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Simulation of the Outlet Temperature using Meteorology of the City of El Jadida-Morocco

Abdelatif Touzani

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Abstract

This article is a continuation of the previous article" Modeling of a parabolic trough using two heat transfer fluids and an economic estimation in the Moroccan dairy industry," presenting new parameters and results. Its objective is to simulate the temperature of the chosen fluid, which is water by using the meteorology of the city of El Jadida, city of the dairy industry.We presented the energy balance of the parabolic trough then the thermophysical properties of the water, as well as the meteorology of El Jadida by taking the maximum, minimum temperature of the year plus the range of the wind speed influenced the glass cover of the absorber. We finished with a visualization of water velocity within the absorber.

Index terms—

1 Introduction

ccording to the recent article "Modeling of a parabolic trough using two heat transfer fluids and an economic estimation in the Moroccan dairy industry" [1], We made a comparison between two heat transfer fluids based on several parameters including the heat exchange coefficient, the Grashof number as well as their environmental and economic impact.

This comparison made it possible to choose water as the heat transfer fluid within the industry. It is in this context, and based on the metrology of the city of el Jadida-Morocco, the simulation proposed below was established under Comsol in transient mode using water as heat transfer fluid.

2 II. Thermal Balance of Parabolic Trough

Accordant with the previous article, we focused on the description of the parabolic trough as well as we presented its thermal balance. Below we will briefly introduce it. [2][3] a) Description of parabolic through Using the constants for simplifications, we have the equations below: Water thermophysical proprieties?? ð ??"ð ??"?? ??+1 = ???? ð ??"ð ??"?? ?? + ?? ð ??"ð ??"(???1) + ?? ?? = [1 ? ?? ð ??"ð ??" ??? ??????? ????] ?? = ?? ð ??"ð ??"(??????? ?? (??) ???? = 1 ?? ?? ?? ???? ?? ?? [?? ??,?? (??) ? ?? ??,?????? (??)] ?? ??,?????? (??) = ? ??,?????? ?? ???? (?? ?? ? ?? ??????) + ?? ?? ???? ???? (?? ?? 4 ? ?? ?????? 4) ?? ?? ??+1 = ?? ?? ?? + ??? ?? ?? ?? ???? ?? ?? [?? ??,?? (??) ? ?? ??,?????? (??)] ?? ?? ??+1 = ?? ?? ?? + ?? with: ?? = ??? ?? ?? ?? ???? ?? ?? [?? ??,?? (??) ? ?? ??,?????? (??)]

Since we chose to work with water as heat transfer fluid, this implies to present its thermophysical properties below.

Volumic mass (Kg/m 3): ?0.0032??

3 Meteorology of EL Jadida-Morocco

In this paragraph, we will look at the meteorology of El Jadida during the year 2019 by presenting the maximum and minimum temperatures and the wind speed.

4 [6][7] a) Temperatures of EL jadida in 2019

According to the Accu Weather website [8], we were able to take the meteorological history of the city in 2019 to identify the maximum and minimum temperatures of the year to use them in our simulation. The figures beyond show the number of days per month, reaching peak temperatures for the first diagram, while the second presents the days with the lowest temperatures. Figures ?? and 9 present the months having the maximum and minimum temperature of the year, recording on January 6, the lowest temperature of the year: 2 °C as for September 30 marks the highest temperature of the year: 32 °C. The figures above show the evolution of wind speed in 2019, varying from 8km/h to 73Km/h. We notice in the second diagram a variation of the wind speed compared to the days of each month of the year. Days [0-10Km/h[[10-20 Km/h[[20-30Km/h[[30-40Km/h[[40-50Km/h[>=50Km/h

V.

5 Results and Discussions

Figure 12: Ambient temperature on 6 January (1) and on 30 September (2)

The figure above shows us the variation of the ambient temperature during the day, starting from 7h to 19h. We observe on 6 January (1), marked the minimal temperature of the year, reaching a maximum of 293K at 10 a.m.

On the one hand and on the other hand, we notice that a higher temperature: 304K at 1p.m was noticeable on 30 September.

