ChemScan® UV-6100 Process Analyzer

PROJECT REPORT AND DATA SUMMARY
SEQUENCED BATCH REACTOR
PROCESS MONITORING AND CONTROL

City of Park Rapids, MN
RDO Foods Treatment Plant
Park Rapids, MN

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Introduction

The RDO Foods Treatment Plant uses an SBR process arranged in three parallel tanks for treatment of a potato processing waste. The SBR process includes nitrification and denitrification steps.

Although the SBR process is customarily controlled based on time intervals, this specific process is being controlled based on ammonia and nitrate concentration measurement of the process samples.

Process Description

Attachment 1 describes the process flow for this facility.

Raw process wastewater flows into Anaerobic Pond #1 where it is subjected to anaerobic decomposition. The anaerobic decomposition process results in the formation of ammonia and the solubilization and decrease of carbon content. Wastewater from Pond #1 is utilized in two forms. One, a partially anaerobically treated wastewater taken from the first zone of the pond, that is high in carbon and relatively low in ammonia. Two, a fully anaerobically treated wastewater taken from the effluent of Pond #1, that is high in ammonia and low in carbon.

The effluent from Pond #1 is pumped to the SBRs. Nitrification and denitrification occurs in the SBRs by subjecting the waste to alternating aerobic and anoxic conditions. In order to accomplish denitrification, a carbon source must be added to provide the denitrifying bacteria with carbon for cell synthesis. The carbon source used is the partially treated wastewater from the first zone of Pond #1. The partially treated wastewater is added into each active SBR based on the initial ammonia concentration of the Pond #1 effluent measured by ChemScan. When the SBR process was first started up, the carbon source was measured to establish its organic content by using the ChemScan analyzer. The ChemScan analyzer provides an absorbance value that is correlated to COD. Eventually it was determined that the COD is constant enough to eliminate the requirement for measuring.

After addition of the carbon source to the pond effluent, air is turned on in the SBR and the nitrification process is allowed to occur. Nitrification converts ammonia into nitrate. Ammonia and nitrate is measured at the start of nitrification using the ChemScan analyzer. Nitrification is allowed to continue until a desired decrease in ammonia level has been accomplished as measured by the ChemScan analyzer.

Following nitrification, the air is turned off and denitrification is allowed to occur. Nitrate and ammonia are measured by ChemScan at the start of denitrification. Denitrification converts nitrate into nitrogen gas. Denitrification is allowed to proceed until a desired decrease in nitrate has been accomplished as measured by the ChemScan analyzer.

Following denitrification, nitrification is once again undertaken. Each batch of wastewater is stepped through nitrification and denitrification until an acceptable ammonia and nitrate level is achieved. Processed wastewater that has been treated to acceptable limits is used for irrigation. Wastewater that is off-spec is transferred to an off-spec storage pond and returned to the system for additional treatment.

ChemScan System

A functional block diagram for the on-line control system can be seen as Attachment 2. A control computer (supplied by others) selects the sample point to be monitored and directs flow from one of the three process tanks through a ChemScan ultrafilter system. A volume of filtrate is collected in an accumulation vessel and then pumped to a ChemScan Process Analyzer for ammonia and nitrate analysis. Signals are output by the ChemScan system to the control computer, where the information is matched to the appropriate sample point and used by the computer as an input to a control algorithm for the process.

The original design called for ChemScan to make a measurement of COD when carbon must be added for denitrification. A second ultrafilter system was used for the carbon samples, with a single ChemScan system used for analysis of both carbon and process samples. The arrangement of this system can be seen on Attachment 3. During operation the operators found that the COD value of the waste used as a source of carbon was consistent and did not require on-line analysis.

Attachment 1

Attachment 2

Attachment 3