Fatigue Failure of Injection Molded Bow Limbs

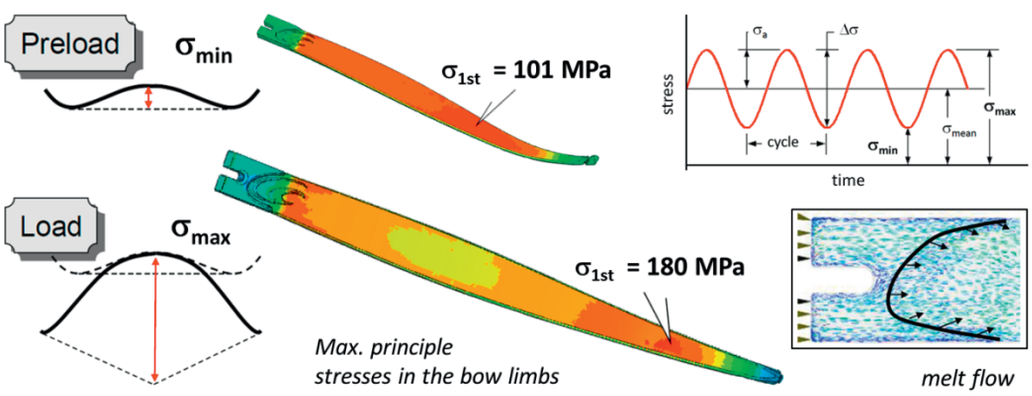
CUSTOMER: SOLVAY Speciality Polymers

- Leading world producer of specialty polymers with widest plastics range
- Over 30 brands available in over 1500 formulations for various applications
- Continuously exploring new technologies, developing new products and serving new markets
- Uses DIGIMAT to support their customers in designing innovative composites

CHALLENGE

- A manufacturer injection-molded plastic bows set the goal to produce the best bows for recreational archery on the market based on SOLVAY material
- A new and apparently improved design of the bow limbs showed a reduced fatigue lifetime as compared to an existing geometry
- The question arose whether the premature failure of the new design is directly connected to the change in the processing of the bow limbs

HOW TO TAKE INTO ACCOUNT THE INFLUENCE OF PROCESSING IN LIFE TIME PREDICTION?



DIGIMAT SOLUTION

- Reverse engineering of an elasto-plastic DIGIMAT material model
- Computation of 1st principles stresses for preload and load cases based on fiber orientation data coming from Moldflow
- Life time prediction using a Haigh diagram
- Comparison between the two different designs for the bow limbs

RESULTS

- The lifetime in fatigue of the original design should be slightly longer than the new design
- The higher stress level for the new design could be connected to a higher local stiffness in the critical region in the bow limb
- The higher local stiffness could be explained by a "better" fiber orientation due to a change in the melt flow in the processing step (combination of two "converging" flows)

MATERIALS
Short fiber reinforced plastics

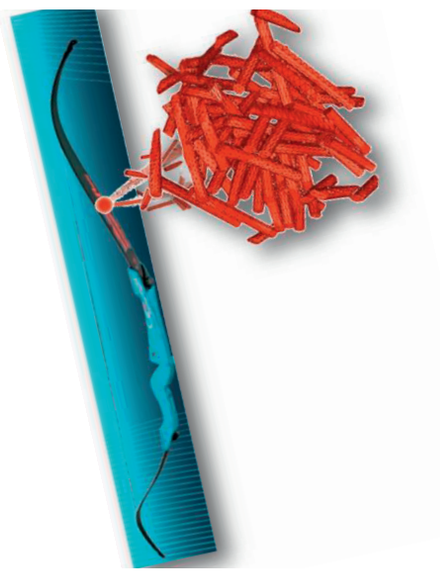
PERFORMANCES
Stiffness, fatigue

DIGIMAT
Digimat-MF, Digimat-CAE, Digimat-MAP

CAE TECHNOLOGY
Abaqus, Moldflow

INDUSTRY
Sports

APPLICATION
Design of a sports bow



Glass fiber reinforced limbs of a sports bow (50% GF).

"By using DIGIMAT we could clearly demonstrate the tight link between geometry, flow of material, fiber orientation and mechanical behavior. We successfully used the approach to evaluate the endurance of a number of different bow limb designs."

Laurent Hazard, CAE Senior Specialist, SOLVAY

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Digimat

The nonlinear multi-scale material & structure modeling platform

Digimat material modeling platform means developing innovative, optimized and cost-effective products. As a unique nonlinear multi-scale material and structure modeling platform, Digimat offers:

Digimat MF: Mean-Field homogenization software used to predict the nonlinear behavior of multi-phase materials.

Digimat FE: Finite Element based homogenization software used to model the nonlinear behavior of Representative Volume Elements (RVE) of material microstructures.

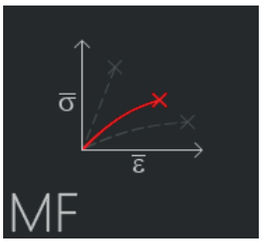
Digimat MX: Material eXchange platform used to prepare, store, retrieve and securely exchange Digimat material models between material suppliers and end-users**.**

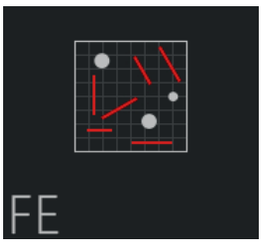
Digimat CAE: Digimat linear and nonlinear interfaces to major processing and structural FEA software to enable multi-scale analyses of composite structures.

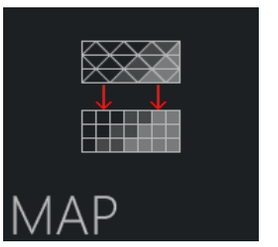
Digimat MAP: Shell & 3D mapping software used to transfer fiber orientation, residual stresses and temperatures between dissimilar processing and structural meshes.

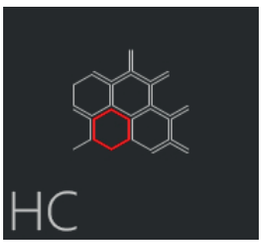
Digimat RP: Easy and efficient solution for the design of fiber reinforced plastic parts.

Digimat HC: Easy and efficient solution for the design of honeycomb sandwich panels.









e-Xstream engineering

MSC Software Company

The material modeling company

e-Xstream engineering is a provider of simulation software & engineering services, 100% focused on advanced material modeling. e-Xstream was founded in 2003 in Belgium and Luxembourg. e-Xstream is an MSC Software company since September 2012 with more than 1100 associates working from over 20 offices around the world.

e-Xstream engineering develops and commercializes Digimat – the nonlinear multi-scale material and structure modeling platform that fastens the development of optimal composite materials and parts.

Digimat customers are material experts and structural engineers who accurately predict the behavior of multi-phase composite materials and structures. Digimat is used by all major material suppliers and users across all industries (Automotive, Aerospace, Electric & Electronics, Leisure, Defense ...).

With this important customer base worldwide, e-Xstream combines deep expertise in material modeling and numerical simulations with the business understanding of the large variety of materials used across all industries.

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