? Outlet water temperature on January 6 and September 30 Figure ??3 shows the simulation under Comsol Multiphysics of the water temperature at the outlet on January 6 and September 30. Take an outlet temperature exceeding 290K for January 6, while September 30 marks a temperature exceeding 400k.

For figure ??4 of the convergence curve of the simulation converges quickly. This convergence shows us the validity of our simulation.

The figure 15presents the temperature evolution from 7h to 19h of the two days mentioned above.

? Variation of Glass cover temperature depending on wind speed The figures above show the variations of the three temperatures during January 6 and September 30 depending on solar irradiation.

It can be seen that solar irradiation has an effect on the three temperatures, more precisely the absorber temperature, its increase implies an increase intemperatures, recording increases in the temperatures of the fluid, the absorber and the glass respectively: 470K, 474K and 327K for a maximum irradiation of 500w / m2 during January 6, moreon September 30 and for a maximum irradiation of 750w / m2 at temperatures of 577K, 581K and 346K.

6 VI.

7 Conclusion

This labor made it possible to work with the water chosen at the end of the previous work by simulating its temperature at the outlet.

This study, first of all, made it possible to visualize the meteorology of the city by identifying January 6 as the day with minimum temperature and September 30 having a maximum temperature, as well as the variation of the temperature at the exit during these two days. Also, we exposed the variant wind speed from 8km / h to 73Km / h in 2019, as well as its influence on the glass cover temperature. [1] [2] [3] [4]

[1] Year 2020 Simulation of the Outlet Temperature using Meteorology of the City of El Jadida-Morocco

[2]

[3] Simulation of the Outlet Temperature using Meteorology of the City of El Jadida-Morocco

[4] Simulation of the Outlet Temperature using Meteorology of the City of El Jadida-Morocco

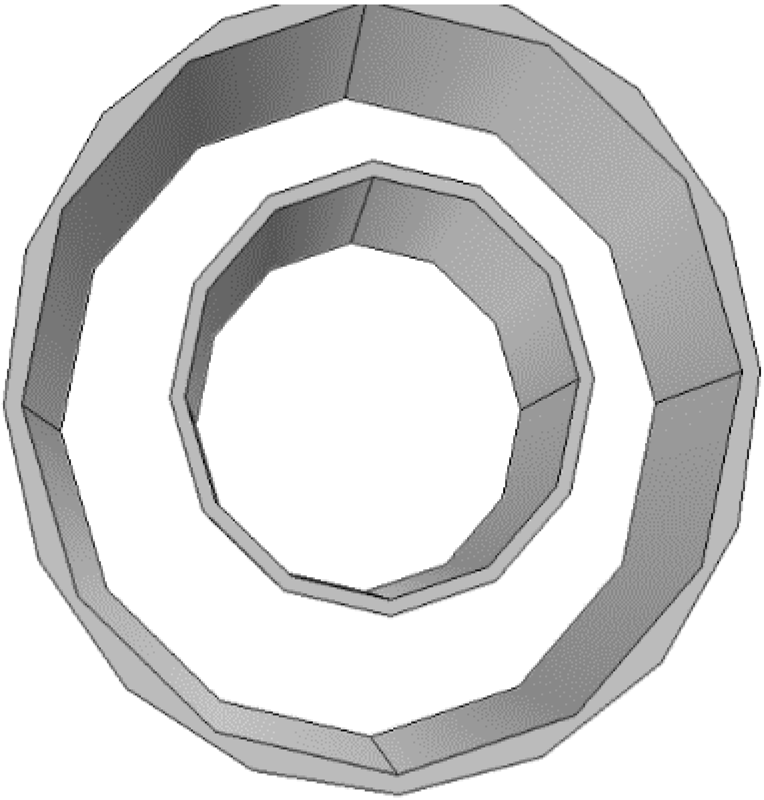

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Figure 1: Figure 1 :Figure 2 :

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Figure 2: Figure 5 :

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Figure 3: Figure 6 :Figure 7 :

