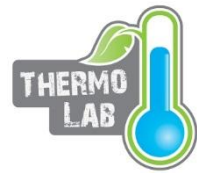


Effect of evaporation inhibitors in the Groasis Waterboxx

De Groene Campus, vocational in cooperation with
Thermolab Investigation laboratory

Test location: Greenhouse on the roof of de Groene Campus in Helmond – The Netherlands

Period: August / September 2013



De Groene Campus represents green innovation, developing, grow and care. Students and businesspeople working together on sustainable products and services in the area of nutrition, health and nature.



In the summer of 2013, Thermolab executed tests and researched the effects of evaporation inhibitors in the Groasis Waterboxx.

Evaporation inhibitors

Evaporation takes energy and heat. Evaporation inhibitors have an influence on the evaporation capacity of water by forming a molecular layer on the surface of the water. There are several compounds with this property. Particularly, people use evaporation inhibitors in the swimming pool industry and in large basins in warm areas.

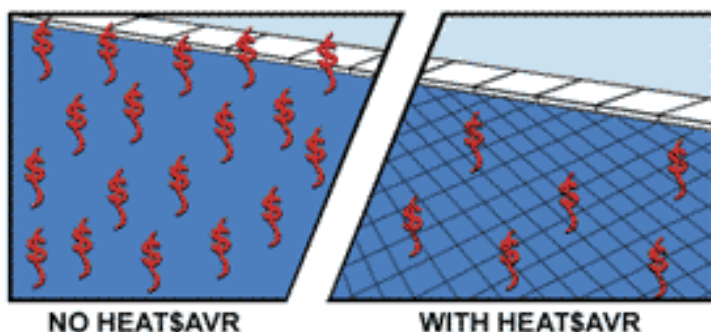
The purpose of evaporation inhibitors is to save money by reducing evaporation. Evaporation inhibitors are used to prevent general evaporation and to reduce the energy consumption in warm water. There are four tests setups created for the test, one untreated series and three series with evaporation inhibitors:

- Heatsavr
- Watersavr
- Olive oil

The research question is whether the use of evaporation inhibitors can reduce the potential evaporation of the water out of the Groasis Waterboxx.

1. Heatsavr

For the application in swimming pools, Heatsavr is developed. It is a concentrated liquid that you add to the water in minimal amounts. It forms a molecular layer on the water surface.

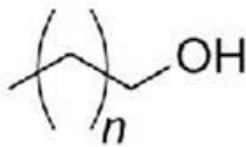


2. Watersavr

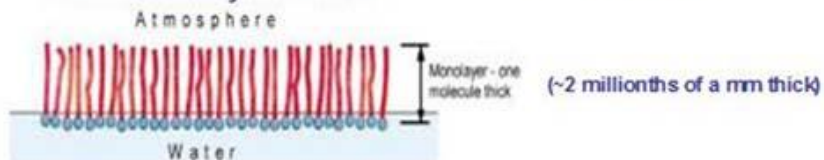
Watersavr is a white powder that you add in water basins. It has a similar effect. With Watersavr, it is not about the reduction of the energy consumption, since the water will not be heated. It is more about the reduction of the evaporation itself.



What is an Evaporation Prevention Monolayer ?



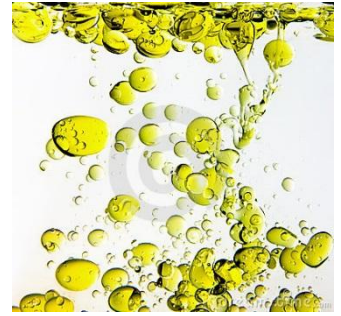
Hexadecanol and Octadecanol $-\text{CH}_3(\text{CH}_2)_{15(17)}\text{OH}$
Insoluble Fatty Alcohols



- ✓Hexadecanol and Octadecanol alkanes are non-toxic, natural components derived from coconut and palm processing.
- ✓Used in consumer products as emollients, emulsifiers and moisturizers in shampoos, cosmetics, antibiotic creams and even foodstuff.
- ✓Biodegraded naturally into H₂O and CO₂ (extremely low concentrations) within 48-72 hours by photo-degradation and chemical and microbial oxidation.

3. Olive oil

Oil has the ability to float on water and to form a layer to reduce the evaporation as well. In addition to the Watersavr and Heatsavr, there are also Groasis Waterboxxes used where oil is added to the water.



