

# 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

**S**implifying, 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 Agency, 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-agency.com](http://www.composite-agency.com)



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