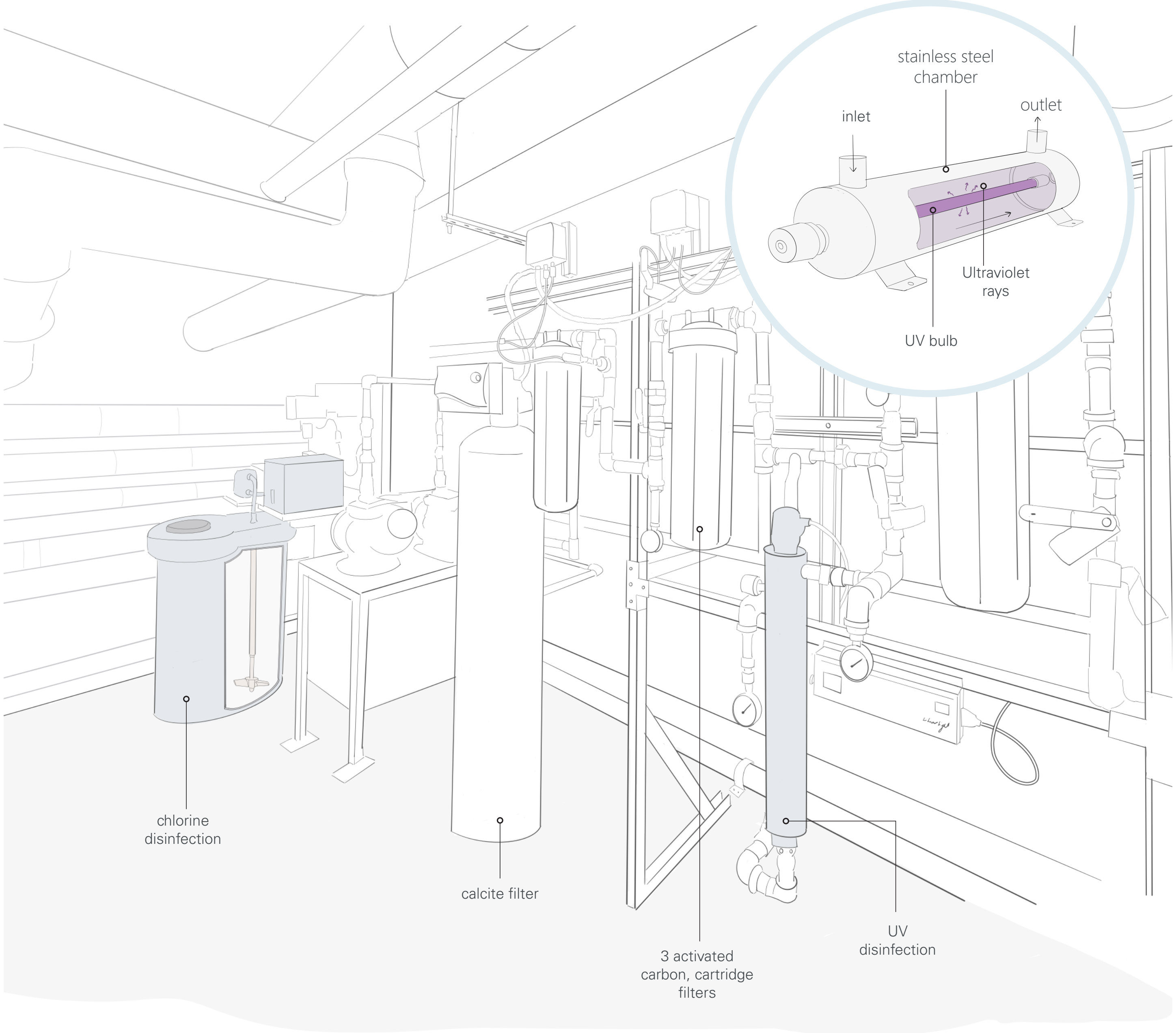
T.50 UV & CHLORINE DISINFECTION

TECHNOLOGY



RW — T.41 CISTERN — T.49 CARBON FILTERS — T.50 UV DISINFECTION — T.49 CARBON FILTER — CALCITE FILTER — T.50 CHLORINE DISINFECTION —

