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(71) Applicants:
- **Evans, Meirion Thomas**
  Bryncoch, Neath SA10 7PF (GB)
- **Morgan, Jeffrey David**
  New Tredegar, Gwent NP2 6NN (GB)

(72) Inventors:
- **Evans, Meirion Thomas**
  Bryncoch, Neath SA10 7PF (GB)
- **Morgan, Jeffrey David**
  New Tredegar, Gwent NP2 6NN (GB)

(74) Representative: **Austin, Hedley William**
Urquhart-Dykes & Lord
Alexandra House
1 Alexandra Road
Swansea Wales SA1 5ED (GB)

(54) Agglomerate production

(57) A method of producing agglomerates, which method includes blending carbonaceous particles, and optionally organic waste material, with an additive comprising particulate clay, and with a binder comprising an aqueous emulsion of polyvinyl acetate. The resultant blend is then shaped to form agglomerates, and subsequently permitting the binder to cure in the agglomerates.

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Description

[0001] The present invention is concerned with methods for the production of fuel agglomerates (such as briquettes or pellets) and, in particular, the production of agglomerates in the nature of briquettes or pellets for gasification.

[0002] It is frequently a problem to convert industrial and domestic waste into a form readily usable in furnaces intended to extract gasses. The cheapest and most cost effective way is generally to briquette or pelletise the waste, which improves the handling properties of the waste, but makes it more difficult to convert the waste to a more commercially useful by-product.

[0003] There are three major problematic waste materials, namely sewage sludge, domestic waste other than metals and glass, and coal fine sludges. These are currently disposed of by various methods. Sewage sludge being generally either spread on agricultural land or dumped at sea. Domestic waste is either disposed of in landfill sites or partially recovered for recycling. Coal fine sludges are stored either in stockpiles or lagoons until sufficiently dry for use in power generation.

[0004] All of these disposal methods are high risk pollutants to the environment.

[0005] Briquettes or pellets are conventionally formed by bonding together particles such as waste materials, using binders such as bitumen or pitch. With such binders, the bonding process is carried out at elevated temperatures, resulting in the emission of substantial quantities of smoke and other polluting by-products from the briquetting or pelletising plant.

[0006] Several other binders (both organic and inorganic) are known; see in this connection the discussion of the prior art in European patent specifications 135784 and 135785.

[0007] It has been proposed to combine the waste sludges with coal fines in a clean and stable briquette or pellet form. Such a method includes utilising polyvinyl acetate as a binder in the agglomeration of coal particles; this method is described in British Patent 1031723. However, the briquettes disclosed in British patent 1031723 have the disadvantage that the agglomerates formed are unable to remain stable during the combustion process. Polyvinyl Acetate commences to decompose at 150°C, allowing the agglomerate to break up before combustion of the fuel takes place.

[0008] It is therefore an aim of the present invention to provide a method of producing agglomerates typically from waste material which is suitable for gasification, in a safe and economic manner.

[0009] According to the present invention, there is provided a method of producing agglomerates, which method comprises blending carbonaceous particles, and optionally organic waste material, with an additive comprising particulate clay, and with a binder comprising polyvinyl acetate, shaping the resulting blend to form agglomerates, and permitting the binder to cure in the agglomerates.

[0010] The binder is such that it is activated in the presence of moisture (moisture being present because the binder is present as an emulsion) and, when cured, generally renders the agglomerate substantially waterproof or at least water resistant.

[0011] The binder used in the method according to the present invention is generally readily available and can be adapted to suit the characteristics of many types of carbonaceous particles required to be agglomerated. The polyvinyl acetate is one which mixes readily and is combustible whilst being substantially free of noxious pollutants; it is safe to handle and sets hard when mixed with finely divided particulate materials such as finely divided sludges.

[0012] The binder used in the method according to the invention, namely polyvinyl acetate, has a special affinity for fine particles of coal (which are preferred), as well as other carbonaceous fuels. The binder continues to bind such particles even in the presence of other materials which are organic in nature.

[0013] It is preferred that the clay is a montmorillonite, such as sodium montmorillonite, or potassium montmorillonite or magnesium montmorillonite. Calcium montmorillonite is the preferred such clay; such a clay may have at least some of the cations replaced by other cations, such as sodium ions. A particularly preferred such clay is sodium exchanged calcium montmorillonite. Preferably, the clay is present in an amount of 0.1 to 5% by weight, based on the weight of the agglomerates. It is preferred that the particulate clay has a particle size of less than 2μ, further preferably less than 1μ.

