Coupled Optical and Thermal Modeling of Novel Solar Thermal Collectors

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INTRODUCTION:

In the present work, the performance of two novel solar thermal collectors have been studied using COMSOL Multiphysics. First, the all glass evacuated tube solar collector involving CPC reflectors(Cx=1.45) and second the Parabolic trough solar collector with seagull secondary design (Cx=58) are modeled and their optical and thermal performance are evaluated.

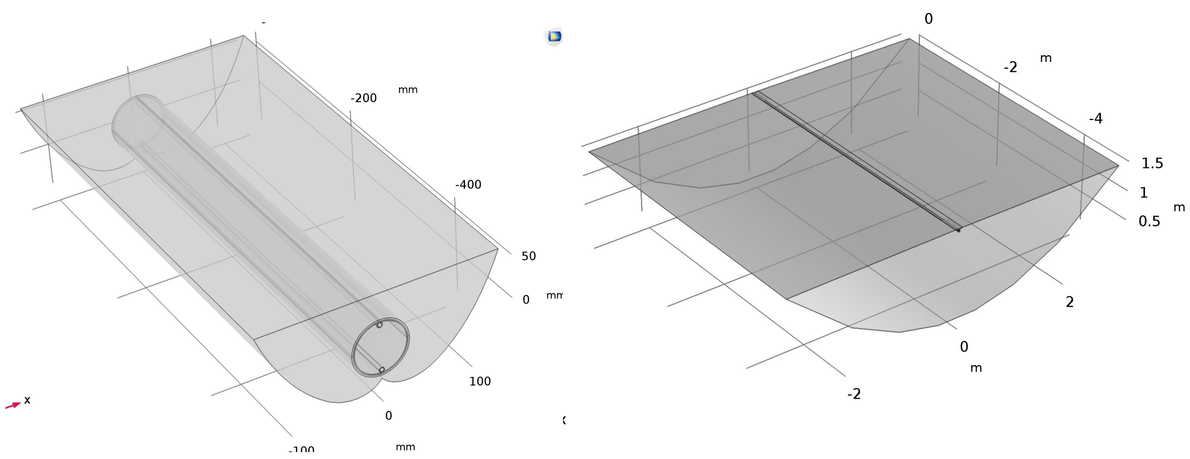
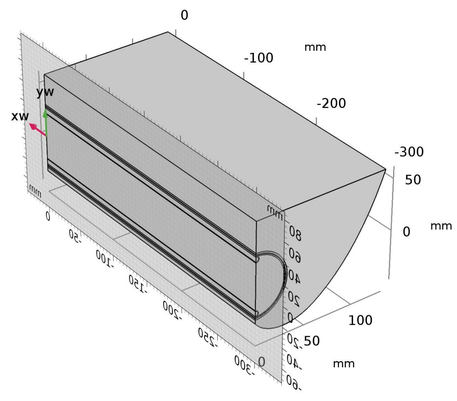
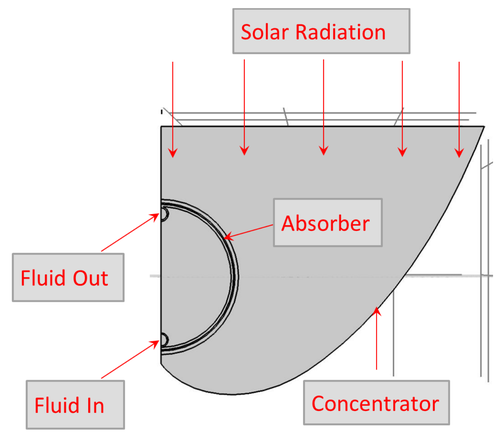


Figure 1. Geometry of a) All glass tube CPC Solar Collector b) Parabolic Trough Collector

COMPUTATIONAL METHODS: The geometrical optics(gop) and heat transfer in solids(ht) modules available in COMSOL were coupled together to study the ray tracing and heat transfer phenomenon respectively in the solar collectors. In order to decrease the computation time, the half symmetry of the geometry was studied. The main equation for ray tracing is Snell's law and for heat transfer is Conduction, convection and radiation.





