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(54) A method for producing fuel for diesel engines from tyres or the like waste rubber material

Verfahren zur Herstellung von Dieselbrennstoff aus Reifen oder aus ähnlichen Altrubbermaterialien

Méthode de production d'un combustible pour moteurs diesel à partir de pneus ou de matériaux analogues de déchets de caoutchouc

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(73) Proprietor: **Wärtsilä NSD OY AB**
00530 Helsinki (FI)

(72) Inventors:
- **Ahnger, Anders**
  Fin-65230 Vasa (FI)
- **Stenhede, Thomas**
  Partille, S-433 70 Sävedalen (SE)

(74) Representative: **Newby, Martin John et al**
JY & GW Johnson,
Kingsbourne House,
229-231 High Holborn
London WC1V 7DP (GB)

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EP 0 702 076 B1

Description

[0001] This invention relates to a method for producing fuel from tyres or like waste rubber material in accordance with the preamble of claim 1.

[0002] In a known process shredded tyres are mixed with spent lubricating oil to obtain a mixture for further processing in a gasifier. The gasifier generates low energy gas to be used in a gas turbine for power generation. This process includes a number of complex process steps, such as the removal of steel and textile material from the tyre material, and the use of a high pressure and temperature gasifier with sulphur absorption and gas cleaning making it costly. Therefore this known process is applicable only in larger plants. Another known process for treating waste rubber material is disclosed in US-A-4108730.

[0003] The disposal of spent tyres constitutes a severe environmental problem. Although it is well known to recycle rubber from tyres, it is usually required that the quality of the finished rubber product should be similar to the original virgin product. This can be achieved by making use of a cryogenic process, known as such, where shredded tyres are cooled to glass transition temperature and the product is thereafter milled and classified with separation of steel wires and textile material from the tyres.

[0004] Rubber that does not meet the quality requirements either has to be burnt in a boiler or dumped on a land fill. Rubber from spent tyres has an energy content of approximately 8 MWh/ton and is constituted by styrene butadiene or similar, carbon black as filler, zinc oxide, sulphur and small parts of various additives.

[0005] Also plastics of different kinds constitute an environmental problem and must be recycled either for reuse or converted for energy production. The energy content is similar to that of rubber.

[0006] An aim of the invention is to create a new way of processing spent or scrap tyres or the like waste products so as to provide fuel for diesel engines to be further converted, for example, into electricity and heat. A further aim is to avoid the drawbacks of known techniques and to provide a less complicated and more cost effective way of putting into practice such an energy conversion process.

[0007] The aims can be met with a method according to claim 1 and the sub claims.

[0008] In accordance with the basic concept of the invention, liquid hydrocarbons, such as diesel oil, heavy fuel oil, lubricating oils, and/or other organic oils, such as vegetable oils, together with crumb rubber and possibly plastics are mixed and cracked in a chemical process so as to provide a homogeneous liquid having an appropriate viscosity to enable it to be pumped into a diesel engine and having an energy content similar to original diesel fuel oil. The oils referred to above for mixing with the rubber material can be virgin or used oils and these waste products can with advantage be recirculated.

[0009] An embodiment of the invention will now be described in more detail, by way of example only, with particular reference to the accompanying drawing, the sole figure of which schematically illustrates a plant for producing fuel from used tyres or other waste material.

[0010] In the drawing there is shown a shredding plant for shredding tyres and plastics materials. The shredded tyres are fed to a cryogenic plant for cooling to the glass transition temperature to produce crumb rubber and this together with the shredded plastics material are fed to a reactor, e.g. through a sluicing system such as a so-called lock-hopper system. A separate pipe feeds oils through a pump into the reactor. There is a pressure of from 15 - 50 bars, preferably 15-30 bars, in the reactor where the rubber and oils are mixed together. The reactor is heated by steam or a hot oil system to a temperature of approximately 300-405 °C, preferably from 320-385 °C. A decomposition of the solid hydrocarbons takes place in the reactor and the long chained compounds are cracked in the oils thereby creating a homogenous mixture which is pumped out from the bottom of the reactor.

