Defect characterization of corrosion under insulation using eddy current inspection with an encircling coil geometry

Joseph Bailey[1], Gideon Gouws[2], Nicholas Long[3]

[1]Robinson research institute, victoria university, New Zealand, [1]School of engineering and computer science, Victoria university, New Zealand, [1]Robinson Research Institute, Victoria university, New Zealand

Current methods to identify corrosion under insulation can be slow and lack spatial resolution. An eddy current testing scheme for corrosion under insulation inspection has been developed that uses a coil that encircles the pipe and an array of tunnel magnetoresistance sensors around the coil's circumference. This scheme can have higher spatial resolution than planar excitation coils typically used in eddy current systems. In addition, it offers the potential for high-speed inspection of insulated pipes with the whole surface measured in a single pass when an array of low-cost tunnel magnetoresistance sensors is used. Using this testing scheme, the effect of corrosion on the induced magnetic field's magnitude and phase change in the axial, radial and azimuthal directions has been investigated through FEM simulations. In addition, the eddy current distribution in the pipe has been extracted from the simulations. Then, using Biot-Savart's law, equations have been developed describing the shape of the magnetic field produced by corrosion. These equations highlight how the system's geometry affects the measured magnetic field and suggest approaches to system design to maximise the ability of the system to detect corrosion. Using the information from the simulations and equations, a method has been produced that, given a set of peaks in the magnetic field produced by a patch of corrosion, the surface extent and depth of corrosion can be estimated. This method's effectiveness has been assessed on a range of simulated data to test its limits and accuracy of corrosion size estimation. A laboratory test system has been built that can test 3 meters of 10-inch pipe with a series of pockets removed to represent areas of corrosion. This system has been used to verify the efficiency of the simulation and the ability of the corrosion sizing method to determine the dimensions of the pockets removed from the steel pipe.