TA Instruments Cement Analysis Software Getting Started Guide

Overview

Cement Analysis software from TA Instruments is a standalone software application for running cement setting experiments and analyzing experimental data. It runs on every version of the TAM Air Calorimeter that is compatible with TAM Assistant Software. TAM Assistant is required to be installed on the computer that runs the Cement Analysis software.

The software startup screen displays all connected TAM Air Instruments in the tabs at the left side of the window. Click on an instrument's tab to gain access to the instrument's heat flow monitor and experiment controls. Each instrument has four navigation tabs at the top of the window: **Heat Flow Monitor**, **Experiment** control, **Temperature** display, and **Calibration** control. In Figure 1, Instrument 10015 has been selected and its **Experiment** tab is activated.

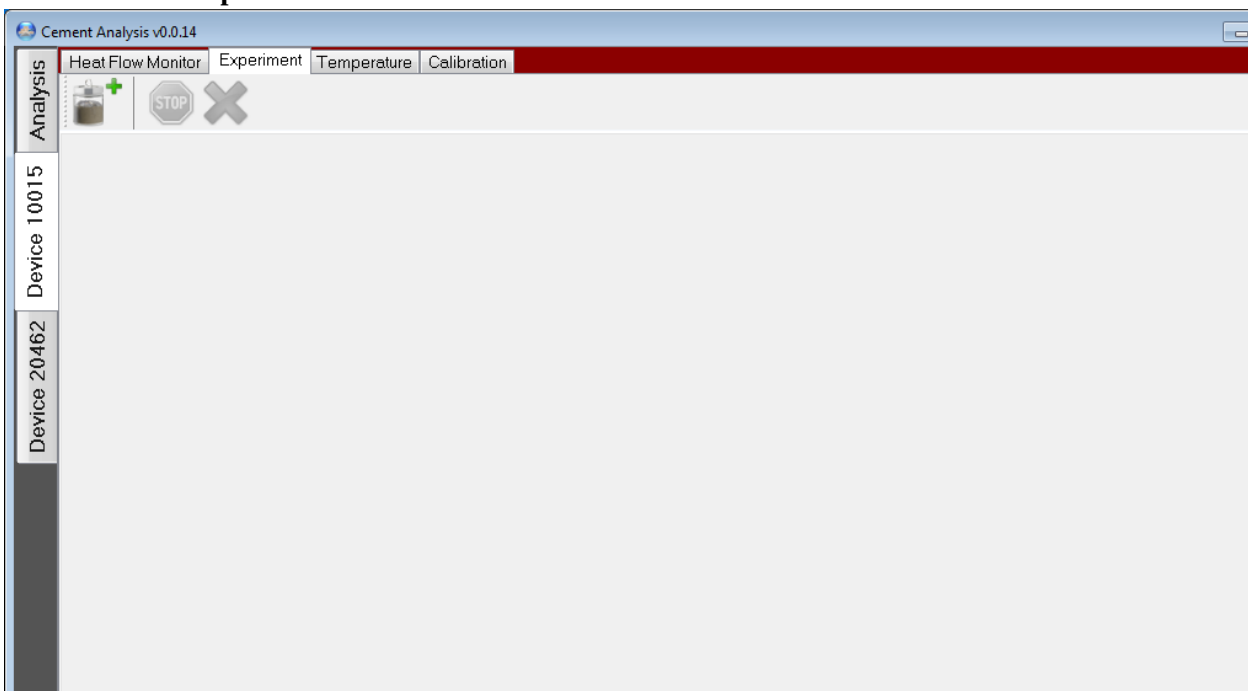


Figure 1 Startup screen.

Getting to Know the Software

When experiments are in progress, experiment tabs appear at the bottom edge of the window. There will be one experiment tab for each currently running experiment. Click on an experiment tab to interact with its data and settings.

Experiment tab

There are four tabs along the right side of the Experiment display: **Sample Information**, **View Information**, data **Graph**, and **Report** screen. Some of these screens are available during experiment analysis only.

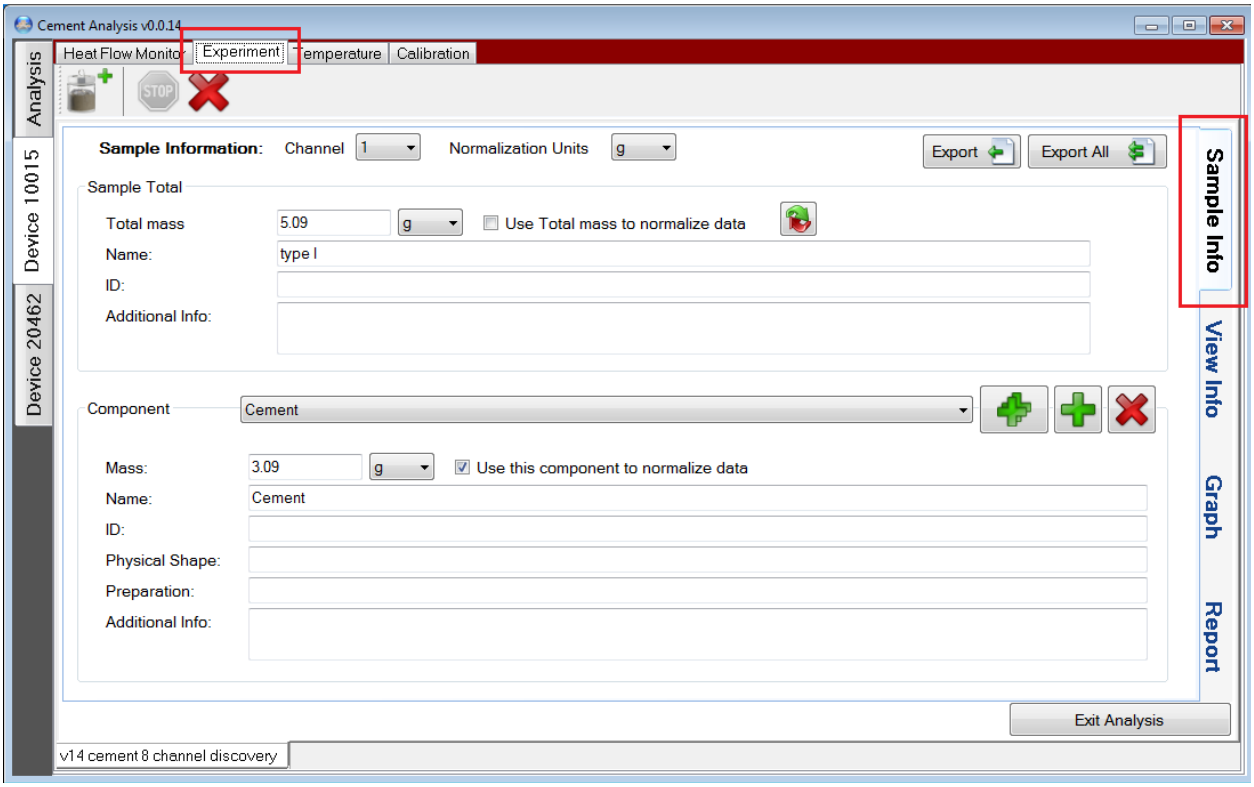


Figure 2 Experiment/Sample Info.

- Sample component descriptions and masses are entered on the **Sample Info** screen (shown above).
- The **View Info** tab selects the data to be presented during an experiment.

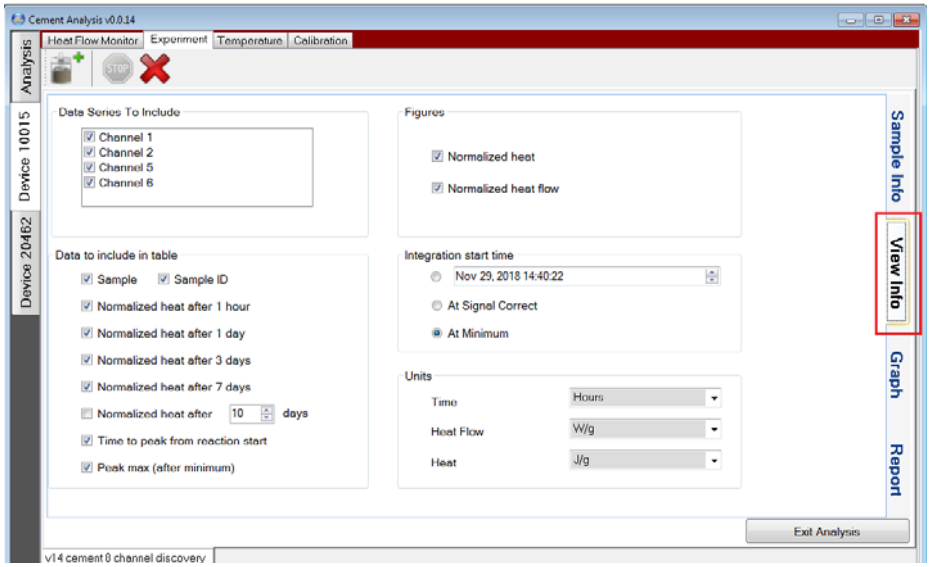


Figure 3 Experiment/View Info

- The **Graph** tab contains a display of the heat flow signals of the instrument channels that are part of the currently selected experiment.

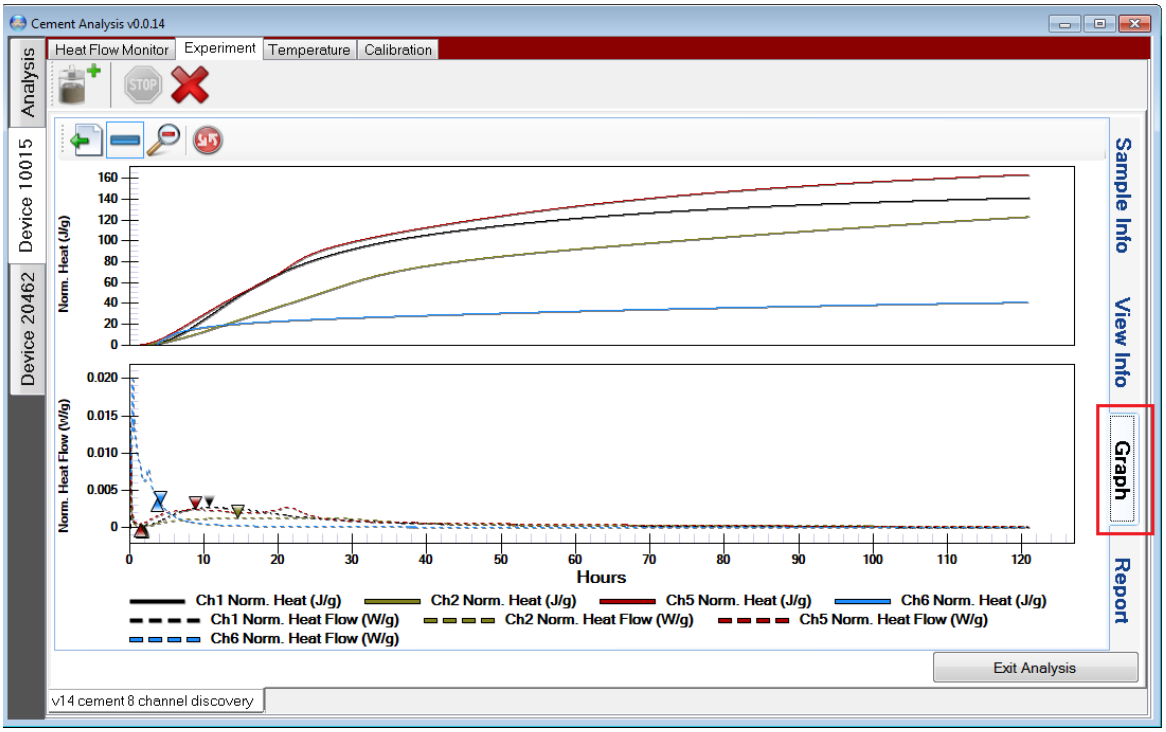
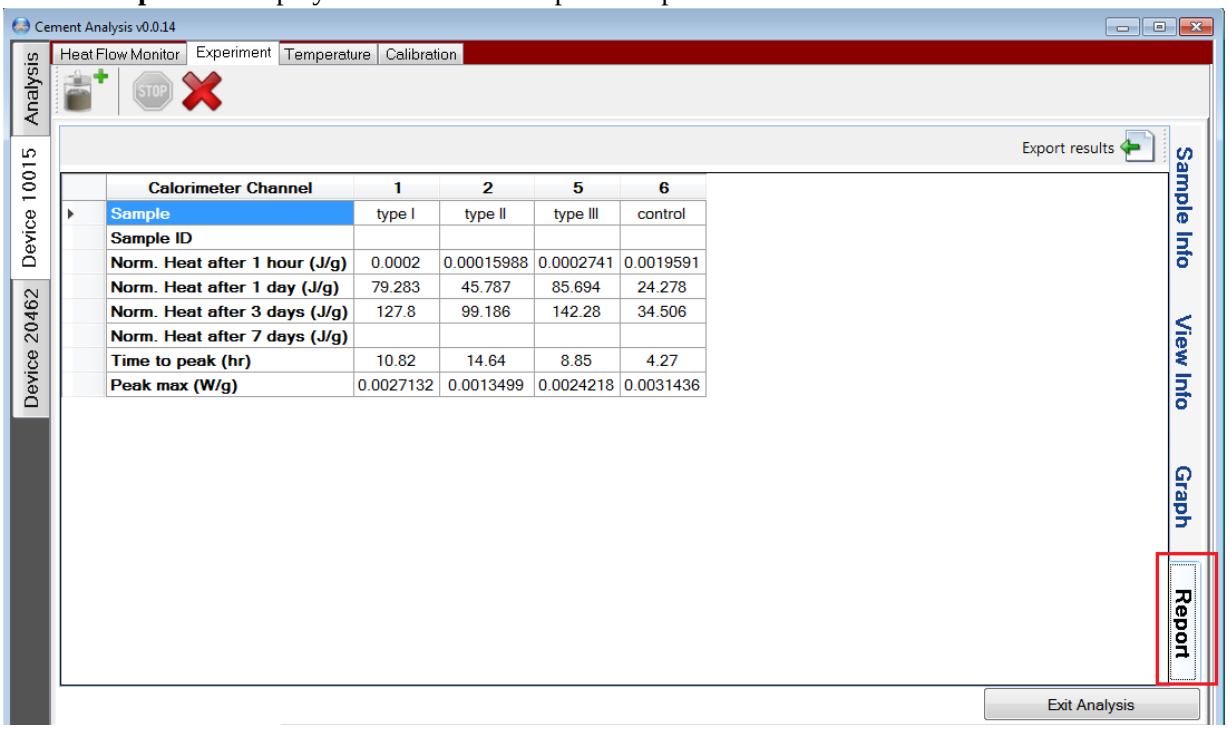


