(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 728 870 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
28.08.1996 Bulletin 1996/35

(51) Int Cl.[6]: **E01C 19/10**

(21) Application number: **96200471.9**

(22) Date of filing: **23.02.1996**

(84) Designated Contracting States:
AT BE CH DE FR LI NL SE

(30) Priority: **24.02.1995 NL 9500374**

(71) Applicant: **VOLKER STEVIN MATERIEEL B.V.**
NL-3300 BD Dordrecht (NL)

(72) Inventors:
- **van de Ven, Caspar Jannis**
  3067 DZ Rotterdam (NL)
- **Jansen, Rob**
  3137 AM Vlaardingen (NL)

(74) Representative: **de Bruijn, Leendert C. et al**
Nederlandsch Octrooibureau
P.O. Box 29720
2502 LS Den Haag (NL)

(54) Method for heating material containing bitumen

(57) Method for heating bitumen-containing material, such as asphalt, in which the material is introduced into a pressure chamber or autoclave in the form of granules or fragments at ambient temperature and one or more constituents of the material are rendered soft or pliable with the aid of compressed, heated gas which is fed to the pressure chamber or autoclave, in which method said compressed gas is at a temperature of at least 150°C and a pressure of at least 5 bars, in particular approximately 180°C and 10 bars, and in which method the gas supply is maintained until a temperature of at least 150°C and a pressure of at least 5 bars has been reached in the pressure chamber or autoclave, water furthermore being introduced into the pressure chamber or the autoclave in such a way that it forms a skin of moisture around the granules or fragments, for which purpose, for example, compressed steam is fed to the pressure chamber or the autoclave as gas, and in which method, after the pressure and temperature referred to have been reached in the pressure chamber or autoclave, the gas supply and/or water supply is interrupted and, at a later instant in time, the pressure is reduced, the processing conditions of pressure, temperature, gas supply and water supply in the pressure chamber or autoclave being controlled in such a way that, after the termination of the gas supply and/or water supply, the skin of moisture around the granules or fragments remains intact essentially until the pressure in the pressure chamber or autoclave is reduced to ambient pressure.

EP 0 728 870 A1

Description

The invention relates to a method for heating material containing bitumen, such as asphalt, so that one or more constituents of the material melts or softens.

NL-A-7708800 describes a method for reprocessing used asphaltic concrete to form an asphaltic layer. In that process, fragments of asphaltic concrete are heated with steam in a pressure vessel to reach a temperature of at least 100°C, in particular 120°C and usually up to approximately 170 to 180°C.

After extensive experiments it has been found that it is only with an appreciably improved method compared with the abovementioned, known method that a satisfactory result can be achieved, in which improved method the bitumen-containing material is at a temperature of at least 100°C after reduction of the pressure in the pressure chamber or autoclave to ambient pressure, the emission of harmful substances, for example products vaporized from the bitumen-containing material, being limited to a minimum. On the basis of the extensive experiments it has been found, surprisingly, that the desired temperature of the bitumen-containing material at which one or more constituents thereof are melted or softened can be reached with a method according to the attached Claim 1.

The invention is based on the insight that the maintenance of a skin of moisture around the granules or fragments of bitumen-containing material is essential for keeping the emission of harmful gases as low as possible. The phenomenon of the skin of moisture around the granules or fragments of bitumen-containing material can reliably be achieved by maintaining the specified pressure and temperature, it also having been found that an optimum thickness of said skin of water is furthermore achieved with said processing conditions, with which optimum thickness the temperature drop as a consequence of vaporization of the skin of moisture is limited to a minimum during pressure reduction to ambient pressure. Any excess of moisture between the granules or fragments of bitumen-containing material appears to flow away under the said processing conditions and can be removed from the pressure chamber or the autoclave, for example, prior to the pressure reduction and in any case, because said excess of moisture is not in direct contact with the bitumen-containing material, it apparently has no influence on the temperature drop as a result of moisture vaporization during pressure reduction, probably because said excess of moisture collects in a small region out of contact with the bitumen-containing material and with only a small contact surface so that, on the one hand, the bitumen-containing material is reliably isolated from the volume of excess moisture, which is colder as a result of vaporization, and, on the other hand, as a result of the small contact surface of said volume of excess moisture, the temperature drop of the latter is relatively limited at the instant when the ambient pressure is reached and the bitumen-containing material can be removed from the pressure chamber or autoclave.