[0014] It is also envisaged that the polyvinyl acetate may be derived from a waste material. A suitable waste material for recycling includes base materials used in the manufacture of emulsion paint. Advantageously, according to this embodiment of the invention, there is provided use of recycled material from the manufacture of emulsion paint in the manufacture of agglomerates, said agglomerates comprising carbonaceous particles, and additive comprising a clay, and said recycled material as binder therefor.

[0015] When the blend contains organic waste, the blend preferably contains substantially equal amounts of carbonaceous particles and organic waste material (typically from 25 to 45% by weight of each), with 0.1 to 5% by weight (such as about 2%) of particulate clay, 0.5 to 8.0% by weight (such as about 2%) of polyvinyl acetate (the latter being measured on a dry solids basis), all in the presence of 2 to 25% (such as about 10 to 12%) by weight moisture.

[0016] The ingredients, when thoroughly mixed into a doughy consistency, are typically extruded or pelletised to form agglomerates of the required shape or size. The agglomerate may be rubbery in nature at this stage but hardens on

curing as excess moisture is allowed to evaporate. The speed of this curing process is directly influenced by ambient temperatures. Typically hardening takes place over 24 hours at about 15°C, or over 3 minutes when at the higher temperature of about 100°C. Evaporation of moisture can be accelerated by the use of radio wave frequencies, or the like.

[0017] When the agglomerates are formed by extrusion, there is generally a temperature increase in the extruder nozzle which assists in the evaporation of moisture. The hardness of the resulting agglomerates progressively increases with time, provided that the ambient temperature is over 0°C. The curing process should ideally take place inside a building in a controlled temperature atmosphere. The agglomerates are preferably allowed to dry and harden and may subsequently be dried by means of gentle heating. When optimum hardness has been achieved, the agglomerate is waterproof, and can be stored outside so as to be exposed to the ambient climatic conditions.

[0018] The binder may contain one or more further polymer materials, including natural polymers such as dextrin or the like.

[0019] It may sometimes be preferred to include in the binder, inhibitors against fungal attack, and/or other additives which enhance the thermal shock resistance of the resulting agglomerates. Suitable additives which enhance thermal shock resistance include calcium carbonate.

[0020] The carbonaceous particles used in the method according to the invention may be charcoal, coke or one of various grades of coal, of which anthracite is preferred because of its clean combustion characteristics.

[0021] The carbonaceous particles may be in moist form when mixed with the binder, without deleterious effect on the resulting briquettes. This is advantageous as the use of such moist material avoids the need for previous drying.

[0022] In order that the present invention may be more fully understood, an exemplary embodiment thereof will now be described with reference to the accompanying drawing, given by way of illustration only.

[0023] Referring to the drawing, the following ingredients were placed in loading hopper 1:

- 50kg of anthracite coal fines (having a moisture content of 10.2% by weight)
- 1kg of sodium exchanged calcium montmorillonite
- 500g of an aqueous emulsion of polyvinyl acetate containing 55% by weight of solids of 0.4μ particle size (typically used in the manufacture of emulsion paint)
- 125g of a "freeze" dried re-dispersible powder of polyvinyl acetate (typically used in the manufacture of ceramic tile adhesive).

[0024] The ingredients were transported by conveyor 2 to tunnel 3, and thence to a plough type rotary mixer 4 for a period of 2 minutes.

[0025] The resultant blend was agglomerated to produce briquettes on twin roll press 6. The briquettes were then air-dried at 80°C for 10 minutes in curing unit 7, and then allowed to cool to ambient temperature. The briquettes were then transported on conveyor 8 to store 9.

[0026] The resultant briquettes have a crushing strength of 63kgf (compared with 32kgf without the presence of clay in the briquette).

[0027] The benefits of using clay are more apparent after heating the briquettes to 300°C which is in excess of the decomposition temperature (150°C) of the organic binder system without clay being present.

[0028] Briquettes manufactured without clay maintain their appearance, but lose virtually all their strength at about 300°C.