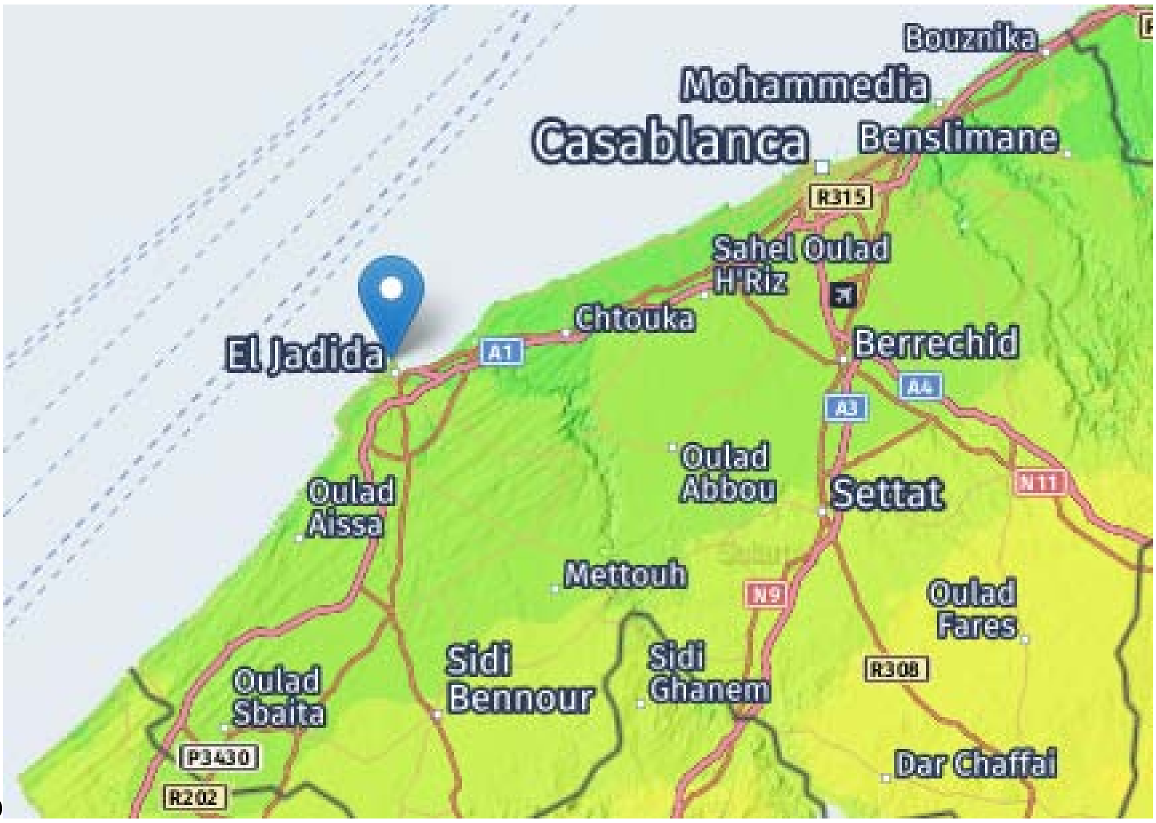
89 

Figure 4: Figure 8 :Figure 9 :

