TIE FOUNDATION FOR A RAILWAY TIE

Inventors: Stefan Potocan, Nenzing (AT); Martin Dietrich, Rankweil (AT)

Correspondence Address:
VOLPE AND KOENIG, P.C.
UNITED PLAZA, 30 SOUTH 17TH STREET
PHILADELPHIA, PA 19103 (US)

Assignee: Getzner Werkstoffe Holding GmbH, Burs (AT)

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ABSTRACT
A tie foundation (1) for a railway tie (2) having at least a first elastic, preferably elastomer layer (3) and at least a second elastic, preferably elastomer layer (4), with a reinforcement layer (5) being embedded between the first elastic layer (3) and the second elastic layer (4), with the second elastic layer (4) forming an outer surface (6) of the tie foundation (1) and the reinforcement layer (5) comprising a fibrous material.
TIE FOUNDATION FOR A RAILWAY TIE

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation of PCT/AT2009/000077, filed Feb. 26, 2009, which claims the benefit of Austrian Application No. A365/2008, filed Mar. 6, 2008, both of which are incorporated herein by reference as if fully set forth.

BACKGROUND

[0002] (a) Field of the Invention

[0003] The present invention relates to a tie foundation for a railway tie having at least a first elastic, preferably elastomer layer, and at least a second elastic, preferably elastomer layer, with a reinforcement layer being embedded between the first elastic layer and the second elastic layer. Additionally, the invention also relates to a method to produce a tie foundation as well as an arrangement comprising a railway tie and a tie foundation.

[0004] (b) Description of the State of the Art

[0005] As known per se, a tie foundation represents an elastic underlayment, arranged and/or to be arranged underneath a railway tie, which is arranged at said railway tie, e.g., by way of adhesion. The tie foundation serves to reduce the emission of impact sound created by railway tracks.

[0006] A generic tie foundation is shown e.g., in DE 43 15 215 A1. Here, it is suggested to provide a reinforcement layer between two layers comprising an elastomer material and to arranged an additional layer comprising a non-woven fabric between the elastomer material and the roadbed such that the tie foundation only contacts the roadbed via the exterior layer of non-woven fabric.

[0007] The later published AT 505 180 A1 describes a coating material for a direct connection to a concrete part, which comprises a layer made from at least one polymer having a first surface to contact the concrete part and being connected thereto, with said surface comprising a surface structuring. The surface structuring is embodied by at least almost channel-like and/or pore-shaped recesses and/or by at least almost channel-like elevations.

[0008] From EP 1 445 378 A2 a railway tie is known, with a plastic layer being mounted to its bottom. In order to connect the plastic layer and the concrete of the sleeper body a spatially extended grid of threads is embedded both in the sleeper body as well as in the plastic layer.

[0009] It has been shown that in the generic tie foundations of prior art the penetration of the gravel into the tie foundation is insufficiently prevented, which may lead to an early destruction of the tie foundation. Furthermore, it has shown that frequently problems occur from an insufficient resistance of the tie foundation against lateral displacement.

SUMMARY

[0010] The object of the invention is to provide an improvement of generic tie foundations, which contributes to the avoidance of the above-mentioned problems or at least to a reduction in them.

[0011] This is attained according to the invention by the second elastic layer forming an exterior surface of the tie foundation and the reinforcement layer comprising a fibrous material.

[0012] Therefore, it is provided that the second elastic layer, particularly at least at the side facing away from and/or opposite the railway tie in the operational position, forms an exterior surface of the tie foundation, with the gravel, upon which in the operational position the tie foundation rests together with the railway tie, directly contacting said elastic exterior surface of the second layer of the tie foundation. This way, the required resistance against lateral displacement can be maintained without any problems. The fibrous material of the reinforcement layer also prevents any excessive penetration of the gravel or foundation into the tie foundation such that an early destruction of the tie foundation is prevented. By embedding the fibrous material of the reinforcement layer between the first elastic layer and the second elastic layer the threads of the fibrous material cannot be pushed apart as easily as in a fibrous layer adhered to the exterior surface layer of the tie foundation from the bottom such that by the embedding, a reinforcement layer is formed of particular tensile strength, which prevents any further penetration of the railway gravel into the tie foundation particularly well.

