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Estimation of Oxide Layer Thicknesses in Nuclear Reactor Pipe Lines Using Ultrasonic Transit Time Measurements

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Abstract

Ultrasonic thickness gauging is used for measurement of coating thickness of oxide layer and monitoring of corrosion process in the pipe lines of nuclear reactor. However, when the thickness of the coating/oxide layer becomes very thin ($< 30 \mu\text{m}$) and the coating/layer is loosely bonded with substrate then ultrasonic thickness gauging may fail. Such situations are not uncommon in the PHWR pipelines. The estimation of thin oxide layer thickness is important for decontamination and hot conditioning of reactors. At present there is no other NDT method available for the correct estimation of thin oxide layer. Successful experimental attempt has been made at IGCAR to estimate oxide layer thicknesses in the range 20-30 μm by measuring ultrasonic transit times. Cross correlation technique using LabVIEW software programme has been employed for precise transit time measurements. Theoretical studies are conducted in parallel to estimate the transit time of the composite waveform arising out of the interference of two waves; one from the metal/oxide layer and the other from oxide layer/air interfaces. Very good correlation was established between theoretically predicted and experimentally obtained oxide layer thicknesses. Results indicate that precise ultrasonic transit time measurements combined with good theoretical understanding are desirable for reliable estimation of oxide layer thickness $< 30 \mu\text{m}$.