

POLYAGE

Polymer Ageing

Polymers are widely used in nuclear power plants due to their particular properties as flexibility (for sealing and coating application) or insulation property (for cables). If qualification tests, which include some ageing tests, guarantee a good polymer performance at the time of installation of the equipment, they cannot predict a lifetime or provide useful information to establish a strategy for the ageing management of components. Indeed, polymer are complex materials typically composed of about ten different components (basic polymer matrix, one or two antioxidants, plasticizers, fillers...). Each component can play a specific role depending on the nature of the ageing environment.

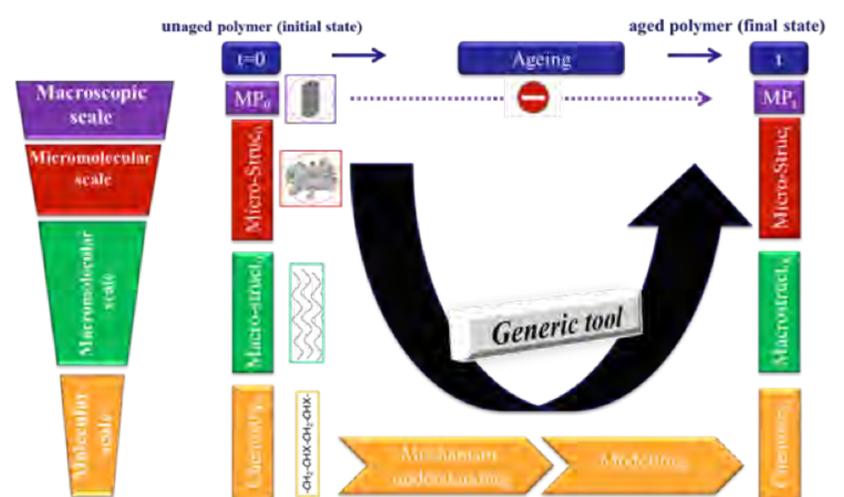
Electrical insulation

~ 1500 km of electric cables per NPP :
PVC, EPR and XLPE insulations



This project aims to improve the polymer ageing management in NPPs through:

- Providing scientific insight in the degradation process/mechanism of polymer materials:
 - Identification and modelling of chemical ageing mechanisms of polymers as a function of their chemistry and for different ageing factors,
 - Identification of relations between the polymer evolution at the molecular and/or macromolecular scales and its macroscopic properties based on a multiscale approach
- Identifying a suitable non destructive methodology for on-site inspection of nuclear cables:
 - Definition of protocols and relevant criteria on micro-sample and non-destructive exams to monitor polymer ageing,
- Developing and validating a numerical tool of polymer ageing simulation and its dissemination to MAI members:
 - Feeding a database of experimental results on studied polymers.
 - Comparison of experimental results obtained on cables removed from sites with simulated results



A multi scale approach is being developed to meet these objectives. It intends, (i) to acquire a comprehensive knowledge of ageing mechanisms, then (ii) to identify the material key ageing parameters, (iii) to develop on-site measurements of these key parameters and (iv) finally to develop predictive models. This will provide utilities with tools for on-site diagnosis of polymer condition and for prognosis about residual lifetime. In the end, material replacements will be avoided or properly anticipated by utilities. Development of ageing mechanisms knowledge, on-site condition monitoring techniques and predictive models is carried out on model materials representative of the polymers considered. Validation of this knowledge and tools is done through experiments on materials used on-site.