Effect of defect geometries upon burst capacity of composite repaired pipe

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ABSTRACT

Oil and gas pipelines have been used all around the world and becoming more crucial in our daily life. These pipelines are subjected to corrosion and one of the most effective ways for repairing them is using composite wrap. Nevertheless, there are still issues and challenges to be overcome for a more effective design of composite repaired pipelines, which could be further investigated. Defect geometries (depth, width and length) on pipelines can affect the burst pressure that can be sustained by the pipelines. Yet, current standards and practices only account for defect depth in determining minimum thickness of composite wrap required in repairing defective pipelines without considering defect width and length. Thus, the aim of this study is to analyze the effect of defect length and width of composite repaired pipe upon its burst capacity using finite element analysis. A finite element model was created and validated followed by parametric study on the effect of combination defect length and width. For parametric study, a total of seven composite repaired pipe models were created and analyzed. Results showed that as the defect dimension of combinations defect geometries increases, the burst pressure of the composite repaired pipe decreases. The burst pressure between the smallest and largest defect is 31.09% which shows a significant difference. In conclusion, defect geometries are proven greatly affect the burst pressure of the composite repaired pipe and the findings can be used for future studies, in particular to refine the design of the composite pipeline repair practice.

Keywords: Composite repaired pipe, Defect geometries, Burst capacity, Finite element analysis

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M.L. Deng: Methodology, Investigation, Validation. C. Bao: Resources, Writing – review & editing. A.T.S. Hung: Writing – original draft, Formal analysis. N. Md Noor: Writing – review & editing. K.S. Lim: Writing – review & editing, Visualization, Supervision.

Declaration of competing interest
The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

Achebe et al., 2012 C. Achebe, U. Nneke, O. Anisiji
Analysis of oil pipeline failures in the oil and gas industries in the Niger delta area of Nigeria
Proceedings of The International Multi Conference of Engineers and Computer Scientists (2012), pp. 1274-1279

Arifin et al., 2021 H.H. Arifin, L. Zardasti, K.S. Lim, N.M. Noor, N. Yahaya, A.N. Mazlan, A.R.M. Sam
Stress distribution analysis of composite repair with Carbon Nanotubes reinforced putty for damaged steel pipeline
Int. J. Pres. Ves. Pip., 194 (2021), Article 104537, 10.1016/j.ijpvp.2021.10453

Asme, 2018
ASME
Repair of Pressure Equipment and Piping
American Society of Mechanical Engineers (2018)

Budhe et al., 2017
S. Budhe, M. Banea, N. Rohem, E. Sampaio, S. DE Barros
Failure pressure analysis of composite repair system for wall loss defect of metallic pipelines
Compos. Struct., 176 (2017), pp. 1013-1019, 10.1016/j.compstruct.2017.06.044

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