Groasis Waterboxx

There is always between 1 and 15 liters of water in the Groasis Waterboxx. In principle, the box is closed with a water lock. Rainwater and condensation water can go in, but can only go out via the wicks at the bottom of the box (water sink). From the biomimicry view, the same principle as a crocodile is used, but with heat (heat sink). The upper water will heat up quickly in the sun, but under the surface, the heat will be limited. The water that evaporates in the Waterboxx, which can be quite warm, condenses on a black plate and returns in the stock. The plate is blackened to avoid the light to come in. In this way, algae cannot grow in the water and it will stay clean. As a result of a lid or cap that does not close properly, incorrect installation, forgetting the condensation plate, or a low water level below the tubes, water evaporation could escape.



During the tests with the evaporation inhibitors, we investigated whether, and if so, how much water from the tank disappears through evaporation. And of course whether there are differences between the different treatments. The hole at the bottom of the box is therefore completely cemented so that no water could escape through there.

Test setup:

Yellow: boxes filled to 2500 gr.

Blue: boxes filled to 6500 gr.

OO	HS	B	OO
2515	2505	6500	6520
WS	B	WS	HS
2485	2505	6500	6510
HS	OO	OO	B
2485	2500	6510	6500
OO	WS	HS	HS
2525	2475	6500	6510
B	B	B	WS
2530	2490	6500	6510
HS	OO	WS	OO
6510	6500	2475	2505
B	WS	HS	HS
6500	6500	2480	2460
OO	WS	B	OO
6500	6500	2525	2520
WS	HS	HS	WS
6500	6500	2510	2485
OO	B	WS	B
6510	6500	2500	2490

- HS = HeatSavr
- WS = WaterSavr
- OO = Olive Oil
- B = no addition

The Waterboxxes are filled to a total weight of 2500 grams and 6500 grams.

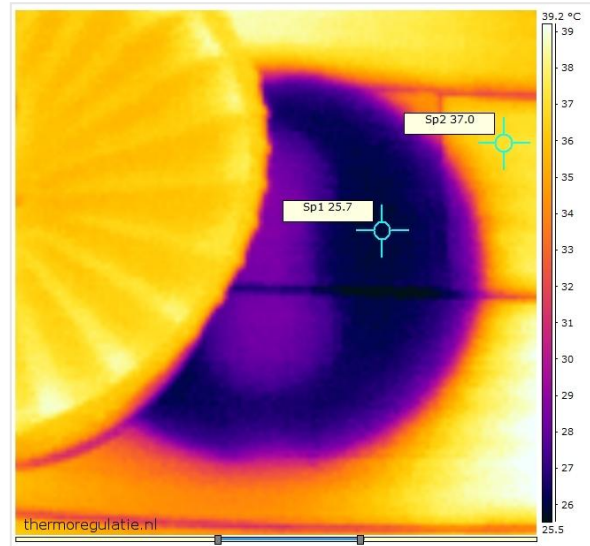
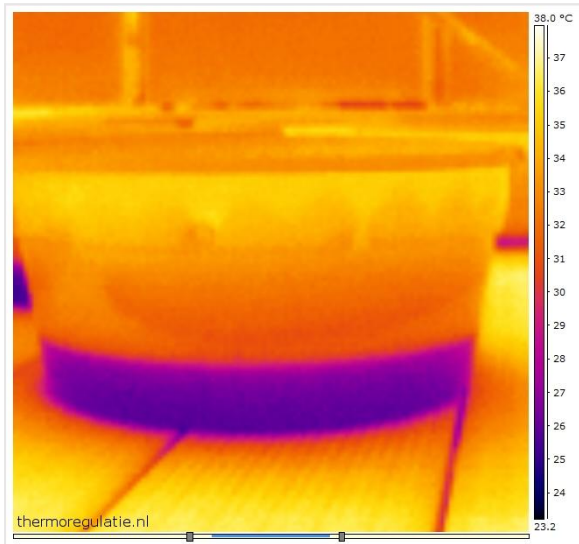
The trial started on August 18 and ended on September 22, 2013. There were quite some hot days in this period. In the greenhouse, with a dark composite floor that was not full of plants, it was pretty hot. Perfect conditions for the trial.

