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(71) Applicant:
KONINKLIJKE WEGENBOUW STEVIN B.V.
NL-3527 HS Utrecht (NL)

(72) Inventor:
Smulders, August Theodorus Adrianus
3906 BZ Zeist (NL)

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

(54) Method for recycling asphalt

(57) The invention relates to a method for recycling asphalt. The asphalt broken into pieces is separated, if necessary, into two fractions which are each fed to a respective proportioning unit. The fractions are then combined, in a changed weight ratio, in a mixing apparatus in which the fractions are mixed with a binder. In the proportioning units the asphalt particles are preferably heated virtually exclusively by steam, most or all of which condenses. It is thus possible to produce, with

very low emissions, a high-quality asphalt consisting of virtually completely reused asphalt with a very small addition of a binder or unused asphalt. Surfacing a road with old, tar-containing asphalt which has been heated virtually exclusively by steam, the said steam condensing in its entirety, is possible with very low emission of polycyclic aromatic compounds.

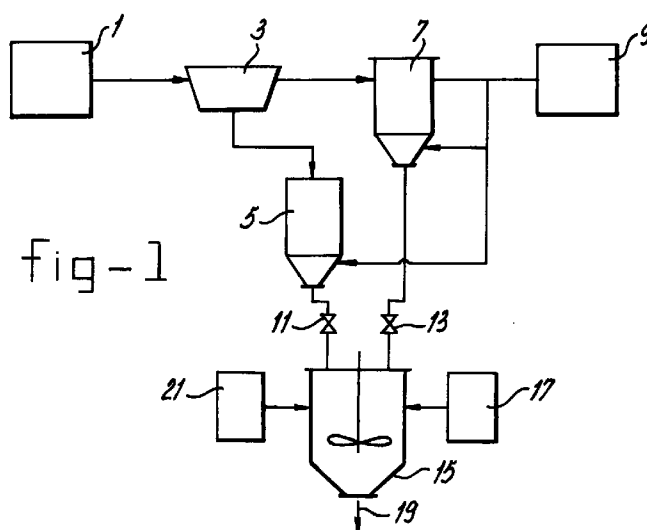


fig-1

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Description

The invention relates to a method for recycling asphalt, used asphalt being broken into pieces which in the main are smaller than 5 cm, the said pieces being separated into at least two fractions, if necessary.

It is known, when recycling asphalt, to break asphalt into pieces and, with heating, mixing it with fresh raw materials. It is likewise known to reuse used asphalt without employing freshly added raw materials. The problem is then often encountered that, because of an unfavourable composition of the asphalt to be reused, the physical properties of the recycled asphalt, particularly with respect to the stiffness modulus and the resistance to deformation, leave something to be desired.

Moreover the known methods for the warm processing of tar-containing asphalt, for example when this is applied to a road surface, and therefore also the reprocessing of warm tar-containing asphalt give rise to a relatively high emission of polycyclic aromatic compounds. Consequently, tar-containing asphalt is generally cold-processed into low-value materials. Subsequent recycling of the said low-value product by means of the known techniques is not readily possible in these cases.

The object of the present invention is to provide a method which avoids these problems.

To this end, the method according to the invention is characterized in that the fractions of old asphalt are separately heated in respective proportioning units, whereupon the fractions, in a weight ratio changed with respect to the original asphalt, are combined in a mixing apparatus. Preferably the fractions are mixed, in the mixing apparatus, with a binder. The remixing of the various fractions of the asphalt to be recycled, which has been broken into pieces, allows for a considerable improvement in the properties in terms of stability, processibility and durability of the recycled product. To obtain high-quality recycled asphalt, the lumps of asphalt are formed into a first fraction containing particles having a size of between about 4 and 50 millimetres, and a second fraction containing particles which are smaller than about 4 millimetres. The different fractions contain different gradations of minerals. The fine fraction contains virtually exclusively sand, filler and bitumen. The coarser fractions contain relatively large amounts of gravel or stone. The fine fraction contains more binder, such as bitumen, than the coarse fraction. Remixing the fractions together in a weight ratio to be chosen between 20/80 and 80/20 produces a very advantageous product in terms of stability, density and degree of filling.

Preferably, no more than 3% of bitumen are added to the fractions formed. It was found that as a result of the different fractions being separated and being back-mixed at the changed weight ratios, relatively little bitumen (in the form of an emulsion or foamed bitumen), from a process point of view, need be added to obtain a sufficiently processible mixture which can be readily

conveyed and mixed within the system.

