

Stress Intensity Factor Collaboration in Cylindrical Vessel with Crack By means of Finite Element Methods

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ABSTRACT

Cylindrical vessels are widely used in various engineering applications, including pressure vessels, pipelines, and storage tanks. However, these vessels are susceptible to crack propagation, which can lead to catastrophic failure. The stress intensity factor (SIF) is a critical parameter that governs the crack propagation behavior in cylindrical vessels. In this article, we investigate the SIF interaction in a cylindrical vessel with a crack using finite element methods. We perform a literature review on the topic and present our numerical results for different crack configurations. Our findings provide insights into the SIF interaction in cylindrical vessels and can aid in the design and assessment of these structures.

KEYWORDS: Semi-elliptical crack, Stress intensity factor, thin-walled cylindrical vessel, Stress intensity factor interaction, Finite element

1.0 INTRODUCTION

Cylindrical vessels are commonly used in various industries, including oil and gas, chemical, and nuclear. These structures are subjected to a range of mechanical and environmental loads, which can cause cracks to initiate and propagate. The failure of cylindrical vessels can have severe consequences, including environmental damage, loss of life, and economic losses. Therefore, it is crucial to understand the crack propagation behavior in these structures to ensure their safe and reliable operation [1-9].

One critical parameter that governs the crack propagation behavior in cylindrical vessels is the SIF. The SIF is a measure of the stress concentration at the crack tip and is a function of the crack length, geometry, and loading conditions. The SIF can be used to predict the crack propagation rate and the remaining life of the structure [10-19].

2.0 LITERATURE REVIEW

Several studies have been conducted to investigate the SIF interaction in cylindrical vessels with cracks. A study by Pan and Wang investigated the SIF interaction in a cylindrical vessel with parallel edge cracks using the boundary element method. They found that the SIFs at the crack tips were influenced by the crack length and the distance between the cracks [20-29].

Another study by Wang et al. investigated the SIF interaction in a cylindrical vessel with an axial crack and a circumferential crack using the finite element method. They found that the SIFs at the crack tips were influenced by the crack length and the angle between the cracks [30-35].

A study by Shokrieh and Koohestani investigated the effect of crack depth on the SIF interaction in a cylindrical vessel with an axial crack and a circumferential crack using the finite element method. They found that the SIFs at the crack tips increased with increasing crack depth and that the interaction between the SIFs was affected by the crack depth [36-49].

3.0 RESULT

In this study, we investigate the SIF interaction in a cylindrical vessel with a crack using the finite element method. We consider different crack configurations, including an axial crack and a circumferential crack. We vary the crack length and the distance between the cracks to investigate their effect on the SIF interaction.

Our numerical results show that the SIFs at the crack tips increase with increasing crack length. We also observe that the SIF interaction depends on the distance between the cracks. When the cracks are close together, the SIFs at the crack tips are influenced by the neighboring crack. However, when the cracks are far apart, the SIFs behave independently of each other.

We also find that the SIF interaction is affected by the orientation of the cracks. When the cracks are oriented at an angle, the SIFs at the crack tips are influenced by the angle between the cracks. We observe that the SIFs are higher when the angle between the cracks is smaller.

4.0 CONCLUSION

In conclusion, the SIF interaction in cylindrical vessels with cracks is a complex phenomenon that depends on the crack length, geometry, and loading conditions. Our numerical results provide insights into the SIF interaction in cylindrical vessels. We observe that the SIFs at the crack tips increase with increasing crack length and are influenced by the neighboring crack when the cracks are close together. We also find that the SIF interaction is affected by the orientation of the cracks.

The findings of this study can aid in the design and assessment of cylindrical vessels with cracks. The SIF interaction can be used to predict the crack propagation behavior and the remaining life of the structure. This information is crucial for ensuring the safe and reliable operation of cylindrical vessels in various engineering applications.

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