

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
26 March 2009 (26.03.2009)

PCT

(10) International Publication Number
WO 2009/038252 A1

(51) International Patent Classification:
C10L 5/46 (2006.01)

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(21) International Application Number:
PCT/KR2007/006903

(22) International Filing Date:
27 December 2007 (27.12.2007)

(25) Filing Language: Korean

(26) Publication Language: English

(30) Priority Data:
10-2007-0094578
18 September 2007 (18.09.2007) KR

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(81) Designated States (unless otherwise indicated, for every
kind of national protection available): AE, AG, AL, AM,
AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA,
CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE,
EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID,
IL, IN, IS, JP, KE, KG, KM, KN, KP, KZ, LA, LC, LK, LR,
LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX,
MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO,
RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM,
TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

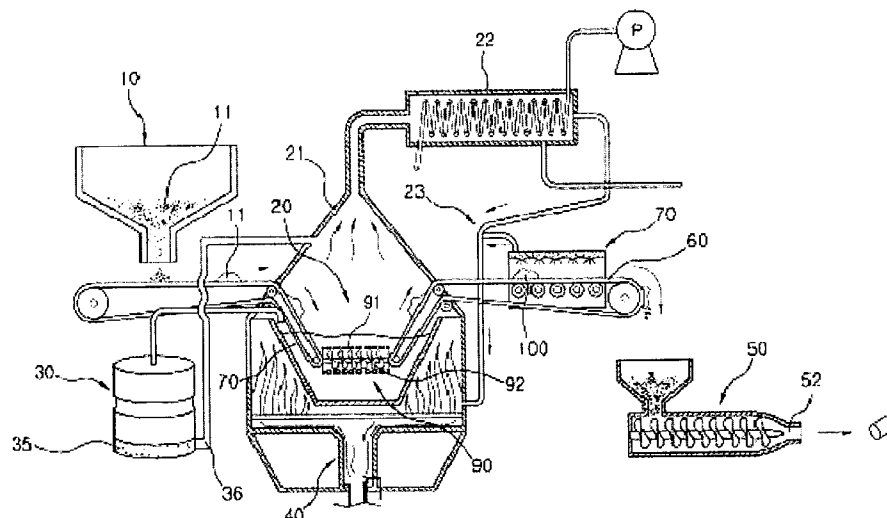
(84) Designated States (unless otherwise indicated, for every
kind of regional protection available): ARIPO (BW, GH,
GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM,
ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM),
European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI,
FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, PL,
PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM,
GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— with international search report

(54) Title: MANUFACTURING APPARATUS AND MUNUFACTURING METHOD OF SOLID FUEL FROM ORGANIC
SLUDGE AND ORGANIC WASTE USING THE FRY-DRYING TECHNOLOGY

[Figure 1]



(57) Abstract: The present invention relates to manufacturing apparatus and manufacturing method of solid fuel from organic sludge and organic waste using the fry- drying technology, in which various organic sludge and organic waste of a desired type having a moisture content of 40 ~ 90% are put into oil for the fry-drying technology, which is fried for 5 - 25 minutes, so that the moisture in the sludge is rapidly vaporized and thus the moisture content is lowered to 1 ~ 20% of weight percent and thus a calorific value of the sludge is increased to 3,000 ~ 7,000kcal/kg.

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【DESCRIPTION】**【Invention Title】**

MANUFACTURING APPARATUS AND MANUFACTURING METHOD OF SOLID
FUEL FROM ORGANIC SLUDGE AND ORGANIC WASTE USING THE FRY-
5 DRYING TECHNOLOGY

【Technical Field】

The present invention relates to manufacturing apparatus
and manufacturing method of solid fuel from organic sludge
10 such as sewage sludge or waste water sludge and organic waste
such as garbage and livestock excretion, which have a moisture
content of 40 ~ 90% of weight percent, by using a residual
product generated when producing bio-diesel and bio-ethanol or
using fuel oil and waste oil including animal and vegetable
15 fat and oil as oil for the fry-drying technology, more
particularly, to manufacturing apparatus and manufacturing
method of solid fuel from organic sludge and organic waste
using the fry-drying technology, in which various organic
sludge and organic waste of a desired type having a moisture
20 content of 40 ~ 90% are put into oil for the fry-drying
technology, which is heated at a temperature of 110 ~ 180℃ and
stored in a fry-drying device, so as to be fully submerged
under the oil, and then fried for 5 ~ 25 minutes, so that the
moisture in the sludge is rapidly vaporized and thus the

moisture content is lowered to 1 ~ 20% and also the oil is displaced at the positions of the vaporized moisture and thus a calorific value of the sludge is increased to 3,000 ~ 7,000kcal/kg.

5 Since the oil used in the fry-drying technology has a smaller molecular weight than the moisture, the oil can be rapidly infiltrated into the various organic sludge and organic waste. Further, since the oil has a boiling point of 170 ~ 340°C which is higher than a temperature that the fry-
10 drying is occurred and thus boiling heat transfer ($2,500\text{W/m}^2\text{°C}$) is occurred, the moisture is more rapidly vaporized than in convective heat transfer ($70 \sim 140\text{W/m}^2\text{°C}$).

 Further, since a negative pressure is generated while the moisture in the various organic sludge and organic waste is
15 vaporized and thus the oil for the fry-drying technology can be easily absorbed into the various organic sludge and organic waste, it is possible to obtain fuel having a low moisture content and a high calorific value.

 Furthermore, according to IPCC (Intergovernmental Panel
20 on Climate Change) in the UN, when the organic sludge and waste of 1ton are buried in the ground, methane gas (CH_4) of 0.133 tons, which causes global warming, is generated until the organic sludge and waste are completely decomposed. And even in case that an equipment for collecting LFG (Land fill

Gas) is provided at the landfill, an amount of the methane gas collected by the equipment is less than 50% of the entirely generated amount. In some nations where the organic sludge landfill is prohibited, if the various sludge is dried and then used as an alternative fuel, the alternative fuel can escape from objects which discharges carbon dioxide. Therefore, in case that the high calorific organic sludge produced by treating the organic sludge and the organic waste using the residual product generated when producing bio-diesel and bio-ethanol or using fuel oil and waste oil including animal and vegetable fat and oil as the oil for the fry-drying technology is used as the solid alternative fuel, it is possible to remarkably reduce greenhouse gas and also establish a CDM (Clean Development Mechanism) business which can secure carbon credits by inspection of the UN.

