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Research on construction environment control of high altitude cold regions tunnel

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Abstract. High altitude cold regions tunnel construction environment is the key factor of tunnel construction progress, also relates to the technical personnel's health, this paper analyzes several key factors of restricting the construction environment, the field test of dust and CO several important indexes such as the maximum value, it is concluded that high altitude cold regions tunnel construction environment is relatively poor, dust and CO value beyond the standard requirements. Based on this, puts forward the measures to control the environment of high altitude cold regions tunnel construction for reference by the similar projects.

Introduction

With the implementation of the strategy of west development, more and more roads began to build in the western region, western China terrain is given priority to with plateau, special environmental conditions, alpine hypoxia is the main features, this brought a lot of difficulties for engineering construction, especially the construction of tunnel, tunnel construction environment was bad, dust and harmful gas with among them, are difficult to effectively control the harm degree in plain area is not apparent, and high altitude harsh construction environment will directly endanger technical personnel's health, therefore, effective control of high altitude cold regions tunnel construction environment is the key issue in the construction of tunnel.

At present our country has already made some high altitude cold regions tunnel, such as the kunlun mountains railway tunnel at an altitude of 4600 m, at an altitude of 3792 m osakayama highway tunnel and so on, many scholars have done research on cold regions tunnel, cold regions tunnel thermal insulation [1] and cold regions tunnel waterproof and drainage[2], low-temperature concrete construction technology[3-4], etc., but less attention to the reality of construction environment problem, including the lack of oxygen, low temperature, high dust, these problems, the author of this paper analyzes the environment of high altitude cold regions tunnel construction influence factors and the feasible control measures are put forward.

Project summary

Jichoushan tunnel is located in sichuan province ganzizhou ugly the mountains, at an altitude of 4200 m, the tunnel length of 2745 m, belongs to the high altitude long tunnel. Tunnel for single hole two-way traffic tunnel and tunnel design standards according to the secondary road 40 km/h speed, clearance take 5 m height, construction methods using conventional drilling and blasting method, implemented in two steps, use open roof tunnel longitudinal slope, appropriately increase the slope to facilitate drainage. Geological conditions are relatively poor, but no fracture structure, using compound lining [5].

High altitude in the region, low temperature, low pressure, low oxygen partial pressure, according to the material, oxygen partial pressure of 21.15 kpa sea region, oxygen partial pressure tunnel site area only 12.64 kpa, the temperature is low, from October to may of next year as the ice and snow for about a year, month average temperature is below zero, are harsh environmental conditions, such as

CO, dust when combined with the construction greatly influence the construction progress, a serious threat to health technical personnel.

Environmental factor analysis

3.1Construction dust

Tunnel construction with traditional drilling and blasting method, drilling blasting, jet concrete, slag trackless transport, provides the main source of dust, high altitude low oxygen content, poor environmental conditions exacerbated the harm of dust, and under the condition of high altitude oxygen levels are already in short supply, too much dust will be a serious threat to hole to the staff's health, reduce construction efficiency, form a vicious circle.

Through the field monitoring, found that the dust concentration is higher sprayed concrete, slag during working procedure, the highest concentration of 5.9 mg/m3, respectively 5.1 mg/m3, the rules and regulations of were greater than 2 mg/m3.

3.2Construction CO

Construction of the root causes of CO and dump slag cars, especially under the condition of the shortage of oxygen, the internal combustion engine fuel combustion is not full, will produce more CO, excessive CO will directly worsen tunnel construction environment.

Through field monitoring, found that the CO concentration times of peak slag process, concentration of up to 401 PPM, beyond the rules, so it is necessary to adopt control measures.

Tunnel in area 4200 m altitude, low temperature, low pressure, low oxygen partial pressure. According to the design data, tunnel oxygen partial pressure only 12.64 kpa, only 50% of the plains, the temperature is low, may for ice and snow for about every year in October to the following year, month average temperature is below zero, are harsh environmental conditions, not only to the technical personnel's body health put forward severe challenges, also not conducive to make full use of all kinds of construction machinery.

construction control technology research

4.1Construction machinery supporting technology

High altitude air oxygen content is low, it will reduce mechanical and manual work efficiency, in order to reduce the labor intensity of workers, protect health of workers, improve work efficiency, should try to adopt mechanical construction, is as important to choose the appropriate machinery package, construction machinery should comply with the construction technology, construction method, make its organic combination, achieve the best production effect, aiming at the problem of high altitude low oxygen content, use less as far as possible the internal combustion engine, the use of electric and pneumatic equipment. Single machine selection should consider the quality is reliable, economic and reasonable, easy maintenance, considering the mechanical efficiency of form a complete set of combination, and related construction progress.

For the above situation, it is suggested that with the method of rail transport, rail transport can use electric equipment, on the one hand, dust slag from orbit to avoid the car, on the other hand USES all electric equipment to avoid the insufficient combustion produces a large amount of exhaust gas. Use rail transport can also weaken the construction ventilation requirements, improve tunnel construction environmental indicators.

4.2 Concrete construction technology at low temperature

Temperature affects the setting time and strength of concrete, the temperature is too low will lead to concrete not condense, intensity is reduced, unable to give play to the role of its bearing, therefore, the tunnel construction in high altitude areas to focus on the concrete construction technology of low temperature conditions. The main measures are:

(1) to preheating, and the application of cement concrete discharging temperature, strengthening heat preservation measures in the process of transportation, to reduce heat loss

(2) mixed with antifreeze, accelerator, early strength agent, etc., and control the mixture ratio, reduce the initial setting time, increased the strength of initial setting.