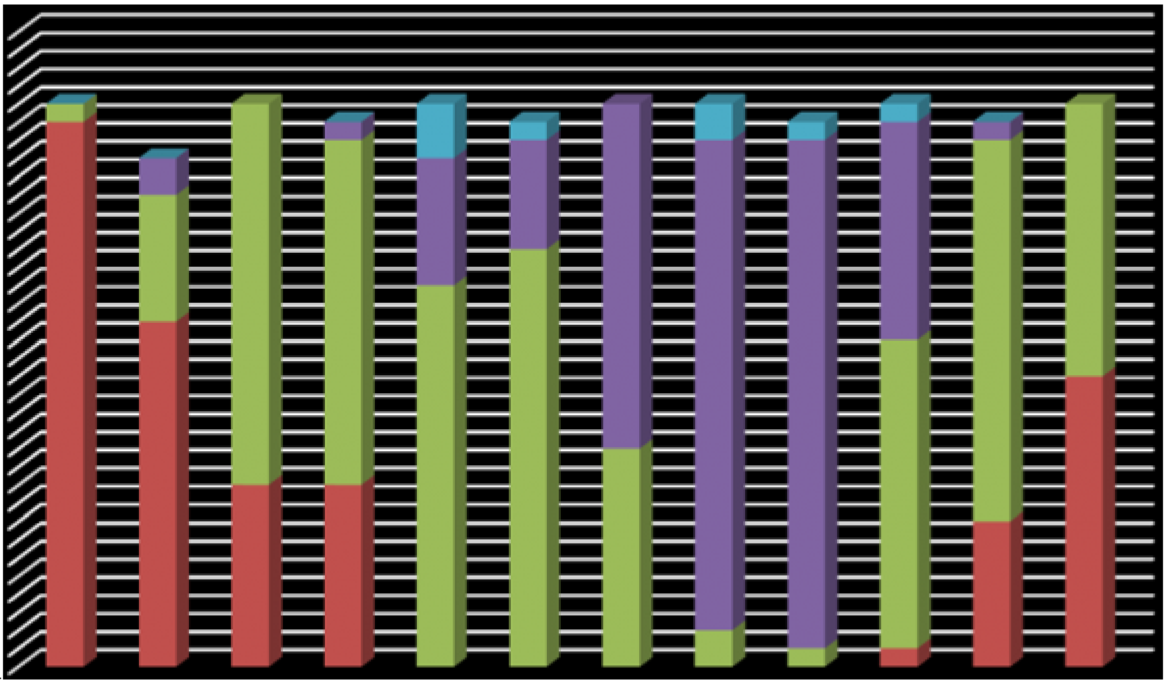


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Figure 5: Figure 10 :Figure 11 :

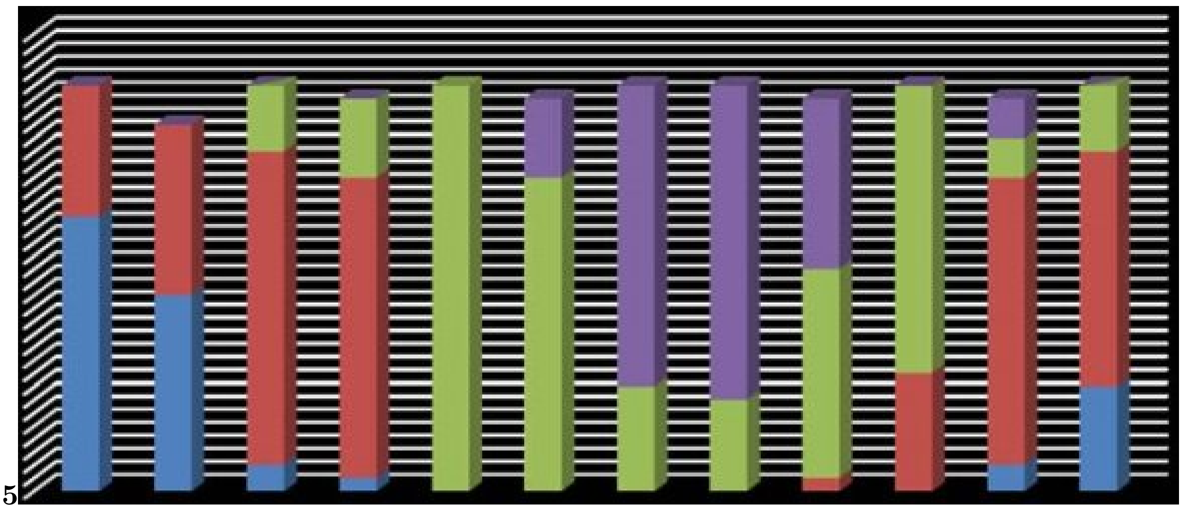

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Figure 6: Figure 13 :Figure 14 :Figure 15 :

