Effects of Sensor Spacing and Material Thickness of Al 6082-T6 using Acousto-Ultrasonics Technique

1. INTRODUCTION

- Acousto-ultrasonics (AU), as a technique for non-destructive evaluation of structures, provides the ability to detect and characterise defects, damage responses and variation in properties of materials *(Gong et al., 2022)*.
- The accuracy of acousto-ultrasonics testing depends on many factors, such as, coupling (contact pressure and type of couplant), emitted ultrasonic pulse (emitter transducer type, pulse energy and pulse or burst mode), received signal (receiving transducer type, gain and signal gating) as well as relative spacing of the transducers on lamb wave mode propagation *(Bhatt et al., 1988)*.
- This present study mainly focused on the effects of relative spacing of the transducer and the thickness of Al 6082-T6 specimen on AUT implementation keeping other parameters constant.

2. EXPERIMENTATION

❑ Experimental Methods/Design

- The Stress Wave Factors (SWFs) as proposed by *(Vary, 1987)* is utilised to achieve the AU experimental results.
- Acousto- Ultrasonics Testing (Fig. 1), at sensor spacings fo 60 mm, 90 mm and 120 mm; material thickness (Al 6082- T6) of 1 mm and 3 mm.
- For Wave Excitation, the frequency range used: 100 kHz-1000 kHz; Initiation amplitude: 3V and 0.5V.

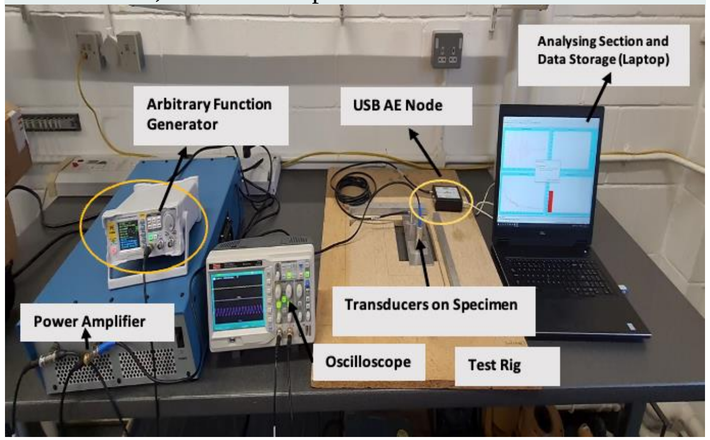
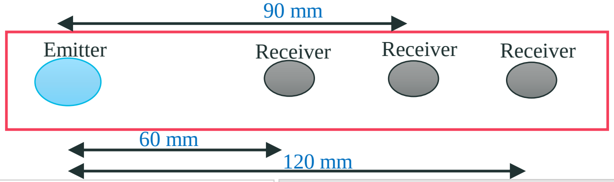


Fig. 1: Acousto- Ultrasonics Experimental Setup

3. RESULTS AND DISCUSSION

Dependency on Sensor spacing



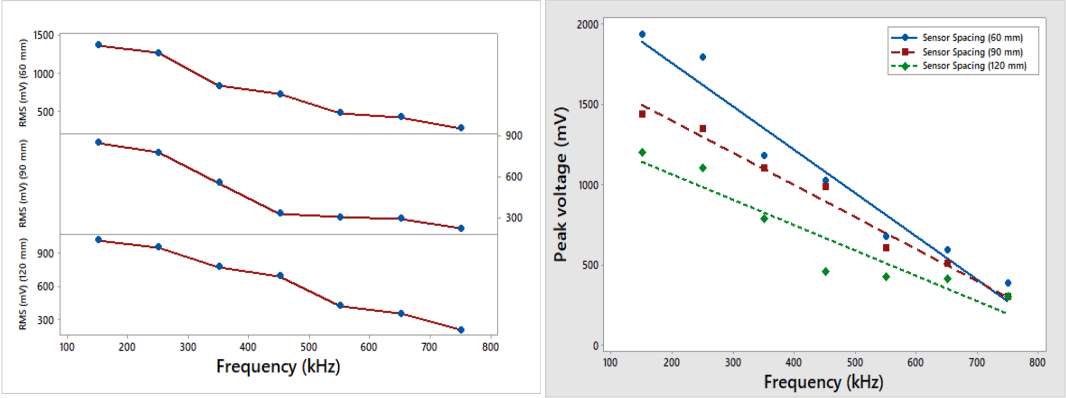
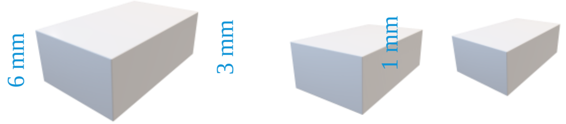


