Drinking water directly from wastewater at the UN camp in Mali

High-tech water cycle in the desert

By Jac van Tuijn

In the middle of the desert at the military camp of the United Nations' Peace Mission in Mali Han Wissink of the MasterMind Company has managed to build a compact water-treatment installation to turn wastewater directly into drinking water. It has not been not a simple task, but mainly thanks to sophisticated online monitoring, including the detection of coliform bacteria, the camp is now abstracting only 35% groundwater per day which is a reduction of 65%. If it were up to Wissink, it would be down to 25%.

"In the Netherlands we are used to quickly calculating whether water re-use is financially viable. It is not often the case since river water or groundwater is widely available to us, and can easily be made into drinking water. But in a desert, it is different," begins water engineer Han Wissink. For the last two years, he has spent a lot of time at Camp Castor in Mali where Dutch and German troops are stationed for the UN Peace Mission. At the request of the Dutch Ministry of Defence, Wissink has built a compact installation at the camp which treats the wastewater and makes drinking water from it. His company MasterMind owns the installation and is paid by the Dutch Ministry of Defence for the treated cubic meters of water he supplies.

Ingenious whole

Wissink built the ingenious installation using a membrane bioreactor to treat the wastewater of the whole camp including the engine workshop, the dog kennels and the hospital.

Camp Castor built in four months in 2014 by Dutch Royal Engineers in the searing heat of Mail has now been transferred to the German Army.

The effluent is then treated with an ozone filter and stripped of all remaining micro-pollutants. Then, as a source for the drinking water, it goes to an aerator and passes through various filters using sand, activated carbon and zeolite. The treated water is pumped to a central storage area and held in several buffer tanks. The water supply for the canteens and the hospital in particular is then treated in a reverse-osmosis unit. The non-drinking water, e.g. for showers and toilets, is treated again in an ultra-filtration unit installation.

The direct treatment of wastewater into drinking water makes the installation very special in Dutch terms. “It is officially forbidden in the Netherlands, and it took me a while to convince the Ministry of Defence it’s technically possible”, explains Wissink. In particular, the very extensive process monitoring played an important role. Five control panels collect sensor data on 65 parameters and enable Wissink to continuously monitor the whole process. “The drinking water I supply is tested to Dutch drinking water standards, except for temperature, hardness, and chlorine.”

Different calculations

According to Wissink it is hard to imagine the exceptional conditions under which he treats water in the middle of the African desert. As an example, he points to additional costs for logistics. “When calculating the feasibility of water treatment technologies, the energy price counts a lot. And I do not mean the global oil price we usually use.

Han Wissink, MasterMind Company: “The drinking water I supply is tested to Dutch drinking water standards, except for temperature, hardness and chlorine.”

One of the five control panels (left) and the two BACTcontrol sensors (right) which can indicate microbiological activity in the water within two hours.

Online monitoring of coliform bacteria

The MasterMind water treatment plant at the UN camp in Mali is equipped with an online BACTcontrol sensor made by microLAN from Brabant. The sensor detects the microbiological activity in the water and produces a measurement result within one to two hours. Normally, such a measurement is done on the basis of a sample examined in a laboratory, which can take up to three days.

The BACTcontrol measures the specific enzymatic activities of coliforms, e.g.

E. coli as an indicator for the presence of bacterial contamination. For the installation in Mali, it was the 'missing link' since in the case of potential contamination, the drinking water supply can now be stopped almost immediately. Without this online monitoring, water samples would have to be analysed in a laboratory, or on-site using 24-hour field tests.

The BACTcontrol sensor is part of a process monitoring system designed and built by Qsenz. The entire system is mounted on panels made in the Netherlands and then only had to be connected to the power and water supply lines in the camp.

In the middle of the desert, it can easily cost 80 dollars to get one litre of fuel into an aggregate tank, which can easily contain 600 litres a day. Just imagine how high the energy costs are then. People often overlook how logistics can drive up the price in remote locations around the world. This applies to everything that has to be supplied remotely, also for high-tech water treatment." says Wissink.

Little oxygen

The high [air] temperature in the desert and the high groundwater temperature of 34oC mean less oxygen can be retained by the water, as a result the bacteria required for wastewater treatment are much less effective. "There was already a membrane bioreactor at the camp, but it wasn't working well because the bacteria died regularly", Wissink explains. "We decided to cover the MBR and implement a special jet aerator. This creates smaller air bubbles and enables better bacterial growth. So, we don't need to use bacterial accelerators when we start up the MBR. Clean water appears after 15 minutes."

The first stage of the waste water treatment.

microLAN: be in CONTROL of your water monitoring

microLAN makes the monitoring of water quality and water security as easy as ABC with its online warning systems for algae, bacteria and chemicals: the ALGcontrol, BACTcontrol and iTOXcontrol. It is 1984. After studying analytical chemistry, founder Joep Appels has to do military service. He is assigned to the water supply division, as part of the Royal Engineers which supplies troops with drinking water. Here, his fascination with water technology is born, although it is limited to active carbon, chlorine and quick tests. Water quality monitoring on a small scale. Ultimately, what microLAN customers do on a large scale. Now, 35 years later, microLAN supplies advanced equipment for water quality monitoring to the Dutch UN mission in Mali. It has come full circle.

One of the contract regulations stipulates that Wissink may not use chemicals. This is specially to prevent anything from entering the drinking water. “It’s difficult because we can’t dose antifoaming agent during treatment. In May, the temperature can reach 50 degrees Celsius, which means the water temperature increases ever further. We have to aerate as much as possible to ensure the bacteria can continue to function. We solved this problem of anti-foaming by adding a mechanical anti-foaming system. We also add ozone at the same time. This allows us to keep the installation compact.”

Chlorination necessary

The only chemical dosing Wissink adds, in addition to ozone and active carbon, is chlorine. “Not for my installation,” he emphasises, “but for the Ministry of Defence, which is responsible for the distribution network. A specialist from the Ministry of Defence works at the camp to check the water at the taps. He tells me if I need to dose more chlorine. By default, I add 1 mg per litre to the storage tanks and there is another 1 ppm in the pressure booster.”

This low chlorine dosage is mainly to clean the network; not as a last resort to kill off any remaining microbial pollutants. “We overcame this by including an online sensor which detects coliform bacteria in the system. Since our installation started in April 2016, this has not been detected. But if the case arises, I immediately know that the ozone dosage in the wastewater treatment is not working properly and I can adjust the whole process accordingly.”

Less groundwater abstraction

The Ministry of Defence approached Wissink in 2015, when it appeared that the groundwater sources that the United Nations had drilled for the Dutch camp began to dry up quickly. The camp was equipped with a membrane bioreactor for wastewater treatment, a mobile reverse-osmosis unit for drinking water treatment and a mobile ultrafiltration unit to process the remaining water. “My main task was to reduce the groundwater abstraction. I proposed re-using the wastewater. Since then, the plant has been working and water abstraction has been reduced by 65% per day. I still see options to further reduce that to 75%.” Wissink never seems to be finished with the installation. “The re-use rate now stands at 65 percent. The rest we discharge into a special pond outside the camp. One kilometre up the road there is a tree plantation. With a pipeline and a pump, we could supply it with clean water from the camp. We could then show everybody that we are returning water to the Malians.”

Supply tanks with drinking water (right), cooling unit (middle) and sensor control panel (left).