Using PCM in order to reduce temperature inside telecommunication outdoor cabinet

Stéphane Le Masson

Orange Labs

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Plan

1 – Introduction –

2 – Cooling solutions

3 – Phase change material

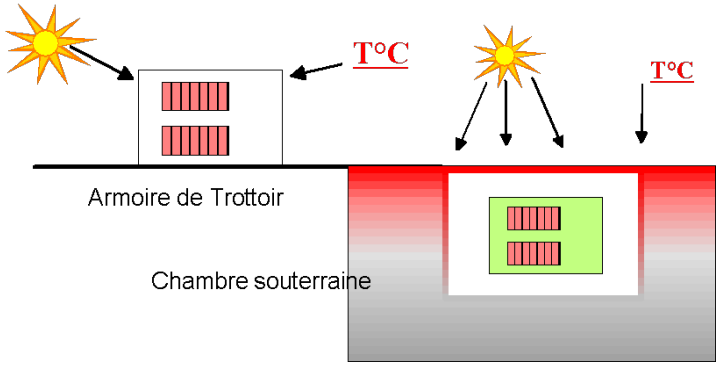
4 – Problem to solve

4 – Results

1. Introduction – Contexte des armoires outdoor

– **Télécommunication equipements are located in outdoor cabinet**

The Loads :



→ External température

→ Solar radiation

→ Internal power => Telecommunication Equipements

par exemple 100W à 1kW

Internal temperatures are limited
(55 °C at the intrance)

2 – Cooling solutions

- **Classical solutions:**

Climatisation

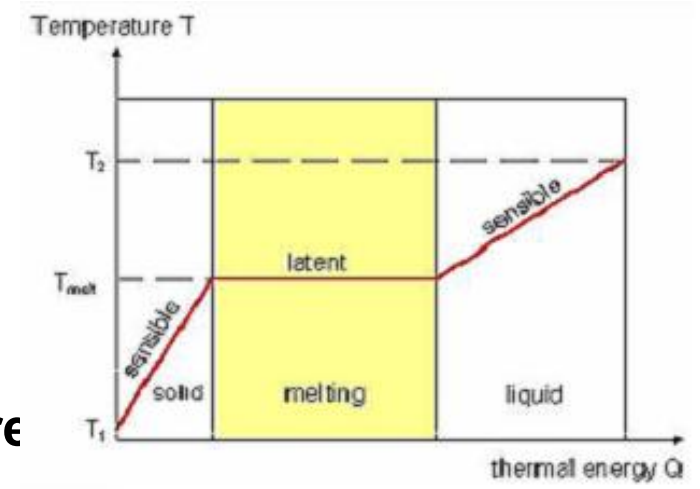
Ventilation

Heat exchange

"Passives" Solutions : PCM based on Molecular Alloys (MCPAM)

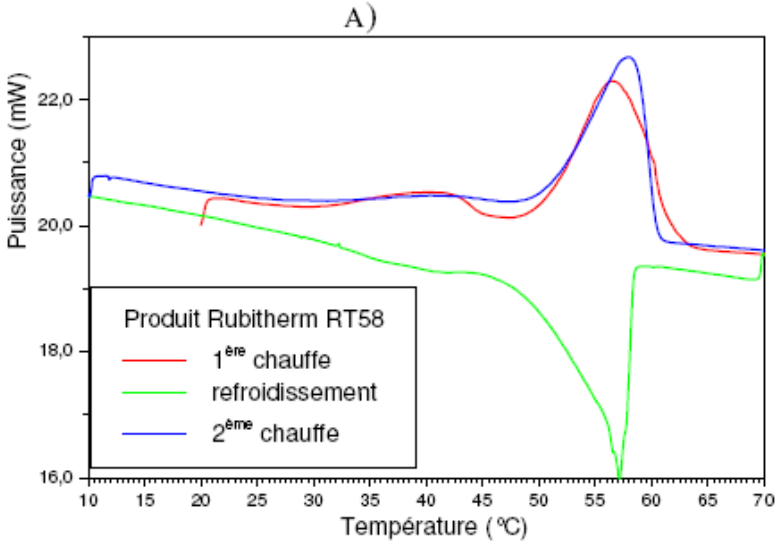
3 Phase Change Materials

Material whose molecular structure change with temperature Tpc **Tpc Phase Change Temperature**



