SCRATCH RESISTANCE OF FLOOR COVERING SURFACES

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ABSTRACT
Floor covering are daily submitted to various mechanical solicitations: walking, rolling chairs, furniture feet indentation, sliding objects, cleaning devices etc. All these solicitations are liable to cause wear of the product, which negatively impacts its visual aspect. A wear mechanism which is particularly severe is the scratch.

The aim of this project is to identify which kinds of scratches have a high optical influence and to prevent them. The final objective is to optimize the material (rheology, structure…) to increase its scratch resistance.

Scratch tests have been performed on a material composed with a plasticized PVC substrate covered by an anti-scratch polyurethane coating. These tests are observed in situ thanks to a microscope coupled to a camera.

Depending on the scratch test conditions (tip radius, normal force, temperature…), different deformation regimes (elastic, elastoplastic, plastic) and 3 different failure mechanisms are observed (figure 1).

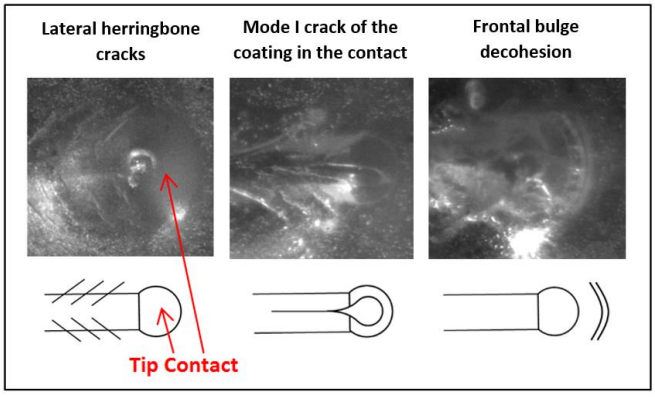

Figure 1 : In situ photos and schemas of 3 different failure mechanisms that may appear together.

These mechanisms do not have the same optical influence: for example a ductile scratch is almost invisible by naked eye, even with the shallow and short lateral cracks (1st mechanism), whereas a scratch with delamination (3rd mechanism) is very visible because of a whitening of the material.

In order to understand the local mechanical conditions during these tests, a numerical model of scratching has been developed. As shown in figure 2 the case of high load/indentation depth is clearly similar to failure mechanism 2. A variety of scratching conditions will be presented and analyzed, the strain and stress fields correlated with the corresponding failure mode.

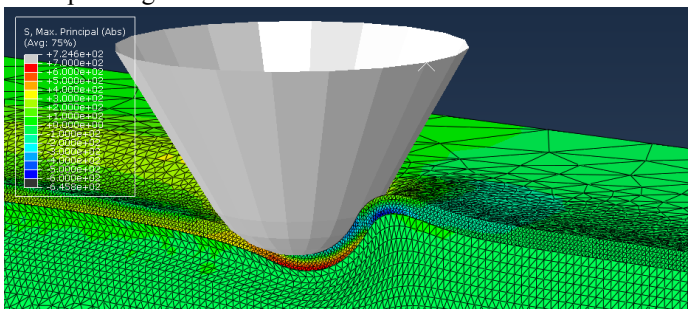

Figure 2 : Numerical simulation of a scratch test, max principal stress (MPa).

REFERENCES
[1] J.-L. Bucaille, E.Felder, G.Hochstetter. Mechanical analysis of the scratch test on elastic and perfectly plastic materials with the three-dimensional finite element modeling. Wear 249 (2001) 422-432
[2] I. Demirci, C. Gauthier, R. Schirrer. Mechanical analysis of the damage of a thin polymeric coating during scratching: role of the coating thickness to the roughness of a scratching tip. Thin solid films 479 (2005) 207– 215
[3] S.J. Bull. Failure mode maps in the thin film scratch adhesion test. Tribology Int. 30, 7 (1997) 491- 49