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Shetty et al.

(54) **COATED CHARCOAL**

(71) Applicant: **The Clorox Company**, Oakland, CA (US)

(72) Inventors: **Abhishek Shetty**, Pleasanton, CA (US); **Nicole Doan**, San Francisco, CA (US); **Aryn B. Oldham**, Pleasanton, CA (US)

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(57) **ABSTRACT**

Disclosed herein is the use of coatings on charcoal heating materials, such as charcoal briquets, to enhance burn properties. It has been discovered that if one half of a pile of charcoal briquets is dosed with lighter fluid and the other half remains undosed, the entire pile of briquets will light and burn. Thus, the amount of lighter fluid necessary to light a pile of charcoal briquets can be reduced by fifty percent. However, over time (2 to 3 months), the lighter fluid migrates from the dosed briquets to the undosed briquets. Therefore, it has been found that by coating the undosed briquets with a material that prevents the lighter fluid from migrating onto them, solvent migration is reduced and/or eliminated. The coated briquets light a little later than the uncoated briquets resulting in an extension of the cooking phase.

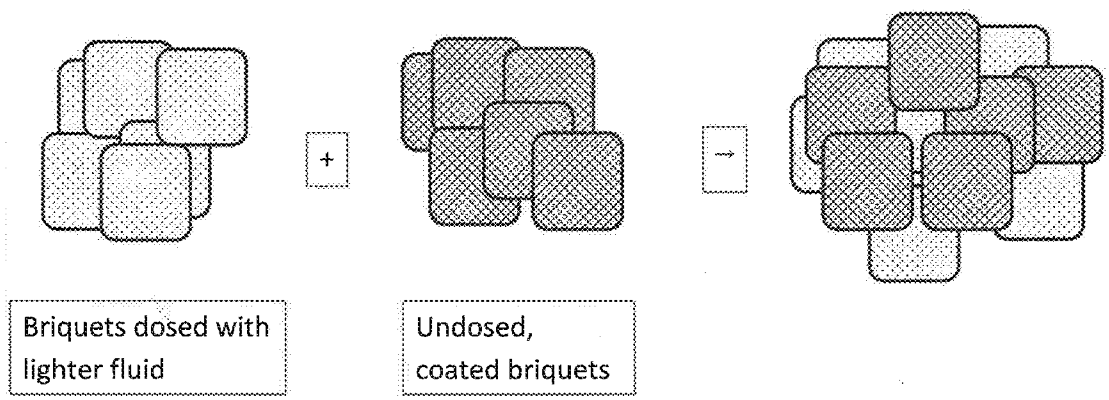


FIGURE 1

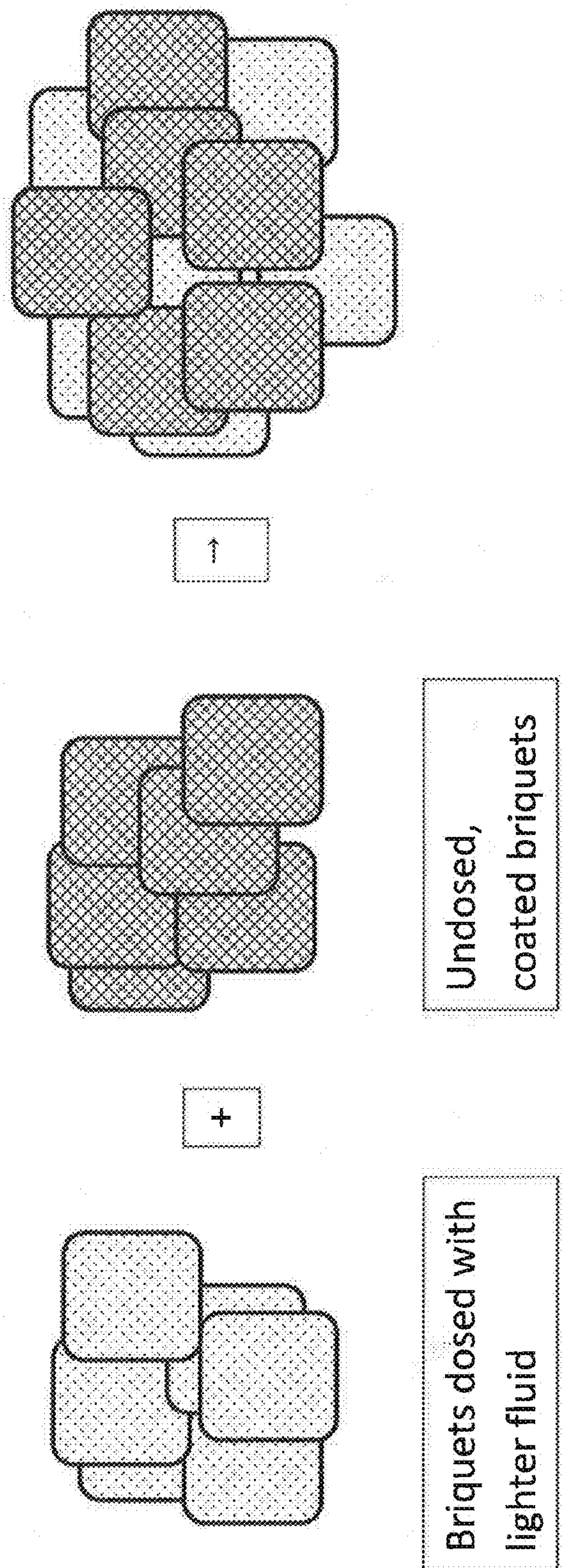
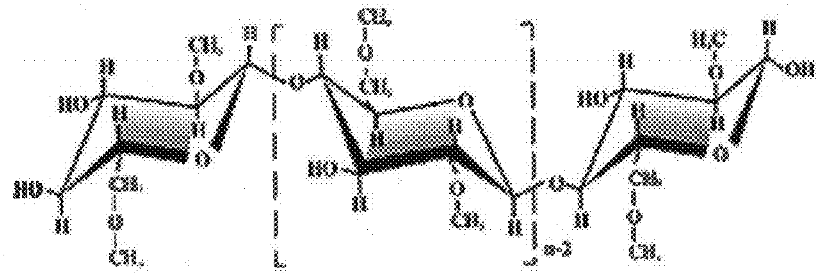
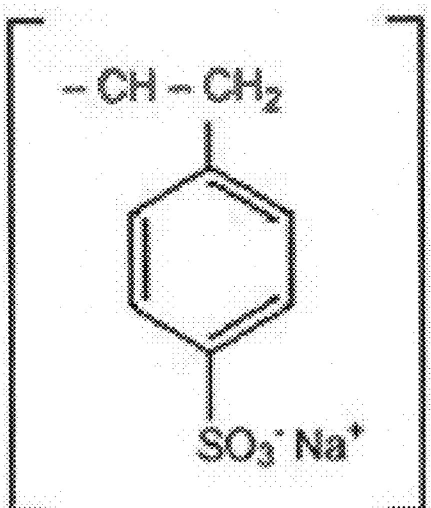

