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(54) **Title**: CHARCOAL HAVING ENCAPSULATED IGNITER MATERIAL

(57) **Abstract**: The properties of charcoal can be improved by providing microcapsules containing an ignitable material on or within the charcoal. The microcapsules can be made of polyacrylate and the ignitable material includes hydrocarbons such as a paraffin combination, alcohols, and combinations.

CHARCOAL HAVING ENCAPSULATED IGNITER MATERIAL

BACKGROUND OF THE INVENTION

[0001] Charcoal has long been used as a fuel especially for cooking. Lighting the charcoal, however, can be problematic. A typical match flame lacks sufficient heat to ignite or burn the charcoal. Accordingly, a common approach has been to first pour lighter fluid on the charcoal and then apply a lit match. The match ignites the lighter fluid which in turn ignites and burns the charcoal. Several difficulties with this process exist including inconvenience and potential danger in use and storage of the flammable lighter fluid. A charcoal that can be more easily lit has been long desired and several inventors have addressed this issue.

[0002] For example, US 2,816,013 proposes impregnating charcoal with a liquid hydrocarbon such as odorless mineral spirits and then coating with a coating material such a polyacrylate and/or cellulose nitrates. The polymeric coating should be flammable, relatively impervious to liquid hydrocarbon and produce little smoke or odor during burning. To improve the flammability of a polyacrylate coating, a cellulose nitrate can be added. A coating containing 40-50% cellulose nitrate with a nitrogen content of 13.41% is considered most suitable.

[0003] US 3,395,002 relates to a so-called "instant igniting" charcoal made by impregnating charcoal with an alcohol and polymer solution and then gelling the impregnated solution in situ. The alcohol and polymer solution is

typically a small amount of nitro cellulose dissolved in ethyl alcohol. The gelled igniter fluid impregnated charcoal can be coated with a suitable flammable polymer such as polyvinyl alcohol or cellulose acetate (or both coatings) to improve storage and clean handling. Generally the charcoal contains 20% or 25% of the gelled impregnant to achieve easy lighting.

[0004] US 3,431,093 also relates to "instant-igniting" charcoal. A mixture of saturated higher fatty alcohols (C12-C18) and higher fatty acids (C12-C18) is impregnated into charcoal. The higher fatty alcohols and acids are heated to a molten state and the charcoal submerged therein to impregnate the igniter mixture therein. This mixture is supposed to easily ignite and burn with little smoke and a pleasant odor. Small amounts of nitrocellulose can also be included in the higher alcohol and acid mixture. Generally around 9-10% of the acid and alcohol mixture is needed for good results. The impregnated charcoal may optionally be coated.

[0005] US 4,165,968 relates to a rapidly ignitable coating composition for charcoal briquettes. The composition is a gelable mixture of a flammable alcohol and a cellulose material that further contains expanded perlite. Once the briquettes are coated with the gel composition, the temperature is dropped, preferably to -10°F to -32°F. The cold atmosphere causes the gel to quickly solidify while major amounts of the alcohol are still suspended. This limits penetration of the alcohol into the briquette. The coated briquettes should be stored in an air-tight bag to prevent alcohol from escaping.

[0006] US 4,822,380 relates to coated carbonaceous materials including charcoal. The charcoal is first dipped into a flammable liquid such as a light kerosene product and then dipped into melted paraffin having a higher melting point of around 160°F. The specified paraffin is described as having the right balance of ignition ease and coating quality. The flammable liquid coating step is reported to reduce the amount of paraffin taken up in the paraffin dip step from 6-7% retention down to 3-4% retention resulting in cost savings. The paraffin can contain additives to provide a white and opaque exterior and colors are also suggested for achieving desired aesthetics.

[0007] Separate from the desire to eliminate the need for lighter fluid, US 4,084,939 is directed to improving the safety or ease in using lighter fluid. To a gelled alcohol charcoal lighter fluid are added microcapsules of volatile solvent that rupture during the fuel gel burning to provide an audible popping or crackling sound. This sound indicates that the lighter fluid is burning. The microcapsules are preferably xylene encapsulated in a modified gelatin though kerosene could also be used. Another suggestion is petroleum distillates encapsulated in a urea-formaldehyde polymer. To insure that the capsules rupture, the encapsulating material must not melt at the burning temperature of the gelled alcohol. The volatile solvent inside the microcapsule will thus burst the capsule upon heating and produce the desired popping sound. The alcohol gel typically uses alcohols having 1-6 carbon atoms. The alcohol(s) are gelled in a dispersion of ethylene-acrylic acid copolymers.