Figure 4 Experiment/Graph

- The **Report** tab displays the results of completed experiments.



Calorimeter Channel	1	2	5	6
Sample	type I	type II	type III	control
Sample ID				
Norm. Heat after 1 hour (J/g)	0.0002	0.00015988	0.0002741	0.0019591
Norm. Heat after 1 day (J/g)	79.283	45.787	85.694	24.278
Norm. Heat after 3 days (J/g)	127.8	99.186	142.28	34.506
Norm. Heat after 7 days (J/g)				
Time to peak (hr)	10.82	14.64	8.85	4.27
Peak max (W/g)	0.0027132	0.0013499	0.0024218	0.0031436

Figure 5 Experiment/Report

Temperature tab

The **Temperature** tab for a TAM Air thermostat device displays the recent temperature control history.

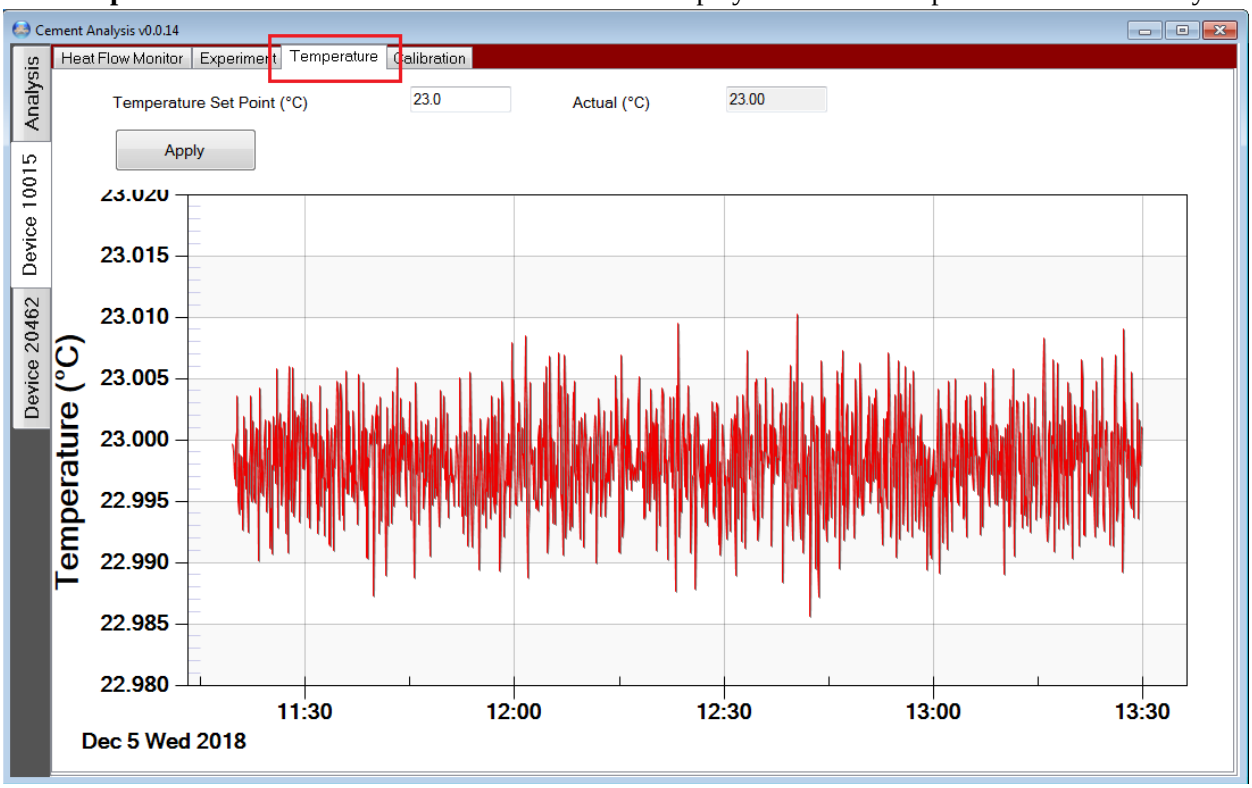


Figure 6 Device Temperature history.

Calibration tab

The Calibration tab displays the channel calibration status for the calorimeter unit.

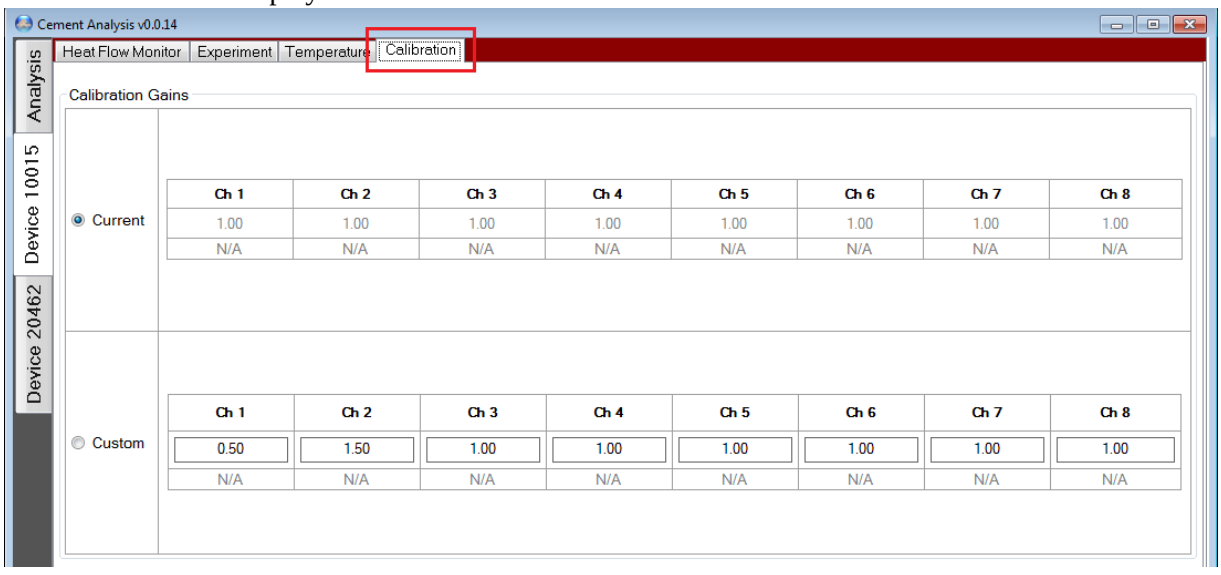


Figure 7 Calorimeter Calibration status.

Running Cement Experiments

Pre-requisites for running Cement Analysis software:

- TAM Assistant must be installed on the computer that the TAM Air instrument is connected to for running the cement software.
- TAM Assistant device configuration files must exist on the computer. These are created through TAM Assistant if they don't already exist.
- Calorimeter calibrations must be run using TAM Assistant. If a calibration does not exist, it should be run before using the cement software.
- The TAM Assistant server must be stopped before running the cement software. The service should be configured for manual start rather than automatic.

Running the experiment

1 Click the Experiment Start button.

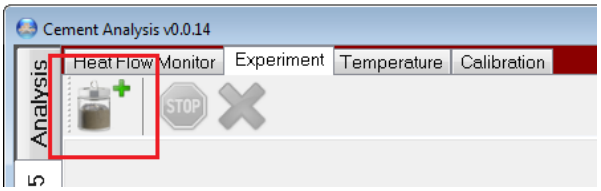


Figure 8 Experiment start.

2 Enter the experiment and operator names.

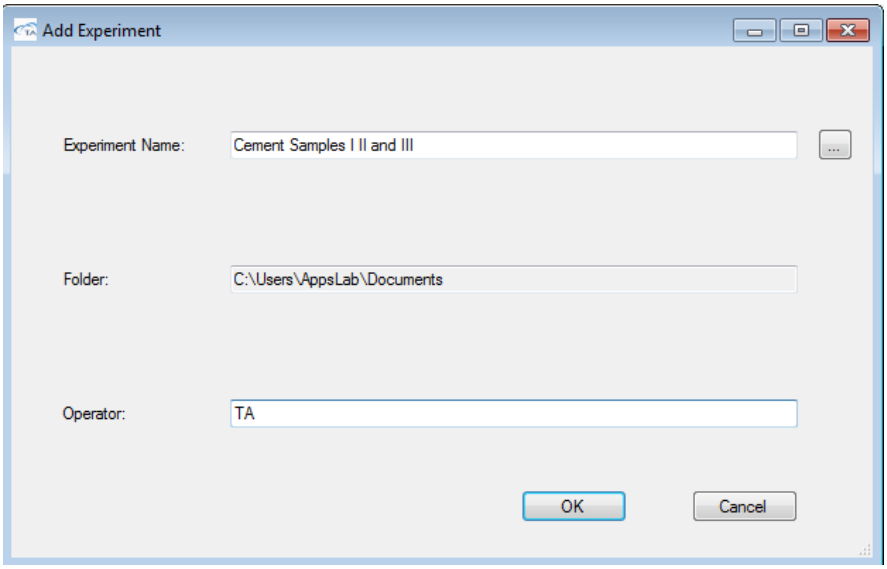


Figure 9 Enter names.

