T1, TH1, TH2, TH3 test case results

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British Geological Survey

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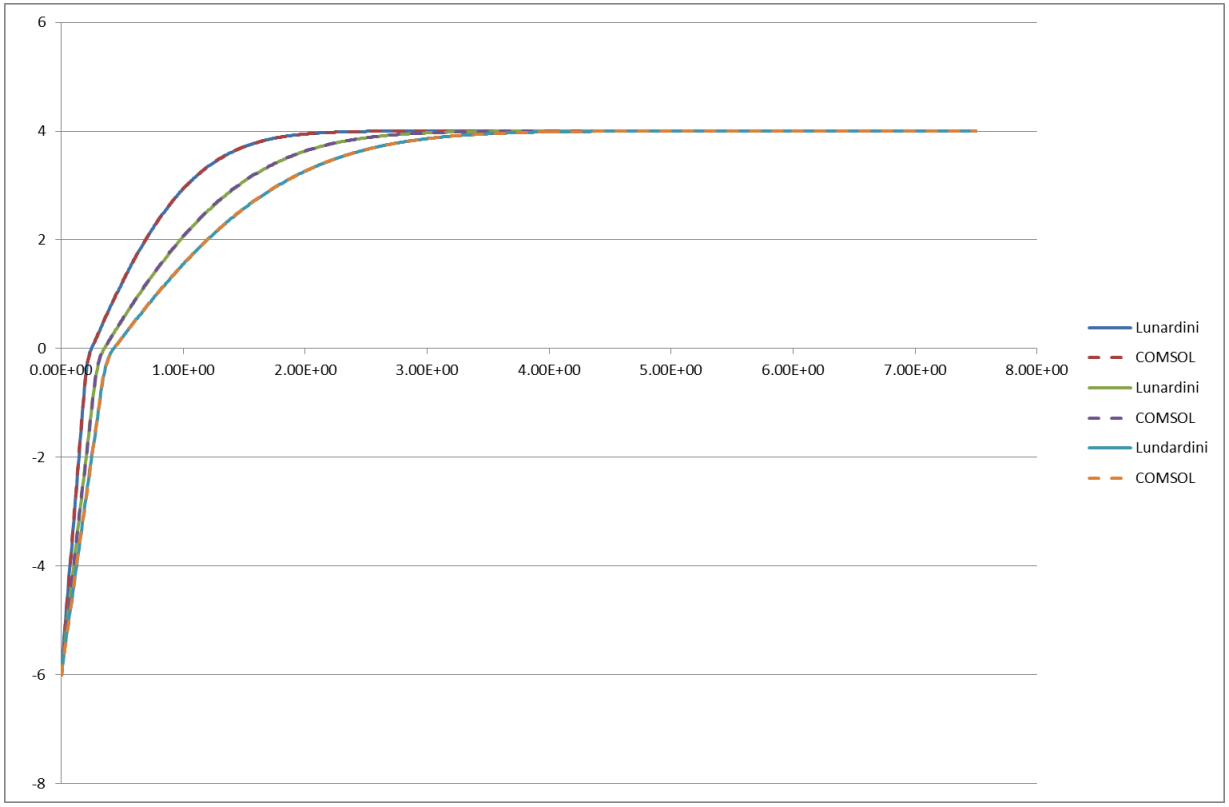
T1: Lundardini heat conduction



The maximum difference of the two solutions lies between 0.0066 °C and -0.0021 °C. The mean error is 3.5 e-6 °C.

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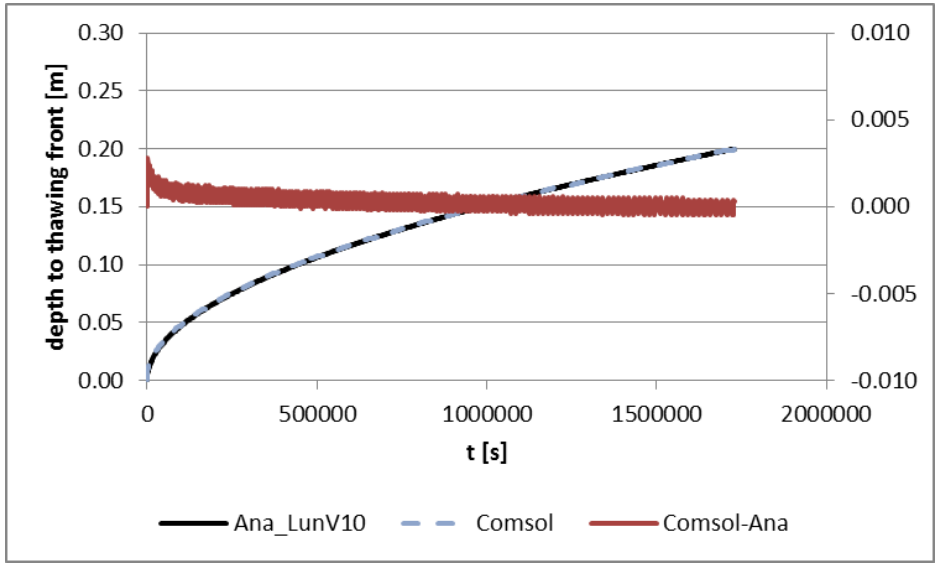
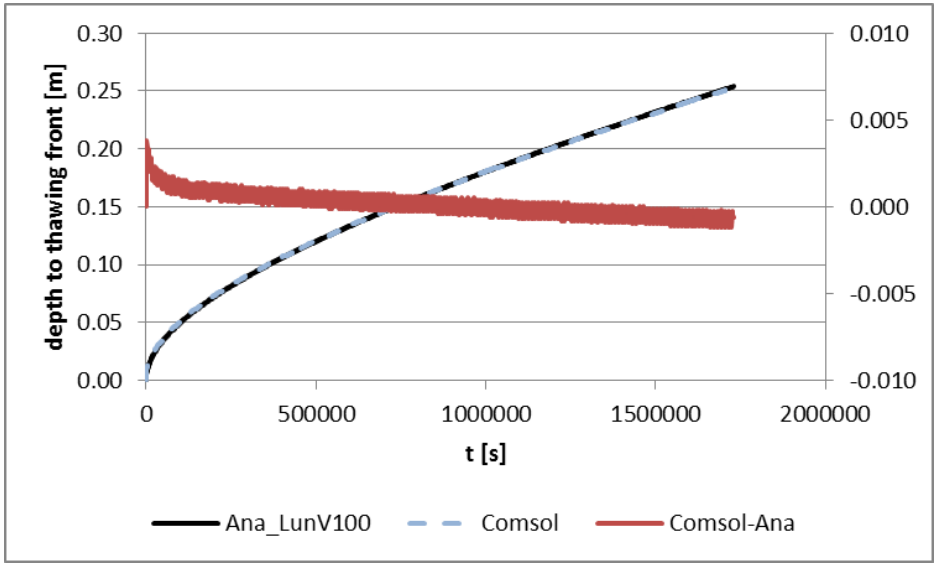
TH1: 1D thawing with conduction and advection





V=10 m/a
Max. difference:
0.0028, -0.0005 m
After 20 d: 0.0003 m

V=100 m/a
Max. difference:
0.0038, -0.0012 m
After 20 d: -0.0006 m

For the numeric solution to match the analytical solution, the absolute and relative tolerance were set to 1e-11. Cell size: 0.001 m