【Background Art】

Generally, organic sludge such as sewage sludge or waste water sludge and organic waste such as garbage and livestock excretion have a moisture content of 40 ~ 90%. To burn up the sludge or use the sludge as the solid fuel, it is essential to go through a dehydrating or high efficient drying process.

As a conventional dehydrator for dehydrating the organic sludge and the organic waste, there was proposed Germany

Patent No. 948,497 in which humid solid dehydrated by a continuously operated screen centrifugal machine, e.g., a sliding screen centrifugal machine, a screw-type screen centrifugal machine or an integral casing centrifugal machine
5 is dried by a drying device.

Such the dehydrated organic sludge is baked and then formed into a lump type having a final humidity and viscosity, and the solid lump is pulverized and then dried in the drying device so as to be a dried material of 90 weight%.

10 However, since the dehydrating device and the drying device for reducing the moisture content has a complicated structure as well as a large size, there is a problem that the cost of equipment and operation is increased. Further, there are other problems that the equipment should be cleaned
15 periodically due to dust generated in the pulverizing process, and the dried solid fuel has a low calorific value.

Meanwhile, an amount of the waste matter including glycerol as a residual product generated when producing bio-diesel and bio-ethanol is sharply increased according as the
20 production of the bio-diesel which can prevent the global warming is increased. However, since there is not yet provided a proper using method of the glycerol, it is difficult to treat it and also it impose an economical burden on the relevant industries due to increase of environmental cost.

Until now, the glycerol generated in the production process of bio-fuel has been used as a raw material of toilet articles and medicines. However, due to the remarkable increase of the amount of glycerol, a unit price thereof is
5 dropped sharply and thus a stored amount thereof is also increased. Further, since it is impossible to recycle other residual products except the glycerol, the residual products are treated as wastes.

The wastes including the animal fat and oil generated in
10 a slaughterhouse and the animal and vegetable fat and oil generated in a restaurant as well as deposits in a sewer pipe are mainly responsible for the increase of treating cost in a sewage treatment plant. However, since the animal and vegetable fat and oil can be formed into liquid state by
15 heating them, the liquid fat and oil can be used as oil for the fry-drying treatment of the organic sludge.

Therefore, according to the present invention, by using the residual product generated when producing bio-diesel and bio-ethanol or using fuel oil and waste oil including animal
20 and vegetable fat and oil as oil for the fry-drying treatment of the organic sludge, the moisture content of the organic sludge such as sewage sludge and waste water sludge and organic waste such as garbage and livestock excretion can be reduced to 1 ~ 15%. And the oil for the fry-drying treatment

of the organic sludge is displaced at the positions of the vaporized moisture and thus it is possible to obtain the solid fuel having the calorific value of 3,000 ~ 7,000kcal/kg, and also it is fundamentally prevent that the methane gas which causes global warming is generated by the landfill and solidifying of the organic sludge.

【Disclosure】**【Technical Problem】**

An object of the present invention is to provide manufacturing apparatus and manufacturing method of solid fuel from organic sludge and organic waste using the fry-drying technology, in which the moisture content of the sludge can be reduced by using the residual product generated when producing bio-diesel and bio-ethanol or using fuel oil and waste oil including animal and vegetable fat and oil as oil for the fry-drying treatment of the organic sludge, so that the sludge can be solidified and used as the solid fuel having a high calorific value.

According to IPCC (Intergovernmental Panel on Climate Change) in the UN, when the organic sludge and waste of 1ton are buried in the ground, methane gas (CH_4) of 0.133 tons, which causes global warming, is generated until the organic sludge and waste are completely decomposed. And even in case

that an equipment for collecting LFG (Land fill Gas) is provided at the landfill, an amount of the methane gas collected by the equipment is less than 50% of the entirely generated amount. In some nations where the organic sludge landfill is prohibited, if the various sludge is dried and then used as alternative fuel, the alternative fuel can escape from objects which discharges carbon dioxide. Therefore, another object of the present invention is to provide manufacturing apparatus and manufacturing method of solid fuel from organic sludge and organic waste using the fry-drying technology, in which the high calorific organic sludge produced by treating the organic sludge and the organic waste using the residual product generated when producing bio-diesel and bio-ethanol or using fuel oil and waste oil including animal and vegetable fat and oil as oil for the fry-drying technology can be used as the solid alternative fuel, and thus it is possible to remarkably reduce greenhouse gas and also establish a CDM (Clean Development Mechanism) business which can secure carbon credits by inspection of the UN.

20

【Technical Solution】

In order to achieve the above objects, there is provided a manufacturing apparatus of solid fuel from organic sludge and organic waste using the fry-drying technology, comprising

an organic sludge and waste supplying hopper which stores organic sludge and organic waste; an oil tank which stores oil for the fry-drying technology; a heat-evaporation drying unit in which the organic sludge and organic waste supplied from the organic sludge and waste supplying hopper and the oil for the fry-drying technology supplied from the oil tank are mixed and heated; a cooling unit which cools solid fuel which is the mixture of the oil for the fry-drying technology and the organic sludge and waste discharged from the heat-evaporation drying unit; and a compression molding unit which molds the solid fuel dried in the cooling unit into a desired shape.

Preferably, the heat-evaporation drying unit is provided with a burner.

Preferably, the organic sludge and organic waste supplied from the organic sludge and waste supplying hopper and the solid fuel discharged from the heat-evaporation drying unit are conveyed by a conveying means.

Preferably, the conveying means is disposed so as to be passed through the heat-evaporation drying unit, and the heat-evaporation drying unit is further provided with a vibrator for vibrating the conveying means.

Preferably, a fry-drying unit connected with the conveying means is further provided in the heat-evaporation drying unit.

Preferably, the fry-drying unit comprises a cylindrical drum having a plurality of through-holes and a screw which is rotated in the cylindrical drum.

Preferably, the fry-drying unit comprises a cylindrical
5 drum having a plurality of through-holes and a chain belt (not shown) which is disposed in the cylindrical drum.

Preferably, the conveying means is a conveyor.

Preferably, a condenser is provided at an upper side of the heat-evaporation drying unit.