Ultraviolet (UV) disinfection and chlorination are treatments to inactivate pathogens, including bacteria, viruses and protozoa present in the water. UV disinfection is based on physical mechanisms (i.e., electromagnetic radiation). As water passes along UV bulbs, the UV light damages the pathogens' genetic material, leaving them unable to replicate. Inactivation by UV depends on the continuous exposure to and intensity of the light (typically 254 nm), the duration of exposure, and the absence of suspended particles. Chlorination is a quick, simple, and cheap method of disinfection based on chemical mechanisms: by adding chlorine to the water to attack pathogens. Chlorination is the only treatment that provides residual disinfection, preventing regrowth of pathogens in water distribution networks and storage tanks. For effective disinfection, the influent requires pre-treatment to remove organic matter, nutrients, and suspended particles.

Chlorine disinfection removes odor, taste, and color, and provides residual disinfection, however, it also produces potentially harmful disinfection byproducts (e.g., trihalomethanes). UV has no effect on color, odor, taste and regrowth prevention, and does not produce disinfection byproducts.

INPUT STREAMS

- GW Pre-treated Greywater
- MW Pre-treated Mixed Wastewater
- RW Pre-treated Rainwater

TARGET OUTPUT(S)

- Treated Water

BULLITT CENTER

Seattle, WA, USA | 2015

Rainwater-to-tap with UV and chlorine disinfection

Rainwater from the rooftop catchment area of this six-story office building (175 occupants) is led to a 800 m³ cistern in the basement. From there, the rainwater is treated by a 5 micron carbon cartridge filter, a 0.5 micron cartridge filter, UV disinfection, a second 0.5 micron cartridge filter, remineralization (calcite filter), and chlorination. Treated water is stored in two 2 m³ tanks. The building uses 94% less tap water than an average building in the city and is Living Building Challenge (LBC) certified.

SPECIFICATIONS

INFRASTRUCTURE

Both chlorine and UV disinfection are compact treatment processes that can be scaled to context. Commercial set ups are widely available for both. Automiatic chlorine dosing requires an energy source for pumps, and mixing mechanisms, while UV systems require an energy source to power the UV bulbs. It is recommended to install UV disinfection units as close as possible to point of water reuse.

> Chlorine derivatives are sometimes included on sustainable building certification 'red lists'. However, certifications can still be granted where regulations require chlorine disinfection for water treatment.

OPERATION & MAINTENANCE

UV disinfection generally has low operation and maintenance requirements, though needs a constant source of electricity and initial equipment costs are higher than chlorine disinfection. After installing UV, operation includes a constant source of electricity and monitoring of the flow rate to and retention of water in the UV disinfection unit. Bulbs need to be cleaned, when dirty, to maintain light emission intensity. While the system has a long lifespan, the bulbs should be replaced in regular intervals (e.g., 12 months).

Chlorination requires continuous or periodic dosing of liquified chlorine gas or sodium hypochlorite solution, or by using on-site chlorine production via electrolysis. Though chlorine is widely available, its sourcing, transport, and dosing needs to be coordinated and carefully executed. Dosing can either be manual or automatic, and is often based on regular monitoring of water quality. It is important to dose chlorine correctly to ensure adequate inactivation, and provide enough residual chlorine to prevent regrowth in pipes and tanks, without negatively affecting taste or even human health.

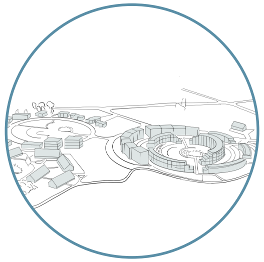
> Both UV and chlorination lend themselves for on-site and off-grid water treatment for reuse thanks to their compact form and simple use and maintenance. Access to chlorine chemicals or replacement bulbs is required.

