3 – layer – calorimeter

instruction manual

introductory remarks

The heat flow optimized temperature curve analysis (WOTKA) in a 3 layer calorimeter is a measuring method for the determination of heat storage capacities especially of phase change material (PCM) in sample sizes of 100 ml.
As a low-cost alternative to conventional measuring methods, PCMs based on salt hydrate with several individual components can also be determined with regard to their heat storage capacity.
The heating and cooling rate is 0.2 K/min in the temperature range from -20 to +100°C.
Water and a hexadecane (99%) are used for calibration.

The sample

The sample of approx. 100 ml (liquid material, powder, bulk material) to be tested is filled as vacuum-tight as possible into a composite film (dimensions 220 x 150 mm) and shrink-wrapped.

Insertion of the sample into the 3 - layer – calorimeter

Fig 1

Fig 2

Sample with PCM (Fig. 1), folded in the middle - see instructions "Sample preparation". The sample sensor (CH 2) with the heat distributor foil is positioned between the folded sample and the upper half is folded down (Fig. 2).

Fig 3

Closing the 3-layer calorimeter (Fig. 3)

The measurement

The temperature sensor marked with 1 records the data of the "outside temperature" and the temperature sensor marked with 2 records the data of the sample temperature in the 3-layer calorimeter. The measuring rate is one minute.
The sample and the calorimeter must have a defined starting temperature, which depends on the PCM (defined solid or liquid).

Example: Calibration material hexadecane (99%)

- Evaluation range 15K (11 - 26°C)
- Temperature of sample and calorimeter either <3°C or >33°C.
- Climatic cabinet temperatures
- 33°C Melting process
- 3°C Solidification process
- Heating time approx. 20 hours
- Cooling time approx. 20 hours

If the evaluation range is extended, the climate chamber temperatures must be adjusted accordingly.

Programming of the data logger (see also Comark Software)

Install the software program "COMARK" of the data logger. Establish the connection between computer and interface (COM interface USB).
After successful installation open the "EV Standard" program
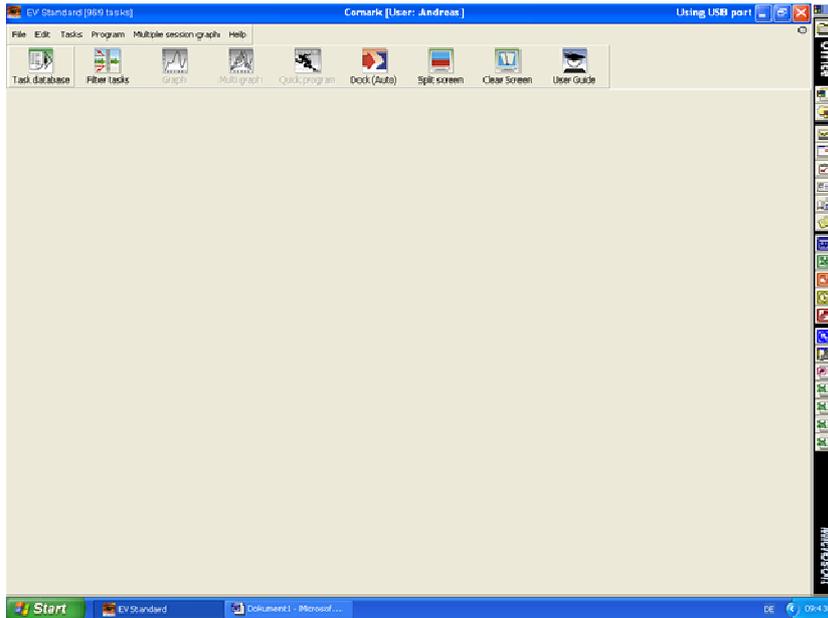
Press "Task Database" and all recorded data will be displayed.
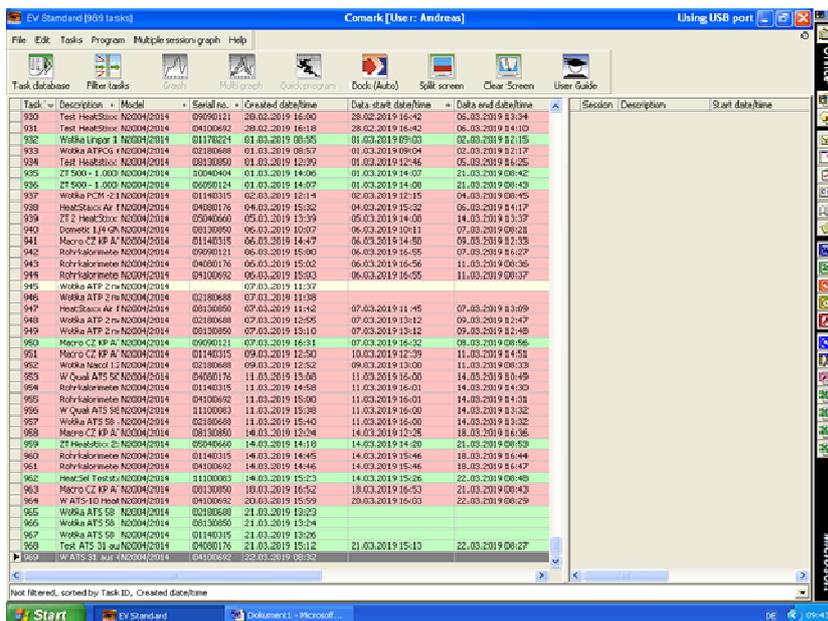
Interface und Datenlogger