[0013] In order to embody the tensile strength of the reinforcement layer as high as possible so that even sharp-edged railway gravel cannot penetrate the reinforcement layer, it is particularly beneficial for the fibrous material of the reinforcement layer to comprise fibrous threads which in addition to the connection by way of embedding between the first elastic layer and the second elastic layer are also connected to each other by at least one additional measure, preferably by way of knotting or webbing or gluing or welding.

[0014] For this purpose, it may be provided that the fibrous material of the reinforcement layer comprises a web or a similar knitted fabric or is made therefrom, in which as an additional measure the threads are interwoven and/or looped around each other. An alternative comprises that the fibrous material comprises a web or is made therefrom, in which fibrous threads are linked or knotted to each other. However, it is also possible for the fibrous material of the reinforcement layer to comprise at least one web or to be made therefrom, with beneficially here additional measures being provided such as an adhesion or welding of the threads to each other. In correspondingly strong textiles it may be sufficient, though, to ensure an appropriately tight interweaving.

[0015] The fibrous material of the reinforcement layer may also be made from different natural or artificial threads, here fiberglass and/or carbon fibers and/or plastic fibers are particularly preferred, preferably polypropylene or polyamide or polyethylene.

[0016] In order to retain the roadbed as effectively as possible, the reinforcement layer should not show any extensively large mesh widths and/or no extensively large apertures. In this context it is beneficial for the reinforcement layer to show apertures having an opening width of no more than 2 mm, preferably no more than 1 mm.

[0017] In a tie foundation, explained in greater detail in the following and particularly easy in its production but also of lasting stability, it may be provided that the first elastic layer and the second elastic layer comprise the same material or are made from the same material. This is not mandatory, though, of course the second elastic layer may also be made from a material different from the first elastic layer. Beneficially, both the first elastic layer and the second elastic layer are made from an elastomer. Here, foamed elastomers are preferred, particularly closed-pored ones. This may include e.g., polyurethane or caoutchouc elastomers. In the foamed
embodiment they are known as polyurethane foam or sponge rubber. The caoutchouc materials and/or elastomers may also comprise natural rubber but also artificial rubber products. In this context, elastomers generally are understood as form-fixed but elastically deformable materials, which under compression or tensile stress temporarily deform but when subsequently released regain their original undeformed shape. Elastomers may represent both man-made plastics as well as natural products. Beneficially the materials of the first elastic layer and/or the second elastic layer have a density of at least 150 kg/m³ and/or a porosity of at least 10%. A density of these materials ranging from 400 kg/m³ to 900 kg/m³ has proven particularly beneficial.

[0018] In addition to the tie foundation per se, the invention also relates to an arrangement comprising a railway tie and one such tie foundation. Beneficially, here the tie foundation is arranged at least at the bottom of a railway tie facing the ground in the operational position. Of course it is also possible for the tie foundation to be arranged laterally at the railway tie, particularly when the railway tie is lowered deeper into the roadbed and the gravel thus also laterally contacts the railway tie.

[0019] In order to fasten the tie foundation to the railway tie several measures can be taken, in general. For example, an adhesion or the like is possible. However, a particularly strong connection is possible, in particular when the exterior surface of the tie foundation opposite the second layer of the tie foundation comprises a connecting layer having at least one solid material, which has clear spaces open to the exterior to accept extraneous material between the solid material preferably to accept concrete from the railway tie. This way it is possible to place the tie foundation with the connecting layer onto the concrete not yet completely cured or onto another not yet cured material of the railway tie such that the concrete or the other material can penetrate the clear spaces of the connecting layer, during the curing of the railway tie resulting in a material-fitting and/or form-fitting and thus particularly strong connection between the tie foundation and the railway tie. In this sense, the connecting layer is therefore beneficially arranged at the side and/or surface of the tie foundation facing the railway tie in the operational position.

[0020] The solid material between which the clear spaces are arranged to accept the extraneous material, i.e. particularly from the concrete of the railway tie, can be shaped particularly in the form of bars, burs, and the like, with beneficially protrusion being provided that can be engaged behind by the material of the railway tie in a form-fitting fashion.