3 The Cement Experiment Wizard Welcome screen displays, click **Next**.

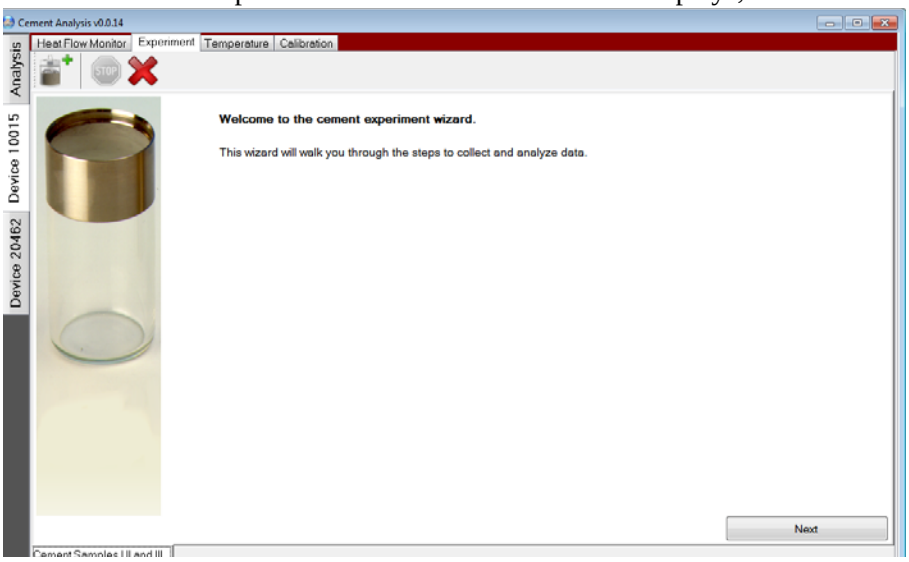


Figure 10 Welcome screen.

4 Select the channels to be included in the experiment.

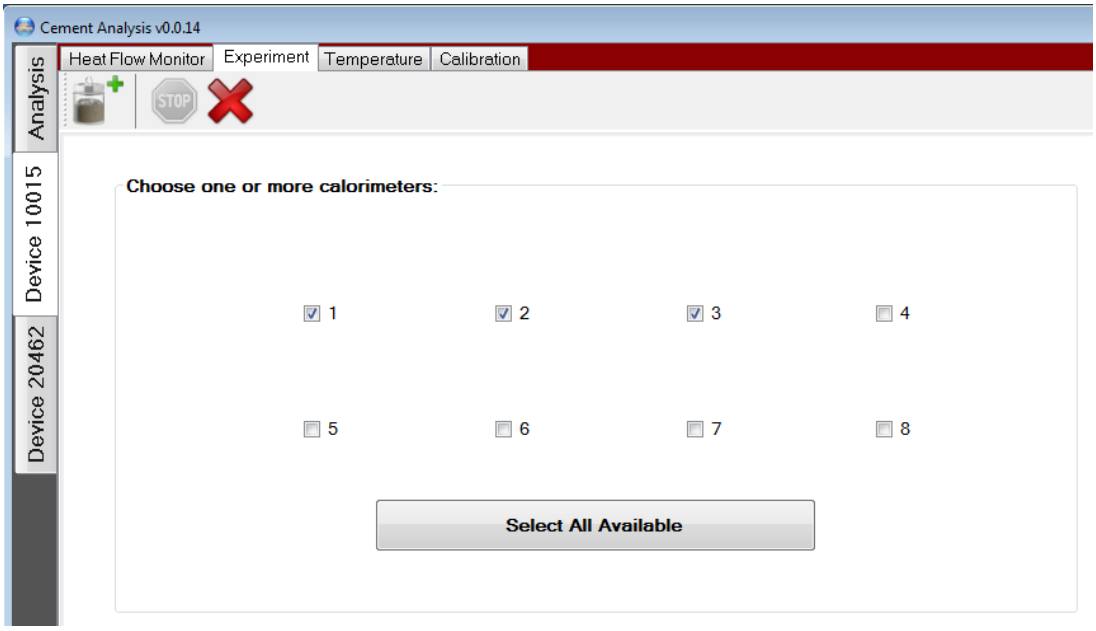


Figure 11 Select channels.

Sample Information

5 The next screen is where sample information is entered.

IMPORTANT NOTE: In order to prepare and insert samples in a timely manner, bypass this screen at this time; there will be an opportunity to enter this data later. The first steps of the experiment collect signal baseline data which may run for typically 30 minutes. The best practice is to wait until the baseline is completed before samples are prepared, in order to not miss the early phases of the reactions.

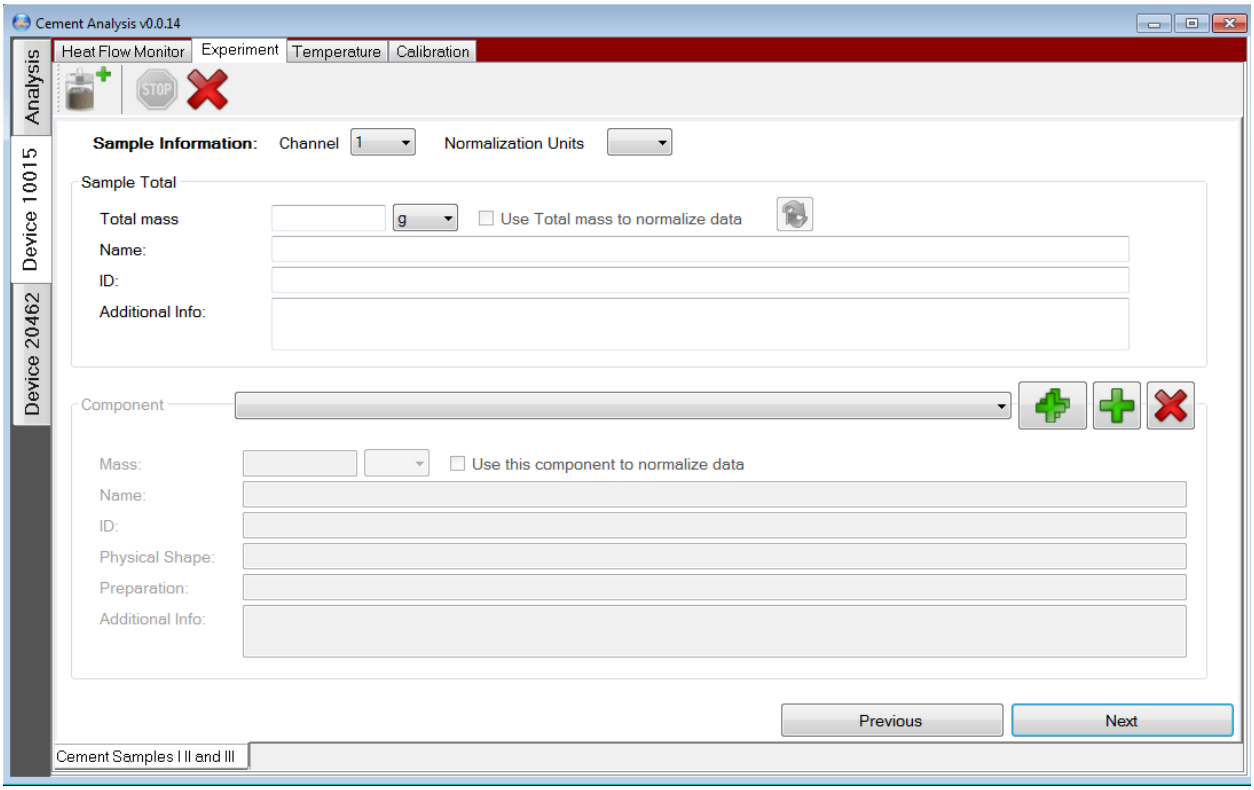


Figure 12 Sample Information screen.

Baseline

6 Enter the desired stability criterion (Low or Moderate) that start as the baseline region, the Maximum Time (timeout) to wait for signal stability before starting the baseline, and the length of the baseline section.

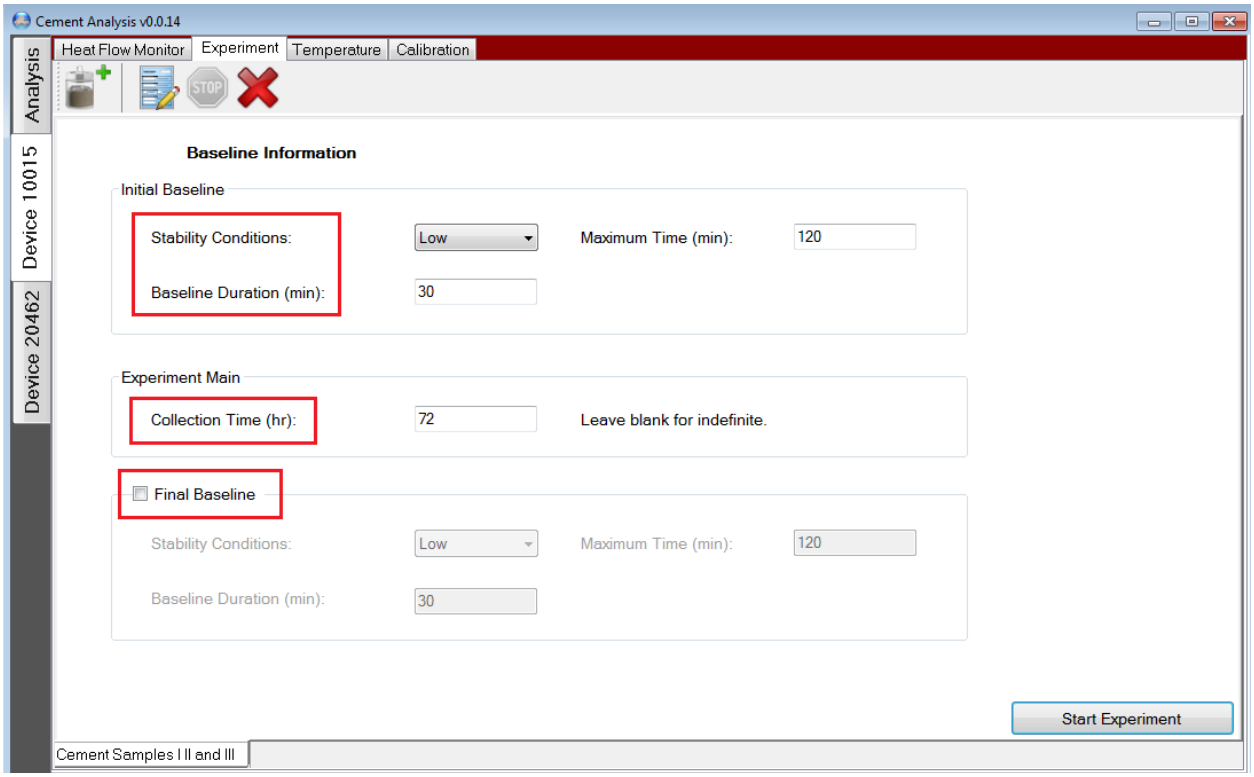


Figure 13 Baseline settings and Start Experiment button.

Stability criteria and basic algorithm:

Statistics are not calculated until the *Window Size* criterion is met. A signal is considered stable when it falls below both the Low *Standard Deviation Threshold* and the Low *Slope Threshold*. A signal can revert to a state of instability if the criteria are no longer met. Once all signals in the experiment are considered stable, the Baseline stage can start.

Table 1 Stability Criteria

		Standard Deviation Threshold (W)	Slope Threshold (J/hr)	Window Size (seconds)
3-Channel	Low	150	12	900
	Moderate	12	4	1200
8-Channel	Low	50	4	900
	Moderate	4	2	1200

7 Click **Start Experiment**.

8 The pre-baseline section begins. At least 15 minutes of data is collected and analyzed for stability. When the stability condition is met, the Baseline section automatically starts.