press start button

Place the display face down on the interface.

After installing the EV Standard software and starting the program, all recorded data logger data will appear.

When Docked (Auto) is activated and the data logger is connected to the interface, the software recognises the respective data logger.

Press the "Quickprogram" button to program.
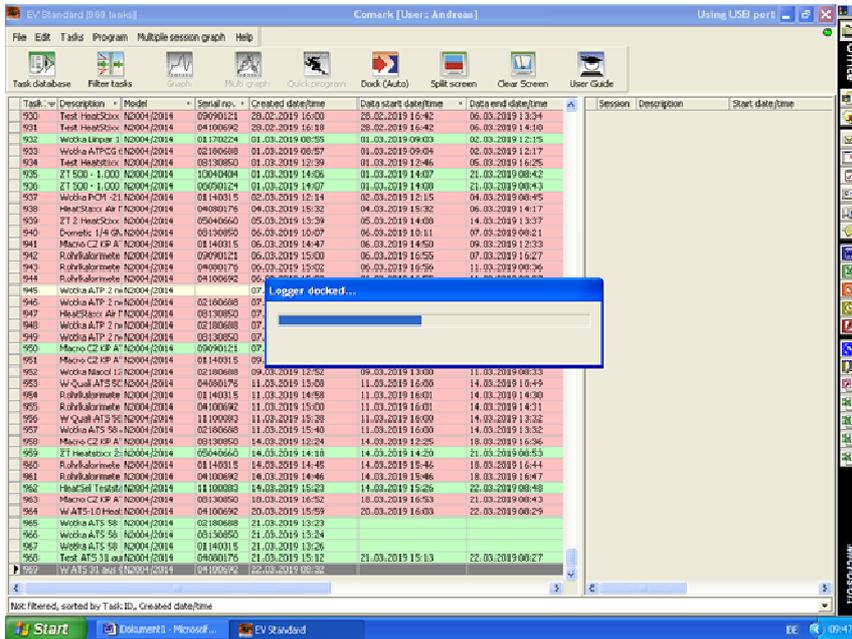
Important! The green LED "top right" must light up - the connection between interface and data logger is correct.
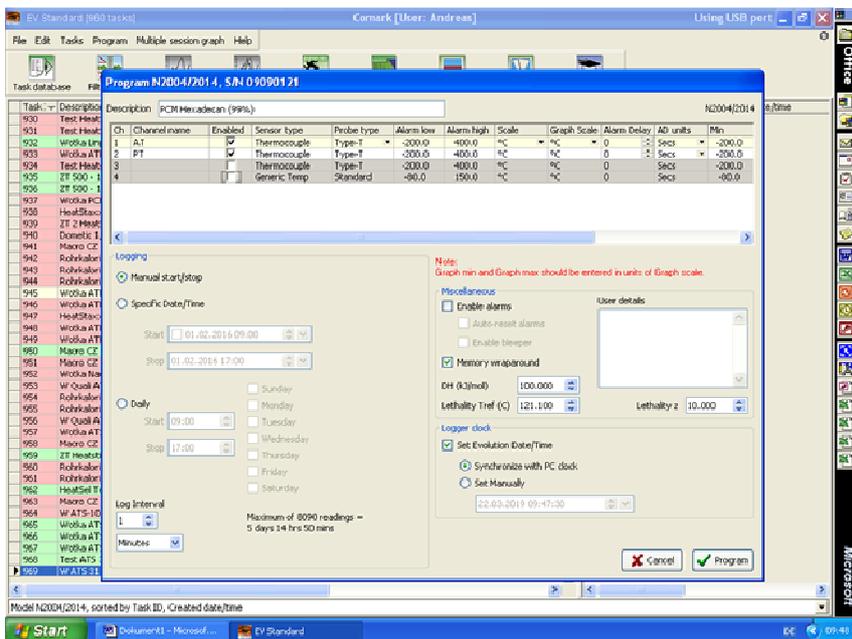
 In the program field now entries can be made about the sample, here "PCM Hexadecan (99%)".
Activate channels 1 and 2 (tick) and enter CH1 "Outdoor temperature" and CH2 "Sample temperature" in the respective fields.
Activate Manual start/stop, Log Interval 1 Minutes, Set Evolution Date/time and press Program.