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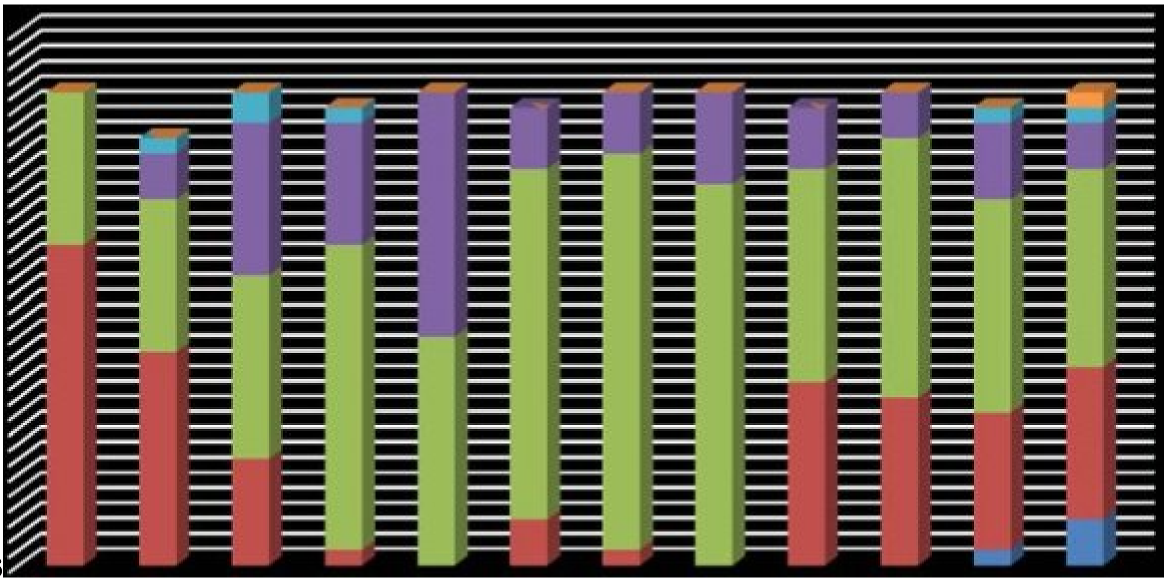