Infrared

With the help of an infrared camera, lots of pictures are made of the test

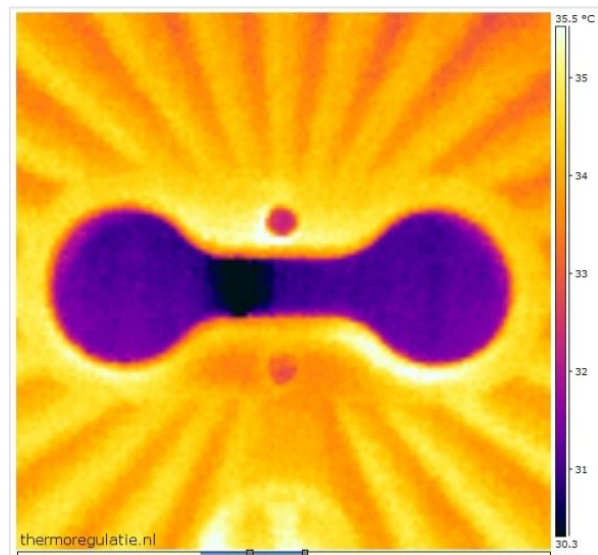
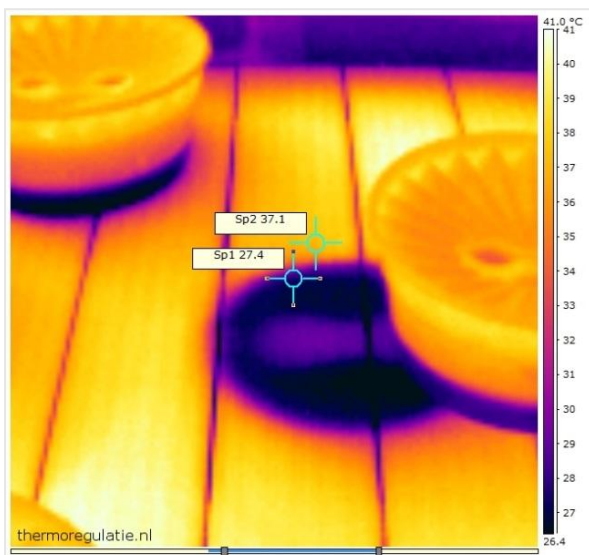
With infra red photos blue means a cooler temperature. The cover of the Waterboxx is white and reflects a big part of the heat. Therefore the water in the Waterboxx is cool.

When you place the Waterboxx aside, you see the impressive cooling effect on the soil below. That is why the roots of the plant do not suffer from the heat of the sun in the desert when you use the Groasis Waterboxx.

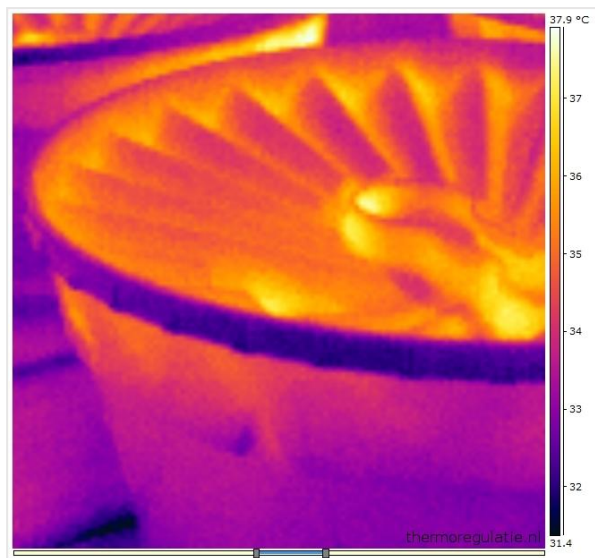


Not only the water and the soil below the Waterboxx are cooled down. Also the middle opening, where you plant the trees, is a lot cooler.

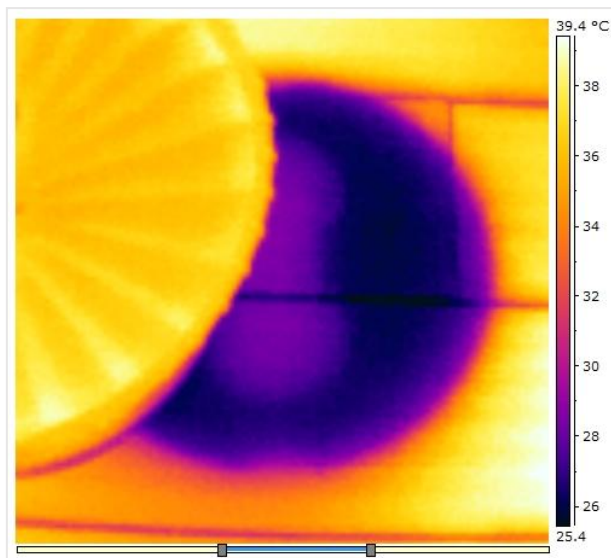
Detail of cool middle opening of the Groasis Waterboxx. Look at the thermometer aside of the photo to check the temperatures.