The data logger is programmed.
Connect the data logger to the temperature sensor adapter of the
3 - layer - calorimeters.
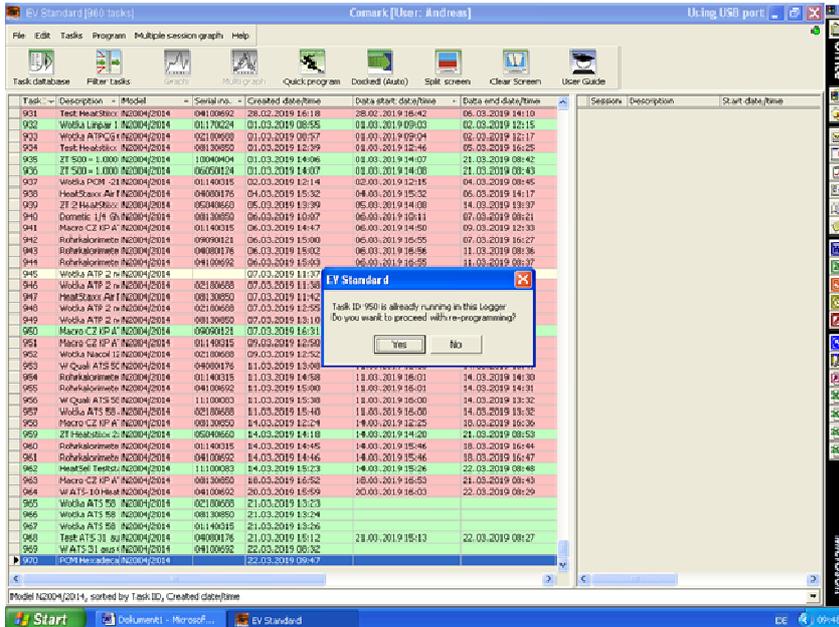
Confirm programming

To start, press the start button of the data logger for at least 5 seconds until the start signal is heard. Place the 3-layer calorimeter in the climate chamber with circulating air. Ensure the required temperatures in the climatic chamber, here 20 hours 3°C and 20 hours 33°C, the measurement begins.

