

Brightsite

Transforming industry

Circular water

A sustainable Chemelot requires a sound water strategy

Brightsite is committed to creating a sustainable chemical industry. This is not just about the reduction of CO₂ emissions at Chemelot – circular water management is also high on the list of objectives within program line 3, ‘Process Innovation’.

Water is increasingly becoming a social issue, given the increase in droughts and heavy rain. The water cycle at the Chemelot site is used for basic processes such as cooling, heating (steam) and safety. “Chemelot extracts water from the Juliana Canal and, after purification, discharges it into the Ur, a stream that flows into the river Meuse. Water shortages due to low water levels

are not yet a problem, but there is no guarantee that this will remain the case. We also discharge indirectly into the river Meuse, which is used for drinking water production, so we are very aware of the importance of good water purification,” says Lianne van Oord, program manager of program line 3 ‘Process Innovation’.

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Circular Water Program for Chemelot

“At 44 million cubic meters per year, Chemelot is a major water user and is dependent on water. You can compare it to your own body: you drink water and excrete it again. It is of vital importance to you, as it is to the site. Water is crucial for the functioning of the plants. We want to optimize our water purification and reduce our water consumption. In order to achieve this, we have launched the ‘Circular Water for Chemelot’ program. We are taking stock of various Chemelot-wide options, bearing in mind the stricter regulations regarding water permits as well as far-reaching process changes that will take place at the site as a result of sustainability steps that have been set in motion. After all, the transition to a climate neutral Chemelot by 2050 will also have an effect on the water consumption and wastewater of plants,” Van Oord emphasizes.

1.5 cubic meters of water per second

“Without water, all of the companies on the site would come to a standstill,” says Tjaart Molenkamp, senior manager Technology & Sustainability at USG (Utility Support Group). USG supplies water as a utility for the Chemelot site. In order to do so, it extracts water from the Juliana Canal, as much as 1.5 cubic meters per second. This water is stripped of the major solid contaminants in a device called a flocculator. The purified water is then pumped to the plants, where it is used, for example, as cooling or extinguishing water. “We also subject the flocculated water to further purification and treatment in our demineralized water plant in order to produce demineralized water, or demi water for short. This is suitable for use in production processes and for our production of steam,” says Molenkamp.

Biological wastewater treatment

After being used in the plants, the water ends up as wastewater at the integrated wastewater treatment plant (IAZI), a shared facility for the plants which is managed by Sitech Services. “The facility receives 1 cubic meter of water per second, with the remainder being lost mainly through evaporation in the course of cooling processes. The IAZI breaks down and extracts substances from the wastewater, after which the purified water is discharged into the Ur, a stream that flows into the river Meuse. What’s special about the IAZI is that it is not a chemical but a biological treatment plant,” explains Hans Geijselaers, who is responsible for water management at Sitech Services. Incidentally, the IAZI is not the only place where treatment is carried out. Several plants already minimize the waste stream and carry out purification steps. In addition, there are various clarifying installations on the site that separate solids from the water.



Complexity of Water Act permit

On 15 December 2020, a new Water Act permit for the Chemelot site was granted to the applicant Sitech Services. Good coordination and cooperation between all parties involved was crucial for this application. The complexity of the application was due not only to the 54 plants producing wastewater, but also to the tightening of the application process. New European requirements call for further improvement of water quality and development of methods to measure and analyze substances. Chemelot was one of the first to go through this new permit process. "Although our discharge has remained the same, we are now monitoring over 630 individual substances that enter the wastewater treatment installation from the plants. Previously, the standards for group parameters were used as a starting point. As a result, the number of

substances to be measured has increased by a factor of twenty. No standards had yet been set for about two thirds of the substances. If you were to compare it to household garbage, you could say that we initially had a permit for up to five garbage bags a week. Now we have to determine in detail what can go into those garbage bags," says Geijselaers.

"Chemelot's ambition to become climate neutral is also reflected in its ambition regarding water."

Circular water calls for creativity

Van Oord explains: "Within Brightsite's program line 3, we are looking for opportunities to further optimize how we use and purify water. We see this program as one of the pillars for making the Chemelot site more sustainable. The ultimate goal is 'zero discharge', or circular water, and that will require a lot of creativity and cooperation. Optimization alone will not be enough – we will also need to introduce new technologies by collaborating with knowledge institutes, technology developers and companies. It is also important for us to take a fresh look at the water system: 'How can it be reconfigured to contribute to sustainability? Is there a single solution that would solve several problems, instead of, for example, just installing extra treatment plants everywhere?'. We can also reduce the demand for (cooling) water by saving energy, and the reuse of residual heat outside the site may also help."

