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- (73) Patenthaver: **Demmer, Johannes Jozef, Barsmark Bygade 121, 6200 Åbenrå, Danmark**
- (72) Opfinder: **Demmer, Johannes Jozef, Barsmark Bygade 121, 6200 Åbenrå, Danmark**
- (74) Fuldmægtig i Danmark: **Novagraaf Brevets, Bâtiment O2, 2 rue Sarah Bernhardt CS90017, F-92665 Asnières-sur-Seine cedex, Frankrig**
- (54) Benævnelse: **FREM GANGSMÅDE OG SYSTEM TIL OMDANNELSE AF VÅD BIOMASSE TIL BRÆNDELSPELLER AF HØJ KVALITET**
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EP-A1- 2 157 158
EP-A1- 2 636 977
DE-A1-102013 107 983

DESCRIPTION

[0001] The invention relates to a method and system for conversion of wet woody biomass, in particular wood waste originating from landscape maintenance (groundskeeping etc.), into high-grade fuel pellets.

[0002] Wood pellets are a well-known product within the international market of (woody) biomass. The global production of wood pellets is growing almost exponentially: from 2 million tonnes in 2001 to 4 million tonnes in 2006, 9 million tonnes in 2008 and 15 million tonnes in 2010. Over the years, the market has become increasingly professional. Moreover, the average production capacity and capital investment per wood pellet production company increases continuously. Mostly, pellets are made from sawn wood waste etc., however, the production of pellets from biomass increases. The quality of the pellets is covered by EN+ certification from the European Pellet Council, based on the European standard EN 14961-2. This standard imposes high requirements on the quality of wood pellets, including the ash content during combustion. Independent certification bodies monitor the quality and durability of wood pellets.

[0003] EP-A-2 157 158 discloses a method for manufacturing pellets from sustainable coarse fibrous products. DE-A-10 2013 107 983 discloses an apparatus and a process for the production of biomass pellets.

[0004] The present invention aims to provide a method and a system (assembly) respectively for conversion of wet or moist woody biomass, in particular wood waste originating from landscape maintenance, etc., into high quality fuel pellets etc. for use as a high quality fuel. The pellets provided have a certification level of EN+ A1, A2, which until now could only be achieved by producing pellets from clean waste from the wood processing industry.

[0005] The method according to the invention comprises the following steps:

- providing a quantity or a flow of woody biomass;
- basic reduction of the ingredients of the woody biomass into coarse chips with a maximum size of 50 mm for example;
- if necessary, cleaning of the coarse chips, preferably with the aid of air support;
- wet milling the coarse chips into wet fine chips by means of e.g. a pellet shredder, a woodchipper, in particular a mill with an edge mill crushing/grinding mechanism;
- drying of the wet fine chips into dry fine chips, e.g. in a tumble dryer;
- splitting the dry fine chips into different fractions, by means of e.g. a shaking sieve (gyratory screen), into
 - a first waste fraction I having a cross section (particle size) of the dry fine chip particles of 1 mm maximum,
 - a second waste fraction II having a cross section (particle size) of the dry fine chip particles of 2 - 4 mm,

a third waste fraction III having a cross section (particle size) of the dry fine chip particles of 1 - 2 mm and

a fourth waste fraction IV having a cross section (particle size) of the dry fine chip particles of greater than 4 mm;

- removal of the first fraction I (<1 mm), for example by combustion in an incinerator for the purpose of the above-mentioned drying of the wet fine chips, storage of the second fraction II (with particle size 2 - 4 mm),
feeding of the third fraction III (with particle size 1 - 2 mm) to a (further) sorting device and
feeding of the fourth fraction IV (with particle size > 4 mm) to a reduction device, for example a hammer mill;
- wherein the sorting device, e.g. a sieve table, sorts (or screens) the fraction III (with particle size 1 - 2 mm) into,
a first sub-fraction IIIa having a density sg_1 , which is lower than the density of the target pellet material,
a second sub-fraction IIIb having a density sg_2 , which corresponds to the density of the target pellet material (or to the density of the already stored dry material of fraction II having a particle size 2 - 4 mm respectively),
a third sub-fraction IIIc having a density sg_3 , which is higher than the density of the target pellet material,
wherein the first (too light) sub-fraction IIIa and the third (too heavy) sub-fraction IIIc are removed and the second sub-fraction IIIb (having the desired density sg_2) is added to the (already) stored second fraction II of the dry fine chips with particle size 2 - 4 mm;
- (com)pressing of the stored dry fine chips into pellets, for example by means of a pellet press, wherein after cooling-down the pellets are suitable for use as a high-grade fuel.