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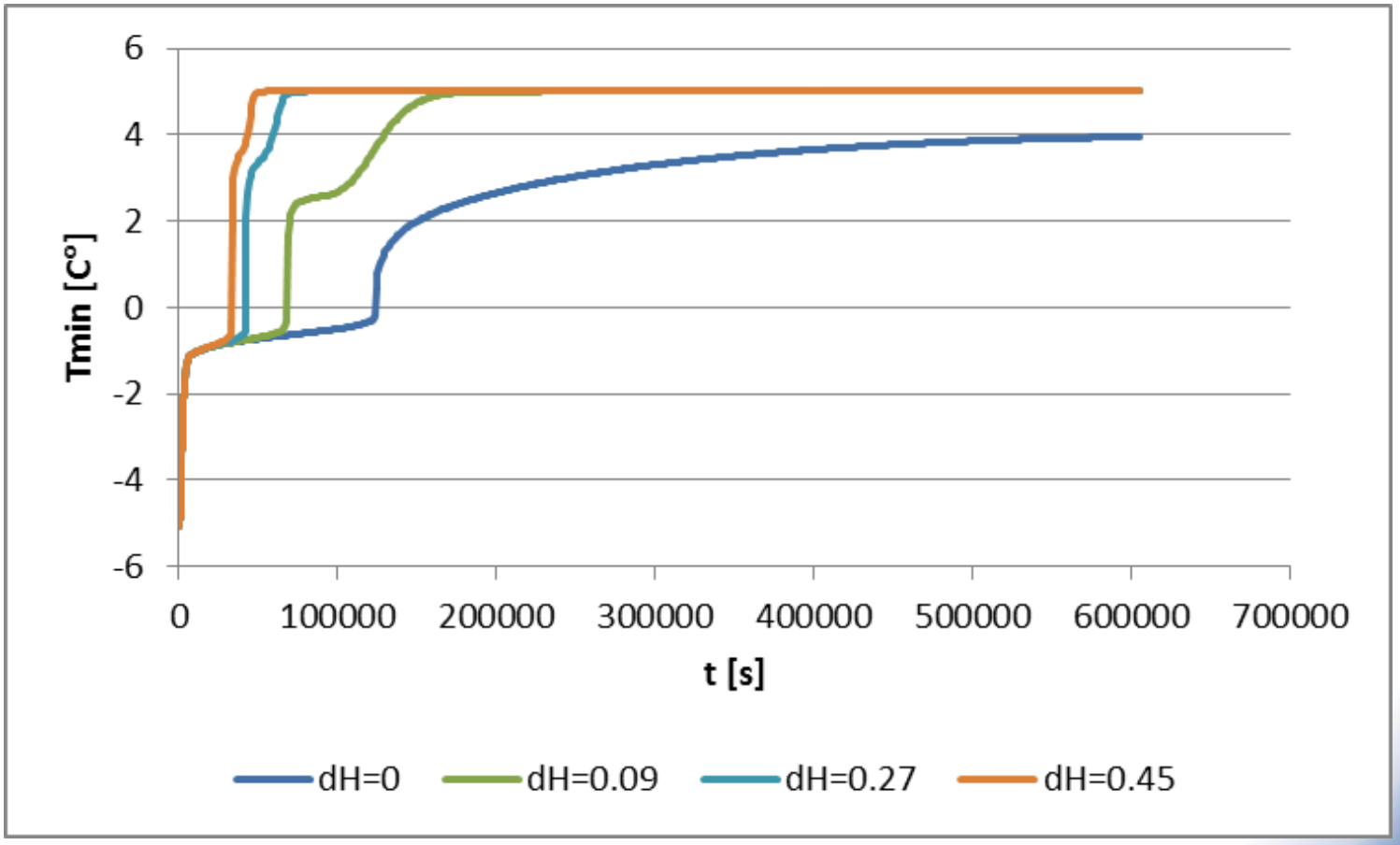
TH2: Frozen inclusion Minimum temperature



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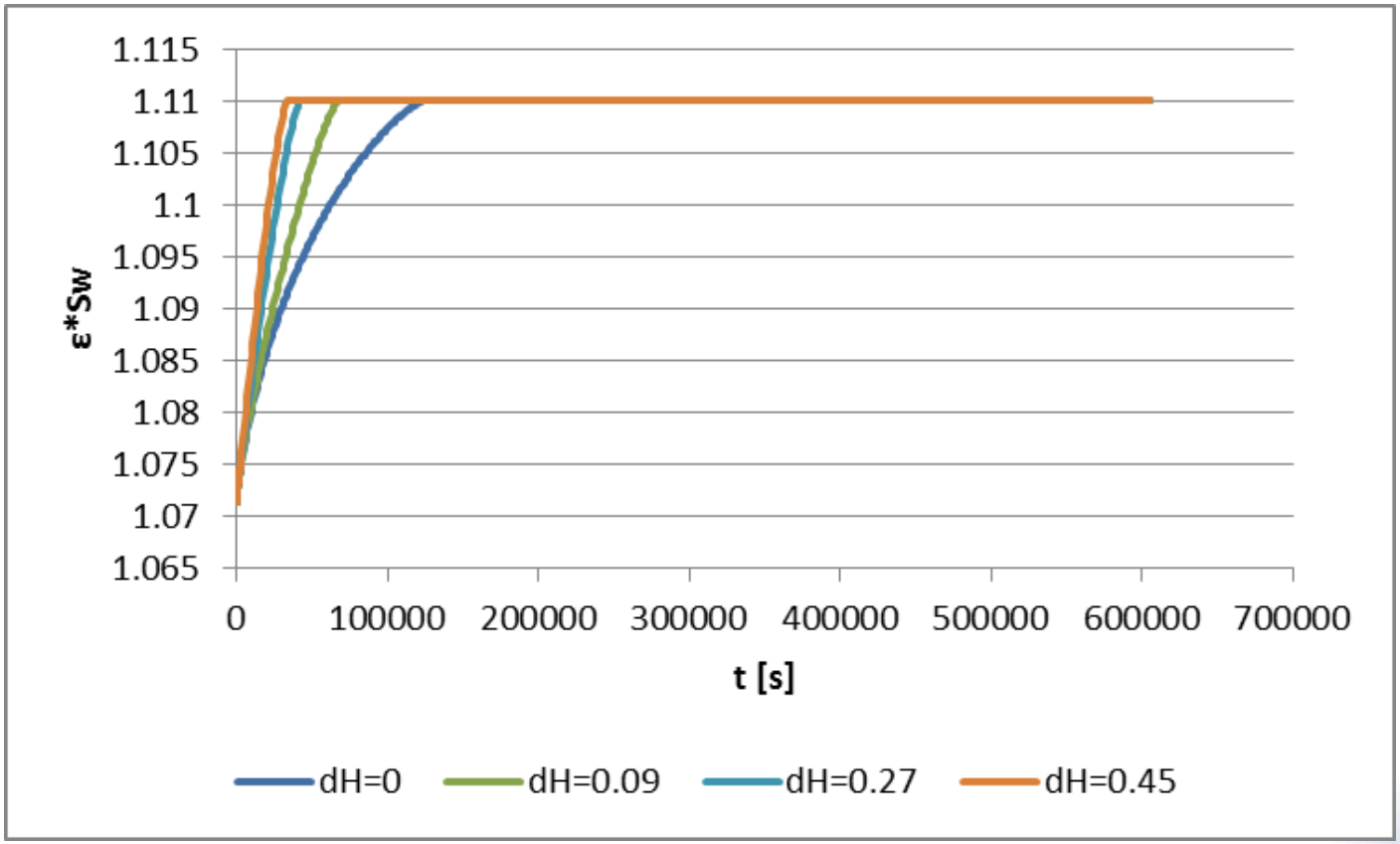
Total liquid water volume



