WTNV125 – capillary Calculation of rebalancing of bi--materials

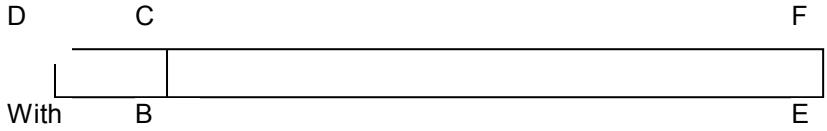
Summary:

This case test corresponds under investigation hydraulic simplified of a slice of ground in a site of storage. Two materials are considered: a worked barrier (BO) and a geological barrier (BG). Initially BO is désaturée and BG saturated. One studies here the capillary rebalancing of the unit (what corresponds to the resaturation of the barrier worked by the geological barrier).

This CAS-test is similar to the case wtna100 (in axisymmetric version).

1 Problem of reference

1.1 Geometry



Coordinates of the points (m) :

Not	X	Y
A	0.425	-10
B	1.1225	-10
C	1.1225	0
D	0.425	0
E	10	-10
F	10	0

The part delimited by $ABCD$ will be called BO and the part $BEFC$, BG.
For the version 3D of the test wtnv125 the geometry is extruded a thickness of $5,181\,m$.

1.2 Properties of material

The properties of material are presented in the table below.

Liquid water	Density ($kg.m^{-3}$)	10^3
	Heat with constant pressure ($J.K^{-1}$)	4180
	Thermal dilation coefficient of the liquid (K^{-1})	10^{-4}
	Dynamic viscosity of liquid water ($Pa.s$)	10^{-3}
Gas	Specific heat ($J.K^{-1}$)	1000
	Molar mass ($kg.mol^{-1}$)	0.02896
		1.8. 10^{-5}
Solid (BO)	Density ($kg.m^{-3}$)	2670
	Drained Young modulus E (Pa)	$1,9.10^{20}$
	Poisson's ratio	0.2
Initial state (BO)	Porosity	0.35
	Temperature (K)	293
	Gas pressure (Pa)	1E5
	Steam pressure (Pa)	2320
	Initial capillary pressure (Pa)	5.10^7 ($S=0,57$)

Homogenized coefficients (BO)	Homogenized density ($kg.m^{-3}$)	2670
	Saturation	$S(P_c)=0.99(1-6.10^{-9}P_c)$
	Intrinsic permeability (m^2)	10^{-20}
	Permeability relating to the liquid	$kr_w(S)=S$
	Permeability relating to gas	$kr_{gz}(S)=1-S$
	Specific heat ($J.K^{-1}$)	482
	Biot	1
	Conductivities thermics	$\lambda_S^T(S)=0.35\cdot S$ $\lambda_T^T(S)=0.6$ $\lambda_{CT}^T(S)=0.728$
Solid (BG)	Density ($kg.m^{-3}$)	2670
	Drained Young modulus E (Pa)	$1,9.10^{20}$
	Poisson's ratio	0.2
Initial state (BG)	Porosity	0,05
	Temperature (K)	293
	Gas pressure (Pa)	1E5
	Steam pressure (Pa)	2320
	Initial capillary pressure (Pa)	7.10^7 ($S=0,81$)
Homogenized coefficients (BG)	Homogenized density ($kg.m^{-3}$)	2670
	Saturation	$S(P_c)=0.99(1-6.10^{-9}P_c)$
	Intrinsic permeability (m^2)	10^{-19}
	Permeability relating to the liquid	$kr_w(S)=S$
	Permeability relating to gas	$kr_{gz}(S)=1-S$
	Specific heat ($J.K^{-1}$)	706
	Biot	1
	Thermal conductivity	$\lambda_S^T(S)=0.05\cdot S$ $\lambda_T^T(S)=0.6$ $\lambda_{CT}^T(S)=1.539$

1.3 Boundary conditions and loadings

On all the edges: Hydraulic flow no one

The only engine is here the saturation of a medium by another.

2 Modeling A

2.1 Characteristics of modeling A

Modeling in axi-symmetry. The worked barrier is with a grid by 15 elements HEXA20 and the geological barrier by 59 elements HEXA20, distributed gradually over the entire length.

It is here about a modeling 3D_HHD.

2.2 Sizes tested and results

N° of node	Coordinate	*PRE1* $t=1,E+06\ s$	*PRE1* $t=1,E+07\ s$	*PRE1* $t=1,E+08\ s$	*PRE1* $t=1,E+09\ s$
203	1.285	3,76E+007	4,57E+007	4,69E+007	4,51E+007
166	1.118	6,72E+007	5,36E+007	4,75E+007	4,51E+007

3 Modeling B

3.1 Characteristics of modeling B

It is the same modeling as for modeling A, but into selective: 3D_HHS.

3.2 Sizes tested and results

N° of node	Coordinate	*PRE1* $t=1,E+06\ s$	*PRE1* $t=1,E+07\ s$	*PRE1* $t=1,E+08\ s$	*PRE1* $t=1,E+09\ s$
203	1.285	3,76E+007	4,57E+007	4,69E+007	4,51E+007
166	1.118	6,72E+007	5,36E+007	4,75E+007	4,51E+007

4 Summary of the results

The results are in the whole in conformity so that one waits.