The invention relates to a road construction and to a method for realizing such a road construction comprising a foundation layer, a road surface provided on top of the foundation layer, and a binder course provided between the foundation layer and the road surface for bonding the road surface to the foundation layer. In the binder course metal particles are incorporated. The metal particles form threads and are iron particles. The binder course comprises bitumen that is incorporated in a fleece.
ROAD CONSTRUCTION, APPARATUS AND METHOD FOR REALIZING SUCH A ROAD CONSTRUCTION

[0001] The invention relates to a road construction and to a method for realizing such a road construction comprising a foundation layer, a road surface provided on top of the foundation layer, and a binder course provided between the foundation layer and the road surface for bonding the road surface to the foundation layer. It is observed, that in addition to the binder course just mentioned, further layers may be present on the foundation layer and under the road surface. In general the binder course comprises bitumen, but other materials may also be used in the binder course. For the sake of clarity, reference will always be made to bitumen as the applicable binder course, while the invention must not be considered to be limited thereto.

[0002] The prior art road construction as realized for many years now has a foundation layer, of which a top layer of asphalt is a component. On this top layer a finishing layer of asphalt has to be applied which will serve as road surface. In the prior art the bonding between the road surface and the foundation layer is realized with a bitumen emulsion, which is applied as a thin layer to the surface of the foundation layer to be asphalted. The water in the emulsion will evaporate under the influence of the heat of the asphalt applied as road surface. This softens the bitumen layer, creating a physical bond between the asphalt layers of the foundation layer and the road surface.

[0003] The known road construction is realized on site. However, the invention aims to make a road construction possible of the so-called modular type, consisting of prefabricated elements. One problem that needs to be solved is that the bitumen binder course cannot be realized in the usual manner because the asphalt to be applied on the bitumen layer no longer holds the heat necessary for allowing the bitumen to bond. The object of the invention is therefore to provide a road construction that allows the road to be finished with prefabricated elements, while nevertheless allowing bonding of the road surface on the foundation layer to be realized.

[0004] To this end the method for the realization of the road construction according to the invention is characterized in that on a foundation layer a binder course is applied, in which particles are incorporated that are sensitive to excitation by electromagnetic waves, in that on the binder course a road surface is applied, and in that the bonding of the road surface on the foundation layer is realized by electromagnetic heating the binder course. Electromagnetic heating may be effected by microwaves or by induction, without being limited thereto.

[0005] Specifically when using microwave energy, compounds are incorporated in the binder course that are based on one of the following types of additives or combinations thereof:

- [0006] metal salts such as, for example, NaCl or KBr;
- [0007] organic salts trimethyl ammonium methosulphate;
- [0008] mineral and synthetic oil or fatty compounds (for example, in the form of emulsions or encapsulated);
- [0009] carbon (C) components (in the form of filaments, particles and tissues);
- [0010] metallic components such as Fe, Al (in the form of filaments, particles and tissues).

[0011] The addition of said substances to the binder course changes some of the material-specific properties of this layer, such as melting and boiling point, thermal capacity and dielectric constant. In this manner said substances ensure that the material of the binder course is still serviceable as binding agent, while at the same time being factors more sensitive to microwave energy than the surrounding material. This makes it possible for the microwave energy to, as it were, completely pass through the asphalt layer, inducing heat only in the binder course. Energy losses to the underground are thus limited to a minimum. In the bottom of the binder course an optional layer may be incorporated preventing losses to the underground.

[0012] When using induction heating with induction coils, it is possible to only induce heat in the binder course, if the binder course is provided with an electrically conductive structure. An electrically conductive structure may be, for example, metal wire netting or carbon fibre.

[0013] The principle, heating by means of induction coils, is based on the indirect and contactless heating of the binder course by means of inducing eddy currents in the electrically conductive structure provided. The eddy currents induce heat that is subsequently given off to the binder course, which as a result softens and thereby effectuates binding or detachment (see below, in connection with the removal of the road surface).

[0014] An important advantage of these forms of heating is that they are contactless. This is especially advantageous where existing roads are concerned that are not completely level.

[0015] The road construction can be realized quickly and effectively because the binder course with the incorporated particles is applied on the foundation layer by unwinding it from a roll of a prefabricated bituminized fleece. Correspondingly, the invention is also embodied in a separate fleece, which is characterized in that said fleece is bituminized and that it incorporates particles that are sensitive to excitation by electromagnetic waves. Such a fleece is preferably wound onto a roll and can be unrolled.

[0016] Alternatively, the binder course may be applied by spraying bitumen followed by scattering the particles over the bitumen.

[0017] To finish the road construction, the same is preferably characterized in that the road surface comprises a sound-absorbing asphalt mattress or rubber mat.

[0018] To improve the properties of the road and to reduce the rolling resistance it may be preferred for the asphalt mattress or rubber mat to be covered with a perforated top layer. Conveniently and to render it wear-resistant, this may be realized such that the top layer is selected from a layer of biorein comprising carborundum and a bituminized fleece enriched with chippings.

