



Available online at www.sciencedirect.com


ScienceDirect
 Journal of Hydrodynamics

2011,23(3):391-397

DOI: 10.1016/S1001-6058(10)60128-X



[www.sciencedirect.com/
 science/journal/10016058](http://www.sciencedirect.com/science/journal/10016058)

APPLICATION OF TIME-VARYING VISCOUS GROUT IN GRAVEL-FOUNDATION ANTI-SEEPAGE TREATMENT*

CHENG Peng-da, LI Lu

Shanghai Institute of Applied Mathematics and Mechanics, Shanghai university, Shanghai 200072, China,

E-mail: turbo_cheng@foxmail.com

TANG Ju

Beijing Wangleihong Foundation Project Co., Ltd, Beijing 100071, China

WANG Dao-zeng

Shanghai Institute of Applied Mathematics and Mechanics, Shanghai university, Shanghai 200072, China

(Received October 28, 2010, Revised December 11, 2010)

Abstract: The time-varying viscosity of common grout and the controllable grout are measured with a rotation viscometer in experiments. The time-varying viscosity of grout is analyzed according to the characteristics in the process of anti-seepage treatment for gravel foundation. The principle of effective stress for porous medium is applied to analyze the fluid-structure coupling in grouting. In the consideration of coupling physical variables, dynamic models of porosity, permeability and viscosity are constructed. The diffusion radius can thus be defined by the foundational porosity. The distribution of holes in field experiments is designed according to the diffusion radius of grout. Then, the permeability test is designed to verify the grout effect. The calculated diffusion radius coincides with experimental results, and the permeability meets the requirements of the project, which is valuable for the anti-seepage treatment in gravel foundation.

Key words: fluid-structure coupling, viscosity, gravel foundation

Introduction

In China, gravel foundation is often applied in the hydroelectric-constructions. For complicated aquatic materials with, strong permeability and uneven distribution of porosity, a series of problems in construction might be encountered. Grouting is a common technique in anti-seepage treatment, so how to efficiently and economically implement anti-seepage in gravel foundation is of great interest^[1]. Based on the controllable viscosity of grout and the characteristics of fluid-structure coupling, scientific construction projects could be designed, with which the strength of foundation and anti-seepage level could be improved.

The rheological behavior of common grout has

been widely investigated. Sun et al.^[2] experimentally studied three cement slurries and found that their experimental results fit an Herschel-Bulkley viscosity model very well. Ruan^[3] investigated viscosity variation of several materials, such as the common grout with water-cement ratio ($W/C = 0.9$), clay-cement grout, composite grout and five kinds of chemical grout. He found that a time-varying viscosity satisfies an exponential law. Previous studies on grouting generally neglected time-varying viscosity and fluid-structure coupling in the process of grouting.

Controllable grout refers to the grout that the viscosity of which could be controlled with accelerator. The viscosity of common grout changes very slowly according to the timeline, and the solidifying process is postponed. Accelerator is an economically efficient solution, with which the grout will generally concreted in 30 s to 600 s. Because of limited solidifying time, the grout diffusion could be controlled, and then the grout pressure could be rapidly enhanced, thus the foundation strength and anti-seepage level could be improved.

* Project supported by the Shanghai Leading Academic Discipline Project (Grant No. S30106), the Shanghai Program for Innovation Research Team in Universities.

Biography: CHENG Peng-da (1983-), Male, Ph. D. Candidate

Corresponding author: WANG Dao-zeng,

E-mail: dzwang@staff.shu.edu.cn