

How the VitaOloïd and VitaFloat work in water storage basins.

Introduction

In this document the functioning of the VitaOloïd and VitaFloat is described in detail. The objective is give sales advisors, dealers and interested customers more insight in the effects of the placement of this equipment in (outside) water storage basins and silos.

This document consists of a couple of topics:

- the functioning of the VitaOloïd;
- comparison of the VitaOloïd with other systems
- the functioning of the VitaFloat;
- comparison of the VitaFloat with other systems
- combination of VitaOloïd and VitaFloat.

Functioning of the VitaOloïd

Once installed in the basin and running, the VitaOloïd causes a couple of effects:

- a flow is created in the water;
- the water is homogenized;
- oxygen is dissolved in the water;
- sediments on the bottom of the basin are turned up and (biologically) broken down;
- the growth of algae is drastically limited.

Each of the effects is explained below.

The creation of flow in the water.

The shape of the paddle of the VitaOloïd has been designed in such a way that, when turning, a flow is created in the water. This was the main design objective of the VitaOloïd. The form of this paddle was originally designed at the end of last century for propelling ships. This design however was never accepted in that industry simply because it turned out to be less efficient than conventional propellers.

The VitaOloïd however turned out to be very suitable for mixing large amounts of water. In order to understand why the VitaOloïd is not suitable as a propulsion system but works well to mix water, one has to investigate and compare the flow created by the VitaOloïd with the ones created by a motor or pump.

In Fig.1 one can see the flow pattern created by a pump or propeller. It is noticeable that the water flow goes into one direction. Also a back-flow is created. Between these two flows is an area where the water hardly moves at all and therefore hardly mixes with the rest water at all. This type of flow is ideal for moving for example a boat because the water immediately behind the boat is propelled very quickly. This flow however is not ideal for mixing purposes.

When we look at the flow pattern of a VitaOloïd then we immediately see that the VitaOloïd has two “paddle strokes” and that there is therefore not one flow. At each paddle stroke the flow profile changes. In addition the water is not propelled into one direction but into several different ones. These types of flows are ideal for mixing liquids but not for propelling boats.

The first series of pictures show a top view of a basin. The second show a cross section of a basin.

Fig. 1: flow hv numn

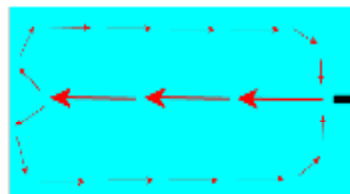


Fig. 2: flow hv stroke 1

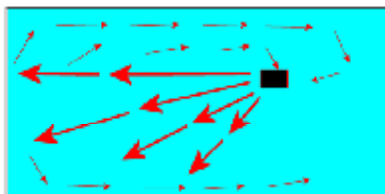
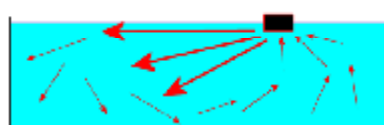
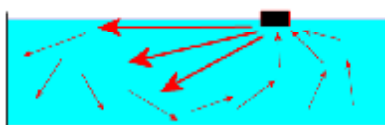
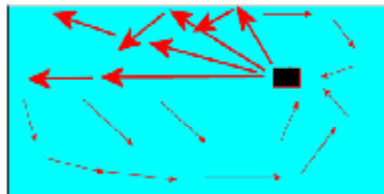


Fig. 3: flow hv stroke 2



Because of the fact that the flow at each stroke of the paddle is different there is no stable flow pattern as with a pump or a motor. We can also observe this at the surface because one can see waves. These only occur with varying flow directions. Think for example of a fast flowing river without obstacles: no waves are present, only fast moving water. If the water passes through a waterfall or rocks (obstacles), the flow direction is changed and waves occur. Everybody familiar with canoeing knows from experience where in this river the most active mixing takes place. Practice confirms these observations: research has proven that conventional pumps or motors need 80 – 100 times more energy than a VitaOloïd to mix the same mixing effect. When applied in an outside water storage basin this would mean a pump with a capacity of 80-100 m³/hr to get the same mixing effect as with a VitaOloïd 400. The energy consumption of such a pump is around 8 kW compared with maximum 200 W of a VitaOloïd 400 !

Why is flow important?

The simple fact that water flows has a deterring effect on algae – these prefer stagnant water in which they can absorb sunlight undisturbed. In addition flow is indispensable for the effects described below.