[0011] The high temperature in the reactor makes the solid hydrocarbons and the oils give off gases which may be released from the top of the reactor. However, to obtain favourable diesel fuel features, it is important to keep as much as possible of the gases dissolved in the fuel. This can be achieved by using a low temperature cracking process of catalysts containing, for example, nickel and/or molybdenum. The released gases can be used together with fuel oil as fuel in a steam boiler or a hot oil system for heating the reactor.

[0012] The liquid fuel produced is cooled and can be fed directly to a diesel engine for power and heat generation or stored in an intermediate tank for later consumption.

[0013] The diesel engine should of course be of a type which is able to operate, when necessary, also on heavy fuel oils or the like, and it should also be equipped with appropriate facilities for cleaning of diesel exhaust gases in order to meet local emission standards.

[0014] By making use of the cryogenic process, the quality of the crumb rubber and milled rubber is better suited for processing in the reactor, and it makes it easier to separate in a classifier the steel wires, textiles and other impurities of the tyres before the rubber material is fed into the reactor. Thus, the reactor can be continuously used without the need to periodically clean it to remove the steel and textile. However, in some cases and in a smaller scale utilization of the process, it may be of advantage to directly feed the shredded tyres into the reactor so as to save the costs of a cryogenic plant, although this entails cleaning the reactor of steel, textile and possibly larger unprocessed rubber parts.

[0015] The shredding of the spent tyres to produce crumb rubber may be performed in any known manner. For example, shredding to produce fragmented rubber

may be achieved in a mechanical shredder or by the use of high pressure water jets as is known per se.

[0016] The invention is not limited to the embodiment shown and described but several modifications are feasible within the scope of the attached claims.

Claims

1. A method of producing fuel from spent tyres or like waste rubber material for use in diesel engines, e. g. for the production of electricity and heating energy, characterised in that it includes the steps of:

   (a) fragmenting said tyres or the like waste rubber material and feeding the fragmented waste rubber material into a reactor;

   (b) feeding liquid hydrocarbons into the reactor and mixing them with said rubber material under a pressure of from 15 to 50 bar;

   (c) heating the mixture in the reactor to a temperature of from 300 to 405 °C to decompose the solid hydrocarbons and crack the long chained compounds into oils to thereby create a homogenous mixture;

   (d) recovering gases released in the reactor in step (c); and,

   (e) after step (c), pumping the homogeneous mixture from the reactor and cooling the homogeneous mixture so that it is ready for utilisation as fuel oil in diesel engines.

2. A method according to claim 1, characterised in that the waste rubber material is fragmented prior to being fed into the reactor by shredding and breaking down said tyres or waste rubber material to produce crumb rubber material.

3. A method according to claim 1 or 2, characterised in that the liquid hydrocarbons comprise diesel oil, heavy fuel oil and/or lubricating oil.

4. A method according to claim 1, 2 or 3, characterised in that the pressure in the reactor is from 15 to 30 bar.

5. A method according to any of claims 1 to 4, characterised in that the mixture in the reactor is heated to from 320 to 385°C.

6. A method according to claim 2 or any one of claims 3 to 5 when dependent on claim 2, characterised in that in step (a), after shredding, the tyres or like waste rubber material are cooled under a cryogenic process to the glass transition temperature.

7. A method according to any one of the preceding claims, characterised in that, in step (a), unwanted materials, for example steel wires and textiles, are removed before feeding of the remaining rubber material into the reactor.

8. A method according to any one of the preceding claims, characterised in that in step (b), fragmented, e.g. shredded, waste plastic materials are also fed into the reactor.

9. A method according to any of one of the preceding claims, characterised in that the mixture in the reactor comprises from about 40-60% of material from said tyres or like waste rubber material.