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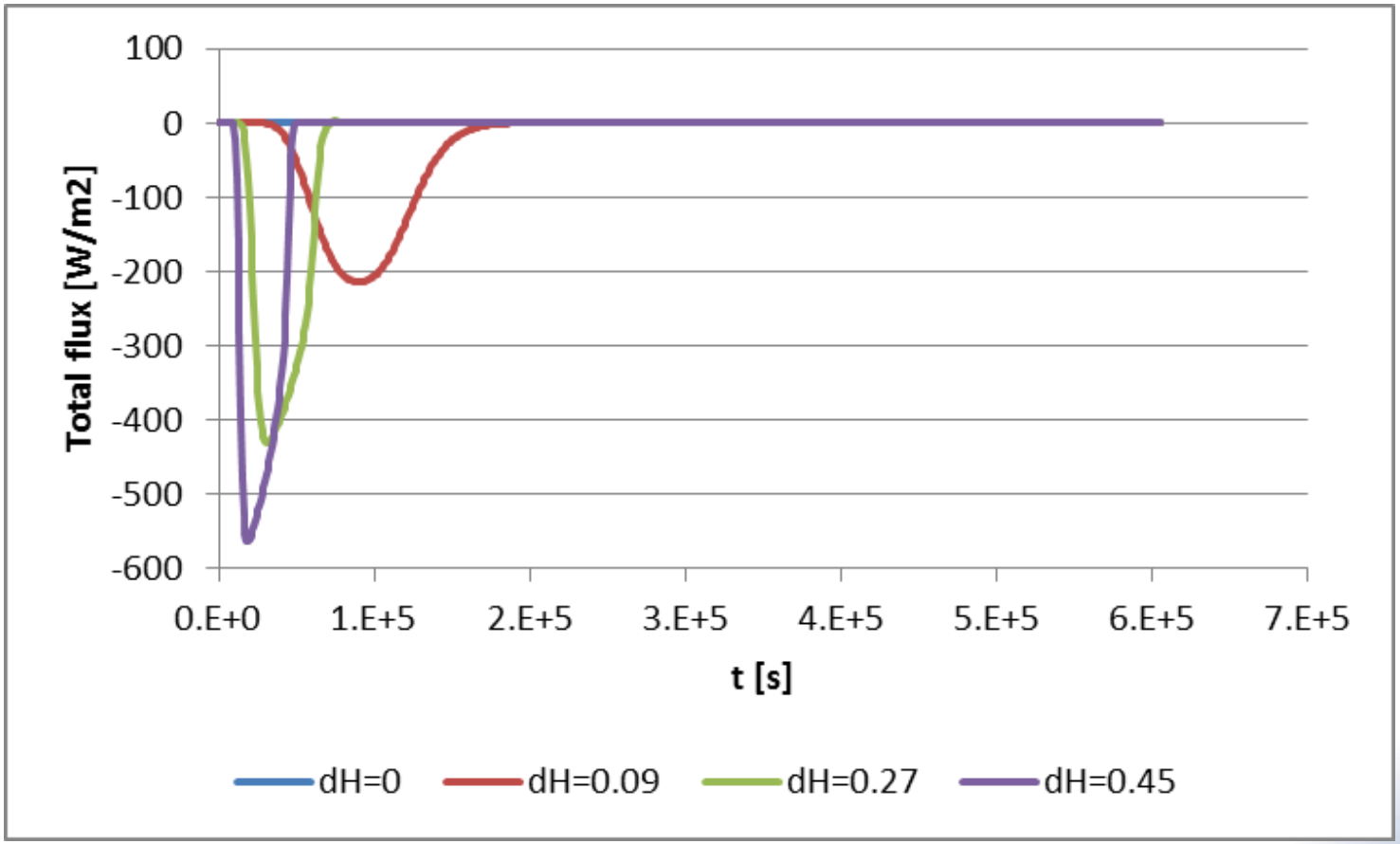
Heat flux exiting the system



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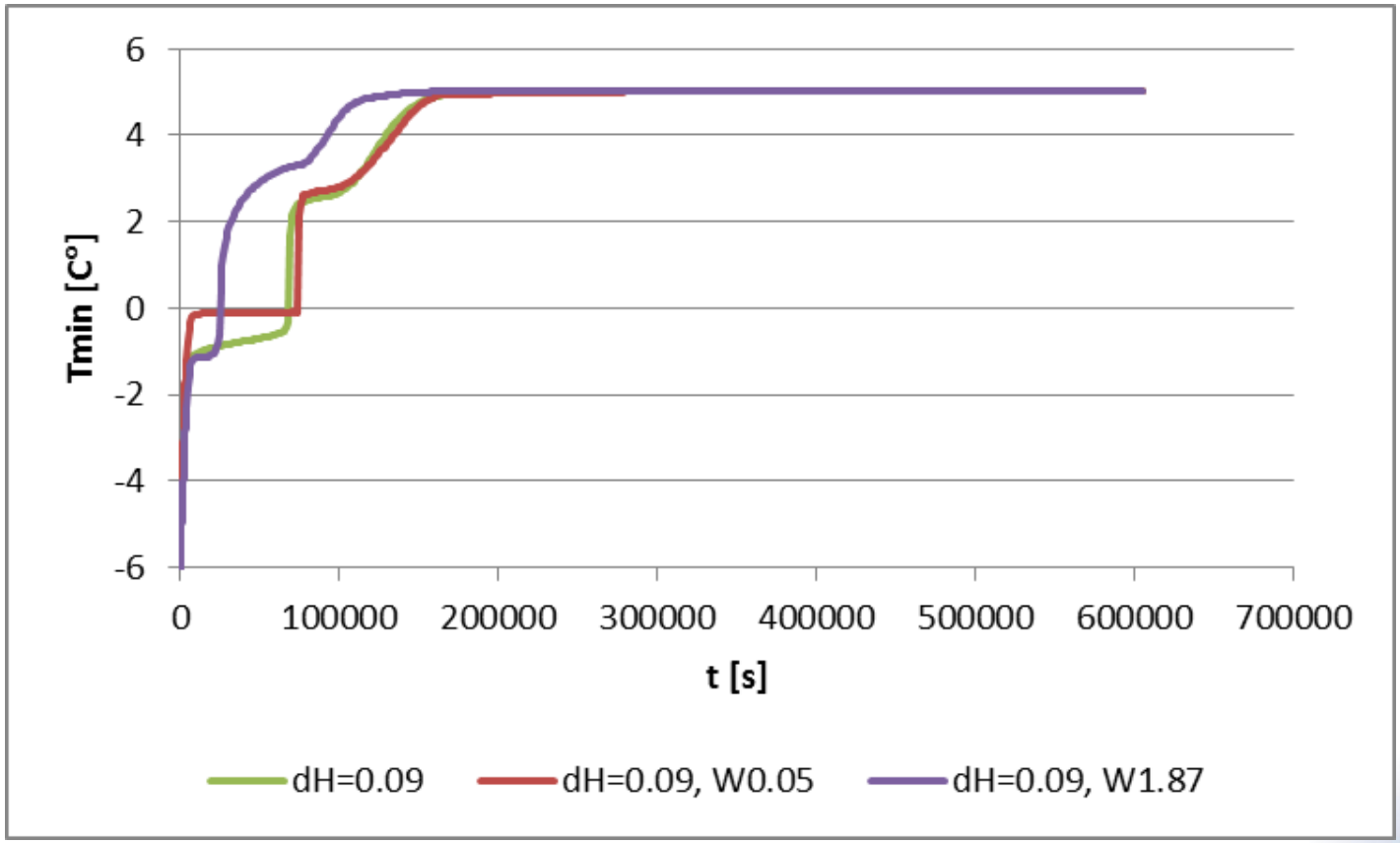
Variation of the W parameter



