MICROBIAL METHANE OXIDATION STUDIES IN LABORATORY SCALE EXPERIMENTS

by

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Abstract

Laboratory scale experiments were conducted with soil column to study the methane oxidizing capacity of methanotrophs. The study was confined to determine the oxidation potential in two soil columns and batch experiments. Methane concentration was monitored at headspace and oxidation capacity was calculated using mass balance. Methane oxidation rates were determined after establishment of steady state condition. Effect of moisture content and temperature was monitored and found to have significant effects on methane oxidation potential. Low moisture content inhibited oxidation rate and oxidation rate was controlled by temperature significantly. Experiment on column system produced an oxidation rate of 100 g CH_4 per m^2 per day. Increases in gas supply rate could not produce comparable increase in oxidation rates although some increase in oxidation rate was observed. Significant oxidation was noticed at a wide range of temperature although optimum was found to be between 30 to 37^0 C. Oxidation rate was slowed down at lower temperature more rapidly. Moisture content between 14 - 20% was favorable for oxidation with oxidation rate dropped to almost zero at moisture content below 5%. Higher moisture content (more than 18%) in column system could not produce higher oxidation that could be due to low diffusion transport of gases. Oxidation rate was found maximum at a depth 15 to 45 cm from top with depth profile of both oxygen and methane overlapped at this depth. High temperature, although favorable for oxidation, also caused decrease in moisture content of topsoil, reducing oxidation rates. Fresh soil produced less oxidation than soil removed from column with high methane atmosphere when incubated under favorable environmental condition of temperature and moisture content. Maximum oxidation capacity of $276*10^{-6}$ g CH_4 per g soil per day ($11.5*10^{-6}$ g CH^4/g soil.h) was observed with soil rich in methanotrophic bacteria. Soil likely to exposed to elevated methane concentration like landfill cover soil could be designed and proper moisture condition can be maintained considering the effect of temperature of the region in order to reduce atmospheric methane concentration. Well-planned, constructed and managed landfill cover soil can have mitigation effects on reducing methane emission from landfill and helps to reduce potential of greenhouse effect.