10. A method according to any of the preceding claims, characterised in that in step (c) catalysts, preferably containing nickel and/or molybdenum, are added to the reactor to keep as much as possible of any gases dissolved in the fuel mixture.

11. A method according to any one of the preceding claims, characterised in that at least some of the gases released and recovered in step (d) are used as fuel for heating of the reactor.

Patentansprüche

1. Verfahren zur Herstellung von Brennstoff aus verbrauchten Reifen oder ähnlichem Altgummimaterial zur Verwendung in Dieselmaschinen, beispielsweise zur Erzeugung elektrischer Energie und Wärmeenergie, gekennzeichnet durch die folgenden Schritte:

   a) Zerstückeln der Reifen oder des ähnlichen Altgummimaterials und Zuführen des zerstükkelten Altgummimaterials in einen Reaktor;
   b) Zuführen flüssiger Kohlenwasserstoffe in den Reaktor und Vermischen dieser mit dem Gummimaterial unter einem Druck von 15 bis 50 bar;
   c) Heizen der Mischung in dem Reaktor auf eine Temperatur von 300° bis 405°C, um die festen Kohlenwasserstoffe abzubauen und die langen Kettenverbindungen in Öle zu cracken, um dadurch eine homogene Mischung zu bilden;
   d) Rückführen der in dem Reaktor in Schritt c) freigewordenen Gase; und
   e) nachfolgend dem Schritt c), Abpumpen der homogenen Mischung von dem Reaktor und Abkühlen der homogenen Mischung, so daß sie für die Verwendung als Brennstofföl in Die-

selmaschinen fertig ist.

2. Verfahren gemäß Anspruch 1, dadurch gekennzeichnet, daß das Altgummimaterial vor dem Zuführen in den Reaktor durch Schreddern und Zerbrechen der Reifen oder des Altgummimaterials zerbrochen wird, um bröseliges Gummimaterial herzustellen.

3. Verfahren gemäß Anspruch 1 oder 2, dadurch gekennzeichnet, daß die flüssigen Kohlenwasserstoffe Dieselöl, Schweröl und/oder Schmieröl enthalten.

4. Verfahren gemäß Anspruch 1, 2 oder 3, dadurch gekennzeichnet, daß der Druck in dem Reaktor zwischen 15 bis 30 bar liegt.

5. Verfahren gemäß einem der Ansprüche 1 bis 4, dadurch gekennzeichnet, daß die Mischung in dem Reaktor auf die Temperatur von 320°C bis 385°C geheizt wird.

6. Verfahren gemäß Anspruch 2 oder einem der Ansprüche 3 bis 5, wenn diese in Abhängigkeit von Anspruch 2 stehen, dadurch gekennzeichnet, daß die Reifen oder das ähnliche Altgummimaterial in Schritt a) nach dem Schreddern in einem Abkühlprozeß bis zur Verglasungstemperatur abgekühlt werden.

7. Verfahren gemäß einem der vorangehenden Ansprüche, dadurch gekennzeichnet, daß in Schritt a) unerwünschte Materialien, beispielsweise Stahldrähte und Fasergewebe, beseitigt werden, bevor das verbleibende Gummimaterial in den Reaktor geführt wird.

8. Verfahren gemäß einem der vorangehenden Ansprüche, dadurch gekennzeichnet, daß in Schritt b) zerstückkelte, beispielsweise geschredderte Altplastikmaterialien ebenso dem Reaktor zugeführt werden.

9. Verfahren gemäß einem der vorangehenden Ansprüche, dadurch gekennzeichnet, daß die Mischung in dem Reaktor ca. 40% bis 60% Material von diesen Reifen oder ähnlichem Altgummimaterial enthält.

10. Verfahren gemäß einem der vorangehenden Ansprüche, dadurch gekennzeichnet, daß in Schritt c) Katalysatoren, vorzugsweise solche, die Nickel und/oder Molybdän enthalten, dem Reaktor hinzugeführt werden, um soviel als möglich jeglicher in der Brennstoffmischung gelösten Gase zurückzuhalten.