Briquets dosed with lighter fluid
+
Undosed, coated briquets
→

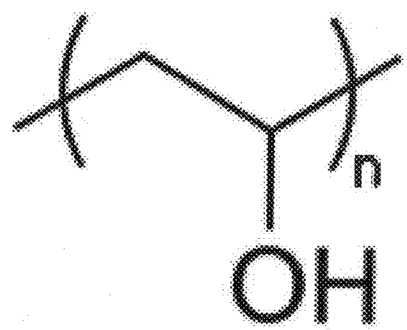
FIGURE 2A



Methocel

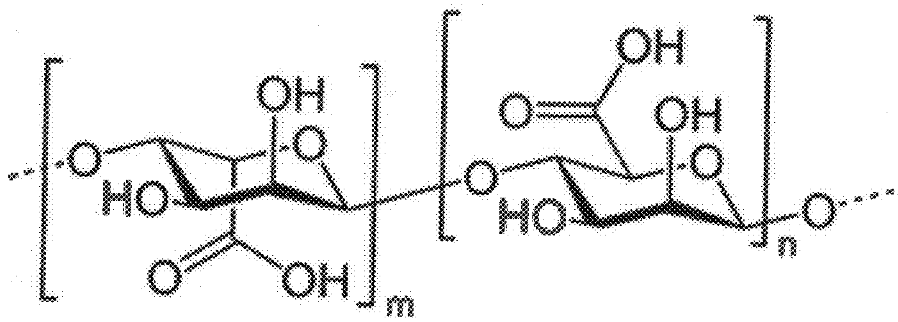


Polystyrene Sulfonate

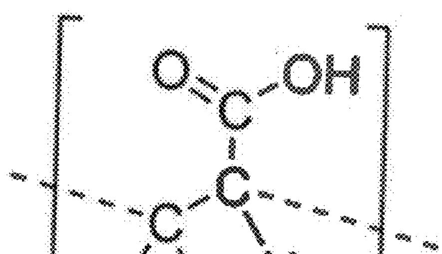


PVOH

FIGURE 2B



Alginate



PAA

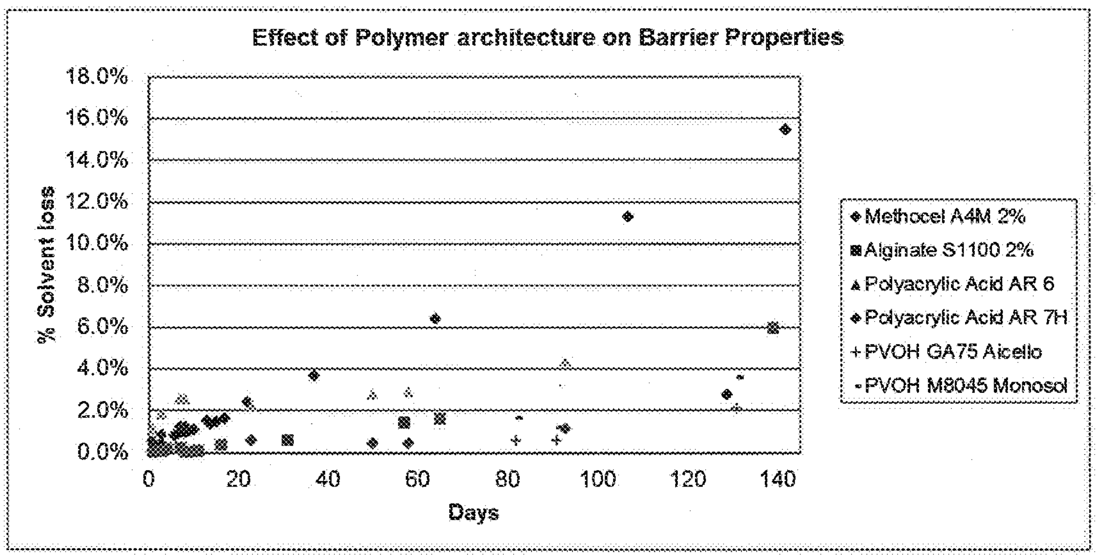

Effect of Polymer architecture on Barrier Properties
18.0%
16.0%
14.0%
12.0%
10.0%
8.0%
6.0%
4.0%
2.0%
0.0%
% Solvent loss
0
20
40
60
80
100
120
140
Days
Methocel A4M 2%
Alginate S1100 2%
Polyacrylic Acid AR 6
Polyacrylic Acid AR 7H
PVOH GA75 Aicello
PVOH M8045 Monosol

FIGURE 3

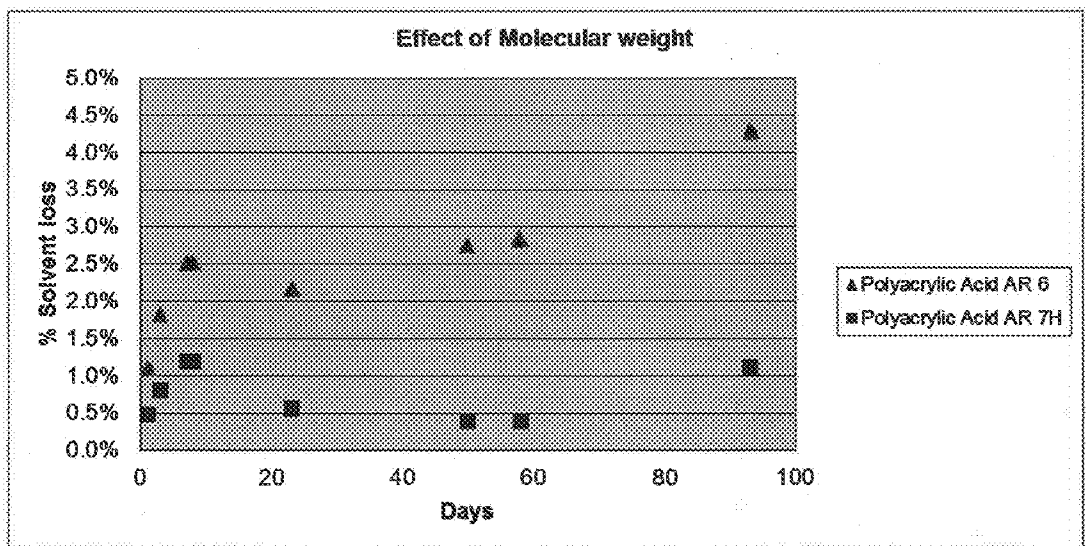

Effect of Molecular weight
5.0%
4.5%
4.0%
3.5%
3.0%
2.5%
2.0%
1.5%
1.0%
0.5%
0.0%
% Solvent loss
0
20
40
60
80
100
Days
Polyacrylic Acid AR 6
Polyacrylic Acid AR 7H

