Work stages: Activity 3

Milestone: 6

Milestone name: Ultrasonic and optical measurements of pultruded profiles in stationary conditions

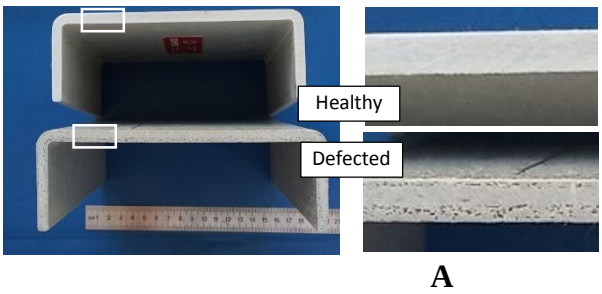
The aim of this research section was to investigate the possibilities of creating a methodology for automated real-time assessment of the quality of pultruded products (composite profiles of various cross-sectional shapes) at the die exit. The main problem is the detection of latent defects invisible to the eye such as porosity, delamination and poor sintering inside the sample.

Methods:

- Traditional ultrasonic testing method used in the laboratory for reference estimations: USPS-3010-Industrie of Dr. Hillger Ultrasonic Techniques immersion scanner with XYZ stage; B-scans of cross-section by 2.5 MHz probe in a water tank.
- Ultrasonic testing method proposed for the use in industrial conditions: Custom-made ultrasonic device with arbitrary waveform generator and amplifier-digitized circuit; 2D waveform profiles of surface obtained by contact transducers at 300 kHz and 100 kHz, Lamb waves.

Materials: Healthy and defected C-shape pultruded composite profiles obtained from COMPOR SIA (Salaspils, Latvia). Defects: pores sized 0.2 – 0.5 mm, concentration 10-20%, located near bottom surface.

Results: The main manifestation of the presence of structural defects in sintered pultruded composites revealed by both techniques is a notable damping of signals reflected from the bottom surface and signals propagated along the plate. The effects are explained by the action of pores that increases ultrasonic scattering in the material at every ultrasonic frequency in the kilohertz and megahertz ranges.



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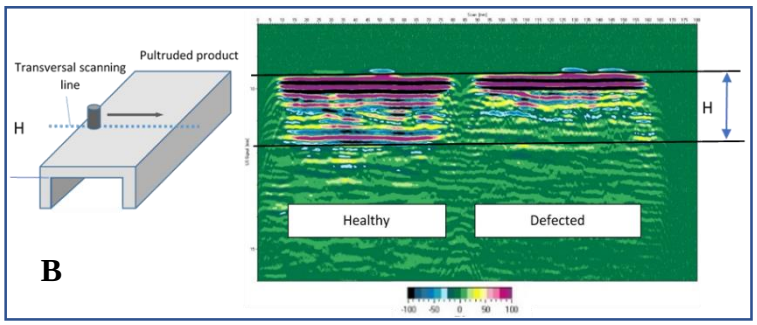

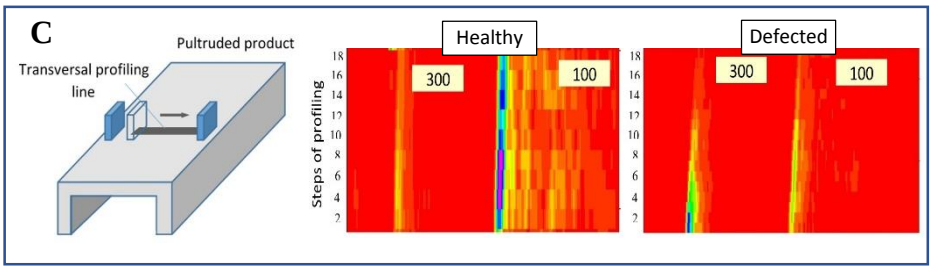

A: *Healthy and defected C-shape pultruded profiles;*

B: *B-scans of cross-section by immersion scanner at 2.5 MHz;*

C: Transversal 2D waveform profiles at 300 and 100 kHz

Conclusion: Ultrasonic testing in a lower kilohertz frequency range using 2D waveform profiles of Lamb waves is an appropriate technique for the detection of inner defects appeared in pultruded products and suitable for the use in industrial environment.

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