TECHNICAL REPORT WRITING FOR ENGINEERS
EXAMPLE DISCUSSION BASED ON THE CHARPY IMPACT TEST

Here is an example of a discussion based on the results from the Charpy impact test of steel at different temperatures:

5 Discussion

In this study, the impact fracture toughness of steel at different temperatures was investigated using the Charpy V-notch impact test. The results showed that it required more energy to fracture steel at higher temperatures compared to lower temperatures. At temperatures above 0°C the steel is more ductile than at lower temperatures and therefore required more energy to fracture. At temperatures below 0°C the steel is more brittle and required less energy to fracture. Therefore the impact fracture toughness of steel is greater at higher temperatures than at low temperatures. This trend in the data demonstrates that the steel experiences a ductile-to-brittle transition as the temperature decreases below 0°C and the impact energy required to fracture the steel is reduced. This is consistent with previous research investigating the impact fracture toughness of this type of low-carbon steel (Chao et al. 2007).

It is important to determine the ductile-to-brittle transition temperature of materials in order to predict how it will perform at different temperatures. If the steel tested in this experiment was to be used for a ship hull or an aircraft, it would encounter both high and low temperatures during operation. At room or increasing temperatures, the steel would be more ductile and more resistant to fracture. However, in cold sea water or at low air temperatures (below 0°C) this steel would be brittle and more likely to fracture on impact, which could be catastrophic. Therefore, this low carbon steel should only be used above its ductile-to-brittle transition temperature.

The Charpy V-notch impact testing was a simple and quick technique to determine the fracture impact energy of the steel at various temperatures. However, there was variation in the data between repeat measurements at the same temperature. As each sample had the same geometry, was consistently positioned using the centering pin and was tested in the same instrument with a pendulum of known mass and length released from the same height each time, the variation is likely to be due to the temperature of the steel samples. Even though the samples had sufficient time to reach thermal equilibrium (in this case more than 1 hour, with the exception of the sample placed in liquid nitrogen), the time taken to load the steel into the Charpy impact tester varied which would have caused the sample to either warm or cool, leading to variation in the data.

This is just one example of what you could include in a Discussion. A more detailed discussion could explain why the appearance of the fractured surfaces differs at different temperatures and discuss other variables that influence the test results, such as size, shape and composition of the test sample. Thinking forward to the conclusion, you could also consider how this experiment could be improved. For example, for a more accurate ductile-to-brittle transition temperature range more measurements at other temperatures would be required.