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Analysis on Grouting Construction Technology and Quality Management Countermeasures of Water Conservancy and Hydropower Project

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Abstract: Based on the industry background, this paper comprehensively discusses the application points and quality management countermeasures of grouting construction technology in water conservancy and hydropower engineering. The key links of grouting construction technology are expounded, including the selection of grouting materials, optimization of drilling construction technology, reasonable selection of grouting method and scientific arrangement of grouting order. In view of the weak links in the quality management of grouting construction, the countermeasures and measures such as strengthening the audit of construction drawings, constructing the whole-process quality control system, strict quality acceptance standards, and strengthening the professional training of construction personnel are put forward. Through the fine application of grouting construction technology and the comprehensive optimization of quality management, the overall construction level and comprehensive benefits of water conservancy and hydropower projects can be effectively improved.

Keywords: Water conservancy and hydropower engineering; Grouting construction technology; Quality management; Construction technology; Countermeasures

Introduction

In recent years, China's water conservancy and hydropower industry has entered a new stage of rapid development, and a large number of large-scale hydropower projects have been started construction, which puts forward higher requirements for grouting construction technology and quality management. As a key link of water conservancy and hydropower project construction, grouting construction technology level and quality control are directly related to the safety, durability and economy of the project. However, due to the complex geological conditions, changeable construction environment and other factors, the grouting construction quality management still faces many challenges. In order to promote the high-quality development of the industry, it is urgent to strengthen the research and innovation of grouting construction technology and quality management, constantly improve the scientific and technological content and management level of the project construction, and lay a solid foundation for the long-term development of water conservancy and hydropower industry.

1. Analysis on the key technology of grouting construction of water conservancy and hydropower Project

1.1 Grout material optimization and performance evaluation

Commonly used grouting materials include cement slurry, fly ash slurry, clay cement slurry, etc., which need to be selected according to the engineering geological conditions, design requirements, construction environment and other factors. In the selection of materials, the slurry fluidity, particle grading, density, setting time, strength and other performance indicators should be comprehensively considered^[1]. Generally, the water ash ratio should be controlled between 0.5 and 1.0, the particle grading is continuous, the density is 1.3~1.8g/cm³, the initial coagulation time is not less than 30min, and the compressive strength of 28d should reach 10~30MPa. For special formation conditions, such as high pressure water gushing and large deformation crushing zone, etc., composite slurry with external admixture such as fast coagulant, expansion agent and water reducing agent can be used to improve the stability and grouting effect of slurry. Before the selection of materials, the necessary indoor matching test and performance test should be carried out to evaluate the pumping ability, pressure filtration, water segregation and other indicators of the slurry, and optimize the slurry formula.

1.2 Drilling construction process optimization and parameter control

According to different formation conditions, the drilling process and equipment should be reasonably selected, and the drilling pa-

parameters should be optimized. In the upper loose layer, impact drill and spiral ger can be used to improve the drilling speed; in the bedrock, diamond drill and tooth drill should be used to improve the drilling quality. In the process of drilling, the verticality, aperture deviation, hole depth error and other parameters should be strictly controlled. The verticality deviation is generally not more than 1%, the aperture deviation is not more than 5mm, and the hole depth error should be controlled within 0.5m. In order to improve the efficiency and quality of drilling, the advanced equipment such as self-propelled drilling rig and guide drilling rig can be used to realize the automatic and intelligent control of the drilling process. Under complex formation conditions, special holes such as inclined holes and horizontal hole can be used to increase the grouting range and compactness.

1.3 Reasonable selection and optimization of grouting construction methods

Common grouting methods include single-hole grouting method, double pipe grouting method, circulating grouting method, etc.^[2]. Single-hole grouting method is applicable to general formation conditions with simple operation, but prone to problems such as string grouting and slurry leakage. Double pipe grouting method is applicable to strata with strong crushing permeability, which can effectively control grouting range and pressure and improve the grouting compaction. Circular grouting method is applicable to karst development and rock mass fragmentation, which can realize slurry recycling and reduce cost. In the actual construction, the grouting process parameters, such as grouting pressure, grouting speed, grouting concentration, grouting time, should be adjusted in time according to the disclosure of the borehole and the grouting effect of the test section. Generally, the initial grouting pressure is 0.3~0.5MPa and the end pressure is 1.0~3.0MPa; the grouting speed is controlled at 20 ~ 60 L/min; the slurry water-cement ratio is gradually reduced from 1:1 to 0.5:1; the single hole grouting time is generally 30~120min.