[0021] A particularly preferred embodiment provides, however, for the solid material of the connecting layer to comprise a spatially expansive grid made from threads, with the thickness of the grid and/or the depth of the clear spaces open towards the outside amounting to at least 3 times, preferably at least 10 times the thickness of one of the threads. This way, any material of the railway ties penetrating into the clear spaces can encompass all threads in a material-fitting and/or form-fitting manner, resulting in an appropriately stable connection during the curing of the material. The threads of the grid can here be arranged irregularly and/or partially be connected to each other and/or project from the first elastic layer in the form of loops. In order to fasten the connecting layer to the first elastic layer of the tie foundation it is beneficially provided for the connection layer and/or the grid to be embedded in the first elastic layer by at least 20% or at least 40% of its thickness. By this embedding, a material-fitting and/or form-fitting or fabric-fitting connection is also achieved between the connection layer and the first layer.

[0022] A preferred method to produce a tie foundation according to the invention provides for the reinforcement layer to be placed upon a foundation and subsequently a reaction mixture of a material of the first elastic layer and the second elastic layer being applied upon the reinforcement layer, preferably at the side facing away from the foundation and/or over the entire surface, and the reinforcement layer subsequently being arranged between the first elastic layer and the second elastic layer by way of floating in the reaction mixture while the reaction mixture is reacting.

[0023] In a tie foundation produced in this manner, the first elastic layer and the second elastic layer therefore beneficially are made from the same material. Embedding the reinforcement layer between these two layers therefore occurs by floating the reinforcement layer in the reaction mixture before said mixture is finally converted and/or has cured.

[0024] In this method, in order to embed a connection layer in the first elastic layer of the tie foundation, it may be provided that during the reaction of the reaction mixture, preferably in a foaming phase or a rising phase of the reaction mixture, the connection layer can be impressed into the reaction mixture, preferably by at least 20% or at least 40% of the thickness of the connection layer. Here, it may be provided that by the impression of the connection layer into the reaction mixture the reinforcement layer may be pressed in the direction towards the foundation and/or the floating of the reinforcement layer be limited. By the latter measure it can be prevented that the reinforcement layer floats too much in the reaction layer.

[0025] An alternate production method provides that initially the first elastic layer is produced, if applicable with a connection layer arranged thereat, as a preliminary product and subsequently the reinforcement layer is applied upon the first elastic layer, and subsequently or simultaneously the second elastic layer is applied, preferably as a reaction mixture.

Brief Description of the Drawings

[0026] Additional details and features of preferred exemplary embodiment variants of the invention are discernible from the following description of the figures.

[0027] Shown are:

[0028] FIG. 1 is a side view of an exemplary embodiment of the tie foundation according to the invention.

[0029] FIG. 2 is a top view of a preferred exemplary embodiment of a reinforcement layer prior to its arrangement in the tie foundation.

[0030] FIG. 3 is a side view of a railway tie with a tie foundation according to the invention.

[0031] FIG. 4 is an example for a suitable connection layer.

[0032] FIG. 5 is a sketch of the principle of a preferred production method of a tie foundation and.

[0033] FIG. 6 is a graph to explain the foaming phase.

Detailed Description of the Preferred Embodiments

[0034] In a preferred exemplary embodiment according to FIG. 1, the reinforcement layer 5 is arranged between the first elastic layer 3 and the second elastic layer 4 of the tie foundation 1. Here, the second elastic layer 4 forms the lower
exterior surface 6 of the tie foundation 1, i.e. in the operating position facing away from the railway tie and/or opposite thereto. On the opposite side, i.e. the one pointing towards the railway tie 2 in the operational position, the tie foundation 1 is provided with the connection layer 7, which in the exemplary embodiment shown here is embedded in the first elastic layer 3. The connecting layer 7 forms a spatially expanded grid made from threads 9. The clear spaces 8 are formed between the threads 9, into which the material of the railway tie can penetrate in the sense of a form-fitting, material-fitting, or fabric-fitting connection. In order to fasten it to the first layer 3, the connection layer 7 is embedded by approx. 40% of its thickness in the first elastic layer 3. Alternatively, it is also possible for the fastening of the connection layer 7 e.g., to apply a relatively thick adhesive layer onto the exterior surface of the first elastic layer 3, into which the reinforcement layer 5 can be embedded. In the preferred embodiments the thickness 22 of the first layer 3 ranges from 5 to 15 mm, preferably 5 to 10 or 10 to 15 mm. The second elastic layer 4 may be embodied considerably thinner. Its thickness 23 beneficially ranges from 0.2 to 4 mm. The thickness of the reinforcement layer 5 embedded between the first elastic and the second elastic layer beneficially ranges from 1 to 2 mm. The thickness 10 of the connection layer preferably ranges from 5 to 15 mm. A thickness of approx. 10 mm is particularly preferred. The projection of the connection layer 7 beyond the first layer 3 ranges from 3 to 8 mm, particularly preferred from 4 to 5 mm. The thickness of the connection layer 7 therefore beneficially ranges from 5 to 10 times the thickness of the reinforcement layer 5. The first elastic layer 3 is generally thicker than the second elastic layer 4, beneficially it is at least twice as thick.