[0019] The invention further relates to a method for the removal of a road surface applied on a foundation layer, wherein a binder course is present between the road surface
and the foundation layer, wherein the binder course comprises particles that are sensitive to excitation by electromagnetic waves, and wherein the binder course is subjected to electromagnetic heating. This causes the binder course to soften to a certain extent, after which the road surface can be rolled up. It is also possible to electromagnetically heat the binder course such that it glazes so that the bonding of the binder course on the foundation layer can be conveniently cancelled by applying a suitable shearing load to the road surface.

[0020] The invention finally relates to an apparatus suitable for use in a method for realising a road construction, comprising a foundation layer, a road surface on top of the foundation layer, and a binder course applied between the foundation layer and the road surface for bonding the road surface to the foundation layer. The apparatus according to the invention is characterized in that the same comprises electromagnetic heating means for the thermal activation or deactivation of the binder course.

[0021] Desirably, the apparatus is mobile to facilitate the successive processing of adjacent road sections.

[0022] The apparatus is preferably embodied with wheels, the heating means being provided between the wheels, mounted on a frame that is carried by the wheels, while the height of the frame can be adjusted in relation to the wheels. In this manner the apparatus can be easily adapted to the road surface's fluctuations in height, while allowing also a certain adjustment of the heating of the binder course. Incidentally, this latter aspect depends substantially on the adjustability of the heating means.

[0023] The invention will now be further elucidated with reference to the following non-limiting exemplary embodiment of the road construction according to the invention and the method for realising the same.

[0024] The components of the road surface are fabricated under controlled conditions, rolled up, and subsequently transported to the site and unrolled. The road surface is constructed in layers and consists of two or possibly three layers, to wit

[0025] 1) a binder course of, for example, bitumen comprising particles that are sensitive to excitation by electromagnetic waves;

[0026] 2) a sound absorbing layer;

[0027] 3) optionally a top layer.

[0028] The particles comprised in the binder course may be selected from the following group:

[0029] metal salts such as, for example, NaCl or KBr;

[0030] organic salts trimethyl ammonium methosulfate;

[0031] mineral and synthetic oil or fatty compounds (for example, in the form of emulsions or encapsulated);

[0032] carbon (C) components (in the form of filaments, particles and tissues);

[0033] metallic components such as Fe, Al (in the form of filaments, particles and tissues).

[0034] Of course, combinations from this group are also possible.

[0035] After the layers have been fabricated in the factory, the rolled up road surface is transported to the desired site. Transportation may be carried out by means of lorries. The size of the rolls will have to be adapted, among other things, to the statutory dimensions of a lorry and the allowable curvature in the respective material. As indication one might consider rolls having a width of approximately 4 m and a length of, for example, 20 m but preferably of approximately 50 m.

[0036] The binder course is then rolled out first on the existing paving. Subsequently the sound-absorbing layer is rolled out on the binder course. Bonding is realized by heating the binder course by means of low-frequency or high-frequency electromagnetic waves resulting in adhesion. In order to improve the cohesion and flatness of the sound-absorbing layer, the road surface may optionally be heated by means of pre-heaters and subsequently pressed on by means of a road roller. If the likelihood exists that the sound-absorbing layer is unable to realize the desirable slid-resistance, an additional top layer may be applied.

[0037] After about one hour, when the bonding is completed, the road surface is ready for use. If the road surface is damaged, it can be removed in a quick and efficient manner. This may be realized, for example, by vibrating the binder course by means of high-frequency electromagnetic waves. This causes the binder course to become rigid, such that the bonding between foundation layer and road surface can be cancelled simply by shear.

[0038] The road surface may then be removed without brute force by a lorry provided with special grippers. While the binder course is being vibrated, the coherence of the remaining layers remains intact. This aspect is realized due to the fact that only the particles in the binder course are sensitive to the electromagnetic waves. It is also possible to use low-frequency electromagnetic waves; the heat thus induced causes the binder course to be softened, after which the road surface to be replaced can simply be rolled up.

[0039] As already mentioned, the road surface is comprised of two or optionally three layers, to wit a binder course, a sound-absorbing layer and optionally a surface layer. The binder course has been described in the foregoing.

[0040] For the sound-absorbing layer there are, among others, the following two possibilities:

[0041] 1) an asphalt mattress;

[0042] 2) a rubber mat.

[0043] Asphalt Mattress

[0044] The asphalt mattress is a product wherein the asphalt is applied on a carrier. The carrier is comprised of, for example, three-dimensionally structured polyamide fibres, which are fused together where they cross each other. The thickness of the mattress is approximately 30 mm. Minerals having a grading from 4-6 mm, for example, a stone fracture of 75-90% with a cavity from 15-30%, may also be used in the asphalt.
Rubber Mat

The rubber mat is preferably made from used car tires that have been ground to a granulate of 0-6 mm grading. The granulate is mixed with a binder, for example, polyurethane and subsequently placed in a mould and heated. Depending on the application, the thickness of the mat may vary between 20-100 mm, preferably 30 mm. The cavity percentage is approximately 25%. Due to the properties of rubber and the amount of cavity, the product has good sound absorbing characteristics. The absorption coefficient may vary between 0.11 at a frequency of 110 Hz and 0.85 at a frequency of 1600 Hz.

