Mechanical Properties Characterization and Finite Element Analysis of Epoxy Grouts in Repairing Damaged Pipeline

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ABSTRACT

Oil and gas pipelines are subjected to various types of deterioration and damage over long service years. These damaged pipes often experience loss of strength and structural integrity. Repair mechanisms have been developed in restoring the loading capacity of damaged pipelines, and composite repair systems have become popular over the past few years. The mechanical properties of the putty/grout are critical to their potential applica-tion as infill materials in structural repair. In this paper, the compression, tensile, and flexural behavior of four epoxy grouts was investigated through laboratory tests. The stiffness of the grouts for compression, tensile, and flexural was found to be 6 GPa to 18 GPa, 4 GPa to 15 GPa, and 4 GPa to 12 GPa, respectively. The ultimate strength for all grouts was found from 62 MPa to 87 MPa, 18 MPa to 38 MPa, and 34 MPa to 62 MPa under compression, tensile, and flexural tests, respectively. The behavior of all the tested grouts is discussed. A finite element (FE) model simulating a composite-repaired pipe was developed and compared with past studies. The FE results show a good correlation with experimental test with margin of error less than 10%. By replacing the infill proper-ties in FE model to mimic the used of different infill material for the repair, it was found that about 4–8% increment in burst pressure can be achieved. This signifies that the role of infill material is not only limited to transferring the load, but it also has the potential to increase overall performance of composite-repaired pipe. [DOI: 10.1115/1.4041792]

Keywords: composite repair, finite element analysis (FEA), infill material, mechanical properties, pipeline