

REINFORCING FIELD FABRICATED BRANCH CONNECTIONS USING COMPOSITE MATERIALS

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ABSTRACT

Field fabricated branch connections are manufactured in lieu of forged tee fittings. To be used in accordance with ASME B31.8, these connections are subject to the area replacement method to ensure that sufficient material is present to reinforce the opening in the run piping. If insufficient material is present in the weld itself, pads are welded into place to serve as the reinforcing mechanism. One question posed recently to Stress Engineering Services, Inc. and Armor Plate, Inc. by a gas pipeline company was the feasibility of using composite materials to reinforce previously-fabricated branch connections that did not have sufficient steel material present to satisfy the requirements of the area replacement method.

Initial evaluation of the concept involved calculating the strength required to ensure that the branch connection would have sufficient long-term strength to withstand operating condition. Elastic-plastic finite element analyses were also performed using limit analysis methods to determine the minimum composite thickness that was required. Once all analytical efforts were completed, a full-scale test was performed on an exemplar branch connection fabricated from a 24-in x 0.375-in pipe and a branch pipe fabricated from 12.75-in x 0.375-in pipe (both Grade X42). Pressure levels exceeding 2.9 times the MAOP of the 24-inch pipe (787 psi) were reached before the branch connection leaked at a maximum pressure level of 2,314 psi. This burst pressure is 1.76 times SMYS. A burst in the connection did not occur, but rather a leak developed in the weld joining the branch and the run pipes and most likely initiated in the crotch region where the highest levels of strain occurred during pressure testing.

Considering the results of the test program and the calculated results, the pipeline operator concluded that a sufficient design margin existed to warrant the use of the composite materials as a valid reinforcement method. In addition to specific elements of the evaluation program, this paper will also provide discussions on using composites materials in repairing and reinforcing high pressure pipelines.

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