ABSTRACT

In construction or repair of a railway road bed a base section of particulate matter is laid and consolidated with polymer:resin:solvent emulsion, a layer of ballast is added, the ties and rails are laid, and additional ballast is laid between the ties and at the ends of the ties to a height and width sufficient to produce a curb on top of the base section and outside the ties. This curb is then consolidated by treatment with this emulsion leaving the center strip and the layer of ballast immediately below the rails unconsolidated to facilitate subsequent leveling or repair.

8 Claims, 3 Drawing Figures
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STABILIZED RAILWAY BED AND METHOD OF CONSTRUCTION

This is a continuation-in-part application of copending Ser. No. 249,775, filed May 3, 1972, entitled "Stabilized Railway Bed and Method of Construction" now abandoned.

BACKGROUND OF THE INVENTION

This invention relates to railway road beds. In one of its aspects this invention relates to the construction of stabilized railway road beds. In another of its aspects this invention relates to the repair of railway road beds. In still another of its aspects this invention relates to stabilization of particulate matter.

In one of its concepts this invention provides a method for stabilizing railway road beds allowing repair of the road bed with minimum destruction of the stabilized bed.

The advantages of cohering the individual particles of the particulate matter comprising railway road ballast into a coherent elastic structure with an elastomeric bonding agent have been recognized for several years. Enhanced track stability, decreased ballast fouling, resistance to rock displacement, improved riding qualities, and unimpeded drainage area few of the advantages that could be expected from such a system. With these advantages, however, a major drawback has been the inability to release the ballast from its consolidated condition for repairs to the road bed without major destruction of the consolidated material. I have now discovered that the advantages of a consolidated road bed can be combined with relative ease of repair by construction of a railway road bed using a containing cell of consolidated particulate matter above which the track rides on ties that are surrounded with unconsolidated ballast.

It is therefore an object of this invention to provide a stabilized railway road bed which can be easily repaired. It is another object of this invention to provide a method for constructing a stabilized railway road bed which can be easily repaired.

Other aspects, objects and the several advantages of this invention will be apparent to those skilled in the art upon reading the disclosure, drawings and the appended claims of this invention.

SUMMARY OF THE INVENTION

Accordingly, a method is provided for stabilizing a railway road bed which comprises: laying a base section of particulate matter of sufficient width and depth to provide support for the passage of railway rolling stock, consolidating the base section with an emulsion comprising thermoplastic elastomer of a butadiene styrene block copolymer type dissolved in a suitable solvent, a resinous material and a polar solvent substantially as described below, placing a layer of loose particulate matter over the base section, laying ties and track on the loose particulate matter, placing loose particulate matter, as a crib, between the ties beneath the rails, placing loose particulate matter above the base at the ends of the ties to produce a curb of height and width sufficient to retain the crib, and consolidating the curbe with an emulsion, as described above, leaving the untreated particulate matter in the crib and beneath the ties and track unconsolidated.

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In one aspect of this invention a stabilized railway road bed is provided comprising: (1) a base section of particulate matter consolidated with the emulsion described above of sufficient width and depth to support railway rolling stock; (2) curbe sections of particulate matter consolidated with this emulsion on each outer edge of the base section these curbe sections being of sufficient height and width to contain between the curbe sections: (a) a first layer of loose ballast above the base section; (b) above the first layer of loose ballast the cross ties; and (c) a second layer of loose ballast between the ties; (3) the ties; (4) the two layers of loose ballast; and (5) the railway tracks on the ties.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings
FIG. 1 represents a cut-away view of a railway road bed of this invention showing the various components of the road bed;
FIG. 2 is a cut-away view of the end of the railway road bed of this invention and
FIG. 3 is a cut-away view of section A of the road bed as shown in Fig. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

By the method of this invention any of the types of particulate matter commonly used in producing railway road beds are applicable for use in this invention. The most commonly used particulate material is a crushed hard rock of particles generally ranging in size from about ¾ inch to about 2 inches.

The preferred elastomeric bonding agent is a thermoplastic elastomer of the block copolymer type, or of the trans-diene polymer type, or a blend of the two polymers. An informative paper on the influence of structure and composition on properties of block copolymer has been published by Childers and Kraus in "Rubber Chemistry and Technology" 40, (4), 1183-1199 (September, 1967). Since no claim is made to the polymers per se, and since they have been described in the prior art, it will be sufficient to refer to the above-cited literature and also to U.S. Pat. Nos. 2,975,160; 3,113,912; 3,251,905; 3,231,635; 3,239,478; 3,242,038; 3,265,765; 3,299,174; and 3,333,024, which pertain to block copolymers.

For a discussion of the present state of knowledge pertaining to block copolymers, their chemical constitution, the influence of molecular weight of the constituent blocks etc., see particularly the research papers by Childers and Kraus.