Material accumulate energy when the phase change From Solid => Liquid

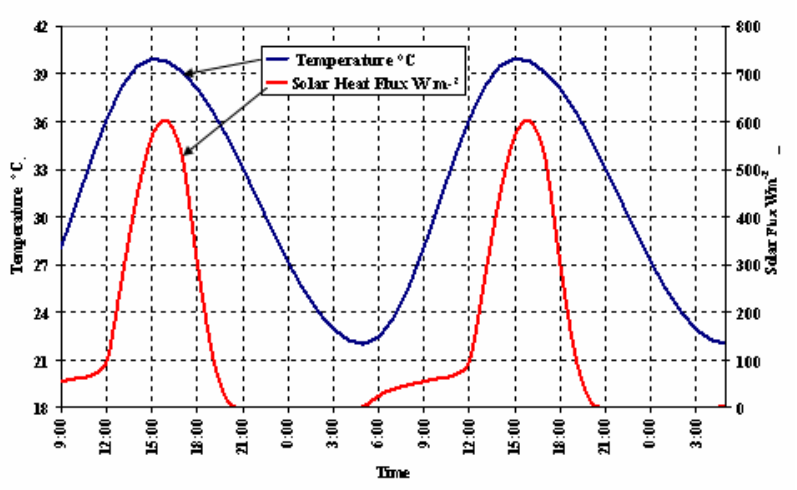
PCM are useful in order to reduce temperature when material is melting

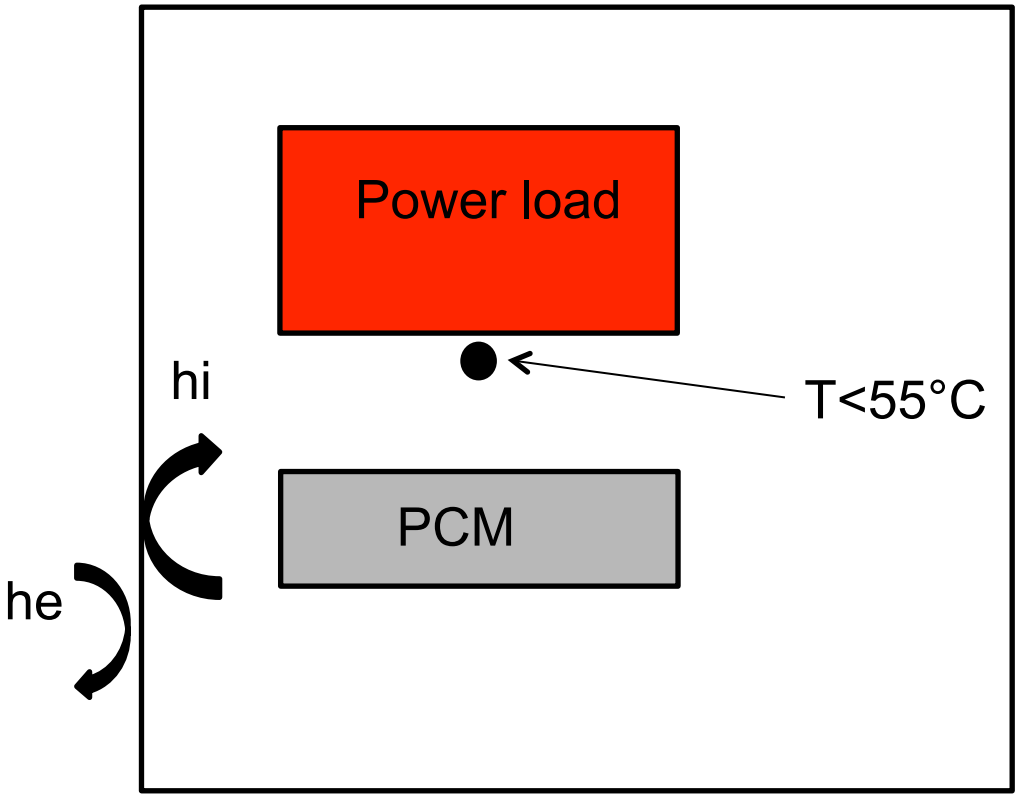


Alcanes	Masse molaire (g/mol)	Température de fusion (°C)	Enthalpie de fusion (J/g)
C24H50	338,66	49,7±0,3	157±18
C25H52	352,69	52,7±0,3	160±17
C26H54	366,71	55,6±0,3	163±17
C27H56	380,73	58,5±	164±
C28H58	394,76	60,5±0,3	165±18

