研究报告

梅昌艮,贺玉龙,苏凯,熊春梅.生物覆盖层属性对气体输运过程的影响[J].环境科学学报,2015,35(10):3210-3217

生物覆盖层属性对气体输运过程的影响

Influence of biocover properties on gas transport

关键词：生物覆盖 空间变异性 扩散 气体通量 数值模拟

基金项目：教育部新世纪优秀人才支持计划项目(No.NCET-11-0710);中央高校基本科研业务费专项资金(No.SWJTU12CX003,2682014CX015)

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摘要：为更好地理解生物覆盖介质属性对甲烷减量化过程中气体通量分布的影响,将熟化时间为24个月和2个月的新旧绿色废物分别用于建设1#和2#生物覆盖单元.通过分布在其表面的12个静态箱测量混合气体的组成和通量,结合生物覆盖层含水率和干密度对示踪气体进行回归分析,并利用数值模拟工具模拟示踪气体的输运过程.测量结果表明,两个覆盖单元表面气体通量分布呈现高度变异性,其中,1#单元中气体通量的最大值与最小值的差别达9倍,在2#单元中,这种差异放大到20倍.生物覆盖层中含水率和干密度(孔隙度)也同样呈现出高度变异性,多元回归分析表明,含水率和干密度的分布与气体通量的分布明显线性关系,其中,含水率的分布总体上决定了气体的输运路径.数值模拟结果表明,气体在2#单元中的输运受到扩散过程的影响较大,结构性因子变异程度更高导致了预测的不确定性.

Abstract：24-month and 2-month old green wastes were filled into two biocovers marked with 1# and 2#, respectively, for a better understanding of biocover properties on gas transport when biocover technology was utilized to mitigate methane emissions. Gas compositions and fluxes were measured by 12 static chambers placed on the top of each biocover. Regression analysis and numeric simulation were performed to analyze the correlation of gas fluxes and properties such as moisture content, dry bulk density and model transport of tracer. Measurement data showed that gas fluxes exhibited high spatial variability, with the difference between maximum and minimum gas flow about a factor of nine and two orders of magnitude in 1# and 2# cell, respectively. Moisture content and dry bulk density in both biocovers also exhibited high spatial variability, and multiple linear regression analysis suggested that gas distribution in both biocovers was correlated with water distribution and dry bulk density. Water distribution played important role in determining the transport path of gas. Simulated results indicated that diffusive process influenced the distribution of gas fluxes in 2# cell more significantly, and higher variation of structure factors might result in prediction uncertainty.

Key words：biocover spatial variability diffusion gas flux numerical simulatio

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