[0008] While many solutions have been proposed, there remains a desire for easy lighting charcoal.

SUMMARY OF THE INVENTION

[0009] The present invention relates to charcoal having microcapsules of ignitable material thereon. Accordingly, a first aspect of the invention relates to a charcoal composition, comprising charcoal and microcapsules disposed on the surface thereof or within the charcoal composition, wherein said microcapsules contain an ignitable material. The ignitable material is typically, but not necessarily a liquid at room temperature and includes conventional lighter fluids and/or alcohols. The microcapsules can be made of any flammable microcapsule material such as a polyacrylate. The microcapsules can be coated on to the charcoal, especially a briquette, usually with a binder.

[0010] Another aspect of the invention relates to a process for making a charcoal composition, which comprises:

(a) coating charcoal with a slurry comprising a liquid having microcapsules dispersed therein, said microcapsules containing an ignitable material, to form a wet coated charcoal; and

(b) drying said wet coated charcoal to form charcoal having said microcapsules disposed on the surface thereof.

DETAILED DESCRIPTION OF THE INVENTION

[0011] The present invention relates to the discovery that ignitable material in a microcapsule can be combined with charcoal and provide improved lighting characteristics. Additionally, evaporation of the ignitable material can be substantially prevented which can improve the storage safety and effectiveness after storage.

[0012] The charcoal used in the present invention can be of any source. Typically the charcoal is derived from wood, but derivations from vegetable matter or from coal, each alone or in combinations of two or more, are also included. The charcoal is conveniently in the form of a briquette, a traditional form for use in cooking or grilling. So-called "lump" charcoal can also be used, but the briquette form is generally preferred for production efficiency.

[0013] The ignitable material contained in the microcapsule is any compound or mixtures of compounds that are normally flammable in the presence of a match flame. Typically the ignitable material comprises at least one hydrocarbon or at least one alcohol, or both, and may further include other compounds such as carboxylic acids, esters, etc. Generally the hydrocarbons contain 5 to 18 carbon atoms and typically are one or more straight, branched, or cyclo- alkanes having 5 to 13 carbon atoms. The alcohols typically have 1 to 13 carbon atoms and 1 to 3 OH groups, more typically 1-8 carbon atoms with one OH group. Carboxylic acids and esters derived from the aforementioned hydrocarbons or alcohols can also be used. Aromatic

compounds can be used or present in the ignitable material but are usually preferred to be omitted for flavor and/or odor reasons. The ignitable material is usually a liquid at room temperature. But in some embodiments a solid can be used as the ignitable material or as a portion thereof. Examples of ignitable material include commercial lighter fluid, mineral spirits including odorless mineral spirits, petroleum distillates, ethanol, propanol, butanol, etc., and combinations thereof.

[0014] The microcapsules are comprised of a relatively thin wall encapsulating a core portion. The microcapsules have a size of less than 200 microns and preferably have a median size or diameter within the range of 1 to 30 microns, more typically 5 to 20 microns. Larger microcapsules may provide greater amounts of ignitable material (per capsule) but may become more prone to accidental rupture during handling or storage. Smaller microcapsules tend to require more wall material for a given amount of ignitable material and thus can raise cost issues. The aspect ratio of the weight of the material encapsulated (the "core") to the weight of the wall material is generally at least 60%; meaning 60% or more core material and 40% or less wall material, respectively. For cost efficiency reasons, higher aspects ratios are usually preferred, such as at least 70% core material, at least 80% core material, and at least 90% core material. Having too little wall material may eventually lead to premature rupture issues. Typically the wall material is at least 2% more typically at least 3%. A common range is that the core material is 80 to 95% of

the weight of the capsule. These values are average values calculated by techniques known in the microcapsule art.

[0015] The microcapsules can be made of any suitable microencapsulating material. The material should be flammable, such as in the presence of a match flame, either per se or in combination with the ignitable material. Common microcapsule materials include polyacrylate, gelatin, melamine-formaldehyde, and polyurethane. Polyacrylate polymers can be especially suitable because they can burn readily and provide combustion products that are essentially the same as those of wood. Also the wide choice of acrylate monomers allows the wall burning properties to be fine-tuned via the glass transition temperature of the chosen monomer and/or monomer blend. For clarity a polymer is considered a polyacrylate if it contains at least 20% acrylate monomers, typically at least 50% acrylate monomers, and often at least 80% acrylate monomers. Gelatin wall-based capsules burn/ignite but can leave more residue than a polyacrylate wall-based capsule. In some applications, noticeable post-burning capsule residue may be undesirable. It is usually desirable for a polymeric wall material to be formed from monomers that are soluble in the ignitable material.