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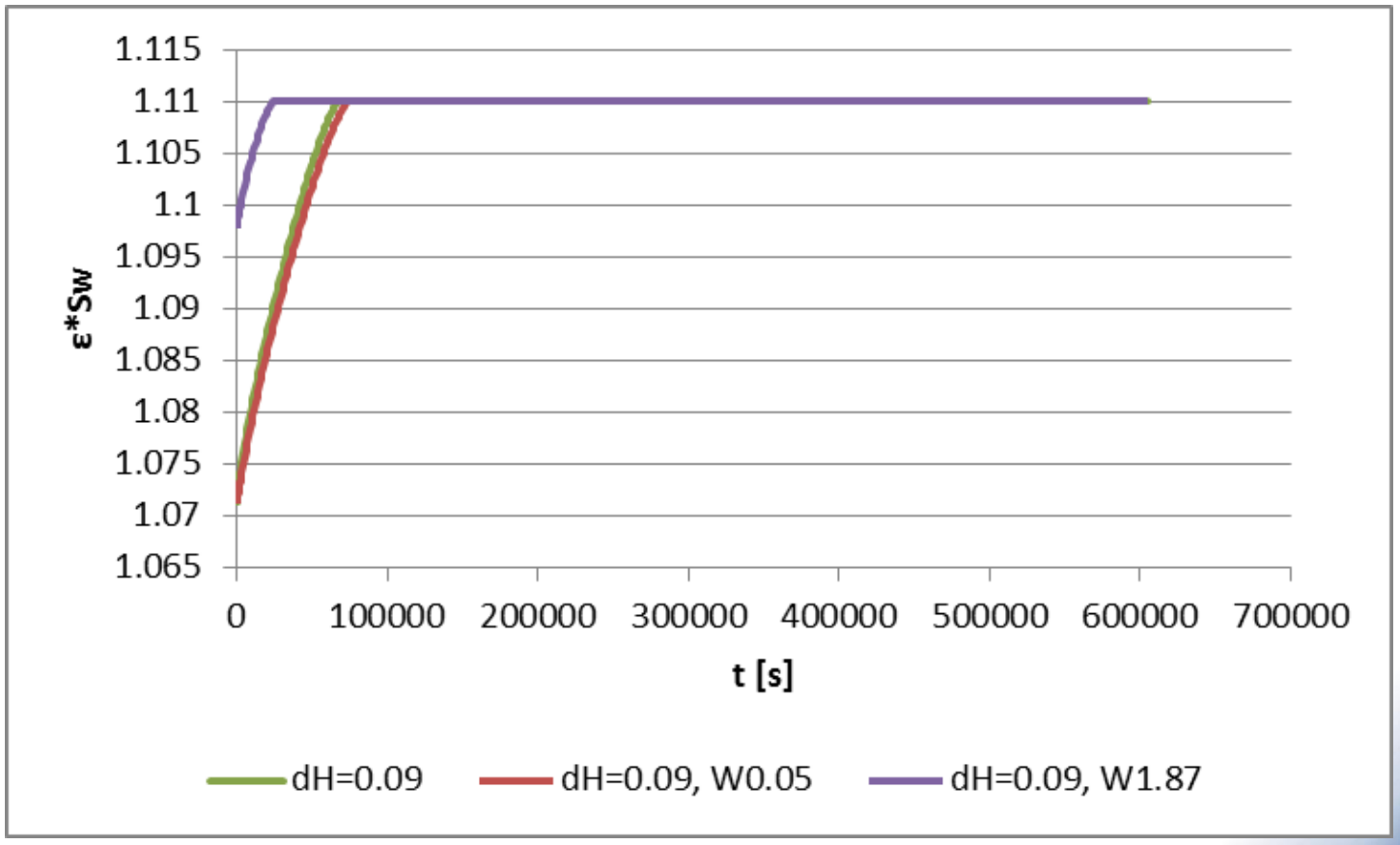

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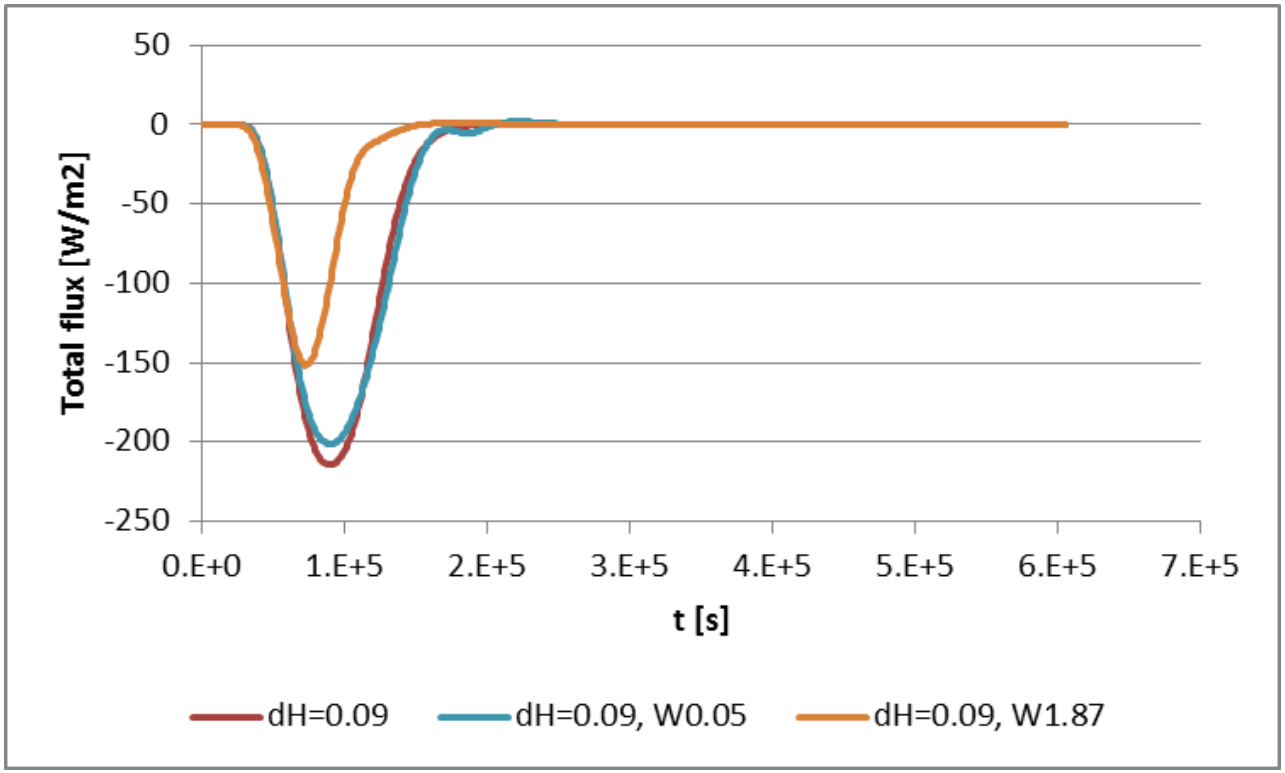

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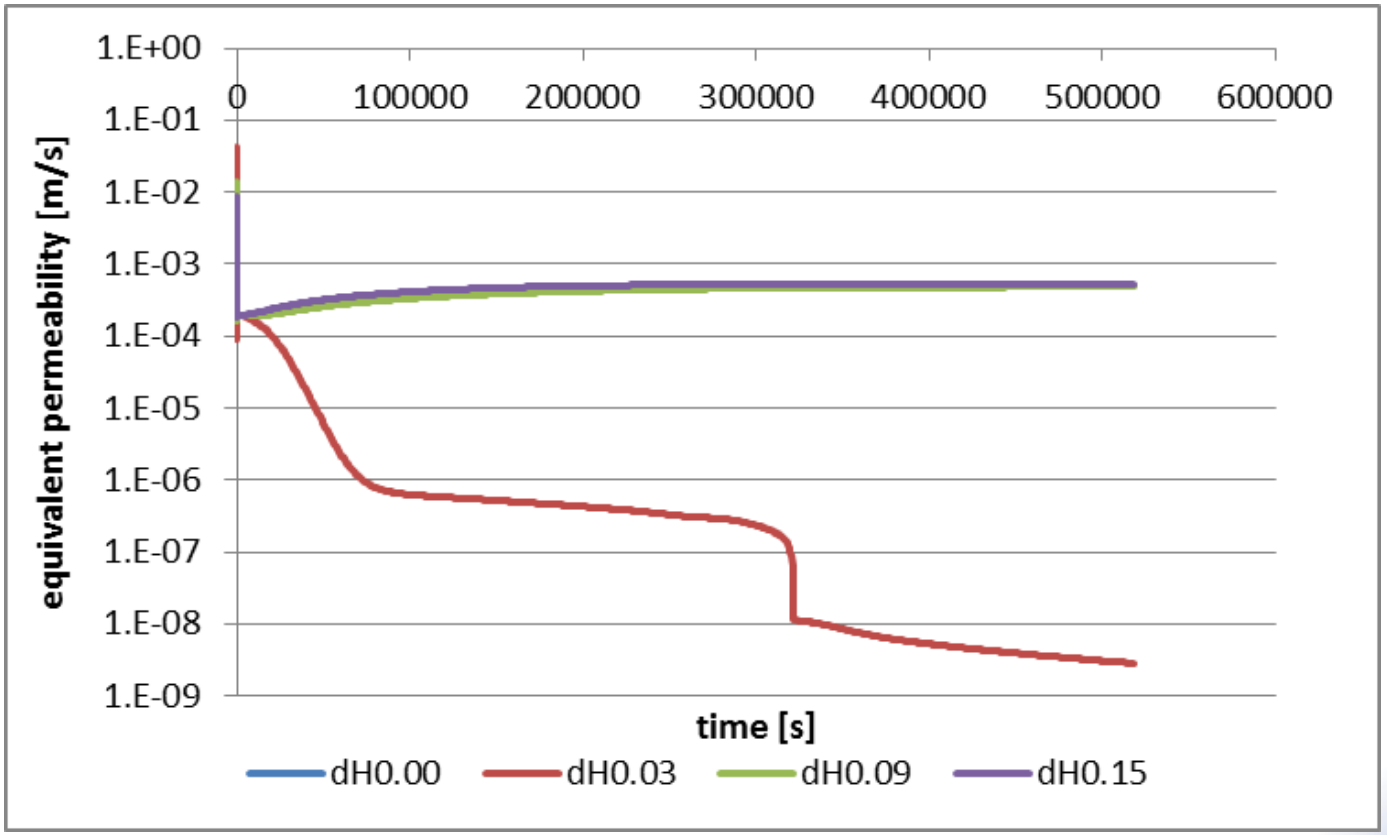
TH3: Talik Opening/Closure equivalent permeability



