Development of a constitutive law for accurate prediction of time dependent deformation of OPC based cementitious material at elevated temperatures

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Introduction

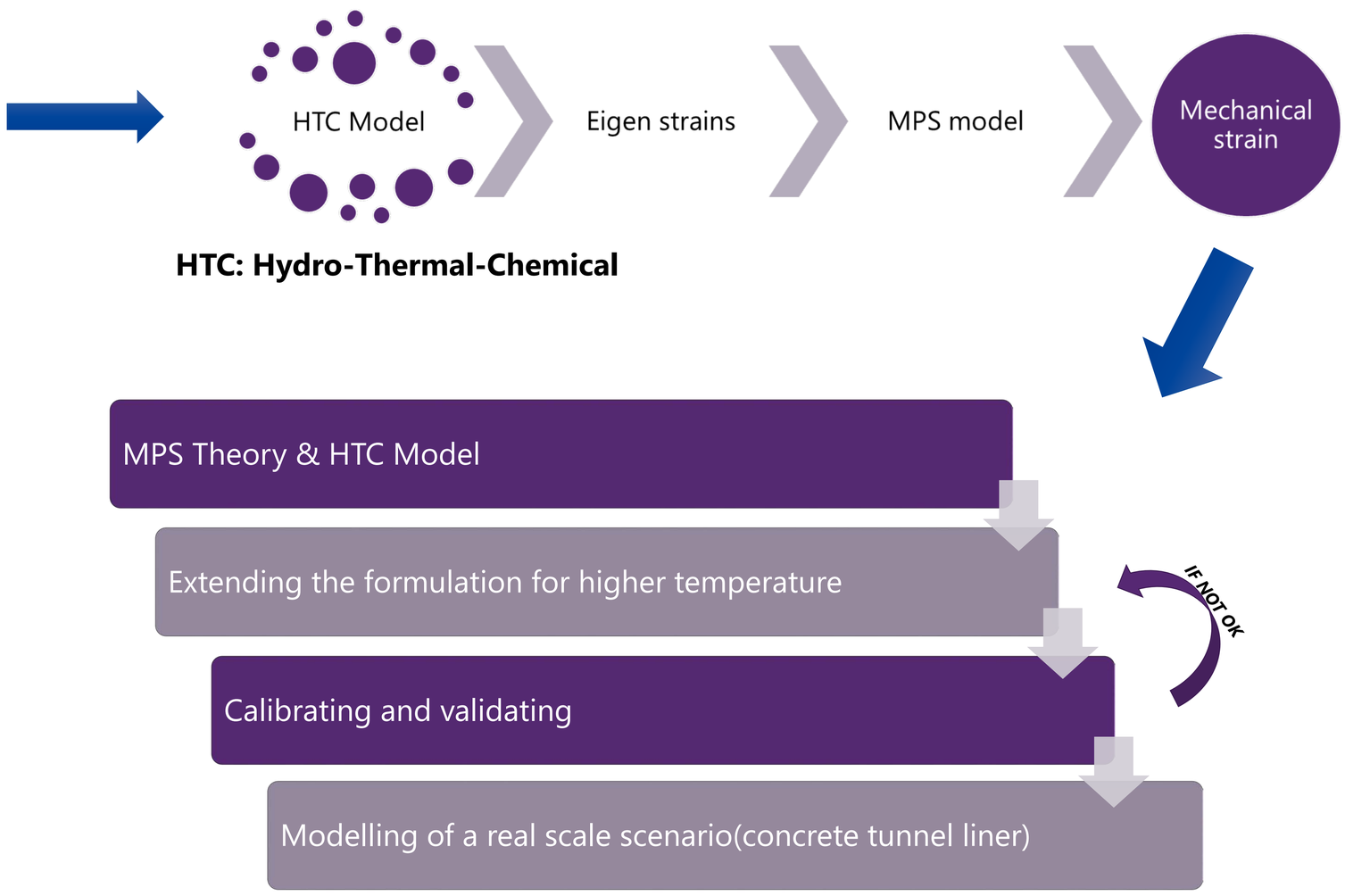
In the Belgian concept of geological disposal gallery for the radioactive waste, high level wastes are encapsulated in non-reinforced concrete buffers, which are then placed in disposal galleries. Mechanical stability of such galleries is ensured via construction of concrete liners to prevent their convergence due to overburden pressure. Furthermore, cementitious backfills are introduced in the annulus between the concrete buffer and gallery liner. This implies that significant volumes of cementitious materials would be inevitable. Therefore, the study of long term durability of such materials are vital from the point of view of safety of the disposal system, given the presence of long-lived radioactive wastes.