Evaluation (see also Comark Software)

After the sample has passed through the heating and cooling process (20 hours recommended), switch off the climatic chamber, press the start button of the data logger for at least 5 seconds until the stop signal can be heard and disconnect the data logger from the adapter.
Start the data logger software and place the data logger on the interface (display down). With Dock (Auto), the software recognizes the data logger and reads out the temperature data.

wärme- und anwendungstechnische Prüfungen
Andreas Laube

Select the recorded measurement and press the Graph button to display the temperature / time diagram.

Translated with www.DeepL.com/Translator
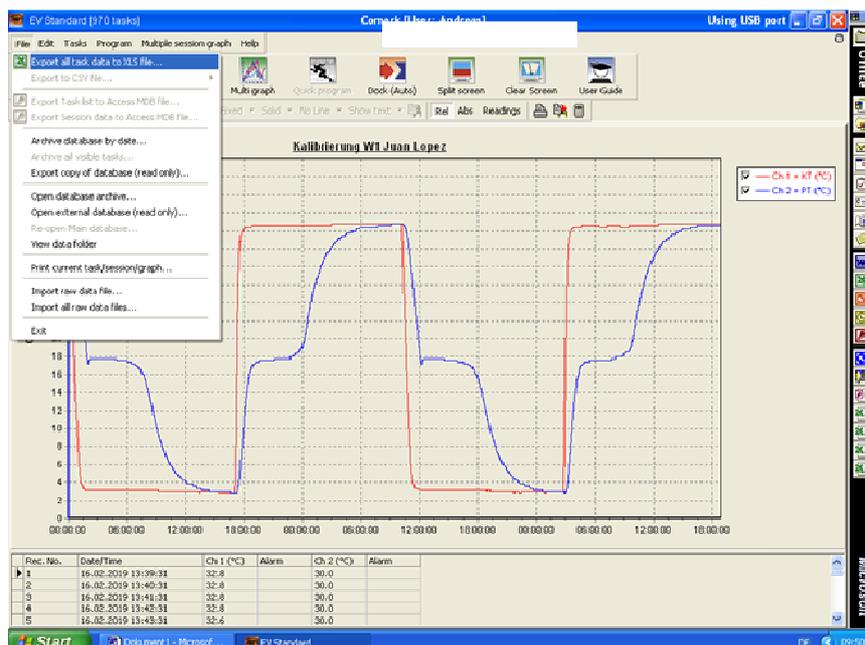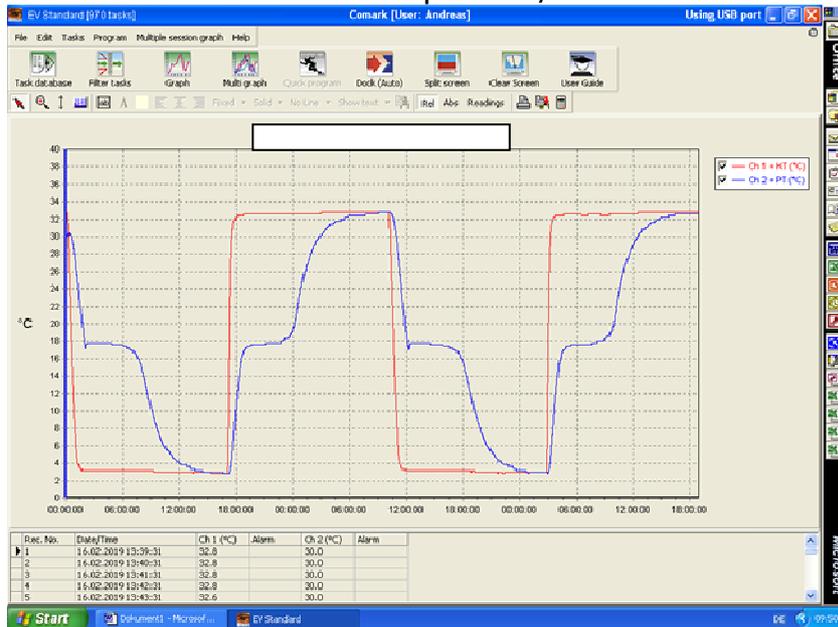