[0006] Hereinafter, the invention will be further discussed with reference to the description of the figure.

Figure 1

shows a preferred embodiment of a device, which is adapted for carrying out the method according to the invention.

[0007] The system assembly shown in Figure 1 comprises a storage module 1 containing wet woody biomass, which forms the raw material for the system. In particular, the biomass comprises wood waste originating from the landscape maintenance etc. This raw material is supplied to a module 2, for example a shredder, which is arranged for basic reduction of large components (such as branches, etc. of trees and bushes) within the biomass supplied to the device, into coarse (wood)chips with a maximum size of for example 50 mm. Subsequently these coarse chips, after having been cleaned in a module 3, are fed to a module 4, e.g. a

pellet shredder, a woodchipper, or a mill with an edge mill crushing/grinding mechanism, which are adapted for wet milling of the (wet) coarse chips into wet fine chips, which are fed to a storage module 5.

[0008] The wet fine chips are fed from the storage module 5 to a module 8, for example a tumble dryer 8, which is provided with hot drying air by a biomass-fired boiler 6 and a fan 7. The tumble dryer is adapted for drying of the wet fine chips, so that the wet fine chips are converted into dry fine chips.

[0009] The flue gases released in the biomass combustion boiler 6 are filtered in a number of plasma filters 9 in order to ensure that the flue gases discharged through the chimney 10 meet the applicable current environmental requirements.

[0010] The dry fine chips produced by the tumble dryer 8 are split into different fractions in a module 11, for example by a multiple shaking sieve, which is adapted for splitting (sorting) the dry fine chips. For example, said fractions include a waste-fraction I having a diameter of up to 1 mm, a second fraction II with a diameter of 2 - 4 mm, a third fraction III having a diameter of 1 - 2 mm and a fourth fraction IV having a cross-section greater than 4 mm.

[0011] The first fraction, i.e. the waste fraction I, cannot be used for processing into pellets, and therefore is fed to the biomass combustion boiler 6 in order to be burnt there as additional biomass fuel. The second fraction II is stored in a storage module 15. The third fraction III is fed to a sorting device 13 for further sorting into usable and unusable material, whereas the fourth fraction IV is fed to a particle size reduction device, for example a hammer mill 12, wherein firstly the (too) large particles are reduced in size, and secondly the size-reduced product is recycled to the storage module 15 (or to sorting module 11).

[0012] The sorting device 13 for fraction III, e.g. configured as a multiple sieve table, is arranged to sort (split) the fraction III into a first sub-fraction IIIa having a density sg_1 , which is lower than the density of the target pellet material, a second sub-fraction IIIb having a density sg_2 , which corresponds to the density of the target pellet material, and a third sub-fraction IIIc having a density sg_3 , which is higher than the density of the target pellet material. The first sub-fraction IIIa and the third sub-fraction IIIc are considered unusable and therefore are removed, while the second sub-fraction IIIb is considered usable, and therefore is added to the already stored second fraction II of the dry fine chips. The first sub-fraction IIIa is fed to the biomass combustion boiler 6 for combustion, whereas the heavy sub-fraction IIIc, usually consisting of sand, small stones (silicon) etc. is discharged as a residue.

[0013] From the storage module 15, the dry fine chips are fed to a module 16, for example a pellet press (also known as pellet mill), which is adapted for compressing the dry fine chips into the actual form of the pellets, which, after cooling in a cooling module 17, are suitable for use as high-grade fuel having EN+ A1 or A2 quality. The pellets are stored in silos 18 and from there are transported to the customers.

