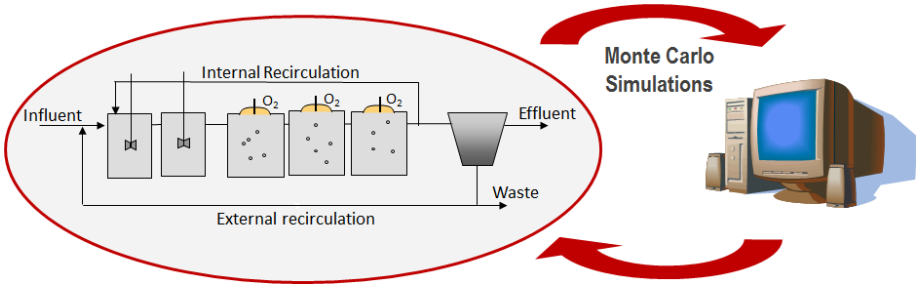
Uncertainty analysis to improve design criteria of wastewater treatment plants (WWTP) thereby reducing associated costs and risks

The Umbrella-DOUT initiative is a net of seven interconnected projects that aim at analysing how uncertainty is being tackled in wastewater treatment plant (WWTP) design.

In practice, design guidelines (Metcalf & Eddy, ATV, Grady, etc.) and safety factors are generally used to develop designs that ensure some effluent requirements (average ammonium below 3 mg/l; total nitrogen below 18 mg/l, etc.).

Research has revealed that the designs are generally overdimensioned and that tens of thousands of dollars might be saved by using dynamic simulations and performing uncertainty analyses on the most important uncertain factors.

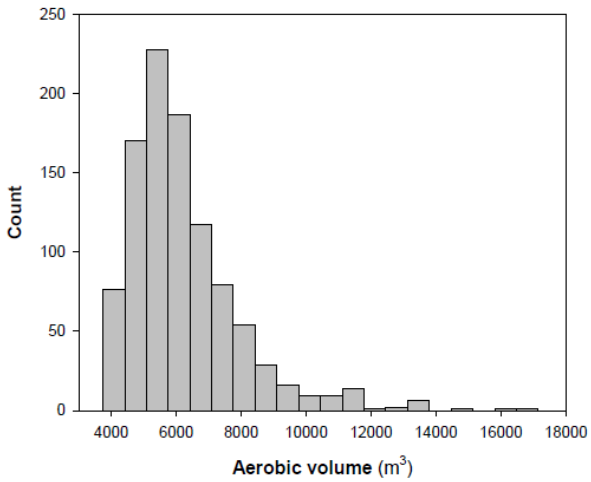
In a Canadian funded NSERC project, co-funded by Primodal Inc., the model*EAU* research group (from Université Laval) has developed a prototype tool for the design of wastewater treatment plants in an uncertainty framework. The main purpose of this prototype tool is to show the potential of using dynamic simulation models in the design phase.

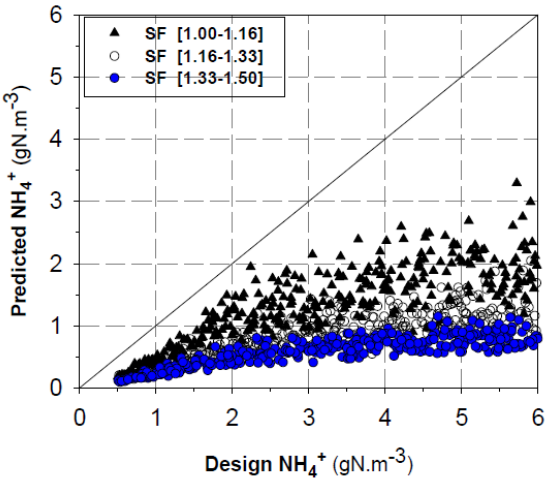


The Metcalf & Eddy guideline is used to size a predenitrification plant for nitrogen removal. An uncertainty analysis was performed on the design space by randomly sampling influent fractions, effluent requirements, and safety factors.

The design guideline proposes 1000 designs. The histogram of the 1000 proposed volumes is skewed with values ranging from 4000 to 17000 m^3. For all these designs, we compared the effluent ammonium of design (introduced in the design guideline) with the effluent ammonium predicted by the dynamic simulation. The figure above illustrates that the dynamic model prediction is always lower

than the design ammonium even when a safety factor of 1.0 (no safety) is used in the design guideline. Since the standard safety factor is 1.6, we can conclude that in general the design guidelines propose overdimensioned wastewater treatment plant designs.





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