Nitrogen Removal from Wastewater by a Sequencing Batch Reactor

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ABSTRACT

Sequencing batch reactor (SBR) is one of several periodically operated, suspended-growth activated sludge system. It has an advantage for nitrogen removal which is difficult to remove with conventional system. This paper reviewed the nitrogen removal performance in SBR for several different industrial wastewaters and discussed the factors which may affect the treatment performance. Several modified processes developed on the basis of SBR were introduced. and some problems in basic research were discussed.

KEYWORDS

Sequencing batch reactor, nitrogen removal, nitrification, denitrification.

INTRODUCTION

The Sequencing Batch Reactor (SBR) is an activated sludge process designed to operate under non-steady state conditions. An SBR operates in a true batch mode with aeration and sludge settlement both occurring in the same tank. The major differences between SBR and conventional continuous-flow, activated sludge system is that the SBR tank carries out the functions of equalization aeration and sedimentation in a time sequence rather than in the conventional space sequence of continuous-flow systems. In addition, the SBR system can be designed with the ability to treat a wide range of influent volumes whereas the continuous system is based upon a fixed influent flowrate. Thus, there is a degree of flexibility associated with working in a time rather than in a space sequence.

The SBR process is characterized by a series of process phases (fill, react, settle, decant), each lasting for a defined period of time. If no wastewater is available (e.g. on industrial application sites), the SBR can rest in an idle phase. When biological nutrient removal (BNR) is desired, the steps in the cycle are adjusted to provide anoxic or anaerobic periods within the standard cycles (EPA, 1992). The different phases of SBR operation are summarized in Fig. 1.

The sum of the phases makes up a process cycle which is progressively repeated. During each cycle unsteady-state conditions prevail. In the long term, control and periodic repetition of the short-term unsteady state allows the enhancement of certain effects such as (a) enzymatic activity, (b) accumulation of metabolic products, and (c) selection and enrichment of specific groups of micro-organisms (Morgenroth et al., 1998). Similar effects are achieved in continuous-flow activated-sludge systems with a plug-flow or cascade-flow bioreactor, where the activated sludge circulating in the system is also exposed to various process situations in the subsequent tanks or zones for a distinct hydraulic retention period corresponding to the duration of the respective phase in the SBR.

The SBR process is accomplished in a simple tank, through sequencing stages. The sequencing series for treatment consists of the following process stages: fill, react, settle, decant and idle. The steps in the react cycle are adjusted to provide anaerobic, anoxic and aerobic phases in certain number and sequence for biological nutrient removal.

Applicability

SBR is applicable for any municipal or industrial waste where conventional or extended aeration activated sludge treatment is appropriate. SBR sizes can range from 12000 L/d to over 20000 ton/d. The technology is applicable for BOD and TSS removal, nitrification, denitrification and biological phosphorus removal. It