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Impact of processing defects on fatigue and crack propagation in filled elastomers

Context

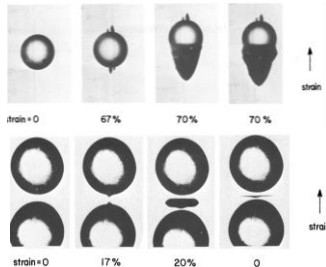
Filled Elastomer

- Anti-vibration, Sealants, Tires etc.
- Resistance to high deformation and fatigue solicitation.

Fatigue failure in filled elastomer

- Crack initiation due to void nucleation In the vicinity of micro-structural defects

Gent *et al.* 1984:
 Nucleation and cavitation of voids near a defect under strain deformation



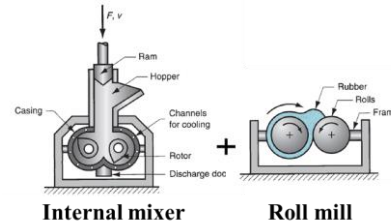
Objective

- Study the impact of morphology and spatial distribution of the defects on crack initiation and propagation mechanism under fatigue solicitation

Method and tools

Processing of materials

- To generate tailor made micro-structural defects using an internal mixer and roll mill.



Characterization

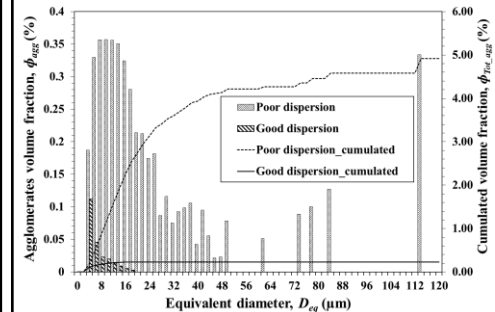
- 3D acquisition of microstructural defects using X-ray Tomography
- 2D surface information of the materials using SEM.

Mechanical Properties

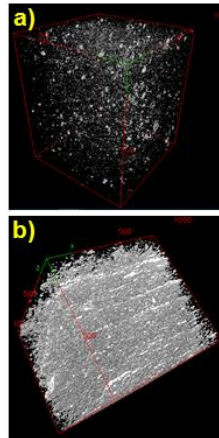
- Tensile and Fatigue tests on notched and unnotched samples
- In-situ/ex-situ tensile experiments under X-ray tomography to study the crack initiation and propagation mechanism

Results

Impact of processing on defects population



3D rendering of the 2 model materials (EPDM with filler) highlighting specific defects in them (1voxel = (700nm)³).
 a) Good dispersion. b) Poor dispersion.



Perspective

- Ranking of the importance of defects (Voids, agglomerates, inclusions of metallic oxides etc..)
- Understand the impact of defects population density and characteristics on the initiation and propagation of crack under static and dynamic solicitation.