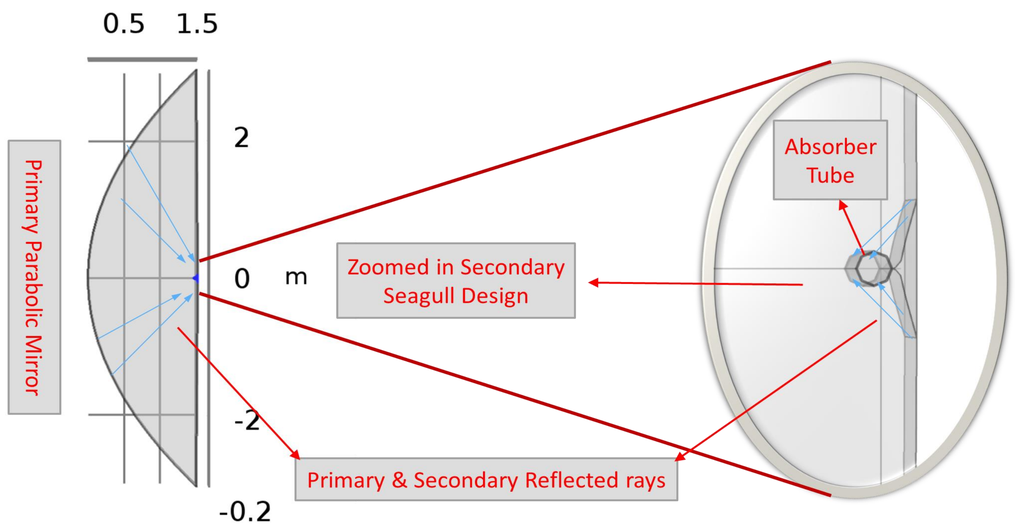


Figure 2. Description of the model a) All glass tube b)Parabolic trough with secondary seagull design

RESULTS: Temperature distribution of both collector are shown in the following figures.