10 Preferably, the heat-evaporation drying unit, the condenser and the cooling unit are communicated with each other through a gas circulation path.

Preferably, the solid fuel discharged from the heat-evaporation drying unit is treated at 110 ~ 180°C for 5 ~ 25
15 minutes.

Preferably, the solid fuel discharged from the cooling unit has a moisture content of 1 ~ 20% and a calorific value of 4,000 ~ 7,000kcal/kg.

Preferably, a mold is provided at an end of the
20 compression molding unit.

Preferably, the oil tank is further provided with a preheating means.

Preferably, the preheating means is communicated with the heat-evaporation drying unit through a waste heat path.

According to another aspect of the present invention, there is provided a manufacturing method of solid fuel from organic sludge and organic waste using the fry-drying technology, comprising a step S1 of supplying organic sludge and waste; a step S2 of supplying oil for the fry-drying technology; a step S3 of heating the organic sludge and waste and the oil for the fry-drying technology at a temperature of 110 ~ 180°C for 5 ~ 25 minutes so that moisture is evaporated; a step S4 of cooling solid fuel which is a mixture of the organic sludge and waste and the oil for the fry-drying technology; and a step S5 of compression-molding the dried solid fuel.

Preferably, the step S2 of supplying the oil for the fry-drying technology may further comprises a step S6 of preheating the oil for the fry-drying technology.

【Advantageous Effects】

According to the manufacturing apparatus and manufacturing method of solid fuel from organic sludge and organic waste using the fry-drying technology, the moisture content of the organic sludge can be reduced by using a residual product of bio-diesel and bio-ethanol or using fuel oil and waste oil including animal and vegetable fat and oil as oil for the fry-drying technology. After the fry-drying

process, the oil for fry-drying technology is impregnated in the solid fuel and also coated on the surface of the solid fuel. Therefore, the solid fuel has a high calorific value and a clean surface but has not the bad smell and thus it is
5 facile to store and convey the solid fuel.

Further, according to the present invention, the residual product of bio-diesel and bio-ethanol or using fuel oil and waste oil including animal and vegetable fat and oil as oil for the fry-drying technology can be recycled so as to provide
10 the solid fuel having a high calorific value which can be used as a low-priced alternative fuel for multipurpose energy like domestic or agricultural heating energy, and thus it can be contributed to the national demand and supply for energy and also it is fundamentally prevent that an environmental problem
15 is occurred by the residual product of bio-diesel and bio-ethanol or fuel oil and waste oil including animal and vegetable fat and oil.

【Description of Drawings】

20 The above and other objects, features and advantages of the present invention will become apparent from the following description of preferred embodiments given in conjunction with the accompanying drawings, in which:

Fig. 1 is a schematic view showing a manufacturing

apparatus of solid fuel from organic sludge and organic waste using the fry-drying technology according to an embodiment of the present invention.

Fig. 2 is a schematic view showing the manufacturing apparatus of solid fuel from organic sludge and organic waste using the fry-drying technology according to another embodiment of the present invention.

Fig. 3 is a graph showing a change in temperature of a mixture of organic sludge and waste and oil for the fry-drying technology in a heat-evaporation drying unit according to the present invention.

Fig. 4 is a flowchart showing a manufacturing method of solid fuel from organic sludge and organic waste using the fry-drying technology according to an embodiment of the present invention.

[Detailed Description of Main Elements]

10: organic sludge and waste supplying hopper

11: organic sludge and organic waste

20: heat-evaporation drying unit

21: closed portion

22: condenser

23: gas circulation path

30: oil tank

31: oil for fry-drying technology

35: preheating means

36: waste heat path

40: burner

50: compression molding unit 51: screw

52: mold 60: conveying means

70: cooling unit 80: vibrator

5 90: fry-drying unit 91: screw

92: cylindrical drum 100: solid fuel

【Best Mode】

Hereinafter, the embodiments of the present invention
10 will be described in detail with reference to accompanying
drawings.

Fig. 1 is a schematic view showing a manufacturing
apparatus of solid fuel from organic sludge and organic waste
using the fry-drying technology according to an embodiment of
15 the present invention, Fig. 2 is a schematic view showing the
manufacturing apparatus of solid fuel from organic sludge and
organic waste using the fry-drying technology according to
another embodiment of the present invention, Fig. 3 is a graph
showing a change in temperature of a mixture of organic sludge
20 and waste and oil for the fry-drying technology in a heat-
evaporation drying unit according to the present invention,
and Fig. 4 is a flowchart showing a manufacturing method of
solid fuel from organic sludge and organic waste using the
fry-drying technology according to an embodiment of the

present invention.

As shown in drawings, the manufacturing apparatus of solid fuel from organic sludge and organic waste using the fry-drying technology according to an embodiment of the present invention includes an organic sludge and waste supplying hopper 10 which stores the organic sludge and organic waste 11 having a high moisture, an oil tank 30 which stores solid or semisolid residual product generated when producing bio-diesel and bio-ethanol or fuel oil and waste oil including animal and vegetable fat and oil as oil for the fry-drying technology, a heat-evaporation drying unit 20 in which the organic sludge and organic waste 11 supplied from the organic sludge and waste supplying hopper 10 and the oil for the fry-drying technology supplied from the oil tank 30 are mixed and heated, a burner 40 which is disposed outside the heat-evaporation drying unit 20 so as to heat the heat-evaporation drying unit 20, a cooling unit 70 which cools solid fuel 100 which is the mixture of the oil for the fry-drying technology and the organic sludge and waste fried at a desired temperature for a desired time in the heat-evaporation drying unit 20 so as to have a lowered moisture content, and a compression molding unit 50 which forms the solid fuel 100 dried in the cooling unit 70 into a desired shape.

Herein, the organic sludge is conveyed by a conveying

means 60 and treated by a fry-drying unit 90. A condenser 22 is provided at an upper side of the heat-evaporation drying unit 20. The condenser 22, the heat-evaporation drying unit 20 and the cooling unit 70 are communicated with each other
5 through a gas circulation path 23.

The oil 31 for the fry-drying technology is one of the residual products generated when producing bio-diesel and bio-ethanol, fuel oil and waste oil including animal and vegetable fat and oil, or a mixture thereof.

