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# An Elasto-Viscoplastic Model Coupled to Damage and Grain Growth to Take Account of Material Variability

**Benoit Vereecke**(1), Rene Billardon(2)

(1) *DEN/SAC/DM2S/SEMT/LM2S, France*
(2) *LMT, ENS, France*

The final objective of this study is the prediction of the failure of nuclear structures at very high temperatures in accidental conditions taking account of the material variability. The material used to build French reactor pressure vessel 16MND5 steel, shows at high temperature different damage mechanisms according to its origin: transgranular by growth and coalescence of cavities or intergranular. This phenomenon can dramatically modify the failure time for creep tests. A metallurgical study has shown that intergranular damage is activated by the smallest size of austenitic grains for temperature around 1000°C. To describe these phenomena, we have developped an elasto-viscoplastic constitutive law with isotropic hardening coupled to two damage evolution laws. The first damage variable is isotropic and is related to transgranular mechanism whereas the second damage variable is anisotropic dependent on grain size and related to intergranular mechanism. We have implemented this constitutive equation in finite element code CAST3M.

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