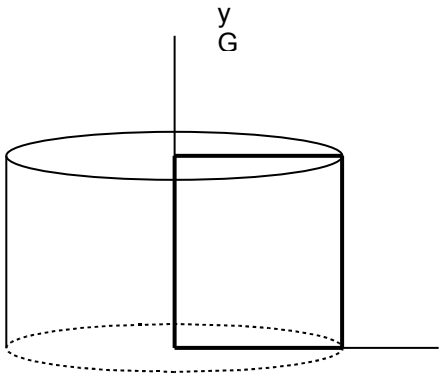
MTLP101 - Metallurgical computation for a Summarized

zircaloy:

The purpose of this test is in the case of carrying out computation with the nodes of the metallurgical evolution associated with a thermal history a zircaloy.
It takes part in validation of the command CALC_META.

1 Problem of reference

1.1



Appears 1.1-a: Geometry of the problem

It acts of a cylinder of radius $0.05\,m$ and height $0.05\,m$.
The square in fat corresponds to the axisymmetric modelization used to [§3].

1.2 Material properties

The materials' properties are described by the following parameters:

(Zirconium)
$\rho C_P = 2000000\,J.m^{-3}.°C^{-1}$
$\lambda = 9999.9\,W.m^{-1}.°C^{-1}$
Coefficients for the metallurgy:
$teqd = 809\,°C \quad K = 1.135\text{E}-2 \quad n = 2.187$
$t1c = 831\,°C \quad t2C = 0. \quad qsr = 14614 \quad Ac = 1.58\text{E}-4$
$m = 4.7 \quad t1r = 949{,}1\,°C \quad t2r = 0 \quad Ar = -5.725\,, \quad Br = 0.05$

1.3 Boundary conditions and loadings

the temperature is imposed on all the cylinder on times $t = 0\text{s}\,, 120\text{s}$ and 240s .
$T(x\,, y\,, t = 0) = 20\,°C$
$T(x\,, y\,, t = 120) = 1200\,°C$
$T(x\,, y\,, t = 240) = 20\,°C$

1.4 Initial conditions

the following variables are initialized with the following values:

$V1(x\,, y\,, t = 0) = 1.0$
$V2(x\,, y\,, t = 0) = 0.0$
$V3(x\,, y\,, t = 0) = 0.0$
$V4(x\,, y\,, t = 0) = 0.0$

V1 : proportion of the cold phase α
V2 : proportion of the cold phase α , mixed with the phase β
V3 : temperatures with the nodes
V4 : time corresponding to end or the initial temperature of the transformation to the equilibrium

2 Reference solution

2.1 Results of reference

the results of reference were got with a previous version of Aster.
The tests carried out are tests of NON-regression.

2.2 Uncertainty on the solution compared to result of NON-regression

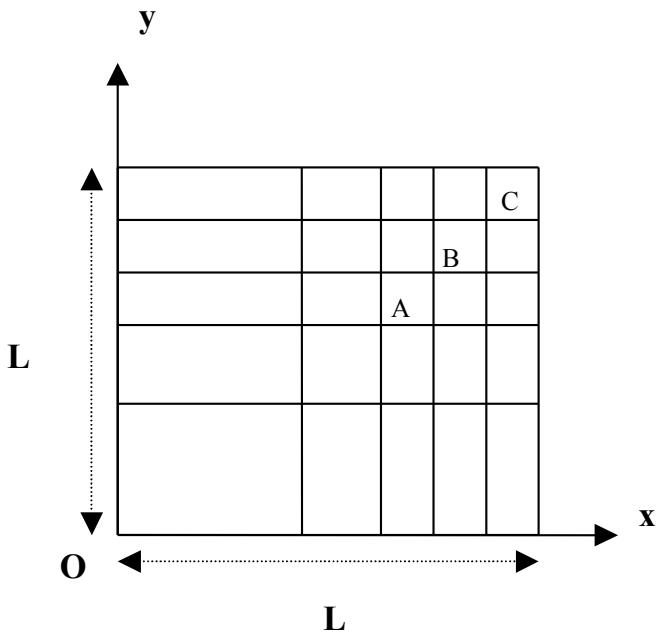
the criterion of uncertainty is in absolute value. It is of $[1E\text{-}4, 1E\text{-}2]$.

3 Modelization A

3.1 Characteristic of the modelization

The modelization used in the case test is the following one:

Elements 2D AXIS (QUA8)



Appears 3.1-a: Geometry and mesh of the modelization used

Cutting: 5 meshes QUAD8 according to the axis of x
the 5 meshes QUAD8 according to the axis of y

the Nodes:

A : net $M13$ the node is outside the field of definition with a right profile of the EXCLU type node: $N39$

B net $M19$ the node is outside the field of definition with a right profile of the EXCLU type node: $N66$

C net $M19$ node $N70$

3.2 Characteristics of the mesh

Many nodes: 96
Number of meshes and types: 25 QUAD8, 20 SEG3.

3.3 Quantities tested and results

Identification	Quantity	Reference
t=30s M13 N39	$V1$	1.0
t=30s M19 N66	$V3$	315.0

t=120s M13 N39	*V1*	0.0
t=120s M19 N66	*V3*	1200.0
t=240s M13 N39	*V1*	0.9999
t=240s M19 N70	*V3*	20.0

V1 : proportion of the cold phase α
V2 : proportion of the cold phase α , mixed with the phase β
V3 : temperatures with the nodes
V4 : time corresponding to end or the initial temperature of transformation to the equilibrium

4 Comments

This case test of NON-regression makes it possible to check the coherence of *Code_Aster* from one version to another with regard to the metallurgy.