Dymico keeps water both clean and living

EcoDeco's Dymico (Dynamic Mineral Control) technology is the only water purification system that keeps water both clean and living. It is a technology that makes it possible to cultivate vulnerable sea organisms that cannot be kept in traditional systems. Dymico guarantees perfect water quality with a minimum of maintenance and energy consumption. In this publication Dymico users relate their experiences.

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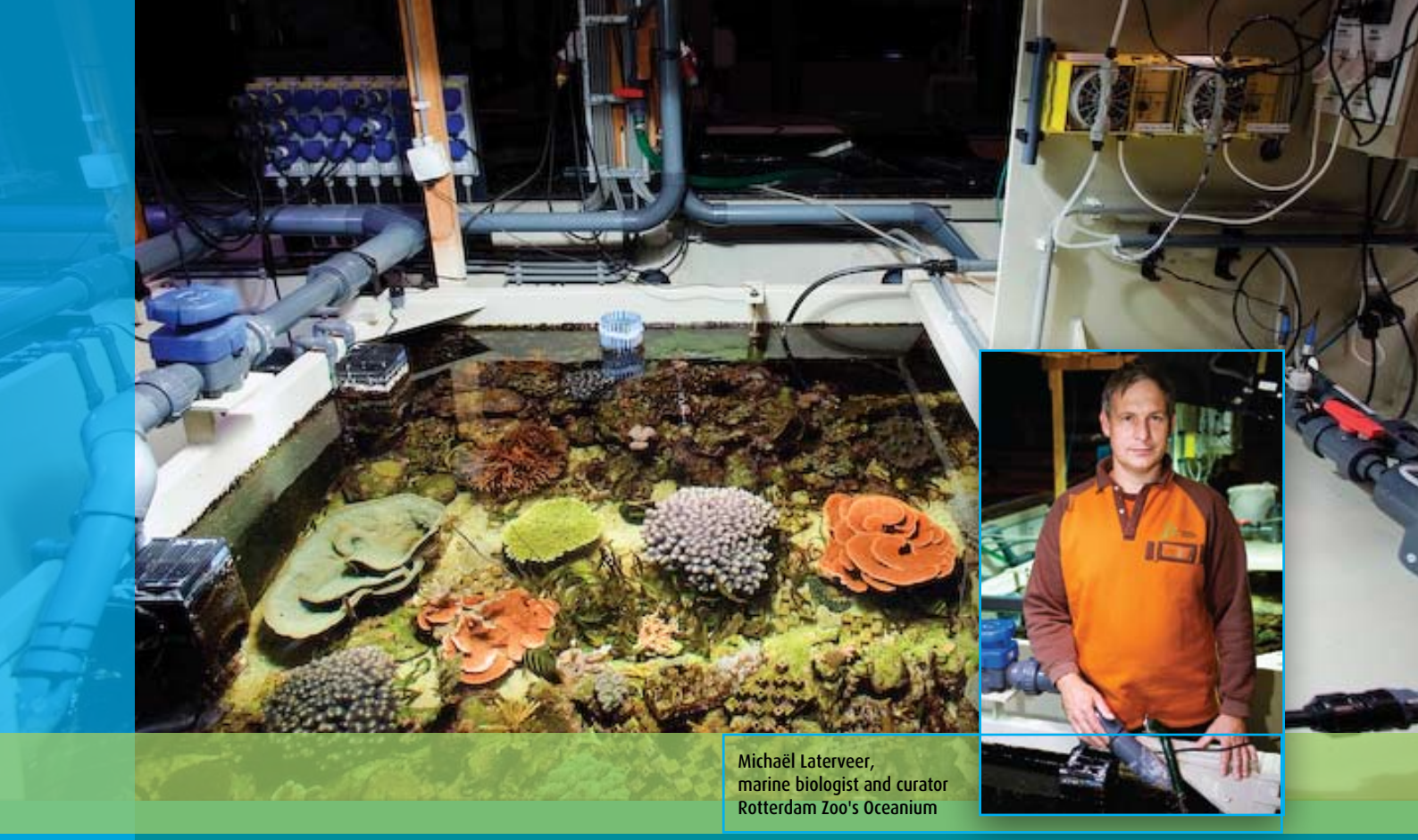
Unique population in Rotterdam Zoo's Oceanium

Michaël Laterveer is a marine biologist and curator of the Oceanium at Rotterdam Zoo. Together with Peter Henkemans of EcoDeco he has experimented with the Dymico system for years. The perfectioning of the system is therefore largely down to the opportunity that Laterveer and Rotterdam Zoo have given EcoDeco.