10 The organic sludge and waste supplying hopper 10 functions to store and supply the organic sludge and organic waste 11. The organic sludge and organic waste 11 supplied from the organic sludge and waste supplying hopper 10 is conveyed to the heat-evaporation drying unit 20 by the
15 conveying means 60.

It is preferable that the conveying means 60 is a conveyer, but also it does not matter that the conveying means 60 is a conventional supplying hopper in which the organic sludge and waste may be supplied while being pulverized by a
20 screw.

The organic sludge and organic waste 11 is supplied from the organic sludge and waste supplying hopper 10 to the heat-evaporation drying unit 20, and the oil 31 for the fry-drying technology is also supplied to the oil tank 30 to the heat-

evaporation drying unit 20.

It is preferable that the oil tank 30 is provided with a preheating means 35 for preheating the oil 31 to a desired temperature.

5 The preheating means 35 is communicated with the heat-evaporation drying unit 20 through a waste heat path 36 so as to preheat the oil 31 for the fry-drying technology by using the waste heat of the heat-evaporation drying unit 20.

10 As described above, since the oil 31 for the fry-drying technology is preheated by using the waste heat of the heat-evaporation drying unit 20, separate energy source for the preheating is not needed.

15 The heat-evaporation drying unit 20 functions to heat the organic sludge and waste 11 supplied from the organic sludge and waste supplying hopper 10 and the oil 31 for the fry-drying technology supplied from the oil tank 30 by using thermal energy generated from the burner 40 provided at a lower side thereof.

20 The organic sludge and waste 11 supplied in the heat-evaporation drying unit 20 is introduced in the fry-drying unit 90 and then treated.

As shown in Fig. 1, the fry-drying unit 90 includes a screw 91 or chain belt (not shown) for conveying the organic sludge and waste 11, and a cylindrical drum 92 which is formed

to receive the screw 91 or chain belt (not shown) therein and also has a plurality of through-holes through which the heated oil for the fry-drying technology can be freely passed.

The organic sludge and waste 11 introduced into the fry-drying unit 90 is heated at a temperature of 110 ~ 180°C for 5 ~ 25 minutes.

If the solid fuel 100 which is the mixture of the organic sludge and organic waste and the oil for the fry-drying technology is heated at a temperature of 110 ~ 180°C for 5 ~ 25 minutes, the moisture on a surface of the organic sludge and waste 11 is instantaneously evaporated by the fry-drying technology. Also, liquid-liquid conduction heat transfer between the moisture in the organic sludge and waste 11 and the oil for the fry-drying technology is occurred by contacting with the heated oil for the fry-drying technology, and thus an internal temperature of the organic sludge and waste 11 is sharply increased so that the moisture in the organic sludge and waste 11 is discharged outside by a high pressure. Therefore, the moisture in the organic sludge and waste 11 is also evaporated.

During such the process, since the moisture in the organic sludge and waste 11 is evaporated, numerous pores are formed in the organic sludge and waste 11 and thus a negative pressure is generated temporarily.

Accordingly, the oil the fry-drying technology having a high calorific value is displaced in the pores.

The heat-evaporation drying unit 20 may has a structure shown in Fig. 1, but it may also have a different structure, as shown in Fig. 2, in which the conveying means 60 is disposed so as to be passed through the heat-evaporation drying unit 20 and fully submerged under the oil 31 for the fry-drying technology.

In this situation, a vibrator 80 may be further provided at a lower side of the conveying means 60.

In case that the temperature of the organic sludge and waste 11 is less than 110°C in the fry-drying process, an evaporation speed of the moisture in the organic sludge and waste 11 becomes slow, and thus it is not possible to obtain a desirable drying effect. And in case that the temperature of the organic sludge and waste 11 is larger than 180°C, the evaporation speed of the moisture becomes somewhat fast, but increase in efficiency is not obtained. That is, the consumption of energy is increased. Therefore, it is preferable that the organic sludge and waste 11 is treated within a temperature range of 110 ~ 180°C. Further, in case that the treatment time of the organic sludge and waste 11 is less than 5 minutes, the quantity of heat transferred from the oil 31 for the fry-drying technology is insufficient and thus

the evaporation of moisture is not occurred sufficiently. And in case that the treatment time of the organic sludge and waste 11 is large than 25 minutes, the evaporation of moisture is occurred sufficiently, but the consumption of energy is increased. Therefore, it is preferable that the organic sludge and waste 11 is treated for 5 ~ 25 minutes.

The organic sludge and waste 11 dried by the fry-drying technology has a moisture content of 1 ~ 20%. Further, the calorific value of the organic sludge and waste 11 is also increased considerably from 500 ~ 800kcal/kg to 3,000 ~ 7,000kcal/kg according to a kind of the organic sludge and waste 11 and a component of the oil 31 for the fry-drying technology. As described above, it is preferable that the fry-drying technology is performed at the temperature of 110 ~ 180°C for 5 ~ 25 minutes.

By the conveying means 60, the organic sludge and waste 11 is conveyed from the organic sludge and waste supplying hopper 10 to the heat-evaporation drying unit 20 and then also conveyed from the heat-evaporation drying unit 20 to the cooling unit 70, and the solid fuel 100 is also conveyed from the cooling unit 70 to the compression molding unit 50.

The solid fuel 100 heated and dried in the heat-evaporation drying unit 20 is conveyed to the cooling unit 70 so as to be cooled and then conveyed to the compression

molding unit 50 so as to be formed into various shapes.

At this time, by a mold 52 provided at an end of the compression molding unit 50, the solid fuel can be formed into various shapes such as a rod shape, a spherical shape, an
5 elliptical shape, a diamond shape, a star shape and the like.

Since the oil for the fry-drying technology is contained in and also coated on the solid fuel 100 formed by the compression molding unit 50, the solid fuel 100 has not a bad smell and has a clean surface, and thus it is facile to store
10 and convey the solid fuel 100.

Meanwhile, at an upper portion of the heat-evaporation drying unit 20, there are provided a closed portion 21 for collecting vapor and bad smell generated in the drying process of the organic sludge and waste 11, and the condenser 22 for
15 cooling and condensing the vapor collected in the closed portion 21. The bad smell cooled by the condenser 22 is introduced again through the gas circulation path 23 into the burner 40. The gas circulation path 23 is preferably disposed between the condenser 22 and the burner 40 and also between
20 the cooling unit 70 and the burner 40 so as to re-circulate the bad smell.

Fig. 4 is a flowchart showing a manufacturing method of solid fuel from organic sludge and organic waste using the fry-drying technology according to an embodiment of the

present invention. The manufacture method includes a step S1 of supplying the organic sludge and waste 11, a step S2 of supplying a residual product generated when producing bio-diesel and bio-ethanol, or fuel oil and waste oil including animal and vegetable fat and oil as oil 31 for the fry-drying technology, a step S3 of heating the organic sludge and waste 11 and the oil 31 for the fry-drying technology at a temperature of 110 ~ 180°C for 5 ~ 25 minutes, a step S4 of cooling solid fuel 100 which is a mixture of the organic sludge and waste 11 and the oil 31 for the fry-drying technology, and a step S5 of compression-molding the dried solid fuel 100.

And the step S2 of supplying the oil 31 for the fry-drying technology may further includes a step S6 of preheating the oil 31 for the fry-drying technology.

As described above, the present invention is focused on a method of removing the moisture in the organic sludge, which was a big trouble in the drying process of the organic sludge. Therefore, by coating the surface of the organic sludge with the residual product generated when producing bio-diesel and bio-ethanol or fuel oil and waste oil including animal and vegetable fat and oil, which has some problems in the waste treatment, the residual product generated when producing bio-diesel and bio-ethanol or fuel oil and waste oil including

animal and vegetable fat and oil can be used as an auxiliary fuel, and also the manufactured solid fuel has no bad smell and also has a clean surface, and thus it is facile to store and convey the solid fuel.

5 The manufacturing apparatus and manufacturing method of solid fuel from organic sludge and organic waste using the fry-drying technology preferably include a combination of the fry-drying unit 90 of the heat-evaporation drying unit 20 and the conveying means 60 for connecting from the organic sludge
10 and waste supplying hopper 10 to the heat-evaporation drying unit 20 and also from the heat-evaporation drying unit 20 to the compression molding unit 50, as shown in Fig. 1, alternatively, the conveying means 60 for connecting from the organic sludge and waste supplying hopper 10 to the
15 compression molding unit 50, as shown in Fig. 2. Herein, it is preferable that the screw 91 or chain belt (not shown) and the cylindrical drum 92 of the fry-drying unit 90, and the conveyer belt of the conveying means 60 are formed of a metallic material.

20 As described above, since the solid fuel 100 as the mixture of the organic sludge and waste 11 and the oil 31 for the fry-drying technology is conveyed and treated by the conveying means 60 and the fry-drying unit 90, it is possible to continuously manufacture the solid fuel 100.

The compression molding unit 50 functions to mold the dried organic sludge and thus continuously manufacture the solid fuel 100. The compression molding unit 50 is provided with the mold 52 compressed by the screw 51. By the compression molding unit 50, the solid fuel can be formed into various shapes such as a rod shape, a spherical shape, an elliptical shape, a diamond shape, a star shape and the like.

<First embodiment>

In the embodiment, an experiment of drying the sewage sludge was performed by using the manufacturing apparatus and manufacturing method of solid fuel from organic sludge and organic waste using the fry-drying technology, as described above.

Table 1 shows the moisture content of the sludge by heating temperatures of glycerol which is the residual product generated when producing bio-diesel and bio-ethanol. This experiment is to find an optimum drying temperature of the sewage sludge having a moisture content of 84%. Considering an evaporation temperature of the moisture and a boiling point of the glycerol, the experiment was performed at the extent of 110 ~ 160°C. As the result, the moisture content was 74% at a temperature of 110°C, 28% at 130°C, in which the sludge can be burned, and also 2.5% at 150°C, in which the moisture was

almost evaporated.

Table 1

	Evaporation temperature (°C)	Moisture content (%)	
Sewage sludge	sample	84	
Dried sludge using glycerol and bio-diesel/bio-ethanol	Room temperature ~ 80°C		Semisolid glycerol
	110°C	74	Liquid state
	130°C	28	Drying time : 10 minutes
	140°C	16	
	150°C	2.5	(optimum temperature)

<Moisture content of sludge by temperatures of residual product of bio-diesel/bio-ethanol>

5

Table 2 shows calorific values of the sludge according to a temperature distribution of the sewage sludge dried by the glycerol which is the residual product of the bio-diesel/bio-ethanol. Comparing with the sewage sludge having a calorific value of 2,534kcal/kg, the dried sludge has a calorific value of 6,150kcal/kg.

Table 2

	Evaporation temperature (°C)	Calorific value of dried sludge (kcal/kg)	
Sewage sludge	Sample	2,534	
Dried sludge using residual product of	110°C	3,831	
	130°C	4,839	

bio-diesel and bio-ethanol or using fuel oil and waste oil including animal and vegetable fat and oil	140℃	5,664	
	150℃	6,150	

<Calorific value of sludge dried by using residual product of bio-diesel and bio-ethanol or using fuel oil and waste oil including animal and vegetable fat and oil>

5 <Second embodiment>

Table 3 shows a result in which the sewage sludge is dried by using the waste oil. This experiment was performed for 10 minutes. The moisture content was 8.1% at a temperature of 160℃ and the calorific value was 6,347kcal/kg, and the
10 moisture content was 0.3% at a temperature of 180℃ and the calorific value was increased to 6,920kcal/kg.

Table 3

	Moisture content (%)	Calorific value (kcal/kg)
Sewage sludge	87.8	539
130℃ Dry sludge	40.0	3,484
150℃ Dry sludge	12.1	5,972
160℃ Dry sludge	8.1	6,347
180℃ Dry sludge	0.3	6,920

Those skilled in the art will appreciate that the
15 conceptions and specific embodiments disclosed in the foregoing description may be readily utilized as a basis

for modifying or designing other embodiments for carrying out the same purposes of the present invention. Those skilled in the art will also appreciate that such equivalent embodiments do not depart from the spirit and
5 scope of the invention as set forth in the appended claims.

【Industrial Applicability】

According to the manufacturing apparatus and manufacturing method of solid fuel from organic sludge and
10 organic waste using the fry-drying technology, the moisture content of the organic sludge can be reduced by using a residual product of bio-diesel and bio-ethanol or using fuel oil and waste oil including animal and vegetable fat and oil as oil for the fry-drying technology. After the fry-drying
15 process, the oil for fry-drying technology is impregnated in the solid fuel and also coated on the surface of the solid fuel. Therefore, the solid fuel has a high calorific value and a clean surface but has not the bad smell and thus it is facile to store and convey the solid fuel.

