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Accidental discharge into an industrial WWTP – Evaluation tools for operational procedures

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Master thesis, Environmental Technologies

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INTRODUCTION

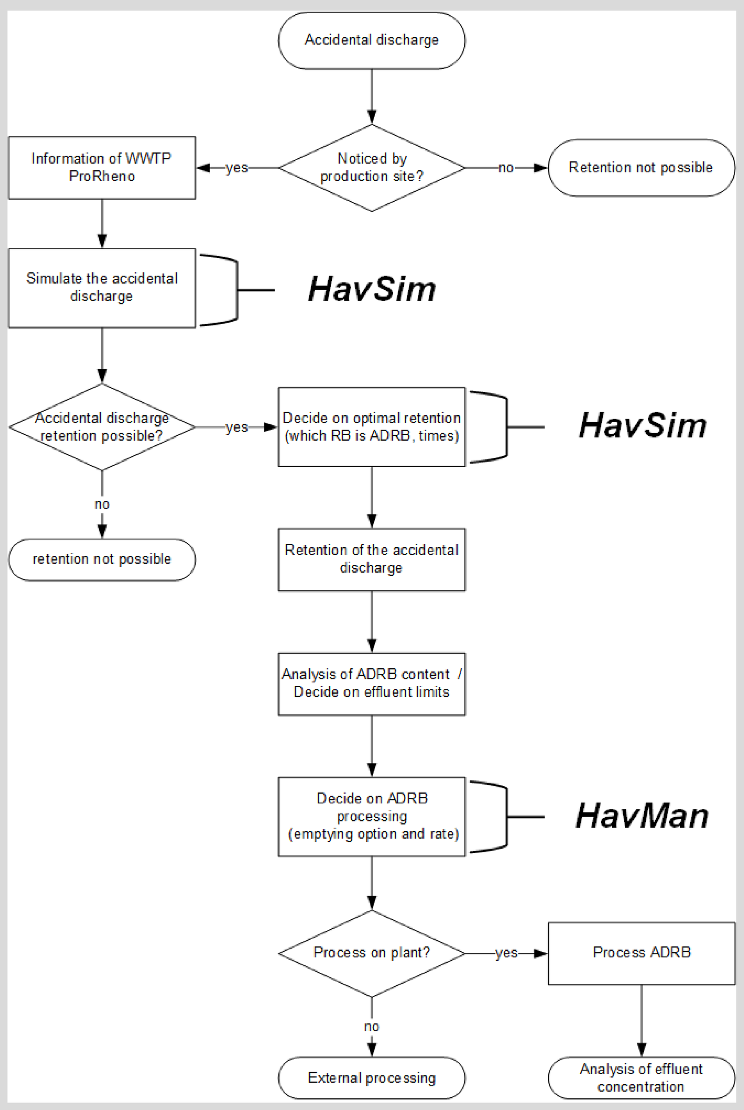
Even though technical and organizational measures are taken accidental discharges into sewerage system can happen. They can occur due to technical faults or incorrect handling and endanger the biology of the wastewater treatment plant, life in the receiving water and can have an impact on groundwater quality. In case of municipal wastewater treatment plant (WWTPs), mainly petrol and heating oil are accidently discharged. For industrial WWTPs the substances accidently discharged can be diverse. On the WWTP the persons responsible must take appropriate and economically acceptable measures to reduce the risk of pollution of a body of water arising from exceptional events like an accidental discharge. From an operational point of view the WWTPs need to avoid the generation of polluted wastewater in great quantities while providing sufficient amount of space in accidental discharge retention basin (ADRB).

Modelling the concentration profile of a substance released during an accidental discharge in a plant helps to

- guarantee the optimal use of the retention basin,
- comply with the legal effluent concentration, and
- guarantee the operation of the WWTP to be cost efficient.

As accidental discharges are not predictable and often occur during the night an evaluation tool for operational procedures based on a graphical user interface can help to calculate the model, interpret the results and therefore speed up the decision making process (see Figure 1).