4 Problem to solve ??
Model in order to predict velocity et thermal field…

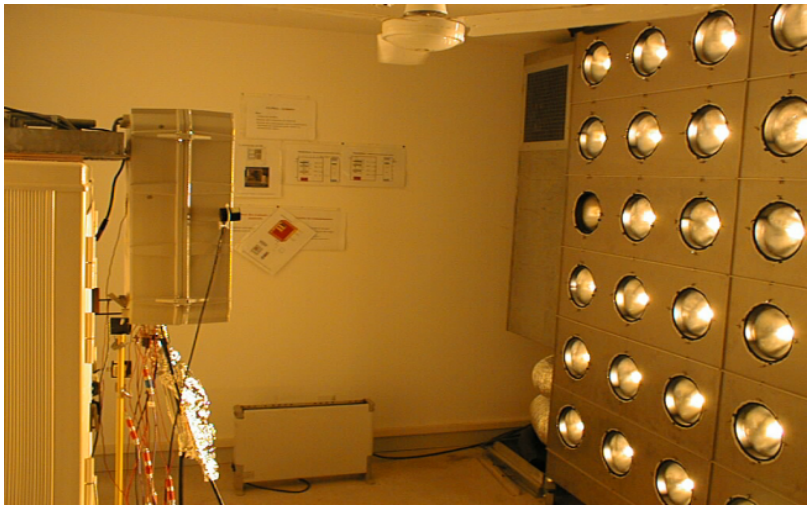
external boundary conditions

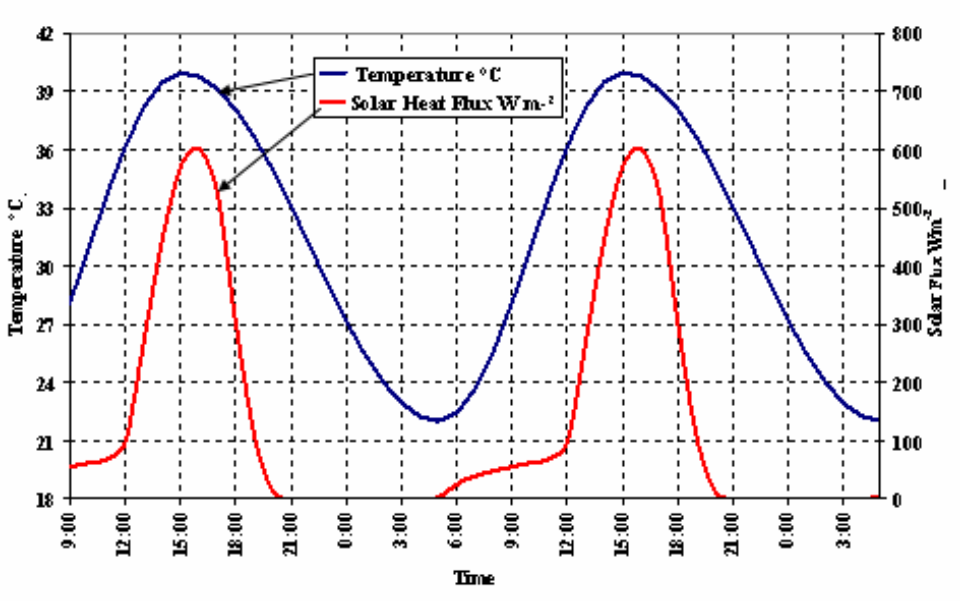


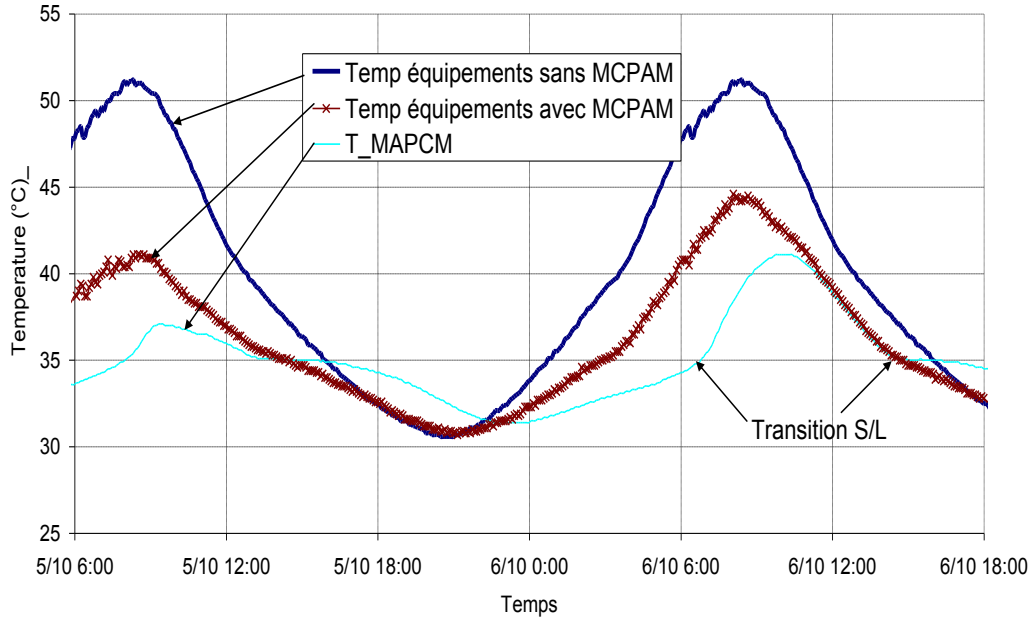


5 PCM : Experimental examples