20 Further, according to the present invention, the residual product of bio-diesel and bio-ethanol or using fuel oil and waste oil including animal and vegetable fat and oil as oil for the fry-drying technology can be recycled so as to provide the solid fuel having a high calorific value which can be used

as a low-priced alternative fuel for multipurpose energy like domestic or agricultural heating energy, and thus it can be contributed to the national demand and supply for energy and also it is fundamentally prevent that an environmental problem
5 is occurred by the residual product of bio-diesel and bio-ethanol or fuel oil and waste oil including animal and vegetable fat and oil.

Furthermore, according to IPCC (Intergovernmental Panel on Climate Change) in the UN, when the organic sludge and
10 waste of 1ton are buried in the ground, methane gas (CH_4) of 0.133 tons, which causes global warming, is generated until the organic sludge and waste are completely decomposed. And even in case that an equipment for collecting LFG (Land fill Gas) is provided at the landfill, an amount of the methane gas
15 collected by the equipment is less than 50% of the entirely generated amount. In some nations where the organic sludge landfill is prohibited, if the various sludge is dried and then used as alternative fuel, the alternative fuel can escape from objects which discharges carbon dioxide. Therefore, in
20 case that the high calorific organic sludge produced by treating the organic sludge and the organic waste using the residual product generated when producing bio-diesel and bio-ethanol or using fuel oil and waste oil including animal and vegetable fat and oil as the oil for the fry-drying technology

is used as the solid alternative fuel, it is possible to remarkably reduce greenhouse gas and also establish a CDM (Clean Development Mechanism) business which can secure carbon credits by inspection of the UN.

【CLAIMS】**【Claim 1】**

A manufacturing apparatus of solid fuel from organic sludge and organic waste using the fry-drying technology,
5 comprising:

an organic sludge and waste supplying hopper 10 which stores organic sludge and organic waste 11;

an oil tank 30 which stores oil for the fry-drying technology;

10 a heat-evaporation drying unit 20 in which the organic sludge and organic waste 11 supplied from the organic sludge and waste supplying hopper 10 and the oil 31 for the fry-drying technology supplied from the oil tank 30 are mixed and heated;

15 a cooling unit 70 which cools solid fuel 100 which is the mixture of the oil 31 for the fry-drying technology and the organic sludge and waste discharged from the heat-evaporation drying unit 20; and

a compression molding unit 50 which molds the solid fuel
20 100 dried in the cooling unit 70 into a desired shape.

【Claim 2】

The manufacturing apparatus of solid fuel from organic sludge and organic waste using the fry-drying technology

according to claim 1, wherein the heat-evaporation drying unit 20 is provided with a burner 40.

【Claim 3】

5 The manufacturing apparatus of solid fuel from organic sludge and organic waste using the fry-drying technology according to claim 1, wherein the organic sludge and organic waste 11 supplied from the organic sludge and waste supplying hopper 10 and the solid fuel 100 discharged from the heat-
10 evaporation drying unit 20 are conveyed by a conveying means 60.

【Claim 4】

15 The manufacturing apparatus of solid fuel from organic sludge and organic waste using the fry-drying technology according to claim 3, wherein the conveying means 60 is disposed so as to be passed through the heat-evaporation drying unit 20, and the heat-evaporation drying unit 20 is further provided with a vibrator 80 for vibrating the
20 conveying means 60.

【Claim 5】

 The manufacturing apparatus of solid fuel from organic sludge and organic waste using the fry-drying technology

according to claim 3, wherein a fry-drying unit 90 connected with the conveying means 60 is further provided in the heat-evaporation drying unit 20.

5 **【Claim 6】**

The manufacturing apparatus of solid fuel from organic sludge and organic waste using the fry-drying technology according to claim 5, wherein the fry-drying unit 90 comprises a cylindrical drum 92 having a plurality of through-holes and
10 a screw 91 which is rotated in the cylindrical drum 92.

【Claim 7】

The manufacturing apparatus of solid fuel from organic sludge and organic waste using the fry-drying technology
15 according to claim 5, wherein the fry-drying unit 90 comprises a cylindrical drum 92 having a plurality of through-holes and a chain belt (not shown) which is disposed in the cylindrical drum 92.

20 **【Claim 8】**

The manufacturing apparatus of solid fuel from organic sludge and organic waste using the fry-drying technology according to any one of claims 3 to 7, wherein the conveying means 60 is a conveyer.

【Claim 9】

The manufacturing apparatus of solid fuel from organic sludge and organic waste using the fry-drying technology according to claim 1, wherein a condenser 22 is provided at an upper side of the heat-evaporation drying unit 20.

【Claim 10】

The manufacturing apparatus of solid fuel from organic sludge and organic waste using the fry-drying technology according to claim 9, wherein the heat-evaporation drying unit 20, the condenser 22 and the cooling unit 70 are communicated with each other through a gas circulation path 23.

【Claim 11】

The manufacturing apparatus of solid fuel from organic sludge and organic waste using the fry-drying technology according to claim 1, wherein the solid fuel 100 discharged from the heat-evaporation drying unit 20 is treated at 110 ~ 180°C for 5 ~ 25 minutes.

【Claim 12】

The manufacturing apparatus of solid fuel from organic sludge and organic waste using the fry-drying technology according to claim 1, wherein the solid fuel 100 discharged

from the cooling unit 70 has a moisture content of 1 ~ 20% of weight percent and a calorific value of 3,000 ~ 7,000kcal/kg.

【Claim 13】

5 The manufacturing apparatus of solid fuel from organic sludge and organic waste using the fry-drying technology according to claim 1, wherein a mold 52 is provided at the end of the compression molding unit 50.

10 **【Claim 14】**

 The manufacturing apparatus of solid fuel from organic sludge and organic waste using the fry-drying technology according to claim 1, wherein the oil tank 30 is further provided with a preheating means 35.

15

【Claim 15】

 The manufacturing apparatus of solid fuel from organic sludge and organic waste using the fry-drying technology according to claim 14, wherein the preheating means 35 is
20 communicated with the heat-evaporation drying unit 20 through a waste heat path 36.