If the sound-absorbing layer does not comply with the civil engineering requirements for use as road surface, it is possible to apply a top layer to the sound-absorbing layer. By means of this layer the desired properties such as, for example, skid-resistance may be realized.

For the self-adhesive top layer there are at least two possibilities:

1. a perforated layer of bioreisin;
2. a perforated layer of a bituminous fabric.

The top layer is comprised of a perforated layer of bioreisin wherein the surface is provided with a layer of carborundum chippings graded from 0-2 mm. The bioreisin is an epoxy resin, which is applied in an environmentally friendly manner. Carborundum is a mineral of a considerable hardness. The mineral is, moreover, wear-resistant. The carborundum provides the desired skid-resistance of the road surface. The bioreisin will be provided with perforations of a diameter of approximately 4 mm. The percentage of open surface may be approximately 25%, rendering the top layer water-permeable. This improves safety in wet conditions. By means of the perforations the so-called air-pumping sound is reduced due to the fact that the expanding air in the mating surface between tire and road surface is led away to the sound-absorbing asphalt layer.

It is also possible to use a perforated bituminized fleece of a thickness of 2 to 3 mm. As in the top layer of bioreisin, the surface is provided with carborundum chippings or an equivalent product, and perforations will be provided.

In the following, finally, the apparatus will be elucidated, which apparatus is proposed in accordance with the invention for use in a method for realizing a road construction as explained in the foregoing.

The apparatus according to the invention will be explained below with reference to the drawing, which shows a side-view of the apparatus; and FIG. 2 shows a rear-view of the apparatus. Identical reference numbers in the figures refer to similar elements.

Generally speaking, the apparatus is indicated in the figures by reference number 1. Said apparatus comprises a frame 2 and wheels 3 that are coupled with the frame, making the apparatus mobile. Between the wheels and suspended from the frame, heating means are provided in casings 4, for example, in the form of a microwave generator with an accompanying high-voltage unit. Where electromagnetic heating by means of microwaves is concerned, a so-called microwave launcher 5 as shown in FIG. 2 is useful. The figure shows clearly that in this way the microwaves are emitted very closely to the road surface.

To the person skilled in the art it is very obvious how such an apparatus has to be further embodied in order to be useful for the above-defined objective of realizing and optionally partly dismantling a road construction.

The above explanation and description of the invention leaves room for many more variations, the development of which is a matter for the future and cannot be anticipated. The protection accorded to the appended claims should therefore not be limited to the foregoing description but extends also to such alternative developments, insofar these fall within the protective scope that may reasonably be afforded the appended claims.

What is claimed is:

1. A method for realizing a road construction, wherein on a foundation layer a binder course is applied, in which particles are incorporated that are sensitive to excitation by electromagnetic waves, in that on the binder course a road surface is applied, and in that the bonding of the road surface on the foundation layer is realized by electromagnetically heating the binder course.
2. A method according to claim 1, wherein the binder course with the incorporated particles is applied on the foundation layer by unwinding it from a roll of a prefabricated bituminized fleece.
3. A method according to claim 1, wherein the binder course is applied by spraying bitumen followed by scattering the particles over the bitumen.
4. A method for the removal of a road surface applied on a foundation layer, wherein a binder course is present between the road surface and the foundation layer, wherein the binder course comprises particles that are sensitive to excitation by electromagnetic waves, and that the binder course is subjected to electromagnetic heating to soften the binder course prior to its removal.
5. A fleece, wherein the same is bituminized and incorporates particles that are sensitive to excitation by electromagnetic waves.
6. A fleece according to claim 5, wherein the same is wound onto a roll and can be unrolled.
7. A road construction comprising a foundation layer, a road surface provided on top of the foundation layer, and a binder course provided between the foundation layer and the road surface for bonding the road surface to the foundation layer, wherein the binder course incorporates particles that are sensitive to excitation by electromagnetic waves.
8. A road construction according to claim 7, wherein the binder course comprises bitumen that is incorporated in a fleece.
9. A road construction according to claim 7, wherein the road surface comprises a sound-absorbing asphalt mat or rubber mat.
10. A road construction according to claim 9, wherein the asphalt mat or rubber mat is covered with a perforated top layer.
11. A road construction according to claim 9, wherein the top layer is selected from a layer of bioresin comprising carborundum and a bituminized fleece enriched with chippings.

12. An apparatus suitable for use in a method for realizing a road construction, comprising a foundation layer, a road surface on top of the foundation layer, and a binder course applied between the foundation layer and the road surface for bonding the road surface to the foundation layer, wherein the same comprises electromagnetic heating means for the thermal activation or deactivation of the binder course.

13. An apparatus according to claim 12, wherein the same is mobile to facilitate the successive processing of adjacent road sections.

14. An apparatus according to claim 12, wherein the same has wheels and in that the heating means are provided between the wheels, mounted on a frame that is carried by the wheels, while the heights of the frame can be adjusted in relation to the wheels.

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