Press "file"- Export all task to xls file
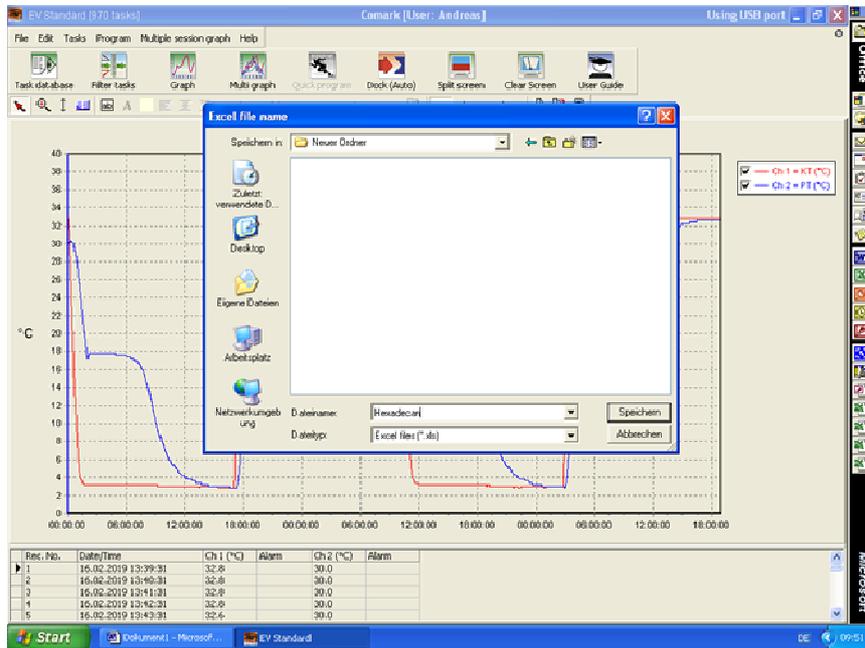
Select data storage location and assign file name
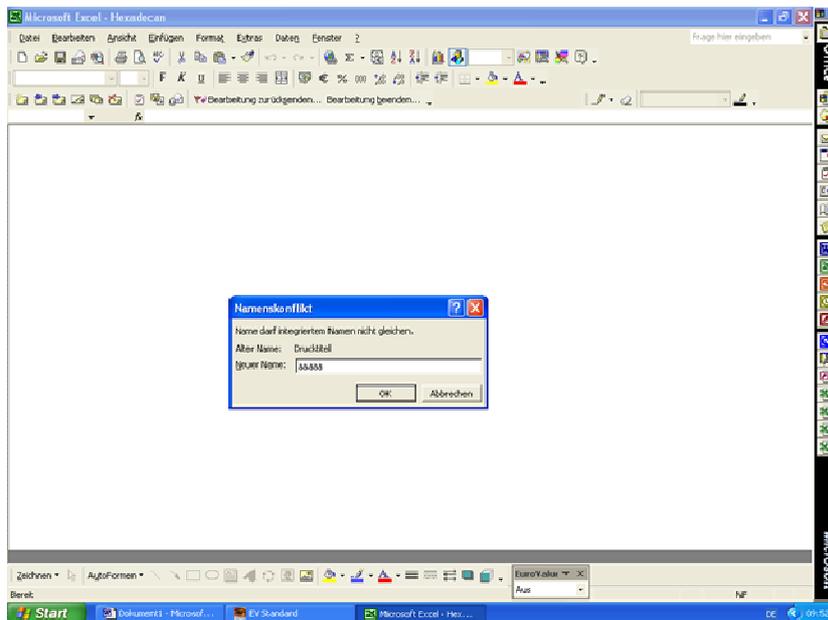
Confirm name conflict with a few letters
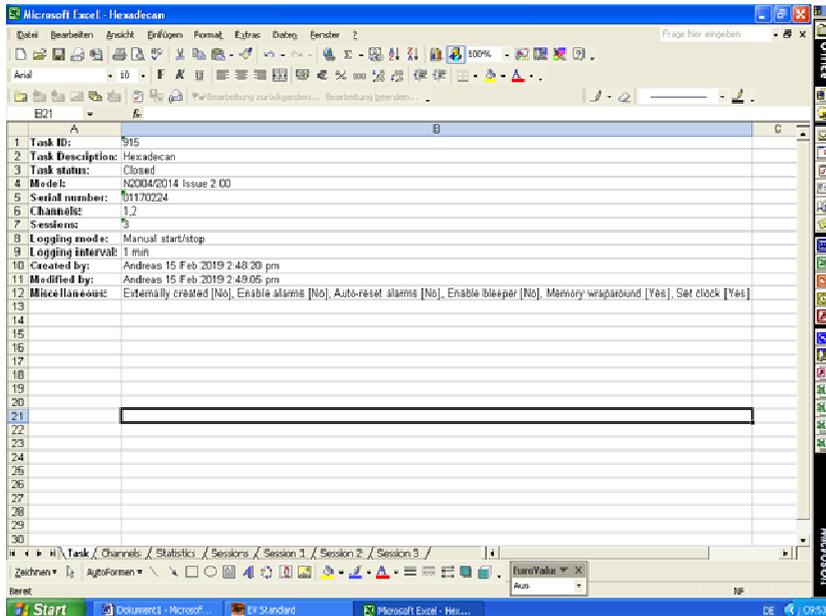
Displayed programming data with session selection
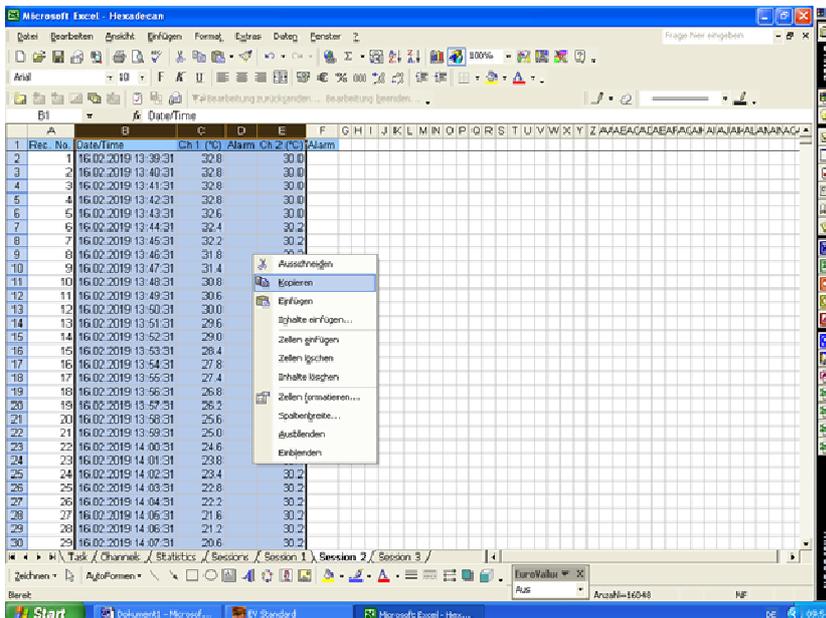
Mark and copy the measurement data

