Impact shock testing

**Objectives**

- To understand the basic properties of strength and toughness of materials

- To study the effect of temperature on impact toughness

**Reference**

ASTM Standards, specific references related to impact tests. Callister, section 8.6.

**Apparatus and Test specimen**

- Equipment

Olsen Impact Testing Machine. The machine consists essentially of a heavy free-swinging bearing-mounted pendulum, a rigid frame, and a vise or anvil for holding the specimen. The energy of the blow is determined by the mass of the pendulum and the height of fall. The energy absorbed by the specimen is the difference between the energy remaining after the blow and the energy input at the time of impact. After the specimen is broken, the pendulum carries a light-weight indicator pointer along an indicator scale, calibrated to read in foot-pounds of energy absorbed by the specimen.

- Materials

Carbon steel and 2000 series Aluminum alloy

**Lab Report**

Students should hand in a brief laboratory report containing:

1. Data Sheets

2. Data analysis (answers to questions)

3. Conclusions

**Background**

An impact test is a dynamic test in which a standard notched specimen is struck and broken by a pendulum, and the energy absorbed in breaking the specimen is measured. The most commonly used impact tests used for metallic materials are the Charpy and the Izod tests. In the Charpy test, the specimen is supported as a simple beam, and in the Izod test, it is supported as a cantilever. The results of the Charpy test gives a measure of the notch toughness of a material under shock loading. Since materials absorb more energy when they fracture in a ductile manner rather than in a brittle manner, the impact test is often used to assess the temperature of transition from the ductile to brittle state that occurs in materials like carbon steels, as the temperature is lowered.

**Data Analysis**

Measure the impact energy necessary to fracture Charpy specimens at two different temperatures (one high and the other low) between -60 C to room temperature. For the low temperature tests the specimens can be immersed in constant temperature baths of cooled alchohol. Note that the tests would be completed within 10 seconds after removing the specimens from the low-temperature bath.

Test process

1. Change the striking edge of the pendulum in order to perform the Charpy test.

2. Swing the pendulum back and secure it to the column with the safety “keeper”.

3. Place the specimen on the Charpy support anvil with the notched side opposite the striking edge.

4. Release the safety “keeper” and raise the pendulum to its proper position.

5. Set the dial on the indicating scale to the left hand side.

6. Release the pendulum by raising the lever on the latching device.

7. Read impact energy in ft-lb on the indicator scale.

RESULTS

Plot the energy absorbed by the steel specimens versus temperature. Include the results from all laboratory sections and given data. Examine the fractured region in the two specimens tested.

1. Explain how the values indicated in the tester (ft-lb) are achieved. (the height of the striking head is 4.4ft and the weight is 66lb)
2. Which of the specimens tested is plastically deformed around the fractured region and how does this correlate with the impact energy value?
3. Covert the ft-lb to Joule.
4. Briefly describe the appearance of the fractured surfaces of the four specimens.
5. Can the steel tested in this lab be used for storing liquid oxygen in a rocket? Explain. How about the Aluminum samples.

**Conclusion**

Please submit the Conclusions as a part of the Lab report, along with the Data sheets and Data Analysis.

Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Materials Laboratory Section\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Date\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

IMPACT TEST - DATA SHEET

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Test

(Charpy/Izod)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Specimen  Number | Material | Test Temperature °C | Absorbed Energy ft-lb | Type of Surface At Break |
| 1 |  |  |  |  |
| 2 |  |  |  |  |
| 3 |  |  |  |  |
| 4 |  |  |  |  |
| 5 |  |  |  |  |
| 6 |  |  |  |  |
| 7 |  |  |  |  |
| 8 |  |  |  |  |
| 9 |  |  |  |  |
| 10 |  |  |  |  |