

SSNA113 – Notched sample in viscoplasticity

Summarized:

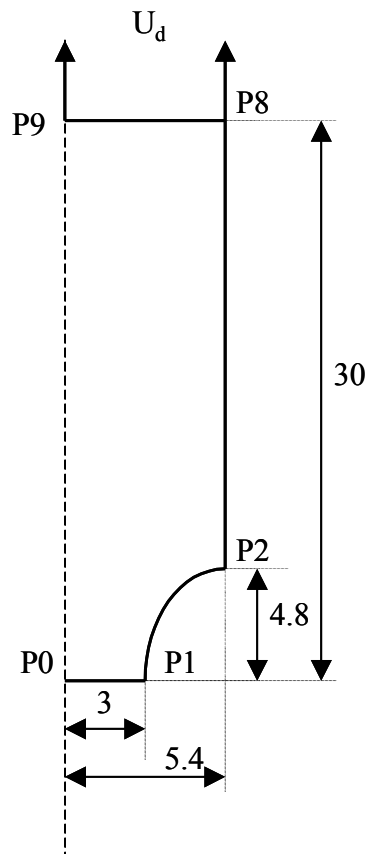
This test models a notched sample into axisymmetric. The constitutive law used is model `VISC_ISOT_TRAC`. Two loading rates are simulated:

- slow: $T=1000\text{s}$ that is to say $\dot{\epsilon} = 10^{-3} \text{ s}^{-1}$
- rapid: $T=0.001\text{s}$ either $\dot{\epsilon} = 10^3 \text{ s}^{-1}$

the results (force resulting and contraction from the ligament) are compared with the computations carried out with the model of viscous Rousselier (`ROUSS_VISC`) degenerated so that the evolution of porosity is negligible.

1 Problem of reference

1.1 Geometry



the test-tube is axisymmetric, and only half of the test-tube is represented. Dimensions are given in millimetres.

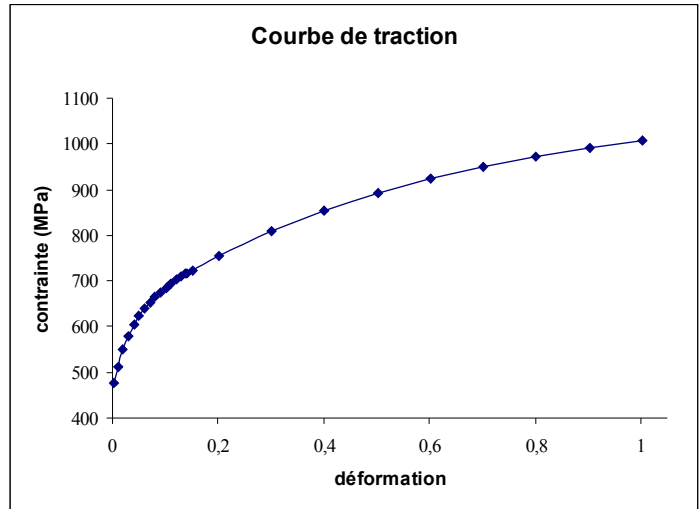
1.2 Properties of the isotropic

material Elasticity

Young Modulus: $E = 215000$ MPa

Curve of tension

Poisson's ratio: $\nu = 0.3$



Coefficient for viscous model
VISC_SINH

$\sigma_0 = 6176$ MPa

$\varepsilon_0 = 3.31131121483 \cdot 10^{13}$

$m = 6.76$

Coefficients of the model of Rousselier
used to obtain the loading and

$f_0 = 5 \cdot 10^{-9}$

$D = 0.0001$

$\sigma_1 = 1575$ MPa

1.3 reference solution Boundary conditions

Because of symmetry, vertical displacements are blocked for the side $P0P1$ is $DY = 0$.

On the east side $P8P9$ subjected to an imposed displacement $U_d = 1$ mm.

The loading is imposed using 500 time step in $T = 1000$ s for the slow case and $T = 0.001$ s the fast case.

2 Reference solution

2.1 Results of reference

the reference solution is obtained by carrying out same computation with the model of Rousselier in viscous version (COMP_INCR = "ROUSS_VISC", DEFORMATION = "PETIT_REAC") whose parameters were selected in order to return the effect of negligible porosity.

One compares the contraction of the ligament, i.e. the displacement following x of the node $P1$ as well as the resulting force (REAC_NODA) on the face $P8P9$. One is interested in 3 values of displacement U_d : 0.05mm , 0.5mm and 1mm .

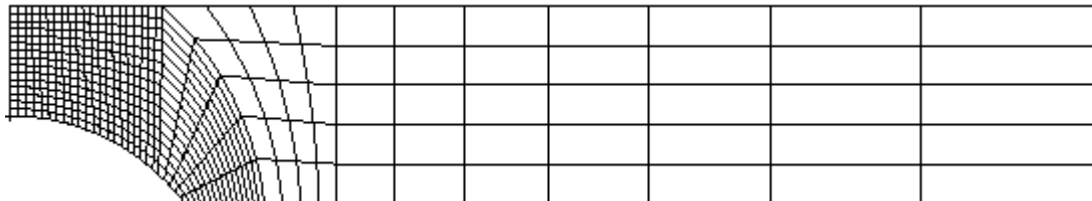
3 Modelization A

3.1 Characteristic of the modelization

- Modelization AXIS_SI

3.2 Characteristics of the mesh

The mesh is obtained by GIBI.



Many nodes: 1440
Number of meshes: 445 QUAD8

3.3 Quantities tested and fast

Velocity results

Displacement	Identification	Reference	Aster	% difference
$U=0.05\text{ mm}$	REAC_NODA on P8P9	3.43132 10 ³	3.42727 10 ³	-0.12
	U_y in PI	-8.0411 10 ⁻³	-8.09476 10 ⁻³	0.67
$U=0.5\text{ mm}$	REAC_NODA out of P8P9	3.93495 10 ³	3.92628 10 ³	-0.22
	U_y in PI	-4.06758 10 ⁻¹	-4.06649 10 ⁻¹	-0.03
$U=1\text{ mm}$	REAC_NODA out of P8P9	3.17328 10 ³	3.16438 10 ³	-0.28
	U_y into PI	-8.89457 10 ⁻¹	-8.89189 10 ⁻¹	-0.03

slow Velocity

Displacement	Identification	Reference	Aster	% difference
$U=0.05\text{ mm}$	REAC_NODA on P8P9	2.86423 10 ³	2.86076 10 ³	-0.12
	U_y in PI	-1.52635 10 ⁻²	-1.52998 10 ⁻²	0.24
$U=0.5\text{ mm}$	REAC_NODA out of P8P9	3.36223 10 ³	3.35580 10 ³	-0.19
	U_y in PI	-4.19637 10 ⁻¹	-4.19497 10 ⁻¹	-0.03
$U=1\text{ mm}$	REAC_NODA out of P8P9	2.73903 10 ³	2.73204 10 ³	-0.26
	U_y into PI	-9.14404 10 ⁻¹	-9.14069 10 ⁻¹	-0.04

4 Summary of the results

One obtain a good agreement of the results between 2 models with lower deviations than 1% .

At the total level, one notes that to the maximum 4 iterations are necessary to obtain convergence. On the level of the integration of the constitutive law, less than 10 iterations are necessary to obtain an accuracy of 10⁻⁹.