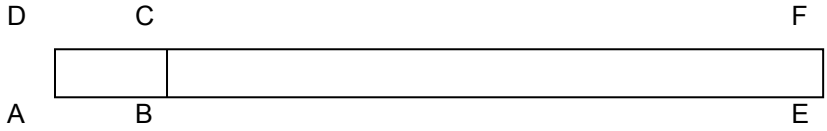
WTNA100 – capillary Computation of rebalancing of bi--materials

Summarized:

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 it BO is désaturée and BG saturated. One studies here the capillary rebalancing of the group (what corresponds to the resaturation of the barrier worked by the geological barrier).

1 Problem of reference

1.1 Geometry



Coordinated points (m):

Point	X	Y
A	0,425	-10
B	1,1225	-10
C	1,1225	0
D	0,425	0
E	10.-10	
F	10	the 0

part delimited by $ABCD$ will be called BO and the part $BEFC$ BG .

1.2 Properties of the material

the properties of the material are presented in the table below.

Liquid water	Density ($kg.m^{-3}$) Heat with constant pressure ($J.K^{-1}$) thermal Coefficient of thermal expansion of the fluid (K^{-1}) Dynamic viscosity of liquid water ($Pa.s$)	103 4180 10-4 10-3
Gases	Specific heat ($J.K^{-1}$) Molar mass ($kg.mol^{-1}$)	1000 0,02896 1,8. 10-5
Solid (BO)	Density ($kg.m^{-3}$) Young Modulus drained E (Pa) Poisson's ratio	2670 1,9.1020 0.2
initial State (BO)	Porosity Temperature (K) Pressure of gas (Pa) Steam pressure (Pa) initial capillary Pressure (Pa)	0,35 293 1E5 2320 5.107 ($S=0,57$)

homogenized Coefficients (BO)	homogenized Density ($kg.m^{-3}$)	2670
	intrinsic	$S(P_C)=0.99(1-6.10^{-9}P_C)$
	Saturation Permeability (m^2)	10-20
	Permeability relating to the fluid	$kr_w(S)=S$
	Permeability relating to the gas	$kr_{gz}(S)=1-S$
	Specific heat ($J.K^{-1}$)	482
	Biot	1
	Conductivities thermal	$\lambda_S^T(S)=0,35\cdot S$ $\lambda_T^T(S)=0,6$ $\lambda_{CT}^T(S)=0,728$
formula (BG)	Density ($kg.m^{-3}$)	2670
	Young Modulus drained E (Pa)	1,9.1020
	Poisson's ratio	0.2
initial State (BG)	Porosity	0,05
	Temperature (K)	293
	Pressure of gas (Pa)	1E5
	Pressure of vapor (Pa)	2320
	initial capillary Pressure (Pa)	7.107 (S=0,81)
homogenized Coefficients (BG)	homogenized Density ($kg.m^{-3}$)	2670
	intrinsic	$S(P_C)=0.99(1-6.10^{-9}P_C)$
	Saturation Permeability (m^2)	10-19
	Permeability relating to the fluid	$kr_w(S)=S$
	Permeability relating to the gas	$kr_{gz}(S)=1-S$
	Specific heat ($J.K^{-1}$)	706
	thermal	1
	Biot Conductivity	$\lambda_S^T(S)=0,05\cdot S$ $\lambda_T^T(S)=0,06$ $\lambda_{CT}^T(S)=1,539$

1.3 Boundary conditions and loadings

On all the edges: Hydraulic flux no one

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

2 Modelization A

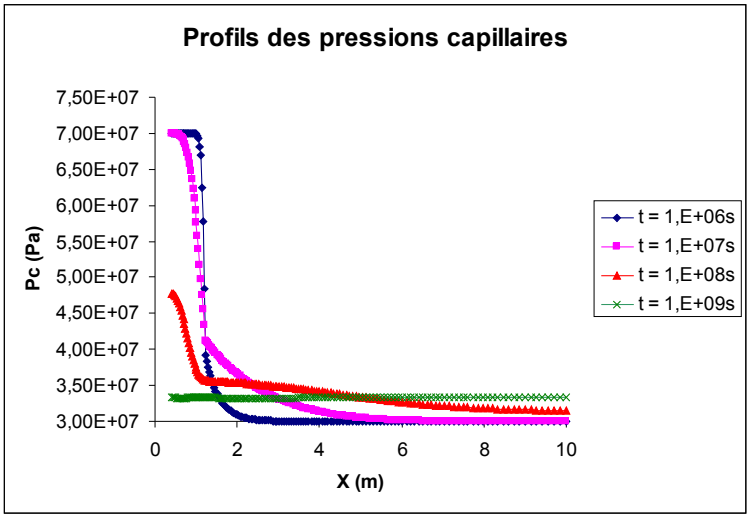
2.1 Characteristic of the modelization A

Modelization 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 modelization AXIS_HHD.

2.2 Quantities 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	Coordinated	$PRE1$ $t=1,E+06\ s$	$PRE1$ $t=1,E+07\ s$	$PRE1$ $t=1,E+08\ s$	$PRE1$ $t=1,E+09\ s$
294	1,285	3,760E+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 Modelization B

3.1 Characteristic of the modelization B

It acts of the same modelization as for the modelization A, but into selective: AXIS_HHS.

3.2 Quantities tested and results

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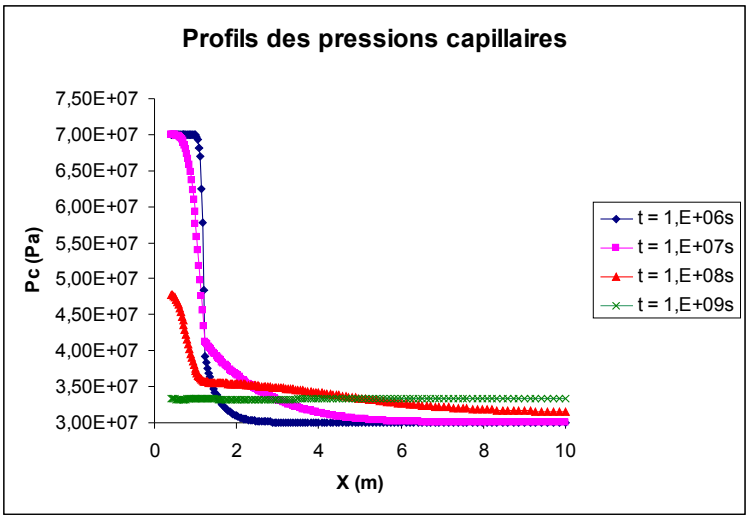

Values tested:

Number of node	Coordinated	*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 group in conformity so that one waits physically.