



Office de la Propriété
Intellectuelle
du Canada

Un organisme
d'Industrie Canada

Canadian
Intellectual Property
Office

An agency of
Industry Canada

CA 2548269 C 2010/10/12

(11)(21) **2 548 269**

(12) **BREVET CANADIEN
CANADIAN PATENT**

(13) **C**

(86) Date de dépôt PCT/PCT Filing Date: 2004/10/30
(87) Date publication PCT/PCT Publication Date: 2005/07/07
(45) Date de délivrance/Issue Date: 2010/10/12
(85) Entrée phase nationale/National Entry: 2006/06/05
(86) N° demande PCT/PCT Application No.: EP 2004/012318
(87) N° publication PCT/PCT Publication No.: 2005/061800
(30) Priorité/Priority: 2003/12/09 (DE103 57 948.6)

(51) Cl.Int./Int.Cl. *C04B 28/02* (2006.01),
E01B 1/00 (2006.01)
(72) Inventeur/Inventor:
POHLMANN, MARKO, DE
(73) Propriétaire/Owner:
DEUTSCHE GLEIS- UND TIEFBAU GMBH, DE
(74) Agent: RIDOUT & MAYBEE LLP

(54) Titre : BETON NECESSITANT UN FAIBLE COMPACTAGE
(54) Title: LIGHTLY COMPACTED CONCRETE

(57) **Abrégé/Abstract:**

The invention pertains to a concrete material for a support layer of a permanent way for railroads or streetcars that is realized in a ballastless fashion, as well as the utilization of this material for producing such a support layer. This material should make it possible to effectively reduce the thus far required expenditure of manual labor for installation and compacting work--particularly for banked tracks in curves. This is achieved in that the concrete material has a limestone powder content of 240-280 kg/m³ and an aggregate content of 1500-1700 kg/m³, wherein 35-45% of the aggregate consist of an aggregate with grain sizes on the order of 0 to 2 mm, 25-35% consist of an aggregate with grain sizes on the order of 2 to 8 mm and 25-35% consist of an aggregate with grain sizes on the order of 8 to 16 mm, and wherein a flow agent content is inversely proportional to the geometric cant of the support layer of the permanent way.



ABSTRACT

The invention pertains to a concrete material for a support layer of a permanent way for railroads or streetcars that is realized in a ballastless fashion, as well as the utilization of this material for producing such a support layer.

This material should make it possible to effectively reduce the thus far required expenditure of manual labor for installation and compacting work--particularly for banked tracks in curves.

This is achieved in that the concrete material has a limestone powder content of 240-280 kg/m³ and an aggregate content of 1500-1700 kg/m³, wherein 35-45% of the aggregate consist of an aggregate with grain sizes on the order of 0 to 2 mm, 25-35% consist of an aggregate with grain sizes on the order of 2 to 8 mm and 25-35% consist of an aggregate with grain sizes on the order of 8 to 16 mm, and wherein a flow agent content is inversely proportional to the geometric cant of the support layer of the permanent way.

- 1 -

LIGHTLY COMPACTED CONCRETE

The invention pertains to a concrete material for a support layer of a permanent way for railroads or streetcars that is realized in a ballastless design, as well as the use of this concrete material for producing such a support layer.

In the construction of the permanent way for track-bound railroad traffic systems, ballastless systems have been advantageously utilized for certain applications and operating conditions over the past decades. During the course of various development activities, a broad variety of different technical approaches were proposed and evaluated with respect to their suitability for use in practical applications. In addition to systems in which the supporting points for receiving the rails are already integrated into precast concrete parts at the factory (e.g., rigid rail of the type "Bögl"), systems in which a track system consisting of rails, rail-fixing material and crossties is fixed by means of in-situ-grouting - usually cast-in-place concrete or asphalt - proved particularly advantageous (e.g., ballastless systems of the type "Rheda").

In addition to the adjustment of the track system on the supporting substructure, the main problem of such cast-in-place concrete systems proved to be the grouting of the crossties within the concrete material of the track slab. In the regions of curved tracks, in particular, the outer rail is arranged higher than the inner rail referred to the vertical direction. This difference in height between the two rails is professionally referred to as geometric cant.

Until now, the construction of a concrete support layer in the region of such geometrically canted track sections required a very stiff concrete recipe in order to prevent the cast-in-place concrete of the track-slab from flowing over the formwork sections on the inner side of the curve. In this

- 2 -

respect, it proved particularly disadvantageous that the processing of such a stiff or firm concrete requires a high expenditure of manual labor because extensive leveling and compacting work needs to be performed.

5

In the 1980's, a self-compacting concrete from Japan was introduced on the market, wherein this type of concrete is in the meantime also used in isolated instances for civil engineering structures being constructed in Europe. In the context of the present problem definition, a simple adaptation of such a self-compacting concrete to the construction of a continuous concrete support layer of a track can only be considered in areas without longitudinal or lateral inclination due to the self-leveling properties of the self-compacting concrete. However, such a track routing without any inclination essentially cannot be found or realized on any railroad tracks. In comparison with railroads tracks that have a classic gravel ballast, ballastless track systems provide the decisive advantage that the track routing can have much more extreme inclination values due to the inherently superior load application and distribution characteristics of the ballastless track such that the civil engineering and soil shifting expenditures can be significantly reduced (shorter tunnels, shorter bridges, less steep through-cuts, etc.). In light of the desired track routing, the utilization of a conventional self-compacting concrete would be a contradiction in itself.