Homogenization of water

The VitaOloïd is extraordinarily suitable for homogenization of the water. This is the result of course of the flow as described above. The main consequence of homogenizing the water is that the temperature and oxygen concentration becomes the same throughout the outside (rain) water basin. This also applies to the EC and pH of the water if we apply a VitaOloïd in a drain water basin. The occurrence of different water layers with each its own EC, pH, temperature and oxygen concentration is prevented.



Why is homogenized water important for the grower?

Homogenization of the water temperature is important especially in the summer because algae mainly grow in the warm water layer at the surface of the basin. Because the water temperature at the surface has been reduced drastically by the VitaOloïd algae growth is restrained.

Dissolving oxygen in the water

The VitaOloïd is capable to get the maximum possible amount of oxygen (100%) dissolved into the water in a basin in a short time period (with the VitaOloïd 400 and a basin with a maximum capacity of 15.000 m³ within a couple of weeks). The VitaOloïd 400 can for example introduce up to 250 gr. of oxygen per hour into the water. The VitaOloïd achieves this in two ways:

- The VitaOloïd lies on the surface of the water and beats with each paddle movement air (and therefore also oxygen) into the water. While the water flow spreads these small air bubbles throughout basin they dissolve slowly. Because not only the water at the surface is flowing but also the water deeper in the basin, the oxygen is introduced in the deeper parts of the basin as well.
- The amount of water that can be dissolved in the water depends on the temperature. Colder water can contain more oxygen than warmer water. However there is always a warmer layer of water at the surface of a stagnant basin (especially in summer time when the oxygen content of the water is already relatively low) which hampers the oxygen uptake in the (colder) water located deeper in the basin. This effect is cancelled out and the solubility of oxygen throughout the basin becomes the same because the VitaOloïd homogenizes the water temperature in the basin.
- The VitaOloïd creates waves on the surface, which tremendously increases the amount of oxygen that can be dissolved into the water. Research has shown that when applying a VitaOloïd the uptake of oxygen via the surface can be as high as 10-50 gram of oxygen per square meter per day. The means that in a basin with a surface area of 5000 m² about 50 - 60 gr. of oxygen per day can be taken up.

Why is oxygen important for the grower?

There are two reasons:

- Recent research has shown that especially in summer time with temperatures above 18° C there is always a lack of oxygen at the roots of the plants. Maximizing the oxygen content in the irrigation water helps to limit this oxygen deficiency at the roots. (A good management of the water content of the substrate slab is another measure that helps. This can be done by means of the Newton 100 substrate weighing system or a water content sensor of for example Grodan and to deliberately manage and control based on substrate water content).
- A high oxygen content helps prevent explosive growth of algae. This is explained later on.

Turning up and breaking down sedimentation

Sediment on the bottom of the basin is turned up because the VitaOloïd produces a strong mixing flow. The turbidity of the water will initially increase after installation of the VitaOloïd causing the (sand) filter having to be cleaned more often. At the same time a lot of oxygen is present in the water. Microorganisms will make use of these ideal circumstances to break down the rotting sediments lying on the bottom of the basin and convert it into carbon dioxide and water. They use the sediment as nutrients. The result is that the basin slowly becomes cleaner and in the end remains clean.



Why is a clean basin important for a grower?

- effective use of the whole capacity of the basin;
- no plugging of filters by sediment (after the basin has been cleaned up of course);
- no cleaning costs to remove the sedimentation.
- a thick layer of sedimentation can function as nutrient for algae present in the basin. Removing the sedimentation hampers algae growth.
- If sediments are present on the bottom of the basin and there is no oxygen in the water, a certain group of microorganisms can break down those sediments. The sediments are not converted into carbon dioxide and water but into potentially hazardous matter like hydrocarbons and for example nitrite or ammonia. At this moment there is little attention paid to the forming of nitrites in the horticultural industry, but just ask a keeper of coy-carps how bad nitrite is for his fish!

Limiting algae growth.

What do algae need to grow?

- Sunlight; algae are small plants and like plants they need plenty sunlight to grow.
- Carbon dioxide; like plants algae need this gas to grow. In oxygen rich basins this gas is present especially at the surface – and throughout the whole basin when the oxygen content of the water is very low.
- A high temperature; the higher the temperature the faster algae grow.
- Oxygen; algae consume oxygen, especially during the night time. If there is not enough oxygen present in the water the algae will “out of desperation” multiply very quickly, resulting in an explosive algae growth (you also can observe this effect with other plants; oak trees for example will produce an enormous amount of acorns when the tree is in the process of dying off due to acid rain).
- Nutrients, specially nitrate and phosphate. The higher the concentration of nutrients the quicker algae will grow. Algae however can also grow quite well at very low levels of nutrients (for example the little escapes out of a layer of sediments).