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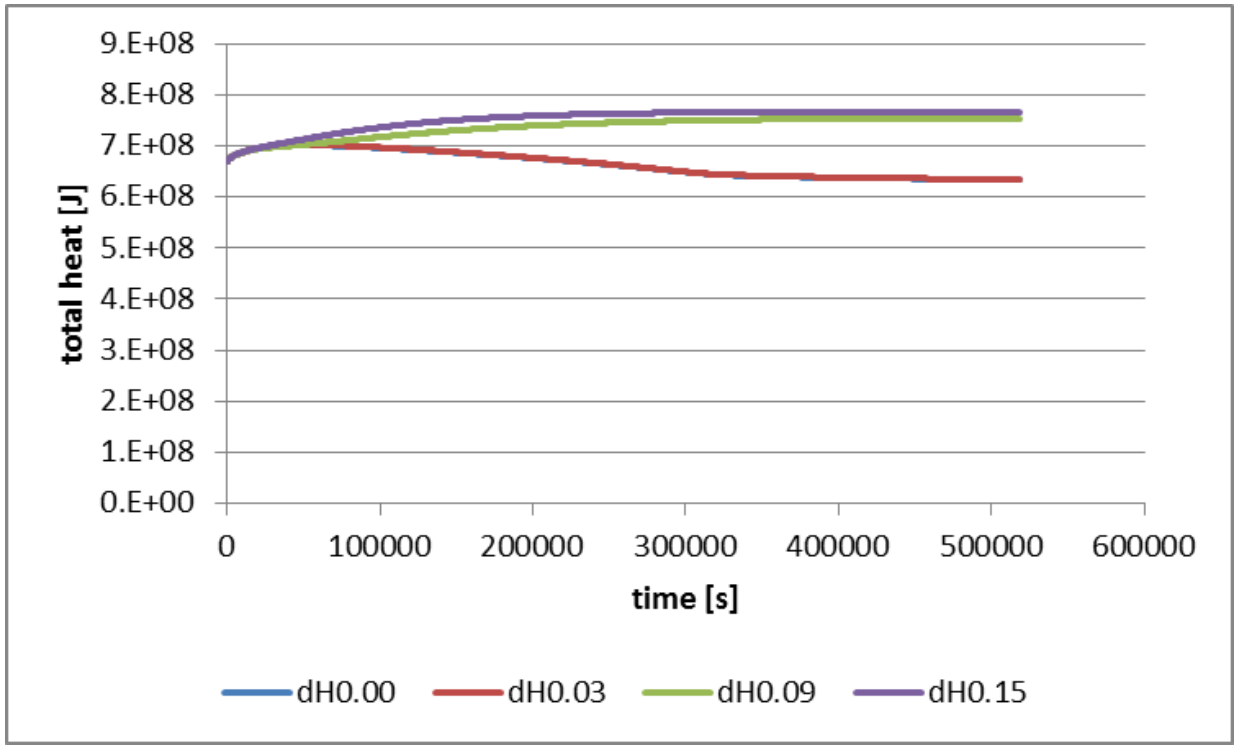
TH3: total heat (Ca*T +Cf)



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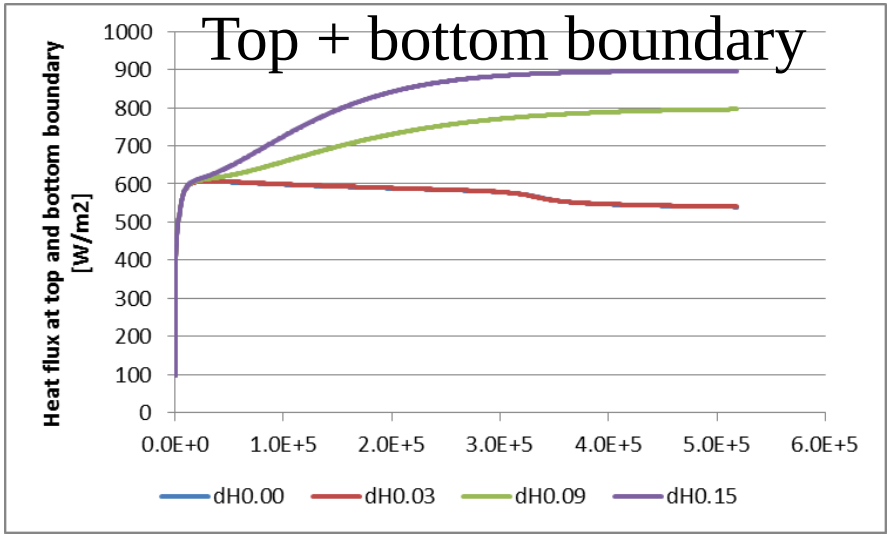
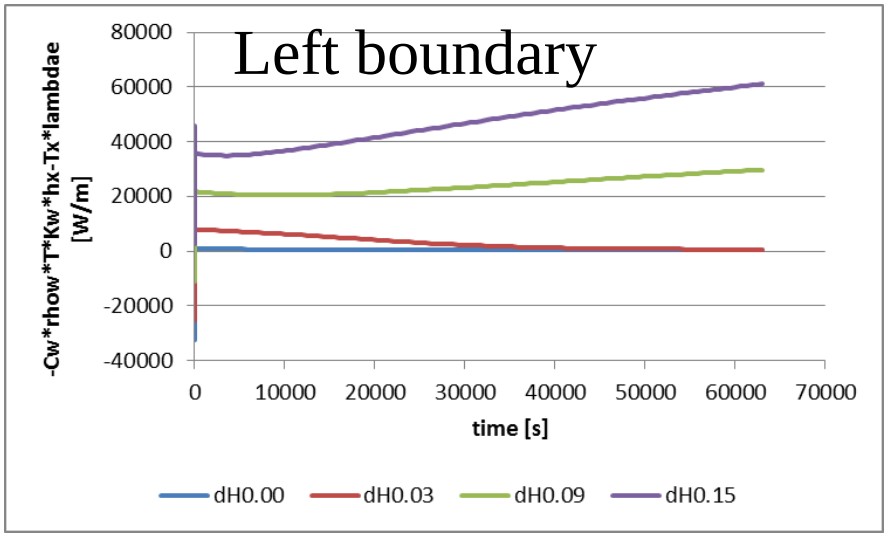
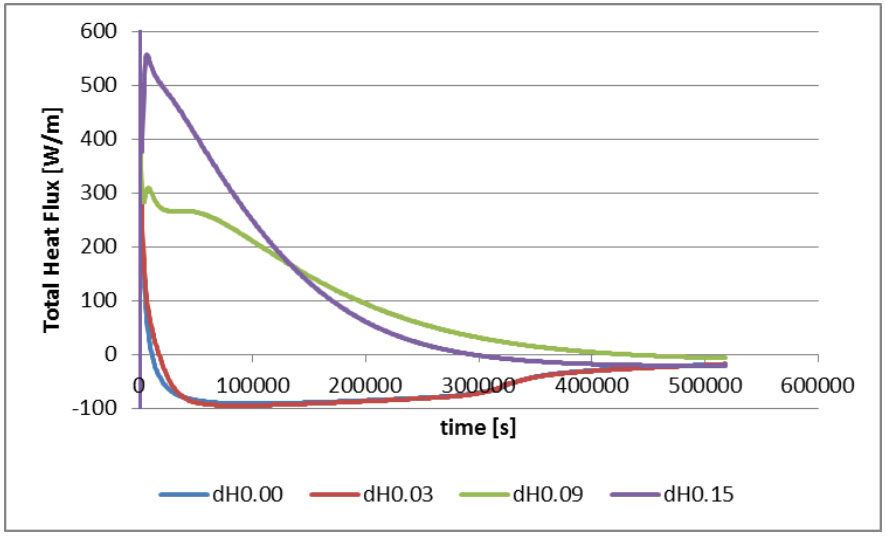
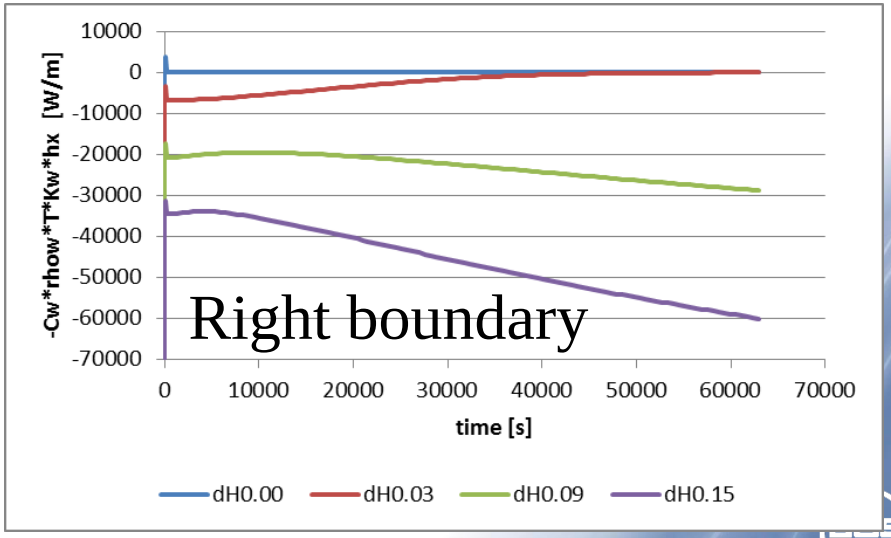
TH3: heat flux at the boundaries