In future, Chemelot wants to become less dependent on the supply of water by extracting less water and reusing more. One of the logical questions is: 'Can't we reuse some of that one cubic meter of wastewater per second?'. Geijselaers explains: "That would be a good solution and it seems to be feasible from a technical perspective. However, it would not only entail considerable costs but also consume a great deal of energy. The latter, of course, does not fit in with the sustainable transition we are aiming for. Moreover, there is

still a brine flow (concentrated flow with removed substances), which we are not yet able to process. Several consortia have already carried out research into this. In this program, we want to look at the value of these solutions for Chemelot."

Closing the circle closer to the plant

One of these solutions is to reduce the amount of water that evaporates. "We are currently losing 0.5 cubic meters per second. Maybe there's another way to carry out cooling. This is one option, but it is technically complicated and would require us to adapt our processes. That's why we are also looking at solutions closer to the plant, for example directly reusing (cooling) water there, or removing substances from the water at the plant so that the water can then be reused on site. The sludge left over at the end of the water purification process contains not only waste but also valuable substances that we could possibly reuse," explains Geijselaers.

"Circular water is about closing circles – from small circles around a plant to large, site-wide circles. It is also about both water and the substances found in the wastewater. At Chemelot, we have been thinking and working for some time on making the water flow more sustainable, and now we are bringing this together under one umbrella within the 'Circular Water for Chemelot' program."

Still the best choice after 40 years

The IAZI is the shared water treatment facility for the Chemelot plants and was put into operation in 1978. It is a biological plant that uses sludge, in which bacteria live, to convert waste materials into nitrogen, carbon dioxide (CO₂) and water. Substances also become trapped in the sludge. The bacterial culture adapts to the waste streams that enter the IAZI from the plants via a sewer system that is over 300 kilometers long. On entering the facility, the wastewater is distributed over three identical treatment lines (basins with a diameter of 114 meters). An important condition for adequate biological water treatment is the balance in the incoming waste flows. By ensuring that there is good communication from the plants and by measuring in advance what waste streams are coming in, it is possible to determine how these streams can be optimally processed. The purified water is discharged via the Ur, a stream that flows into the river Meuse. Some of the remaining sludge goes back to the treatment stage, and the rest is disposed of. Studies have shown that the IAZI still meets the highest requirements for water treatment and has a disposal efficiency of 99% for many substances.

Site users interested

According to those involved, water problems are a concern for most site users. "Because of the Water Act permit, preventing undesirable emissions is now on the agenda for many people. That is not the case for water shortages, however, as these have never occurred before. Water often receives only limited attention in the sustainability programs of individual plants. In addition, saving water is simply not enough to justify investments. That is why it is a good idea to make saving water part of a site-wide approach," says Molenkamp. "A tour of site users shows that many companies are interested in participating in the Brightsite program Circular Water for Chemelot."

"Closing the water cycle requires an integral approach and is linked to the other (sustainability) developments at Chemelot and in the surrounding area."



International pioneer

“It’s great to see how far Chemelot has come in its thinking on circular water use,” says Arjen van Nieuwenhuijzen, R&D and Innovation Director Circular and Biobased Solutions at the Witteveen+Bos engineering firm. “Two years ago, on behalf of USG, Sitech Services and WBL (the water board company for Limburg), we conducted a study on how to close the water cycle at and around Chemelot. We looked at various climate scenarios and mapped out the water management of Chemelot and its surroundings. This involved looking at the complete picture – sustainability, cost-effectiveness, nature, society, CO₂ emissions, etc. – and taking into account the concerns of all the stakeholders. One of the possible options from our analysis was to use purified sewage water from WBL as a freshwater source for Chemelot. It remains to be seen whether the implementation of such an alternative is appropriate, and this will depend on the costs and possible secondary effects on the environment.

During the project, the need for USG and Sitech Services to be self-sufficient and circular was apparent. It is great to see that Chemelot and Brightsite have included elements from our analysis in their ambitions for a broader circular water project. They are one of the international pioneers in this area and are setting an example for the world. Closing the water cycle requires an integral approach and is linked to the other (sustainability) developments at Chemelot and in the surrounding area. Chemelot is playing an important role in the Netherlands’ ambition to have a fully circular economy by 2050. In order to achieve this goal, we need to take action now; time is of the essence, and the plans already developed for Chemelot offer good prospects,” Van Nieuwenhuijzen emphasizes.

Does your company recognize itself in the working method of Brightsite?

Within Brightsite’s program line 3, we are looking for opportunities to further optimize how we use and purify water. We see this program as one of the pillars for making the Chemelot site more sustainable. The ultimate goal is ‘zero discharge’, or circular water, and that will require a lot of creativity and cooperation. Do you want to contribute to this or get more information? Then contact us.

Lianne van Oord

Program manager
Process innovation
lianne.oord-van@sitech.nl
+31 (0)6 278 218 16