Fig. 2: Effect of Sensor Spacing on SWFs (Peak voltage and RMS value)

Dependency on Material Thickness



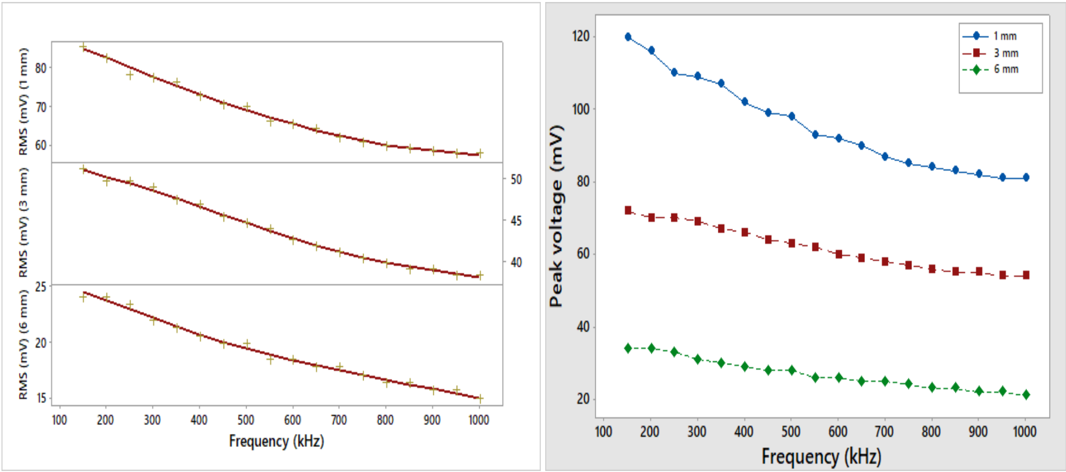


Fig. 3: Effect of Material Thickness on SWFs (Peak voltage and RMS value)

- The SWFs are highly dependent on the sensor spacing and the material thickness as can be seen from the Fig. 2 and Fig. 3, respectively.
- Both, the peak voltage and the rms voltage are diminishing their values with the increase in the thickness of the material tested and the sensor spacing.
- As per the experiment, calculated SWFs, experimentally are:

✓ $V_{Peak} \propto 1/\text{Sensor Spacing}$
✓ $V_{Peak} \propto 1/\text{Material Thickness}$
✓ RMS value $\propto$ 1/Sensor Spacing
✓ RMS value $\propto$ 1/Material Thickness

4. CONCLUSIONS

- Evidently, as the sensor spacing and the material thickness increases, keeping all other factors constant, the value of SWF (Peak Voltage and Root Mean Square) decreases, in both cases.
- Also, the SWF decreases towards the higher frequency ranges.
- Conclusively, it can be advised that if the thickness of the material is high or sensors are placed at large distance apart while doing damage detection using AU, it is suggested/better to use higher excitation/ initiation amplitude through the exciter.
- As a future work and investigations, the same sample could be studied with other parameters to check their effects on the wave propagation and SWFs implementing AU technique.

5. REFERENCES

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