Preferably, during recycling, heating takes place by the virtually exclusive supply of steam to the proportioning units, in which the filling level and temperature are such that all of the steam condenses. The proportioning units are constructed in such a way and the steam injection takes place in such a way that no steam leaves the proportioning unit. This is advantageous, in particular, in recycling tar-containing asphalt and results in the emission of polycyclic aromatic compounds being reduced to an acceptable level without special provisions such as filters and afterburners being necessary. Heating of the asphalt to be recycled, which involves complete or virtually complete condensation of the steam, can likewise be employed advantageously if the asphalt to be reused is not separated in terms of weight fractions. Tar-containing asphalt which, during recycling, has been heated in the abovementioned manner can be applied, for example, to a road surface without significant emission of noxious substances such as naphthalene. It is assumed that as a result of the condensation of steam the polycyclic aromatic compounds in particular are dissolved in the condensate and are therefore unable, while the asphalt is being processed, to escape into the atmosphere as vapour.

Preferably, the temperature in the proportioning units is between 80° and 100°C, preferably between 90 and 95°C, which is relatively high compared with heating to about 65°C via, for example, a known system such as the "turbo-steam unit", in which fuel such as oil is burnt under water in a high-pressure vessel. In the case of the known heating method the gas mixture of steam and combustion gases is injected in its entirety into the proportioning hoppers. The energy efficiency of this known process is relatively low, since large amounts of steam disappear into the air, entraining polycyclic aromatic compounds. If steam is employed virtually exclusively for heating, using the method according to the invention, the temperature rises to 90 to 95°C. This is very important in order to convert even pure, previously used old asphalt into a processible compound without, for example, bitumen emulsion being added. Because emulsion is present in limited amounts, a lubricating effect does not occur, so that this high temperature is necessary to make it possible to process and to densify the asphalt to be recycled. Moreover, in the case of the novel method, virtually all the steam condenses in the proportioning units, so that the emission from the proportioning units is virtually nil.

Preferably asphalt is recycled with the addition of minimal amounts of other and fresh raw materials. If the addition of extra material is necessary, this material is first heated in the proportioning unit, before the heated fractions of old asphalt are fed into the mixing apparatus, and is then, together with a binder, fed to the mixing apparatus. This mixture, which for example comprises hardcore and/or sand and bitumen, is then homogenized. The homogenized mixture is then admixed with the first and the second fraction of the old asphalt in the

correct weight ratios. The previous homogenization of the unused material ensures that the added emulsion comes into effective contact with the fresh materials, very homogeneous and beneficial mixing being obtained as a result.

It is also possible to add cement or lime to the asphalt fractions in the mixing apparatus. The stiffening rate of the recycled asphalt and the ultimate stiffness can thus be increased.

A few embodiments of the method according to the invention will be explained in more detail with reference to the accompanying drawing, in which:

Figure 1 shows a schematic representation of a method according to the invention, in which the weight fractions of the asphalt to be recycled are formed by screening, and

Figure 2 shows a method in which the weight fractions are formed by various ground processes.

Figure 1 schematically shows how used asphalt is crushed, in a crushing apparatus 1, into fragments having a size of at most 5 centimetres. Via a conveyor these fragments are fed to a screening apparatus 3, two fractions being formed in the process.

Alternatively it is possible, however, to obtain two fractions of asphalt particles of different sizes by employing various processes for grinding used asphalt, followed by screening. In this case the maximum size of the particles, about 5 cm, can essentially be formed by, for example, the old asphalt being broken up by rotary cutting, after which the cut asphalt is screened. When old asphalt is broken up into so-called clods, these clods need to be broken into particles smaller than 5 cm with the aid, for example, of a breaker, followed by screening. The separated fractions obtained from the various crushing processes and/or screening processes, which may be at a distance from the proportioning units 5 and 7, are then separately fed or conveyed to the proportioning units 5 and 7.

The fraction of particles having a size smaller than 4 millimetres is then fed to the proportioning units 5, 7 by means of, for example, a shovel. The fraction of larger particles having a size of between 4 and 50 millimetres, which remains behind on the screening apparatus 3, is fed to a proportioning unit 7, the weight fraction of the small particles fed to the proportioning unit 5 being between 10 and 90% of the total weight of the broken-up asphalt fed to the screening apparatus 3.

