Graphene Additive in Composite Overwrapped Tubular Structures

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Abstract
The increasing use of hydrogen in energy and chemical industries is contributing to the growth of the hydrogen energy storage market [1]. As demand of storage is strengthening, there is a need to generate improved pressure-loading capability that enable more hydrogen gas to be stored at higher pressure while maintaining safety across the value chain. Leveraging graphene superior performance as an additive, this paper continues from earlier work [2] and reported the performance of graphene additives' potential mechanical strength improvements in tubular structures. Different graphene loading concentrations were fabricated via single tow filament winding coating technique and tested for burst strength improvement. Amine functionalized graphene mixed via the solvent exchange method combined with single tow inline coating technique showed 11% normalized improvement compared to control in conducted tube burst test setting. This result sheds light to the graphene additive in the resin matrix and how it affects the overall composite system. The result reveals graphene distribution in the inter-tow and intra-tow region and how critical it is to generate a more pervasive distribution of graphene whilst aligning to current industrial filament winding composite overwrapped pressure vessel manufacturing technique. In the future, the result will provide information to design engineers on how to best apply graphene in pressure vessel manufacturing to achieve superior material-optimized performance.

References

[1] T. Business Research Company, "Hydrogen Energy Storage Global Market Report 2023," 2023. Accessed: 13/7/2023. [Online]. Available: https://www.thebusinessresearchcompany.com/report/hydrogen-energy-storage-global-market-report

[2] I. Thiyahuddin *et al.*, "Development of Graphene-hybrid Composite Hydrogen Pressure Tank for Gas Storage Application," presented at the 23rd International Conference on Composite Materials (ICCM23), ICC Belfast, Northern Ireland, 2023, Paper 1114. [Online]. Available: https://iccm23.org/.

Figures

Figure 1: Illustration of tubular structure hydrodynamic burst test conducted.