Open the excel file - calculation program - table "insert data" and paste the copied data into cell B1.
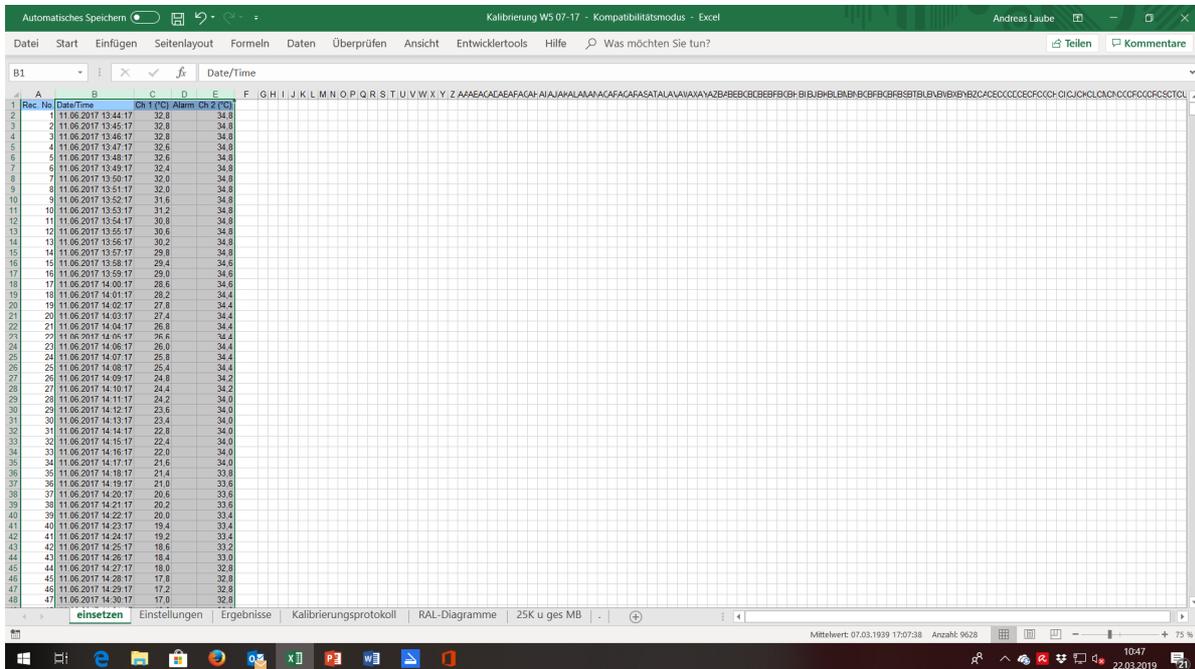
The data is inserted
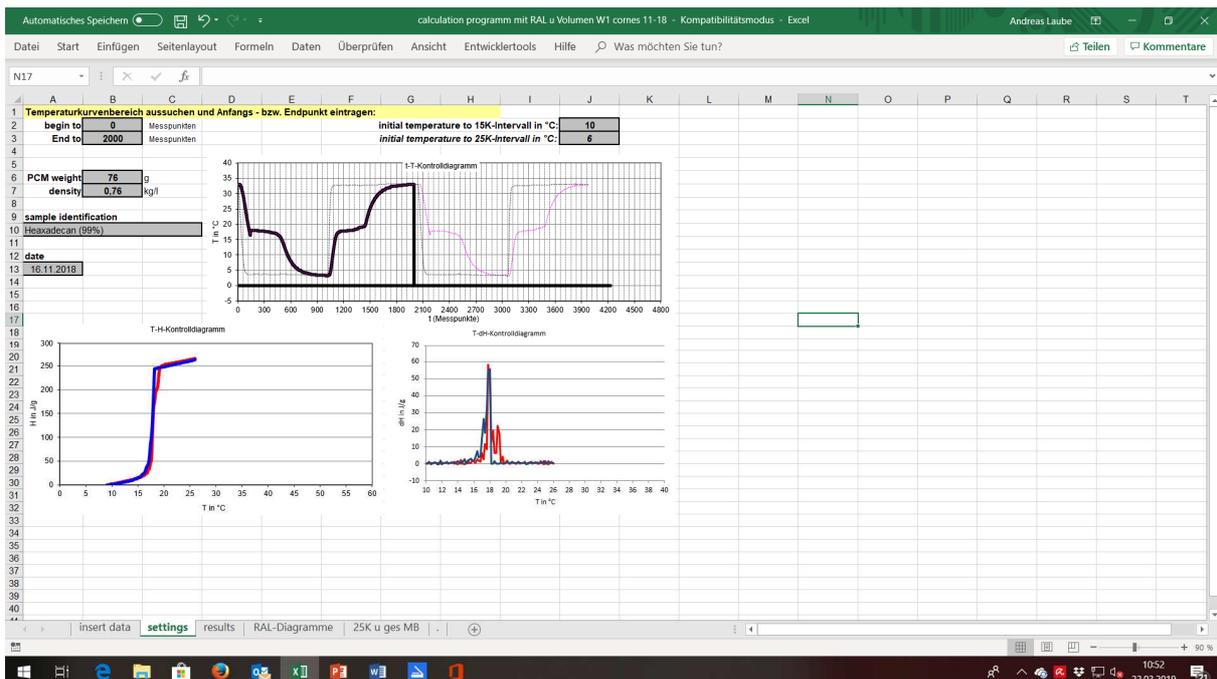
Enter the "settings" table below:

- Start to (here 0)
- End to (here 2000)
- PCM weight
- density
- date
- Start evaluation 15K
- Start evaluation 25K
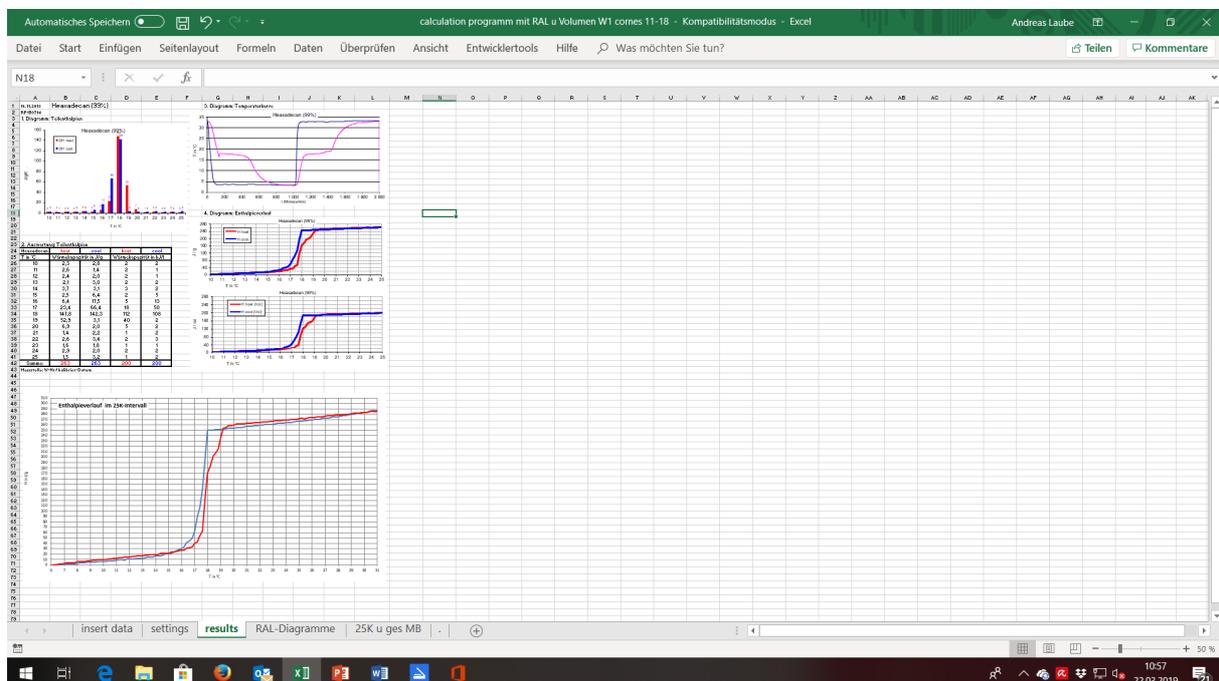
The calculated results are displayed in the task "results
adjust the diagrams "Temperature curve" and "Enthalpy curve" to the respective measuring times, temperatures and enthalpies.
Move / copy the "Results" table to a new workbook and save it for archiving the measurement data.

Attention:
Please do not save the changes in the calculation program when closing the Excel program!