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Research of Railway Crashed Stone Use of 40 –70 mm Fraction

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Abstract

The results of the conducted researches on operating, physical and mechanical properties of crushed stone of 40-70 mm fraction are presented in the article as well as the results of the comparison of the given fraction with the fraction of 25-60 mm and determination of the former fraction usage for the ballast with the purpose of more rational fund use during railway repair works.
The conducted researches of 40-70 mm fraction of crushed stone allowed receiving:
– actual values of technical indices of the product and adopted technical decisions;
– conformity of the product with the operating conditions as well as physical and mechanical properties during track maintenance;
– ability to perform tests;
– comparison of physical, mechanical and operational properties of crushed stone of 40-70 mm fraction with the crushed stone of 25-60 mm fraction.
KEY WORDS: *railway track, ballast crushed stone, crushed stone of 40-70 mm fraction, crushed stone of 25-60 mm fraction, operating properties of crushed stone, physical and mechanical properties of crushed stone.*

1. Introduction

The crushed stone of 40-70 mm fraction is intended for the arrangement of the ballast layer on railways, which provides vertical and horizontal stability of the track.

On general railways with soil subgrade (more than 99% of the total length of railways), the upper structure of the track with a ballast layer is the main construction which usage is conditioned both technically and economically.

The ballast layer consisting of granular materials is one of the most important elements of the upper structure of the railway. It provides vertical and horizontal stability of the track. The structure and quality of the ballast layer depend on: the general condition of the railway, the level of permissible train speeds, the service life of the elements of the upper structure of the track (rails, fastenings, sleepers), the cost of the current maintenance of the track and the entire system of its repairs.

According to [1-3], the ballast layer must:

– take pressure from sleepers (girders on turnouts) and distribute it practically evenly on possibly larger area of the subgrade;

– provide the stable design position of the rail-sleeper grid during operation;

– provide the possibility of track correction in the profile and plane due to the ballast layer (by track tamping, straightening) to compensate inevitable residual deformations;

– quick drainage from the ballast prism and from the main site of the subgrade, prevent overwetting and overdrying of the upper layer of the soil of the subgrade, the loss of its bearing capacity (in the spring) and counteract upheaval (in winter);

– participate in the formation of the optimum elasticity of the underrail base, especially during reinforced sleepers' usage.

In accordance with the requirements of the national standard [4], ballast fractions of 25-60 mm are used for ballasting the main roads of general railways. Crushed stone is obtained by crushing rock. Depending on the type of initial

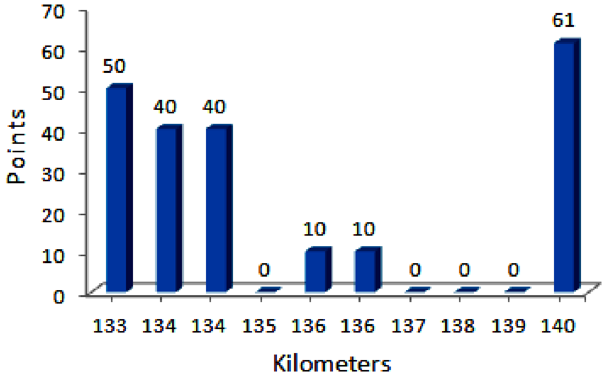

Fig. 10 Parameters of track state on the section No 1

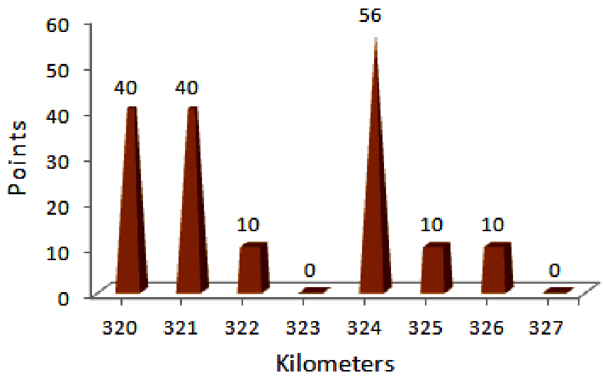

Fig. 11 Parameters of track state on the section No 2

4. Conclusions

According to the data of physical and mechanical tests of crushed stone fractions of 40–70 mm and 25–60 mm, the experimental parameters of the average and bulk density, voidness, crushing and rubbing properties, the content of dust, organic impurities and clay in the lumps are within the current standard for the ballast crushed stone [4].

Due to the increased voidness up to 51.1–50% of the ballast crushed stone of fraction 40–70 mm, its contamination is relatively larger and makes up 0.79% in the selected samples for the fraction of 40–70 mm and 0.67% for the fraction of 25–60 mm. In the selected samples of both fractions, the content of grains of the lamellar form is increased and numbers about 25%, however, when comparing their mechanical properties, the crushing and rubbing indices correspond to high grade of crashing stone – Dr1400, where rubbing index is C20.

Taking into account the foregoing, subject to the requirements of the granulometric composition, crushed stone of fraction 40–70 mm can be recommended for railway ballasting as well as crushed stone of fraction 25–60 mm due to the expected economic effect of reducing crushing stages, energy saving and approximate cost reduction of the product from € 5.5 / t for the fraction of 25–60 mm up to € 4.8 / t for the fraction of 40–70 mm, however the economic effect may be revised taking into account local conditions.

After analyzing crushed stone ballast performance of fraction 40–70 mm on separate sections of railways with the same load capacity, and after comparative analysis of it with the crushed stone ballast performance of fraction 25–60 mm and their influence on the parameters of track state (in terms of points), it can be concluded that the stability of the track on the crashed stone ballast with the fraction 40–70 mm can be considered similar to the track on the crashed stone ballast with the fraction 25–60 mm. Thus, it is possible to recommend using crushed stone of fraction 40–70 mm for the ballast of the railway track as well as the fraction 25–60 mm.

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