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Short Communication

CheFEM 3: Reliable Chemical Exposure Analysis of Polymers and Their Composites

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Abstract

CheFEM 3, developed by Composite Analytica, is a state-of-the-art software tool designed for advanced thermo-mechanical analysis with a focus on polymer-based composites. Featuring sophisticated chemical-physical simulation capabilities and calibrated thermo-mechanical modeling, CheFEM 3 offers a reliable platform for analyzing chemical exposure scenarios, predicting service life, and optimizing the operational expenditure of equipment. This article presents an overview of CheFEM 3, highlighting its ability to reduce the need for extensive exposure experiments, thus lowering costs and environmental impact. Leveraging calibrated cubic equations of state alongside finite element methodology, the software accurately predicts key material properties such as permeability, chemical resistance, and mechanical response. CheFEM 3 operates as a standalone application and integrates with other FEM packages like Abaqus, Ansys, and SolidWorks, providing unparalleled flexibility in workflow management. CheFEM 3 is set to become a critical tool in industries that rely heavily on composite materials, offering a robust solution for the design and maintenance of durable, high-performance structures.

***Keywords:** CheFEM 3, Chemical Exposure Analysis, Composite Materials, Chemical-Physical Simulation, Thermo-Mechanical Analysis*

Introduction

The durability and performance of composite materials in harsh chemical environments are critical concerns in industries such as aerospace, automotive, and chemical processing. Understanding how these materials respond to chemical exposure is essential for ensuring their long-term reliability and effectiveness. Traditional methods for analyzing chemical exposure involve extensive and costly experimental procedures, which also have a significant environmental impact. To address these challenges, Composite Analytica has developed CheFEM 3, an advanced software tool designed to streamline the analysis of chemical exposure in polymer-based composites. This communication discusses the key features of CheFEM 3, its applications, and its potential impact on the industry. [1-10]

Methods

CheFEM 3 integrates advanced finite element analysis with calibrated cubic equations of state to accurately predict material properties under chemical exposure. The software's chemical-physical simulation capabilities allow it to model complex chemical exposure scenarios and predict the service life of composite materials with high precision. The methodology behind CheFEM 3 involves detailed modelling of chemical diffusion, mechanical stress response, and thermo-mechanical interactions within the material. By reducing the dependency on physical experiments, CheFEM 3 not only cuts costs but also minimizes the environmental footprint associated with material testing. The software's flexibility is further enhanced by its ability to function as a standalone application or integrate seamlessly with other leading FEM packages like Abaqus, Ansys, and SolidWorks.

Results

Benchmarking tests conducted with CheFEM 3 have demonstrated its superior capability in predicting the permeability, chemical resistance, and mechanical response of composite materials under various chemical exposure conditions. The chemical-physical simulation algorithms significantly reduce computation time while maintaining high accuracy in simulation results. Furthermore, CheFEM 3 has proven effective in forecasting the service life of materials, providing valuable insights into the long-term performance and durability of composite structures. The ability to integrate with other FEM software packages has also been validated, offering users a flexible and efficient workflow.

Discussion

CheFEM 3 represents a significant advancement in the field of composite material analysis, particularly in the context of chemical exposure. Its chemical-physical simulation capabilities enable more accurate predictions of material behavior, reducing the need for extensive physical testing and thereby offering substantial cost savings. The integration of calibrated cubic equations of state with finite element analysis provides a robust framework for understanding the complex interactions within composite materials. Additionally, the software's compatibility with other FEM tools enhances its utility, making it a versatile solution for engineers and researchers alike. [1-10]

Conclusion

CheFEM 3 by Composite Analytica is a transformative tool for the analysis of chemical exposure in composite materials. Its advanced features, including chemical-physical simulation capabilities, calibrated thermo-mechanics, multi-scale modelling, and integration with leading FEM software packages, make it an essential asset for industries reliant on durable, high-performance composites. By reducing the need for costly experiments and minimizing environmental impact, CheFEM 3 not only advances the field of composite material analysis but also promotes more sustainable engineering practices.

Conflict of Interest

The author declares no conflict of interest.

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