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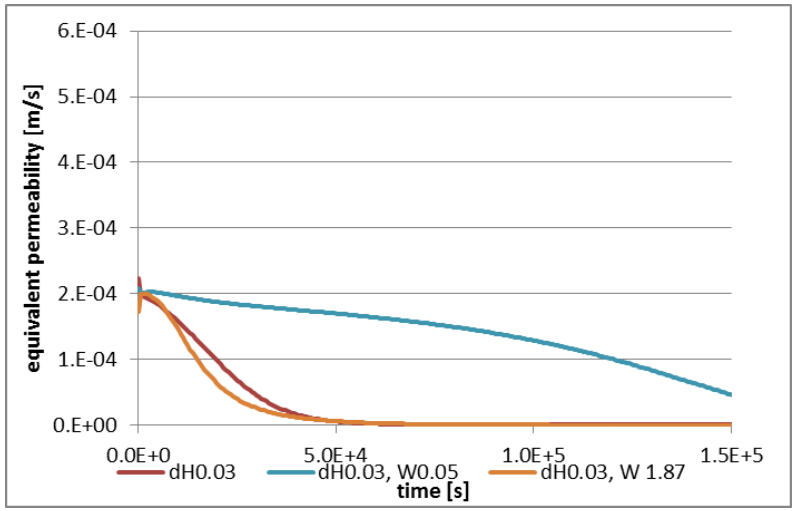
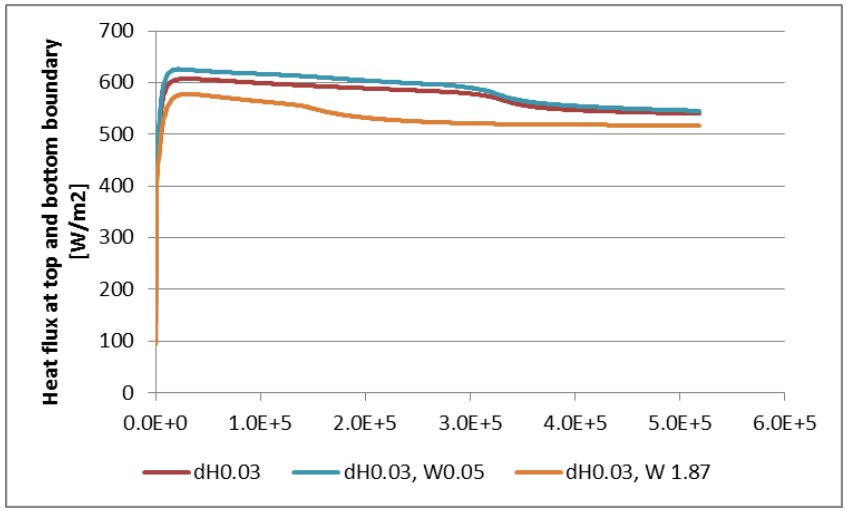
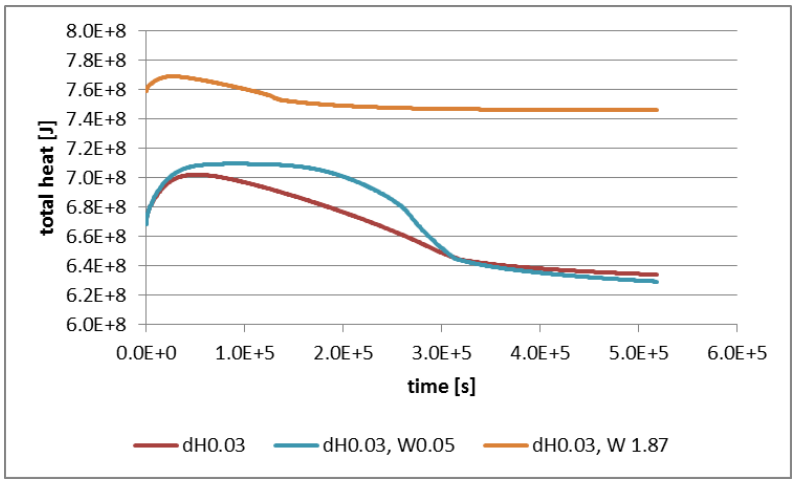
Variation of the W parameter







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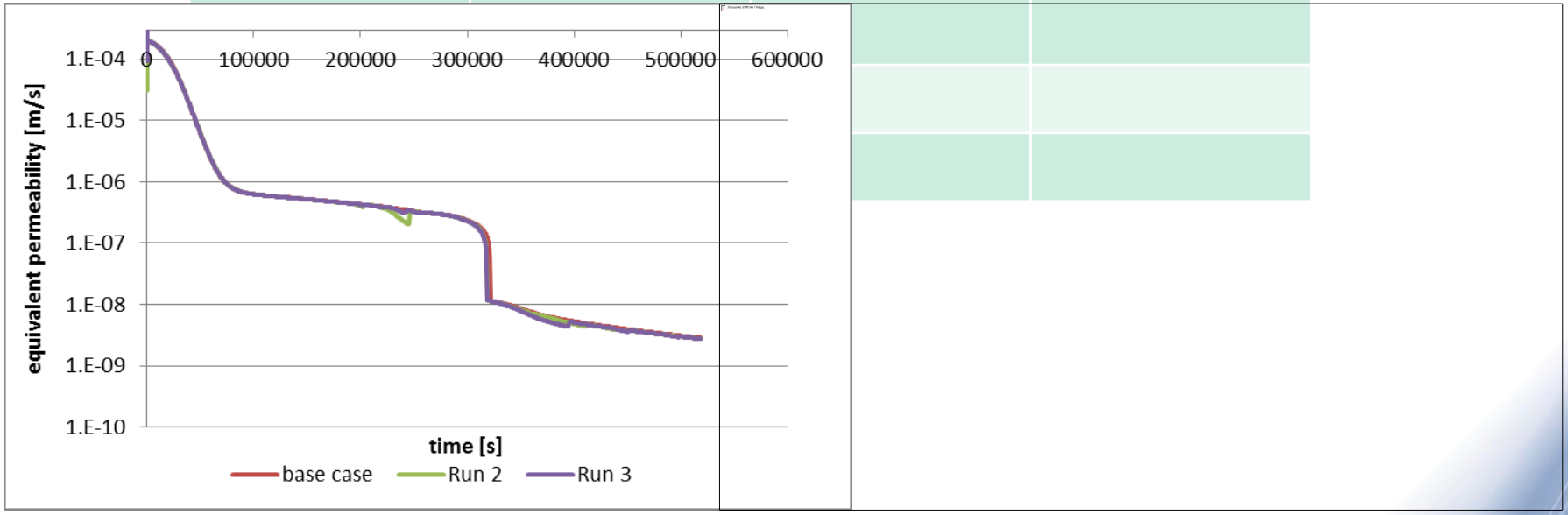
Model performance TH3

