Fachhochschule Köln
Cologne University of Applied Sciences

Gummersbach Environmental Computing Center

Development of an Integrated Control and Adjustment Strategy for Sewerage Systems and Wastewater Treatment Plants

Wastewater Treatment Plant

Sewerage System

Biogas Plant

Drinking Water

Decentralised Monitoring

Introduction

Sewerage systems are mainly operated as uncontrolled, static systems; they are not managed but left to their own devices.
These static systems are not capable of reacting to the natural fluctuations in precipitation/outflow events with a flexible operating action. Furthermore, the operational behaviour of sewerage systems often deviates considerably from the planned state.

Figure 1: Project Aim - a clean River

Better use of the available capacity of a sewerage system leads to a fall in the discharges, a steady discharge flow pattern and smaller capacities being required for stormwater overflow tanks (so-called SWTs).

However, the priority when it comes to managing a sewerage system is the protection of the lakes and rivers. The complex control systems, within the context of the project, are developed and provided centrally using modern methods of Computational Intelligence.

The development work is carried out in close collaboration between Aggerverband in Gummersbach and Prof. Bongards of the Cologne University of Applied Sciences.

Project Aims

Improvement in the use of available SWTs through optimisation of the throttle-water volumes via a fuzzy controller.
As a result, the storage capacity can be exploited in the best possible way and adding on more stormwater tanks can be dispensed with.

Harmonisation of the control of the SWTs, so that discharges from SWTs directly following a rain event (one SWT empties itself and the SWTs downstream run over) are avoided. The early identification of an event is made through weather information and classification by a state machine.

Steadying of the flow of the load being fed to the wastewater treatment plant. In contrast to the usual approach of equalising the inflow volume, the intention in the case of the planned control strategy is to steady the flow of the ammonium load and/or the COD load.

Optimisation of the inflow load and control of the wastewater treatment plant on the basis of the permitted outflow concentrations (BOD and/or total N or NH4-N) from the wastewater treatment plant. Through the integrated control of sewerage system and wastewater treatment plant the optimum level of management of the process was achieved. Thus good outflow values can be achieved with energy consumption kept to a minimum and stable management of the process.

Wasser. wir wissen
DER AGGERVERBAND
wie's läuft

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Radar measurement for recording the rainfall within the catchment area of the sewerage system. A clear improvement in the forecast values is expected through the integration of these parameters.

Immissions-orientated and integral View

A focal point of the research is to show the potential for an immissions-orientated and integrated control and adjustment strategy. That has been achieved mainly through the use of modern computational intelligence tools. Within the context of a simulation, control is, along with measurement technology and modelling, the third component required for the holistic optimisation of wastewater treatment plants.

For the implementation of a control concept at the municipal sewerage system of Homburg-Bröl a detailed safety concept was developed in order to ensure that, even in the event of the failure of individual components of the control system, this does not result in any risk to the wastewater systems, the lakes and rivers, the environment or the people living there.

Whilst checking the fuzzy control process developed using an upstream state machine, a reduction of 35% in the quantities discharged within the sewerage system in relation to selected rain events was shown during the simulation.

This was achieved through the optimum exploitation of the capacities available within the sewerage system.

The exploitation of the sewer capacity

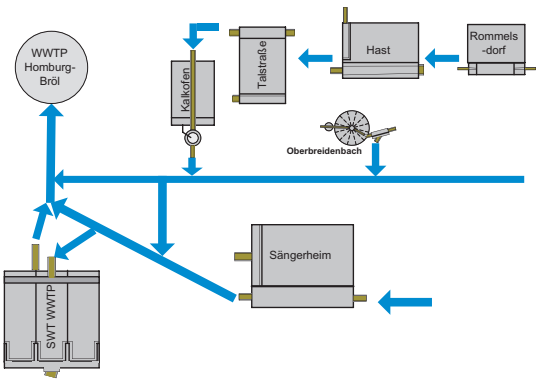

Figure 2: Overview screen sewerage system Homburg-Bröl with SWTs

represents great potential for the active protection of the lakes and rivers through a reduction in the combined wastewater loads. Within the KANNST project it was possible to achieve the top environmental aim, the protection of the lakes and rivers, using modern measurement technology. The technical implementation took place, taking into account all the components integrated into the wastewater system, through simulation on models and using suitable control processes.

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