Via a steam source 9, steam is introduced into the centre of the proportioning units 5, 7, at a temperature of about 110° or higher. The steam is introduced at a point at the bottom of the proportioning units 5 and 7. At the bottom of the proportioning units 5 and 7, whose bottom end is funnel shaped, the molten asphalt forms a plug through which the steam introduced at the bottom is passed upwards, heating the cold asphalt. At regular intervals, such as every 2 to 3 min, heated material is drawn off from the proportioning units 5, 7 via closing

devices 11, 13, for example from 2 to 4 metric tonnes of asphalt being discharged, and the proportioning units are replenished with fresh, cold material. If the shut-off valves 11, 13 are dimensioned correctly, the shut-off valves, for example, being designed to have different respective through-flow diameters or having a different open-close cycle, different weight ratios of materials are fed to a mixing apparatus 15 from the proportioning units 5 and 7. The purpose of determining the weight fractions and feeding to the mixing apparatus is preferably served by a belt weigher, as shown in Figure 2. The mixing apparatus 15 is supplied, from a container 17, with a binder such as bitumen emulsion which is preferably sprayed over the introduced asphalt via a nozzle situated within the mixing apparatus 15. Up to 2 wt% of cement can be supplied to the mixing apparatus 15 from a container 21. Via a discharge valve 19, the asphalt mixed with the binder from the container 17 is discharged from the mixing apparatus 15.

The fractions from the proportioning units 5 and 7 are preferably each supplied separately to the mixing apparatus 15. If a first fraction consists of fresh material and has been placed into the mixing apparatus 15, the required amount of bitumen emulsion is supplied from the container 17. Instead of bitumen emulsion it is also possible to use foamed bitumen. A method and apparatus for producing and applying foamed bitumen has been described in the Canadian Patent No. 1261183. The one weight fraction is then blended with the binder into a homogeneous mass. Then the mixed weight fraction is fed in from the proportioning units 5 or 7 and is blended with the bitumen present in the mixing apparatus 15 and with the first weight fraction. If necessary, a further amount of emulsion can be fed in at this time from the container 17.

Using the apparatus according to the invention, 2-6 metric tonnes of asphalt can be recycled per batch, with a process time of from 2 to 3 minutes per batch. The steam injection into the mixing apparatus allows effective prevention of the emission of noxious substances and volatile vapours.