According to Claim 2, it is furthermore preferable to establish a pressure difference across the bitumen-containing material contained in the pressure chamber or autoclave so that a gas flow can be established through the bitumen-containing material, with which gas flow any moisture excess which forms between the granules or fragments of bitumen-containing material, for example as a consequence of condensation during steam injection, is entrained with the gas flow and brought outside the bitumen-containing material to be collected elsewhere in the pressure chamber or the autoclave. After the establishment of a pressure drop across the material introduced in the pressure chamber, the so-called "pressing-through", the outlet side of the autoclave can be brought to ambient pressure with the inlet side sealed so that residual moisture can leak away out of the material.

For the further optimization of the process with regard to the limiting of the temperature drop during pressure reduction as a consequence of vaporization of the skin of moisture around the granules or fragments of bitumen-containing material, performance of the method according to Claim 3 is preferable.

It has been found that the method according to the invention takes place in a wide range of granule and fragment dimensions. Both mixtures in which the granules or fragments are of equal or virtually equal size and mixtures in which the dimensions of the granules or fragments varies from very small, for example a few millimetres, to very large, for example 10 or 20 cm, are found to be satisfactorily processable. Probably, it is important for a good result that the bitumen-containing material has sufficient holes and gaps as determined by the boundary surfaces of the granules and fragments leaning against one another so that the heating gas can penetrate deeply and the contact surface is relatively large. For an optimum result it is preferable to maintain the conditions according to Claim 4, at any rate if the mixture of bitumen-containing material has a granule size of equal or virtually equal value.

A relatively fast way of carrying out the intended heating of the bitumen-containing material is described in Claim 5. By maintaining a "rest time" prior to the reduction of the pressure, during which rest time no water is supplied, but a gas flow through the bitumen-containing material is possibly maintained, it may furthermore be ensured that excess moisture still contained in the bitumen-containing material is able to leak away from the latter or can be removed from the latter by blowing gas through it, the skin of moisture around the granules or fragments of bitumen-containing material remaining intact. If, during the said rest time, the blowing-through of a gas is maintained, it is preferable that said gas is at a temperature which essentially corresponds to the temperature prevailing in the pressure chamber or autoclave, the gas not adversely affecting the skin of mois-

ture around the granules or fragments of bitumen-containing material, for example not causing it to vaporize. The blowing-through can take place throughout the rest period or during only a portion thereof.

It has been found that not only can old asphaltic concrete be converted into reusable asphaltic concrete, as suggested in NL 7708800, by the method according to the present invention, but it has also been found possible to manufacture asphaltic concrete from the component constituents, in accordance with the measures according to Claim 6. It has been found that, during this process it is not necessary to add the mineral additives in granular form, that is to say usually sand and gravel, after predrying. The manufacture of completely "new" asphaltic concrete starting from the separate constituents comprising sand, gravel, bitumen and filler is possible. It has also been found possible to add, for example, 25% "old" asphaltic concrete without prior drying or preheating. Appreciable advantages have been recorded in relation to the emission of harmful gases in connection both with the working-up of "old" asphaltic concrete and with the manufacture of "new" asphaltic concrete using the present invention. For example, it has also been found possible to bring mastic asphalt in fragments at ambient temperature to the desired final temperature. For example, fragments of mastic asphalt can also be mixed with fragments of used asphaltic concrete, to which, for example, sand and gravel are then also added in order to reprocess the final product obtained to form an asphaltic layer for a road surface.

