

Research on safety and protection measures of optical fiber transmission in railway communication network

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Summary: With the development of the transportation industry in our country, railway is one of the main transportation modes, which plays an important role and value in the transportation of goods and people. In the process of railway transportation, the safety and protection measures of optical fiber transmission in communication network have been concerned by all levels of society. This paper briefly analyzes the safety and protection measures of optical fiber transmission in railway communication network, hoping to provide some valuable reference for readers.

Key Words: Railway; communication network; optical fiber transmission

Introduction

There is a close relationship between national economic development and railway communication. Railway communication mainly refers to the transmission and processing of information by various communication methods in the process of railway transportation, construction and production. In the process of railway transportation, optical fiber transmission plays an important role, it is related to the normal railway transportation. At present, there are a lot of factors that affect the optical fiber transmission in railway communication network. Once the fault occurs, it must be repaired in time to ensure the normal transportation of railway. Therefore, the relevant departments need to develop a detailed and effective contingency plan to ensure the normal operation of railway transport.

1. Environmental Impact on Fiber Optic Transmission in Railway Communication Network and Solutions

According to data surveys, most railway sections in China are built in relatively desolate and sparsely populated areas. During the entire process of train travel, it is very easy to be affected by abnormal weather, leading to communication obstruction. Especially when facing extreme weather conditions such as heavy rainfall and blizzards, not only will it have a serious impact on signal transmission, but in severe cases, it may even have an impact on railway sections, causing some sections to be submerged. Destruction, resulting in a large amount of material not being able to be transported to the designated location on time, causing huge economic losses, is a very common phenomenon. Although people have predicted the arrival of extreme weather, they are powerless. Although we cannot change the weather, we can take effective preventive measures against these adverse weather conditions to enhance the resistance of optical fibers to adverse weather and ensure the effectiveness of pipeline transmission. Firstly, in terms of fiber optic materials, China can optimize and upgrade. Looking for a material with strong anti-interference ability to replace the original material, for example, some advanced foreign materials, after practical verification, do have strong anti-interference ability, providing guarantee for information transmission. However, due to certain problems in China's production methods and resources, it is necessary to import from abroad at a high price, which will lead to a significant cost expenditure. Therefore, our country can only adhere to the path of self-innovation. Through the unremitting efforts of Chinese researchers, excellent optical fiber materials have finally been developed, greatly reducing costs and significantly improving anti-interference capabilities. In addition, in order to strengthen prevention awareness, relevant personnel need to conduct regular inspections and maintenance along the railway route, especially after extreme weather, which can easily cause collapse of a certain section of the road, thereby affecting the transmission of information through optical fibers. If the transmission signal is interrupted, it will have a serious impact on the safety of train passengers and the transportation of materials. Therefore, the inspection work is particularly important and necessary. There are three ways of railway inspection work, namely regular inspections, special circumstances inspections, and surface monitoring inspections. According to existing technology, China's railway department mainly adopts two inspection methods: personnel walking inspection and vehicle carrying inspection. Basically, it is necessary to ensure that weekly inspections are conducted. During the inspection process, relevant departments should coordinate and divide the entire road section. The specific road section is the responsibility of the station, and the station dispatches specialized personnel to conduct inspections within the designated area. This also requires the inspection staff to prepare well, be familiar with the inspection route, and comprehensively understand the situation of the road section during the inspection process. Once any abnormalities are found, they should be reported to the higher authorities in a timely manner to handle the problem and avoid causing huge economic losses. From this, it can be seen that staff not only need to have a strong sense of responsibility and mission, but also need to have patience and strong professional qualities. In this regard, the railway department should strengthen the training and education of employees, enhance their professional competence and comprehensive ability. In addition, relevant departments should also develop detailed reward and punishment systems based on actual situations, in order to mobilize the enthusiasm and initiative of staff in their work. After rewarding outstanding employees, it is also necessary to learn from previous work experience, make timely corrections to areas of non-compliance, and keep detailed records of these issues. Conduct a detailed analysis of these issues, identify similarities, and lay a solid foundation for the normal operation of the railway communication network.

2. Construction protection measures must be in place

Currently, with the continuous improvement of China's economic strength, the construction industry is experiencing vigorous development. Construction has gradually become one of the most important causes of cable damage. Especially on the Beijing Guangzhou railway line, due to the special terrain, construction activities such as bridge erection are necessary, and these activities are unavoidable. Therefore, in order to ensure that optical cables are not damaged during the construction process, ensure their integrity and transmission accuracy, it is necessary for the construction department and the railway department to communicate and coordinate effectively, in order to ensure that optical cables are not damaged by construction. Based on the analysis of a large number of actual cases, it can be concluded that many cases of cable damage could have been avoided, mainly due to inadequate communication between construction companies and railway units. In order to prevent damage to optical cables during construction, the railway department should dispatch professional personnel to the construction site for on-site investigation, take preventive measures in advance, optimize the construction plan, and carry out safety warning work. Especially before construction, it is necessary to mark the direction and burial location of the cables. During the specific work process, the railway department should maintain close contact with the construction unit, continuously monitor the construction progress, and lay a foundation for the smooth progress of the next step of work. In addition to avoiding damage to the optical cable during the construction process, other external factors should also be excluded from the construction process. For example, many railway sections are surrounded by large areas of farmland, and sometimes farmers may cause damage to optical cables during farming. If this phenomenon cannot be reported to relevant departments in a timely manner, it will have a serious impact on the normal operation of the railway communication network. In this regard, the railway department should fully carry out publicity work, strengthen the awareness of farmers, make them aware of the harm and impact of damaging optical fibers, and avoid farmers unintentionally damaging cables during the agricultural process, which will have an impact on the railway communication network.