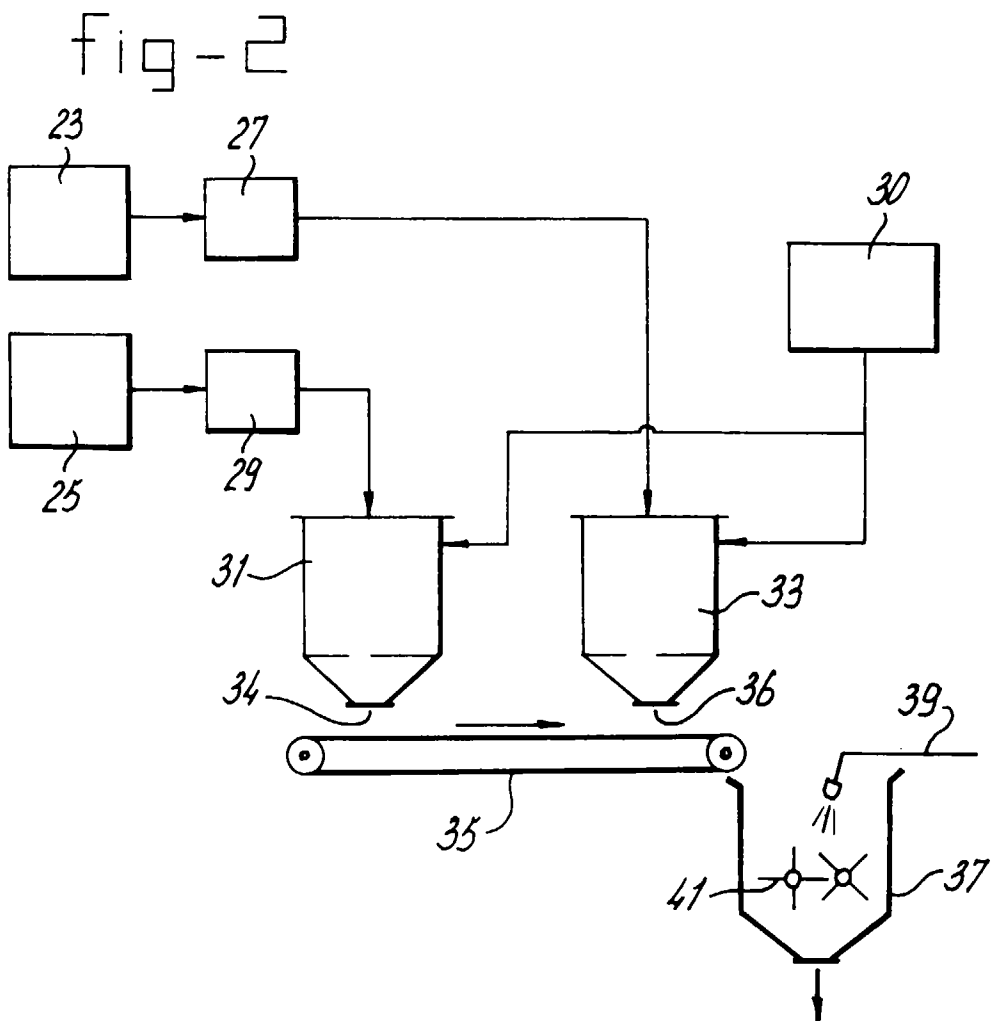
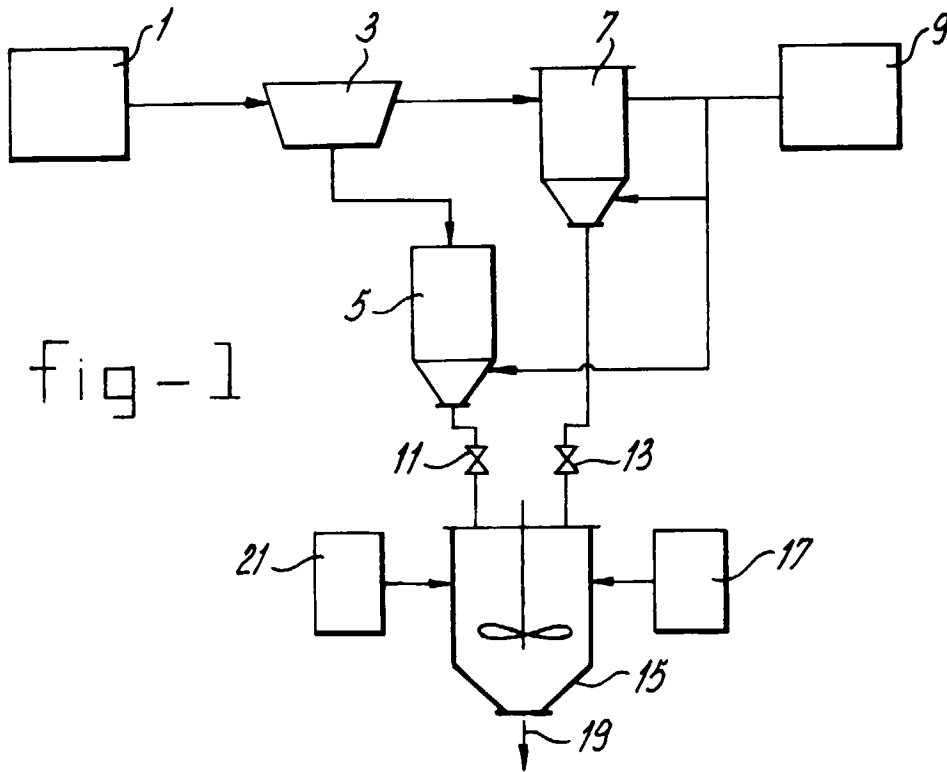
Figure 2 shows an alternative embodiment of an apparatus according to the present invention. In the apparatus shown in Figure 2, the two fractions of asphalt to be recycled are formed by used asphalt being broken up, in separate breaking and screening installations 23, 25, into a fraction of lumps having a size of between 4 mm and 5 cm, and a fraction of particles having a size smaller than about 4 mm. The asphalt particles formed and separated in the breaking and screening apparatuses 23, 25 are stored in an intermediate store 27, 29, for example on a heap. In this situation the breaking and screening apparatuses may be at different locations, at a relatively large distance from the proportioning units. With the aid of a shovel the particles are then dumped into the proportioning units 31, 33 from the intermediate store 27, 29. Via a steam source 30, steam having a temperature of at least about 110°C is injected into the proportioning units 31, 33. From the

respective proportioning unit 31 or 33, the heated fractions are fed, one by one, via an automatically operated valve 34, 36, to a conveyor belt 35. The conveyor belt 35 comprises a weighing device (not shown) for determining the weight of heated material dumped on the conveyor belt. The conveyor belt 35 feeds a weighed amount to a mixing apparatus 37. In the mixing apparatus 37 the fractions coming from the proportioning units 31, 33 are mixed together by means of mixing paddles 41, and a bitumen emulsion is fed in via a line 39 and a nozzle. From the mixing apparatus 37 the mixed fractions can be dumped, for example, into a lorry and the recycled asphalt can be transported to a site in order to be applied once more as a road surface.