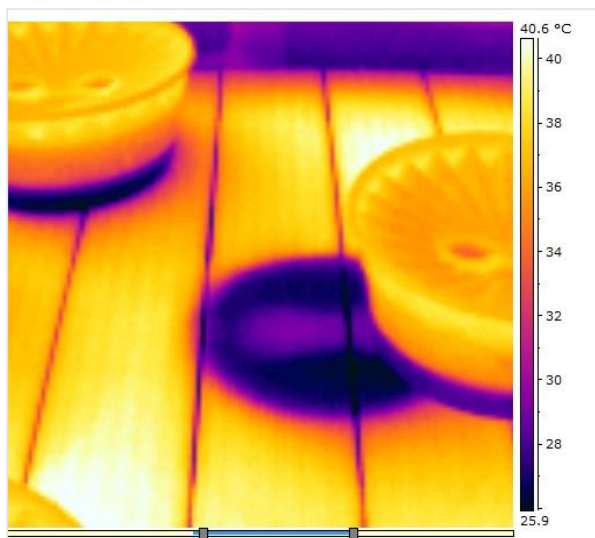
The whole Groasis Waterboxx is cooler than its surroundings



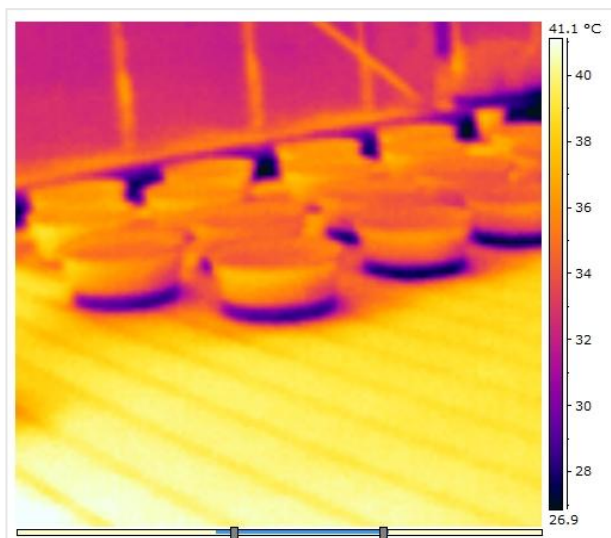
Detail of Groasis Waterboxx cooling effect on the soil temperature



Groasis Waterboxx cooling effect on the soil temperature



Overview of Groasis Waterboxx experiments at Thermolab – Helmond – Holland in cooperation with De Groene Campus School – Helmond - Holland