In particular, if the method according to the invention is used for reprocessing used asphaltic concrete to produce an asphaltic layer for a road surface, it has been found that the final product obtained has particularly good processing properties. In practice, this has had the result that usually less so-called "rejuvenation oil" needs to be added to the heated and liquefied asphaltic concrete mixture. A further appreciable reduction of the emissions can thereby be achieved. "Rejuvenation oil" is usually used to increase the processability of asphaltic concrete, which is at least partially composed of asphaltic concrete previously used in a road surface. As a result of adding "rejuvenation oil", the proportion of short chains in the bitumen-containing material is increased.

The present method furthermore offers the advantage that small amounts of the intended final product can also be prepared, depending on the dimensions of an individual pressure chamber or autoclave. To achieve a more or less continuous process it is preferable to use a large number of pressure chambers or autoclaves which, displaced in time one after the other, each exhibit a new cycle of charging with bitumen-containing material, increasing pressure and temperature, maintaining an optional "rest time", reducing pressure to ambient pressure, removing bitumen-containing material, and so on.

For the purpose of further illustration, the invention is explained with reference to a number of test results.

Test 1

So-called "rubble asphalt" was broken 0/40 and, after air separation, the proportion of granules having a dimension of less than 1 mm was reduced. As a result of steam injection into an autoclave, a pressure of 10 bars and a temperature of 180°C was reached in 10 min. The steam supply was then shut off and a "rest time" of 10 minutes was maintained, during which period the pressure remained virtually constant at 10 bars. The pressure was then reduced adiabatically to the ambient pressure of 1 bar. The final temperature of the crushed 0/40 asphalt was 120°C. At the end of the test, the structure of the heated rubble asphalt appeared unchanged, but the rubble asphalt disintegrated completely when touched and a cohesive "lump" was produced. It is presumed that, as a result of the specific processing conditions in accordance with the method according to the present invention, in particular the pressure and the temperature, and including reducing the pressure down to ambient pressure, the structure of the bitumen-containing material remains unaltered, with the result that the porosity is also maintained, which is of importance for the initial achievement of a skin of liquid around the granules and fragments and finally ensures that the skin of liquid is reliably removed at the conclusion of the method, with the result that a relatively dry, but nevertheless directly processable bitumen-containing material is left.

Test 2

After air separation to reduce the proportion of granules having a size of less than 1 mm, 0/40 cut asphalt was immediately introduced into the pressure chamber. The same processing sequence was achieved as in Test 1. The final temperature of the cut asphalt was 120°C.

Test 3

Mastic asphalt in fragments having a size varying from 5 mm to 50 mm was introduced into the pressure chamber. A pressure of 10 bars and a temperature of 180°C was reached in 15 minutes. The all-round steam injection was then maintained for 30 min at constant pressure and temperature. Immediately after that, the steam injection was terminated and the pressure was reduced to ambient pressure (1 bar). The mastic asphalt had collapsed as a pulp and had a temperature of 150°C.

Test 4

Fragments of old 20/40 asphaltic concrete were introduced into the pressure chamber, after which a pressure of 16 bars and a temperature of 205°C were

reached after 20 minutes, during which time steam was injected. The steam injection was then terminated and the pressure immediately reduced to reach ambient pressure (1 bar) after 10 min. The temperature of the asphaltic fragments was found to be 155°C. So-called "rejuvenation oil" was added to the still hot asphaltic fragments, and how much "rejuvenation oil" had to be added in order to achieve a practically acceptable processability for reuse of the used asphaltic concrete was determined. 10% by volume less rejuvenation oil had to be added compared with used asphaltic concrete heated according to the prior art.

Test 5

The same conditions were maintained as in Test 4, except that, after the pressure of 16 bars and the temperature of 205°C had been reached, the steam injection was maintained for approximately 10 min, with a pressure difference across the charge of approximately 3 bars. At the end of the test, the temperature of the asphaltic fragments was found to be 170°C.

