Detection of the thickness loss in the ferromagnetic steel pipe covered with insulation using Pulsed Eddy Current

M.B. Kishore*, Duck-Gun Park†
Nuclear Materials Development Division, Korea Atomic Energy Research Institute, Taejeon, South Korea -305-353,
†Corresponding author: dgpark@kaeri.re.kr

The thickness loss by corrosion of pipeline during operation in the power and oil industry is important problem to threat the integrity of plants. Therefore, local wall thinning is a point of concern in almost all steel structures such as pipe lines, and pipelines are usually covered with a thermal insulator made up of materials with low thermal conductivity (fiberglass or mineral wool); hence, NDT methods that are capable of detecting the wall thinning and defects without removing the insulation are necessary. The pulsed eddy current (PEC) technique offers an alternative to these conventional techniques because of its potential advantages such as less susceptibility to interference and less power consumption owing to the use of short pulses, which are more desirable specifications in the development of portable instruments. In the present study, a PEC system to detect the wall thinning of a pipeline without removing the insulator is proposed. The PEC system consists of a pulse amplifier, a probe with a driving coil with a magnetic field detecting sensor (Hall-sensor), a sensitive differential amplifier with variable gain to amplify the output voltage from the Hall-sensor, a A/D converter, and a computer with signal processing software. The PEC probe characteristics are determined by a combination of measuring environments such as induced current, insulation thickness, and sample thickness. The excitation coil in the probe is driven by a bipolar rectangular current pulse; the time domain features of the detected pulse, such as ‘peak value’ and ‘time to zero’ were used to describe the wall thinning in the tested sample. A real-time LabVIEW program was developed for the data acquisition and for scanning the probe on the insulated sample. The scanning results were continuously displayed on the computer monitor. To simulate the wall thinning of a steel pipe, a mock-up of a wall thinned pipe was fabricated. The strength and duration of an induced pulse signal resembles the average wall thickness that can be measured. The duration of the eddy currents will have an effect on the transition period of the detected pulse. The system was applied in the mock-up sample with various thickness regions covered with a 95 mm thick insulator with galvanizing cladding. The system can distinguish a wall thickness of 2.5, 5, and 8 mm under 95 mm insulation covered with 0.4 mm of stainless cladding.

Keywords: steel pipe, wall thinning, pulsed eddy current, Hall-sensor