(3) after pouring, ensure the temperature in the tunnel, in the concrete surface heat preservation material, and create favorable conditions for concrete curing, ensure the intensity of final set.

4.3 Tunnel construction Oxygen technology

Tunnel of high altitude, thin air, oxygen is serious, poor environmental conditions, combined with the construction of dust, harmful gas concentration is high, the air inside hole than thin air hole, a lower oxygen content, construction personnel in such conditions bear the heavy manual labor, threats to their health and life security, so in high altitude oxygen technology must be used in tunnel construction.

(1) hole to oxygen to diffuse through the DN15 galvanized pipe oxygen input hole, constraints in ShiGongChu and two lining work with oxygen to diffuse type hose. Pipe layout at the beginning of the second lining or concrete surface, hose take protective measures, to prevent damage to construction.

(2) the car oxygen bar oxygen, hole to set up mobile car oxygen bar, car oxygen bar by the room body, oxygen pipe, valve, flow meter, and oxygen mouth, mobile convenience, can accommodate more than oxygen. Tunnel construction personnel if feel lack of oxygen, oxygen to car oxygen bar, health security personnel, improve the work efficiency.

(3) the hole mechanical drivers equipped with small oxygen tank, slag using trackless transport tunnel, bad slag discharge the air inside the hole, and severe hypoxia site, in order to ensure drivers drivers work efficiency, give drivers drivers equipped with back portable oxygen tank, drivers driver can continuous oxygen while working.

(4) the worker oxygen inside the room, construction personnel and management personnel every day for heavy manual work, in order to ensure their healthy body, improve the work efficiency, in the staff room for continuous oxygen, oxygen cure outside of work to recover quickly.

4.4 The water curtain dust technology

Water curtain at a distance of 30 to 50 m constraints dust device, after completion of blasting open water curtain JiangChenQi, can significantly reduce the dust concentration produced by blasting, the shotcrete also can undertake the water curtain dust dust high stage, can play a controlling role.

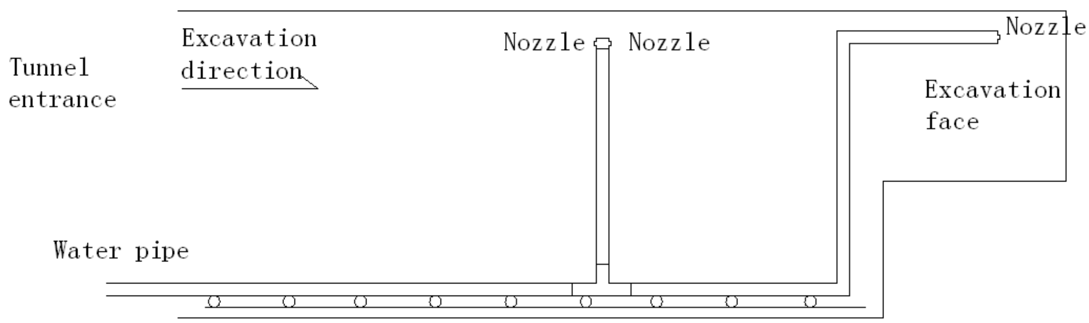

Figure1 Tunnel water curtain dust schematic diagram

4.5 To strengthen the construction ventilation

Strengthen the ventilation, ventilation during construction is one of the important measures to reduce dust concentration and CO for slag dust and harmful gas production mixing ventilation, great process recommended according to different process, dust concentration is different, can choose the fan power, adjust the air volume, saving energy consumption, note that in order not to lower the temperature in the tunnel, but to pre heating for the wind.

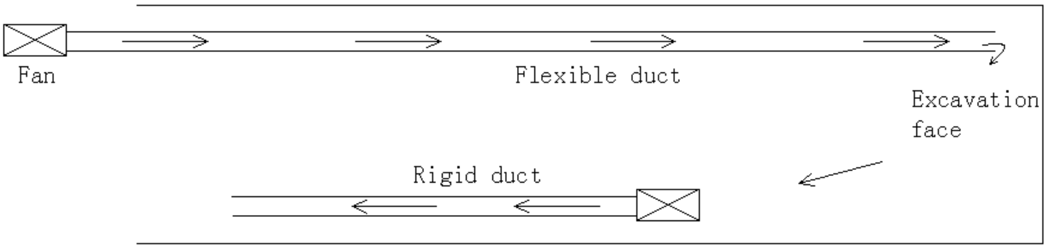

Figure2 Tunnel compound ventilation schematic diagram

Conclusion

Based on the conditions of high altitude cold regions tunnel construction problems, this paper analyzes the influence factors of affecting the construction environment, dust and CO concentration exceeds bid is the most critical factor. In order to effectively control high altitude cold regions tunnel construction environment and security technical personnel's physical health, improve the efficiency of the tunnel construction, put forward the oxygen to the tunnel construction, construction ventilation, wet shotcrete, strengthen the supporting measures such as ventilation, so as to achieve control of high altitude cold regions tunnel construction environment, the purpose of the research results can provide reference for similar projects.

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