Experimental setup

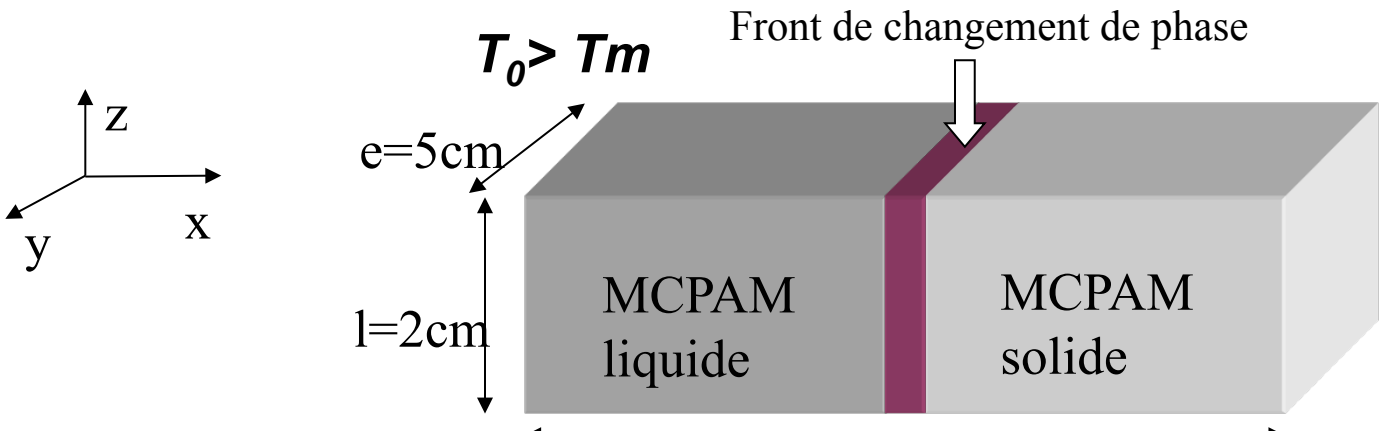






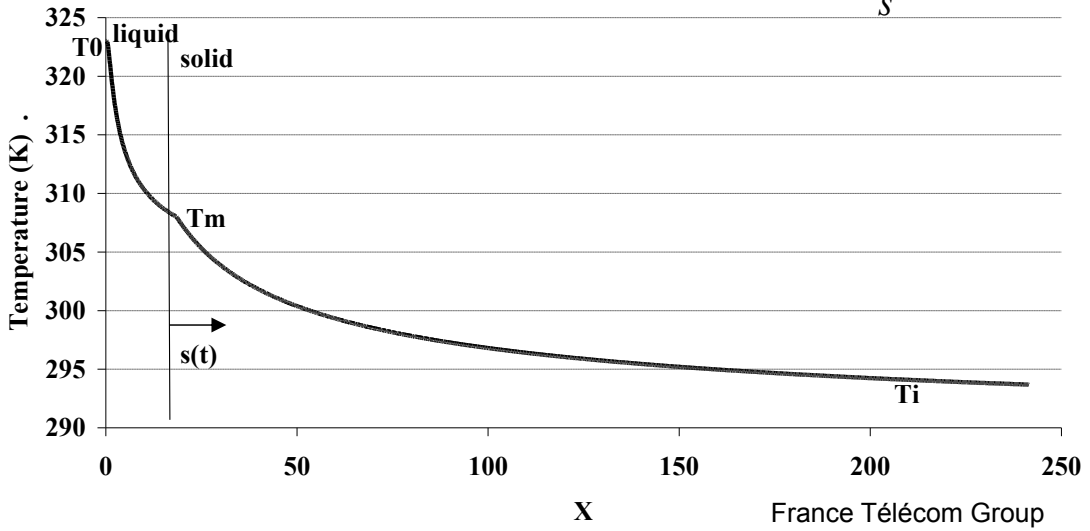
5– Numerical simulation
One dimension case

$$k_s \frac{\partial T_s(x,t)}{\partial x} - k_l \frac{\partial T_l(x,t)}{\partial x} = \rho L \frac{ds(t)}{dt}$$

