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Ultrasonic Guided Wave Inspection of Composite Structure with Air Coupled Transducers

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Abstract: *Air coupled ultrasonic Non -destructive inspection (NDI) is considered a viable option to the Ultrasonic water jet based systems which are currently used to check the composite structures. Present research paper demonstrates experimental method of inspection E-glass composite laminate using ultrasonic guided wave technique using air coupled transducers.*
Keywords: *Composite structures, guided waves, air coupled transducers, Ultrasonics, NDI.*

I. Introduction

The various applications like (FRP) composite materials in aerospace, high strength military and civilian structural applications, corrosion resistance, and modulus have provide excellent performance. During visual inspection, delaminations are the most common sub-surface damage, which cannot be detected. In order to address this issue, ultrasonic non-destructive testing (NDT) methods are used to find the damages. The conventional immersion inspection method is monotonous and cumbersome. Air Coupled Ultrasonic's is an advanced non-destructive testing method which explores an innovative viable services and non-contact testing of materials. It has various advantages like removal of couplant and its application time, accelerated inspection etc

The user can allow test samples which cannot be wetted compared to contact testing [1].Probably for the past two decades, Ultrasonic-Nondestructive evaluation (NDE) method is mainly based on the guided wave propagation. The growth aspect of commercial and industrial environment made key recipients for a transfer from scientific and technological areas. Deployable arrays used of transducers to generate and receive guided waves in pipelines. It is accomplished to achieve the successful commercial application in pipe lines. It allows fast screening of these structures and loss of cross sectional area can be evaluated.

The detection and location capability of low frequency guided waves are excellent. A standard screening technique only estimates the residual wall thickness. A conventional NDE technique is used for complement guided wave inspection for exact size considerations. The growth aspect of oil companies are handling protocols to extent the pipeline inspection with equipments. Guided waves have peculiar properties that can be used for the evaluation that remaining thickness in the key structure in which they are propagating. Researchers have looked up into various approaches like dispersive nature, velocity variation with frequency thickness product. Moreover, the cutoff frequency thickness products of higher modes can be used for thickness evaluation over the large areas. The major key concern of petrochemical mapping industry is a challenging for pipe wall area, particularly mapping the remaining pipe wall over large area with defects of diameter 3 to 4 times the pipe wall [2].For details regarding guided wave ultrasonics and composite materials see [3-9].

II. Experimental Set Up

The self explanatory figures of complete experimental setup and transducer arrangements are as shown in figures 1a and 1b.

Figure1a: Complete experimental arrangement consisting of Ritec Pulser Receiver system, XY scanner for c-scan imaging system, Ultran air coupled Transducers-glass laminate.

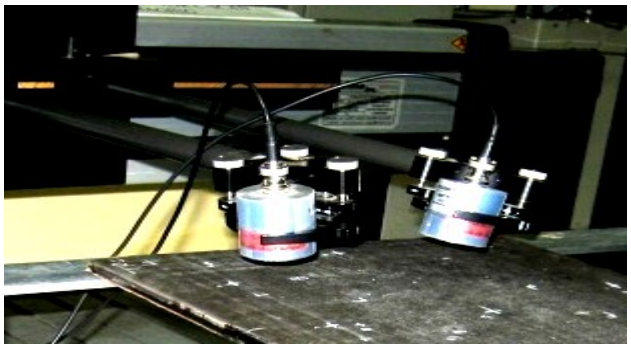

Figure 1b: Transducer arrangement

A. Instrumental Settings:

Frequency of transducer=200 KHz
The distance between laminate and receiver is fixed = 35mm
Distance between two transducers=60mm
Tone burst voltage=365V (p-p)
Gain=20dB
PW cycles=3
PW used=15
RR=20Hz

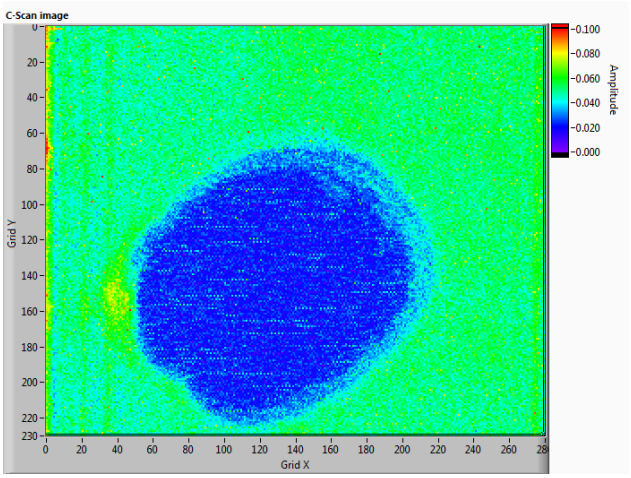

Figure2a: C-scan image

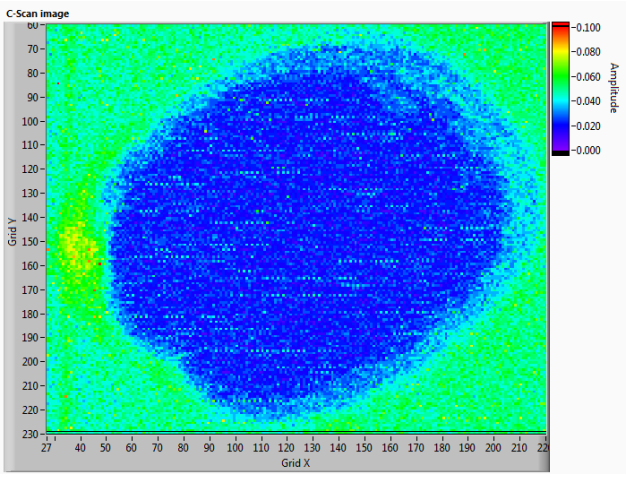

Figure2b: Defective area

C.Experimental Results

X-scale=220-27=193mm
Y-scale=230-60=170mm
Defective area=193X170=32810mm^2

III. Conclusion

The above research provides us detailed information with regard to how low-frequency NC ultrasonic's can be used as a non destructive diagnostic technique for composite structure up to 25mm thick. There is an particular need of NC(Non Contact) operation to be addressed, which can further can held up based on surface preparation, couplant, and operator errors. The various operations which are associated with non contact transducers are becoming more popular.

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