1.4 Scientific arrangement and dynamic adjustment of the grouting order

According to the geological conditions and design requirements, divide the grouting section and hole group, and define the grouting sequence and time sequence; secondly, in each section, grouting the peripheral hole group, then gradually to form the closed grouting network, and then, to improve the closed grouting network; finally, the dynamic monitoring of the grouting process should be strengthened, and the grouting sequence and parameters shall be optimized and adjusted according to the monitoring data and grouting effect. For example, when a large range of grouting occurs in the local formation, the grouting can be suspended until the grouting in the local area rises sharply; and the grouting amount decreases sharply, pipe plugging or overpressure may exist, which needs to be handled in time.

2. Grouting quality management countermeasures of water conservancy and hydropower projects

2.1 Strengthen the review and optimization of grouting construction drawings

In order to strengthen the quality management of the grouting construction, we must strengthen the review and optimization of the grouting construction drawings. In the audit process, check the integrity, accuracy, rationality and operability of the drawings to ensure that the drawings meet the design intention and specification requirements. It is necessary to carefully examine whether the layout of the grouting holes is scientific, whether the spacing meets the needs of the grouting range; whether the selection of the grouting materials meets the geological conditions and design requirements; whether the grouting process parameters are reasonable, and whether the grouting quality is ensured. The problems found in the audit should be timely communicate with the design unit and put forward optimization suggestions. In the optimization process, the actual situation of the construction site, which should be fully considered, such as geological conditions, construction period, mechanical equipment and other factors, should be fully considered, and necessary adjustments and improvements should be made to the grouting construction drawings, so as to improve the feasibility and guidance of the drawings. The optimized drawings can be used before approval, and shall be corrected in time according to the actual situation during the construction process.

2.2 Strict grouting construction quality acceptance standards and methods

Grout construction quality acceptance is an important link to ensure the grouting effect and ensure the engineering safety. In order to strengthen the quality management of grouting construction, relevant acceptance standards must be strictly implemented and acceptance methods and procedures must be standardized. Acceptance standards mainly include construction specifications, design documents, contract agreements, etc., to focus on checking whether the grouting materials, grouting equipment, grouting parameters, grouting effect and other aspects meet the requirements^[3]. For example, the commonly used acceptance indicators include grouting pressure, grouting amount, grouting paragraph, grouting time, grouting density, etc., and the specific standard value should be determined according to the design requirements and site conditions. The acceptance method generally adopts the combination of sampling inspection and full inspection, and the key parts and key processes should be fully inspected. The common inspection methods include field observation, data analysis, drilling core sampling, pressurized water test, etc. The problems found in the acceptance process should be rectified in time, and reinspected to ensure that the quality

meets the requirements. The acceptance results shall form a formal document, as an important basis for the project quality assessment and acceptance.

2.3 Strengthen the professional skills training and assessment of grouting construction personnel

The professional skills of the grouting construction personnel are the basis to ensure the grouting construction quality. In order to strengthen the quality management of grouting construction, attention must be paid to the professional training and assessment of the construction personnel. The training content should include two aspects: theoretical knowledge and practical skills. Theoretical knowledge mainly involves grouting principle, grouting materials, grouting technology, etc., and practical skills mainly involve equipment operation, parameter control, quality testing, etc. The training method can be classroom teaching, on-site demonstration, practical training and other forms, highlighting practicality and pertinence. In the training process, the safety awareness and quality awareness education should be strengthened to improve the sense of responsibility and mission of the construction personnel. After the training, a strict assessment should be carried out, and the assessment content should correspond to the training content, focusing on the mastery of key skills. Those who pass the examination can take up the post, and those who fail the examination should be supplementary training and re-assessed.

3. Tag

Grouting construction technology and quality management is the key to achieve this goal, we need to constantly strengthen technical innovation and management improvement. In the future work, I will work with colleagues in the industry to deeply study the new grouting construction technology, new materials and new equipment, optimize the construction scheme and parameters, establish and improve the quality management system and standards, improve the professional quality and skill level of employees, and contribute my own strength to create high-quality projects and intelligent projects.

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