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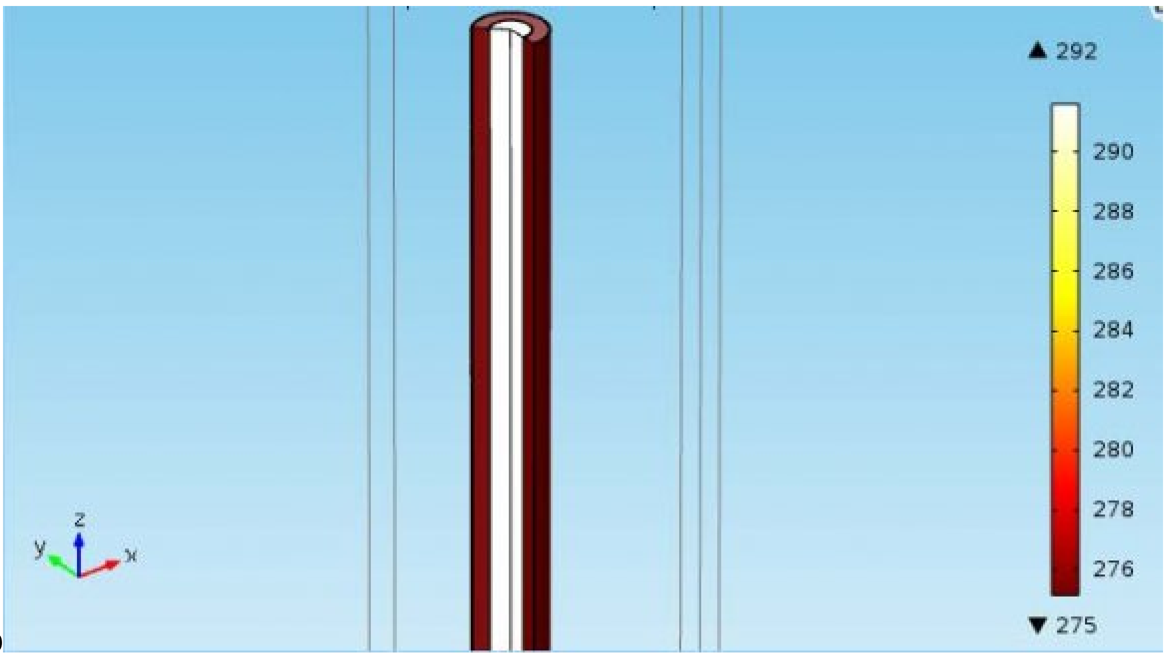
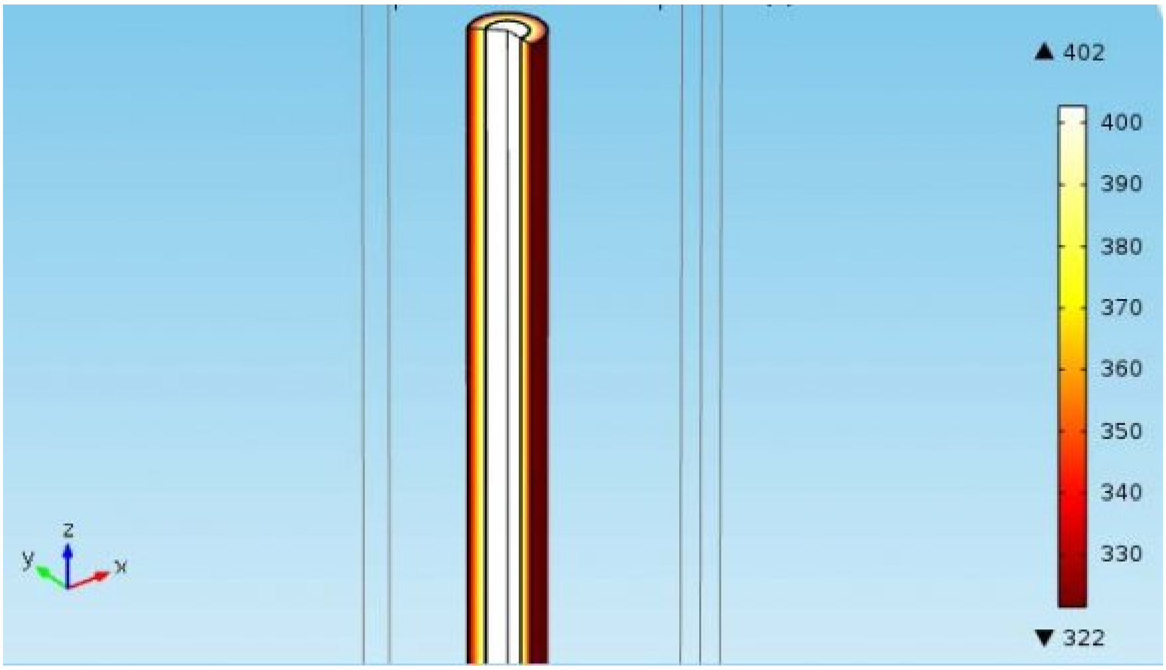


Figure 8: Figure 17 :Fig. 18 :Fig. 19 :



