TEAM ASSIGNMENT COVER SHEET

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Subject number and name	ENGG103 – Materials in Design
Subject coordinator	Mr. Mohammad Yousuf
Title of Assignment	Experiment 2 – Bending Test
Date and time due	October 22, 2023, 23:59:59
Lab Number	2

Student declaration and acknowledgement (must be read by all students)

By submitting this assignment online, the submitting student declares on behalf of the team that:

1. All team members have read the subject outline for this subject, and this assessment item meets the requirements of the subject detailed therein.
2. This assessment is entirely our own work, except where we have included fully documented references to the work of others. The material contained in this assessment item has not previously been submitted for assessment.
3. Acknowledgement of source information is in accordance with the guidelines or referencing style specified in the subject outline.
4. All team members are aware of the late submission policy and penalty.
5. The submitting student undertakes to communicate all feedback with the other team members.

Results

Table 1: Results from Mini – Charpy Impact Testing of V-notched samples.

Material	Sample Temperature (°C)	Width w (mm)	Thickness t (mm)	Depth d (mm)	Absorbed Energy E (J)	Fracture Energy W (J/mm²)
Brass	0	10	10	4	16.9	0.28
	21	10	10	4	14.7	0.25
	100	10	10	4	13.1	0.22
Aluminum	0	10	10	3	19.5	0.28
	21	10	10	3	20.7	0.30
	100	10	10	3	18.5	0.26
Steel 15 HRC	0	10	10	3	48.5	0.69
	21	10	10	3	93	1.33
	100	10	10	3	99.5	1.42