The Oceanium is a special aquarium. Its main attraction is undoubtedly the shark tank, which visitors can walk through. Connoisseurs though often linger longest at the deep reef tank to wonder at the many coral species, pipe worms, anemones and other filter feeders. Animal species that only flourish with difficulty in captivity elsewhere in the world thrive here thanks to Dymico, EcoDeco's unique water purification system, which keeps the water both clean and living.
Laterveer tells how he was immediately won over on first contact with Peter Henkemans of EcoDeco: 'Peter's theories, the natural biological principles behind his system, seemed to be valid. All that wasn't yet entirely clear was how precisely the system was supposed to work. I knew that this was the way to go, because the principle was in keeping with a new trend in our aquarium. We wanted to move away from purely mechanical filtering and make rather more use of the self-cleaning ability of nature, as discussed in Dynamic Aquaria, the pioneering book by Walter Adey and Karen Loveland. Most large aquaria, especially in America, worked - or work - by straightforwardly filtering out everything, then adding all kinds of substances to make the water normal again. In the Oceanium the filtration is already somewhat less traditional, because we use a more physical filter system with a foam fractionator, with the administration of a little ozone, followed by a sand filter and biological trickle filter, and therefore with no chemical manipulations.'

Even cup coral

However physical it may be, with foam fractionators the reproduction of many vulnerable animals such as sponges and corals is hampered because the system also removes eggs from the water. The corals are experiencing unprecedented growth in the tank with the Dymico system. 'Biologically speaking this is a very special tank,' says Laterveer. 'You can see animals that live below 30 metres on Caribbean coral reefs. They can sometimes be seen in aquaria measuring a metre by a metre-and-a-half, because they can feed them individually with a syringe. This size – the tank holds 50,000 litres – is unprecedented. We keep a very mixed company of filter feeders: coral species, sponges, pipe worms, anemones and certain species of shellfish. We even cultivate cup corals, which are rarely seen in a public aquarium. We can do this because with Dymico we have a water purification system



Michaël Laterveer,
marine biologist and curator
Rotterdam Zoo's Oceanium

that doesn't filter. The pump doesn't grind the plankton. Very many pumps work with pressure build-up; this pump works with water acceleration, without building up pressure. Even fish larvae can pass through.'

Second tank

Rotterdam Zoo will shortly be erecting a second tank with the Dymico system. Laterveer is sure that many more tanks can operate with this system. 'If I want to keep polar bears in it, it's not suitable. Corals do not pollute much because they are

oligotrophic systems. There is no filtering against sea lions, polar bears and penguins. At the level in-between are fish. Now that's fine because there's already a large school of false herring swimming around in the deep reef aquarium. For that matter we also have them in the shark tank, but there they need three times as much food. I'm sure that fish systems could all run on an EcoDeco system, provided that the population is not too large. Here we have a maximum population of 1 kg per 1,000 litres. If you have an unnaturally large population, as in aquaculture, the system is less appropriate, especially with larger types of food. But you can have a lot of success with finer food such as fish larvae. And if the system does occasionally become contaminated, then it has a great self-cleaning ability, so the duration of the contamination is very short. In traditional systems you have to add fresh sea-water regularly. That happens here too, but it's not necessary as such. We allowed an early system to run for nine months without refreshment and the water quality was still excellent.'

Self-cleaning ability

How great the self-cleaning ability of the EcoDeco system is became apparent in the first few years, when things once went completely wrong with a 3,000 litre test setup. Michaël Laterveer: 'In this tank we increased the population and the degree of pollution by way of a test. There were a hundred seahorses in it, for example. The system was running perfectly until the water was contaminated with five litres of alcohol as a result of a mechanical fault, which did not actually have anything directly to do with the EcoDeco system. Disastrous of course, the seahorses died immediately. The alcohol had removed all the oxygen from the water and there was a large bacteria formation. It was impossible to see whether the other animals were still alive, because they were hiding behind a large white mush. Everyone said: "Throw it away, switch everything off and empty it, it's had it." Now Peter and I are great believers in the power of nature. So we said to each other: it can't get any worse than this. So let's just see what happens. That same afternoon you could see the water clearing and two days later everything was crystal clear again. All the sea-urchins, shrimps, sea cucumbers, crabs and snails that were in the system were still alive. The water quality was back to its old, high level.'

How it works

The Dymico system consists of a bottom reactor, a pump unit and a switch box. Only the switch box is placed outside the tank, the rest is under water. Dymico (Dynamic Mineral Control) is based on the same three principles by which ecosystems keep themselves in balance in nature. The combination and management of these three principles in closed systems is at the heart of the Dymico technology.

1. Plankton is vital for balance

Where traditional techniques prevent a natural build-up of plankton populations, in a Dymico system everything has been designed precisely to stimulate the growth of phyto- and zooplankton. The natural cycle of eating and being eaten sets in during the running-in phase to produce a stable balance. The systems do not contain any mechanical filtering or skimmers, which remove plankton in addition to suspended waste and sediment. Special pumps maintain the plankton populations.