The invention is based on the objective of making available a concrete material for a support layer of a permanent way for railroads or streetcars that is realized in a ballastless design, wherein this concrete material makes it possible to effectively reduce the expenditure of manual labor for the leveling and compacting work to be performed--particularly with respect to geometrically canted tracks in curves.

- 3 -

According to an embodiment of the present disclosure there is provided a concrete material for a support layer of a permanent way for railroads or streetcars that is realized in a ballastless design, which has a limestone powder content of 240-280 kg/m³, an aggregate content of 1500-1700 kg/m³, wherein 35-45% of the weight of these aggregates consist of aggregates with grain sizes in the range of up to 2 mm, 25-35% consist of aggregates with grain sizes in the range of 2 to 8 mm and 25-35% consist of aggregates with grain sizes in the range of 8 to 16 mm, a mass ratio of water to cement of 0.4, a retarder, present in the amount of 0.8% by mass of cement, and a flow agent content which is reduced with increasing geometric cant of the support layer of the permanent way.

In addition to this mixing ratio, the usual applicable requirements (particularly ZTV concrete - StB 01) naturally also apply, namely with respect to a minimum cement content of 350 kg/m³ of the quality CEM I 32,5 R, as well as a water/cement ratio (= mass ratio of water to cement) of 0.45.

According to the invention, the water/cement ratio is 0.4. The inventive concrete material also contains a retarder, the mass fraction of which referred to the total mass amounts to 0.8% of the cement mass fraction.

The main advantage of the present invention can be seen in that the properties of the hardened concrete (e.g., compressive strength, modulus of elasticity, bending tensile strength, resistance to splitting tension and frost resistance) remain almost unchanged in a thusly mixed material despite the required variation of the flow agent in order to realize different consistencies while the processing parameters, (e.g., plasticity, compacting efforts and processing speed) can be optimally adapted to the respective track geometry.

- 4 -

The aforementioned deviation ranges are based on the required adaptations to the regionally varying properties of the locally used aggregate deposits and the locally available cements. For example, a limestone powder with a coarser grain requires a larger mass than limestone powder with a finer grain because the specific water absorption capacity of limestone powder drops as the grain size increases. The best results were achieved with an aggregate comprising 40% of the weight of the aggregate with grain sizes in the range of up to 2 mm, 30% aggregate with grain sizes in the range of 2 to 8 mm and 30% aggregate with grain sizes in the range of 8 to 16 mm.

According to an additional development of the inventive concept, it proved particularly effective that the concrete material has a flow agent content of 1.7-1.8 kg/m³ in order to achieve a consistency class F6. This refers to the consistency classes F1 ("stiff") to F6 ("free-flowing") standardized in DIN-EN 12350-5. The variations described below proved practical for achieving different consistency classes, wherein a flow agent content of 1.65-1.75 kg/m³ is used for achieving a consistency class F5, a flow agent content of 1.6-1.7 kg/m³ is used for achieving a consistency class F4, a flow agent content of 1.4-1.5 kg/m³ is used for achieving a consistency class F3, a flow agent content of 1.1-1.25 kg/m³ is used for achieving a consistency class F2 and a flow agent content of 0.5-0.75 kg/m³ is used for achieving a consistency class F1. In this respect, the cited deviation ranges are also caused by the required adaptations to the regionally varying properties of the locally used aggregate deposits and the locally available cements.

Extensive investigations showed that inventive concrete materials of the consistency classes F5 and F4 are most suitable for instances in which the ballastless slab track to be constructed has a ratio of inclination between 7 and 10%. Inventive concrete materials of the consistency classes F3 to

- 5 -

F1 are suitable for more significant inclinations up to approximately 12%.

5 It is particularly practical if the flow agent used is based on a polycarboxylateether. This promotes the adjustment of a low frictional resistance within the concrete suspension such that any air inclusions created during the concreting are able to rise within the concrete suspension and to be finally ventilated.

- 6 -

CLAIMS

1. A concrete material for a support layer of a permanent way for railroads or streetcars that is realized in a ballastless design, wherein the concrete material has a limestone powder content of 240-280 kg/m³, an aggregate content of 1500-1700 kg/m³, wherein 35-45% of the weight of these aggregates consist of aggregates with grain sizes in the range of up to 2 mm, 25-35% consist of aggregates with grain sizes in the range of 2 to 8 mm and 25-35% consist of aggregates with grain sizes in the range of 8 to 16 mm, a mass ratio of water to cement of 0.4, a retarder, present in the amount of 0.8% by mass of cement, and a flow agent content which is inversely proportional to a geometric cant of the support layer of the permanent way.
2. The concrete material for a support layer of a permanent way for railroads or streetcars that is realized in a ballastless design according to claim 1, wherein the concrete material has a flow agent content of 1.7-1.8 kg/m³ for achieving a consistency class F6, a flow agent content of 1.65-1.75 kg/m³ for achieving a consistency class F5, a flow agent content of 1.6-1.7 kg/m³ for achieving a consistency class F4, a flow agent content of 1.4-1.5 kg/m³ for achieving a consistency class F3, a flow agent content of 1.1-1.25 kg/m³ for achieving a consistency class F2 or a flow agent content of 0.5-0.75 kg/m³ for achieving a consistency class F1.

- 7 -

3. The concrete material for a support layer of a permanent way for railroads or streetcars that is realized in a ballastless design according to claim 1 or 2, wherein the concrete material contains a flow agent on the basis of a polycarboxylateether.
4. Use of the concrete material according to any one of claims 1 to 3 for constructing a support layer of a permanent way for railroads or streetcars that is realized in a ballastless design.