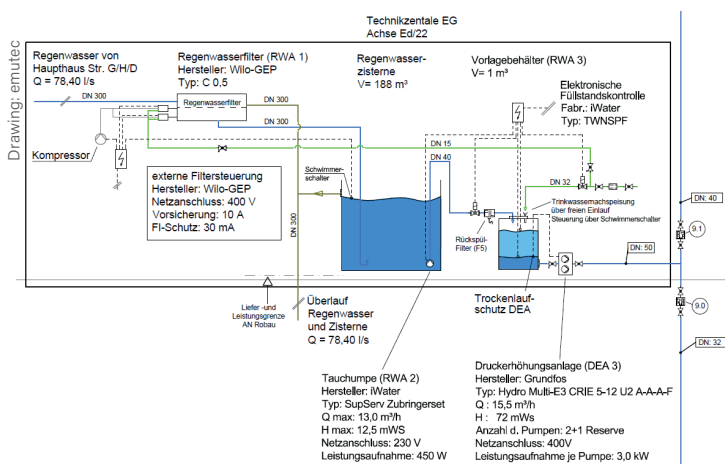


# Gray water and rainwater included in sanitary engineering



**Figure 1:** The IKEA store in Kaarst was opened in October 2017. Apart from its unusual architecture, it has resource-saving technology and high energy efficiency. Therefore, the company has named it "More Sustainable Store".

The building in Kaarst, a town located in the Lower Rhine region, is Germany's most sustainable IKEA store. One of the features of the store is that it uses water for handwashing twice over. What is referred to as gray water is collected, processed in the building using simple technology, and used together with rainwater in toilet cisterns. This type of water recycling reduces wastewater, which saves resources and costs. The pilot project for sustainable material cycles secured the German building services engineering award at the Berliner ENERGIETAGE energy transition conference in May 2018.



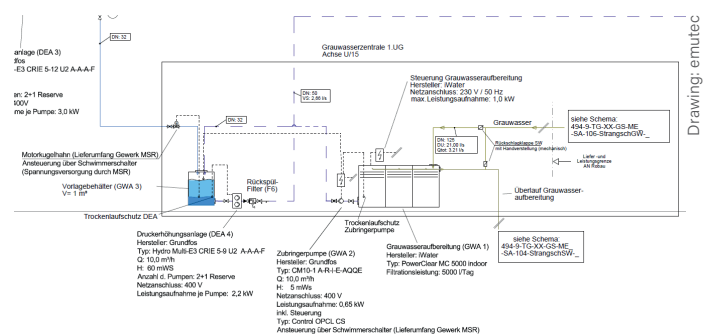
**Figure 2:** Rainwater system with a 188 m<sup>3</sup> tank in the service room on the ground floor of the More Sustainable Store in Kaarst. Rainwater is collected and used in toilets and irrigation, saving on water and wastewater.

IKEA has invested more than €100 million in this showpiece project and has named it "More Sustainable Store". At 25,000 sqm, the Kaarst store has almost three times the area of the previous IKEA it replaces, which was the smallest in Germany at the time at around 9,000 sqm of retail space. "We'll be placing special emphasis on sustainable products in our showroom as we aim to inspire our customers towards living a more sustainable life at home," said the store manager, Stephan Laufenberg, at the store's opening on 12 October 2017. "Our aim was to align the three pillars of ecology, economy and social issues as effectively as possible in this international pilot project."

The holistic approach of the store includes a specialised architectural concept that connects the individual parts of the building using landscaped terraces with large windows allowing natural light into the building. The wooden fronts and the outdoor landscaping design provide a welcoming atmosphere. The new store has a wide variety of sports and leisure facilities available to customers, co-workers and the people of Kaarst – even outside opening hours. An outdoor concept with plenty of green was developed in cooperation with the German association for natural conservation NABU. The energy concept in the store comprises a combination of efficient, resource-saving technologies such as combined heat and power, solar thermals and photovoltaics, highly effective insulation, daylight-controlled LED-lighting, and rainwater and wastewater recovery.

## Water recycling

Wastewater from handwashing basins in the washrooms on three floors of the store is collected as gray water and passed through a cleaning system into reusable service water for irrigating outdoor facilities as well as for use in urinals and toilet cisterns. "We also use rainwater from tanks with a capacity of 188 m<sup>3</sup> to replenish supplies if the service water requirement outstrips the amount of gray water available. Once that's been used up, a mains water



**Figure 3:** Gray water center on the first floor above ground at the More Sustainable Store. This includes around 160 metres of piping for collecting and processing gray water for treatment and distribution as service water.

Photo: König



**Figure 4:** PowerClear MC 5000 gray water system with fully automatic control, potential-free contact integrating alarm signals into the building's services.

connection also ensures a stable supply of service water," says Franz Epping, commercial director for sales and purchasing at Zilisch in Ahaus. "Amongst other things, we also had orders to install a rainwater system in the service room on the ground floor and the gray water center on the first floor of the store." Zilisch earned the German building services engineering award for implementing this system in May 2018.

The technology used in the treatment and use of gray water uses a tried and tested method also in place in several residential and business properties in Mönchengladbach as well as some of the students' hostels in Düsseldorf for the last few years. This was followed by additional orders from across Germany and Europe for the Troisdorf-based manufacturer, with customers going as far as a research station in Antarctica and a hospital in Afghanistan.