It was found that when the above-described process was used, even without the weight fractions of the asphalt to be used here being adjusted, heating with complete steam condensation results in a very low emission of polycyclic aromatic compounds when asphalt recycled according to the invention is applied once more.

Claims

1. Method for recycling asphalt, used asphalt being broken into pieces which in the main are smaller than 5 cm, the said pieces being separated into at least two fractions, characterized in that the fractions are separately heated in respective proportioning units, whereupon the fractions, in a weight ratio changed with respect to the original asphalt, are combined in a mixing apparatus.
2. Method according to Claim 1, characterized in that a first fraction comprises particles having a size of between 4 and 50 mm, for example of between 4 and 20 mm, and a second fraction comprises particles smaller than 4 mm, the weight ratio of the first and the second fraction being between 80/20 and 20/80, and the weight ratio, during mixing, of the first and the second fraction being between 20/80 and 80/20.
3. Method according to Claim 1 or 2, characterized in that the fractions are mixed, in the mixing apparatus, with a binder.
4. Method according to Claim 1 or 2, characterized in that the fractions are admixed in the mixing apparatus with not more than 3 wt% of bitumen and/or not more than 2 wt% of cement.
5. Method according to any one of the preceding claims, characterized in that heating takes place by the virtually exclusive supply of steam to the proportioning units, in which the temperature is such that virtually all of the steam condenses.
6. Method for recycling tar-containing asphalt, used asphalt being broken into pieces which in the main are smaller than 5 cm, the said pieces being heated in a proportioning unit, characterized in that heating takes place by the virtually exclusive supply of steam to the proportioning units, in which the temperature is such that virtually all of the steam condenses.
7. Method according to Claim 5 or 6, characterized in that the temperature in the proportioning units is between 80 and 100°C, preferably between 90 and 95°C.
8. Method according to any one of the preceding claims, characterized in that initially a first heated fraction such as unused material or asphalt and a binder are fed to the mixing apparatus, and the mixture formed is then homogenized therein, the heated second fraction and/or a further first fraction being introduced into the mixing apparatus after the homogenization and being mixed with the previously homogenized contents.
9. Method according to Claim 6, wherein the binder includes bitumen.
10. Method according to Claim 6, characterized in that the mixing apparatus is supplied with cement and/or lime.
11. Method according to any one of the preceding claims, characterized in that the separation of the fractions takes place by screens having different mesh sizes.





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EUROPEAN SEARCH REPORT

Application Number
EP 97 20 1460

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)
X	DE 41 40 964 A (WIBAU MASCHINEN) 17 June 1993 * column 2, line 34 - line 35 * * column 4, line 7 - line 10 * ---	1,8	C10C3/00 E01C19/10
Y	US 4 096 588 A (R.L. MENDENHALL) 20 June 1978 ---	6,9,11	
A	* column 3, line 42 - line 60 * * column 4, line 27 - line 36; claims 1,2 * * column 6, line 1 - line 14 * ---	1-3	
Y	NL 7 708 800 A (DE MOEL WEGENBOUWMIJ) 13 February 1979 ---	6,9,11	
A	* page 2, line 2 - line 7 * ---	5	
A	FR 2 689 051 A (SCREG ROUTES ET TRAVAUX PUBLICS) 1 October 1993 * page 3, line 30 - line 32; claims 1,6,7 * * page 6, line 25 - line 30 * ---	1-4,9,11	TECHNICAL FIELDS SEARCHED (Int.Cl.6)
A	US 4 619 550 A (M.R. JEPPSON) 28 October 1986 * column 5, line 36 - line 44 * * column 5, line 56 - column 6, line 7 * ---	1-3,9,11	C10C E01C
A	US 3 999 743 A (R.L. MENDENHALL) 28 December 1976 * the whole document * ---	1-3,9,11	
A	US 4 272 212 A (A.J. BAUER) 9 June 1981 * column 2, line 27 - line 35; claim 1 * ---	10	
A	US 2 413 908 A (W.F. CHESTER) 7 January 1947 * claim 1 * -----		
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 29 August 1997	Examiner Hilgenga, K
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			

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