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Research Article

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Preliminary prediction of rail wave wear zone based on in-car noise test

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Abstract Based on the influence of rail wave grinding on subway interior noise, combined with the previous rule of rail grinding on Line 2, the influence degree of rail wave grinding on subway interior noise was studied.By analyzing the noise inside the car under different rail wave wear conditions, the reference value of the noise inside the car during rail wave wear is predicted, and the reference value is used to study the rail surface state in reverse, so as to find a reasonable grinding cycle and slow down the occurrence of wave wear.

Keywords subway;Rail wave grinding;Car noise;Rail grinding.

1. Introduction

Rail wave wear refers to the phenomenon that the rail top appears along the longitudinal surface with a certain regularity after the rail is put into use.The characteristics of the subway line, such as many curves of small radius, short spacing between stations and frequent starting and braking of vehicles, make the rail wear problem increasingly prominent in the daily operation of the subway.Rail wave wear intensifies the vibration of track and vehicle structure, increases the train noise when the train passes, reduces the passenger ride comfort and the service life of wheel and rail components.After the rail wave grinding is found in the daily inspection, the rail grinding car or small grinding tools are used to polish the treatment, to improve the contact relationship between wheel and rail, thereby reducing the running vibration and noise, and improving the comfort of passengers.

At present, the research on the relationship between rail wave wear and noise is mainly reflected in the influence of wave wear on train noise, and the reverse research is rarely done.In this paper, Metro Line 2 is selected as the research object, the section under the same conditions is observed, and the noise value inside the train under different rail surface states is tested. Through comparative analysis of the test results, the occurrence and development of rail wave wear are preliminarily predicted, and a reference value is provided for the grinding of the track line.

2. Subway noise standards and analysis of the influence of rail grinding on noise

2.1 Subway noise standards

GB14892-2006 "Urban rail Transit train noise limits and measurement methods" stipulates the urban rail transit train noise limits and measurement methods. The standard stipulates that when the train is running at 75% of the maximum operating speed, the noise limit for the microphone test at the position "in the middle of the longitudinal axis of the passenger room, according to the floor height of 1.2 meters, the direction is up" shall comply with the requirements of Table 1.It can be seen that the subway noise test point is located in the middle of the passenger room, and there is no limit requirement for the noise at the end of the passenger room and the through road.

3. Test conditions and methods

The source of the noise generated in the subway car mainly involves the vehicle, track structure, track bed form, speed, wheel-rail contact surface roughness, tunnel environment and other factors. Therefore, when doing the noise test in the subway car, we choose the same tunnel environment, the same track structure and track bed form, and the same speed of the same car, so that the data obtained can be more valuable for reference.

During the test, two people cooperate, one person A monitors the line status and line mileage in the driver's cab, and one person B monitors the noise in the middle of the passenger room. When the driver's cab monitor A sees the mileage of the selected test section, he immediately reports the start and end mileage to the passenger room B and records the speed. At this time, the passenger room B turns on the noise monitoring equipment to measure and record according to the instruction of A. Due to the delay of mobile phone signal and the lack of professional equipment, there may be large errors in the test data. In order to ensure that the test data is as accurate as possible, several round-trip test measurements are taken in this experiment.

4. Interior noise analysis under different rail surface states

4.1. Interior noise test in the section of slight rail corrugation

Figure 2 shows the selected rail in the K38+ 520-K38 +600 section of the upward mileage of Metro Line 2, which is located on the curve of R=800. The track bed is in the form of a general vibration damping integral track bed, and there is slight wave grinding on the rail surface as shown in the figure. (The wave grinding length collected by the carrier-carrier grinding system is within the range of 10mm~30mm. The RMS value is in the range of 8μm to 12μm). Figure 3 is the interior noise distribution value of M0202 vehicle passing through this section at a constant speed of 70Km/h. It can be seen from Figure 3 that the noise value in the middle of the carriage is between 68-72dB, and the fluctuation of the noise value does not change much, and the distribution is relatively symmetrical. Therefore, we choose 68-72dB as the reference value of the internal noise in the section of slight rail corrugations.