[0016] The microcapsules containing the ignitable material can be made by techniques known in the microencapsulating art. Typically the microcapsules are formed from monomer(s) via in situ polymerization. Specifically emulsion polymerization is a useful technique. In an oil-in-water emulsion, the

polymerization occurs at the interface of the fine droplets of oil phase dispersed in the water or hydrophilic phase. The polymerization results in the oil drops having a polymer wall formed around them. Either the oil phase or the water phase, or both, can contain the monomer(s) and the initiator(s) and/or catalysts. In one embodiment, the dispersed oil phase contains the ignitable material and the monomer(s) dissolved therein. Initiators or catalysts can optionally be present in the oil phase as well. The water phase contains an initiator and optionally additional monomers. The monomers in the oil phase must be dissolved in the oil phase of the ignitable material. This includes, however, heating the oil phase. Thus ignitable material that would normally be solid at room temperature but is made liquid or molten and into which the monomers dissolve can be used. In this way, microcapsules of solid ignitable material can be made; e.g., upon cooling formed microcapsules, the encapsulated ignitable material becomes solid.

[0017] In some embodiments it is preferred to use a divalent acrylate monomer. The divalent acrylate monomer can comprise at least 20%, typically at least 50%, and in some embodiments at least 80% of the polymeric wall material. The divalent acrylate monomer can be used as the only acrylate monomer or part of a mixture of acrylate monomers. Non-acrylate monomers can also be incorporated. Ethylene dimethacrylate is a useful divalent acrylate monomer and is generally soluble in liquid ignitable materials. The techniques and materials taught in US 7,736,695, which is incorporated herein in its

entirety, are suitable for making microcapsules of ignitable material for use in the present invention, provided that an ignitable material is used in the oil phase and the acrylate monomer is soluble in the oil phase, and usually soluble in the ignitable material.

[0018] Once the microcapsules containing ignitable material are formed they may be disposed on the surface of the charcoal in various ways. One convenient method involves coating the charcoal with a slurry comprising a liquid having the microcapsules dispersed therein to form a wet coated charcoal; and drying the wet coated charcoal to form charcoal having the microcapsules disposed on the surface of the charcoal. The coating can cover all surfaces of the charcoal or only a portion such as one major face or one side. Often the formation of the microcapsules results in an aqueous slurry that can be used to coat the charcoal. The slurry can be concentrated if desired before coating. Alternatively, the microcapsules can be recovered from the slurry or other medium in which they were formed and coated onto the charcoal, optionally after being dispersed in a different solvent or coating material. A binder such as a polymer can be present in the slurry/coating medium so that upon drying of the wet coated charcoal, the solvent is removed and microcapsules are dispersed in a binder layer. The recovered microcapsules can also be incorporated into the charcoal such as during formation of a briquette, preferably with a portion of the microcapsules being present at the surface of the charcoal. In an alternative embodiment, such as with charcoals

formed from wet pressing powdered carbonaceous materials or otherwise fashioning the briquettes from particulates, the microcapsule slurry is incorporated or included within the particulate mix that forms the charcoal. The microcapsules containing ignitable material in such embodiment would be within the charcoal or briquette. Such charcoal can have microcapsules disposed on or in the charcoal, or both, resulting in charcoal containing microcapsules with ignitable material. In all embodiments where the microcapsules are contained within the charcoal, a coating of microcapsules containing the same or different ignitable material can be placed on one or more surfaces of the charcoal.

[0019] The microcapsules containing an ignitable material are intended to help the lighting characteristics of charcoal. To this end, the amount of the ignitable material provided varies depending on cost, efficacy desired, and materials selected. In general the microcapsules provide the ignitable material in an amount of 1% to 50%, more typically 2% to 25%, and in some embodiments 3% to 15% based on the weight of the charcoal. Thus for a typical charcoal briquette weighing around 22 grams, the amount of ignitable material is generally in the range of 0.2 grams to 11 grams, more typically 0.4 to 5.5 grams. Higher amounts may not be practical economically and/or from over-flame issues. The use of lower amounts of ignitable material within the above range is generally desirable from a cost perspective. Also, because the ignitable material is microencapsulated, the fear of loss of the ignitable material

during storage by evaporation is diminished, which may facilitate the reliable use of lesser amounts. Accordingly for a typical charcoal briquette (having a weight of around 20 to 25 grams) the microcapsules may provide 0.5 to 7 grams, more typically 0.5 to 3 grams, and in some preferred embodiments 0.5 to 2.5 grams. It is believed that some commercial lighter fluid impregnated charcoal uses 3 grams per briquette. Using less than that amount would be advantageous such as 2.5 grams, 2 grams, 1.5 grams, or even 1 gram.