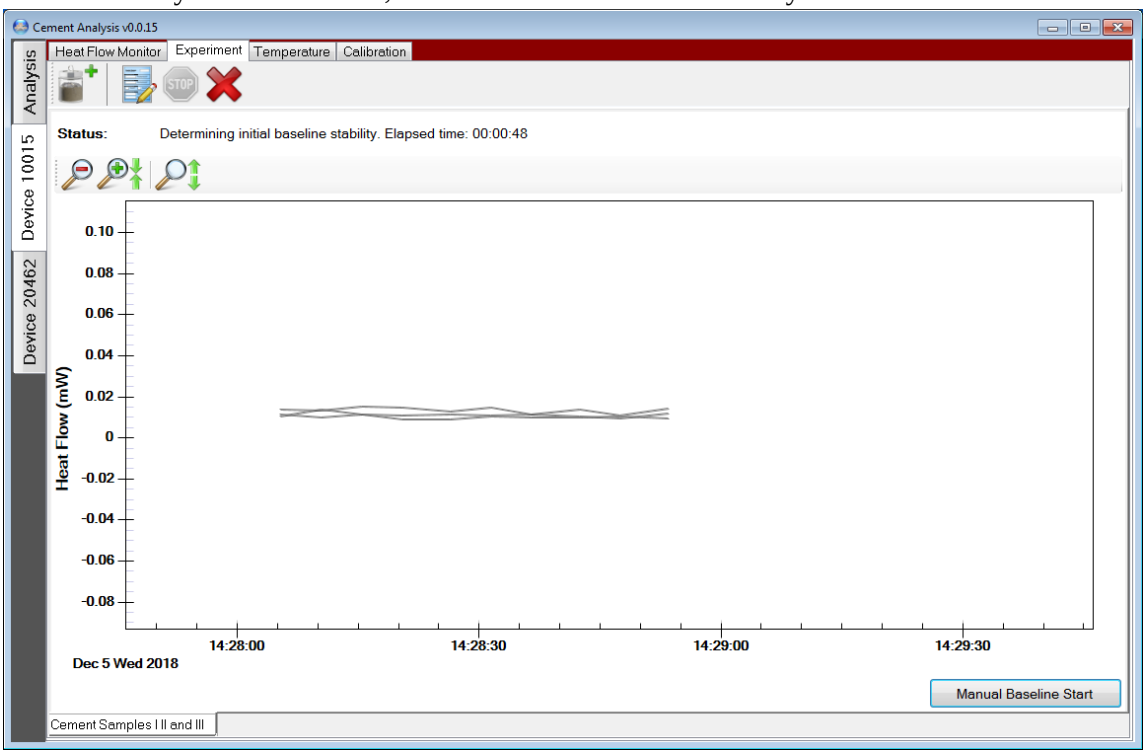


Figure 14 Pre-Baseline.

Baseline region data is highlighted in green:

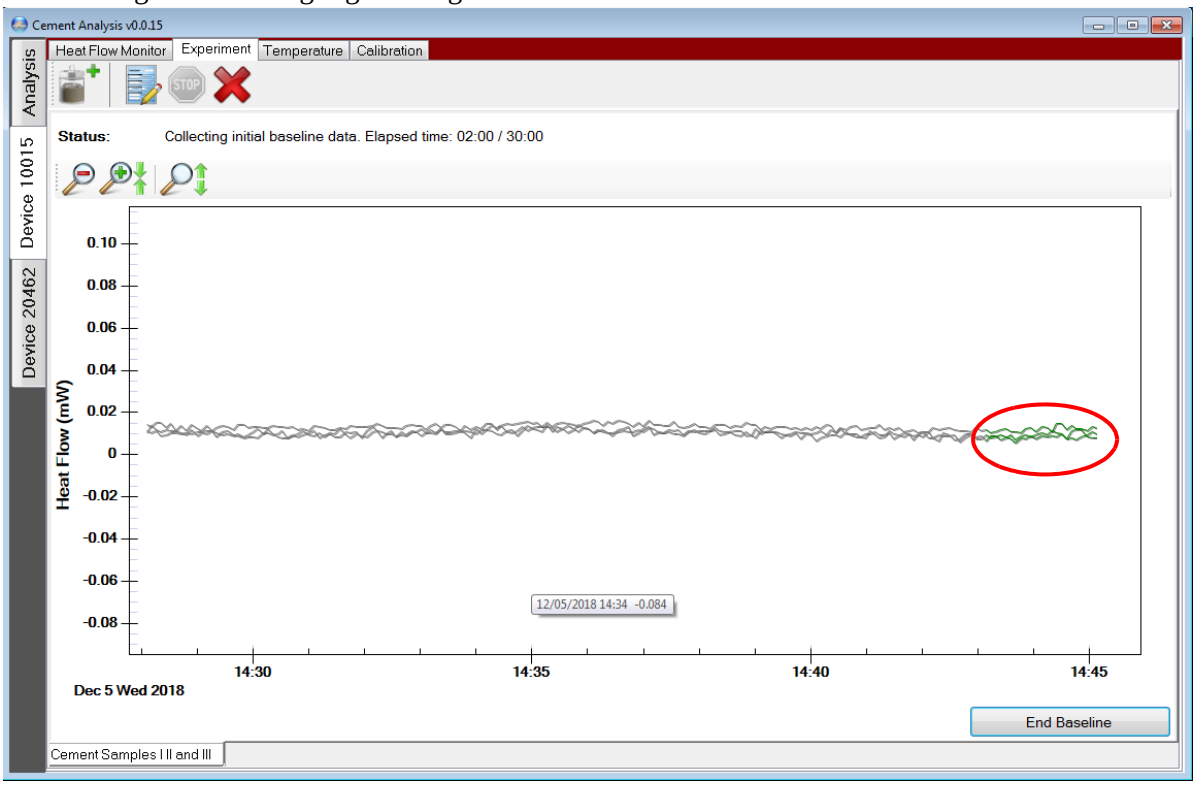


Figure 15 Baseline.

When the Baseline region has been collected for the designated time period, the Mix Start Times screen displays (see Figure 16).

NOTE: Prepare the samples at this time.

Prepare the Samples

The software is set up to accept a data entry of the weights of individual components, not an accumulating total weight. The basic process is to:

- Tare the ampoule
- Add component “A”
- Weigh the ampoule and record the mass of component “A.”

This process is repeated for component “B,” then “C,” etc. as appropriate.

Required Equipment:

- Ampoules, caps, and lifter eyelets for each sample
- Sample lifter tool
- Cap crimping tool
- Analytical balance with 0.01 gram resolution for 20 mL ampoules, or 0.1 gram resolution for 100 mL
- Cement samples, plus any optional sample components if appropriate to the experiment
- Notebook
- Stopwatch
- Inert Reference ampoules (containing water or quartz sand)
- Method of pre-adjusting the temperature of samples and references.

Work flow for sample preparation:

a Tare an empty ampoule.

b Add the cement component, weigh, and record the weight.

c Add any additional components one at a time as needed for the experiment:

- Tare the ampoule, add the component, and record the component weight.
- Optional: If there are multiple samples to run, it may be most convenient to wait until later to add the water

d Complete the steps above for all samples. At this time before the water is added, the reactions have not yet started and timing is not critical.

e Add water and mix each sample:

> **NOTE: Timing is important in this phase of the experiment. The samples should receive their water and be mixed without any unnecessary delays, and then all samples should be inserted into the TAM Air instrument at close to the same time.**

f Water addition:

- Place a sample ampoule on the balance and tare the balance.
- Add water and record the mass. Proceed to the next step without delay:
- Mix the sample then start the timer for that sample.

g Crimp the cap onto the vial and attach the lifter eyelet.

h Insert the sample into the designated TAM Air channel.

Enter Mix Start Times

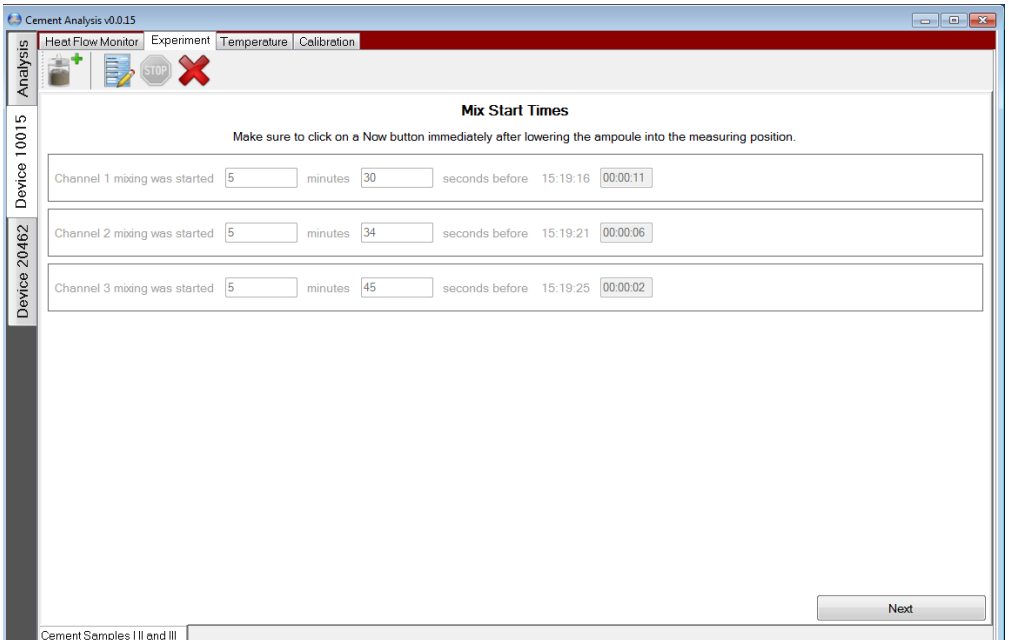


Figure 16 Enter the mix timing information for all samples.

9 On the screen shown in Figure 16, enter the time interval in minutes and seconds since the mixing occurred, and click **Now**.

10 When all samples have been processed, and samples and references have been inserted and their timing data entered, click **Next**.

Main Experiment

The main experiment section begins:

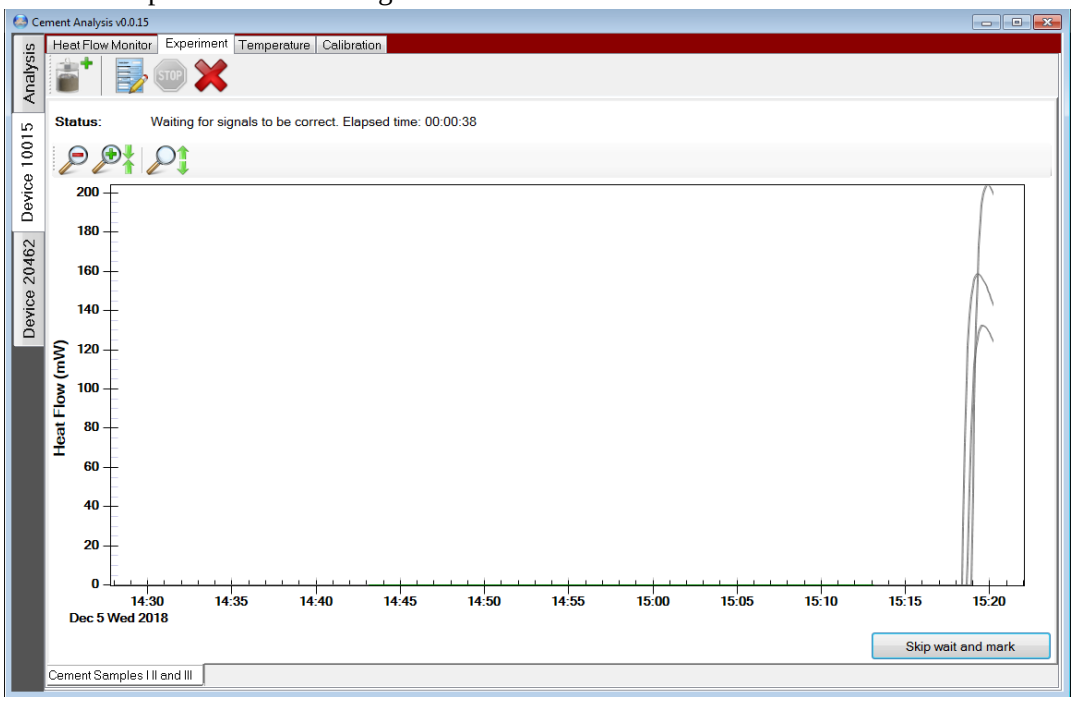


Figure 17 Main experiment section.

11 Enter the sample mass information in the Cement Analysis program. Click the icon shown below to display the entry table.

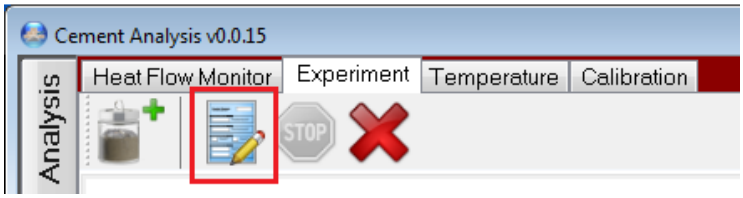


Figure 18 Sample data entry.

12 To add sample data for multiple samples in one form, click the "multiple add" icon.

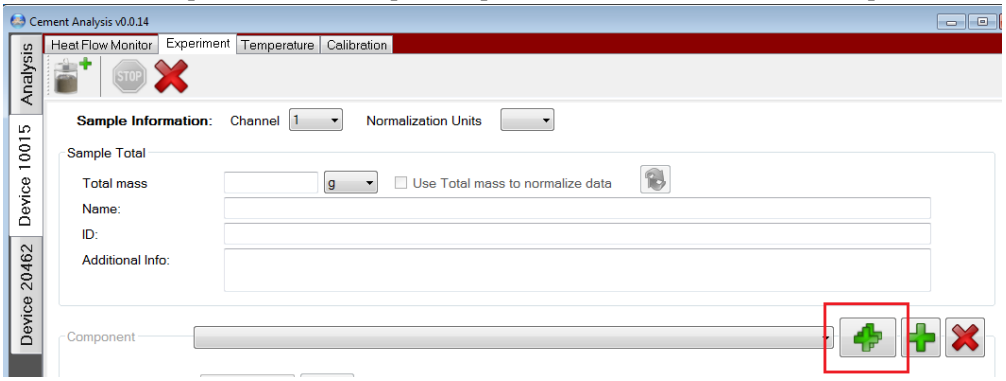


Figure 19 Multiple Add icon.

13 Enter the mass of each component for each sample, from the data that was manually recorded in the notebook during the sample preparation. Click **OK** when finished.

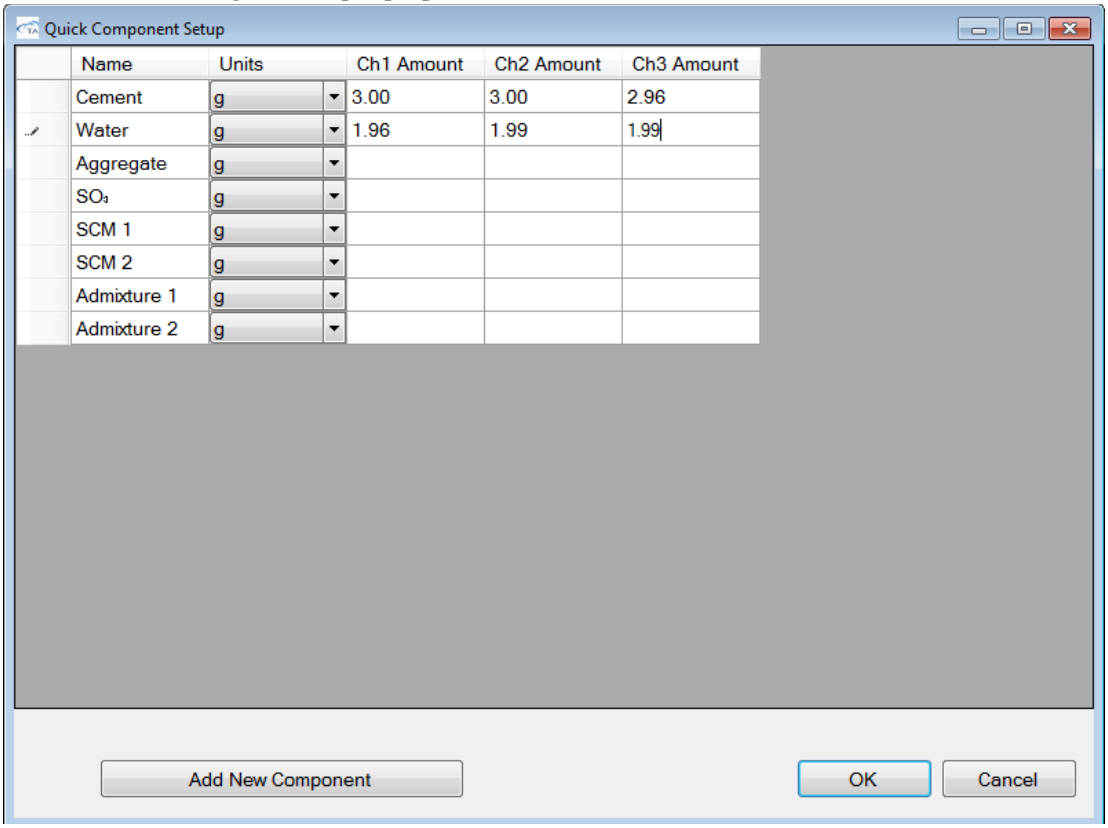


Figure 20 Quick Component Setup screen (sample component information table).

NOTE: If there is any reason to add or correct any of this information, the table can be accessed and modified at any time during the main section of the experiment.

14 Additional data and notes can be added for each sample. Each sample may be individually accessed. The Quick Component Setup screen contains the controls for how to normalize the data. Click **OK** when finished with data entry and review.

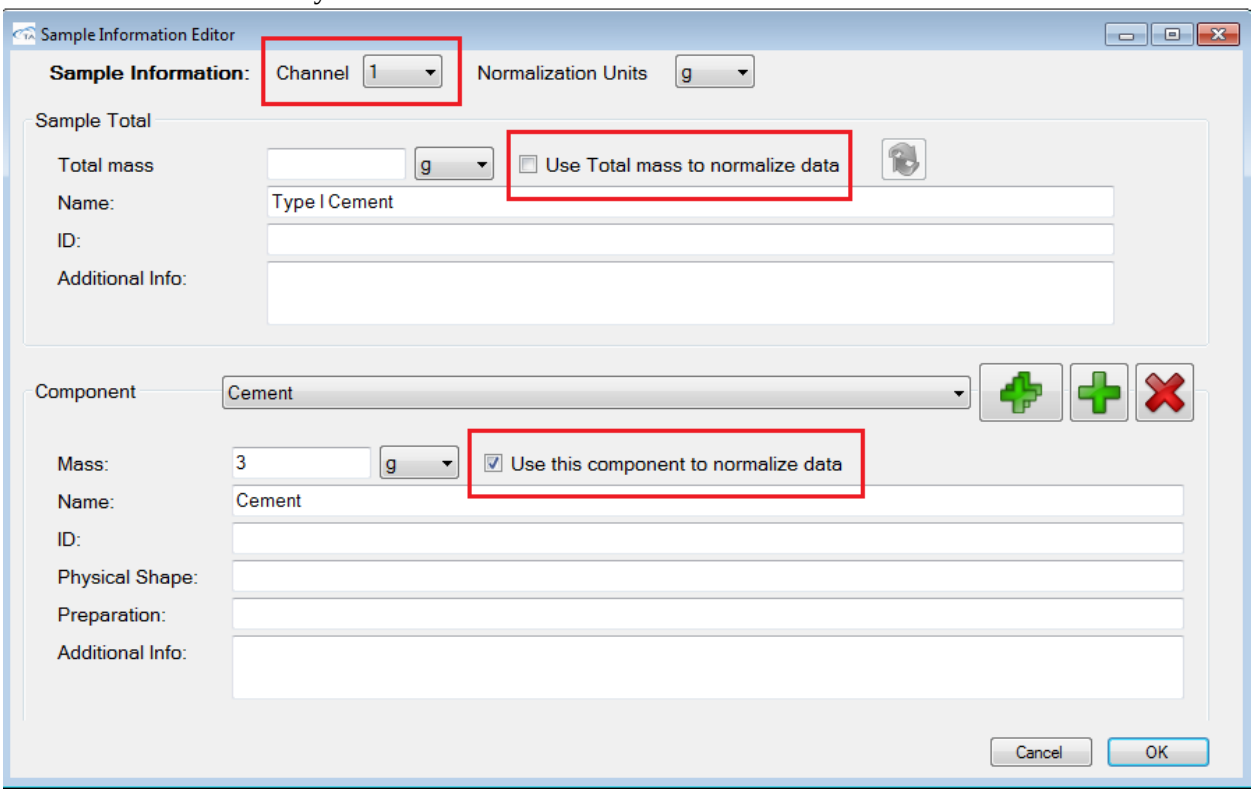


Figure 21 Additional sample data.

Signal not yet correct

The experiment proceeds to the “Signal not yet correct” region of data collection. The initial spike comes from the sample equilibration to the thermostat.

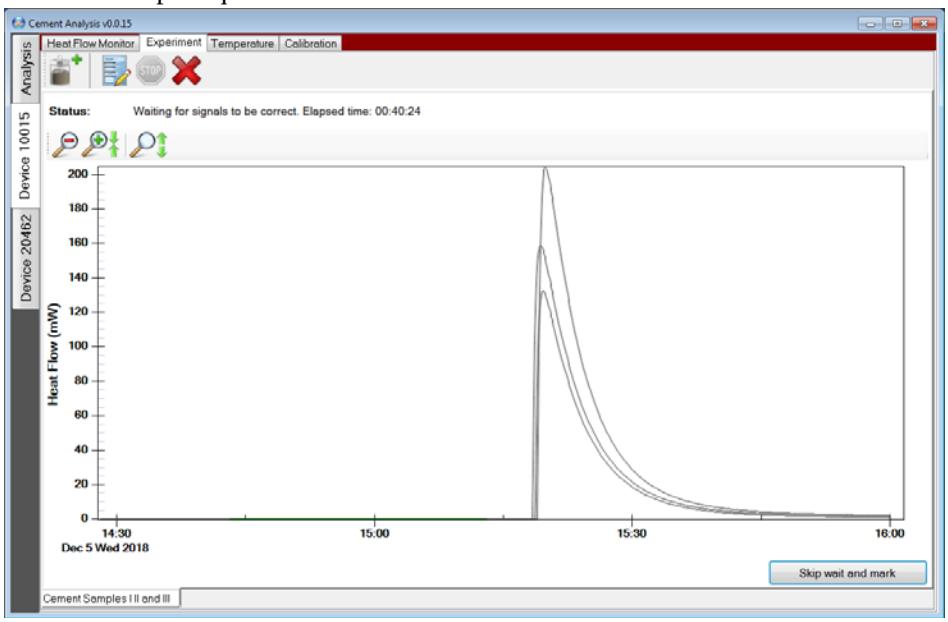


Figure 22 Samples inserted.

Main data

When the signals stabilize, the Main region of the data collections occurs, and is marked in red:

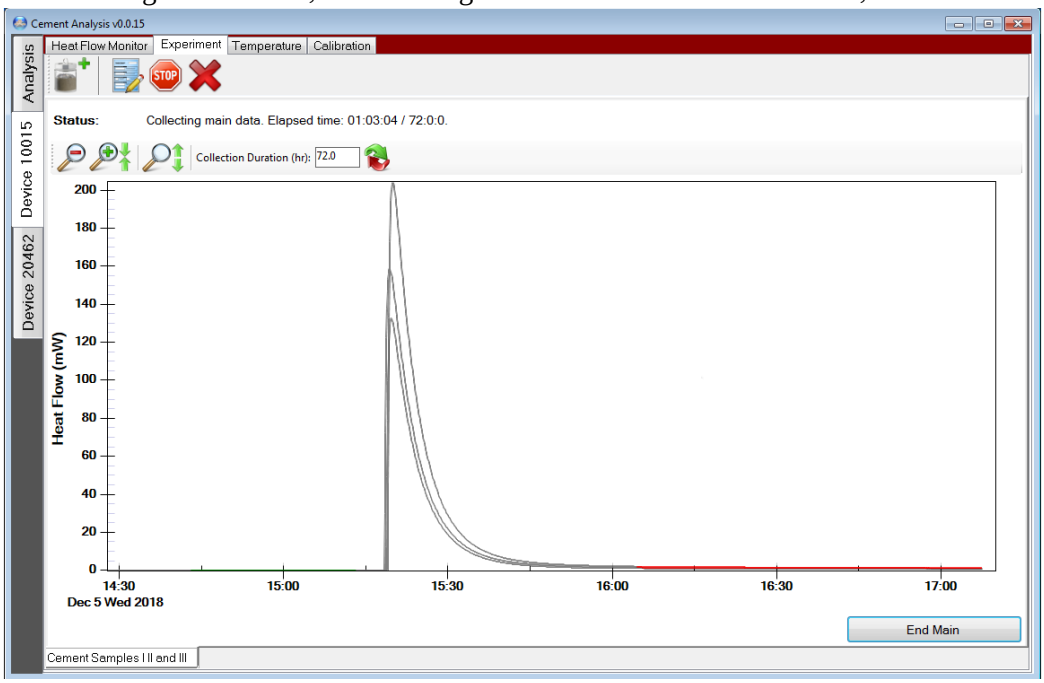


Figure 23 Main section start.

