

Functional Specification: Evaluation for N-DAMO in wastewater treatment plant

1. Background:

There are two problems frequently discussed in operating biological process in the wastewater treatment plants. The first problem is methane emission problem. Methane is produced in the anaerobic digestion process in the wastewater treatment plants. As a greenhouse gas, the emission of methane in the wastewater treatment plants accelerates the extent of global warming. The second problem is carbon deficiency in the denitrification process. Denitrification is an important process required in the wastewater treatment plants for removing nitrite/nitrate nitrogen in the wastewater. Wastewater containing nitrite/nitrate will cause severe environmental problem, such as eutrophication. Denitrification conducted by organisms called denitrifiers require organic carbon as electron donor to convert nitrite/nitrate to nitrogen. Wastewater contains carbon contaminants can be served as carbon source for denitrification process. However, the carbon is depleted by the biological process prior to denitrification process, which builds the gap for removing nitrite/nitrate in the wastewater. Nitrite/nitrate dependent anaerobic methane oxidation (N-DAMO) organisms have been widely proposed as the solution of these two problems existing in the wastewater treatment plants. N-DAMO organisms are able to use methane as carbon source and electron donor. Although several studies point out the potential for using anaerobic effluent (which contains dissolved methane) as the carbon source for enriching N-DAMO organisms to denitrify, there is no wastewater treatment plant actually conducting this idea. It is possible that changing operation process will lead to dramatic changes of organisms in the biological process and further decreases denitrification performance. As a result, the idea of this project is to design a model, which can preliminary evaluates the denitrification performance if we apply N-DAMO organisms in the wastewater treatment plant.

2. User profile:

The target users are the civil engineers working in the wastewater treatment plant to preliminary evaluate the denitrification performance for switching to N-DAMO organisms for denitrification. They might need to have basic understanding on python. I plan to write a code for them to put water quality parameters, which are frequently collected in the wastewater treatment plants. The users can simply type the value of respective water quality data, and they can get preliminary result from

the model.

3. Use cases:

Use case1: I plan to use COD to predict dissolved methane. Methane amount could be roughly predicted by COD, but the dissolved methane is influenced by salinity and temperature. The objective of the user interaction is to know the dissolved methane by three water quality values: COD, salinity and temperature. The expected interactions between the user and my system is that the user can simply input one-month (or hopefully longer, like one year) COD, salinity and temperature data and get one-month dissolved methane data. This result can be a very preliminary data for evaluating the carbon source for N-DAMO microorganisms. The visualization result will be a figure of one-month dissolved methane concentration.

Use case2: I plan to evaluate nitrite/nitrate removal by N-DAMO organisms. The objective of the user interaction is to obtain one-month nitrite/nitrate concentration after reacted by N-DAMO organisms. The expected interactions between the user and my system is that users will need to input the nitrite/nitrate concentration. The dissolved methane data previously obtained will be directly used for the input. I assume methane could be thoroughly used by N-DAMO organisms and the user can obtain the nitrite/nitrate concentration after denitrification process by N-DAMO organisms. One-month data of nitrite/nitrate concentration will also be visualized as a figure to see if N-DAMO microorganisms could replace traditional denitrification based on the dissolved methane in the wastewater treatment plant.