FIG. 2 shows in a top view a preferred exemplary embodiment of the reinforcement layer 5 in the form of a net. The fibrous threads 11 of this web are interwoven or knotted to each other at their intersections 12, resulting in a particularly good tensile strength. The mesh width and/or the width of the apertures 13 between the individual fibrous threads 11 beneficially amounts to no more than 1 to 2 mm. Alternatively to the net shown here, of course textile knitted fabric, such as an interlaced yarn, can be used. In such reinforcement layers 5 the particularly high tensile strength is achieved by the interlacing mesh of the fibrous threads 11. Alternatively, of course woven materials can also be used, in which the fibrous threads 11 are interwoven by being interlaced with each other. In all above-mentioned exemplary embodiments the intersections 12 of the individual fibrous threads can additionally be adhered or welded to each other. It is even possible to use fibrous non-woven webs as reinforcement layers, if their threads are connected in a fixed manner to each other by way of welding, adhesion, felting, or other appropriate measures. The threads and/or fibrous threads 11 of the reinforcement layer 5 are beneficially made from fiberglass and/or carbon fibers and/or plastic, preferably polypropylene or polyamide or polyethylene or at least comprise such materials.

FIG. 3 shows a side view of a railway tie 2, with the tie foundation 1 according to FIG. 1 being arranged at its bottom. The connection layer 7 is therefore embedded in the material of the railway tie 2 as well as in the material of the tie foundation 1, thus creating a particularly strong connection. The arrangement of the railway tie 2 and the tie foundation 1 formed in this manner rests with the exterior surface 6 of the second elastic layer 4 on the foundation 14, here having the form of a roadbed. The railway track is not shown here, which is supported by the upper edge of the railway tie 2, as known per se.

FIG. 4 shows a perspective view of the connection layer 7 embodied in the form of a 3-D grid of the exemplary embodiment according to FIG. 4. The grid of the connection layer 7 comprises threads 9 or cords spatially interlaced with each other preferably comprising a plastic, such as PP (polypropylene), PA (polyamide), or PE (polyethylene) and having certain elasticity. Such grids are used for example as drain filters or geo-grids and are commercially available under those names. The spatial expansion as well as the embodiment of clear spaces 8 is important in order to allow a form-fitting or material-fitting connection to the material of the railway tie 2 as well as to the first elastic layer 3.

FIG. 5 shows a preferred production method for a tie foundation 1 according to the invention. First, the reinforcement layer 5 is placed as the first processing step, e.g., by uncoiling it from a roller 21 onto a base 15, preferably spread in a planar fashion. The base 15 is preferably formed by a conveyer belt or the like, which transports the reinforcement layer 5 to the jet 17 and further in said direction. This jet 17 applies a reaction mixture 16 onto the reinforcement layer 5, preferably over the entire surface. The reaction mixture 16 placed upon the reinforcement layer 5 begins to react or continues its reaction that has begun earlier. During this reaction period, the reinforcement layer 5 rises in the reaction mixture 16. Additionally, during the reaction a beneficial increase in volume of the reaction mixture occurs, e.g., by way of foaming. In order to embed the connection layer 7, a pressure roller 19 is provided in the exemplary embodiment shown here. The reaction layer 7 is fed via this roller and pressed into the reaction mixture 16 that has not yet fully cured, causing the connection layer 7 to be embedded in the first elastic layer 3. The depth of said impression of the connection layer 7 is adjusted via the distances of the rotary axis 20 of the impression roller 19 and/or the lower surface of the impression roller 19 in reference to the base 15. After the feeding of the connection layer, the reaction of the reaction mixture ends, and here the connection layer 7 can also be used to prevent any further floating of the reinforcement layer 5 in the reaction mixture or to press the reaction layer 5 in the direction of the base 15 such that the desired arrangement in the final product is achieved. At the end of the reaction process the first elastic layer 3 and the second elastic layer 4 are produced in the desired thickness comprising the reaction mixture 16. The reinforcement layer 5 is embedded therebetween at the desired depth. The same applies to the connection layer 7.

FIG. 6 shows a diagram, in which the density D of the reaction mixture is applied in reference to the reaction period 1. The so-called foaming phase 18 is discernible, in which the reaction mixture a particularly strong increase in volume occurs, but also a change in viscosity. In the method shown in FIG. 5 the distance between the jet 17 and the impression roller 19 should be selected such that, depending on the reaction speed of the reaction mixture 16, the impression of the connection layer 7 occurs during the foaming phase 18 and/or the rising phase shown in FIG. 6.

LEGEND CONCERNING THE REFERENCE NUMBERS

1 tie foundation
2 railway tie
1. A tie foundation (1) for a railway tie (2) comprising at least a first elastic layer (3) and at least a second elastic layer (4), with a reinforcement layer (5) being embedded between the first elastic layer (3) and the second elastic layer (4), and the second elastic layer (4) forms an exterior surface (6) of the tie foundation (1), the reinforcement layer (5) comprises a fibrous material.

2. A tie foundation (1) according to claim 1, wherein the exterior surface of the tie foundation (1) opposite the second layer (4) comprises a connection layer (7) having at least one solid material, which between the solid material has a first elastic layer (3) applied thereon, and a second elastic layer (4) open towards an outside to accept extraneous material.

3. A tie foundation (1) according to claim 2, wherein the solid material of the connection layer (7) comprises a spatially spread grid made from threads (9), with a thickness (10) of the grid or a depth of the the clear spaces (8) open towards the outside at least amounts to 3-times a thickness of one of the threads (9).

4. A tie foundation (1) according to claim 3, wherein the solid material of the connection layer (7) comprises a spatially spread grid made from the threads (9), with the thickness (10) of the grid or a depth of the clear spaces (8) open towards the outside amounts to at least 10-times a thickness of one of the threads (9).

5. A tie foundation (1) according to claim 3, wherein the threads (9) of the grid are arranged irregularly.

6. A tie foundation (1) according to claim 3, wherein the threads (9) of the grid are partially connected to each other.

7. A tie foundation (1) according to claim 3, wherein the threads (9) of the grid project as loops from the first elastic layer (3).

8. A tie foundation (1) according to claim 2, wherein at least one of the connection layer (7) or the grid are embedded in the first elastic layer (3).

9. A tie foundation (1) according to claim 2, wherein at least one of the connection layer (7) or the grid are embedded in the first elastic layer (3) by at least 20% or at least 40% of a thickness (10) thereof.

10. A tie foundation (1) according to claim 3, wherein the threads (9) are comprised of plastic.

11. A tie foundation (1) according to claim 10, wherein the plastic is polypropylene or polyamide or polyethylene.
26. A method according to claim 24, wherein the reaction mixture (16) of the material of the first elastic layer (3) and the second elastic layer (4) is applied over an entire surface of the reinforcement layer (5).

27. A method according to claim 24, further comprising during the reaction of the reaction mixture (16), impressing the connection layer (7) into the reaction mixture (16).

28. A method according to claim 27, further comprising during the reaction of the reaction mixture (16), pressing the connection layer (7) into the reaction mixture (16) in a foaming phase (18) or a rising phase of the reaction mixture (16).

29. A method according to claim 27, wherein during the reaction of the reaction mixture (16) the connection layer (7) is pressed into the reaction mixture (16) from a side facing away from the base (15).

30. A method according to claim 27, wherein during the reaction of the reaction mixture (16) the connection layer (7) is pressed into the reaction mixture (16) by at least 20% or by at least 40% of a thickness (10) of the connection layer (7).

31. A method according to claim 27, wherein due to the impression of the connection layer (7) into the reaction mixture (16) the reaction layer (5) is pressed in a direction towards the base (15) or the floating of the reinforcement layer (7) is limited.

32. A method for the production of a tie foundation (1) according to claim 1, further comprising initially producing the first elastic layer (3) as a preliminary product, and subsequently applying the reinforcement layer (5) upon the first elastic layer (3), and subsequently or simultaneously applying the second elastic layer (4).

33. A method according to claim 32, wherein the first elastic layer (3) is produced as a preliminary product using a connection layer (7) arranged thereon.

34. A method according to claim 32, wherein the second elastic layer (4) is applied as a reaction mixture.

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