We prefer to use the poly(styrene)-poly(butadiene)-poly(styrene) block copolymers having the conjugated diene blocks of molecular weight between 2,000 and 1,000,000, and the end blocks having a molecular weight between 2,000 and 100,000.

Other block copolymers such as poly(styrene)-poly(acrylonitrile)-poly(styrene); poly(styrene)-poly(isoprene)-poly(styrene), or other combinations of plastic elastic block polymers may also be used. Those skilled in the art will also be able to substitute, for block copolymers, graft polymers or polymers stiffened by incorporation of organic fillers as long as this fulfills the requirements of the characteristics for which the block copolymers are chosen in accord with the present invention, i.e., capable of developing material strength without the step of vulcanization by heat.
The elastomers may be stiffened by adding a stiffening resin in the form, for example, of an amorphous resin. A suitable stiffening resin may be a styrene polymer or coumarone-indene resin. The resin should have properties which are similar to those of the coumarone-indene type, and resins derived from coal tar or petroleum can be used. The preferred stiffening point range of the amorphous resin is from about 140° to 300° F. The main characteristics of the resin are that it is compatible with the block copolymer, amorphous, and does not possess the elastomeric properties of being extensible and retractable.

An extender oil, such as commonly used in rubber compounding and described in ASTM Method D2226, Description of Types of Petroleum Extender Oils, may also be used. The use of extenders is well known. However, it is preferred to use a minimum concentration of such extender oil which will produce the desirable qualities of the composition set forth herein, and preferably to omit such oil entirely.

The preferred elastomeric bonding agent, modified as desired by the addition of a stiffening resin, or an extender, or both, may be applied dissolved in a volatile solvent or applied in the form of an emulsion. Antioxidants and antiozonants, such as commonly used to inhibit the attack of oxygen and ozone on rubber compounds, may be added to the composition to improve the aging properties of the binder.

The polymer may be applied to the aggregate as a dispersion, either as solution in a solvent or as an emulsion. Suitable solvents are low boiling, e.g., below about 125° C, chlorinated hydrocarbons, such as trichloroethylene, and aromatic solvents such as benzene, toluene, and xylene. Coal tar naphtha containing these chemicals may also be used. One skilled in the art may select various suitable solvents or azeotropes from those listed in the literature, e.g., Solvents Guide, by Marsden and Mann (Cleaver-Hume Press Ltd., London).

The preferred cohering material used in this invention is an emulsion comprising thermoplastic elastomer of a butadiene styrene block copolymer type dissolved in a suitable solvent, a resinous material and a polar solvent substantially as described above, sold by Phillips Petroleum Company under the tradename Petroset® RB. This material produces a bonding agent which, without vulcanization, has, as shown by standard stress strain tests, more than 10 times the strength of conventional rubbers.

* A Phillips Petroleum Company registered trademark.

The method for bonding the particulate matter is as follows. The ballast is washed with water and allowed to drain. It is sprayed with a solution of dilute ammonia of concentration range of approximately 0.5–5 percent, preferably 1–3 percent, and allowed to drain again. Part of the ammonia solution is held between individual rocks by capillary forces at the points where the rocks come into contact with each other. The Petroset emulsion is then sprayed on the ballast and "breaks" on contacting the ammonia thereby depositing the cementing agent at these points of contact. After a few hours, the cementing agent develops into small, individual elastomeric vibration pads at the points of contact which weld the treated ballast into an elastomeric consolidated structure. It has been found that heat can be used to cure the consolidated structures more rapidly; preferably steam or hot air is used in such curing process.

The process of this invention can be better understood in view of the drawings. In the drawing, FIG. 1 represents a cut-away view of the railway road bed of this invention showing the various components of the road bed. The figure will be described as the method by which the road bed is constructed which will also point out the structural features of the completed road bed.

On a graded right of way, a base section of particulate matter 11 is laid down and consolidated by spraying with the emulsion. The base section is of sufficient width and depth to provide support for railway rolling stock. Above the base section 11 a layer of loose particulate material (ballast) 12 is laid to a depth sufficient to allow future adjustment of tie elevation without damage to the stabilized base by track-leveling equipment. On this loose ballast the ties 13 are placed and on the ties are laid the rails 14. Loose ballast is then supplied to fill the space between the tabs (which is known as the crib) 15 to a depth that can place the level of the top of the ballast at the base of the laid track. Loose ballast is then heaped against the ends of the ties 16 and the edges of the crib 17 to form a curb 18 of height equal to the top edge of the ties and of sufficient width to support the weight of the loose ballast in the crib. This loose ballast in the curb 18 is then treated with the emulsion to consolidate at least a part of the curb section sufficient to maintain the shape thereof. This consolidation treatment is carefully carried out so that while the curb 18 is consolidated with the base section 11 the crib 15 and loose ballast 12 beneath the ties is not consolidated. Upon curing the curbs 18 and the base section 11 form a unified body of consolidated ballast within which the loose ballast 12, 15 supports the ties 13 on which the rails 14 ride. For repair additional ballast can be added to the crib 15 in the usual method for leveling the tracks. Repair or replacement of individual ties can be accomplished by removal of only so much of the curb at one side of the road bed as will allow transfer of the tie. After which the curb can be consolidated into its original form. The length of the replacement tie is not of critical concern since the curb is not a fixed solid boundary limiting the length of the ties, but is solid boundary that can be changed to accommodate tie lengths which vary within reasonable limits.

