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Corrosion Assessment in Rail Systems

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***Abstract**:*

The biggest problem of developing cities is trying to be solved with traffic, public transportation vehicles and incentives. Undoubtedly the most attractive public transport is the metro. Rail systems are the indispensable side of developing transportation. In today's engineering studies, one of the most important problems encountered from the beginning to the end of a project is leakage corrosion. Corrosion shortens the life of the building and causes serious losses. In this study, it examines the corrosion phenomenon in rail systems subject to mechanical and electrical engineering.

Keywords

Electric rail systems, corrosion, electric transport vehicles, transportation vehicles.

1. Introduction

Direct-current rail vehicles, direct current-carrying high-voltage power lines and welding machines emit leakage current into the ground. These leakage currents cause corrosion by entering the metallic structures in the environment. The most important issue in underground underground tunnels in metallic structures in water are the measures taken against corrosion [1-5]. For this reason, the necessary measures should be taken when starting the construction.

2. Rail Public Transport

Leakage current is the flow of a part of the current flowing into the ground in the form of leakage by completing the circuit in the systems running electricity. This leakage causes many problems in the structure (touch tension, corrosion, etc.). Corrosion, corrosion, etc. In other words, electrical, chemical or mechanical wear of mines. Electrochemical damage due to leakage current is called leakage current corrosion. It is not possible to stop the corrosion. However, the measures to be taken can reduce the rate of leakage corrosion [6-8]. Corrosion occurs chemically with reduction and oxidation reactions.

Corrosion consists of three processes. The electrons formed after the anodic reaction cause cathodic reactions. If the resulting electrons do not react in the cathodic reaction, the reaction is stopped in the anode. At the same time, the absence of oxygen in the environment stops this reaction. The electrons produced by ionization of iron in corrosion react with oxygen and water and cause corrosion (rust) formation in the anode [9-11]. Figure 1 shows the Corrosion current in rail systems.

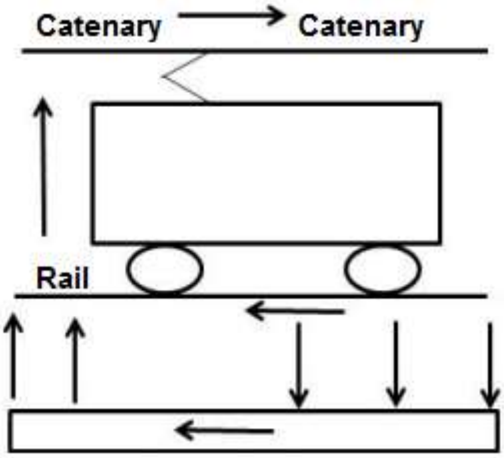

Figure 1. Corrosion current in rail systems

3. Cathodic Protection

Cathodic protection is the process of removing anodic currents on the metal surface by making the metal to be protected into a cathode of an electrochemical cell [12-18].

3.1. Galvanic Anodized Cathodic Protection

Galvanic anode protection is based on the principle of connecting an anode which is more active to the metal to be protected. In this case, the ionization reaction is more active in the anode of the metal that needs to be protected in the reaction does not occur. The active anode in the galvanic anode has a certain life span and must be replaced at regular intervals [11-13].. The active anodes are usually made of magnesium, zinc or aluminum alloy.

3.2 Cathodic Protection

Outer anodes are used in external current source cathodic protection. In this case, an external direct current must be applied to the system. In these systems, the anodes are placed into the electrolyte around the structure to be protected and connected to the + end of the rectifier, while the structure to be protected is connected to the end. Inert anode refers to "Electrode that responds to system potential but is not involved in cell reaction İn [13-17]..

The inert anodes do not have the capacity to produce any current, therefore have longer life. These anodes can be made of graphite, cast iron, mixed metal oxide coated titanium or platinum-niobium coated metals. Although the most common DC current source is a rectifier, it is used in other sources such as solar energy systems with developing technology [18,19].

In large electrical systems, cathodic protection is done by external current. Preventing leakage current before cathodic protection works are carried out from the first start of construction. The most preferred anodic type in cathodic protection is Mixed Metal Oxide Coated Titanium Anodes Kat. Such anodes are not affected by the chemical compounds resulting from the anode reaction and the mass loss is the minimum [17-22].

4. Leak Current Corrosion Protection in Railed Systems

There must be a return path of the traction force current transmitted to the vehicles by the carrier rail. If it is assumed that the flow path will form a closed circuit, the total return current must be equal to the current flowing through the conductor rails. A finite resistance between the rails and the rail and the ground causes a portion of the return current to flow into the earth and a portion of the return flow to the ground [18-21].