Run	Mesh size	Relative tolerance	Absolute tolerance
Base case	0.005 m	1e-6	1e-4
Run 2	0.01 m	1e-4	1e-3
Run 3	0.01 m	1e-2	1e-4
Run 4	0.005 m	1e-2	1e-2



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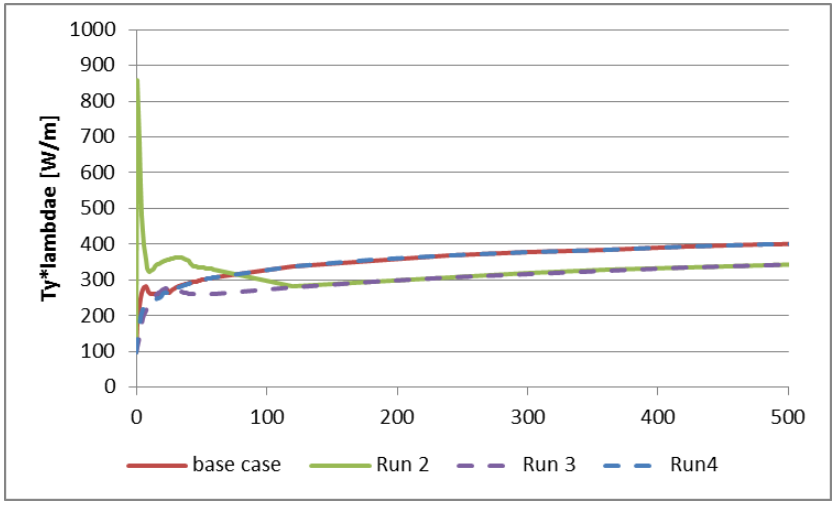
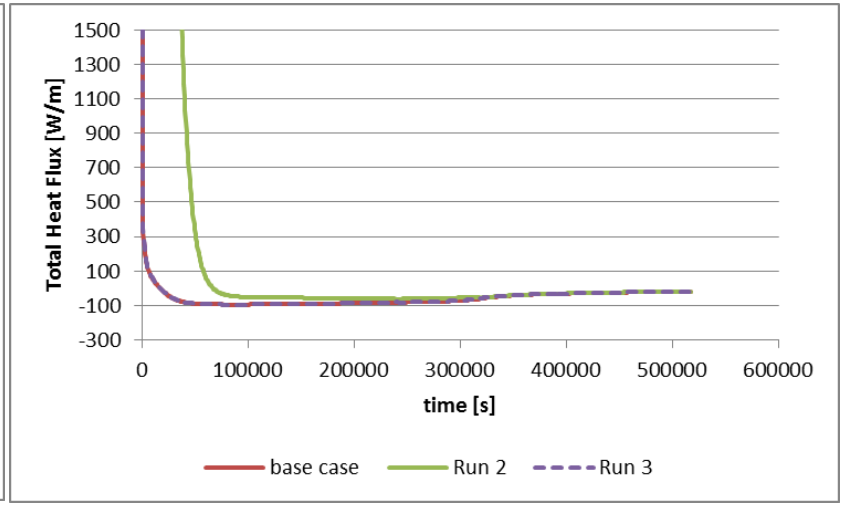
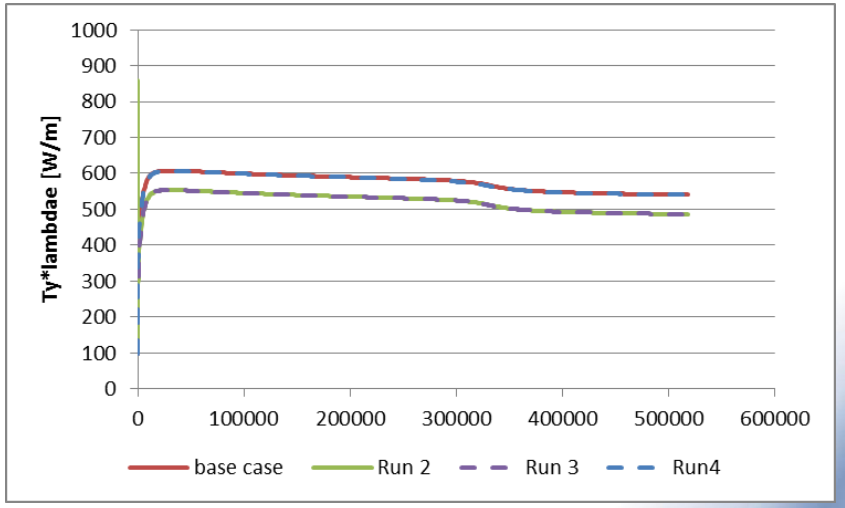
Model performance TH3: Total boundary fluxes





Total boundary fluxes
Base case and Run 3 are similar, despite the difference of top and bottom boundary fluxes



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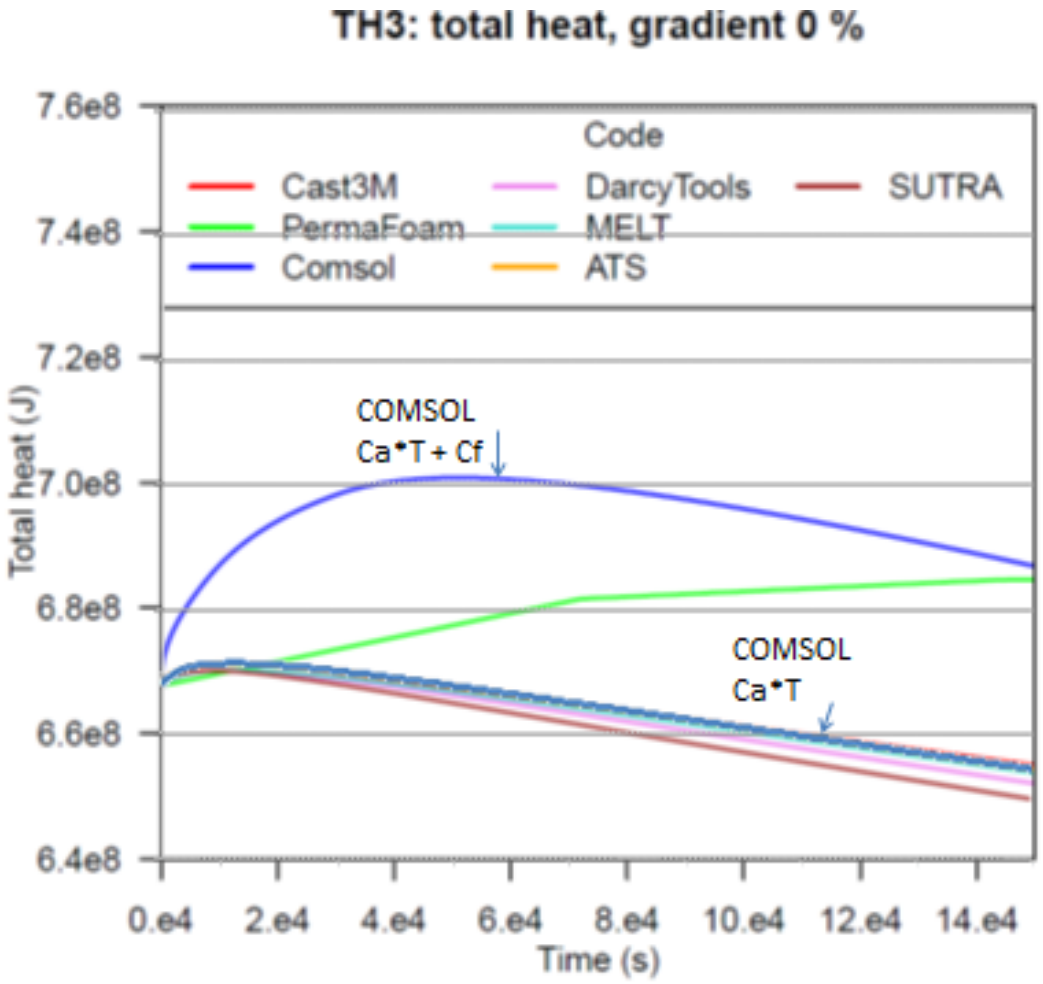
Corrected total heat calculation