The unified structure of the road bed can be better illustrated with a sectional view of the end of the bed as in FIG. 2. In this figure the base section 11 and the curb sections 18 are shown in their relation as a unified body as the consolidation treatment for the curb section obliterates the line of distinction 19 between the base and curb sections. The loose ballast 12 on which rest the ties 13 can be seen in its position relative to the curb 18 and base section 11.

FIG. 3 shows a sectional view taken at A—A through the road bed as shown in FIG. 2. In this view is illustrated the relative position of the base section 11 over which is laid the loose ballast 12 with the ties 13 resting on this loose ballast and supporting the track 14. In this figure is most clearly shown the crib sections 15 filled with loose ballast.

EXAMPLE 1

A section of railroad track was selected for treat-
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ment. Ballast and ties were removed to a depth about 6 inches below tie level in an area 9 feet 6 inches wide \times 7 feet 6 inches long (parallel to rail). Several areas were thus prepared each of which comprised four ties and five cribs.

Clean ballast was placed in the excavation. The ballast was levelled (approximately 6 inches deep) and sprayed with 9 gallons of 1 percent NH₃ solution, then followed while still damp with 9 gallons of Petroset RB emulsion (Phillips Petroleum Company). Ties were placed immediately and rails spiked in place to allow a train to pass. Crib ballast was then placed and the shoulder treated with 1 percent NH₃ and Petroset emulsion.

EXAMPLE II

A similar section of track was treated as in Example I. Following application, the area was heated with steam by flowing steam under a tarpaulin over the area.

All ballast was steamed approximately 30 minutes.

Reasonable variation and modification are possible within the scope of the foregoing disclosure and the appended claims the essence of which is that a stabilized railway road bed can be constructed by consolidating the particulate matter at the base and edges of the roadway producing a structure of sufficient strength to support the loose ballast, ties, and track within the consolidated structure.

I claim:

1. A method for stabilizing a railway road bed comprising:
   a. laying a base section of particulate matter of sufficient width and depth to support the weight of railway rolling stock;
   b. consolidating the base section with an emulsion comprising a thermoplastic elastomer, a resinous material and a polar solvent;
   c. placing a layer of loose ballast on the base section;
   d. laying ties on the loose ballast;
   e. laying track on the ties;
   f. placing loose ballast, as a crib, between the ties beneath the rails;
   g. placing loose particulate matter above the base section at the ends of the ties to produce a curb of height and width sufficient to retain the crib; and
   h. consolidating at least a part of the curb with said emulsion.

2. The method of claim 1 wherein the particulate matter is railway ballast.

3. The method of claim 1 wherein consolidation of the particulate matter with said emulsion comprises:
   a. wetting the particulate matter with an ammonia solution;
   b. allowing the excess liquid to drain;
   c. wetting the particulate matter with said emulsion;
   d. allowing the emulsion to break; and
   e. allowing the resulting elastomeric, consolidated structure to cure.

4. The method of claim 3 wherein the curing is affected using heat.

5. The method of claim 4 wherein the curing is effected by steam.

6. A stabilized railway road bed comprising:
   a. a base section comprising particulate matter and cohering material said cohering material comprising a thermoplastic elastomer and a resinous material said base solution consolidated to a sufficient width and depth to support the weight of railway rolling stock;
   b. curb sections comprising particulate matter and cohering material said cohering material comprising a thermoplastic elastomer and a resinous material said curb sections consolidated to a sufficient height and width to contain between the curb sections;
      i. a first layer of loose ballast above the base section;
      ii. the cross ties above the first layer of loose ballast;
      iii. a second layer of loose ballast between the ties;
   c. said layers of loose ballast;
   d. said ties; and
e. railway tracks on said ties.

7. A railway road bed of claim 6 wherein the thermoplastic elastomer is a butadiene-styrene block copolymer.

8. The method of claim 4 wherein the curing is effected by hot air.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,841,554 Dated October 15, 1974

Inventor(s) Richard J. Bennett

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 6, line 23, "solution" should be -- section --.

Signed and sealed this 11th day March 1975.

(SEAL)
Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks