

# Ice Cone Freezing Experiment

July/August 2017

George Hackleman

OilExTech LLC

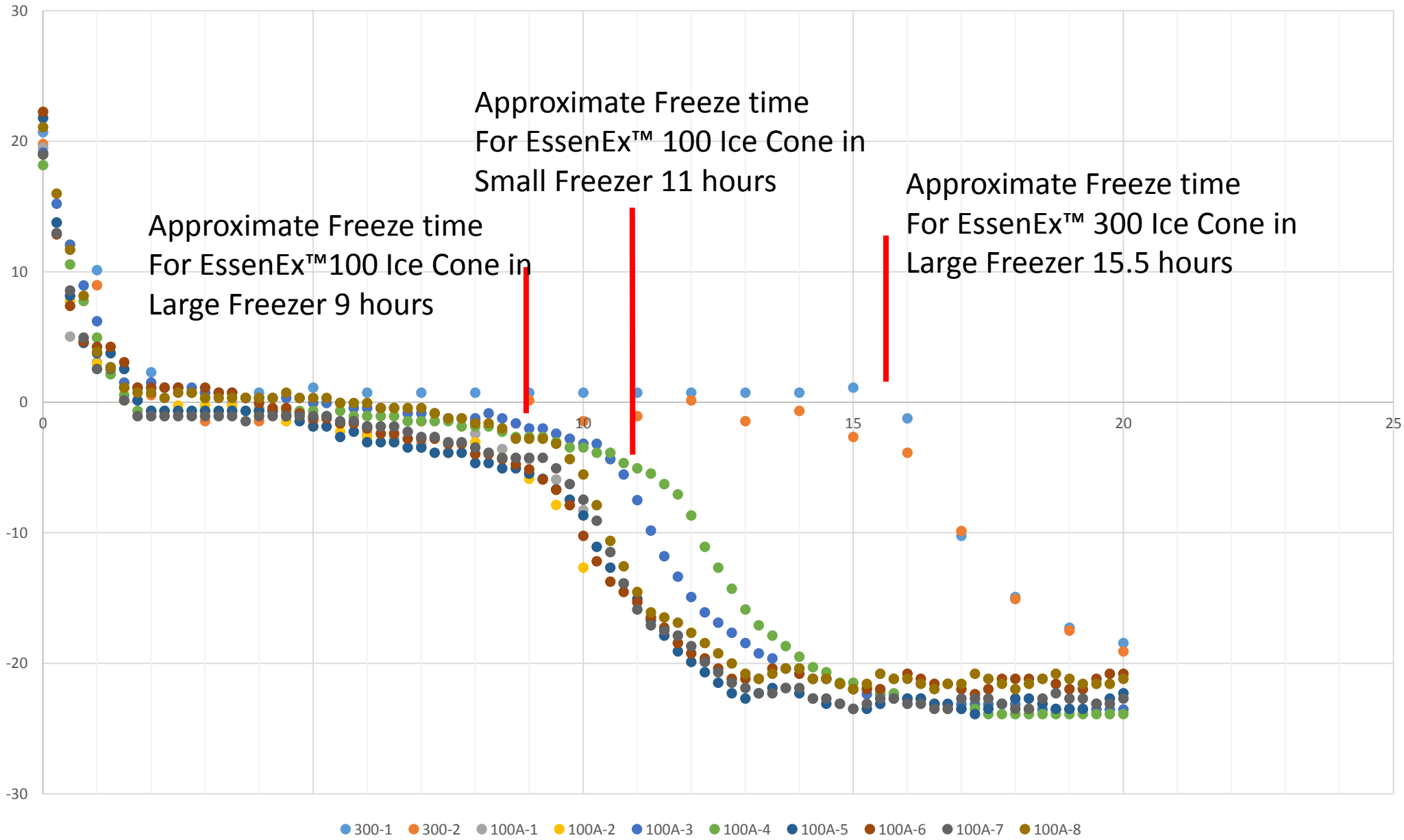
Freezing of water ice in the EssenEx Ice Cone forms.

Some customers are interested in knowing more detail around how to freeze the ice cone for the OilExTech's EssenEx family of Distillation kits.

The EssenEx 100A and EssenEx 300 use a thermoformed cone, called the Ice Mold, to produce a measured shape and size of ice block. A foam insulator on top of this block encourages the ice to form from the tip of the cone in a way that produces a structurally sound and optically clearer ice mass. Questions have come up regarding the length of time to freeze the ice, and also around the choice of water or conditions.

I performed several experiments, freezing water in different freezers and for both the EssenEx 100A and 300. I did informal experiments on hot and cold water, as well as more formal experiments for timed freezing using thermocouples to measure temperature with a data-logger to track time. By projecting the point where the temperature of the water/ice in the cone drops to below freezing, I was able to determine the freezing time for both cones. See chart for detail.

