First 200 days LTH logger results

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Introduction

LTH (Low Temperature Heating) systems has in general a low water inlet temperature, which is often depended on the outside air temperature. During cold days the water temperature is higher compared to warmer days. This behavior is investigated here and can also be seen in Fig. 1, where in general dots T = f(T) are shown. On the x-axis the outside average temperature is shown for the period from October 5th, 2019 till April 23rd, 2020. Each day has three dots, which are paired vertically. These dots are red, blue and a green and each represents a different temperature, namely:

- the maximum heating water inlet temperature of that day,
- the average heating water inlet temperature, and
- the average inside temperature (in the attic) respectively.

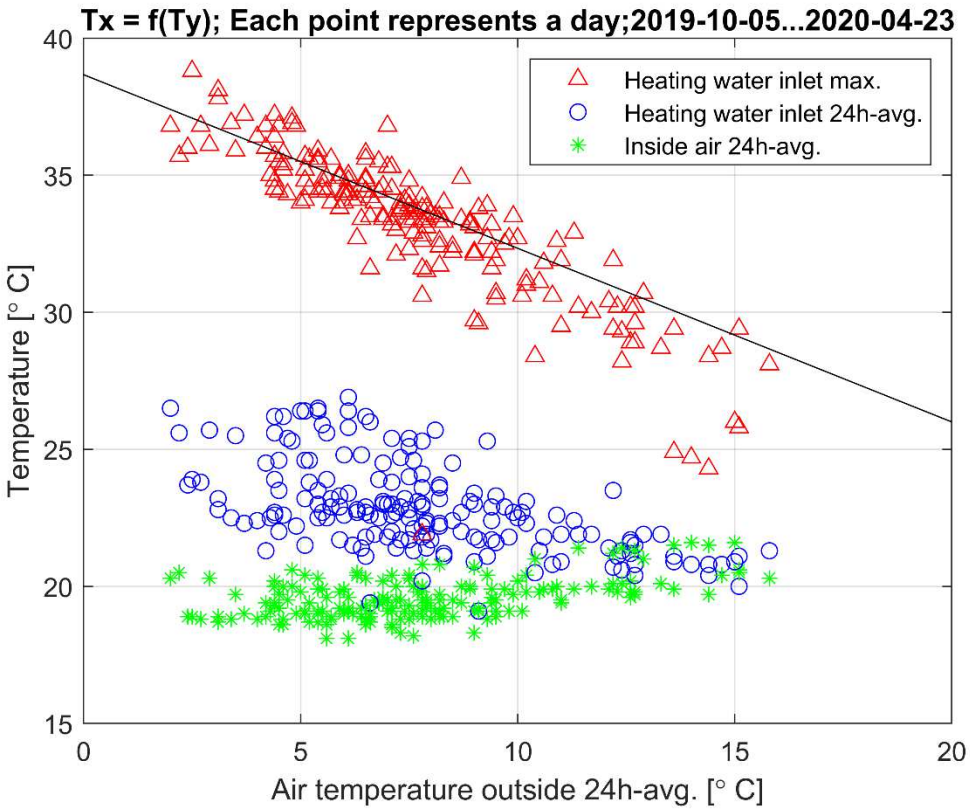

Fig. 1: First logged temperatures from October 2019 till April 2020, which are used to investigate the behavior of the LTH (Low Temperature Heating) system. Graph shows Tx,y,z = f(outside temperature). The black line represents the heating curve of the warm water supplier.

Data preparation

Matlab™ software is used to collect and display the data from the online SQL database. It sequentially calls a PHP file with the date (input parameter) of a specific day. The PHP file calculates and returns in a CSV format all average, maximum and minimum temperatures of that day. Per 24 hours there are 2880 samples per temperature channel. Generation of Fig.1 lasts roughly 25 sec. Days that have less than 2000 data points are not included in Fig. 1. This can be caused by a not running logger, online provider services that were down … etc.

Interpretation of the data

GENERALLY
- In this period of the year average temperatures between 4 … 8°C are most common. This is illustrated by the higher concentration of dots in the clouds.

red triangles:
- Roughly from 2°C…16°C outside temperature a maximum inlet temperature between 40°C and 25°C can be seen. The data points are more or less a cloud, because of the control principle of the heating system. The final temperature is (at the measurements point) not always reached during a heating interval.
- There is one red triangle into the cloud of blue dots (at ~8°C outside temperature). This point has been validated in the database and is correct. During this day the heating was not active at all. The day before it was relatively cold day and the heating was on for a long time, so there was a huge amount of energy stored in the concrete of the house.
- The black line represents the heating curve, which is stated in the "Terms of delivery" from the warm water supplier (In this case DEEM / Eteck).

blue circles
- During colder days you see a higher average inlet temperature, which means that the heating is turned on for a longer time. But not every cold day, because the stored heat of the day before has also influence on the day after.

green stars
- These dots are showing the temperature at the attic, which is an uncontrolled room of the house. So, it hasn't its own thermostat. It is turned on by the thermostat of the living room. At colder day you see slightly lower temperatures at the attic.

Next steps

Today the logger is up for 203 days and the aim is to gain data for at least a complete year and preferably more years. Fig.1 shows the system only in its heating mode. Another interesting part that will be the behavior of the cooling. Hopefully we will get a hot summer… I'm also preparing remote sensors to measure other (un)controlled rooms in our house. (See RF-link for sensors on the main website.)

As described before the temperatures of a specific day are influenced by the day(s) before. So one of the next steps is to investigate the time constant(s) of the system [1].

Also the influx of the sun and the influence of the wind will heat-up and cool down the house respectively. Both effects can be clearly seen in the day-by-day data, but are not investigated yet. There is logged light data to distinguish sunny and more darker days. This will be investigated further soon.

References

[1]: Johan Hedbrant, On the thermal inertia and time constant of single-family houses, Division of Energy Systems Department of Mechanical Engineering Linköpings universitet, SE-581 83 Linköping, Sweden. www.liu.se, Linköping 2001, ISBN 91-7373-045-9.

Questions?

If you are interested in the hardware, scripts, measurement data over a longer period, or something else, please contact me at mail@bartroodenburg.nl