WTNL101 – Problem THM saturated coupled

Summarized:

It is about a dimensional mono problem of THM saturated. The thermal loading is a constant heat flux at an end of the field. This test is currently a test of non regression.

1 Problem of reference

1.1 Geometry

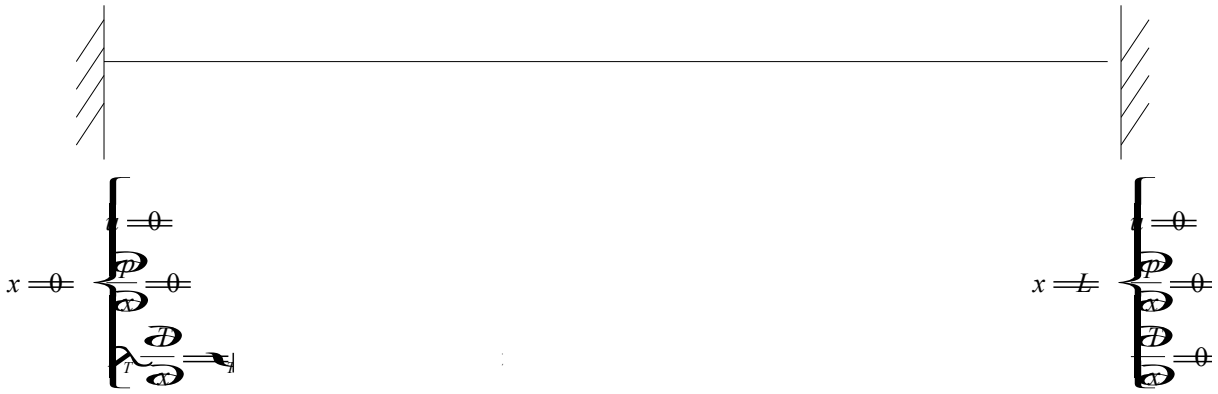
One is placed in the frame of a monodimensional problem in Cartesian coordinates, corresponding to an assumption of plane strains in the direction x .

The “structure” considered, is finally a segment length $L=20\,m$.

1.2 Properties of the liquid

material Water	Density $(kg.m^{-3})$	10^3
	Specific heat with pressure constant $(J.K^{-1})$	4180
	Dynamic viscosity of liquid water $(Pa.s)$	0.001
	thermal Coefficient of thermal expansion of the fluid (K^{-1})	1.10^{-4}
	Permeability relating to water	$kr_w(S)=1$
	Solid (Pa^{-1})	$K_e=5.10^{-10}$
Compressibility	Young Modulus drained $E(Pa)$	$2,166\,10^9$
	Poisson's ratio	0.3
	thermal Coefficient of thermal expansion of the solid (K^{-1})	10^{-5}
gas	Specific heat $(J.K^{-1})$	1000
	Molar mass $(kg.mol^{-1})$	0.02896
	Permeability relating to the gas	$kr_{gz}(S)=0$
	Viscosity of the gas $(kg.m^{-1.}.s^{-1})$	0
initial State	Porosity	0.14
	Temperature (K)	293
	liquid Pressure (Pa)	0
	Steam pressure fluid (Pa)	2320
	initial Saturation	1
Constants	Constant of perfect gases	8.32
Coefficients homogenized	Isothermal Density $(kg.m^{-3})$	2410
	homogenized of sorption	$S(P_c)=1$
	Coefficient of Biot	1
	intrinsic Permeability (m^2)	$K_{\text{int}}=10^{-19}$
	thermal Conductivity	$\lambda_T=1.8$

1.3 Boundary conditions and loadings



With $\lambda_T \frac{\partial T}{\partial x} = \Psi_T$ independent of time t

What corresponds to:

- In $x=0$: null displacement, hydraulic flux no one, constant heat flux $\Psi_T = 100$ imposed in time
- In $x=L$: null displacement, hydraulic flux no one, heat flux no one.

1.4 Initial conditions

$u(x)=P(x)=0 \quad T(x)=T_0=20°C$ everywhere.

2 Reference solution

the test is here into non regression.

Note: This modelization is carried out on linear elements. An analytical solution was conceived at the origin for this test then into quadratic: The computation of a new adapted analytical solution is the object of file 16737.

3 Modelization A

3.1 Characteristic of the modelization A

•Modelization in plane strains.
•100 elements $Q4$ of width equalizes for an overall length of 20 .
Note: like all the modelizations THM, the mesh must be quadratic, but the digital processing is made on Des. $Q4$

3.2 modelization Result A

Discretization in time: 10 time step of $50\,000\,s$ each one.

Table of nodes at time $5\times10^{5}s$:

$N°$ **NODE**	$COOR\_X$	$COOR\_Y$	$TEMP(°C)$	**Tolerance** (%)	$PRE1(Pa)$	**Tolerance** (%)
2	0	20	43.50	10	4.59×10^{6}	10
7	0	19.8	33.30	10	4.45×10^{6}	10
12	0	19.6	24.86	10	4.07×10^{6}	10
17	0	19.4	18.06	10	3.54×10^{6}	10
22	0	19.2	12.77	10	2.98×10^{6}	10

4 Modelization B

It acts of the same modelization in THMS (selective modelization). The results are the same ones.

5 Summary of the results

the results are into coherent physically and will have to be consolidated by an analytical solution (file 16737).