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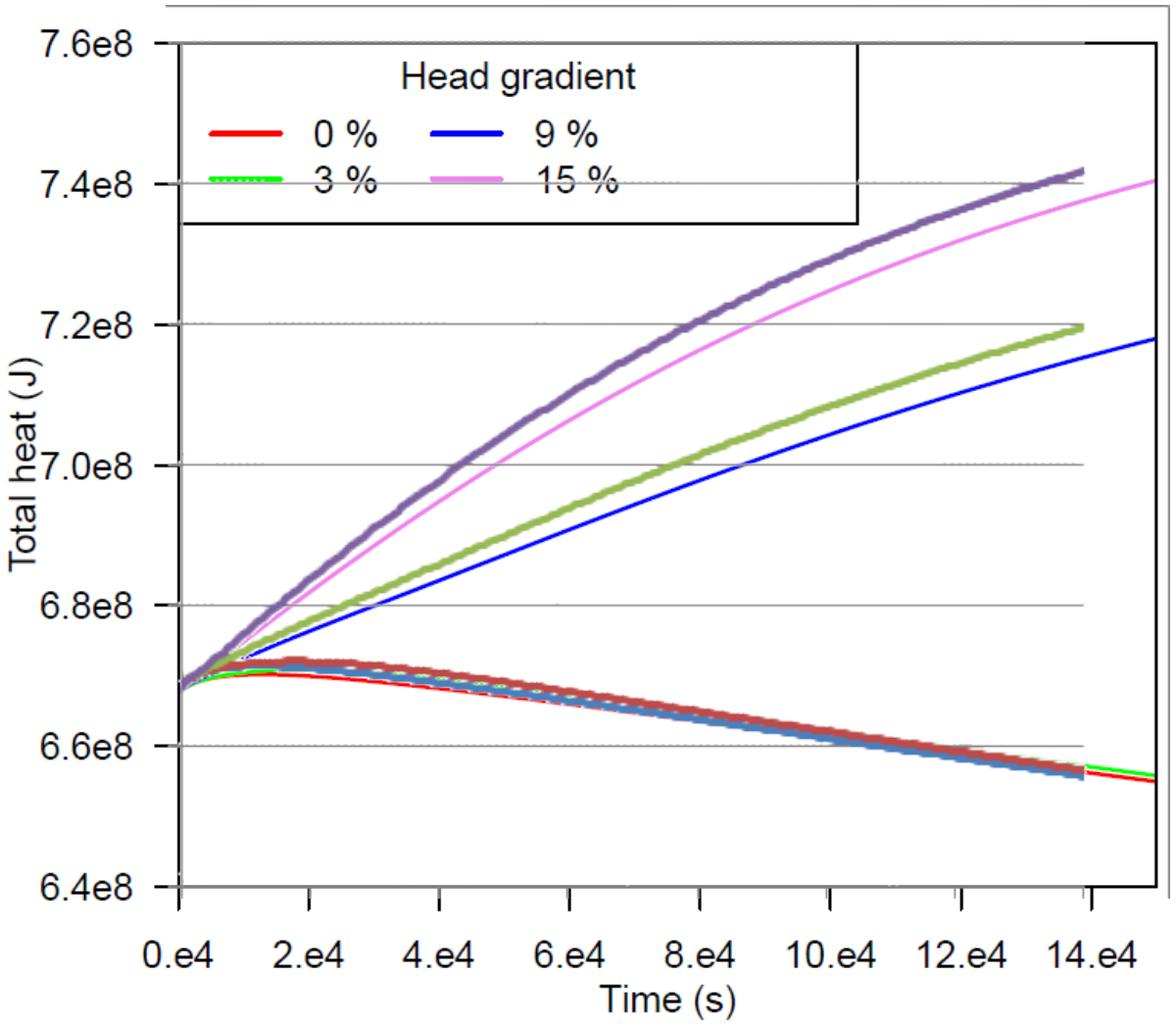

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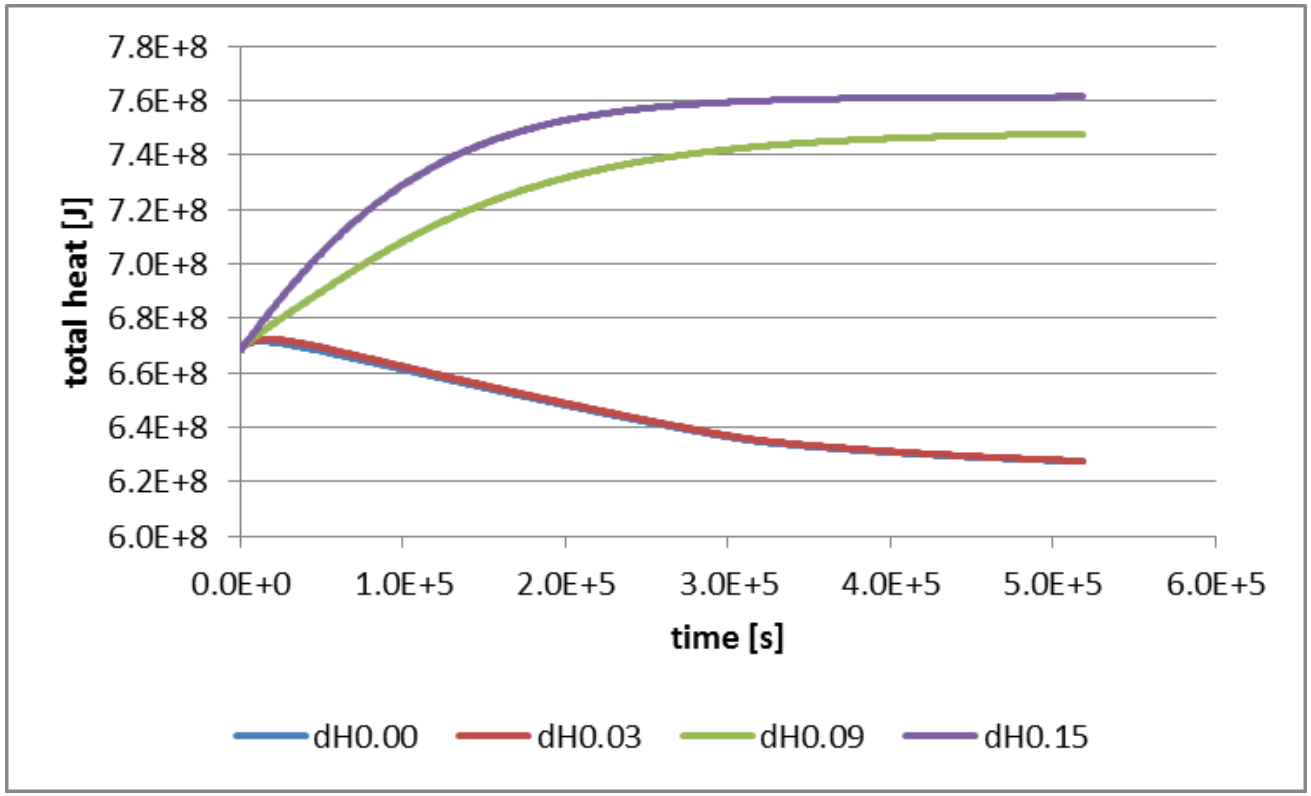
Corrected total heat calculation



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General observation

- The model is more stable when a freezing curve with a continuous derivative is used
- For TH2 and TH3, an uncoupled model was used as initial conditions. The switch from a prescribed temperature distribution to a modelled temperature distribution results in instabilities in the boundary fluxes.

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