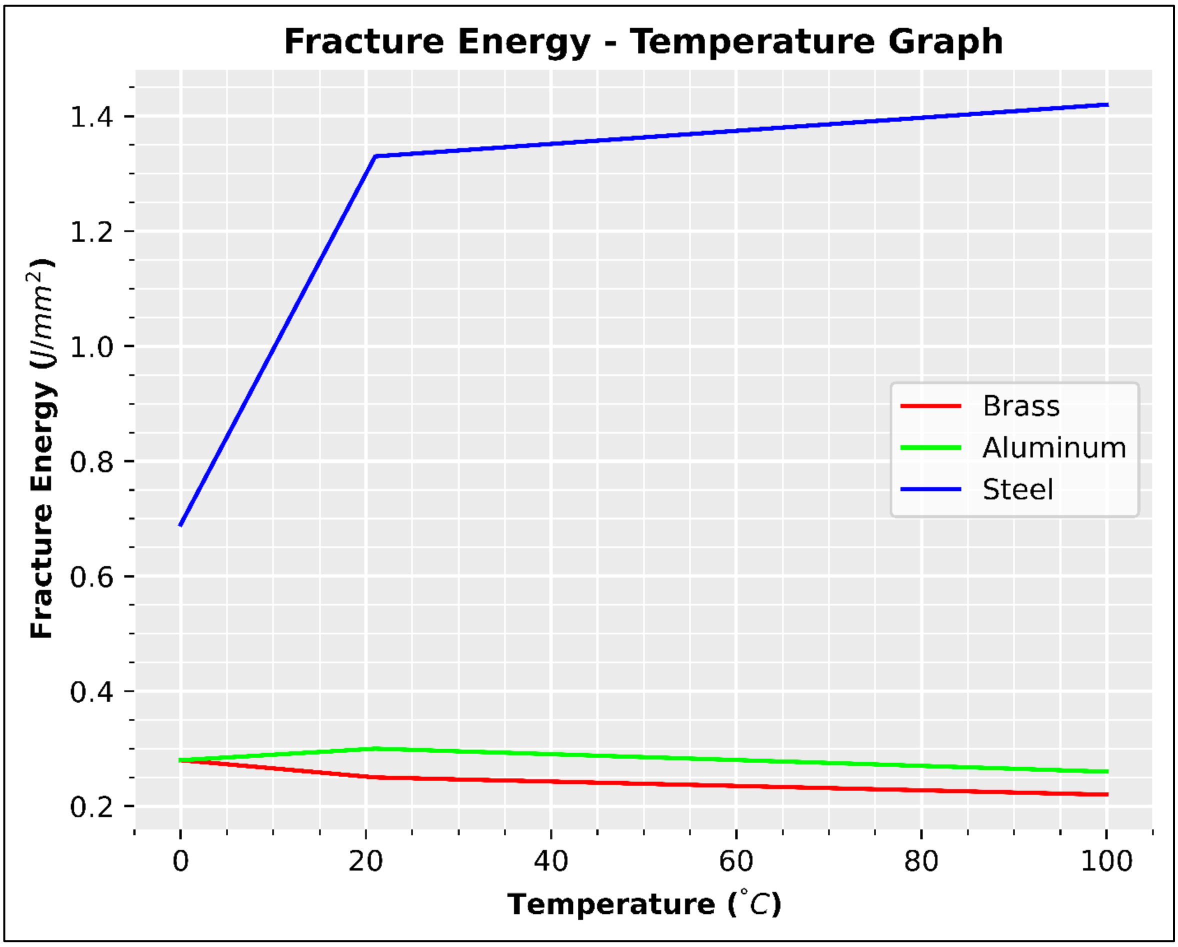

Figure 1 – Fracture Energy vs Temperature graph for all materials

Discussion

The scope of the experiment is to investigate the factors influencing the "strength" of materials, focusing on the effects of strain rate and temperature on material behavior, and comparing brittle and ductile failures in metals.

The results of the experiment are summarized in Table 1 and show the fracture behavior of three different materials (Brass, Aluminum, and Steel 15 HRC) at various temperatures. The data includes information about sample temperatures, dimensions (width, thickness, depth), absorbed energy (J), and calculated fracture energy (W) in J/mm^2.

The experimental results show that when temperature increases from 0 to 100° C, brass and aluminum reduce in fracture energy. However, conversely, steel has an increase in fracture energy.

The behavior of Steel 15 HRC stands out compared to the other two materials (brass and aluminum). This is because its fracture energy increases with temperature. This unique behavior indicates that steel becomes tougher and more ductile at higher temperatures, which is contrary to the decreasing fracture energy in brass and aluminum as temperature is increased.

Since the experiment investigates how temperature affects fracture energy (G_c), it has a connection to both impact energy and fracture mechanics. It shows that the fracture energy is temperature-dependent, which is consistent with the basic ideas of fracture mechanics, that consider variables such as crack size (a) and elastic modulus (E).

The results obtained validate the theoretical foundation of fracture mechanics, supporting the idea that as temperature increases, materials become more brittle and require less energy to propagate cracks. However, it was also revealed that this can vary depending on the material, as steel followed the opposite.

Looking at our table of results we can see that Steel 15 HRC, at a temperature of a 100° C, required the highest amount of energy (J) to fracture compared to our other materials, indicating its high fracture point and high fracture energy (J/mm^2). The inverse is true for Brass at 100° C, requiring the least amount of energy (J) to fracture and having least value for fracture energy (J/mm^2).

This experiment can contain errors if not done precisely, errors such as:

- Temperature of given material may not be accurate if left out of its cooling/heating container for too long before conducting experiment.
- The scale of the Mini Charpy impact Tester may not have been adjusted to 0 before the experiment.
- The position of material may not have been adjusted suitably for the experiment.

The sample for which we have obtained values greater than 25 Nm of energy in this experiment is due to the material having a very high fracture point. Therefore, it requires greater force by repeating the experiment to fracture it. Such is the case with steel. The material has absorbed the force and has not fractured but it has been permanently deformed and thus requires more energy to bring it to fracture point, so we reset the scale and repeat experiment again until the material fractures and adding up the amount of energy taken to break the material thus giving us a value greater than 25 Nm.