Prifysgol Cymru
Y Drindod Dewi Sant
University of Wales
Trinity Saint David

The effect of impact damage on materials

Ashley Morris
Rob Goodson

School *of* **Engineering**
BEng (Hons) Mechanical Engineering

Introduction

The world of engineering has changed significantly since the introduction of new manufacturing processes. Composites such as carbon fibre and fibreglass have changed the aerospace and automotive industry immensely, with a shift further towards weight reduction to improve the efficiency and performance of planes and cars. This begs the question by moving away from more traditional materials such as aluminium, does this cause a safety issue with vehicles when projectiles make's contact with the vehicle?

The idea behind this report came as I was thinking about the debris that encounters planes and cars throughout their years in use.

$f=1/2\pi \sqrt{(k/m)}$ $E=1/2\ mv^2$

Background

Modern structures of cars and airplanes have started to use reinforced plastic composites; this is due to their high specific mechanical properties. These reinforced composites do however, tend to be brittle and susceptible to low velocity impact. These low velocity impacts tend to leave a small surface damage; these small damaged parts are barely visible. Such damage may be small and hardly noticeable but can damage the internals of the material. This will reduce the strength of the material, which in due time will result in the delamination slowly expanding under stress that can be potentially lead to failure (Meo & Polimeno, 2009).

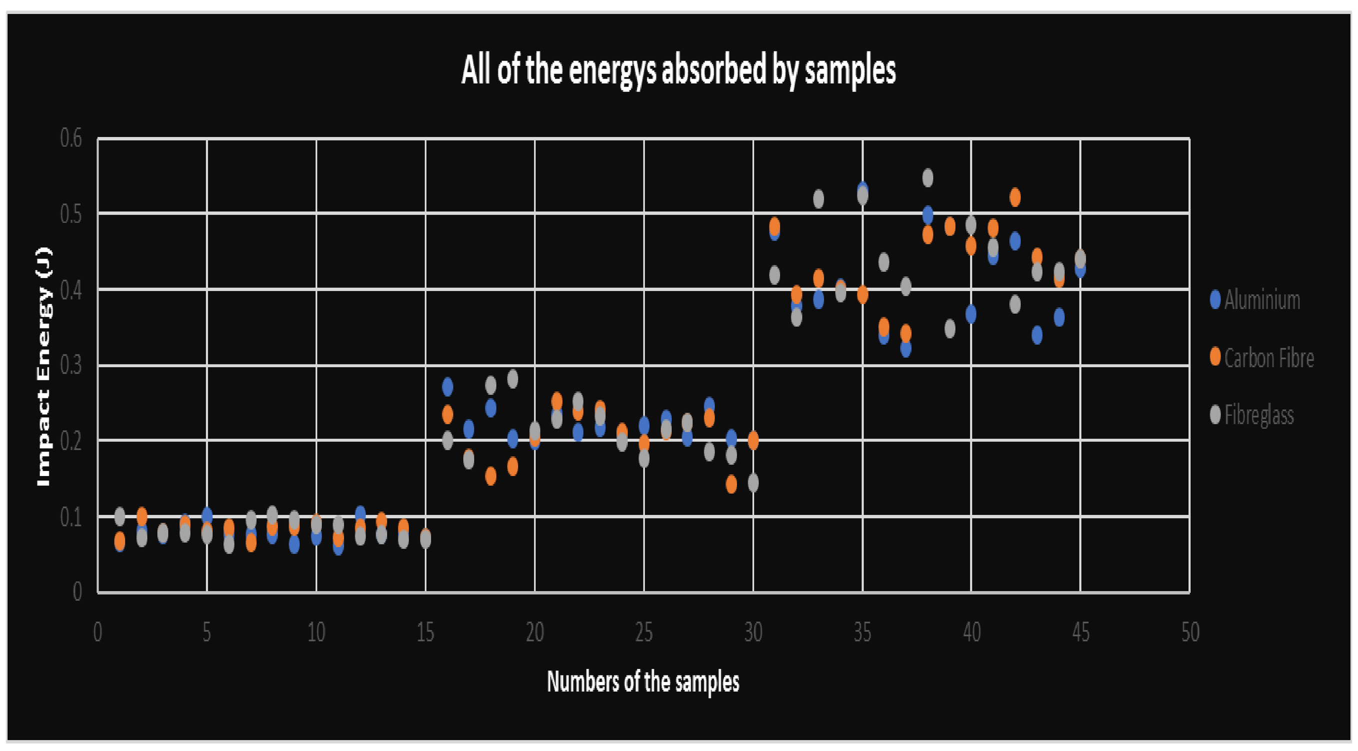
The aim of the investigation is to see the affect that projectiles have on material.

Images of all of the test samples, these include the damage and undamaged test samples.

This was the set up used for non-destructive testing, by using the laser Doppler vibrometer

The laser Doppler vibrometer used for non-destructive testing .

LDV is a form of measuring velocity resolution and displacement. This will be the main way of detecting the damage done throughout the test samples. This is done by measuring the frequency of the test samples and seeing if they have changed from when they were damaged. If the frequency has decreased then this means that the part has been compromised.



Each test sample and their impact energy that was absorbed by the part.

The table shows the aluminium and composite test pieces that were anomalies found when the experiment concluded.

Aluminium test samples	Carbon fibre	Fibreglass
17	12	82
46	87	85
47	103	114
65	120	69
92	15	81
		7

The samples shown had either frequencies from the testing either considerably lower than average or considerably higher.

The results from the LDV testing showed that carbon fibre and fibreglass were affected by the experiment with drops in stiffness for both materials, both materials also saw a decline in stiffness as the impact energy increased, this is what was expected and predicted at the beginning of the investigation. The aluminium samples on average did not show any loss of stiffness from the experiment, as found in the analysis this might be caused by the face of the projectile that makes contact with the test sample, that significantly affects the damage that the aluminium receives.

Acknowledgements

I'll begin by thanking Robert Goodson, Andrew Tibbott, Dave Cooper, Leezann Davies, Kelvin Lake and all the staff in UWTSD that have helped me in their assistance for the duration of this project. Special thanks to my family for helping me throughout this part of my life.

References

Meo, M. & Polimeno, U., 2009. Detecting barely visible impact damage detection on aircraft composites structures. Elsevier Ltd, pp. 398-402.