The signals view can be zoomed by clicking and dragging the mouse over the desired region. The zoom can be reset by clicking the **Undo** magnification icon.

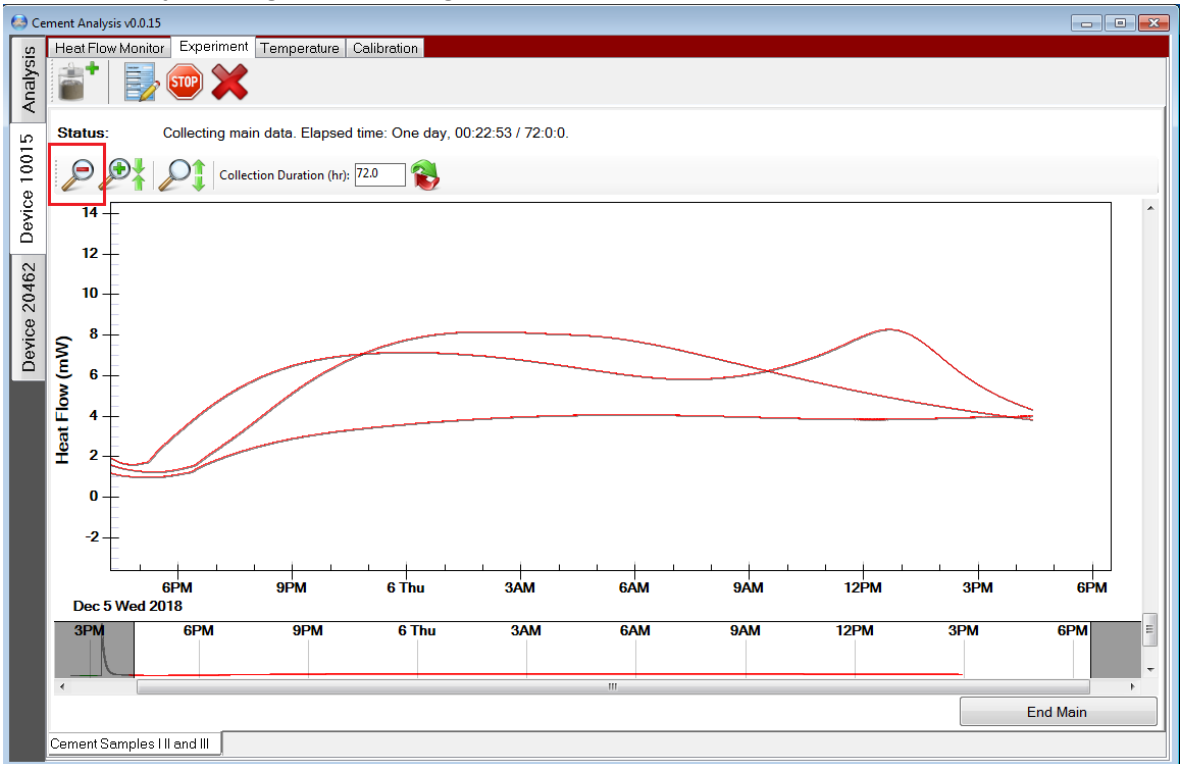


Figure 24 Zoomed in on Main section.

15 When the planned experiment duration expires, a message displays to remind you to remove the samples and mark the end time. Data continues to be collected up until the **Mark** button is pressed, even if that occurs after the planned experiment duration.

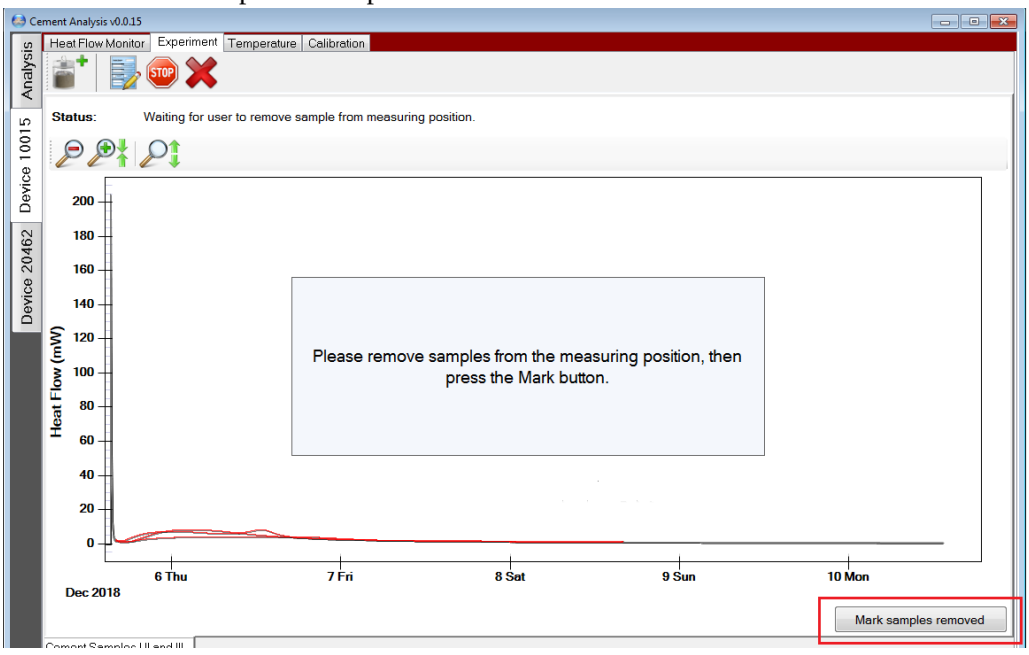


Figure 25 End of experiment.

If desired, the signal window can be zoomed via the computer mouse:

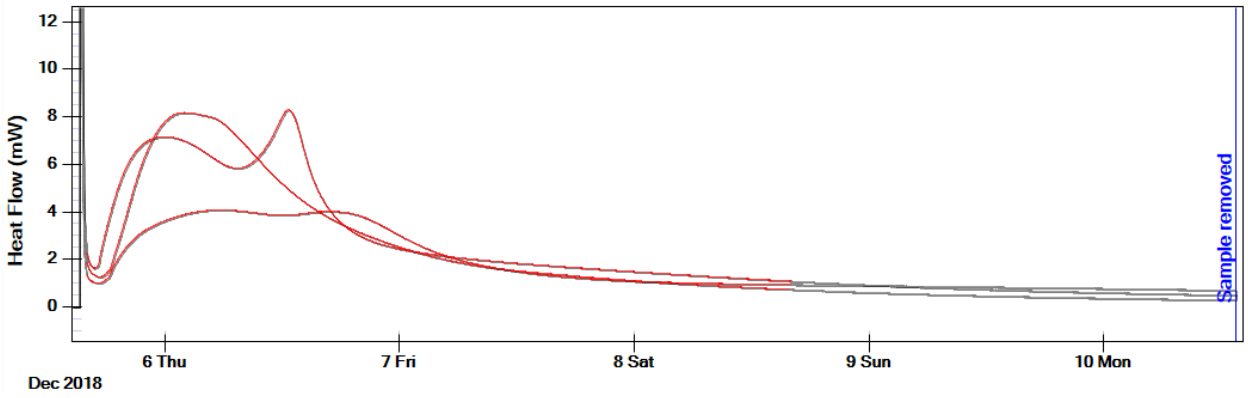


Figure 26 Zoomed in on signals.

Analyze data

16 The experiment is now concluded and the major events tagged with time stamps. Click **Analyze Data** to proceed.

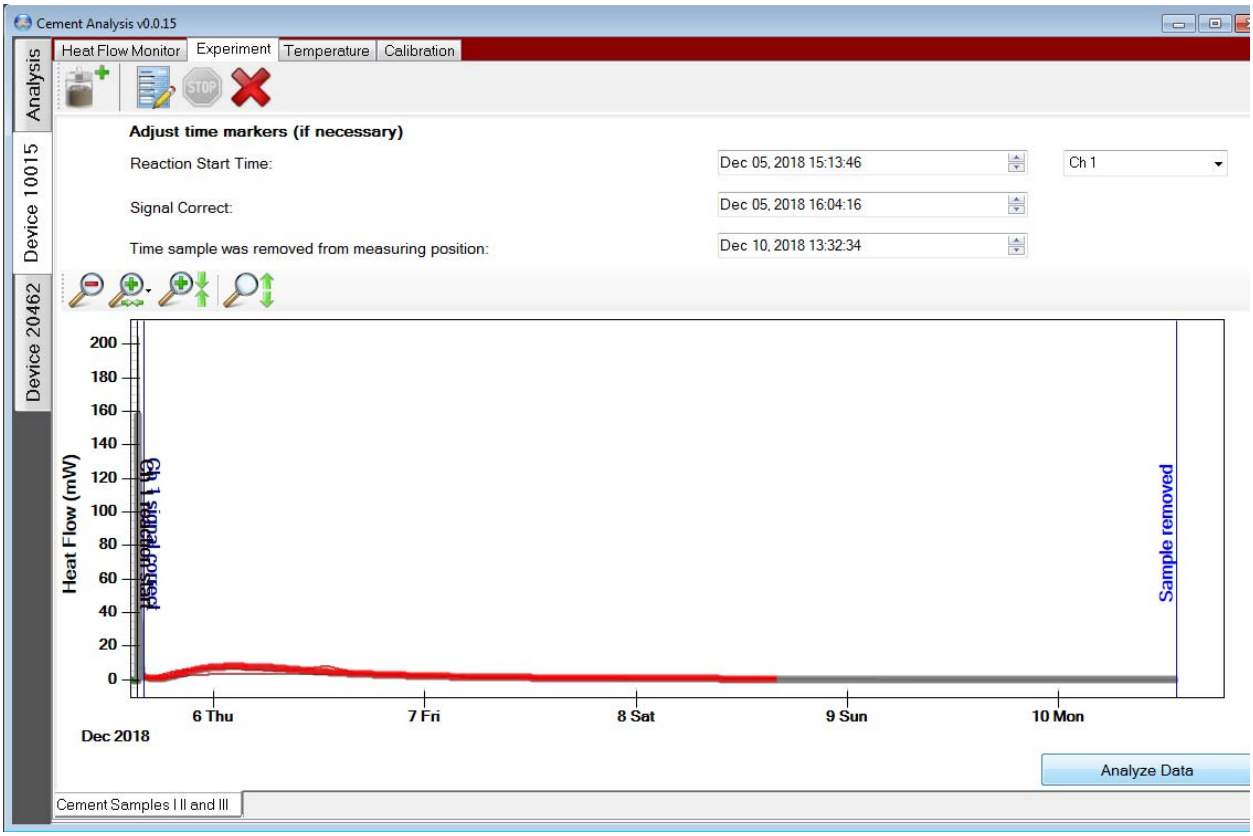


Figure 27 Data markers placed automatically by software. Data collected after the defined end of the experiment can be displayed but not analyzed. If no time is entered for the experiment run time, the experiment continues with analyzable data being collected until the experiment is stopped manually.