FIGURE 4

FIGURE 5

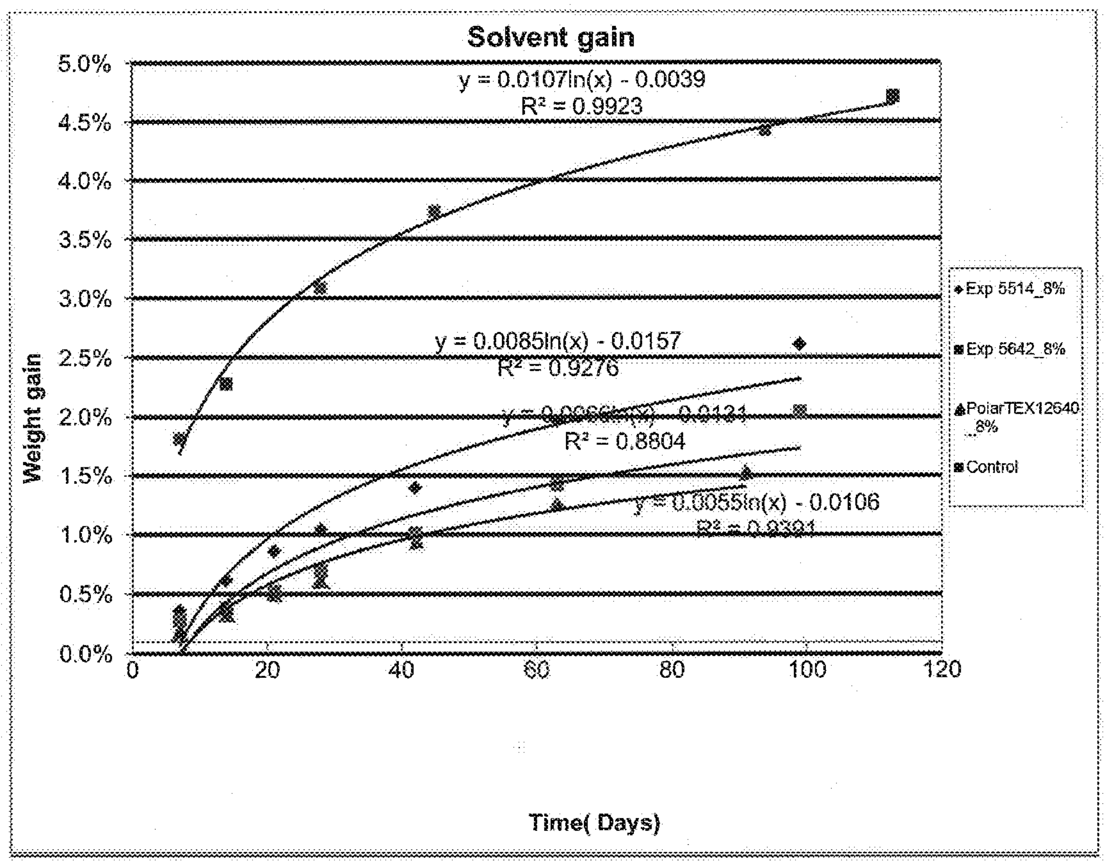
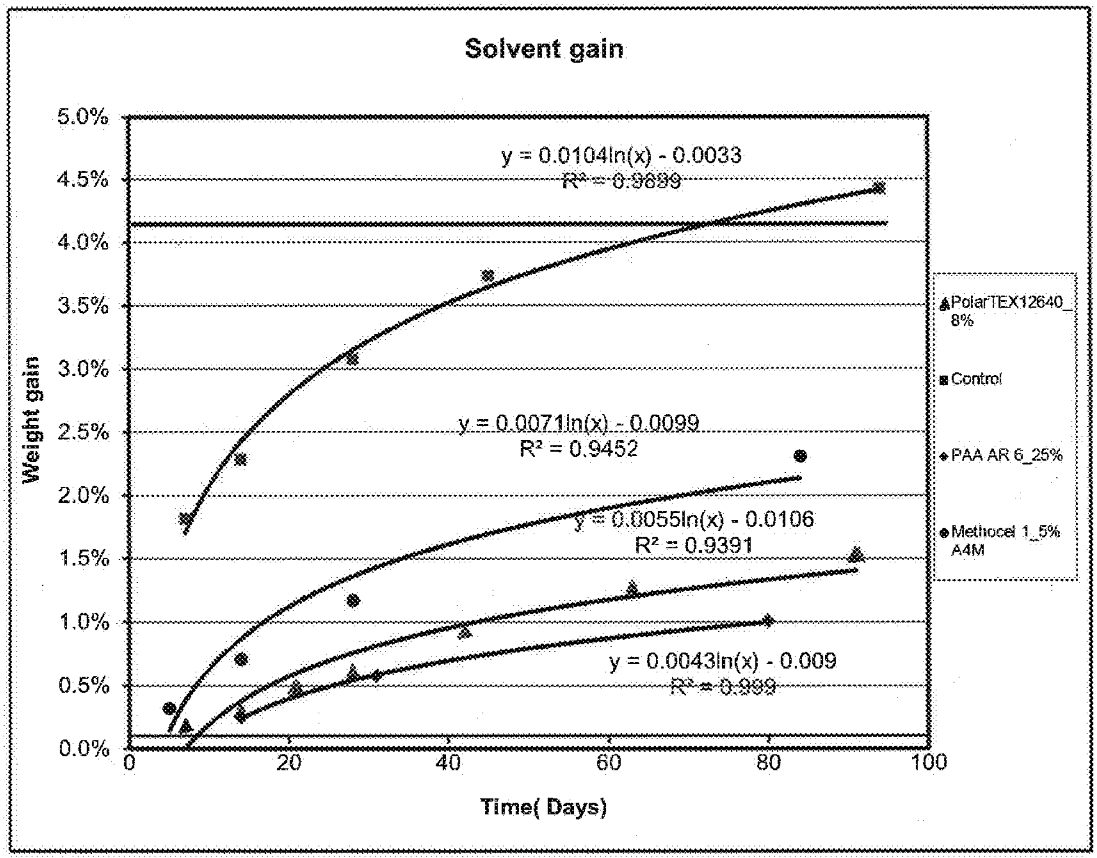

Solvent gain
y = 0.0107ln(x) - 0.0039
R² = 0.9923
y = 0.0085ln(x) - 0.0157
R² = 0.9276
R² = 0.8804
y = 0.0055ln(x) - 0.0106
Weight gain
Time(Days)
5.0%
4.5%
4.0%
3.5%
3.0%
2.5%
2.0%
1.5%
1.0%
0.5%
0.0%
0
20
40
60
80
100
120
Exp 5514_8%
Exp 5642_8%
PolarTEX12640_8%
Control