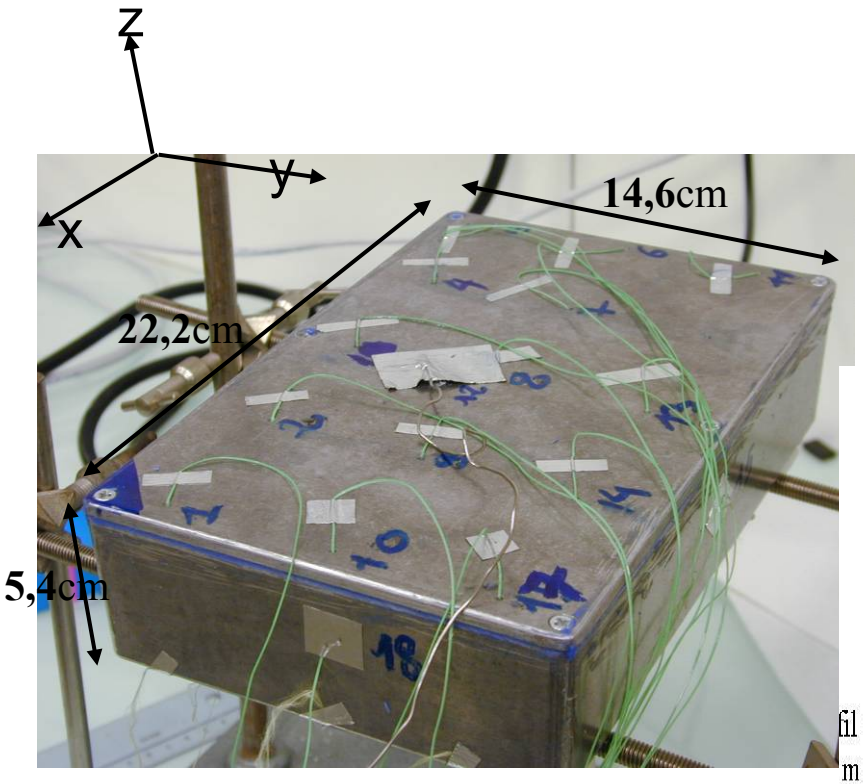


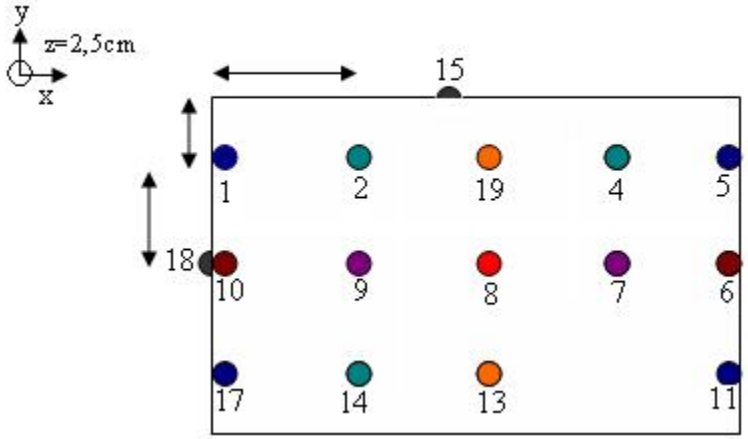
$$\frac{\partial^2 T_l(x,t)}{\partial x^2} = \frac{1}{a_l} \frac{\partial T_l(x,t)}{\partial t}$$

$$\frac{\partial^2 T_s(x,t)}{\partial x^2} = \frac{1}{a_s} \frac{\partial T_s(x,t)}{\partial t}$$