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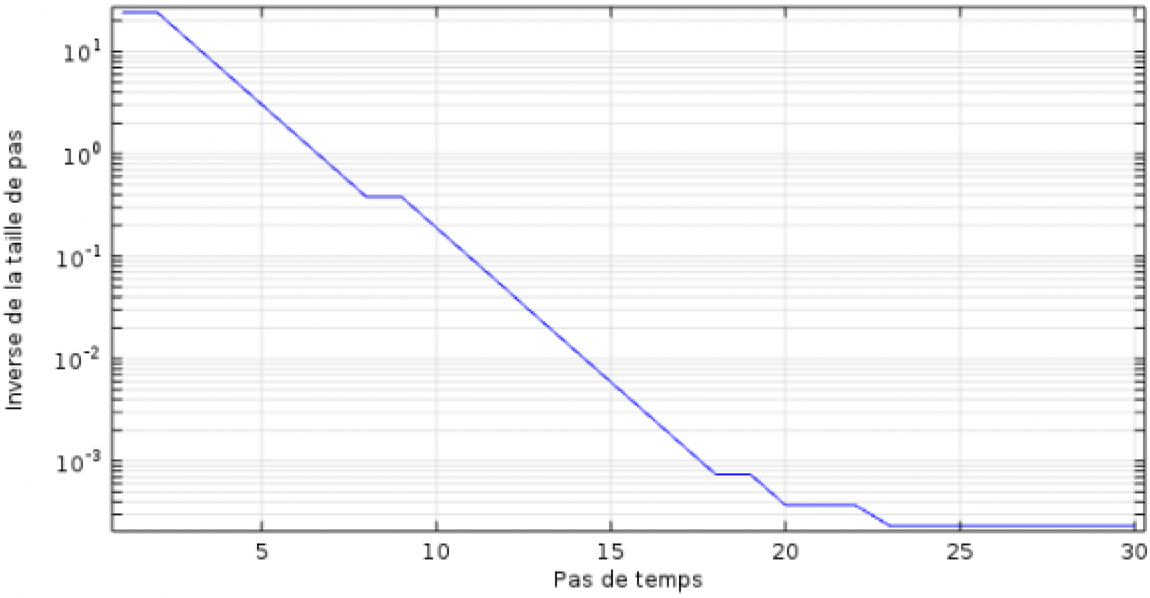

Figure 10:

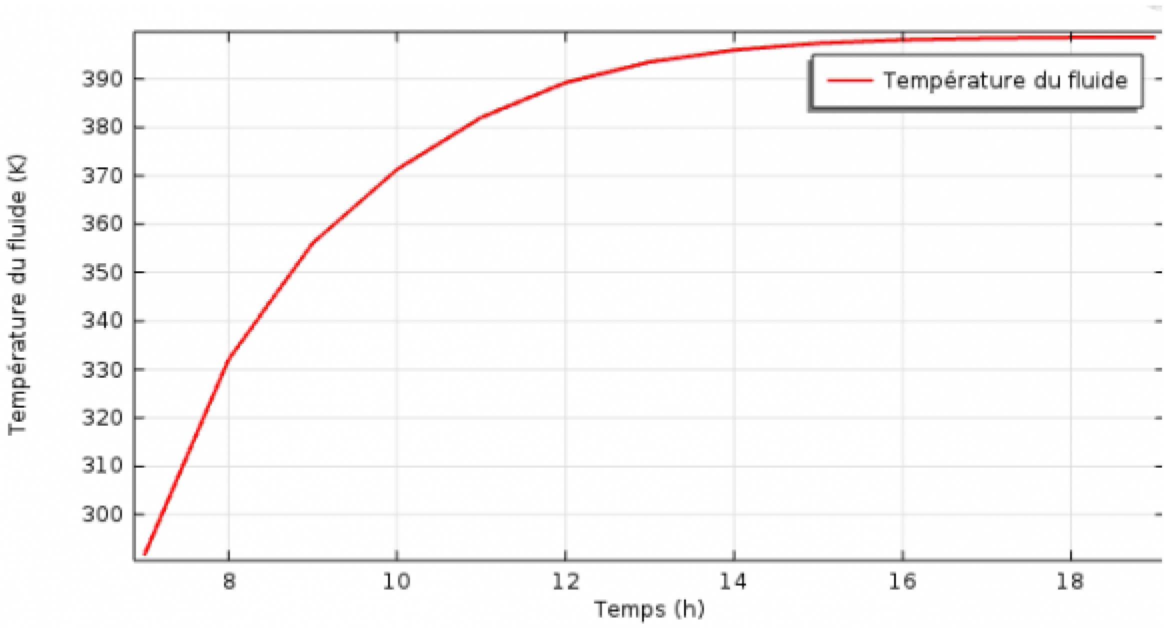

Figure 11:

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Figure 12:

.1 Acknowledgment

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[Variation of temperatures depending on solar irradiation] *Variation of temperatures depending on solar irradiation*, https://www.accuweather.com/,2020