3D EAU

Hydraulic 3D modelling at the service of water and the environment

Design: Evaluating a tank's settling capacities

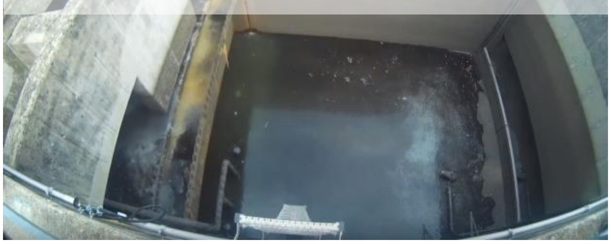
Challenge

Evaluating and optimising the operation of a planned or existing structure with respect to the expectations of the project owner

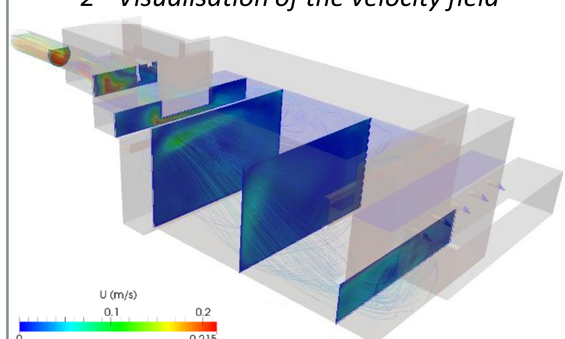
The 3D EAU solution

- **Visualising the structure operating** in its hydraulic environment
- **Calculating the retention rate of the tank** according to the characteristics of the particles encountered in the structure (particle fall velocity, density, diameter, etc.)
- **Assessing the operation** and proposing improvements
- **Evaluation of the effects** of the proposed optimisations after 3D simulations

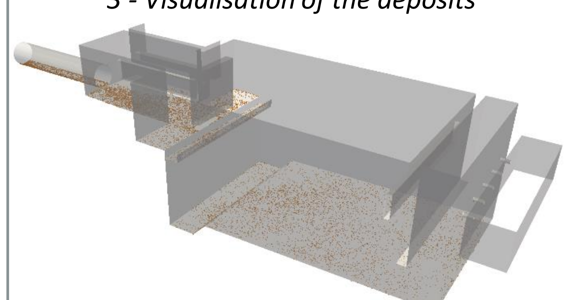
1 - Actual structure



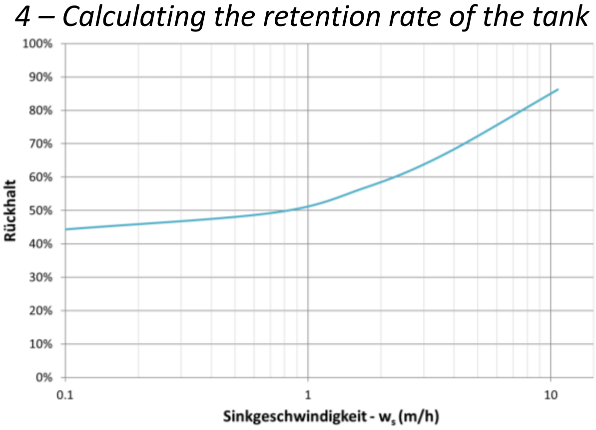
2 - Visualisation of the velocity field



3 - Visualisation of the deposits



4 – Calculating the retention rate of the tank



Details of the proposed solution

3DEAU has its own software solution for special applications, and develops and uses open-source software such as **Openfoam®** in order to solve Navier-Stokes equations for fluid mechanics (for flow rate) and Lagrangian equations (for particle tracking).

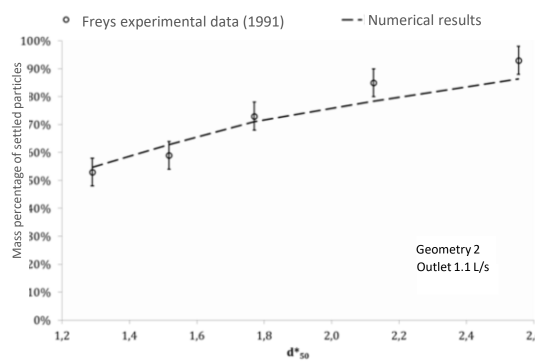
The setup of the model leverages the 3D hydraulic modelling **expertise** developed at the ICube laboratory (University of Strasbourg) and ENGEES[1], to which 3D EAU holds an exclusive licence. In sedimentation tank studies, the flow is considered **turbulent** (RANS equation), **incompressible** and **without heat transfer**, subject to **gravity**, **transitory** and **two-phase** (water + air). Furthermore, the **properties of the particles** are taken into account in calculating the transport of the suspended solids.

[1]: - Dufresne, M., J. Vazquez, A. Terfous, A. Ghenaim, et J-B Poulet. **Experimental investigation and CFD modelling of flow, sedimentation, and solids separation in a combined sewer detention tank**. Computers & Fluids 38, n° 5 (2009): 1042-1049.

- Dufresne M, Dewals B J, Erpicum S, Archambeau P, Pirotton M (2010). **Classification of flow patterns in rectangular shallow reservoirs**. Journal of Hydraulic Research 48(2):197-204.
- Schmitt V, Dufresne M, Vazquez J, Fischer M, Morin A (2014). **Separation efficiency of a hydrodynamic separator using a 3D computational fluid dynamics multiscale approach**. Water Science and Technology, 69(5):1067-1073
- Isenmann G, Dufresne M, Vazquez J, Mosé R (2017). **Bed turbulent kinetic energy boundary conditions for trapping efficiency and spatial distribution of sediments in basins**. Water Science & Technology, 76(8):2032-2043.

Example

As part of the PhD dissertation of Gilles Isenmann (2016), a special module was developed based on a critical turbulent kinetic energy criterion for the movement and deposition of particles. The accuracy of the calculation code for the reduction of suspended solids is approximately 5% (validation under experimental laboratory conditions).



Vorteile

- Improved **understanding** of how the tank works
- **Evaluation of the tank's particle retention rate** with identification of the areas of deposit
- **Analysis** of the 3D model's results to determine the flow in the structure and to optimise it
- A **flexible model**, to determine what effects making simple structural adjustments to the tank would have on the flow

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