FIGURE 6


Solvent gain
Weight gain
Time(Days)
5.0%
4.5%
4.0%
3.5%
3.0%
2.5%
2.0%
1.5%
1.0%
0.5%
0.0%
0
20
40
60
80
100
y = 0.0104ln(x) - 0.0033
R² = 0.9899
y = 0.0071ln(x) - 0.0099
R² = 0.9452
y = 0.0055ln(x) - 0.0106
R² = 0.9391
y = 0.0043ln(x) - 0.009
R² = 0.999
PolarTEX12640_8%
Control
PAA AR 6_25%
Methocel 1_5% A4M

COATED CHARCOAL

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation of pending U.S. application Ser. No. 14/326,667, filed Jul. 9, 2014, which is hereby incorporated by reference in its entirety.

THE FIELD OF THE INVENTION

[0002] The present invention relates to charcoal heating/cooking materials. Specifically, the invention relates to coatings that can be applied to charcoal briquets to aid in the combustion of charcoal for subsequent use of the charcoal in cooking (e.g., grilling) or heating.

RELEVANT ART

[0003] Charcoal heating/cooking materials, such as charcoal briquets, are commonly used for cooking food. Foods cooked with charcoal can have a unique flavor and have wide appeal. Conventional charcoal briquets generally provide a relatively slow-burning fuel with a high BTU output.

[0004] Consumers desire cooking and grilling with charcoal briquets that are easily stackable to form the traditional starter pile, easily ignitable, maintain a uniform and efficient combustion that ignites the individual briquets in the starter pile, and have a sufficiently long burn period. Similarly, consumers desire to handle dirty charcoal as little as possible when forming traditional starter piles and the like.

[0005] Charcoal briquets are often configured in a generally pillow-shape. This configuration provides for both reasonable ease of manufacturing by the supplier, and handling by the consumer. Pillow shaped briquets are typically used for cooking on a grill or the like by using a pile of briquets in a mounded or conical configuration or stack formed by pouring briquets from a bag onto a grate below the grill area. Then lighter fluid is often added, and followed by igniting the briquets with an ignition source.

[0006] An "ignition phase" follows, as burning proceeds from the surface of the briquet, and a gray ash is formed on a significant portion of the briquet until a majority of the exposed surfaces have ignited, and burning has progressed inwardly toward the intended area of the briquets. Thus, completion of the ignition phase of burning is identified by the formation of visible ash on the briquet.

[0007] At this point, the briquets are spread out under the grill or the like, and they continue to burn with intense heat suitable for cooking and grilling throughout a "burn phase". For maximum performance of the briquets, it is desirable that the ignition phase be limited in time so that the briquets may be used for cooking or grilling without undue delay, such that the duration of the burn phase is optimized and extended to provide adequate cooking or grilling time as desired by the consumer intended use.

One of the shortcomings of conventional charcoal briquets is that the briquets can be difficult to ignite and may not continue to burn, even after they appear to have been ignited. To address this problem, lighter fluid is sprayed onto the briquets by the user immediately prior to use, or it may be applied during manufacture to provide so called "instant light" briquets. However, the use of lighter fluid can emit volatile organic compounds (VOCs), which could potentially have an effect on air quality. Accordingly, what are needed are charcoal briquets that optimize the ignition and burn phases, yet reduce the amount of lighter fluid necessary.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] The invention will be described and explained with additional specificity and detail through the use of the accompanying drawings in which:

[0009] FIG. **1** shows an illustration of a mixture of coated and uncoated briquets;

[0010] FIGS. **2**A and **2**B shows the chemical structure of various polymer backbones potentially suitable for use as a briquet coating;

[0011] FIG. **3** is a chart illustrating the effect of polymer architecture on the barrier properties of various coatings;

[0012] FIG. **4** is a chart illustrating the effect of molecular weight on the barrier properties of various coatings;

[0013] FIG. **5** is a chart illustrating the effect of starch type, molecular weight and modification on the barrier properties of various starch coating compositions.

[0014] FIG. **6** is a chart illustrating the barrier properties of various non-starch polymer coating compositions.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0015] I. Introduction

[0016] Before describing the present invention in detail, it is to be understood that all publications, patents and patent applications cited herein, whether supra or infra, are hereby incorporated by reference in their entirety to the same extent as if each individual publication, patent or patent application was specifically and individually indicated to be incorporated by reference in their entirety.

[0017] It must be noted that, as used in this specification and the appended claims, the singular forms "a," "an" and "the" include plural referents unless the content clearly dictates otherwise. Thus, for example, reference to an "additive" includes two or more such additives.

[0018] Unless defined otherwise, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which the invention pertains. Unless otherwise stated, amounts listed in percentages ("%'s" are in weight percent.

[0019] Charcoal briquets may comprise traditional charcoal ingredients and/or other additives. For example, the charcoal mixture can include, but is not limited to, wood char, optionally coal, one or more binders, one or more ignition aids, one or more oxidizers, and/or other ingredients. As used herein, the term "wood char" or "char" refers to the hard fibrous substance that makes up the greater part of the stems, branches, and roots of trees or shrubs beneath the bark, which has been subjected to pyrolysis so as to convert the material to at least some extent to carbon. Thus, char is a comprehensive term, and includes retort chars, kiln chars, etc.

[0020] As used herein, the term "coal" refers to a solid combustible substance formed by the partial decomposition of vegetable matter without free access to air, under the influence of moisture, and often increased pressure and temperature. Furthermore, coal can include substances such as the foregoing either before or after partial burning and/or scorching in an oxygen-poor environment (or charring) such as might be carried out to remove undesirable components. One will appreciate, therefore, that coal can include lignite and lignite char, anthracite, semi-anthracite, bitumen, mineral carbons, and mixtures of any of the foregoing, as well as any partially burned or scorched portions thereof, etc.

[0021] The term "binder," as used herein, refers to materials that possess adhesive qualities that produce or promote the holding together of loosely aggregated components. Binders can include, but are not limited to, starch made from corn, milo, wheat, or other complex carbohydrates. The term "ignition aid," as used herein, refers to materials that are useful in the act or process of initiating combustion of a fuel or other component, such as a briquet. Thus, ignition aids can include, but are not limited to, sawdust, fines resulting from char production, other particulate cellulosic matter, solvents, aliphatic and petroleum hydrocarbons, and mixtures and blends thereof. As used herein, the term "oxidizer" refers to any material or component which can effectively increase the supply of oxygen to combustible ingredients, such as nitrates.

[0022] "Other ingredients" as used herein refers to additional components which may be desirable to include in a briquet. Such as, for instance, components to enhance appearance or aesthetic qualities. Examples of such components include fillers, ash whiteness enhancers (e.g., limestone), processing aids (e.g., Borax), flavoring agents (e.g., mesquite) as well as combinations of any of the foregoing.

[0023] As used herein the term "lighter fluid" means a petroleum based solvent such as Kingsford® Lighter Fluid and when used in the context of dosing a briquet is synonymous with the term "solvent". Kingsford® Lighter Fluid is a colorless liquid that comprises aliphatic petroleum solvent. The term aliphatic petroleum solvent as used herein means a blend of 6-20 carbon chain length molecules, which may include straight chains, branched chains and rings that contain a very low level of aromatic compounds.

[0024] As used herein the term "impermeable to lighter fluid" means a material that when exposed to lighter fluid does not absorb the lighter fluid. For example, if a briquet dosed with lighter fluid was placed next to a briquet coated with a material impermeable to lighter fluid, the result would be that the lighter fluid from the dosed briquet would not be transferred (except perhaps in negligible quantities) from the dosed briquet to the coated briquet.

[0025] As used herein the term "substantially free of" means virtually free of, containing only negligible quantities of, etc.

[0026] The present invention is directed to coatings for charcoal briquets and the advantages thereof. Coating the surface of a select number of briquets in a bag of briquets impregnated with lighter fluid provides a barrier to solvent exchange between coated and uncoated briquets.

[0027] Charcoal fuel, for consumer use, is conventionally available in the form of pillow-shaped briquets. These briquets are formed in a molding operation which leaves the briquets in the shape of a pillow, and yields a molded briquet surface which is relatively smooth.

[0028] Conventional charcoal briquets are typically used in charcoal cookers which are made specifically for that purpose. A standard charcoal cooker is a bowl shaped metal container approximately 18 to 22 inches in diameter having a fairly tight fitting bowl shaped lid, such that the closed cooker, in the use configuration, appears as more or less of a sphere. The lower receptacle portion of the cooker has a plurality of holes near its bottom to provide for incoming combustion air. Inside the receptacle, and above the holes, is a combustion grate, for holding charcoal fuel. Above the combustion grate is the cooking grate, at approximately the top of the receptacle portion of the cooker for holding food. Both the combustion grate and the cooking grate are removable. The lid portion of the cooker has a plurality of holes for venting hot gases from the cooker, with closure means for partially or totally closing the vent holes. Standard charcoal cookers were employed to record the burn characteristics of the briquets described herein.

[0029] It is well known that in order to ignite charcoal in a standard charcoal cooker a substantial amount of heat must be applied to the charcoal; substantially more heat than is generated by a match. Typically charcoal is ignited by the use of an electric starter or by the application of a lighter fluid. The use of lighter fluid is the most common means of igniting conventional charcoal. The typical recommended amount of material for use is the combination of 4 lbs. of charcoal briquets and 4 ounces of lighter fluid.

[0030] Alternatively, "instant light briquets" (charcoal impregnated with lighter fluid at the time of manufacture which does not require the use of additional lighter fluid) can be used. The use of instant light briquets does present some challenges. Since the lighter fluid is flammable and vaporizable, the packaging must be substantially vapor impermeable in order to contain the impregnated fluid. Additionally, since the lighter fluid is uniformly impregnated into the briquets, it may not completely burn off before the burn phase starts and therefore, may be present for a portion of the cooking.

