Pressurized Chamber Access Technology and Application for Ultra-large Diameter Slurry Shield TBMs: Post-print

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Abstract

Due to the complex geological conditions in Guangzhou, shield tunneling frequently encounters issues such as abnormal cutter wear and muck accumulation with poor discharge in the excavation chamber. Chamber access and cleaning constitutes an effective remedial measure; however, constrained by geological conditions and surface environment, such operations entail stringent safety requirements. This study, based on the super-large diameter slurry shield construction of the Guangzhou Haizhuwan Tunnel and the project's hydrogeological context, analyzes the problems of parameter deterioration, stone crusher oil leakage, and rear grid rupture encountered during construction, along with their root causes, and presents targeted countermeasures. The following conclusions are drawn: (1) When shield tunneling manifests significantly increased earth pressure and torque coupled with reduced advance speed, chamber access should be deemed necessary to inspect mud cake formation on the cutterhead and cutter wear, with an appropriate section selected for such access; (2) Pressurized mud cake removal and cutter replacement must strictly adhere to the technical workflow: rear water stopping → bentonite injection → filter cake formation → liquid level reduction → pressure holding test → personnel chamber entry → decompression and exit; (3) During chamber access operations, particular attention must be paid to whether the air replenishment rate and Samson valve opening satisfy requirements, whether chamber pressure and liquid level remain stable, with enhanced monitoring and surface patrols; (4) When the forward-shifted P2.1 pump suction port at the air cushion chamber bottom becomes unsuitable for tunneling conditions, evidenced by frequent suction blockages or sudden pressure drops at the P2.1 pump suction port, stone crusher deployment should be determined necessary, requiring extended suction port removal and grid restoration; (5) Following shield machine parameter deterioration and cutterhead mud cake formation, pressurized chamber access measures can effectively mitigate muck accumulation and mud cake phenomena, thereby

improving tunneling efficiency. These research findings can serve as reference for future analogous projects.

Full Text

Technology and Application of Super-large Diameter Slurry Shield with Pressure Opening

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Abstract

Due to Guangzhou's complex geological conditions, shield tunneling frequently encounters abnormal cutter wear and slag accumulation in the chamber, necessitating chamber cleaning as an effective solution. However, geological and surface environment constraints impose stringent safety requirements on such operations. This paper examines the super-large diameter slurry shield construction of Guangzhou Haizhuwan Tunnel, analyzing the causes of parameter deterioration, crusher oil leakage, and rear grid breakthrough based on the project's hydrogeological conditions, and proposes targeted countermeasures. The following conclusions are drawn: (1) Significant increases in thrust pressure and torque coupled with decreased advance rate during shield excavation indicate the need for chamber entry to inspect cutterhead mud accumulation and tool wear, with appropriate tunnel sections selected for access; (2) Pressure chamber operations for mud cake removal and tool replacement must strictly adhere to the technical sequence: rear water stopping → bentonite injection → filter cake formation → liquid level reduction → pressure holding test → personnel entry → decompression exit; (3) During chamber operations, close monitoring is required for air replenishment rates and Samson valve opening compliance, chamber pressure and liquid level stability, with enhanced monitoring measurements and surface patrols; (4) When the forward position of the P2.1 pump suction at the air cushion chamber bottom becomes unsuitable for excavation, evidenced by frequent suction blockages or sudden pressure drops, crusher deployment is necessary, requiring removal of the extended suction port and grid restoration; (5) Implementing pressure chamber measures following shield parameter deterioration and cutterhead mud accumulation effectively alleviates slag discharge stagnation and mud accumulation, improving excavation efficiency. These findings provide valuable reference for similar future projects.

Keywords: slurry balance shield; composite strata; pressure chamber opening; technical control points; efficiency comparison

Note: Figure translations are in progress. See original paper for figures.