Objectives

Develop understanding of phenomenological changes at elevated temperatures and RH conditions that affect the time dependent deformation (shrinkage and creep) behavior of concrete via experimental and numerical investigations.

- Dependence of moisture transport on temperature and ambient RH values.
- Interaction phenomena between creep and shrinkage and their temperature dependence.
- Evaluation of long-term strain development at temperature and RH conditions relevant to disposal system on the performance and safety level.
- Extend an existing creep and shrinkage model based on Micro-Prestress-Solidification MPS model for elevated temperature.

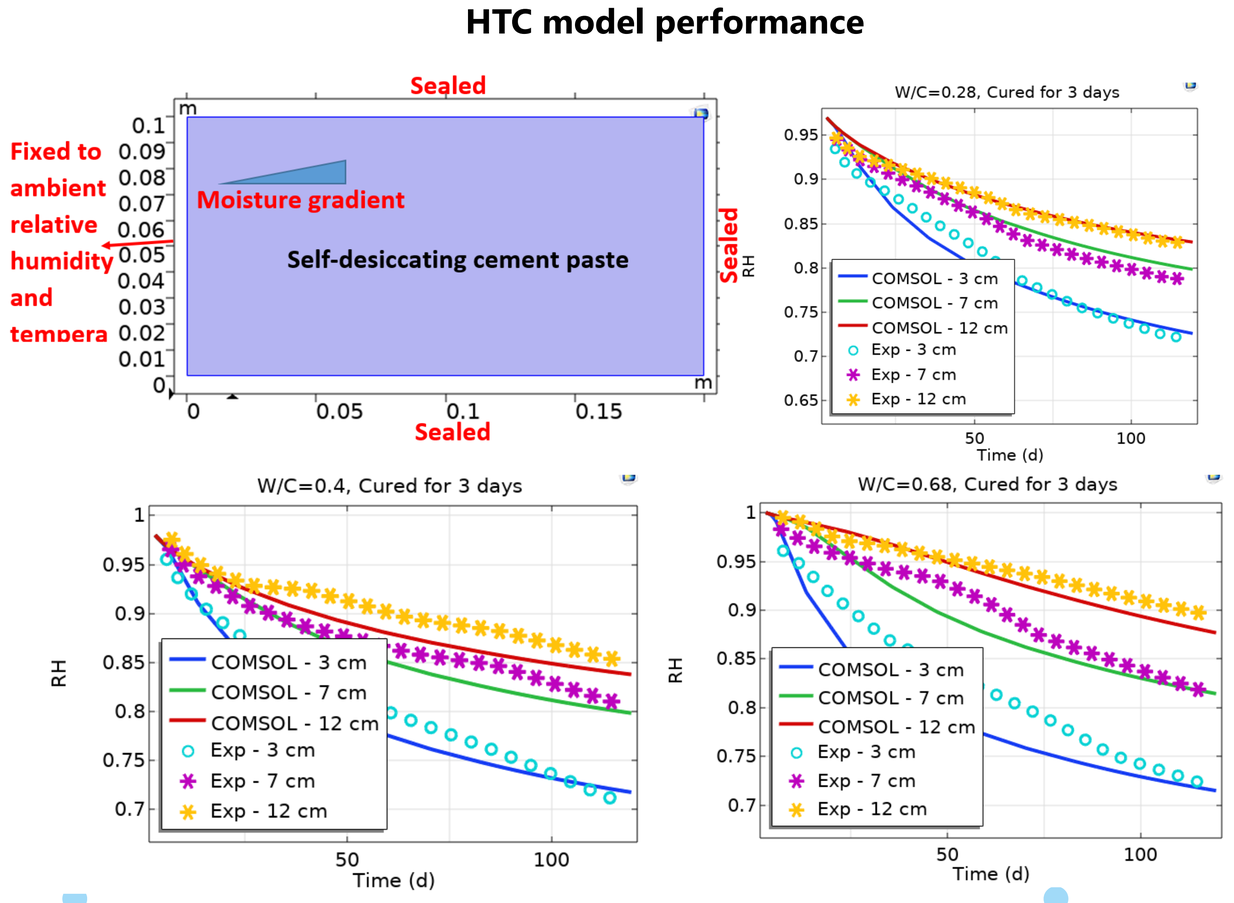
Methodology



Conclusion

- A well-structured set of experiments is required in order to feed all aspects of the (HTC and MPS model).
- Due to the complexity and heterogeneity of the concrete micro-structure, there is still a need for a more powerful model that can reflect all the aspects of this phenomenon as shown in the following figure.
- MPS model implementation is ongoing, which will be coupled to the HTC model.

HTC model performance



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