Figure 1 Process diagram of an accidental discharge demonstrating where the evaluation tools can support the decision making process



CONCEPT

HavSim and HavMan, evolution tools for operational procedures firstly developed in 1998 by Zahnd [1], model the concentration profile of accidentally discharged substances in the industrial wastewater treatment plant ARA Chemie.
The new versions of HavSim and HavMan that are described in this thesis were developed in MATLABs GUI environment, are based on updated models and provide additional functions in order to improve the user-friendliness.

The tools described improve the existing HavSim and HavMan tools by providing:

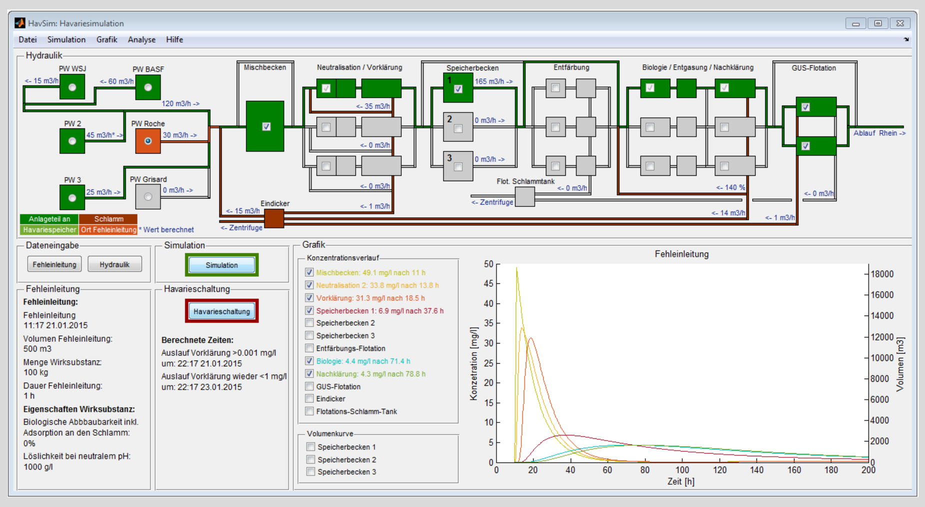
- the ability for HavSim and HavMan to be executed as a standalone Thapplication,
- a Graphical User Interfece (GUI) with the look and feel of the companies process control system and known Microsoft Windows compliance,
- a representation of the plant adapted to the actual plant situation,
- models considering the delay time from the dischargers to the plant,
- more flexibility in the general use of the evaluation tools,
- the ability for the user to save and load data as well as change the default values, and
- a help system in form of an user manual.

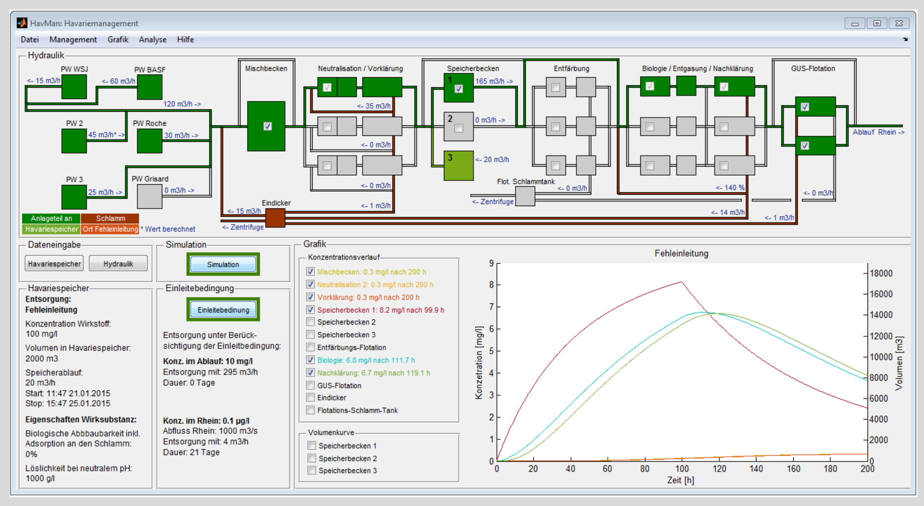
In order to meet the requirements a software requirement specification is defined and the models are compared with the old model, a tracer study and old cases of accidental discharges.

