MTLP102 - Metallurgical calculation for a steel with taking into account of the size of grain

Summary:

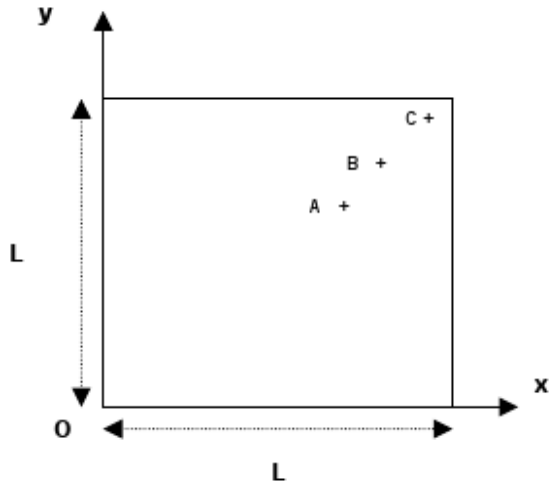
The purpose of this test is to in the case of observe the evolution of the size of grain according to the change of temperature a steel.

The size of grain is calculated with the nodes A , B and C by the operator CALC_META.

1 Problem of reference

1.1 Geometry

Section of the bar



It is about an infinite bar with square section of with dimensions $L=0.05\,m$.

1.2 Material properties

The properties materials are described by the following parameters:

(Steel 16MND5)
$\rho\, C_P = 5260000\, J.m^{-3}.°C^{-1}$
$\lambda = 33.5\, W.m^{-1}.°C^{-1}$

Coefficients for the metallurgy:

"Standard "TRC
$AR3 = 830\,°C$, $alpha = -0.0306$
$MS0 = 400\,°C$, $AC1 = 724\,°C$, $AC3 = 846\,°C$
$\tau_1 = 0.034$, $\tau_3 = 0.034$
$\lambda_0 = 0.117$, $qsr = 37500$,
$D10 = 3.31$, $wsr = 12860$.

1.3 Boundary conditions and loadings

The temperature is imposed on all the bar on times $t = 0\text{s}$, 200s , 1100s and 1900s .

$T(x, y, t=0) = 700\,°C$
$T(x, y, t=200) = 900\,°C$
$T(x, y, t=1100) = 900\,°C$
$T(x, y, t=1900) = 100\,°C$

1.4 Initial conditions

The following variables are initialized with the following values:

$Zf(x,y,0)=0.7$
$Zp(x,y,0)=0.0$
$Zb(x,y,0)=0.3$
$Zm(x,y,0)=0.0$
$d(x,y,0)=0.0$

2 Reference solution

2.1 Results of reference

The results of reference were got with a previous version of aster. It is about a test of not-regression.

2.2 Uncertainty on the solution compared to the result of not-regression

The value of uncertainty is of 1%.

3 Modeling A

3.1 Characteristics of modeling

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

Elements 2D 'PLAN' (QUA8)

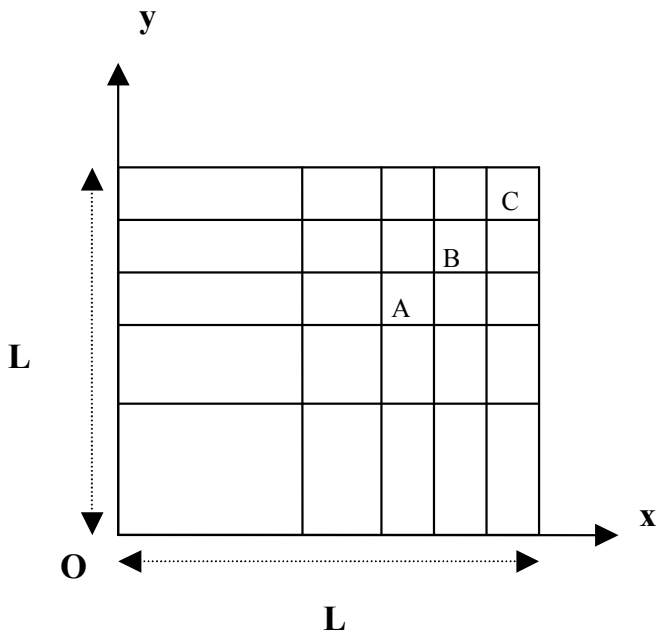


Figure 3.1-a: Geometry and grid of modeling

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

Nodes:
A : mesh $M13$ node $N39$
B : mesh $M19$ node $N66$
C : mesh $M19$ node $N70$

3.2 Characteristics of the grid

Many nodes: 96
Many meshs and types: 25 QUAD8, 20 SEG3.

3.3 Values tested

Identification	Size	Reference
t=200s M19 N66	V5	2.565E-6
t=620s M19 N70	V5	9.43E-6
t=1354s M13 N39	V5	1.34E-5
t=1900s M13 N39	V4	0
t=1900s M19 N66	V3	0.45
t=1900s M19 N70	V1	0,403

$V1$: proportion of the phase ferrite
$V3$: proportion of the phase bainite
$V4$: proportion of the phase martensite
$V5$: austenic size of grain

4 Comments

This case test of not-regression makes it possible to check the coherence of *Code_Aster* of a version on the other with regard to the metallurgy.