### Gray water treatment

Wastewater is collected from drains underneath thirty-five wash-basins on the ground floor as well as the first and second floor above ground and passed into a separate drainage system for treatment at the gray water center, which consists of three plastic tanks at a capacity of 3,000 liters each. Gray water flows down



Photo: König

**Figure 5:** PowerClear MC 5000 gray water system with three tanks at a capacity of 3,000 liters each for installation in buildings. Capacity: Five thousand litres of service water supplied daily.

by gravity alone into the first tank via a collecting pipe. The treatment system uses membrane filtration in the middle tank. This method has different names depending on filter gauge. The ultra-filtration system used in IKEA holds back any particles greater than 0.00005 mm with the support of an aerator that forces air from the outside into the lower part of the gray water tank. The filter membranes are bundled into a block in the middle of the tank. The air constantly bubbling up the ultrathin membrane keeps it free of deposits. The filtered material is automatically sucked out as fine sludge.

Small automatically controlled pumps force the water from the first tank into the second and, after passing through the membranes, into the third tank that acts as a reservoir for clear and

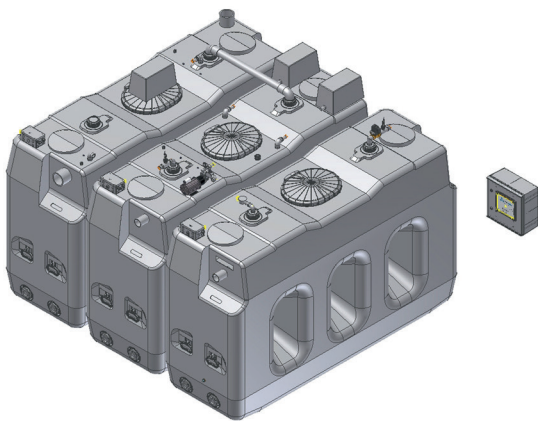
### Project data

Address:	Hans-Dietrich-Genscher-Straße 1, 41564 Kaarst
Principal:	IKEA Verwaltungs-GmbH, Hofheim-Wallau
Architectural concept:	Henning Larsen Architects, Munich
Building services engineering:	emutec GmbH, Norderstedt
Planning and implementation of water recycling plants:	Zilisch, Sanitär-, Heizungs-, Kälte- und Lüftungstechnik GmbH & Co. KG, Ahaus
Manufacturing and supply of water recycling components:	iWater, Wassertechnik GmbH & Co. KG, Troisdorf
Completion:	October 2017





**Figure 6:** View of the PowerClear MC 5000 gray water system. The membrane filtration uses a filter gauge of 0.00005 mm for reliable and complete retention of dirt particles.



**Figure 7:** Isometric view of the PowerClear MC 5000 gray water system. System ventilation serving the microbiological flora continuously cleans the filter membrane, maximising its service life.

odor-free service water. The downstream pressure system keeps the water pressure constant throughout the service water network. Users will not notice any difference in the water used for irrigation or toilet flushing compared to normal mains water.

**Quality and safety**

“A gray water system has to be low-maintenance and trouble-free in operation,” says Frank Pantel from the manufacturer iWater Wassertechnik. “We optimize ecological and economic efficiency by designing the monitoring and control as well as the pump system to save as much power as possible.” Even so, the main aim is to deliver high-quality water, according to Pantel. The German mains water regulations also prohibit any impairment of the mains water grid. Safety required by law ensures transfer systems compliant with DIN EN 1717. This is part of the system manufactured and assembled at iWater – one less thing to deal with for the contractor. According to Pantel, the type of treatment applied in this project has been designed for gray water from washing basins in sanitary facilities. “Our technology includes a barrier effect with membrane ultrafiltration that keeps back almost all bacteria,” he says; “It even complies with the hygienic requirements of the European Bathing Water Directive.” Even so, IKEA store visitors shouldn’t go bathing in this water – it’s only meant for flushing toilets and irrigation, somewhat like filtered rainwater in this respect.

**Economy rather than autonomy**

The nationally active emutec GmbH company from Norderstedt planned the water recycling along with the other building services. According to the company’s project manager Markus Tüpker (now freelancing for the KiT GmbH engineering firm), a separate pipeline network is always needed for collecting and distributing gray water; this network is around 160 m in length at IKEA Kaarst. Tüpker designed the treatment system for a capacity of 4,500 liters per day. “That’s enough for flushing fifty-seven toilets at peak demand,” he says. “The twenty-seven urinals work without water. The overriding control system starts an automatic hygiene flushing program with service water every so often using motor ball valves.” This generally keeps requirement and supply in balance for gray water. The flushing water requirement rises with large numbers of visitors. This also causes correspondingly large amounts of gray water from hand washing. A rainwater tank is also available to provide service water for irrigation on peak days. A mains water supply opens automatically to top up supplies on those days of the year when the rainwater tank doesn’t provide enough. If there’s too much, the gray water overflow spills over into the drainage ditch and passes into the public sewer.

Installing the largest rainwater tank to catch the last drop during heavy rain with the aim of eliminating the need for mains water altogether was not advisable for economic reasons. The same applied while dimensioning the gray water system. Occasional gray water overflow together with mains water supply to cover for a shortfall were seen as tolerable. The aim of the ecological project plan was not self-sufficiency, that is, an off-the-grid water management system, but rather an efficient resource-saving technology that was economically attractive enough to be copied by others.

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*Gray water and rainwater system*

Gray water system, working principle:	Membrane ultrafiltration bioreactor
Gray water system model:	ewu-aqua PowerClear MC 5000
Gray water source:	Thirty-five handwashing basins
Rainwater source:	Roofs
Gray water and rainwater use:	Toilet flushing, irrigation for outdoor facilities