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有机污染物在HDPE膜-膨润土复合防污帷幕中的一维扩散解析

**Analytical solution for one-dimensional diffusion of organic pollutants through HDPE geomembrane-bentonite composite barrier**

关键词: [有机污染物](#) [HDPE膜-膨润土复合帷幕](#) [一维扩散](#) [解析解](#)

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**摘要:** HDPE膜-膨润土复合防污帷幕被认为是目前最为安全有效的地下污染源阻隔技术之一.针对帷幕底部嵌入不透水层和帷幕下游地下水较为活跃的工况,推导了有机污染物在HDPE膜-膨润土复合防污帷幕三层结构中一维扩散解析解.利用本文的解析解分析了HDPE膜-膨润土复合帷幕对亲水性和疏水性两类有机污染物的阻隔效果.分析结果表明:由于亲水性有机物与HDPE膜间的分配系数低,该复合防污帷幕对其阻隔效果显著优于具有高分配系数的疏水性有机物.对于疏水性有机物,可通过增大复合帷幕中膨润土的阻滞因子和帷幕厚度来改善其阻隔效果;膨润土的阻滞因子增大10倍且帷幕厚由0.6m增大为1.0m,改进后复合帷幕对疏水性有机物的阻隔效果可达到原帷幕对低分配系数亲水性有机物的阻隔水平.工程实践中可通过对HDPE膜进行表面处理以降低其分配系数或膨润土改性以增大其阻滞因子等措施来增强该复合帷幕的阻隔效果.

**Abstract:** HDPE geomembrane-bentonite composite barrier is known as one of the most reliable and effective technologies for containing underground contaminants. Analytical solution for one-dimensional diffusion of an organic solute in three-layered membrane-bentonite composite barrier was presented, particularly for the case that the vertical barrier is keyed in bedrock and active ground-water flow exits at the downstream boundary of the barrier. Based on the solution, the barrier performances for hydrophilic organic pollutants and hydrophobic organic pollutants were investigated. The results showed that the geomembrane-bentonite composite barrier exhibits much better performance against hydrophilic organic pollutants than hydrophobic organic pollutants. This is because of smaller partition coefficient between the hydrophilic organic pollutants and the HDPE geomembrane. For the hydrophobic organic pollutants, the barrier performance can be significantly improved by increasing the retardation factor of bentonite and the barrier thickness. It is found that when the retardation factor of bentonite increases by ten times and the thickness of barrier increases from 0.6 m to 1.0 m, the performance of the enhanced barrier against the hydrophobic organic pollutants can reach the excellent level for the hydrophilic organic pollutants. In engineering practice, the performance of the composite barrier can be improved by making a surface treatment of HDPE geomembrane to decrease the partition coefficient or enlarging the retardation capacity of the bentonite.

**Key words:** [organic contaminant](#) [HDPE geomembrane-bentonite composite barrier](#) [one-dimensional diffusion](#) [analytical solution](#)

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