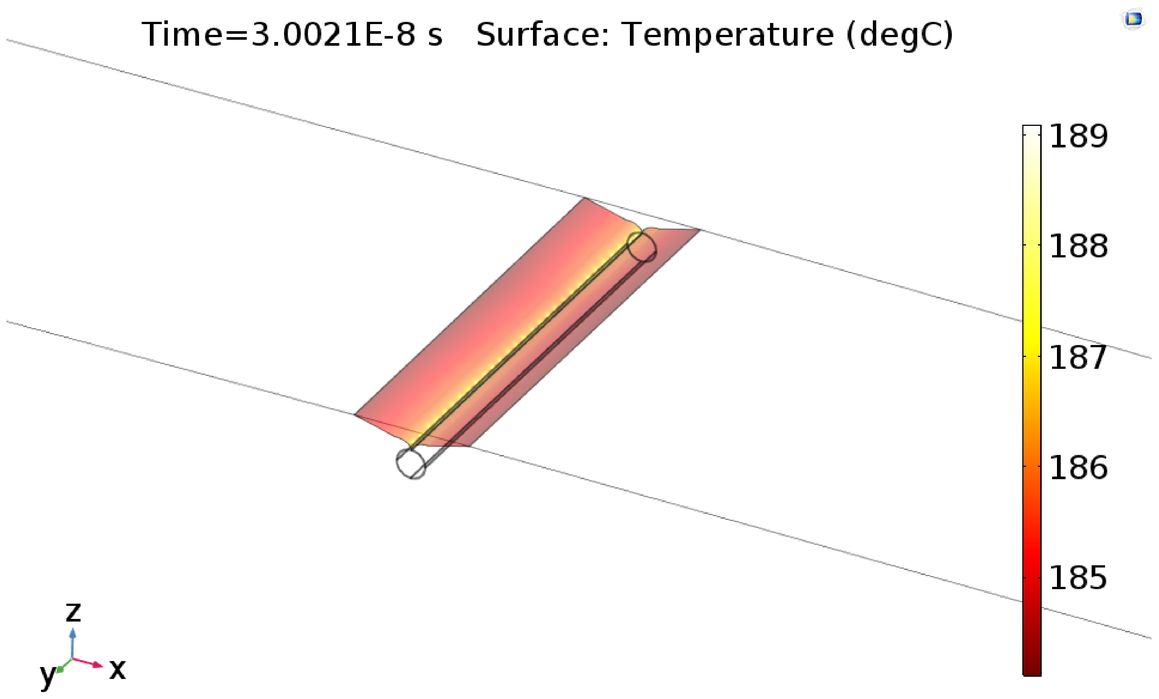


Figure 3. Temperature distribution in seagull reflector

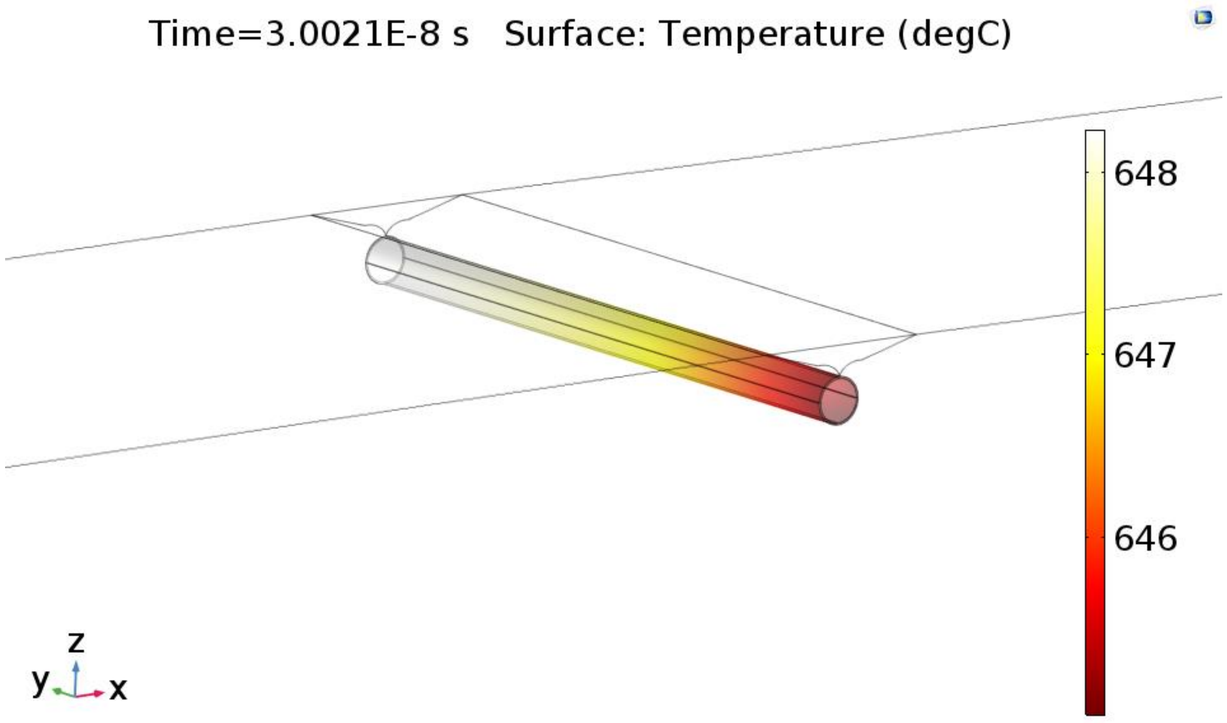


Figure 4. Temperature distribution in Parabolic trough absorber

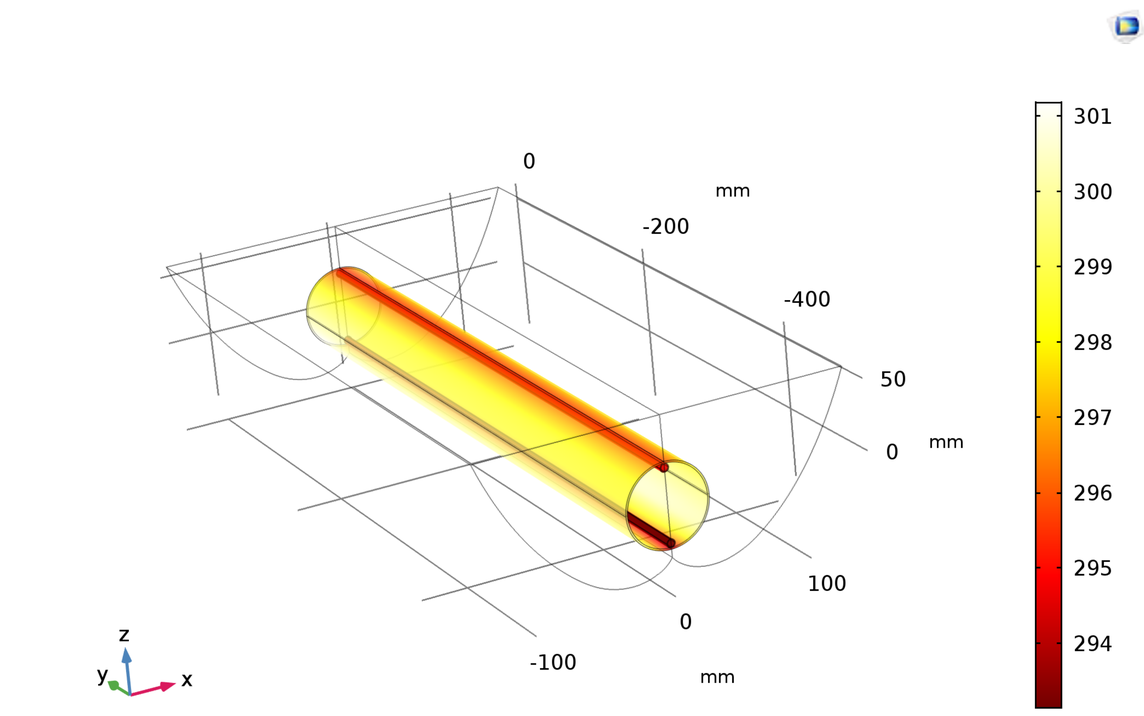


Figure 5. Temperature distribution in all glass tube collector with CPC reflector

CONCLUSIONS: The simulation in COMSOL could help us predict the best absorber configuration and material. We also are going to build and test these collector experimentally, so COMSOL results helps us to validate our empirical results.