[0031] In practice, a random stack of instant light briquets is poured on the combustion grate and ignited with a match. The match ignition ignites the lighter fluid in and on the briquets. The lighter fluid burns with a substantially yellow flame. As it burns, the heat from its burning raises the temperature of the charcoal briquets. This is the "ignition phase". As the temperature of the charcoal rises, the charcoal itself is ignited and burns, substantially without flame, but with a radiant glow accompanied with a surface covering of ash, which appears shortly after the ignition of the charcoal. By the time the lighter fluid has been consumed, the charcoal should be fully capable of sustaining combustion.

[0032] As used herein, the term "ashed-over" refers to the circumstance when approximately 70% of the briquet surfaces have turned grey and the briquets are ready to be spread for cooking. As used herein, the terms "cook time" or "cooking phase" are synonymous and refer to the period of time the cooking surface heated by the briquets remains above 380° F. A long cooking phase is desirable.

[0033] Additionally, it is highly desirable that the briquets become self-sustaining before the lighter fluid is completely consumed in the ignition phase, to ensure continuity of ignition. If the lighter fluid is all consumed before self-sustaining burning is achieved, the ignition sequence falters and a sustained burn is not achieved. With conventional instant light charcoal briquets, a generous amount of lighter fluid is impregnated into each briquet in order to alleviate any difficulty in consistently achieving a self-sustaining burning of charcoal with every ignition.

[0034] Once the charcoal briquets have been adequately ignited and ashed-over to provide heat adequate for cooking food, the stack of briquets is typically spread out to generally cover the combustion grate for the cooking process. Another problem with conventional instant light charcoal briquets is that a larger amount of charcoal than is needed for the cooking phase is typically used in order to ensure a successful ignition. In addition to being wasteful of the charcoal, the heat output from this larger amount may be so great as to burn the food.

[0035] The present inventors have surprisingly found that if one half of a pile of charcoal briquets were dosed with lighter fluid and the other half undosed, the entire pile of briquets will light and burn because the dosed briquets will light the undosed briquets, thus reducing the amount of lighter fluid necessary by fifty percent. However, over time (2 to 3 months), the solvent will migrate from the dosed briquets to the undosed briquets. For example, if fifty percent (50%) of a package of briquets were dosed at 14% by weight lighter fluid and packaged with the remaining fifty percent undosed briquets, the solvent will migrate from the dosed briquets to the undosed briquets and equilibrate in a relatively short period of time. The result is that all of the briquets in the package contain 7% lighter fluid and do not light.

[0036] Embodiments of the present invention alleviate the drawbacks of conventional instant light briquets by addressing the problem of solvent migration and still allowing for approximately a fifty percent reduction in lighter fluid dosing per bag as compared to the amount of lighter fluid dosing in a standard bag of conventional instant light briquets.

[0037] The inventors have found that by dosing with lighter fluid only a fraction of the total briquets in an instant light briquet product and coating the remaining portion, solvent migration is reduced and/or eliminated, thus reducing the total level of solvent dosing necessary. An added benefit is that the coated briquets light a little later than the uncoated briquets resulting in an extension of the cooking phase. A staged lighting process is followed where the solvent dosed briquets are lit first to start the ignition of the pile. Soon after, heat is transferred from the lit briquets to the coated, undosed briquets which then start burning and linger the combustion process. FIG. **1** illustrates a random pile containing both coated and uncoated briquets.

[0038] Various coatings were investigated. Briquets were prepared with various coatings and evaluated via a dip test method in order to determine whether the coatings prevented solvent absorption. The less solvent absorbed, the better the coating. The dip test comprised dipping a coated briquet into solvent for 8 seconds and allowing it to dry for one minute. Initial and final weights were measured and a percent solvent absorbed was calculated. The inventors identified several coatings as meeting the initial threshold criteria of less than 8% solvent absorbed and more preferably less than 2% solvent absorbed. Table 1 shows the results of the dip testing.

TABLE 1

Sample	Initial Wt. (g)	Final Wt. (g)	% Absorbed	Comments
CORN SYRUP				
Control 1	180.6	211.96	14.8	
Corn Syrup	194	216.5	10.4	
Corn Syrup + Guar Gum	194.4	218.6	11.1	
Corn Syrup + Xanthan Gum	206.4	218.9	5.7	
Control 2 Rep. 1	185.9	217.7	14.6	
Control 2 Rep. 2	188.6	216.8	13	
Corn Syrup Rep. 1	204.5	224.8	9.1	
Corn Syrup Rep. 2	204.4	224.9	9.1	
0.5% CMC w/ Corn Syrup Rep. 1	207.7	225.2	7.8	Very sticky, pooling in grooves of briquet
0.5% CMC w/ Corn Syrup Rep. 2	209.3	223.7	6.5	Very sticky, pooling in grooves of briquet
1% CMC w/ Corn Syrup Rep. 1	207.5	219.6	5.3	Very sticky, pooling in grooves of briquet
1% CMC w/ Corn Syrup Rep. 2	216.5	227.9	5	Very sticky, pooling in grooves of briquet
CMC, SODIUM ALGINATE (SA)				
Control	188.6	216.8	13	
5% CMC in water	185.6	215.1	13.7	Thin film formed under briquet after drying
1.5% SA in water + 5% $CaCl_2$ water solution	188.9	201	16	Gelled before drying, flakes off briquet after drying
1.5% SA in water + 5% $CaCl_2$ water solution + 16% Glycerine	185.5	188.7	1.7	Prevented gelling before drying
1.5% SA in water + 5% $CaCl_2$ water solution + 32% Glycerine	197.6	200.9	1.7	
2% SA in water + 15% Glycerine (No $CaCl_2$)	188.5	193.3	2.5	No bubble seen during dip test
2% SA in water + 5% $CaCl_2$ water solution + 15% Corn Syrup	190.4	194.4	2	
2% SA in water + 16% Corn Syrup dipped	183.8	195.1	5.8	Bubbles appeared - coating might have holes
2% SA in water + 16% Corn Syrup brushed	184.9	196.4	5.9	Bubbles appeared - coating might have holes