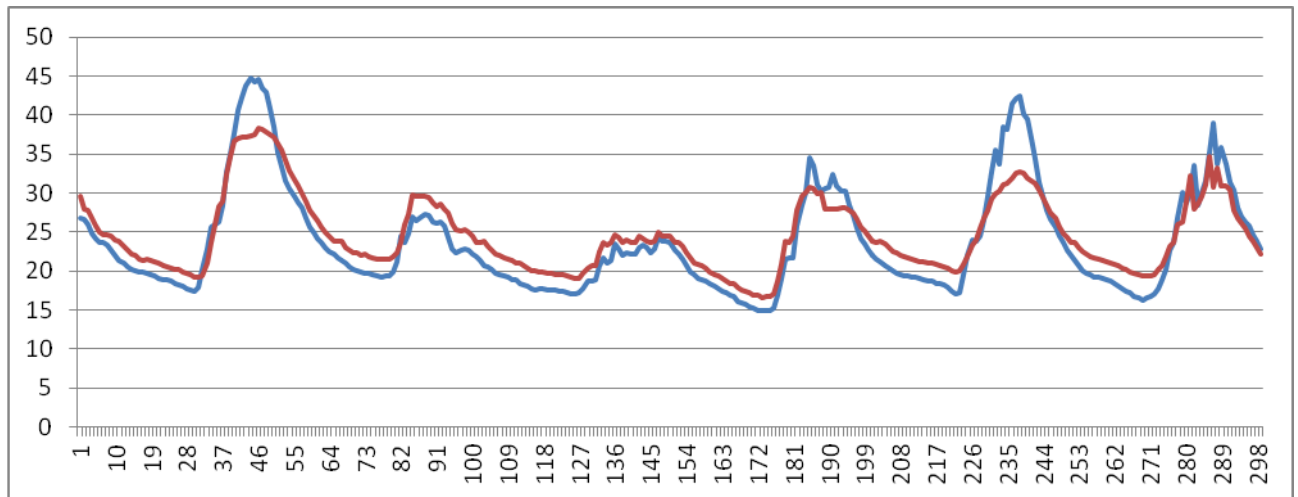


The images provide us with information about the surface temperatures in both the sun and shade. You can, for example, see the water level in the Groasis Waterboxx from the outside (you look so to speak through the Waterboxx). When you shift the box a bit on a hot day, you see the big influence that the filled Groasis Waterboxx has on the soil temperature under the box. Due to its water stock, the Groasis Waterboxx has a huge leveling level on the microclimate under the box. Both a heating effect in cold conditions as a cooling effect in hot conditions.

Turbotag Dataloggers



In addition to infrared images, there are also 20 data loggers placed in and around the boxes. One data logger is able to record 700 measurements, so depending on the selected time interval, you can measure the temperatures for hours and even days. The loggers were set to 30 minutes. It provides the following charts on which you can compare the highest and lowest temperatures in the box. In these 300 hours, the temperature in the box fluctuated between 15 and 45 degrees Celsius.



In the graph above, the blue line is the air temperature outside the Waterboxx and the red line is the air temperature in the Waterboxx, under the black cover. You can see that a Groasis Waterboxx has a leveling effect on the microclimate around the plant.

Weighing results

The figure below shows the loss of weight per box. The highest and lowest values are not included in the average. The differences lie between 0,2 and 1% weight loss. If you look at the average per treatment, you see that there is almost no difference between the four variants. The average weight loss in the boxes of 2500 grams and 6500 grams was similar in percentages.

HS	OO	WS	W
-0,6%	-0,4%	-0,6%	-1,0%
-0,6%	-0,3%	-0,6%	-1,0%
-0,5%	-0,6%	-0,6%	-0,3%
-0,5%	-0,8%	-0,5%	-0,6%
-0,9%	-0,5%	-0,6%	-0,6%
-0,5%	-0,3%	-0,8%	-0,8%
-0,8%	-0,6%	-0,8%	-0,8%
-0,6%	-0,2%	-0,8%	-0,6%
-0,6%	-0,5%	-0,5%	-0,8%
-0,6%	-0,5%	-0,6%	-0,7%

*The highest and lowest values are not included in the average.

HS = HeatSavr,

OO = Olive Oil

WS = WaterSavr

W= no addition

Conclusions

Practically, olive oil in particular polluted the Waterboxx. It is an organic oily substance which sticks to the edges of the box, causes mold and possibly has a negative influence on the permeable ability of the wicks.

The pollution appears to be less at the Watersavr and Heatsavr. It occurs in minimal amounts and we just have to search for the optimal dosage. The dosage was probably too high instead of too low, since the test took place on such a small surface. The supplier could not give us a proper answer to that question, as the method of administration and the dosage in the average swimming pool deviates a lot from this closed trial. In the swimming pools, we have to take a continuous dosage and degradation due to waves and sunlight into account.

It has been an interesting and exploratory trial. We had two weighting times, during one month.

The differences between the treatments are naught and do not seem significant. Special to the Waterboxx is that in practice, rain and condensation water is coming in and due to evaporation, water is extracted from the plant. The amount of water in the Waterboxx is therefore highly dynamic and differs from time to time.

These factors are eliminated by doing the trial in a closed greenhouse, without trees on a hard plastic floor and closed kitted holes. In this way, water could only get there by condensation on the cover or by a leak or something. If there was water inlet by condensation on the cover, that would have been visible by moisture around the tube openings. During the test, there have been no moist lids.

Consequently, one can assume that water did not come in the box due to the condensation on the cover.



The conclusion is that the Groasis Waterboxxes, if properly sealed, are completely locked. Almost no water loss occurred during this period due evaporation.

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