Test 6

Crushed mastic asphalt having a size varying from 5 mm to 60 mm, 4/8 chippings, 4/32 gravel and medium sand, all at ambient temperature, were introduced (simultaneously) into a pressure chamber in a quantitative ratio suitable for manufacturing asphaltic concrete for processing to form the asphaltic layer of a road surface. Sand, gravel and chippings were not predried. A pressure of 10 bars and a temperature of 180°C were reached in 10 min by means of steam injection. The steam injection was then maintained for 5 min, while a pressure difference across the charge of approximately 4 bars prevailed. The steam injection was then removed and a rest time of 15 min was maintained, during which time the pressure remained unaltered. Finally, the pressure was reduced to ambient pressure within 5 min. After thoroughly mixing the various constituents, the asphaltic concrete thus obtained was found to have a temperature of 130°C without interim additional heating. The same test has been carried out in which mixing elements were installed in the pressure chamber so that the various constituents were already thoroughly mixed during the reduction of the pressure to ambient pressure. No noticeable alteration occurred as a result, either in the structure or in the final temperature of the asphaltic concrete thus obtained.

Claims

1. Method for heating bitumen-containing material, such as asphalt, in which the material is introduced into a pressure chamber or autoclave in the form of granules or fragments at ambient temperature and one or more constituents of the material are rendered soft or pliable with the aid of compressed, heated gas which is fed to the pressure chamber or autoclave, in which method said compressed gas is at a temperature of at least 150°C and a pressure of at least 5 bars, in particular approximately 180°C and 10 bars, and in which method the gas supply is maintained until a temperature of at least 150°C and a pressure of at least 5 bars has been reached in the pressure chamber or autoclave, water furthermore being introduced into the pressure chamber or the autoclave in such a way that it forms a skin of moisture around the granules or fragments, for which purpose, for example, compressed steam is fed to the pressure chamber or the autoclave as gas, and in which method, after the pressure and temperature referred to have been reached in the pressure chamber or autoclave, the gas supply and/or water supply is interrupted and, at a later instant in time, the pressure is reduced, the processing conditions of pressure, temperature, gas supply and water supply in the pressure chamber or autoclave being controlled in such a way that, after the termination of the gas supply and/or water supply, the skin of moisture around the granules or fragments remains intact essentially until the pressure in the pressure chamber or autoclave is reduced to ambient pressure, wherein said pressure is reduced so quickly that an essentially adiabatic expansion is preferably achieved and, during said pressure reduction, said skin of moisture around the granules or fragments is removed, all this being done in such a way that, after the pressure has been reduced to ambient pressure, the bitumen-containing material is at a temperature of at least 100°C, in particular at least approximately 120°C, more particularly approximately 140°C.

2. Method according to Claim 1, wherein the bitumen-containing material is introduced into the pressure chamber or autoclave in such a way that free spaces are situated on either side of said material and the gas referred to is introduced into the one free space from outside the pressure chamber or autoclave and any gas is removed from the other free space, all this being done in such a way that a pressure difference is established between the said free spaces, with the result that a gas flow is established through the granules or fragments of material.

3. Method according to Claim 1 or 2, wherein a temperature of at least 180°C and a pressure of at least 8 bars is achieved in the pressure chamber or autoclave.

4. Method according to one of the preceding claims, wherein the granules or fragments of bitumen-containing material have a size of at least 4 mm.

5. Method according to Claim 2, wherein the said pressure and temperature are reached in the pressure chamber or autoclave within approximately 10 minutes, after which the supply of the said gas and the water is maintained for approximately 5 to 10 minutes, with a pressure difference across the material of at least approximately 1 bar, preferably more than 3 bars, more particularly 2 to 10 bars and then a waiting time of approximately 10 minutes is optionally maintained before or after that, during which time no water is supplied and, optionally, no gas is supplied either, after which the pressure is removed.

6. Method according to one of the preceding claims, wherein minerals in granular form, such as sand or gravel, at ambient temperature are introduced into the pressure chamber or autoclave to produce heated asphaltic concrete for processing to form the asphaltic layer for a road surface.

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 96 20 0471

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	WO-A-92 10612 (HOLLANDSCHE BETONGROEP NV) 25 June 1992 * the whole document * ---	1	E01C19/10
D,A	NL-A-7 708 800 (MOEL WEGENBOUWMIJ.) 13 February 1979 * the whole document * -----	1	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

E01C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	7 June 1996	Dijkstra, G

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)