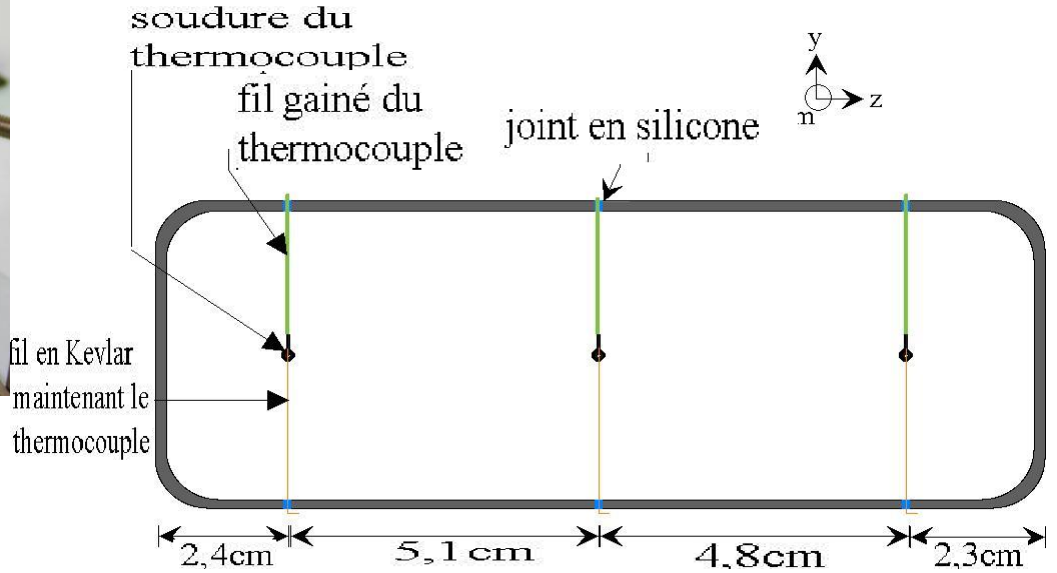


5. 3D experimental



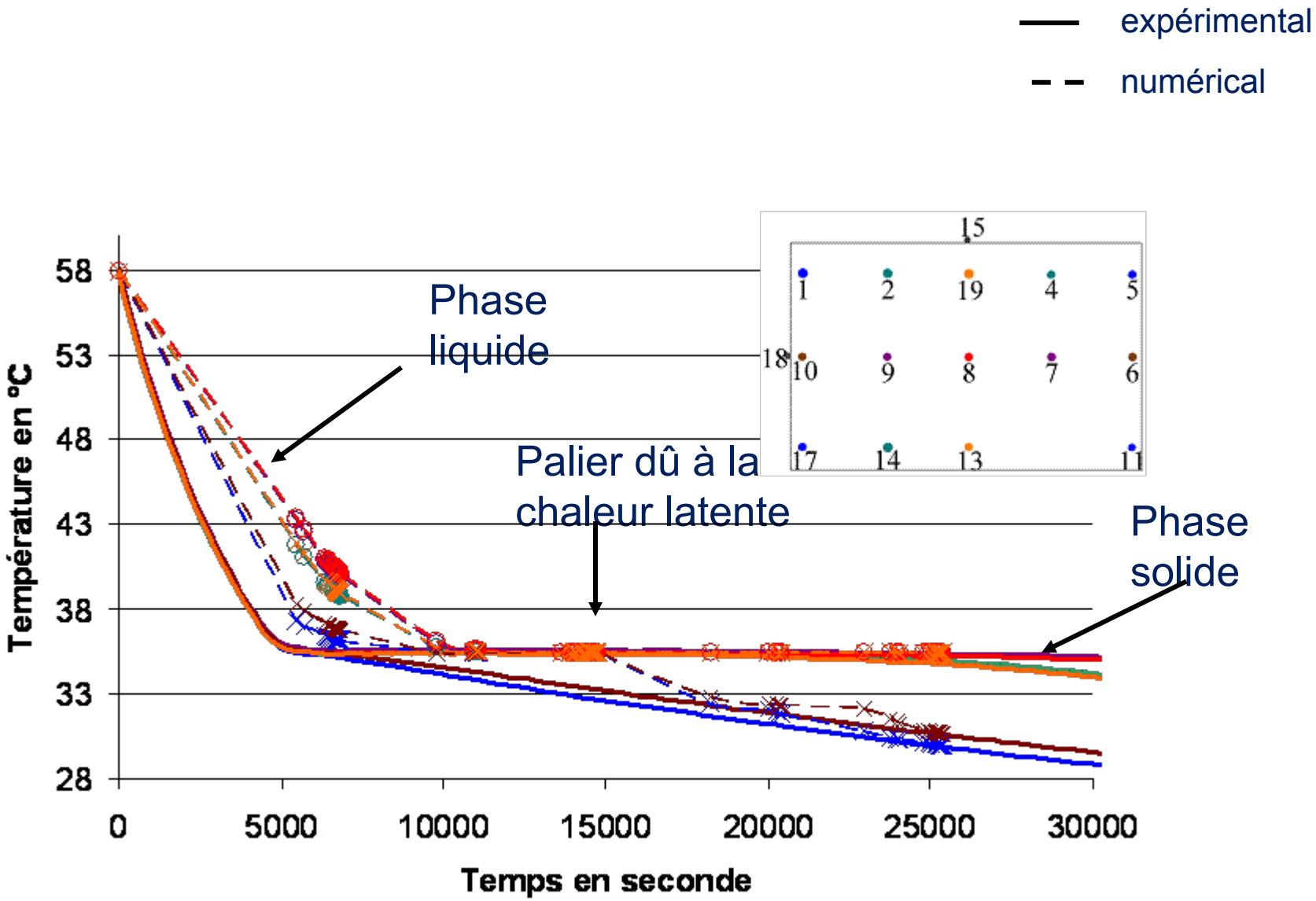


Coupe en (xy)



Coupe en (yz)