The Graph contains an updated view of the experiment progress:

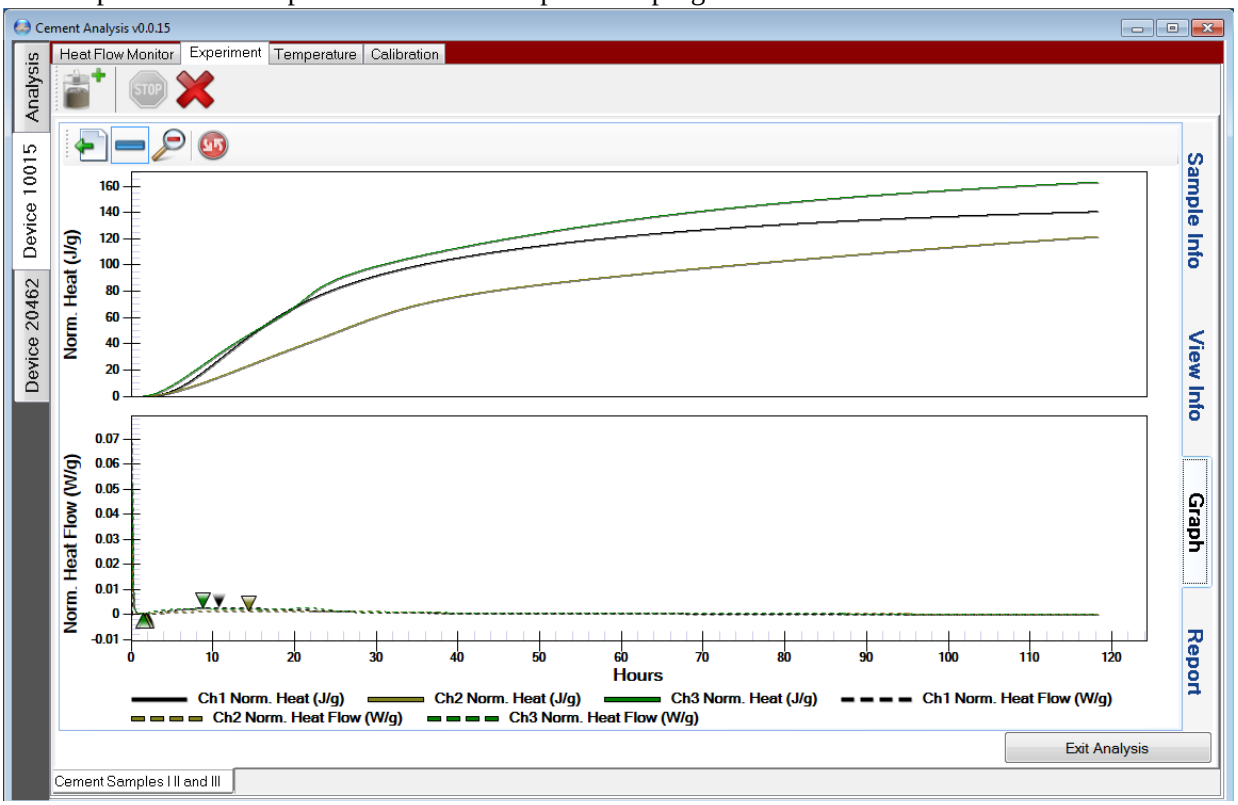


Figure 28 Graph view of completed experiment.

The signals window can be zoomed for close inspection. If the times of the minima or the first maxima were not correctly assigned by the software, the markers may be moved manually if necessary on this screen.

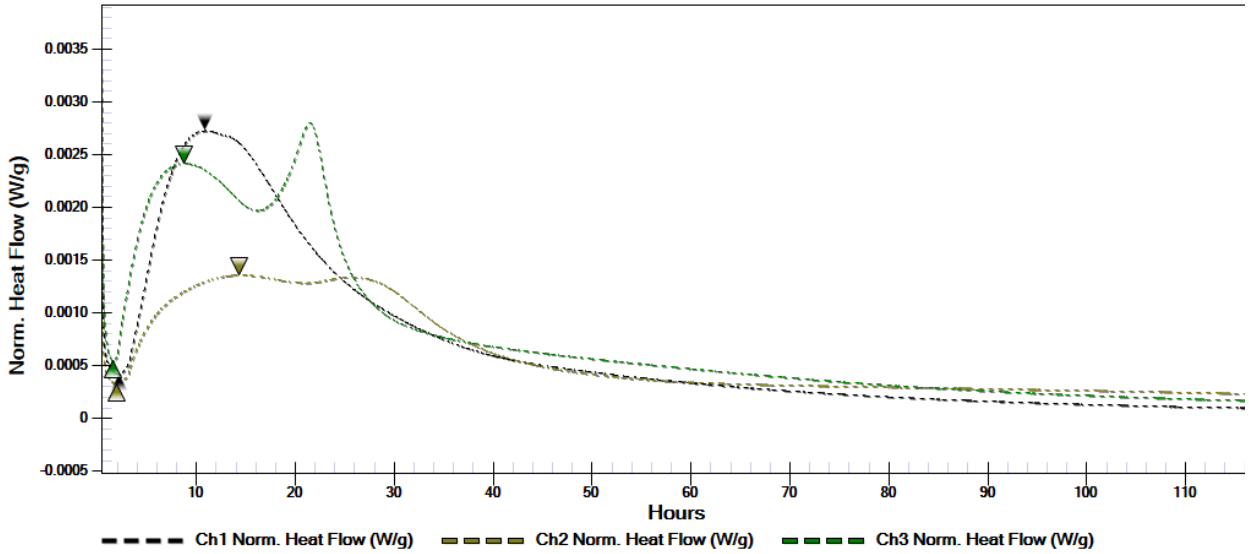


Figure 29 Zoomed in for marker review.

Both windows can be magnified together if the zoom window encompasses both regions:

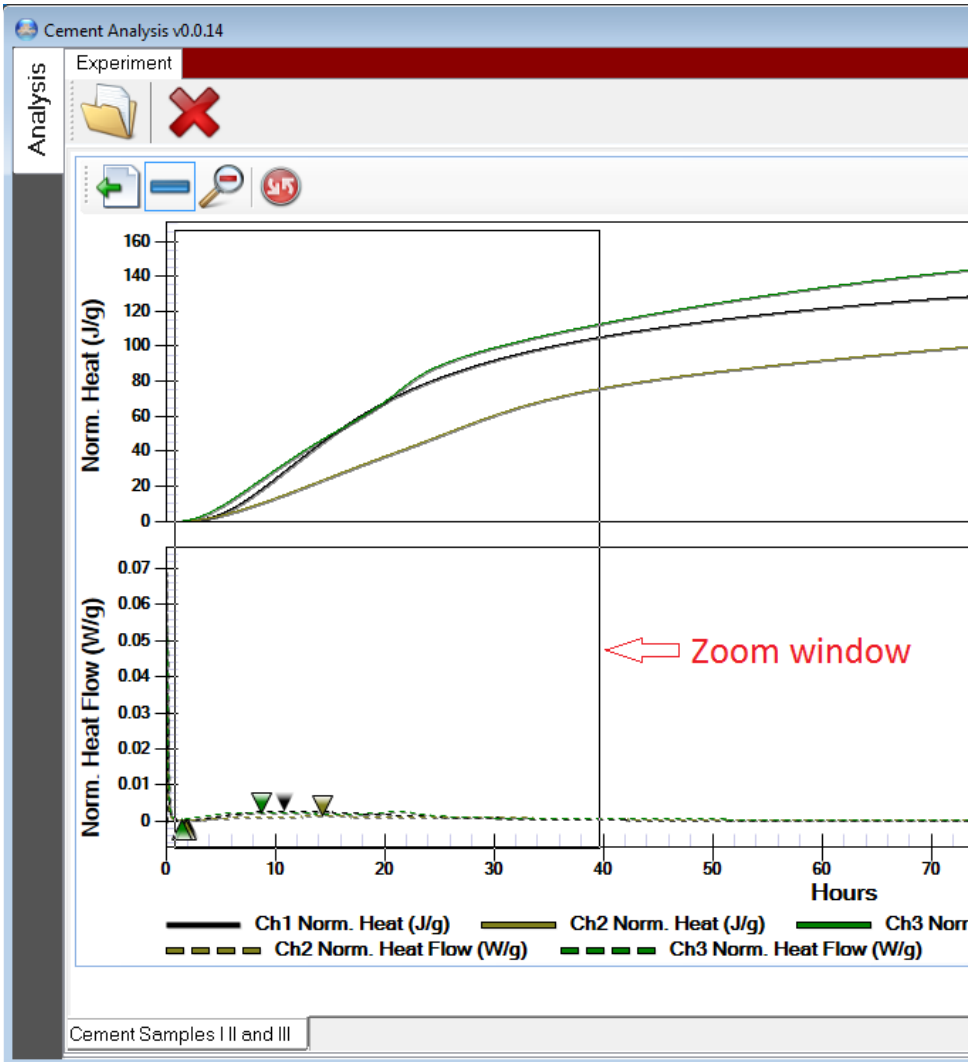
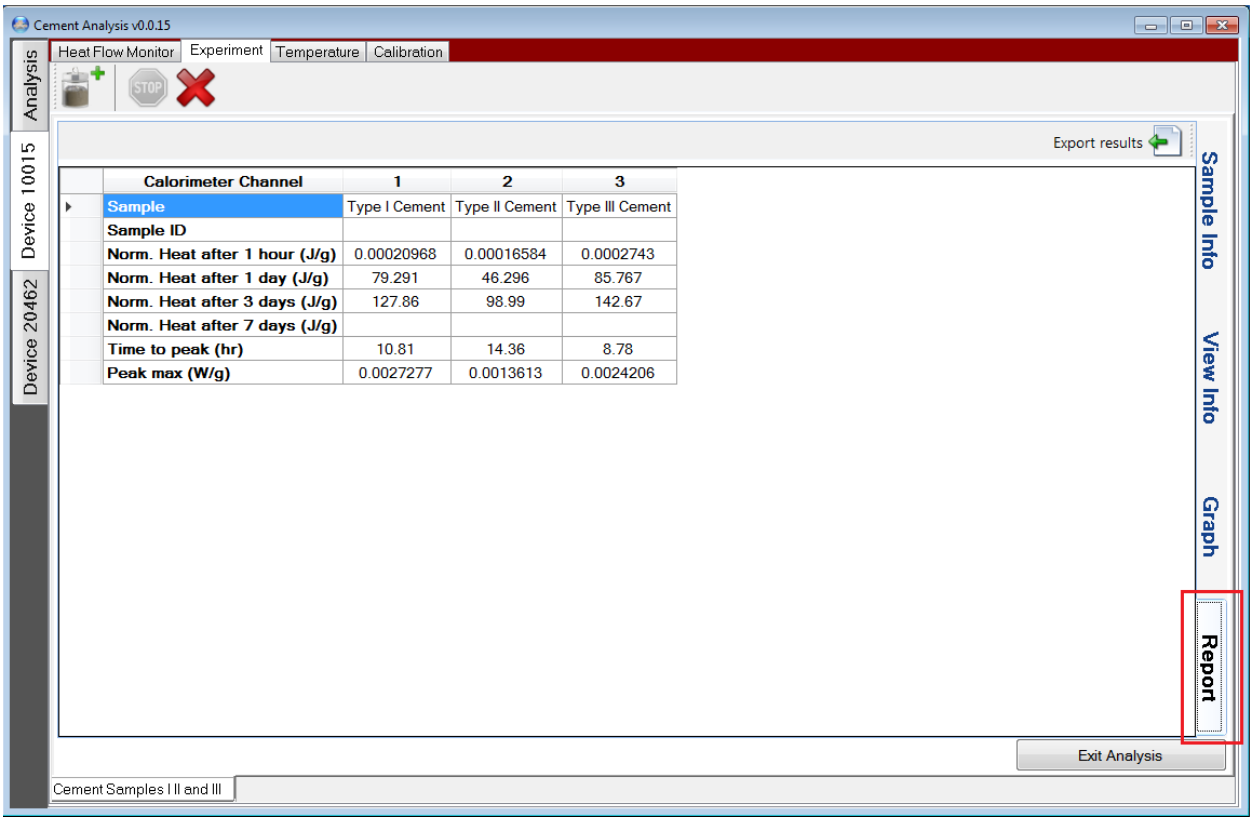


Figure 30 Dual window zoom.

Report

The Report section contains a table of calculated results:



Calorimeter Channel	1	2	3
Sample	Type I Cement	Type II Cement	Type III Cement
Sample ID			
Norm. Heat after 1 hour (J/g)	0.00020968	0.00016584	0.0002743
Norm. Heat after 1 day (J/g)	79.291	46.296	85.767
Norm. Heat after 3 days (J/g)	127.86	98.99	142.67
Norm. Heat after 7 days (J/g)			
Time to peak (hr)	10.81	14.36	8.78
Peak max (W/g)	0.0027277	0.0013613	0.0024206

Figure 31 Results data table.

