Available online at www.sciencedirect.com

ScienceDirect

Energy Procedia 107 (2017) 217 – 221

Energy Procedia

3rd International Conference on Energy and Environment Research, ICEER 2016, 7-11 September 2016, Barcelona, Spain

Contamination Prediction and Control of Landfills to Groundwater in Coalmine Subsidence Area

Fei Lin, Peigui Liu*, Ting Wei, Honglei Ren, Dan Wu, Yuezan Tao

School of Civil Engineering, Hefei University of Technology, Hefei 230009, China

Abstract

This paper aimed at the prediction and control of NH_3-N in the transportation of leachate under the monitored natural attenuation (MNA) of a landfill in the coalmine subsidence area of Huainan, Anhui province, China, and four scenarios were analyzed: (1) natural state without biodegradation, (2) natural state with biodegradation, (3) closure state without biodegradation, (4) closure state with biodegradation. The results showed that the leachate could be well controlled by anti-seepage wall and that the biodegradation played an important role in MNA process of NH_3-N in leachate. The feasibility of anti-seepage measures was put forward in terms of leachate control in landfill and conclusions according to the evaluation could be applied for actual contamination sites.

Peer-review under responsibility of the scientific committee of the 3rd International Conference on Energy and Environment Research.

Keywords: Biodegradation; coalmine subsidence area; landfill; leachate; monitored natural attenuation

1. Introduction

As a serious environmental issue, contamination of groundwater has aroused wide concern for its impact on groundwater quality and drinking water resources. In coalmine subsidence area, landfilling used to be performed without the presence of appropriate liners to prevent percolation of leachate into underlying aquifers in the past decades. Leachate of municipal waste landfill formed after its closure, which usually contains high concentration of

* Corresponding author. Tel.: +86-0551-62902730; fax: +86-0551-62902730.
E-mail address: linfei@mail.hfut.edu.cn

Peer-review under responsibility of the scientific committee of the 3rd International Conference on Energy and Environment Research.
doi:10.1016/j.egypro.2016.12.130

organic contaminants. The infiltrated leachate can cause regional groundwater contamination inevitably [1, 2]. Moreover, the quality of groundwater and microbial communities changes significantly through the degradation of organic contaminants, depletion of electron acceptor and changes of redox zone in the time and space, etc. [3-5]. For aerobic degradation, oxygen is one of the most important factors [6], in the contaminated aquifer, aerobes consume oxygen and convert organic contaminant to carbon dioxide and water. According to the study of characterization of microbial populations in landfill leachate during aerobic biodegradation, count of aerobes in leachate increased by two orders of magnitude during the first several months of air injection [7-8]. The number of bacteria in leachate contaminated aquifers was relatively high, in comparison with that in pristine aquifers [9]. Therefore, in order to protect water resources in coalmine subsidence area, the contamination of landfill to groundwater needs to be predicted and controlled. Also, some prevention and protection measures should be put forward.

2. Computing method

Hydrogeological and boundary conditions of groundwater in coalmine subsidence area are very complex, and mathematical models relying on analytical methods normally cannot reflect actual hydrogeological conditions, such as heterogeneity of aquifers and boundary conditions, etc. Therefore, numerical simulation methods are more appropriate to solve differential equations. Computing models using numerical simulation methods are well established based on Groundwater Modeling System (GMS) [10], which is one of the most intuitive and capable software platform used to create groundwater and subsurface simulations in a 3D environment.

3. Case study

3.1. Hydrogeology condition

Huainan (Fig. 1) is located in the middle reaches of Huaihe river and belongs to the Huaihe river alluvial plain in Jianghuai hilly region. Its topography is higher in the south and lower in the north. Huainan belongs to warm temperate semi-humid monsoon climate zone and characterizes with wet summers and cold winters. The average temperature ranges between 15.8 and 40.3 ˚C. Its average rainfall is 942.8 mm. The groundwater level depth varies from 0.5 to 12 m. The simulation area is about 5 km^2 with three main stratums. The first layer is filled with miscellaneous and domestic garbage and the thickness is about 0 ~ 19 m. The second layer is filled with silty clay and the thickness is 0.7 ~ 15 m. The third layer is weathered sandstone. At present, the landfill site spreads over an area of about 650 × 200 m^2 and the height of waste varies from 10 to 20 m. This site has not been designed systematically before being used for the landfill and the base has not been lined, thus it is of necessity to predict the transportation of leachate and evaluate the impact on subsurface groundwater system.

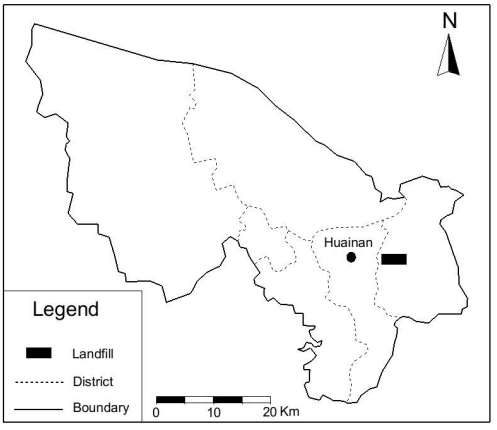

Fig. 1. Location of landfill sites in Huainan.