[0014] As a result, a method and system is provided for converting wet woody biomass into high-quality pellets. The system comprises a module 2 for basic reduction of the ingredients of the biomass 1 into coarse chips, a module 4 for wet milling of the coarse chips into wet fine chips, a module 8 for drying of the wet fine chips into dry fine chips. A module 11 provides for sorting of the dry fine chips into various fractions I, II, III and IV having different cross sections. Particles < 1 mm (fraction I) are discharged/removed as not usable ("NOK, Not OK"), particles of 2 - 4 mm (fraction II) are allowed through as useful ("OK"), particles of 1 - 2 mm (fraction III) - in which a non-negligible percentage of sand etc. is included - are subjected to a further selection/sorting in a sorting module 13 based on their density, resulting in the subfractions IIIa ("NOK"), IIIb ("OK") and IIIc ("NOK"). Particles > 4 mm (fraction IV) are fed to a reduction module 12, where the size of the particles is reduced to < 4.5 mm. Subsequently this product is fed to the storage module 15 (or recycled to the sorting module 11). Finally, a pellet press 16 compresses the stored dry fine chips into pellets, which are suitable, after cooling, to be used as a high-grade fuel having a high EN+ quality.

[0015] With regard to the well-known methods from previous patent publications, like from DE 102013107983, DE10224850 and AT510925, the following is noted.

[0016] With the manufacturing of the pellets, it is of great importance to ensure, in accordance with EN+ certification from the European Pellet Council based on the European standard EN 14961-2, that the pellets are produced having a high calorific value and a low ash content, including the corresponding required melt-values for that ash (otherwise, there is a risk on the formation of slag in the boiler). According to the invention and as found in practice during extensive tests, wet milling is proposed for reducing the particle size of the chips. As a result, the size of the particles of the bark components are differently and better reduced, contrary and with respect to using a chopping device or a hammer, e.g. It has been found, that by crushing/grinding, preferably by means of a mill comprising an edge mill crushing/grinding mechanism (Kollergang), and not by chopping or hammering, it is achieved that the undesired ash content-increasing bark particles, formed due to the milling, remain below 1 mm, and as a result can be screened/sieved off much better and more effectively than by the application of hitherto known reduction techniques.

[0017] The method applied for splitting the dry fine chips into several fractions after drying is furthermore of importance among others, in addition to the method according to the invention, in which the wet crushing/grinding is performed. After the split, each fraction is treated in a different way, in such a way that those components are removed, which are responsible for or contribute to the formation of ash during the combustion of the finished product. For example, by screening and removing the fraction (III) containing particles having a diameter of 1 - 2 mm on the basis of their density, it is nevertheless achieved that the end product possesses an exceptionally high and constant quality (EN+), in spite of having a starting base material of a low and non-constant quality (such as wood waste from landscape maintenance, etc.).

[0018] In the documents mentioned, systems are known for pelletizing of landscape wood, however, in these documents the purity and quality of the end-product is not mentioned. It is

observed in this regard, that pelletizing landscape wood itself has never been a problem, but that the quality of the pellets always caused problems. The quality must be high in order to be able to present the product as a comfortable fuel for the customer. Therefore, the present invention seeks to provide a system (method/device) to produce certified pellets from low-grade raw material, which pellets are very high-quality and EN+ certified, and which can be burnt without problems with a low ash content and with preservation of the warranty of the boiler manufacturer.

[0019] Due to the large and ever-growing demand for EN+ quality pellets, the supply of raw material already shows shortages resulting in expensive raw materials and rising pellet prices. In spite of woody biomass being abundantly available in the form of landscape wood and forest chips, up to the present however, it was not used because it was not possible up till now to produce EN+ quality. This has resulted in not considering these materials anymore for the certification as raw material for EN+ pellets by the European Pellet Council. However, by applying the method according to the invention, landscape wood and forest chips may be included again as a potential raw material thereby creating much more possibilities for each country, instead of import, to solve nationally the increasing demand for the pellets. This solution according to the invention is more sustainable and less expensive, while trunk wood can be preserved, and be used better for more sophisticated applications.

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- [EP2157158A \[0003\]](#)
- [DE102013107983A \[0003\]](#)
- [DE102013107983 \[0015\]](#)
- [DE10224850 \[0015\]](#)
- [AT510925 \[0015\]](#)