11. Verfahren gemäß einem der vorangehenden Ansprüche, dadurch gekennzeichnet, daß zumindest einige der freiwerdenden und in Schritt d) zurückgeführten Gase als Brennstoff zum Heizen des Reaktors verwendet werden.

Revendications

1. Méthode de production de carburant à partir de pneus usagés ou de déchets similaires au caoutchouc pour être utilisé dans des moteurs diesel, par exemple, pour la production d'électricité et d'énergie de chauffage, caractérisée en ce que celle-ci comprend les étapes de :

   (a) fragmentation desdits pneus ou de déchets similaires au caoutchouc et l'alimentation d'un réacteur en déchets de caoutchouc fragmentés ;
   (b) alimentation du réacteur en hydrocarbures liquides et leur mélange avec ledit caoutchouc sous une pression de 15 à 50 bars ;
   (c) chauffage du mélange dans le réacteur à une température de 300 à 450 °C en vue de décomposer les hydrocarbures solides et craquage des composés à longue chaîne en huiles afin de créer ainsi un mélange homogène ;
   (d) transformation des gaz dégagés dans le réacteur à l'étape (c) ; et
   (e) après l'étape (c), évacuation par pompage du mélange homogène du réacteur et refroidissement du mélange homogène de façon telle qu'il soit prêt à l'emploi comme fuel-oil dans des moteurs diesel.

2. Méthode selon la revendication 1, caractérisée en ce que l'on fragmente les déchets de caoutchouc avant d'en alimenter le réacteur par déchiquetage et écrasement desdits pneus ou déchets de caoutchouc pour produire une matière de caoutchouc émietté.

3. Méthode selon la revendication 1 ou 2, caractérisée en ce que les hydrocarbures liquides comprennent le carburant diesel, le fuel-oil lourd et/ou l'huile lubrifiante.

4. Méthode selon la revendication 1, 2 ou 3, caractérisée en ce que la pression dans le réacteur est comprise va de 15 à 30 bars.

5. Méthode selon l'une quelconque des revendications 1 à 4, caractérisée en ce que l'on chauffe le mélange dans le réacteur à une température de 320

°C à 385 °C.

6. Méthode selon la revendication 2 ou l'une quelconque des revendications 3 ou 5 lorsqu'elle dépend de la revendication 2, caractérisée en ce que dans l'étape (a), après déchiquetage, on refroidit les pneus ou les déchets de caoutchouc à la température de transition vitreuse par un procédé cryogénique.

