USE OF TENSIOMETRY IN NON-ISOTHERMAL CONDITIONS

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This paper analyses the mean sources of variation on the tensiometry measurements, according to non isothermal conditions (fig. 1). The mean classical sources of variation taken into account (air-water interfacial tension for exemple) seem unable to provide a satisfactory interpretation of the field measurements with high temperature changes (table I). According to the hypothesis of air included in the soil in the vicinty of the porous ceramic (fig. 2), theoritical explanations are proposed.

These explanations try to take into account :

i the increasing pressure of the vapor phase due to the increasing temperature (perfect gaz law)

ii the effect of the vaporisation of water with increasing temperature

iii the variation of the air-water interfacial tension with the temperature.

First, a model with a constant air volume included in the soil provides a possible explanation of the experimental data (table I, fig. 3). Second, a more complicated model that takes into account the variation of the gazeous phase volume is presented (fig. 4) : in the case of a conic pore model with air and water inside (fig. 5) it's possible to obtain geometrical and physical relations describing the model (table III, IV, V, VI). Calculations show that an increasing temperature provides a variation of the water potential measurements (table VII). Finaly, the first and the second model give theoritical results that are in the same order of magnitude than the experimental data (table VIII). In fact, a complete explanation or prevision of the effet of temperature according tensiometry measurements needs probably more complicated models and more experimental data with high controlled laboratory conditions.

Table II : Model with a constant air-volume included in the soil porosity : Partial contribution of different terms to the total mercury length variation with increasing temperature.

Increase of temperature (°C)	Cumulated variation of the mercury length due to increasing pressure of the vapor (without water vaporisation) (mm Hg)	Cumulated variation of the mercury length due to the water vaporisation (mm Hg)	Total cumulated variation of the mercury length (mm Hg)
2	- 5,6	- 2,4	- 8,0
4	-11,2	- 5,1	-16,2
6	-16,7	- 8,1	-24,8
8	-22,2	-11,5	-33,7
10	-27,7	-15,3	-43,0
12	-33,1	-19,6	-52,7
14	-38,5	-24,5	-63,0
16	-43,8	-30,0	-73,8
18	-49,1	-36,2	-85,3
20	-54,4	-43,2	-97,6

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Table VII : Variation of the mercury column length versus increasing temperature according to the conic model for included water vapor.

Temperature (°C)	Cumulated variation of the mercury length (mm Hg)	Partial contribution to the total variation of the mercury length (%)			Air content
		Variation due to the increasing pressure with temperature (without vaporisation) (%)	Variation due to the vaporisation of water (%)	Variation due to the air-water interfacial tension (%)	
22	- 1,6	14,4	5,3	80,3	0,021
24	- 3,3	14,5	6,0	79,4	0,022
26	- 4,9	14,7	6,8	78,5	0,024
28	- 6,6	14,8	7,7	77,5	0,025
30	- 8,3	14,9	8,7	76,4	0,026
32	-10,1	14,9	9,8	75,3	0,027
34	-11,8	15,0	10,9	74,1	0,029
36	-13,6	15,0	12,2	72,8	0,030
38	-15,4	14,9	13,6	71,4	0,032
40	-17,2	14,9	15,2	70,0	0,033

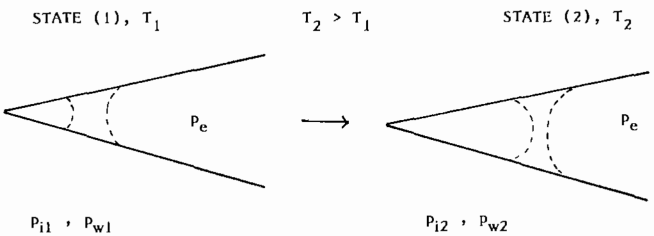

Figure 4 : Schematic diagram of the conic pore model with variable air volume included in the soil porosity.