Heat Treatment Calculator (H.T.C)

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Introduction

- H.T.C is a software program coded in Visual Basic using Microsoft Visual Studio .NET.
- It calculates
  - The amount of energy needed to heat a building to the required temperature.
  - Lower bound for the quantity of fuel needed to get this energy.
  - Estimated cost for the required fuel consumption.

Description

- The user inputs the temperature conditions for the heat treatment. The user then gives the description of the building subjected to heat treatment.
- The software uses equations from Air Conditioning that can be applied to practical situations.
- These equations are used to calculate heat loss from the building subjected to heat treatment and the necessary energy consumption to heat the building to the necessary temperature.
- For these calculations a database that includes U values, K values and other useful properties of different building materials is used.
- The software can be used by personnel responsible for planning heat treatment. The user should have access to the measurements of the buildings. These include the length and breadth of exposed areas, the volume of the building and the building materials used for the construction of the building subjected to heat treatment

Algorithm(1)

1. **Exposed Surfaces and ceilings**:

Single Surface

Know U Value? ----------> $q = \Delta T * A * U$

Else

Select Material----------> Get K

Select Thickness----------> Get x, $q = \Delta T * 1/(x/k) * A$

Composite Surface

Know U Value? ----------> $q = \Delta T * A * U$

Else

----------> $1/U = 1/f_i + x_1/k + 1/c_1 + \ldots + 1/c_{n-1} + x_n/k_n + 1/f_o$

Repeat for each room

Repeat for each floor

Algorithm(2)

2. **Floors**:

ΔT is the temperature difference between the outer surface of the floor and the temperature of the ground in the location.

$$q = \Delta T * A * U$$

3**. Infiltration**:

$$q = 0.018 * \Delta T * Volume$$

Terms in the Equations

ΔT: Temperature difference of the exposed wall.

A: Area of the exposed surface.

U: Coefficient of heat transfer

k: Thermal Conductivity

f: Surface coefficient of heat transfer

c: Conductance

x: Thickness

Uses

- Can be used to study the variations of energy, fuel and cost with respect to changes in the heating requirements and weather conditions.
- Enables the user to arrive at a price estimate of heat treatment under the given climatic conditions.
- Helps the user to choose optimal conditions for cost effectiveness without actually doing the heat treatment.
- Given the temperature and heating parameters, the HTC can help us to develop the most optimal heat treatment schedule for a specific building at a specific location.

Issues

- The Heat Treatment Calculator calculates the amount of energy needed for the heat up based on the equations mentioned above. For applying these equations, we should know the physical constants related to the building materials used in the building.
- The HTC has a comprehensive database of building materials and their physical features. But it is not possible to record every building material being used to build structures because of the enormity of building materials used. This may limit the use of the HTC.
- If the user is aware of the various physical properties of the building materials used, this information may be added to the database. But this is rarely the case.
- In such cases, the user may have to select approximate values for the physical constants. This will result in an approximate estimate of the amount of energy needed.
- Further, the HTC does not account for leakages other than those specified in the equations. These leakages may be due to wear and tear of the heating media (pipes/tubes etc)

Further work

- Including the capability to generate graphs would help in visualizing the effects of variations of different parameters of the heat treatment on the cost of the heat-up.
- Noting the insect mortality of a particular heat treatment, it may be possible to predict the insect mortality of a future heat treatment with varied temperature parameters given similar experimental conditions.
- A further investigation of this problem would help to measure the performance of a heat treatment. It would also help in studying variations of mortality of various species of insects with respect to heat.

References

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Discussion