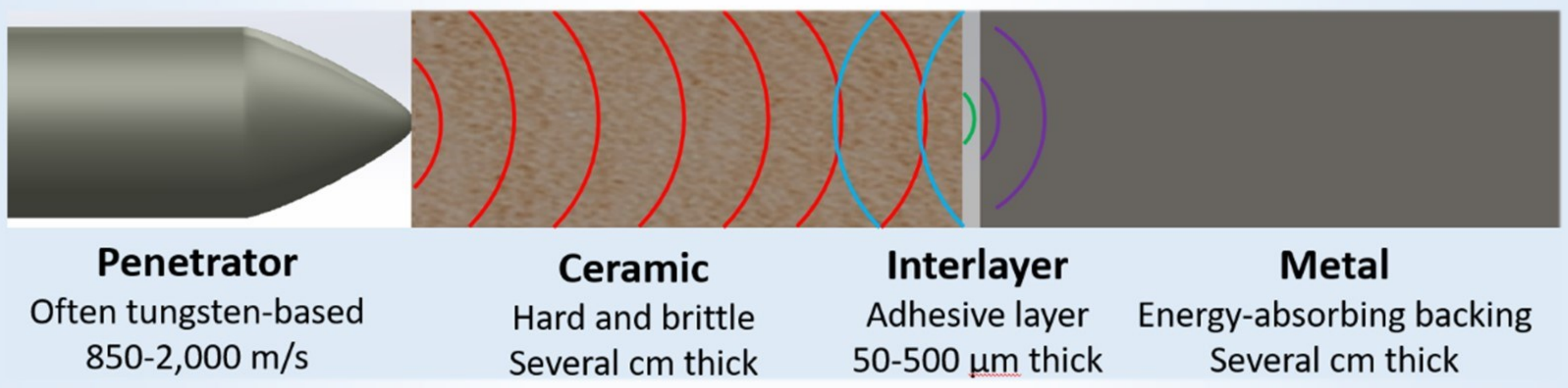
Critical interlayers and interfaces in ceramic armour systems

4th year PhD

1. Introduction - the problem

Vehicle armour must be capable of resisting multiple types of threat. One such threat is **kinetic energy armour-piercing projectiles**; these aim to penetrate armour by directing immense energy into the target at velocities of up to 2,000 m/s using dense materials.

Ceramic armour systems are currently used to resist this threat. These comprise of a **ceramic disruptor** and a **metallic absorber**, connected through a comparatively thin (and under-researched) **interlayer**.



Controlling the passage of shock waves (generated upon impact) through this interlayer could potentially minimise damage to the ceramic, increasing erosion of the incoming projectile. This control would be achieved through optimisation of interlayer **acoustic impedance** - a property governing how acoustic waves (and shock waves) pass through materials.

2. Proposed solutions

Multiple possible solutions were identified to compare against the datum solution of pure epoxy resin.

Brazed metallic interlayer
50 µm thick
High impedance
No disruption to shock wave