Patentkrav

1. Fremgangsmåde til omdannelse af våd træbiomasse, herunder træaffald, der stammer fra landskabspleje, til brændselspiller af høj kvalitet, hvor
- 5 fremgangsmåden omfatter trinnene:
- levering af en mængde eller en strøm af våd biomasse;
 - grundlæggende reduktion af ingredienserne af træbiomasse til grove flis med en maksimal størrelse på 50 mm for eksempel;
 - vådfræsning af grove flis til våde fine flis;
 - 10 – tørring af de våde fine flis til tørre fine flis;
 - opdeling af de tørre fine flis i forskellige fraktioner, herunder en første fraktion I, der har et tværsnit på maksimalt 1 mm, en anden fraktion II, der har et tværsnit på 2-4 mm, en tredje fraktion III, der har et tværsnit på 1-2 mm, og en fjerde fraktion IV, der har et tværsnit større end 4 mm;
 - 15 – fjernelse af den første fraktion I, f.eks. gennem forbrænding, med det formål at udføre den ovennævnte tørring af de våde fine flis, opbevaring af den anden fraktion II, fødnings af den tredje fraktion III til en sorteringsanordning og fødnings af den fjerde fraktion IV til en reduktionsanordning;
 - hvori sorteringsanordningen sorterer den tredje fraktion III til, en første underfraktion IIIa, der har en tæthed på sg1, der er lavere end tætheden af det ønskede pillemateriale, en anden underfraktion IIIb, der har en tæthed på sg2, der svarer til tætheden af det ønskede pillemateriale, og en tredje underfraktion IIIc, der har en tæthed på sg3, der er højere end tætheden af det ønskede pillemateriale, hvori den første underfraktion IIIa og den tredje underfraktion IIIc fjernes, og den anden underfraktion IIIb føjes til den opbevarede anden fraktion II af de tørre fine flis;
 - 20 – komprimering af de opbevarede tørre fine flis til piller, afkøling af pillerne, så de er egnet til brug som første klasses brændsel.
- 30 2. Fremgangsmåde i henhold til krav 1, hvori nævnte vådfræsning af de grove flis til våde fine flis udføres ved hjælp af en pillesønderdeler, en træflishugger eller en fræser med en kantfræsende knuse/kværne-mekanisme.

3. Fremgangsmåde i henhold til krav 1-2, hvori nævnte tørring af de våde fine flis til tørre fine flis udføres i en tørremaskine.

5 **4.** Fremgangsmåde i henhold til ethvert af de foregående krav, hvor nævnte opdeling af de tørre fine flis i forskellige fraktioner udføres ved hjælp af en rystesi.

10 **5.** Fremgangsmåde i henhold til ethvert af de foregående krav, hvori nævnte reduktionsanordning er en flishugger.

6. Fremgangsmåde i henhold til ethvert af de foregående krav, hvori nævnte sorteringsanordning omfatter én eller flere siborde.

15 **7.** Fremgangsmåde i henhold til ethvert af de foregående krav, hvori komprimering af de lagrede tørre fine flis til piller udføres ved hjælp af en pillepresser.

20 **8.** System til omdannelse af våd træbiomasse, herunder træaffald, der stammer fra landskabspleje, til brændselspiller af høj kvalitet, hvor systemet omfatter:
et modul (2), der er tilpasset til grundlæggende reduktion af ingredienserne af den træbiomasse (1), der fødes til anordningen, til grove flis med en maksimal størrelse på 50 mm;
et modul (4), inklusive en pillesønderdeler og en træflishugger, som er tilpasset
25 til vådfræsning af grove flis til våde fine flis;
et modul (8), inklusive en tørremaskine, som er tilpasset til tørring af de våde fine flis til tørre fine flis;
et modul (11), inklusive en rystesi, som er tilpasset til at lade flis, der har samme forskellige tværsnit, passere, hvor nævnte modul er tilpasset til opdeling
30 af de tørre fine flis i forskellige fraktioner, herunder en første fraktion I, der har et tværsnit på maksimalt 1 mm, en anden fraktion II, der har et tværsnit på 2-4

mm, en tredje fraktion III, der har et tværsnit på 1-2 mm, og en fjerde fraktion IV, der har et tværsnit større end 4 mm;

opbevaringsmidler (15) til opbevaring af den anden fraktion II, en sorteringsanordning (13) til hvilken den tredje fraktion III fødes, en

- 5 reduktionsanordning (12), inklusive en flishugger, til hvilken den fjerde fraktion IV fødes;

– som sorteringsanordningen (13), inklusive en bordsi, er tilpasset til at sortere den tredje fraktion III til, en første underfraktion IIIa, der har en tæthed på sg1, der er lavere end tætheden af det ønskede pillemateriale, en anden

- 10 underfraktion IIIb, der har en tæthed på sg2, der svarer til tætheden af det ønskede pillemateriale, og en tredje underfraktion IIIc, der har en tæthed på sg3, der er højere end tætheden af det ønskede pillemateriale, hvori den første underfraktion IIIa og den tredje underfraktion IIIc fjernes, og den anden underfraktion IIIb føjes til den lagrede anden fraktion II af de tørre fine flis (15);

- 15 et modul (16), inklusive en pillepresser, tilpasset til komprimering af de lagrede tørre fine flis til piller, som er egnet, efter afkøling, til brug som brændsel af høj kvalitet.