Ice Core Temperature in degrees Celsius vs Time in Hours



## Data Description for Ice Core Samples

Sample Title	Description
300-1 and 300-2	EssenEx300 Ice Cone forms with filtered water, in large freezer
100-1 and 100-2	EssenEx100 Ice Cone forms with filtered water in large freezer
100-3 and 100-4	EssenEx100 Ice Cone forms with filtered water in small freezer
100-5 and 100-6	EssenEx100 Ice Cone forms with distilled water in large freezer
100-7 and 100-8	EssenEx100 Ice Cone forms with orange hydrosol instead of water

### Conclusions:

#### General

- The freezer makes more difference than the water used for the ice.
- Although there is a slightly longer time to freeze hydrosol, it is not significant compared to freezer selection.
- Freezer size and cooling capacity will affect cooling time.
- The door or lid seal on the freezer can affect time to freeze.

#### Test limitations:

- Variations in absolute temperature may be due to the sensors (thermocouples) having not been calibrated.
- Slight differences in the slope of the line and absolute differences can be due to the position of the thermocouple in the ice block, which was not well controlled.

# Frequently Asked questions

- How long does it take to freeze the ice in the ice mold cones?
  - Water in the EssenEx 100A ice mold cone will take about 9 hours to freeze, depending on the freezer. This is for a chest freezer set to 0 degrees Fahrenheit (-17.8 Celsius), a typical setting for a chest freezer. A freezer in a consumer refrigerator/freezer should be set to a similar temperature, but may take more time depending on settings and the size of the unit. It can take as much as 10 to 12 hours, even assuming the same temperature setting. The EssenEx 300 ice molds can take 16 hours in a freezer where an EssenEx 100A ice mold takes around 9 hours.
- Does the type of water matter for freezing time?
  - Not much. You may for your particular needs, desire to use tap, filtered, distilled, purified, or a mineral water. We encourage you to experiment and use your own judgement. The freezing time will not change much by the type of water, unless you use a water with so much salt or other dissolved materials that the freezing temperature is affected. We do not recommend this, as it could of course affect the quality of the extracted oils.
- Does hot water freeze faster than cold water?
  - It is possible for this to happen, but it does not change the freezing time significantly. There is interesting information on the web regarding this, what is known as the Mpemba effect, but cold or tepid water is quite acceptable and easier to handle in the ice cone molds. Water over 180 degrees Fahrenheit can damage your ice cones. Again, the time to freeze is not affected much if at all. Other factors such as how much else is in the freezer, its condition or the door seal will affect the time much more.

# Additional Frequently Asked Questions

- Can I use distilled water?
  - Yes. Distilled water has almost no contaminants or minerals, but freezes similar to filtered water as to time and clarity.
- Why is the foam disc used (new with improved EssenEx100A)?
  - The foam disc encourages the ice to form from the tip of the cone first. As dissolved air tends to stay in the liquid water, it will migrate up as the ice freezes, usually making the ice block clearer and more uniform.
- My ice looks foggy! What did I do?
  - This is almost always just due to dissolved air in the water, and has no negative effect on the quality of the oil.

- Can I use Hydrosol to make the ice core?
  - The Hydrosol is a mixture of the botanical oil in water. It can be used for the ice core, but is not a requirement.
- My core won't freeze all the way, what do I do?
  - Check your freezer temperature, it may be too warm. You can place an inexpensive thermometer inside. It should run around 0 degrees Fahrenheit. Also check to make sure the freezer door is sealing well when it closes.
- My ice cracks off and falls into the hydrosol. What now?
  - Ice can crack before you place it in the microwave, either in the freezer or if you warm it too fast after the freezer. Try taking the ice cone out and sitting it on your counter for a half hour before removing it from the form. If your ice core is cracked before use, sometimes you can leave it out to melt partly in the cone, then place it back in the freezer to re-freeze in just a couple of hours.

## General Conclusion

Freezing Ice in the EssenEx Ice Molds is easily done overnight, and takes around 9 hours (EssenEx100A) if your freezer is set to the proper temperature and in good condition as to operation and the door seal. The type of water doesn't affect the freezing time as much as freezer type or condition. Fractures in the ice are more due to too fast exposure to heat after removal from the freezer than anything else. The EssenEx300 Ice mold behaves similar, but takes longer of course due to the larger mass of ice.



# References

- [http://math.ucr.edu/home/baez/physics/General/hot\\_water.html](http://math.ucr.edu/home/baez/physics/General/hot_water.html). This is a general paper talking about the Mpemba effect; hot water freezing faster than cold water.
- <https://arxiv.org/vc/arxiv/papers/1310/1310.6514v1.pdf>; A paper exploring the effect of temperature on hydrogen bonds in liquid water, and how that may affect freezing.