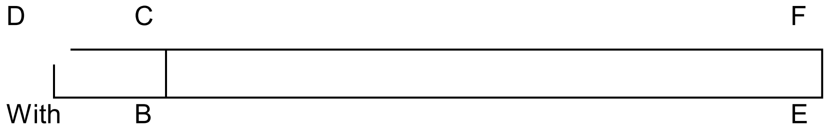
WTNA100 – capillary Calculation of rebalancing of bi--materials

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).

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 .

1.2 Properties of material

The properties of material are presented in the table below.

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

Homogenized coefficients (BO)	Homogenized density ($kg.m^{-3}$) Saturation Intrinsic permeability (m^2) Permeability relating to the liquid Permeability relating to gas Specific heat ($J.K^{-1}$) Biot Conductivities thermics	2670 $S(P_C)=0.99(1-6.10^{-9}P_C)$ 10^{-20} $kr_w(S)=S$ $kr_{gz}(S)=1-S$ 482 1 $\lambda_S^T(S)=0,35\cdot S$ $\lambda_T^T(S)=0,6$ $\lambda_{CT}^T(S)=0,728$
Solid (BG)	Density ($kg.m^{-3}$) Drained Young modulus E (Pa) Poisson's ratio	2670 $1,9.10^{20}$ 0.2
Initial state (BG)	Porosity Temperature (K) Gas pressure (Pa) Steam pressure (Pa) Initial capillary pressure (Pa)	0.05 293 1E5 2320 7.10^7 (S=0,81)
Homogenized coefficients (BG)	Homogenized density ($kg.m^{-3}$) Saturation Intrinsic permeability (m^2) Permeability relating to the liquid Permeability relating to gas Specific heat ($J.K^{-1}$) Biot Thermal conductivity	2670 $S(P_C)=0.99(1-6.10^{-9}P_C)$ 10^{-19} $kr_w(S)=S$ $kr_{gz}(S)=1-S$ 706 1 $\lambda_S^T(S)=0,05\cdot S$ $\lambda_T^T(S)=0,06$ $\lambda_{CT}^T(S)=1,539$

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

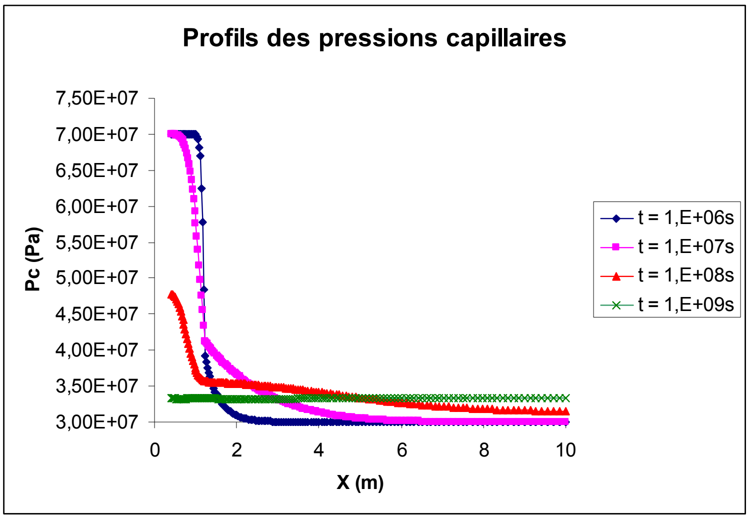
2.1 Characteristics of modeling A

Modeling in axi-symmetry. The worked barrier is with a grid by 15 elements QUAD8 and the geological barrier by 59 elements QUAD8, distributed gradually over the entire length.

It is here about a modeling AXIS_HHD.

2.2 Sizes tested and results

This case test does not present a reference solution (it is resulting from a benchmark on storage), we thus present profiles of capillary pressures in conformity so that one can physically wait for such simulations.



Values tested:

Number of node	Coordinate	*PRE1* $t=1,\mathrm{E}+06\,s$	*PRE1* $t=1,\mathrm{E}+07\,s$	*PRE1* $t=1,\mathrm{E}+08\,s$	*PRE1* $t=1,\mathrm{E}+09\,s$
294	1.285	3,760E+07	4,082E+07	3,561E+07	3,326E+07
309	1.118	6,701E+07	4,975E+07	3,613E+07	3,327E+07

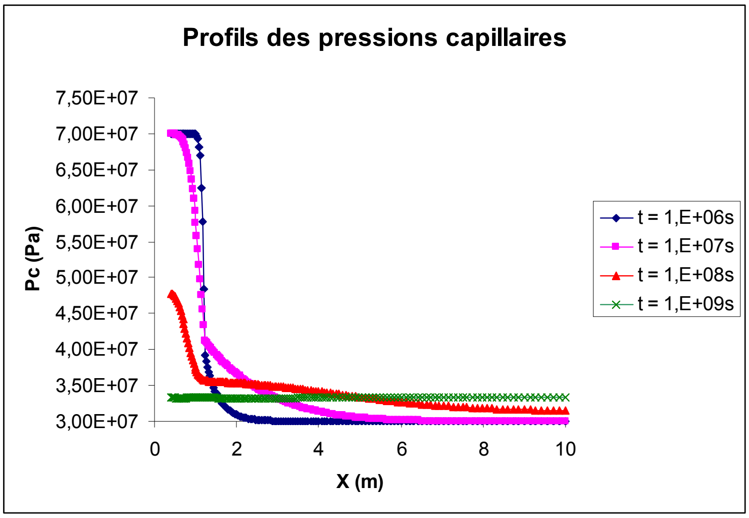
3 Modeling B

3.1 Characteristics of modeling B

It is the same modeling as for modeling A, but into selective: `AXIS_HHS`.

3.2 Sizes tested and results

This case test does not present a reference solution (it is resulting from a benchmark on storage), we thus present profiles of capillary pressures in conformity so that one can physically wait for such simulations.



Values tested:

Number of node	Coordinate	$PRE1$ $t=1,E+06\,s$	$PRE1$ $t=1,E+07\,s$	$PRE1$ $t=1,E+08\,s$	$PRE1$ $t=1,E+09\,s$
294	1.285	3,674E+07	4,082E+07	3,561E+07	3,326E+07
309	1.118	6,697E+07	4,986E+07	3,609E+07	3,327E+07

4 Summary of the results

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