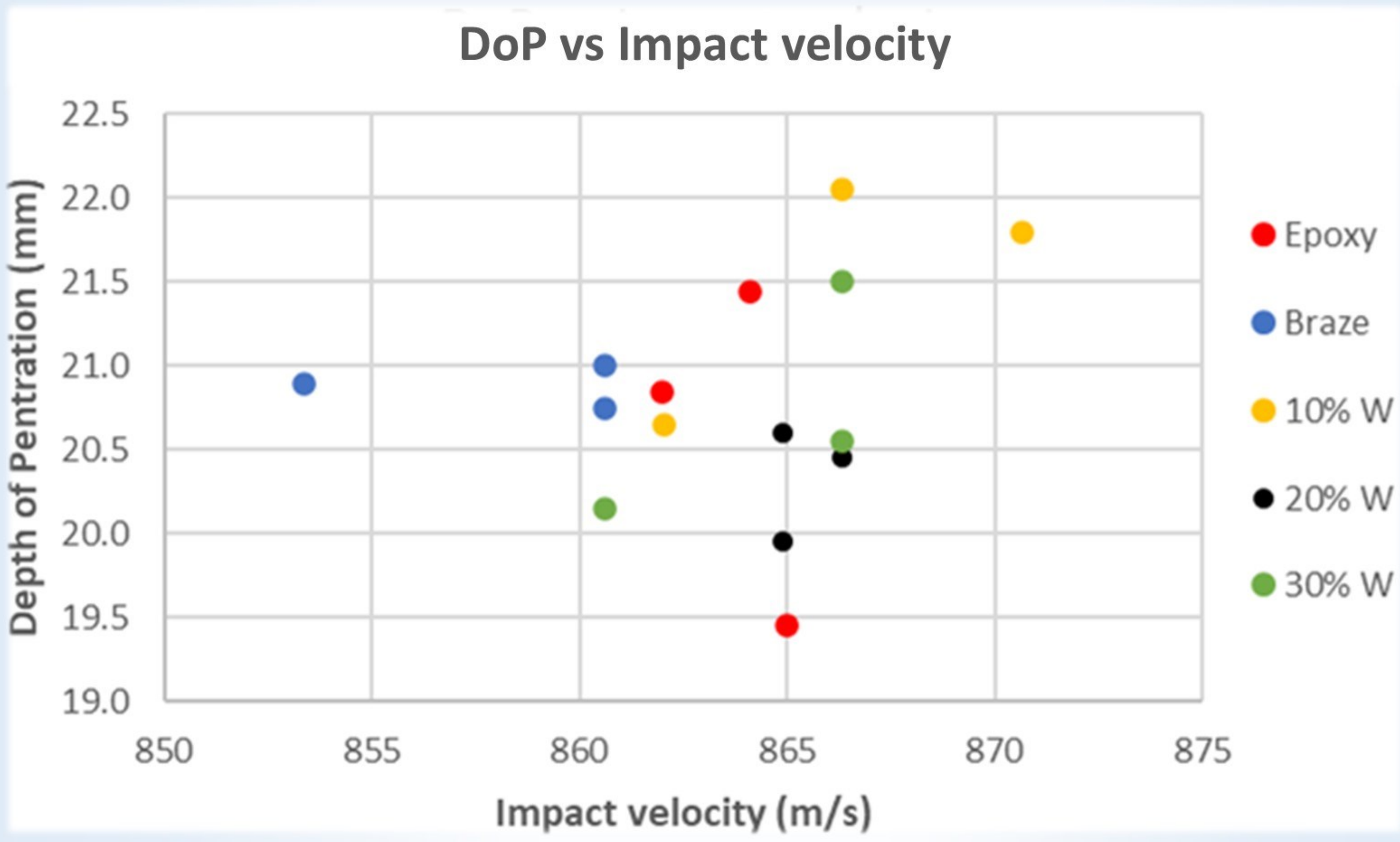
Tungsten(W)-doped epoxy interlayers (10%, 20%, 30%)
250 µm thick
Low-medium impedance
Disruptive to shock wave