RESULTS

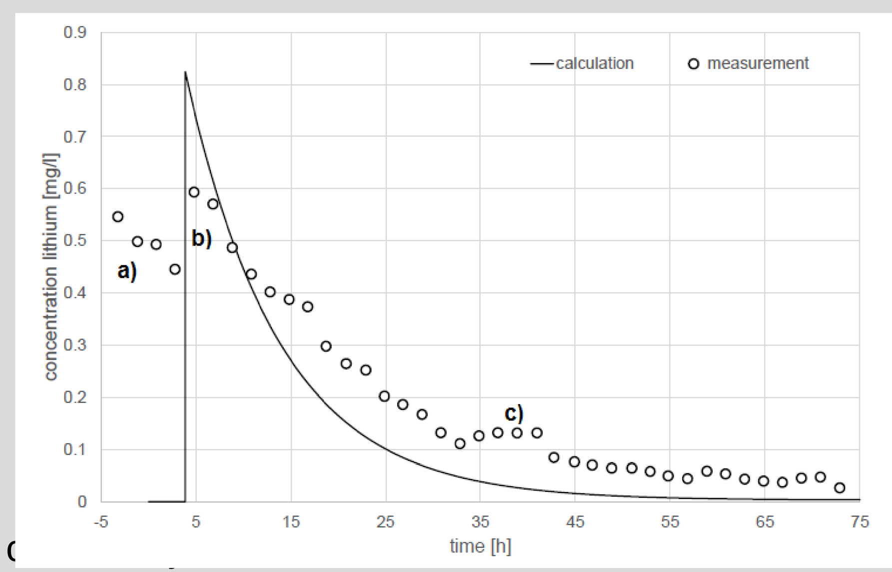
The developed HavSim and HavMan version 2.0 tools fulfil the software requirement specification to a large extend.

Figure 2 and 3 show the base window of the evaluation tool HavSim and HavMan. HavSim can be used to simulate an accidental discharge and to calculate the optimum times for the accidental discharge retention. Whereas HavMan can be used to simulate the processing of the ADRB content and to calculate the maximal discharge rate of an accident collected in the ADRB in regard to the legally required effluent concentrations. The tools run on Windows as well as Macintosh operating systems and can be executed as standalone applications.





In order to validate the delay time in the sewer system a tracer study was carried out. Lithium chloride was selected as a tracer for its advantages; cheap, easily available and easily measurable. As there was already lithium chloride in the system (Figure 4 a)) the tracer study can not be used for evaluation concerning the concentration but the delay time in the sewer system is confirmed (Figure 4 b)). Having only results of one measurement the model of the discharge situation cannot be validated. In comparison to the old model, which did not take the discharge situation into account, it is still an improvement and therefore it is decided to accept the model.



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Results

In the thesis three old cases of accidental discharges were evaluated with the tools. In one case an accidental discharge was retained in an ADRB. Using the *Einleitebedingung* function of HavMan a maximal discharge rate of 19 m3/h was calculated to comply with the legal effluent concentration of 1 µg/l in the receiving water (Figure 5). In the report of the case study the rate was reported as 10 m3/h considering a safety factor of 2. Taking this safety factor into account both results agree. The three case studies showed that there are still possibilities to improve the models in the level of detail. But in general the models fits the data to a great extent and are therefore accepted.

CONCLUSION

In general, the principal is satisfied with the advancement of the tools. The further development of the models and tools as well as the adaption of the current situation allows taking decisions quickly and therefore optimizing the operational procedures. It is expected that this can lead to reduced costs for the accidental discharge retention and processing and lower the impact on the quality of the receiving water.

REFERENCES

[1] Zahnd, P., 1998. *Fehleinleitung in eine Industie-ARA - Bewertungsinsturment für deren Auswirkungen und für chemische Produktionsverfahren*.

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