

A new tool for composite development

In many real-life circumstances, chemical exposure triggers several chemical-mechanical effects that influence material service life to a significant extent. However, in composite design and development, chemistry and mechanics are often separated fields of expertise.



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By

Simplifying, the chemistry department analyses the manufacturer's chemical resistance guides and focuses on a material with the "chemical-resistant" label. Mechanical engineers work on the latest peel tests and combine results with a Finite Element Method (FEM) software. There is not much wrong with this approach as long as chemical absorption, chemically-driven stress and chemical degradation have little impact on the material's mechanical response.

Design and materials

Yet, if there is substantial interaction, the experimental design and material selection process could better be performed in a more quantitative integrated manner. Examples of such interactions are loss of matrix stiffness by glass temperature depression (plasticizing), loss of matrix-filler interfacial strength due to diffusion/microvoid controlled chemical reaction, or excessive strain on a coating during an explosive decompression.

Simulation

The CheFEM® software, developed by Composite Analytica, enables virtual

analysis of these effects on any material in any configuration and application. CheFEM stands for Chemical potential-based FEM simulation of polymer-based materials. Chemical potentials are used to parameterize fluid and gas exposure by (multicomponent) diffusivity and solubility, chemical degradation kinetics, swelling potentials, degree of plasticizing, effect of crystallinity, matrix-filler interface stability, permeation rates, breakthrough times and rapid gas decompression behaviour. FEM is used to analyze the overall mechanical response. Applications of CheFEM include the development of thin-film photovoltaic cells, the simulation of graphene nanocomposites, heavy-duty coatings, flexible pipelines for chemical mixtures at high pressures and temperatures and integrated lifetime analysis of rotor blades.

Some distinctive features of CheFEM are:

- The software can be used anywhere and any

time due to its web-based user interface with computation engine and library on the CheFEM server.

- The built-in library contains all chemical-physical parameters for the chemicals and materials of interest (e.g. Sanchez-Lacombe equation of state).
- The simulation results demonstrate a high degree of correlation with the outcomes of laboratory experiments in similar conditions.
- CheFEM can be used alone or integrated with mechanically-oriented FEM software. ■

More information:
www.composite-analytica.com



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