

Anammox Process for Removal of Ammonia from Landfill Leachate

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Abstract

Landfilling is a common practice used to dispose municipal solid waste due to economic considerations in developing countries as Sri Lanka. Among the different ways of landfilling, open pit dumping can be identified as the worst case which creates severe impacts on environment. Major impact which was reported over the years is the contamination of ground and surface water. This highly contaminated waste water which comes through landfills, are called landfill leachate. Since, leachate is directly unveiled to the environment, proper treatment should be carried out prior to dispose. Composition of leachate varies with time. Testing of this research based on Karadiyana Dump site, Sri Lanka and it is recorded that contamination of water in terms of ammonia, nitrite and phosphorous as 700-900 mg/L, 60-126 mg/L and 33-66 mg/L respectively. Also, in Karadiyana high LPI value of 28.88 was indicated. Conventional as well as innovative treatment methods are used to treat leachate. In recent past, many innovative techniques were discovered by scientists to treat leachate. Anammox process is one of the major findings to treat high nitrogen loaded wastewater. Conventional nitrification requires high aeration and denitrification requires high carbon sources. Hence, conventional techniques incurred higher cost. Reduction of oxygen consumption by 60% and no additional carbon source requirement can be identified as dominant advantages over conventional nitrification/denitrification process comparing with anammox process. Anammox bacteria were enriched by applying synthetic wastewater under anaerobic condition in a sequencing batch reactor (SBR). After successful enrichment of anammox bacteria, reactor was set to 32±0.5° C and pH 7.5 with HRT of 4 days for anammox process. After a successful anammox process that partially treated wastewater was set to flow through bio char barricades and thereafter through a constructed wetland. 99% ammonia removal as well as 98% of nitrite removal was identified during 25 days of testing period. Further, 82% of phosphorous removal also was recorded. Addition to those, 65% of COD removal was obtained. Additional development can be done to anammox process since nitrite is an intermediate component for both nitrification and denitrification. This partial nitritation (PN) prior to anammox treatment can be performed in a Single reactor for High activity Ammonia Removal Over Nitrite (SHARON). Main objective of PN is to achieve stoichiometric ratio between ammonia nitrogen to nitrite nitrogen for better anammox process. According to the anammox reaction this ratio should be 1:1.32 between ammonium nitrogen to nitrite nitrogen under aerobic condition and ammonium oxidizing bacteria (AOB) have to be prepared prior to the process. Sludge taken from an aeration tank can be used to enrich AOB. And this combined process is called PN-Anammox.

Keywords: Anammox, Leachate treatment, Partial nitritation