In the region close to the switchgear, this return current returns to the rails and grounding system. Pipe, cable armor and so on. The sum of the current passing through the metals is equal to the current transmitted to the vehicle. In DC systems, the current flowing from the ground causes leakage current corrosion which must be minimized. Necessary precautions should be taken especially to prevent corrosion due to leakage current for rail system applications in tunnels. In order to meet the demands regarding these issues, it is necessary to determine and select the facility grounding suit in accordance with the relevant standards. These rules must be applied both during construction and during electrical installation [22-26].

• Rail ground: The rails, return cables and the rectifier return busbar form the rail ground.

• Tunnel soil: Electrically connected tunnel reinforcement elements form the tunnel soil. Constructed with common equal potential connection conductors, the structure is also used as medium voltage and low voltage protection earth.

• Neutral Soil: Neutral soil is external earth potential and is connected to grounding conductors with tunnel ground and level rail assemblies.

• Rail Potential: Ray potential is the potential difference between the rail ground and the tunnel ground.

• Contact voltage: This is the voltage difference between the two facilities by bridging the people side.

Figure 2 shows the Corrosion measurement system in rail systems.

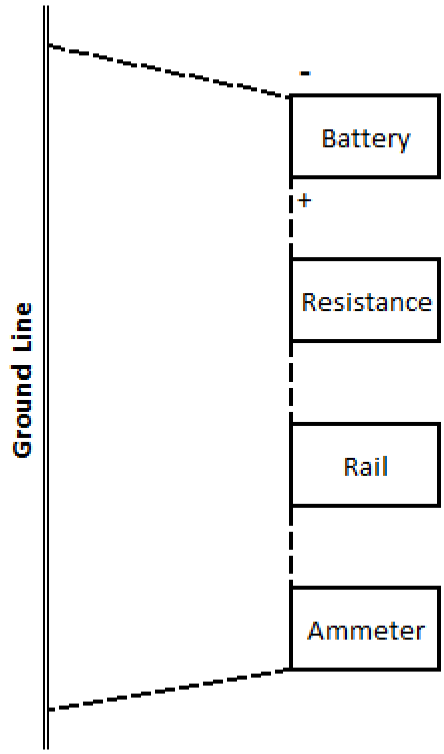

Figure 2. Corrosion measurement system in rail systems

Figure 3 shows the Measurement of corrosion in rail systems.

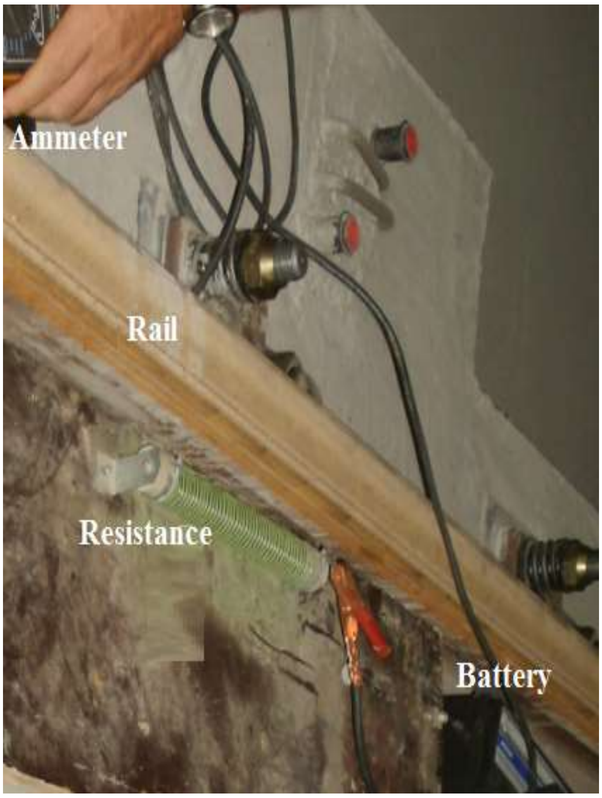

Figure 3. Measurement of corrosion in rail systems

5. Conclusion

The return of the current drawn by the vehicles is done on the rails. The rails are mainly designed to form a path for the vehicle and to transport the vehicle. But rails are also used as return conductors. However, in this case, different problems arise. For example, a leakage current occurs between the rail and the ground due to the tension on the rail along the line.

Due to the fact that the rail has a finite resistance, the voltage difference between the rail and ground when the current passes through the rail is known as the rail tension. Therefore, in rail systems, the insulation between the rail and the ground must be considered. In the case of the current, the current flowing from the ground to the ground is returned to the rails. In this case, the subject of this study increases the corrosion.

Therefore, it is necessary to take precautions against corrosion on the rails and the metals in the vicinity.

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