

Removal of micropollutants in the Mannheim wastewater treatment plant

Motive and objective

In the Mannheim wastewater treatment plant, the adsorptive process technology to eliminate micropollutants, which was developed by the Biberach University of Applied Sciences in cooperation with the Zweckverband Klärwerk Steinhäule (Steinhäule Wastewater Treatment Plant Association), was installed on a large scale for the first time ever. In order to gain operative experience with the new technology, a fifth of the future planned dimensioning has been installed to date. The operation of the process stage for partial flow treatment of the total 1,500 L/s volume flow is scheduled to start in September 2015. With this voluntary measure, the Stadtentwässerung Mannheim (Mannheim municipal wastewater authorities) aimed to significantly reduce the entry of micropollutants into the Rhine River while further decreasing the dissolved organic residue substances that usually remain in the wastewater.



Process technology used

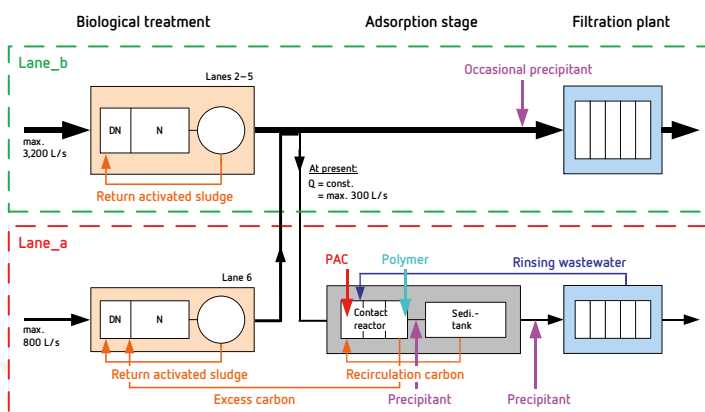


Figure 1: Current integration of the adsorption stage and filtration plant into the current process

In the Mannheim wastewater treatment plant, powder activated carbon (PAC) is used to eliminate micropollutants.

Specifications of the wastewater treatment plant

Ausbaugröße und Belastung

Treatment capacity and load	725,000 PE
Load *	517,700 PE

Inflow volumes

Max. in rainy weather	4.000 l/s
Biologically treated wastewater volume p.a.	30 million m ³

Former process technology

Mechanical treatment	Coarse rack, screen, grit chamber, grease trap, primary sedimentation tank
Biological treatment	One-stage aeration plant
Filtration plant	Two-layer filter with support layer (0.25 m gravel, 0.55 m quartz sand, 1.00 m expanded shale)

* Mean value of 2010 to 2012; determined on the basis of the mean COD value measured in the inlet and the annual wastewater volume.

Process technology used

In this case, adsorptive treatment of the wastewater essentially succeeds biological treatment and precedes the existing filtration process in an adsorption stage consisting of a contact reactor, which is designed as a three-stage cascade, and a downstream sedimentation tank. In accordance with the current dimensioning for a fifth of the overall treatment capacity ($Q_{\max, \text{ads.}} = 1/5 \times 1,500 \text{ L/s} = 300 \text{ L/s}$), the adsorption stage has been constructed to succeed one of the five lanes of the biological treatment stage (= lane_a), which are operated in parallel, and has been installed in one part of the existing tank volume of rainwater treatment. Within the scope of the scientific monitoring conducted by the Biberach University of Applied Sciences until March 2012, the adsorption stage was loaded with a maximum of 300 L/s in proportion with the capacity. If the inflow available for lane_a exceeded 300 L/s, one part of the wastewater was diverted before the adsorption stage and added to the lane for biological treatment only. In order to enable a consistent separation of the differently treated wastewater flows until they reached the outlet of the wastewater treatment plant, three filter chambers of the two-layer filter were additionally assigned to lane_a. The rinsing wastewater of the lane_a filter was fed back into the contact reactor. In order to further utilise the adsorbent, the partially loaded PAC was conveyed to the biological treatment of lane_a as excess carbon. Thus, this separation allowed for a direct comparison between the two treatment processes with and without the use of PAC.

At present, the adsorption stage is operated in accordance with [Figure 1](#): the effluent of the secondary sedimentation tanks of the two lanes are initially combined in order to maximise the amount of wastewater that is additionally treated in the adsorption stage. Afterwards, the adsorption stage is loaded with a constant wastewater volume of 300 L/s at maximum.

Operator contact

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Dimensioning of the adsorption stage

Maximum treatable volumetric flow rate	$Q_{\max, \text{ads.}} = 300 \text{ L/s}$
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Contact reactor

Volume	$V_{\text{CR}} = 740 \text{ m}^3$
Minimum retention time for dimensioning inflow	$t_{\text{R, CR}} = 40 \text{ min}$

Sedimentation tank

Volume	$V_{\text{Sedi.}} = 2,350 \text{ m}^3$
Surface area	$A_{\text{Sedi.}} = 945 \text{ m}^2$
Minimum retention time for dimensioning inflow	$t_{\text{R, Sedi.}} = 2.2 \text{ h}$
Maximum surface load for dimensioning inflow	$q_{\text{R, Sedi.}} = 1.1 \text{ m/h}$

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