[0029] Combustion tests were conducted under standardised conditions using the procedures specified by HETAS Ltd. A primary criterion of three performance standards is that the combustible loss expressed as a percentage of dry fuel burned is below 15%.

[0030] The effect of the addition of clay to the briquette is further exemplified in Table 1.

Table 1

Table 1 Effect of Sodium Exchanged Calcium Montmorillonite as a Binder Component on Cured Crushing Strength and Thermal Stability

Trial	Binder (as % of Coal{Dry Basis})			Crushing Strength, kgf				Combustible Loss as % Dry Fuel Burned
	Recolite Powder	Recolite Liquid	Clay	Cured (Heat Treatment @ 80°C)		After Heat Treatment @ 300°C		
				Mean	Range	Mean	Range	
Test A	0.25	1.0	-	32	26.44	8	6 - 9	15
Test B	0.25	1.0	2.0	63	49 - 75	58	44 - 73	10.3

Claims

1. A method of producing agglomerates, which method includes:

   (i) blending carbonaceous particles, and optionally organic waste material, with an additive comprising particulate clay and with a binder comprising an aqueous emulsion of polyvinyl acetate;
   (ii) shaping the resultant blend to form agglomerates; and
   (iii) permitting the binder to cure in said agglomerates.

2. A method according to claim 1, wherein the clay is a montmorillonite, such as sodium montmorillonite, potassium montmorillonite, magnesium montmorillonite or calcium montmorillonite, preferably sodium exchanged calcium montmorillonite.

3. A method according to claim 1 or 2, wherein the clay has a particle size of less than 2μ, (preferably less than 1μ) and/or the clay is present in an amount from 0.1 to 5% by weight.

4. A method according to any of claims 1 to 3, wherein the carbonaceous particles are of charcoal, coke or coal.

5. A method according to any of claims 1 to 4, wherein the carbonaceous particles (preferably in amount of 25 to 45% by weight) and organic waste material (preferably in an amount of 25 to 45% by weight) are present in substantially equal amounts.

6. A method according to any of claims 1 to 5, wherein the blend further includes:

   inhibitors against fungal attack; and/or
   calcium carbonate; and/or
   a natural polymer, such as dextrin.

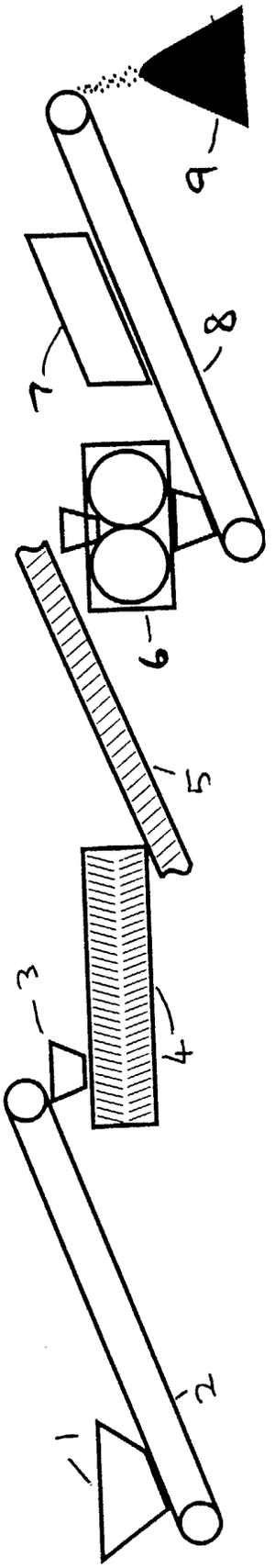
7. A method according to any of claims 1 to 6, wherein the polyvinyl acetate is derived from a recycled material which preferably includes base material used in the manufacture of emulsion paint.

8. A method according to any of claims 1 to 7, wherein the blend contains:

   polyvinyl acetate in an amount of 0.5 to 8.0% by weight (such as about 2% by weight); and/or
   moisture in an amount of 2 to 25% by weight (such as about 10 to 12% by weight).

9. A method according to any of claims 1 to 8, wherein the blend is extruded or pelletised to form the agglomerates.

10. A method according to any of claims 1 to 9, wherein the binder is cured in a controlled temperature atmosphere, preferably over about 24 hours at about 15°C, or over about 3 minutes at about 100°C.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