

# 无水砂卵石地层土压盾构施工泡沫技术研究

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**摘要** 使开挖土体处于良好的塑流状态, 是保证土压平衡盾构顺利掘进的重要措施。无水砂卵石是一种典型的力学不稳定性地层, 盾构在此条件下掘进, 土体塑性差, 刀盘及螺旋输送机磨损严重, 开挖面土压平衡不易保持, 容易崩塌。以北京市凉水河南岸污水盾构隧道为背景, 在加泥的基础上, 针对砂卵石地层对泡沫技术进行了室内试验研究和现场应用, 与单独加泥的效果进行了比较, 并分析了泡沫的作用机理。使用泡沫后, 不仅有利于保持开挖面土压平衡, 而且机械负荷及刀盘磨损大大减轻, 对于保证盾构顺畅地切削排土及匀速推进具有重要的意义。

**关键词** [隧道工程; 无水砂卵石; 土压平衡盾构; 泡沫; 泥浆; 土体塑性](#)  
**分类号**

## STUDY ON FOAM TECHNOLOGY DURING SHIELD EXCAVATION IN SANDY COBBLE BED WITHOUT WATER

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### Abstract

The main types of shield machine used recently in tunnel construction are earth pressure balance (EPB) shield and slurry shield. In order to keep muck discharged fluently and lighten machine burden, the soils in chamber of EPB shield should be plastic and fluid. This is fundamentally critical to ensure the shield to advance continuously and smoothly. Sandy cobble without water is a typically unstable stratum and its mechanical properties are unfavorable to force's transitivity and spread. Sandy cobble is of unfavorable plasticity and fluidity, which is sure to bring serious wear of cutter wheel and screw. Moreover, earth pressure balance of face is not easily maintained and the face is easy to collapse. As a case of EPB shield construction, a sewage tunnel in Beijing is presented. In the beginning 200 m of the shield tunnel, field driving tests are carried out. Firstly mud is injected into the chamber to sustain the plasticity and fluidity, but perfect effects are not acquired. Then foam technology is studied experimentally and used in field shield construction, in which calculation method

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and dosage of the foam are recommended. Then test results between injection of mud individual and combined injection of mud and foam are compared; and oil pressure of the cutter wheel and the screwer of the later is about 1/3 of the former; surface settlements also decrease from 20 mm to 5 mm. Finally, the mechanism of foam effects is analyzed and its effects can be summed up to two aspects as following: (1) forming a admixture level in the tunnel face composed of sandy cobbles, mud and foam; (2) forming a thin membrane around every granules. Study and practice prove that the mud and foam are not only beneficial to earth pressure balance, but also can lighten mechanical load and abrasion, which are remarkably significant to smooth cutting, soil discharge and high-speed advance of the EPB shield.

**Key words** [tunneling engineering](#); [sandy cobble without water](#); [earth pressure balance shield](#); [foam](#); [mud](#); [plasticity and fluidity of soil](#)

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