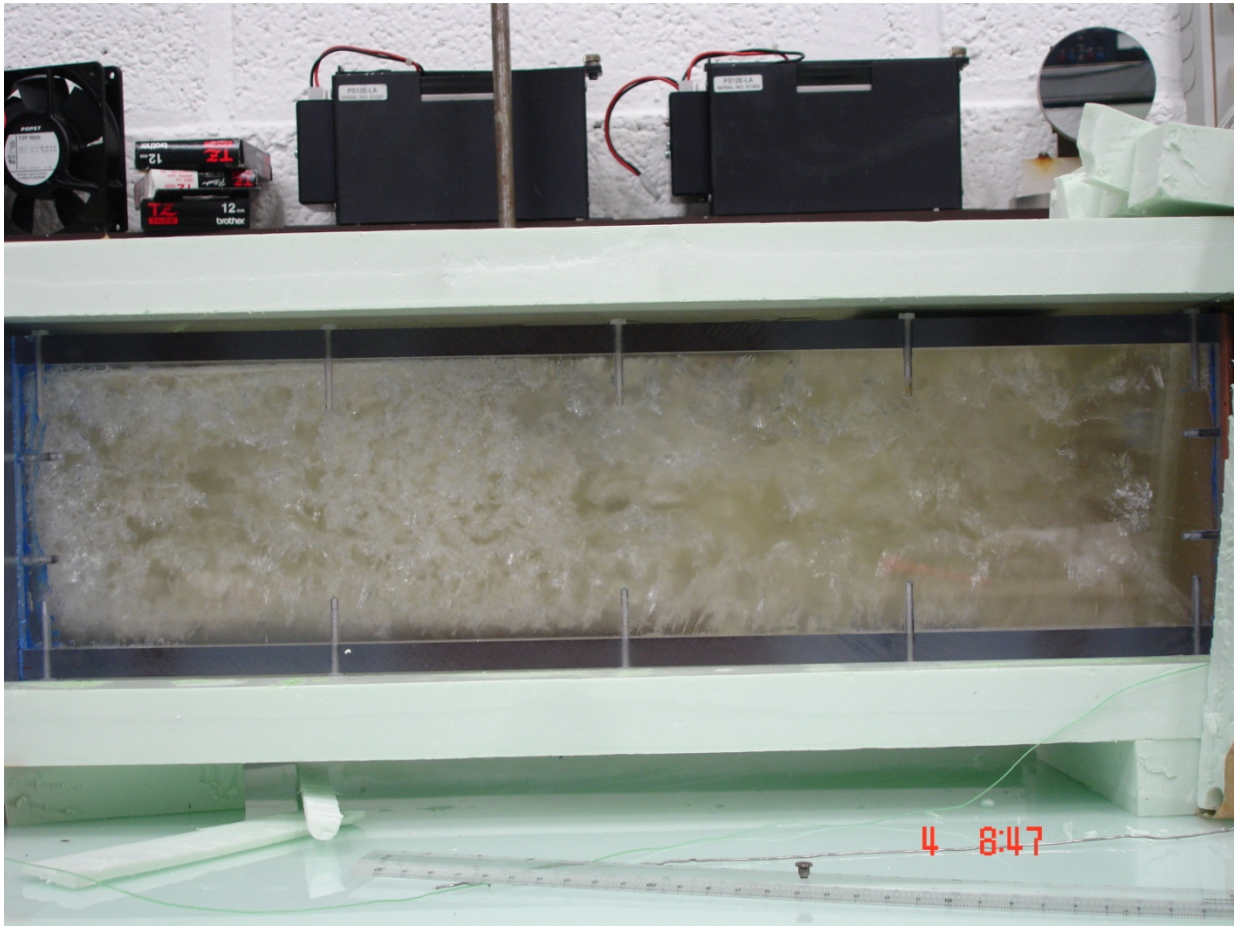
5. Comparison between experimental and numerical



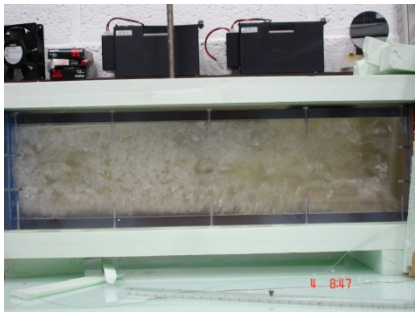
5. Changement de phase solide/liquide

Température uniforme initiale 10°C. Température imposée par un échangeur en cuivre 60°C