How does the VitaOloïd combat algae growth?

It is actually quite simple: by taking away the above-described conditions of growth:

- Sunlight.
The VitaOloïd does of course not make it become dark outside but because the water is very effectively mixed the algae are moved to the lower water layers in the basin where it is a lot darker. From literature it is known that the light intensity in distilled water at a depth of 40 cm is only 60 % of that at the surface. The amount of light at 40 cm depth, in a basin where one can still see up to a depth of 70 cm (which is considered as very good water !) is only 10 % of that at the surface. The VitaOloïd therefore assures that it gets quite dark for the algae.
- Carbon dioxide.
The VitaOloïd transports the algae from the surface (where they can take up carbon dioxide) to deeper water. By continuously bringing the water into contact with the surface air, carbon dioxide is transferred to the air.
- Temperature.
Because the water in the whole basin is homogenized by the VitaOloïd the water temperature at the surface (where algae prefer to be) will drastically decrease. It gets therefore much colder for the algae.
- Oxygen.
The VitaOloïd causes the water throughout the whole basin to have the same level of oxygen. The algae therefore will not get the urge to start to grow explosively.
- Nutrients.
Because the VitaOloïd sets to work on the layer of sediments on the bottom of the basin the nutrients will slowly disappear out of the basin. These sediments are actually slowly consumed by the microorganisms that feed on the sediments. The microorganisms float in the water and can be easily removed by a sand filter.

As you see the VitaOloïd causes the growth conditions of algae to deteriorate drastically deteriorate; reason for water basins with a VitaOloïd to gradually have less problems with algae. The VitaOloïd does not actively kill the algae; one should not expect that a bilious green basin is totally clean within a couple of weeks. One will however observe in most basins a considerable improvement taking place during a season. There is however one exception: see below.

When is the VitaOloïd not effective against algae?

In the long term the VitaOloïd will always limit the growth of algae. However, if there is a very thick layer of sediments at the bottom of the basin, application of a VitaOloïd can initially cause algae to grow even more. We have observed that last year in one natural pond.

Why does that happen?

The reason is that when the enormous amount of sediments are stirred up and a lot of oxygen is introduced in the water, suddenly a large amount of nutrients are becoming available which can be advantageous for the algae. This is a temporary effect because in the end all the sediment will be consumed by the microorganisms and be filtered out. In these kinds of circumstances it is recommended to apply the VitaFloat in combination with the VitaOloïd. Algae will die in a short time span because the VitaFloat actively kills algae; the VitaOloïd assures that algae will not return in the long run.

Comparison of the VitaOloïd with other systems

In the horticultural industry the following methods are used to (partly) achieve the same as with the VitaOloïd:

- Aeration with effervescent stone
- Pumps or outboard engines
- (floating) tarpaulin
- use of water plants (iris)

In the table below you can see what these systems can and cannot achieve and how they compare with the VitaOloïd.

Table 1: comparison between VitaOloïd and other methods

Method	Aeration with air stones	Pumping by pump or motor	Floating tarpaulin	Water plants
Flowing of water	Hardly any	Yes, in certain areas of the basin	None	None
Homogenization	No, because hardly any flow	Only with very large pumps	No	No
Dissolving oxygen	Not effective	Some, via the surface	No	No
Removal of sediment	No	Only with very large pumps	No	No
Combat algae growth	Can help at low algae presence, but a good functioning is not sure because not all algae growth conditions are dealt with	Can help at low algae presence, but a good functioning is not sure because not all algae growth conditions are dealt with	A floating tarpaulin deals with on important growth condition: it takes away the light. A floating tarpaulin however is never 100 % light tight and does nothing about the other algae growth conditions. It does work well however in many types of silos or basins.	Water plants can combat algae growth only if they are able to take up all the nutrients from the water (especially N and P) faster than the algae can. They can only perform well if they get enough oxygen at their roots. The VitaOloïd can make that happen.
Energy consumption	Low, but also low level of aeration	High, large pumps are required (7,5 kW)	None	None
Price comparison	Including good compressor: couple of thousand of Euro	A pump of 100 m ³ /hr costs Euro 3 to 4.000	A floating tarpaulin, when used in outside water storage basins, costs more than a VitaOloïd (approx. Euro 10.000)	Less than Euro 1.000 ?
Extent of suitability compared with the VitaOloïd	Air stones are especially suitable for oxygenation if the water is deeper than 5 mt. This is because the oxygenation takes place while the air bubble travels to the surface; the air bubbles therefore should not arrive at the surface too quickly. A good air stone supply oxygen to a surface of 20-50 m ² . The VitaOloïd is much better suited for outside basins because of the fact that it has many other effects in addition to those of air stones.	A pump can make the water move and therefore cause some oxygenation. As the flow does not occur throughout the whole basin there will always be sections where the effects of the pump are not felt. Also the pump does not deal with the sediment layer. Conclusion: the VitaOloïd is a better option when compared with a pump.	A floating tarpaulin can work well to combat algae. Many growers are quite content with them. Floating tarpaulins however do not oxygenate the water and do nothing against the sediment layer (dirt and sediments can come into basin along the side of the basin). A floating tarpaulin can also sink and get blown off the basin. A floating tarpaulin costs more than a VitaOloïd 400; therefore the VitaOloïd is a more interesting option.	Floating water plants can enhance the effectivity of the VitaOloïd by taking nutrients from the water (like the microorganisms that are present). Especially interesting with basins with ground water influences in which many nutrients can be present. Regular "harvesting" is quite important because only then all nutrients are removed from the water. If that is not done the floating plants will start to rot after a while, causing sediments to collect at the bottom of the basin. Without the VitaOloïd floating plants will soon start suffering from lack of oxygen at the roots, will then start dying and thereby causing sediments to form which in turn will again cause sediments to form and thereby more algae growth.