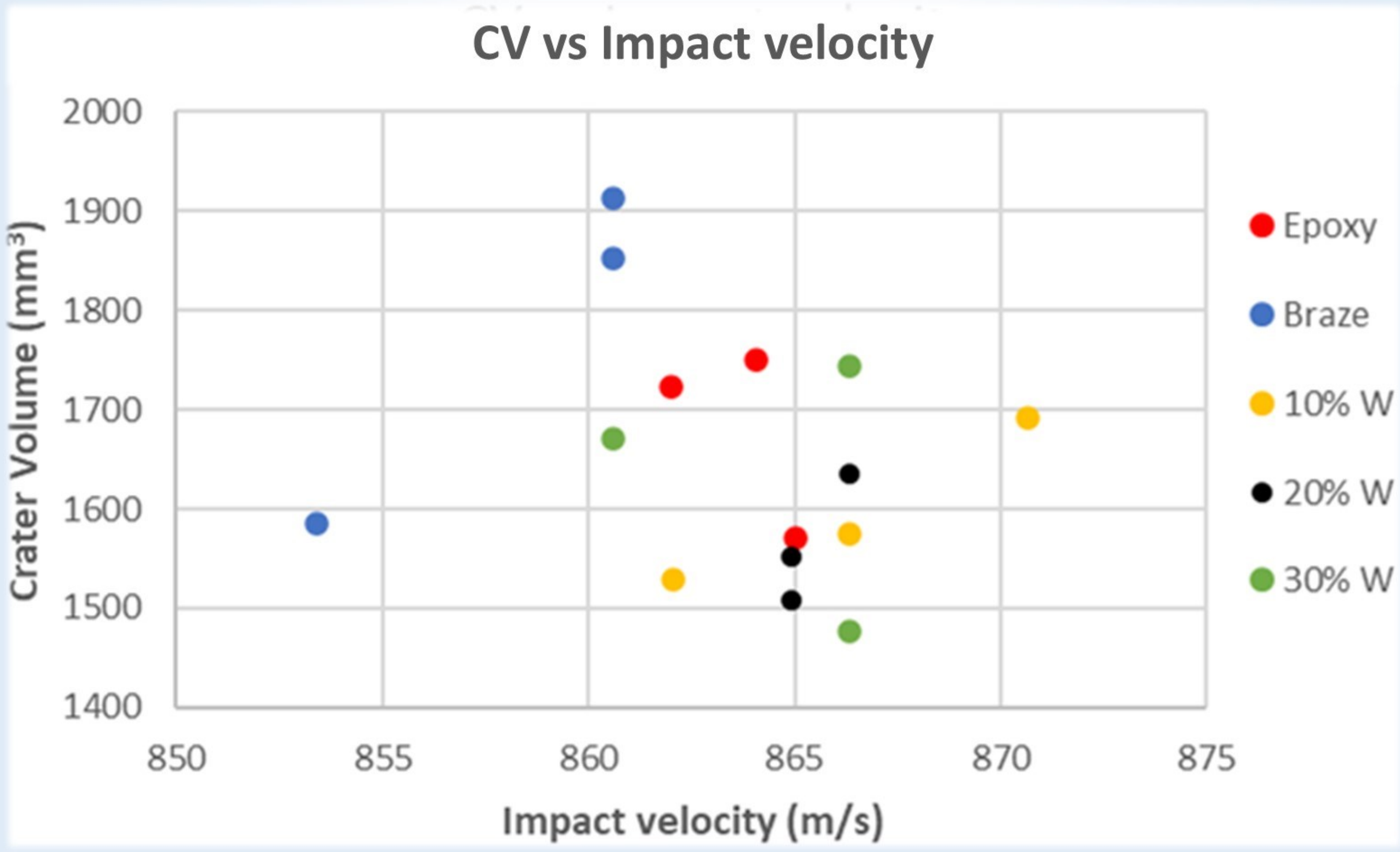
3D-printed ceramic with brazed metallic interlayer
100 µm thick
High impedance
Disruptive to shock wave

3. Results

Targets were manufactured to be as consistent as possible, **varying only the interlayer**. 3D-printed ceramics have not yet been tested.

WNiFe long rod penetrators were fired into each target. The depth of penetration (DoP) and crater volume (CV) in the backing steel were recorded to observe any difference in armour performance.





4. Conclusions

No significant differences were seen between various interlayer solutions. This data therefore **does not support the hypothesis** that the acoustic impedance of the interlayer can improve armour performance.

However, there are typically lower crater volumes in epoxy or doped epoxy interlayers compared with brazed interlayers. Interlayers may therefore influence crater formation and/or energy transmission in armour. This may lead to other benefits in armour systems.

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