[0020] The microcapsules disposed on the surface of the charcoal can be, as mentioned above, contained in a binder. Such a binder can be present in the coating slurry and is normally a flammable material. The binder can be hydrophilic or hydrophobic. When hydrophilic, the binder can be present in the aqueous phase of an oil-in-water emulsion polymerization method for forming the microcapsules. Examples of such binders include polyvinyl alcohol.

[0021] In disposing the microcapsules on the surface of the charcoal, a sub-coating can be applied between the charcoal and the microcapsules if desired. Such a sub-coating can be used to improve adhesion of the microcapsules to the charcoal, whether dispersed in a binder or not, and/or to improve flammability.

[0022] Additional ingredients can be added to the microcapsules, the charcoal, and the optional binder-containing layer. For example, the microcapsules may contain further ingredients within the core such as a

colorant or flavor/odor enhancer. Usually, however, it is preferred that only ignitable material and residues from the encapsulation process are within the core. The charcoal may be impregnated with ignitable material and then the microcapsules disposed thereon. When the microcapsules are dispersed in a binder-containing layer, the layer may contain additional additives such as colorants, additional igniter agents, etc. In one embodiment, a colorant is added to the coating slurry so that the charcoal is colored. The charcoal may be coated on only one side but the color will indicate to the user which side to light; e.g., which side contains the microencapsulated ignitable material. In another embodiment, two different coating slurries are formed having different colors and the charcoal is partially coated in each slurry.

[0023] The invention is further illustrated by the following non-limiting example.

Example:
MATERIALS

Oil 1

Commercial charcoal lighter fluid (petroleum distillate)	122.69 g
2,2'-azobis(2,4-dimethylpentanenitrile) (Vazo 52 - DuPont, Wilmington DE)	0.65 g
2,2'-azobis(2- methylbutyronitrile) (Vazo 67 - DuPont, Wilmington, DE)	0.42 g

Oil 2

Commercial charcoal lighter fluid (petroleum distillate)	40.90 g
2-(tert-butylamino) ethyl methacrylate TBAEMA (Sigma-Aldrich, St. Louis, MO)	0.55 g
2-carboxyethyl acrylate (Beta C - Bimax Inc., Glen Rock, PA)	0.42 g
Ethylene dimethacrylate (SR297 - Sartomer Company, Inc ., Exton, PA)	21.42 g

Water Phase

Polyvinyl alcohol (Celvol 540 - Celanese Ltd., Pasadena, TX)	30.51 g
Water	368.70 g
(4,4'-azobis(4- cyanovaleric) acid (Vazo V-501 - Du Pont, Wilmington, DE)	1.27 g
20% NaOH (Hydrite Chemical Co. Brookfield, WI)	1.62 g

PROCESS

Oil 1 Preparation

Components are combined at room temperature and stirred until in solution.

Oil 2 Preparation

Combine all components except SR297 and stir at room temperature. SR297 is added later in the process.

Water Phase preparation

Combine all components and stir at room temperature until solution.

PROCEDURE

[0024] The Vazos are dissolved in Oil 1, and the solution added to a jacketed stainless steel beaker with nitrogen blanket and heated to 35°C while agitating. Once Oil 1 is at 35°C, the solution is then gradually heated to 75°C and thereafter cooled to 55°C. Before Oil 1 reaches 55°C, SR297 is added to the remaining, already combined Oil 2 components. When Oil 1 reaches 55°C, Oil 2 is added to Oil 1. The Water Phase is added and an oil-in-water emulsion is formed by milling at high shear (3500 rpm) until target drop size is achieved.

After emulsification, the high shear blade is replaced with an agitator and mixed so as to keep the emulsion agitated. After the oils have been combined, the emulsion is heated in stages over 13 hours to 75°C, to 90°C being held at 90°C for 8 hours. The nitrogen blanket is turned off, and the coating material slurry allowed to cool to room temperature.