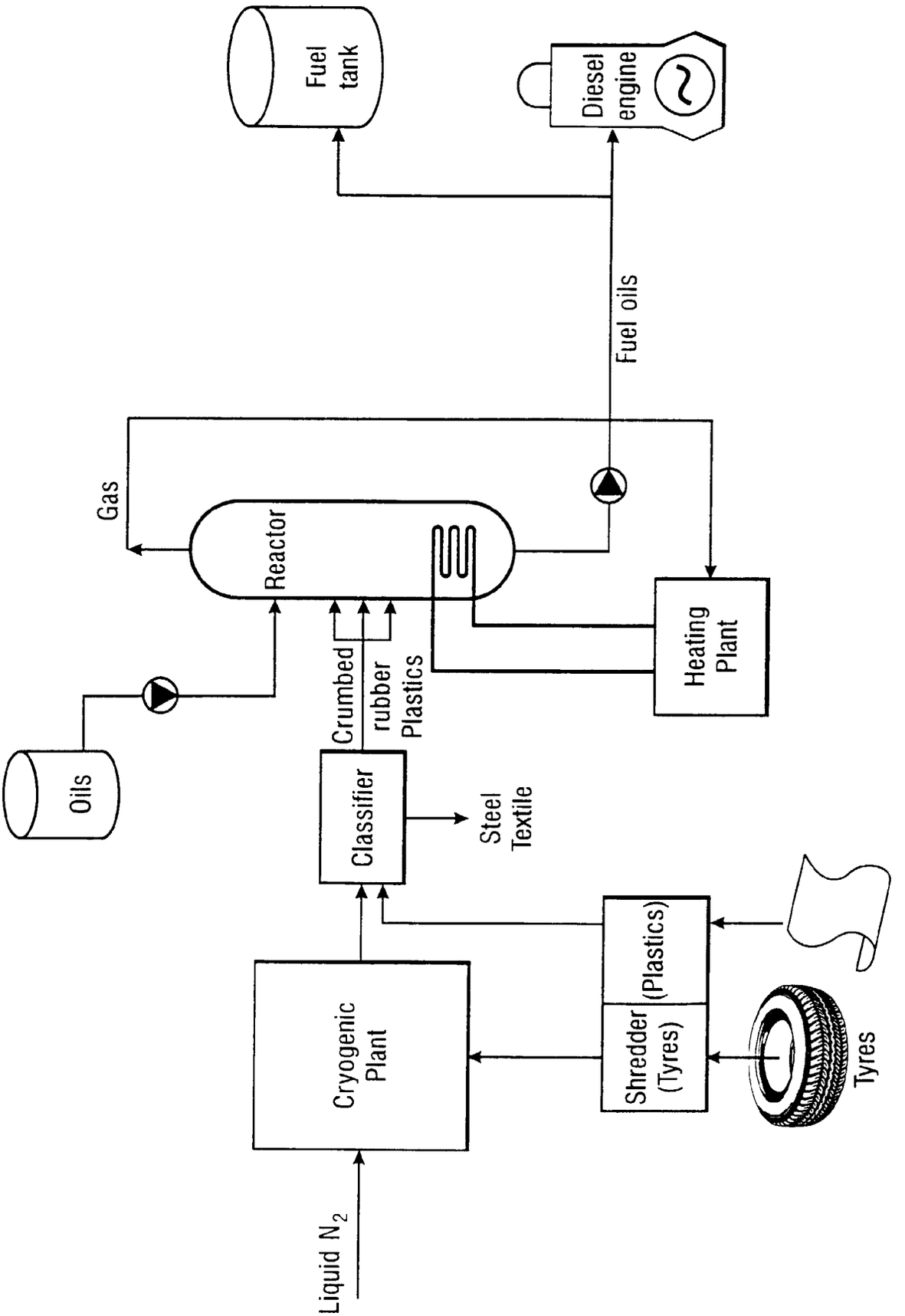
7. Méthode selon l'une quelconque des revendications précédentes, caractérisée en ce que dans l'étape (a), on élimine les matières indésirables, par exemple les fils d'acier et les textiles, avant d'alimenter le réacteur en caoutchouc restant.

8. Méthode selon l'une quelconque des revendications précédentes, caractérisée en ce que dans l'étape (b), on alimente le réacteur également en déchets de plastiques fragmentés, par exemple, déchiquetés.

9. Méthode selon l'une quelconque des revendications précédentes, caractérisée en ce que le mélange dans le réacteur comprend d'environ 40 à 60 % de matière desdits pneus ou de déchets de caoutchouc.

10. Méthode selon l'une quelconque des revendications précédentes, caractérisée en ce que dans l'étape (c), on ajoute au réacteur des catalyseurs, de préférence contenant du nickel et/ou du molybdène, en vue de conserver la plus grande quantité possible de tout gaz dissous dans le mélange de carburant.

11. Méthode selon l'une quelconque des revendications précédentes, caractérisée en ce que l'on utilise comme carburant pour le chauffage du réacteur au moins une certaine quantité de gaz dégagés et récupérés dans l'étape (d).


Fuel tank
Diesel engine
Fuel oils
Gas
Reactor
Heating Plant
Crumbed rubber
Plastics
Oils
Classifier
Steel
Textile
Cryogenic Plant
Shredder (Tyres)
(Plastics)
Tyres
Liquid N_2