【Claim 16】

 A manufacturing method of solid fuel from organic sludge

and organic waste using the fry-drying technology, comprising:

a step S1 of supplying organic sludge and waste 11;

a step S2 of supplying oil 31 for the fry-drying technology;

5 a step S3 of heating the organic sludge and waste 11 and the oil 31 for the fry-drying technology at a temperature of 110 ~ 180°C for 5 ~ 25 minutes so that moisture is evaporated;

a step S4 of cooling solid fuel 100 which is a mixture of the organic sludge and waste 11 and the oil 31 for the fry-drying technology; and
10

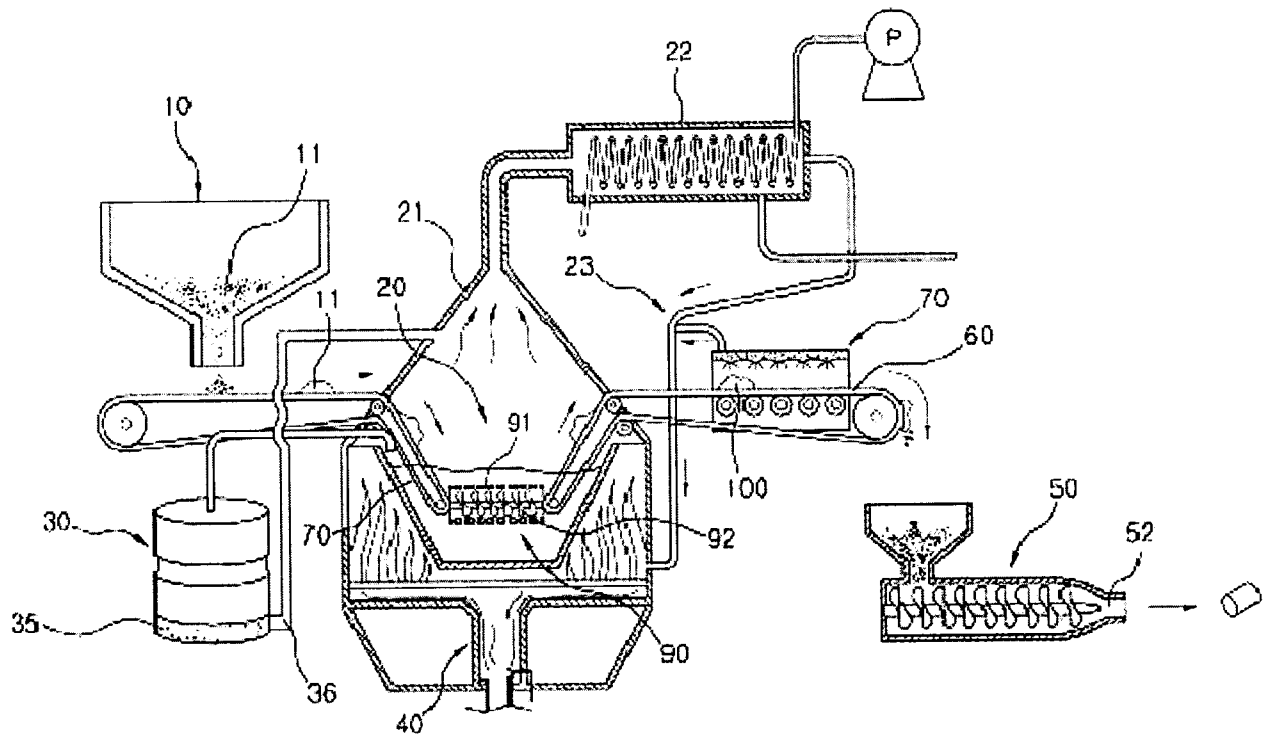
a step S5 of compression-molding the dried solid fuel 100.

【Claim 17】

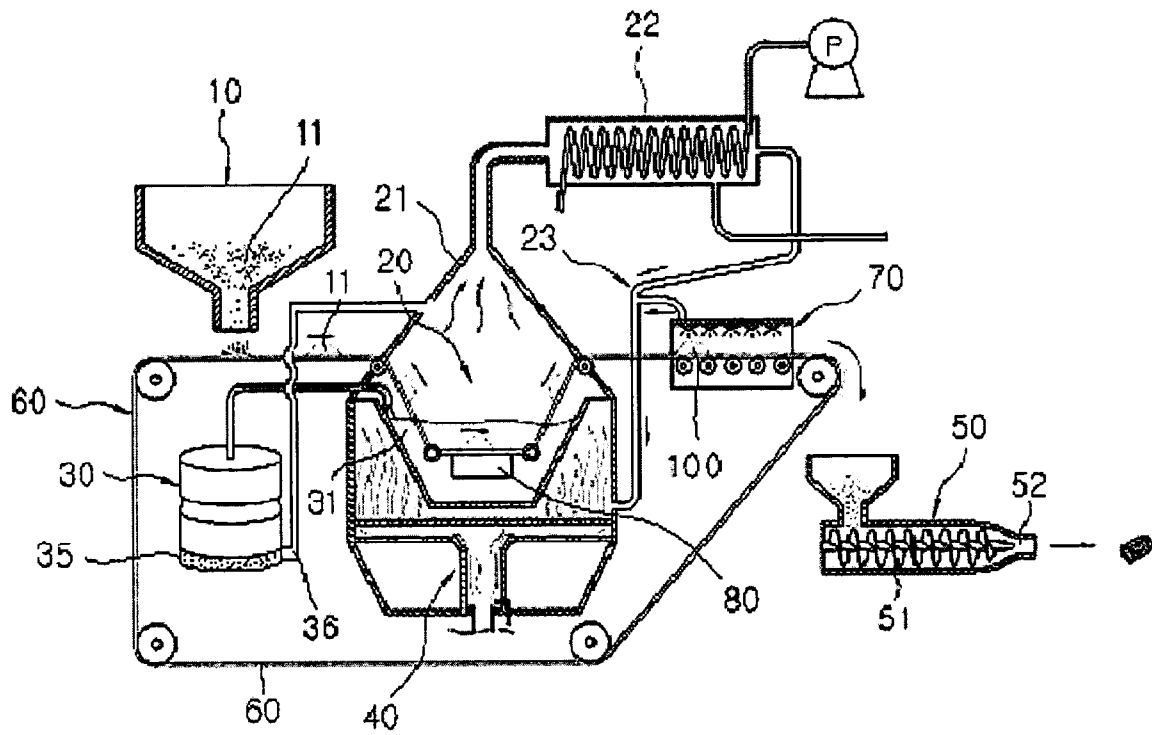
The manufacturing method of solid fuel from organic
15 sludge and organic waste using the fry-drying technology according to claim 16, wherein the step S2 of supplying the oil 31 for the fry-drying technology may further comprises a step S6 of preheating the oil 31 for the fry-drying technology.