DRAWINGS

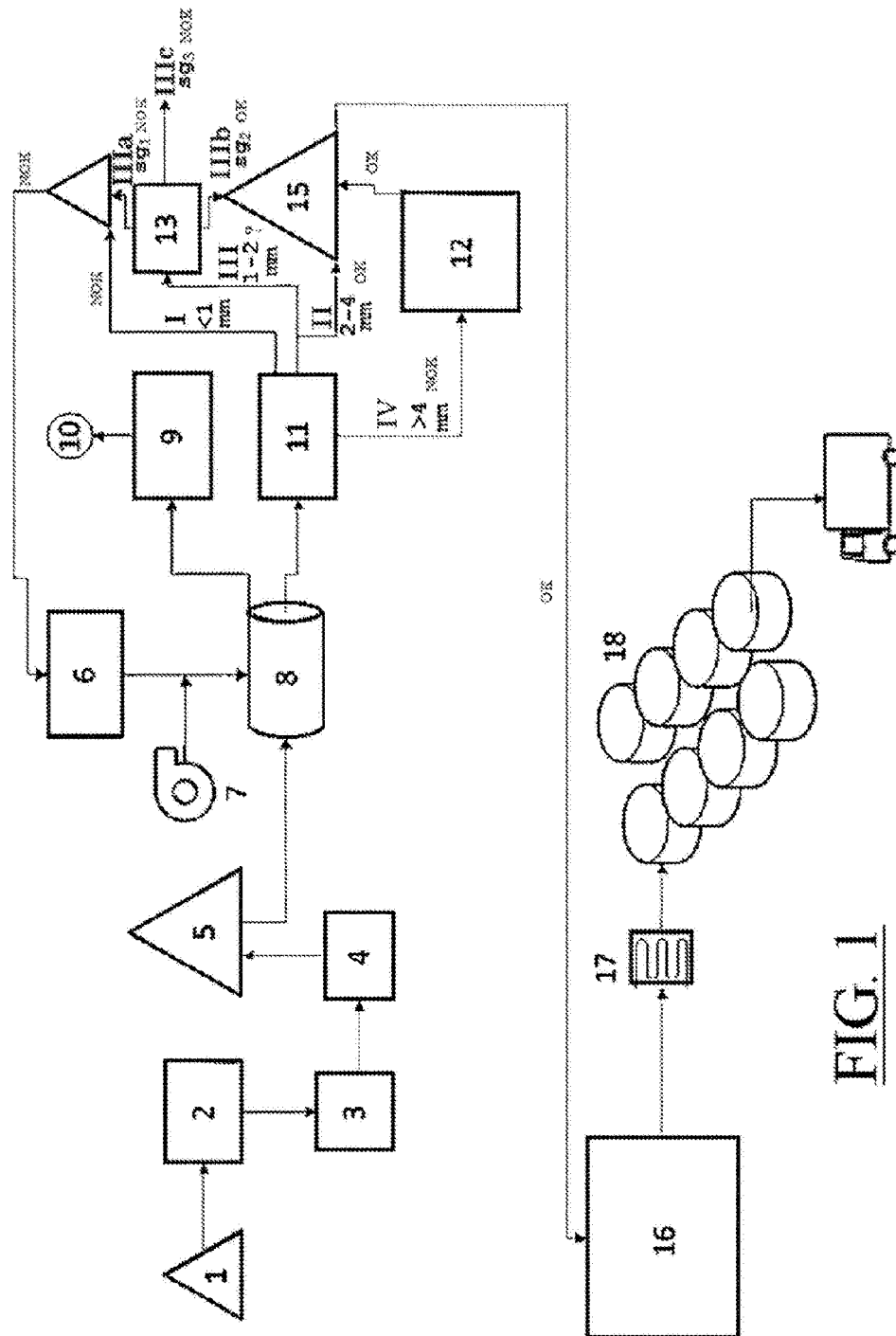


FIG. 1