Functioning of the VitaFloat

The VitaFloat is especially effective in combating algae by means of ultrasound. Ultrasound is sound that cannot be heard by humans because the height of the tone is higher than a human can hear. Contrary to the VitaOloid the VitaFloat does not disturb the growth circumstances of algae in a basin but it actively kills them.

The mechanism with which ultrasound kills algae is not known in detail yet. It has been proven however that it has to do with the formation of unstable gas bubbles in the water caused by high-energy sound waves in the water.



The gas bubbles have a very short life span in the water and implode again after a few microseconds. This is accompanied with enormous forces in the water surrounding these bubbles. It is thought that the walls of the cells of the algae cannot withstand these forces and that the algae therefore get “ripped open”.

Intensive research has been carried out in recent years in the functioning of ultrasound against algae. A couple of important empirical observations have been made:

- The right frequency of ultrasound is very important. This frequency has to be between 20000 en 60.000 Herz;
- The sound intensity is also an important parameter. If the intensity of the sound is too low the algae can adapt by growing thicker walls and therefore the effect of ultrasound will after a while diminish. The selected sound intensity of the VitaFloat is such that the algae cannot adapt themselves.

The VitaFloat is available in two models:

- for basins till 6000 m³; electrical power 550 W;
- for basins till 15.000 m³; electrical power 1,1 kW

Comparison of the VitaFloat with other systems

In the field the VitaFloat is sometimes compared with the AquaSonic, sold by for example BE De Lier. Growers have varying experiences with this system: at some sites the algae disappear and never return, at other sites it had no effect at all. The result is that growers sometimes react skeptically to this technique for fighting algae. In our opinion this is not justified.

The most important difference between the VitaFloat and the AquaSonic is the generated sound intensity: The AquaSonic has a power of 100W while the VitaFloat (depending on the model) applies a power of between 550W and 1,1 kW. This prevents algae to become “immune” against the ultrasound, which does probably occur with the AquaSonic.

The VitaFloat has already a proven track record of more than 3 year.

Combination of VitaOloid and VitaFloat.

As indicated above it can happen that in basins with a very thick sediment layer the algae growth can initially increase because, due to stirring up the sediments, suddenly a lot of N and P is released into the water. In these case a combination of VitaOloid and VitaFloat is a good solution: an extra measure is introduced into the battle against the algae so that they do succumb.

Our sistercompany Beeckman in Belgium has tested this combination of systems at several sites with excellent results. The pictures shown below give an impression of the results at one of these sites.

The combination of the VitaOloid and VitaFloat can also be a good choice to keep water storage basins free of algae in case there are influences from ground water. This is not often the case in Holland but quite frequently in Belgium. Groundwater often has a higher nutrient content and also iron can present – these are substances that promote algae growth. With this type of water storage basins it is a safe option to apply the combination of the two

systems because successful killing and removal of algae is achieved in a period that is shorter than when only the VitaOloïd is applied.



Algae growth in basin with ground water influence
At the beginning only VitaOloïd is used (June 2003)



Situation in the basin after 2 weeks; to accelerate the killing of the algae a VitaFloat is added



This is the situation eight weeks after installing the VitaOloïd and six weeks after installing the VitaFloat: a water storage basin without algae, with an oxygen level of 100%. Temperature, EC and pH are also the same throughout the whole basin