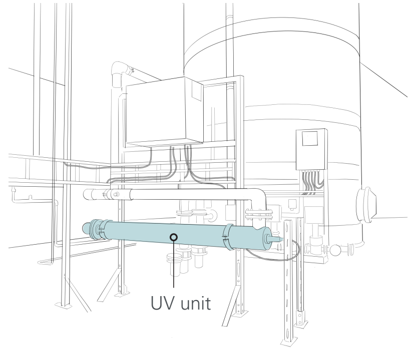
TARGET OUTPUTS

The treated water from both disinfection processes is suitable for high-quality reuse. The combination of disinfection processes with the preceding treatment technologies renders a high-quality treated water for onsite, often indoor, reuse. In some instances, the water is even safe for drinking (e.g., Bullitt Center).

SELECTED CASE STUDIES

NYE SUBURB
Aarhus, Denmark | 2018



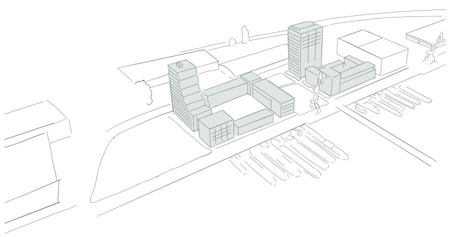


Neighborhood rainwater treatment with UV disinfection

The Aarhus suburb of Nye (~13,500 inhabitants) is a modular housing project, with a rainwater treatment and reuse system operated by the local utility company. Rainwater, collected in outdoor collection ponds, is first treated in a multi-media pressure filter, followed by ultafiltration and storage in a clean water tank. Before distribution, the water undergoes UV disinfection. The treated rainwater is reused for toilet flushing and in washing machines, covering 40% of the water demand in Nye.

RW — T.41 CISTERN — T.49 MULTIMEDIA FILTER — T.48 ULTRAFILTRATION — T.41 STORAGE TANK — T.50 UV DISINFECTION

DE NIEUWE DOKKEN
Ghent, Belgium | 2020

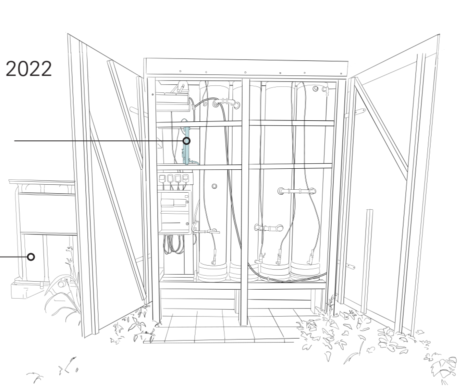


Greywater treatment with chlorination for district reuse

At De Nieuwe Dokken source-separated greywater and the effluent from vacuum blackwater treatment (including anaerobic digestion and struvite precipitation) is treated biologically, followed by an activated carbon filter to remove color, a heat exchanger for heat recovery, and chlorination for disinfection. The treated water is reused as process water by a neighboring soap factory. The treatment train is designed for 430 apartments (1200 p.e.), and the expected water available for reuse is ~30,000 m³ per year.

GW — T.42 SCREEN — (BW) T.41 BUFFER TANK — T.47 MBR — T.49 ACTIVATED CARBON FILTER — T.61 HEAT EXCHANGER & HEAT PUMP — (heat) T.50 CHLORINE DISINFECTION — T.41 STORAGE TANK

GUTSGARTEN
Hellersdorf, Germany | 2022



UV disinfection of kitchen greywater for irrigation

Located on the historic Hellersdorf estate, the Gutsgarten community vegetable garden treats kitchen greywater for onsite plant irrigation. The treatment includes a sieve and grease trap to retain solids and remove grease. After a buffer tank, the water is biologically treated in a four-columned Moving Bed Biofilm Reactor (MBBR) using foam cube carriers. The last treatment step is UV disinfection to reduce pathogenic risks during reuse. The treated water is used to irrigate 60 raised garden beds.

GW — T.42 SCREEN — T.42 DEGREASER — T.46 AERATED BIOREACTOR — T.50 UV DISINFECTION — T.41 STORAGE TANK