Nitrification in a Circulating Bed Reactor: pH and Dissolved Oxygen Effects

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This study is aimed at investigating the influence of dissolved oxygen and pH on the nitrifying activity of a biofilm reactor, the Circulating Bed Reactor(CBR).
The effect of the dissolved oxygen concentration (DO) on reactor nitrification activity was studied in short term experiments (10 –12 hours), by manipulating the oxygen partial pressure in the incoming gas and thereby the dissolved oxygen in the reactor. A Biological Oxygen Monitor (BOM) was used for the measurement of the respiration rate of biofilm particles taken from the reactor, at two different operating condition, without and with pH control. The respirometric method used has been described elsewhere [1]. The biofilm mass was estimated by means of Total Protein (TP) measurements (Lowry method).
Fig. 1 presents the influence of bulk oxygen to ammonia ratio on reactor ammonia removal efficiency. The transition from ammonia limitation to oxygen limitation was found to occur when the bulk oxygen to ammonia ratio was about 1.5 – 2 g O_2/gN–NH_4^+. This value is lower than the ones reported in literature, 2.5 – 4 g O_2/gN–NH_4^+ [2].
The specific ammonia oxidation rate (SAOR) as determined from CBR operation and the one obtained in the BOM are compared in Fig. 2. For the case of no pH control, the oxidation rate values obtained by both procedures are similar, once the ammonia concentration was not limitin (15 mg N–NH_4^+/L for CBR and 10 mg N–NH_4^+/L for the BOM). Due to pH control implementation, the oxidation rate in the reactor increased and the ammonia concentration became limiting (<5 mg N–NH_4^+/L). This explains the large difference between the values obtained in the BOM (where ammonia is not limiting) and in the CBR.

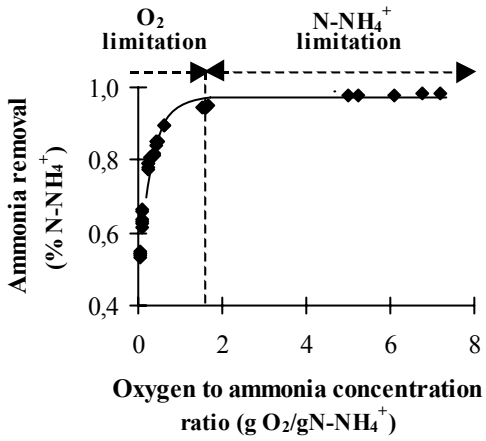

Fig. 1 Ammonia removal as a function of bulk O_2/N–NH_4^+ effluent concentration.

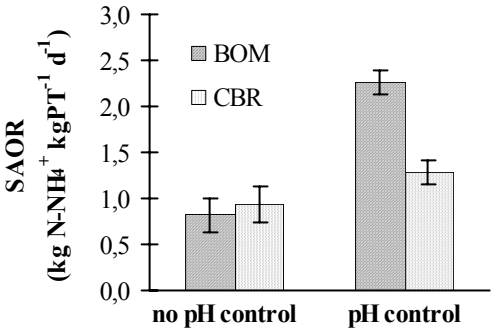

Fig. 2 SAOR obtained in CBR and determined in the BOM

The main conclusions to be drawn from the present work are:
– the lower transition value from ammonia limitation to oxygen limitation, appears to be due to the high turbulence in the CBR which results in reduced resistances to oxygen transport;
– the respiration rate is a valuable tool for the characterisation of biofilm activity, and could be useful for controlling and identifying disturbances (in particular those due to a pH effect) that affect nitrification reactor performance.

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