3. The problem of attenuation points in optical cables and effective solutions

In some railway sections, due to the special terrain, the optical cable is compressed and deformed. In addition, extreme weather can also easily cause water ingress into the joint box, affecting the effectiveness and quality of optical fiber transmission. In the actual problem-solving process, it is difficult to estimate the location of the attenuation point, which requires staff to accumulate a large amount of data for speculation and calculation in daily work. Based on each maintenance record, record the distance from the fault point to the fiber optic, and then combine relevant information to infer the specific location of the attenuation point. Through this method, relevant operations can be carried out in a timely manner. After analyzing and summarizing a large number of practical cases, we found that the main reasons for the failure are as follows: firstly, there are certain problems with the waterproof measures, such as aging of the waterproof sealing ring, which cannot play its water blocking role, causing water to enter the joint box, thereby affecting the quality of the optical fiber and preventing it from playing its due role. Secondly, there are issues with the coating layer, which cannot effectively protect the optical fiber, especially in some special road sections, making the optical fiber very prone to deformation and accelerating attenuation. In fact, if significant deformation occurs, new terminals will inevitably form. Thirdly, although external factors have a relatively small impact on optical fibers, they can also cause attenuation due to inappropriate bending radius of the fibers. In fact, if the bending radius is small, it will to some extent prevent the function of light from being fully utilized, thereby causing serious impact on information transmission. Fourthly, there are defects in the quality of fiber optic welding, which requires staff to re weld the fiber optic cable in the damaged department. Through careful inspection and testing in all aspects, it is ensured that the number of fiber optic attenuation points is reduced, so that information can be transmitted smoothly and railway transportation can proceed safely.

4. Pay attention to safety during the process of fault repair

The above discussion mainly focuses on preventive measures, but when a railway communication network failure occurs in practice, how to effectively repair and operate the fault in order to minimize losses is a thought-provoking issue. In addition to strictly adhering to relevant operating standards, staff should also be prepared for emergency repairs during daily work processes. Daily maintenance and repair of repair tools should be carried out, while ensuring that they can be used normally. They should also be placed in a fixed position. In the event of a malfunction, staff can locate these tools as soon as possible and they can be used. In the actual repair process, the staff must first rate the fault problem, confirm the fault level, and then clarify the repair workflow and sequence. Firstly, it is necessary to inspect the critical circuit. If a critical circuit malfunctions, it needs to be repaired and unblocked as soon as possible to ensure its smooth operation. Secondly, it is necessary to strictly control the time, and for some faults, they should be repaired as soon as possible. During this period, the staff needs to maintain a stable attitude, clarify the focus of work, and ensure the effectiveness of actions. In the actual repair process, the most complex and critical position should be the fiber optic cable joint repair stage, and there are many things to pay attention to during the repair process. Firstly, it is necessary to ensure the cleanliness of the fiber optic end face to prevent dust from the surrounding environment from contaminating it. Once dust is contaminated on the fiber optic end face, it will cause a certain degree of pollution, and excessive dust can also contaminate the fiber optic fusion splicer, making it unable to work properly and seriously affecting the subsequent repair work, making the repair work unable to proceed smoothly. In general, a small bending radius of optical fibers will accelerate losses. Therefore, in the actual repair process, the control of this radius should be done in one go. After putting the sorted optical fibers into the containment tray, the impact of the bending radius should be minimized as much as possible. In addition, the staff also need to use OTDR to conduct detailed testing and monitoring of dissolution loss, ensuring that the loss is controlled below 0.08dB. They also need to fix the position of the fiber reinforcement

core in the joint box to prevent a large proportion of excess parts from occurring, which may cause damage to the fiber. At the same time, throughout the entire repair work process, relevant staff should take responsibility seriously, be brave enough to take responsibility, and fully realize the importance of their own work, Strictly follow the operating procedures, calmly, seriously, carefully, and proficiently complete the repair tasks, laying the foundation for the safety of the entire transportation section. This also requires relevant departments to provide strict training and training for maintenance personnel, cultivate their professional abilities and qualities, and provide strong support for the smooth communication of railways.

Conclusion

In short, in the new era, with the continuous improvement of China's economic strength, railway communication plays an important role and plays an important role. At present, the railway communication network is developing towards comprehensiveness, intelligence, and digitization, which will greatly improve information transmission efficiency, significantly enhance the status of China's railway industry, bring huge development opportunities to the entire railway transportation industry, and also create huge economic benefits for enterprises and the people. However, at the same time, we can also see that there are some problems in the actual operation of railway communication networks, which requires relevant departments and staff to actively prepare, develop effective contingency plans for possible faults, timely handle common faults, and comprehensively analyze and summarize these fault handling processes, By drawing on experience and lessons, we can improve fault prevention and emergency response work in this way, ensure the safety and reliability of fiber optic transmission in railway communication networks, and provide assistance for the prosperity and stability of China's economy.

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