17 Note in the report example above, there is no data presented in the field for the normalized heat after 7 days. This experiment was not run for that length of time, therefore there is nothing to present. The report table may be edited to remove this superfluous field by going back to the View Info tab and unchecking the data field that is not required:

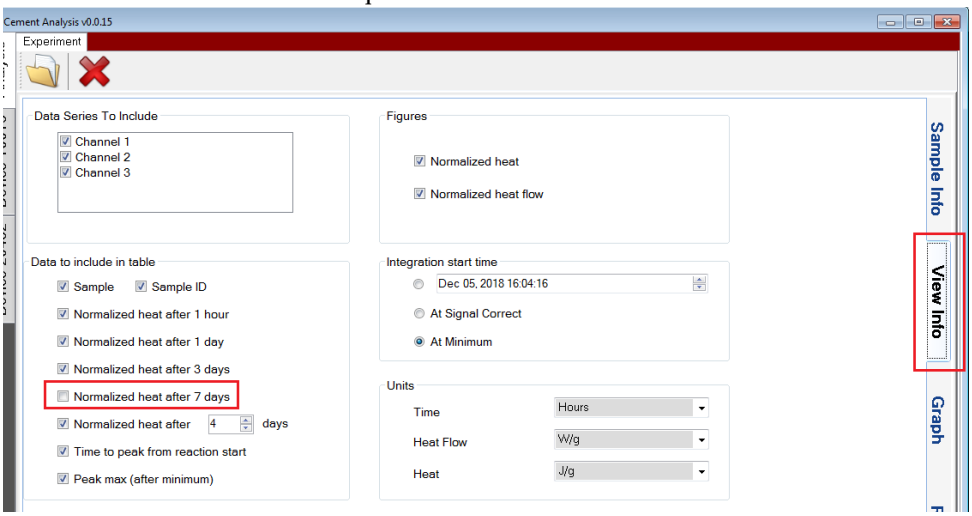
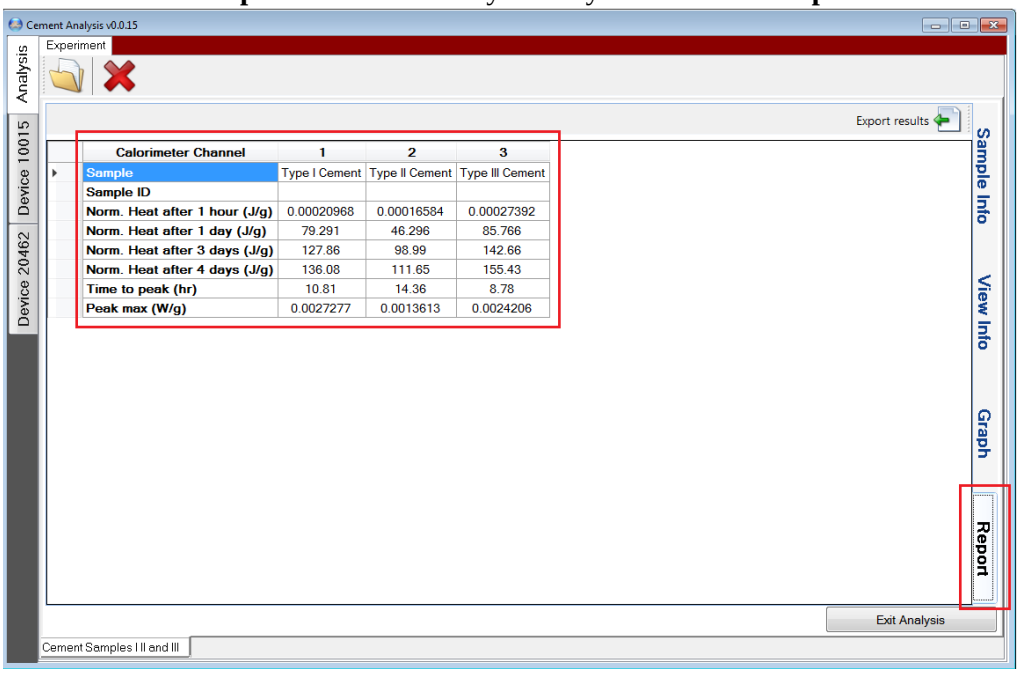


Figure 32 Edit data fields for report.

18 Click on the **Graph** tab to automatically re-analyze the data. The **Report** tab shows the updated data table:



Calorimeter Channel	1	2	3
Sample	Type I Cement	Type II Cement	Type III Cement
Sample ID			
Norm. Heat after 1 hour (J/g)	0.00020968	0.00016584	0.00027392
Norm. Heat after 1 day (J/g)	79.291	46.296	85.766
Norm. Heat after 3 days (J/g)	127.86	98.99	142.66
Norm. Heat after 4 days (J/g)	136.08	111.65	155.43
Time to peak (hr)	10.81	14.36	8.78
Peak max (W/g)	0.0027277	0.0013613	0.0024206

Figure 33 Updated data table with superfluous data fields removed.

Export

A .pdf-format file record of the test results is available from the Export buttons on the Sample Info tab. **Export** produces a file from the selected channel only; **Export All** combines all channels into one report.

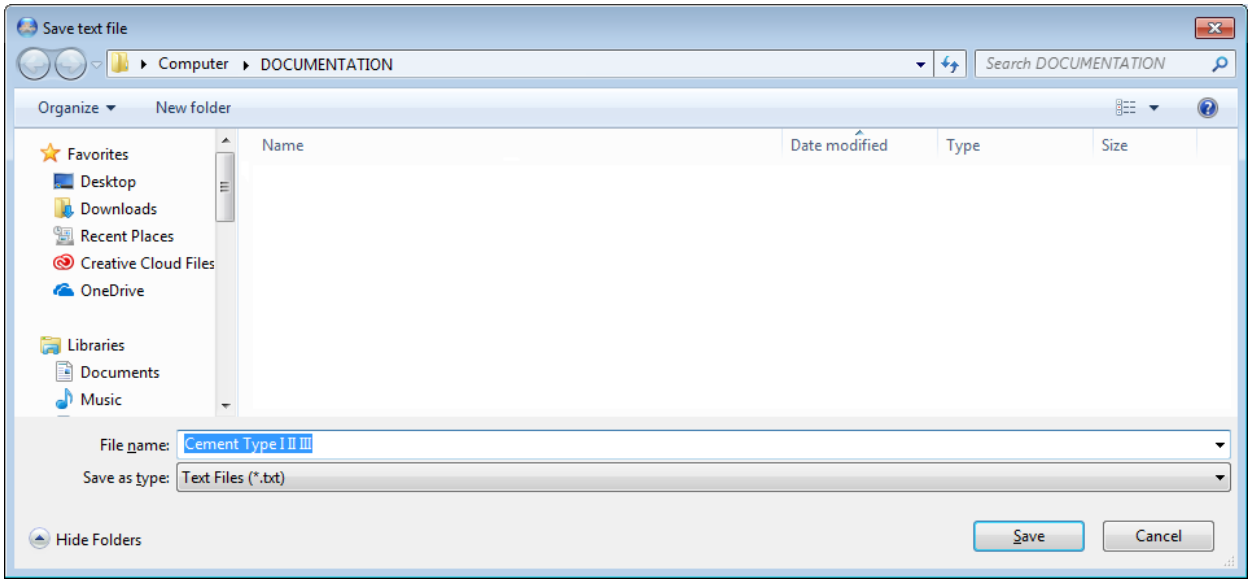
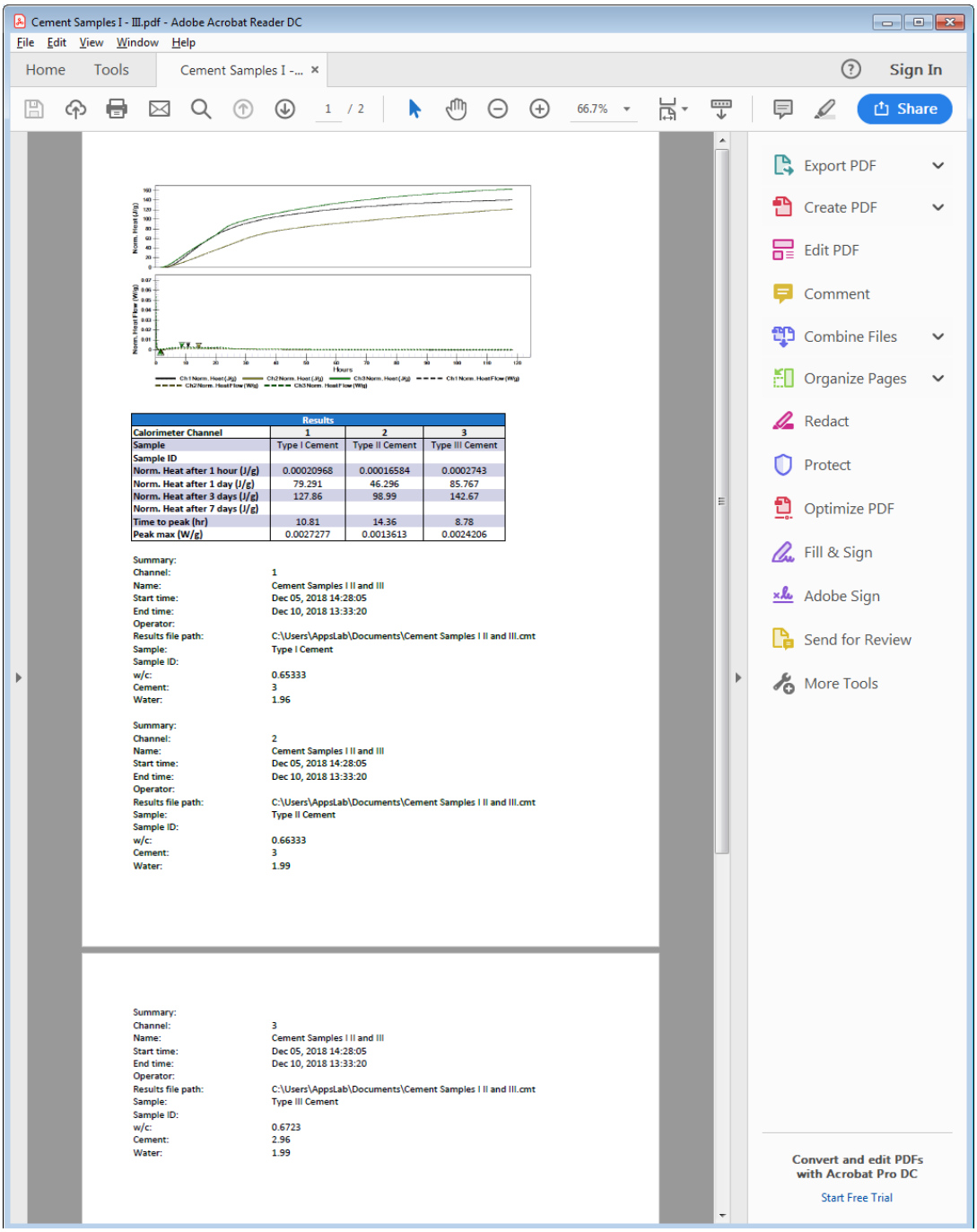


Figure 34 Export file, name selection.



Results			
Calorimeter Channel	1	2	3
Sample	Type I Cement	Type II Cement	Type III Cement
Sample ID			
Norm. Heat after 1 hour (J/g)	0.00020968	0.00016584	0.0002743
Norm. Heat after 1 day (J/g)	79.291	46.296	85.767
Norm. Heat after 3 days (J/g)	127.86	98.99	142.67
Norm. Heat after 7 days (J/g)			
Time to peak (hr)	10.81	14.36	8.78
Peak max (W/g)	0.0027277	0.0013613	0.0024206

Summary:
Channel: 1
Name: Cement Samples I II and III
Start time: Dec 05, 2018 14:28:05
End time: Dec 10, 2018 13:33:20
Operator:
Results file path: C:\Users\AppsLab\Documents\Cement Samples I II and III.cmt
Sample: Type I Cement
Sample ID:
w/c: 0.65333
Cement: 3
Water: 1.96

Summary:
Channel: 2
Name: Cement Samples I II and III
Start time: Dec 05, 2018 14:28:05
End time: Dec 10, 2018 13:33:20
Operator:
Results file path: C:\Users\AppsLab\Documents\Cement Samples I II and III.cmt
Sample: Type II Cement
Sample ID:
w/c: 0.66333
Cement: 3
Water: 1.99

Summary:
Channel: 3
Name: Cement Samples I II and III
Start time: Dec 05, 2018 14:28:05
End time: Dec 10, 2018 13:33:20
Operator:
Results file path: C:\Users\AppsLab\Documents\Cement Samples I II and III.cmt
Sample: Type III Cement
Sample ID:
w/c: 0.6723
Cement: 2.96
Water: 1.99

Figure 35 Exported content.