Figure 1: Rail ground by light microwave

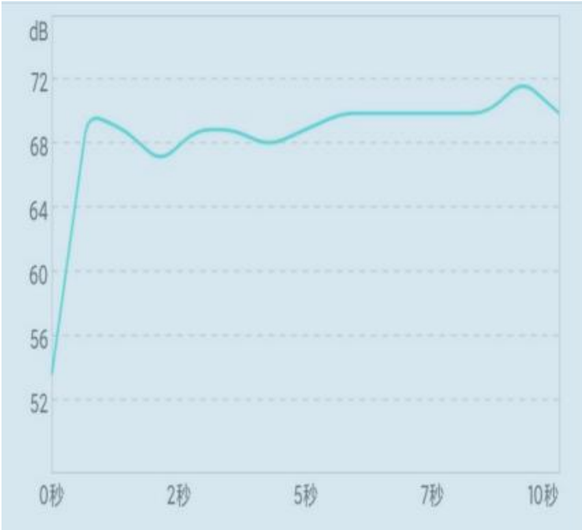

Figure 2: Ascending K38+520-K38+600 interior noise value

4.2 In-car noise test for severe rail corrugations

Figure 4 shows the rail of section k45+ 595-K45 +690, the upward mileage of Metro Line 2, which is located on the curve of R=800. The track bed is in the form of a general vibration damping track bed. As shown in the figure, the surface of the rail has obvious wave grinding (the wave grinding length collected by the carrier grinding system is within the range of 30mm~100mm.The RMS value is in the range of 8μm to 24μm).Figure 5 is the noise distribution value of M0202 vehicle passing through this section at a constant speed of 70Km/h.It can be seen from Figure 5 that the noise value in the middle of the carriage ranges from 74-81dB, and the noise value fluctuates, with the maximum noise of 81dB.Therefore, 74-81dB is selected as the reference value for predicting the internal noise in the more severe rail corrugations.

Figure 3: More severe wave wear rail

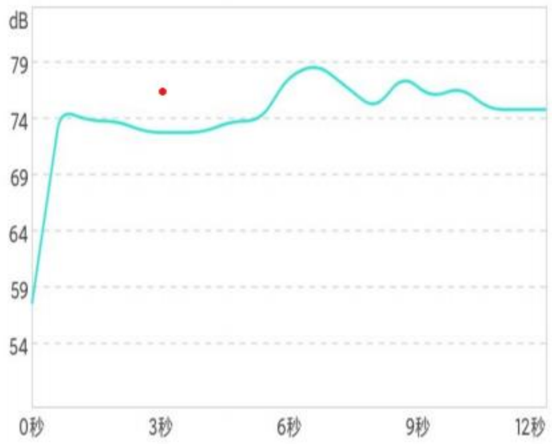

Figure 4: Uplink k45+595-k45+690 noise test values

5. Experimental Demonstration

Through the test, we obtained the reference value of the in-car noise under different track surface conditions, and demonstrated whether the data of this point of view is reference by continuing the test. The test was not to know the condition of the track surface in advance, and the measurement personnel measured in the middle of the passenger room. When the in-car noise and the reference value of the track state were the same, the location mileage at this time was recorded. The operator verifies whether the track status of the recorded location mileage conforms to the reference value of the different track status obtained in the previous test.

Through demonstration and test, the measured noise value can basically meet the noise reference value of the rail surface under the same conditions under the test environment. However, there are differences in the test data under different conditions. For example, the noise detection value in the middle of the passenger room in the upper K26+300-K26+400 section of Taili Section of Line 2 reaches the reference value of the noise in the severe wave wear section. After field inspection, it is found that the track bed in this section is a steel spring floating plate track bed with special shock-absorbing buckle and the curve radius is 320m.The carrier-carrier grinding system shows that the wavelength of this section is mainly in the range of 10-30mm, the RMS data is in the range of 8um-12um, and the rail surface wear is determined to be light microwave grinding. From this, we can see that the noise reference value under the condition of severe wave grinding of the rail surface obtained through the above test. The surface state of the rail ground by light microwave under different conditions was captured in the test demonstration. Due to the limited test conditions, it may be limited to test demonstration under the same conditions.

6. Conclusion

The following conclusions can be drawn from the internal noise test of Metro Line 2 under different rail surface states and the reverse prediction of rail wave wear state:

(1) The production of noise inside the vehicle is the result of the joint action of the vehicle and the track, tunnel, track bed, etc., and the track surface state is only part of the factors.

(2) Under the same conditions, the reference value of in-car noise obtained under the condition of slight rail wave grinding can be used as a reference for predicting the rail surface state. Under such condition, the noise value in the middle of the passenger room is within the acceptable range of the human body. At this time, the surface grinding of the rail can effectively delay the further development of rail surface wave grinding, so as to reduce the noise in the middle of the passenger room.Extend rail life.

(3) Due to the influence of external environment such as tunnel environment, track bed form, line form, rail surface profile, vehicle and speed, as well as the limitations of test tools and test times, this result is only applicable to the test environment and cannot be generally applied for the time being. Further studies are needed to explore a reasonable grinding cycle.

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