Briquette Coating Process

[0025] A charcoal briquette is held by tongs, and dipped into finished coating material slurry. The charcoal can be immersed or partially dipped to effect partial coating. The briquette is then removed from the slurry, placed on a drying rack, and allowed to dry at room temperature or in a 35°C oven until dry. This process can be repeated if a higher amount of capsule coating is desired.

[0026] Each of the patents mentioned above is incorporated herein by reference. The invention having been described it will be obvious that the same may be varied in many ways and all such modifications are contemplated as being within the scope of the invention as defined by the following claims.

We Claim:

1. A charcoal composition, comprising charcoal and microcapsules disposed on the surface thereof or within the charcoal composition, wherein said microcapsules contain an ignitable material.
2. The charcoal composition according to claim 1, wherein said microcapsules have a median size within the range of 1 to 30 microns.
3. The charcoal composition according to claim 1, wherein said ignitable material comprises at least one hydrocarbon, at least one alcohol, or combinations thereof.
4. The charcoal composition according to claim 3, wherein said ignitable material is a liquid at room temperature.
5. The charcoal composition according to claim 3, wherein said ignitable composition comprises C5 to C13 alkanes.
6. The charcoal according to claim 3, wherein said ignitable material contains a C1-C13 alcohol.
7. The charcoal composition according to claim 1, wherein said microcapsules have a wall comprising a polyacrylate, gelatin, or melamine-formaldehyde.
8. The charcoal composition according to claim 7, wherein said microcapsules have a wall comprising polyacrylate.

9. The charcoal composition according to claim 1, wherein said microcapsules have an aspect ratio of core to wall such that the cores are at least 70% by weight of said microcapsules.

10. The charcoal composition according to claim 9, wherein said cores are 80 to 95% by weight of said microcapsules.

11. The charcoal composition according to claim 1, wherein said microcapsules are contained in a coating layer on said charcoal.

12. The charcoal composition according to claim 11, wherein said coating layer further comprises a binder.

13. The charcoal composition according to claim 1, wherein said microcapsules provide the ignitable material in an amount of 2% to 25% based on the weight of the charcoal.

14. The charcoal composition according to claim 1, wherein said charcoal is in the form of a briquette.

15. The charcoal composition according to claim 14, wherein said microcapsules provide 0.5g to 7g of the ignitable material to the briquette.

16. A process for making a charcoal composition, which comprises:

(a) coating charcoal with a slurry comprising a liquid having microcapsules dispersed therein, said microcapsules containing an ignitable material, to form a wet coated charcoal; and

(b) drying said wet coated charcoal to form charcoal having said microcapsules disposed on the surface thereof.

17. The process according to claim 16, wherein said charcoal is in the form of a briquette.

18. The process according to claim 17, wherein said slurry liquid contains water and polyvinyl alcohol and said drying step removes substantially the water from the wet coated charcoal to form a coating layer of microcapsules dispersed in a polyvinyl alcohol binder.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 2012/038914

A. CLASSIFICATION OF SUBJECT MATTER

C10L 5/44 *(2006.01)*
C10L 5/32 *(2006.01)*
C10L 9/00 *(2006.01)*
C10L 5/14 *(2006.01)*

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)

C10L 5/10, 5/26, 5/30, 9/10, 11/04, 7/04

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

PatSearch, Esp@cenet, RUPAT, EAPATIS, DWPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y A	US 4084939 A (COLGATE-PALMOLIVE COMPANY) 18.04.1978, col. 1, lines 59-68, col. 2, lines 5-17, example II, claims	1, 4, 7, 9-12, 14 16-18 2-3, 5-6, 8, 13, 15
Y	GB 956976 A (DOUGLAS LOUIS BREITHAUPT) 29.04.1964, example 1	16-18
Y	US 2010/0167158 A1 (KURITA WATER INDUSTRIES LTD.) 01.07.2010, abstract	18
A	GB 152968 A (SOLVAY & CIE) 21.05.1969	1-18
A	US 4165968 A (NORMAN B. DUNCAN) 28.08.1979	1-18

☐ Further documents are listed in the continuation of Box C.

☐ See patent family annex.

* Special categories of cited documents:

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"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

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10 July 2012 (10.07.2012)	13 September 2012 (13.09.2012)
Name and mailing address of the ISA/ FIPS Russia, 123995, Moscow, G-59, GSP-5, Berezhkovskaya nab., 30-1 Facsimile No. +7 (499) 243-33-37	Authorized officer E. Vetrova Telephone No. (495)531-64-81

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