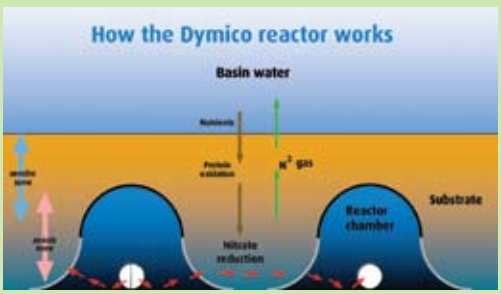
2. Clear water without sand filters

The use of sand filters and ozone is the most common method for obtaining clear water, but the drawbacks of this application are well-known: labour-intensive, significant seawater loss, plankton removal, susceptibility of the technique to interference and high maintenance. An integral part of the Dymico technology is a waste principle that the sediment separates naturally from the plankton. The separated sediment remains in the system and contributes to the chemical buffering of the water. The natural cycles are stimulated in this way.

3. Full nutrient decomposition inside the tanks

Any system with living organisms produces waste matter, which has to be removed through microbial decomposition. The Dymico technology does this very effectively, offering unprecedented benefits:

- Aerobic and anaerobic processes take place alongside one another in a single reactor.
- The reactor is located in the bottom and forms part of the ecosystem.
- The flow in the bottom is controlled for optimum nutrient decomposition.
- Since the Dymico technology causes the bottom reactor to react dynamically to the nutrient load in the water, feeding is no longer critical.



Unprecedented results in freshwater too

Dr Ronald Osinga is a researcher with the Aquaculture and Fisheries Group at Wageningen University. Although his greatest wish – large-scale sponge cultivation – has not yet been fulfilled, he has already had many other pioneering experiences with the Dymico system. So many that he is currently preparing a scientific publication about the system.

Ronald Osinga: 'When I first came into contact with EcoDeco, I was engaged on research into the cultivation of sponges for biopharmaceuticals.


Dr. Ronald Osinga, researcher Aquaculture and Fisheries Group, Wageningen University

I immediately saw something in collaboration. I was enthusiastic about the concept of manipulating the bottom, but didn't think that all the theories were valid. We applied for an investment subsidy and used it to make five prototypes to see precisely how the system actually works. Then I moved to this group for another project concerning the cultivation of corals. Here they were already running a trial setup, but I was keen to use EcoDeco again. We built a new, improved version, which was much better and far smaller. After successful trials in saltwater, we then did experiments in freshwater, to see whether the system might also be of interest for tropical fish cultivation. The results are very promising. In a small 600 litre system, including sediment (that is with around 400 litres of water) we had 90 ten-centimetre carp swimming around. We fed them so that they didn't grow. In this way we could keep the load on the system at a constant level. We then artificially doubled the load and then quadrupled it, in each case by adding ammonium. The system performed above expectation and appeared capable of much

more. This means that more is possible, but also that we don't yet know everything about the system. Theoretically the results were actually impossible. The waste was removed far quicker than anticipated.'

More applications

'The reactor does the work that anaerobic organisms do in the bottom,' Osinga explains. 'We can operate it so that this process runs to optimum effect in a controlled manner, which isn't possible with classical denitrification systems. We have now started research into precisely where the boundaries lie. The question is whether there 0are more applications than just show aquaria, which have a relatively low load. Here in our institute we have systems consisting of 50% fish. You need a huge decomposition capacity in them. If the bottom keeps absorbing everything - because you aren't filtering - you do get a very high concentration and I want to know how far we can go with loading this system. This is also a very good fit in our group, which specialises in fish, in aquaculture for food production. With my coral research I was really a bit of an outsider. But now the research projects can dovetail nicely together.'

Osinga has not yet given up on growing sponges. 'It is not enough that the system maintains a good water quality. You also have to provide the right food. Dymico is very capable of keeping the food in suspension, but we clearly don't know what the right composition is for sponges. We have tried using iron supplementations and selenium, but they didn't grow. We have experimented with different flows to create the right physical conditions, etc. Then we succeeded in growing them a number of times, but we were unable to repeat it. I still have some other ideas though. One thing I know for sure: it's nothing to do with the system.'

Antwerp chose Dymico for aquarium renovation

The aquarium at Antwerp ZOO currently has two Dymico tanks with a selection of hard and soft corals, anemones and tropical fish species, but this is about to change. Following a complete renovation, all the seawater tanks are going to be purified with EcoDeco's Dymico technology, using an extensive filter system in the basement of the aquarium building. Curator Philippe Jouk explains why.

'The great thing about this technology is that it's almost entirely hands-off. Our coral tanks have been running for two years now and in that time we have had hardly any maintenance on them. I had been aware of EcoDeco for a long time, but there had never been any reason to use the technique. In my opinion you must only do it when you're going to renovate – because the whole system has to be replaced – or when you're designing new systems. The system was installed two-and-a-half years ago when we renovated the coral tanks. There were no start-up problems. It's a very simple system, which has to be adjusted slightly, but then it runs trouble-free.'

Easy to maintain

The choice to equip the other tanks with Dymico too is connected with the ease of maintenance of the system, Jouk says: 'Classical systems are far more labour-intensive. Just think of the regular supply of all the seawater needed for refreshments. That's not needed with Dymico.'

A low-maintenance and easy-to-use system is very much in keeping with the philosophy of the Antwerp aquarium. 'But it's also better for the animals that we switch to the new system,' Jouk adds. 'The more stable the water quality, the better it is for the animals.'

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