【DRAWINGS】

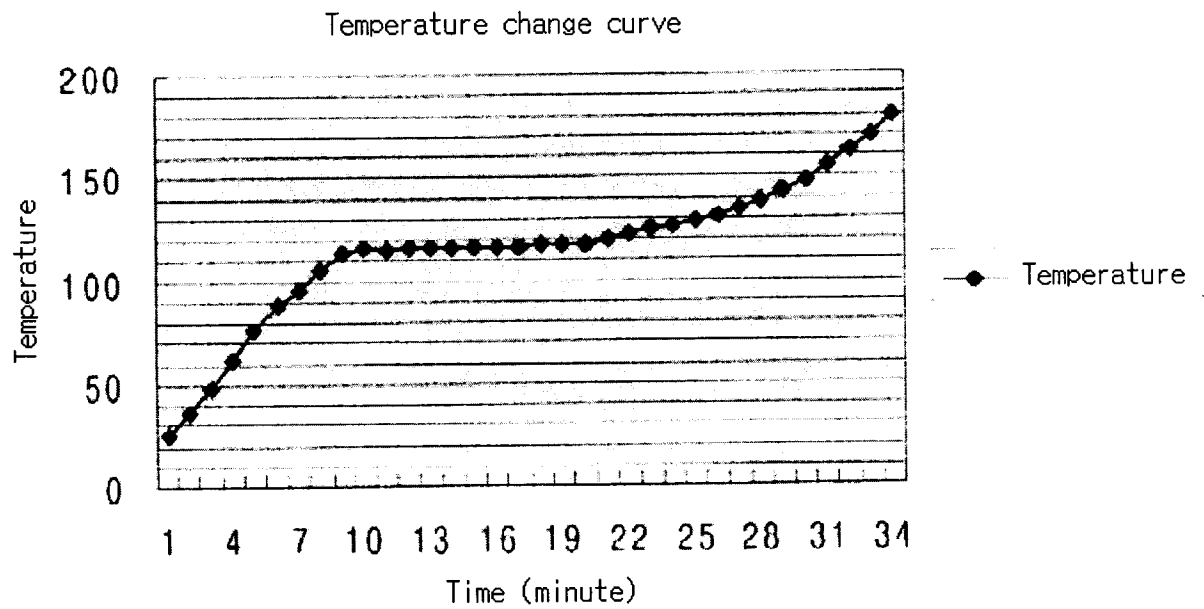
【Figure 1】



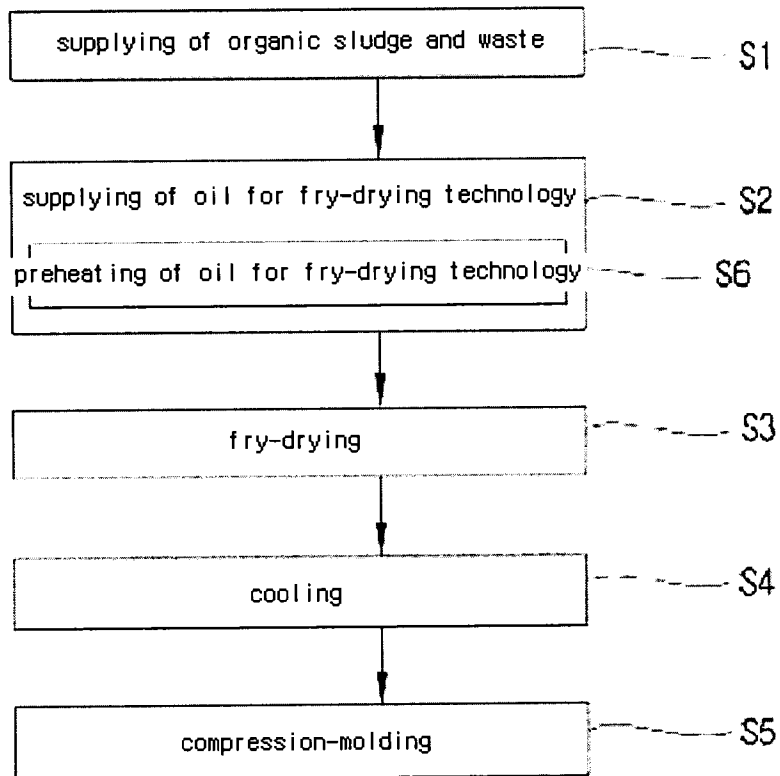
【Figure 2】



【Figure 3】



【Figure 4】



A. CLASSIFICATION OF SUBJECT MATTER*C10L 5/46(2006.01)i*

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 8 C10L 5/46, C10G 17/00, B01D 15/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
KR, JP IPC as aboveElectronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKIPASS(KIPO internal) "solid, fuel, sludge, organic, fry-drying, oil, heat-evaporation, cooling, compression, molding"**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US4985131 A (THERMAL WASTE MANAGEMENT) 15 JAN 1991 See abstract and figure 1.	1-17
A	US5087375 A (AGGIO RECOVERY) 11 FEB 1992 See abstract and figure 1; claims 1-21.	1-17
A	JP11165156 A (HITACHI ZOSEN CORP, TANAKA BUTSURYU KK) 22 JUN 1999 See abstract and claims 1-10.	1-17
A	KR2002-0096022 A (YUKI INDUSTRIAL CO., LTD.) 28 DEC 2002 See abstract and claim 1.	1-17
A	KR2002-0043526 A (JIN, YOUNG SUB) 10 JUN 2002 See abstract and claims 1-7; figure 1.	1-17



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

29 MAY 2008 (29.05.2008)

Date of mailing of the international search report

29 MAY 2008 (29.05.2008)

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/KR2007/006903

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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