10°C



60°C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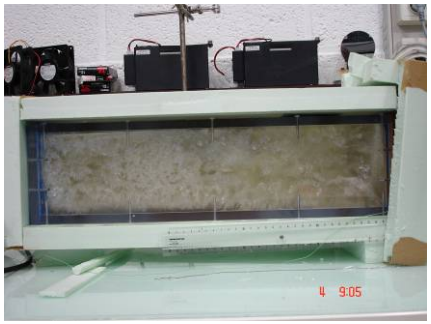
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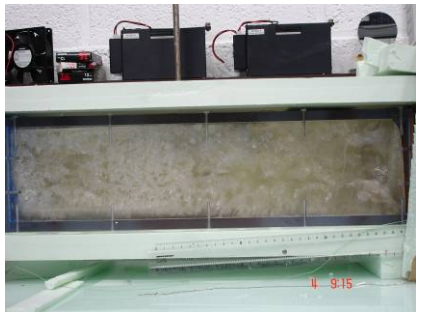
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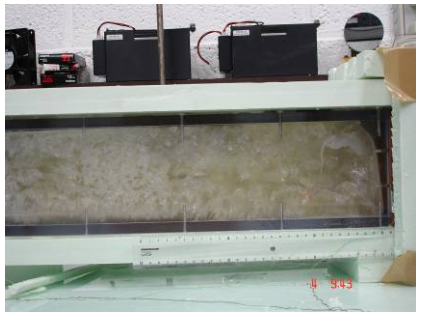
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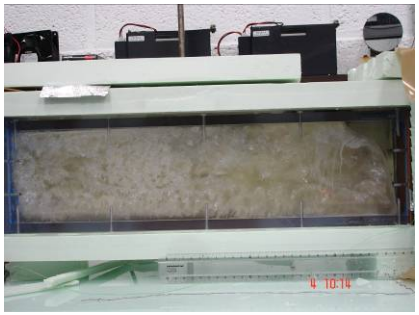
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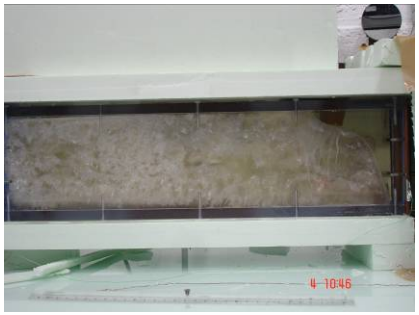
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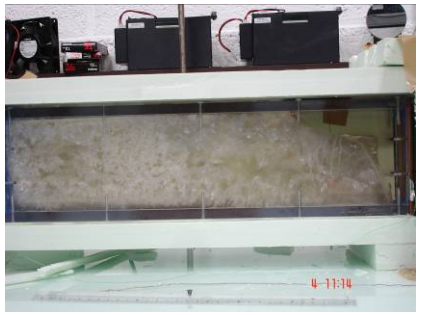
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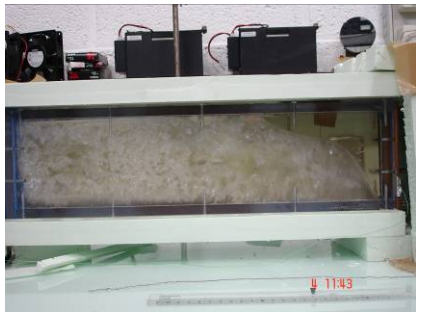
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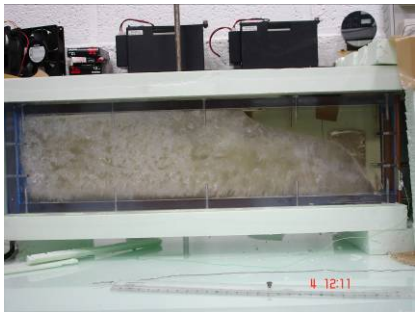
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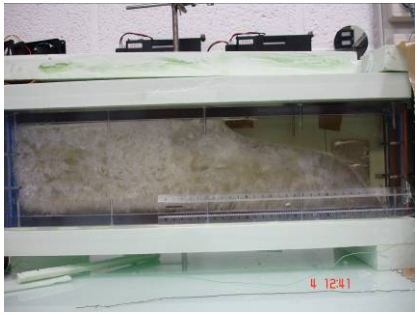
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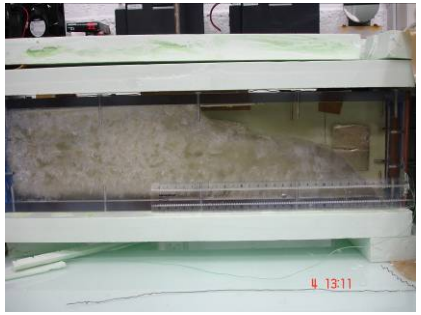
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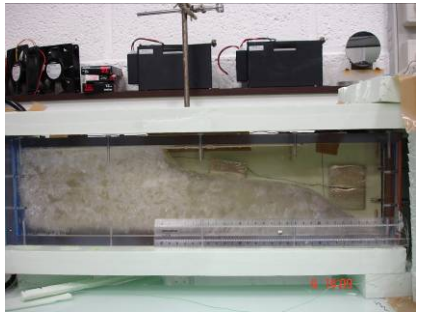

4 15:08

4 16:58


⇒Boundary is not vertical

⇒ Our "simple model" is not adapted to this case

⇒We need another model

Merci

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