TABLE 1-continued

Sample	Initial Wt. (g)	Final Wt. (g)	% Absorbed	Comments
2% SA in water + 8% Corn Syrup brushed	183.6	193.6	5.2	Bubbles appeared - coating might have holes
5.8% Ticalose CMC in water	184.4	199.6	7.6	
PVP				
7.7% PVP	186.1	213.8	13	
12.8% PVP	190.5	207.3	8.1	
METHOCEL				
2% Methocel	183	191.3	4.3	
STARCH/GUAR/XANTHAN GUM				
15% Glycerine with +/−4.3% Starch Rep. 1	185.3	210.18	11.8	
15% Glycerine with +/−4.3% Starch Rep. 2	181.5	207.6	12.6	
5% Famal GMS 2142 Starch	186.4	194.8	4.3	
2.6% Guar Gum (Tixoc FCC Powder)	183.8	192.9	4.7	
10% Kingsford Starch	181.3	215.5	15.9	
2.3% Guar Gum	188.8	196.2	3.8	
1.4% Guar Gum	185.2	191	3	
1.25% Litter Guar with 9% Glycerine	185.8	195.3	4.8	
2% Xanthum Gum	184.7	212.6	13.1	
WAXES				
1.8% Alginate, 14.5% Glycerine, 10% Michem Emulsion 70750	188	194.3	3.2	
Michem Emulsion 70750	192.2	222	13.4	
Michem Guard 55	190.5	225.9	15.7	
Michem Prime 4983R	189.7	210.2	9.8	
Michem Emulsion 00240	186.7	209.7	11	

[0039] Coatings that met the threshold criteria were identified as good candidates for further testing. Briquets with these coatings were prepared and combined with dosed briquets and packaged in a standard nylon-lined instant light briquet bag. The bagged briquets were stored in a constant temperature (70° F.) relative humidity (50%) room for 1 week, 2 week and 1 month periods of time. The briquets were then burned and burn parameters measured.

TABLE 2

SODIUM ALGINATE (SA)/CORN SYRUP - 1 WEEK*							
Coating	Dosed	VA10	VA20	TT70VA	TT380	TO380	PCT
Control (11.5% solvent; 100% dosed)		100	100	1.6	14	21	539
2% SA in water + 16% Glycerine in water with 5% $CaCl_2$ Bath	50 Dosed at 14%: 50% Undosed and Coated	17	67	21	16	35	537
2% SA in water + 16% Glycerine in water with 5% $CaCl_2$ Bath	50 Dosed at 14%: 50% Undosed and Coated	19	54	25	14	35	496
2% SA in water + 16% Glycerine in water with 5% $CaCl_2$ Bath	50 Dosed at 18%: 50% Undosed and Coated	33	70	20	13	40	503

*VA10—visual ash after 10 min.;
VA20—visual ash after 20 min.;
TT70VA—time to 70% visual ash (min.);
TT380—time to 380° F. (min.);
TO380—time over 380° F. (min);
PCT—Peak Cooking Temperature

TABLE 3

SODIUM ALGINATE (SA)/GLYCERINE						
Coating	Dosed	EOI	TT70VA	TT380	TO380	PCT
Control (11.5% sovent; 100% dosed)		79	9	8	29	553
2% SA in water + 16% Glycerine in water with 5% $CaCl_2$ Bath	50 Dosed at 14%: 50% Undosed and Coated	48	14	11	32	505
2% SA in water + 16% Glycerine in water with 5% $CaCl_2$ Bath	50 Dosed at 14%: 50% Undosed and Coated	43	16	10	36	554

TABLE 3-continued

SODIUM ALGINATE (SA)/GLYCERINE						
Coating	Dosed	EOI	TT70VA	TT380	TO380	PCT
2% SA in water + 16% Glycerine in water with 5% $CaCl_2$ Bath	50 Dosed at 18%: 50% Undosed and Coated	55	12	10	28	515

* EOI—ease of ignition (% visual ash after 10 min.);
TT70VA—time to 70% visual ash (min.);
TT380—time to 380° F. (min.);
TO380—time over 380° F. (min.);
PCT—Peak Cooking Temperature

TABLE 4

METHOCEL and STARCH COATINGS - 1 WEEK*							
Coating	Dosed	VA10	VA20	TT70VA	TT380	TO380	PCT
Control (11.5% sovent; 100% dosed)		87	100	8	9	21	520
1.7% Methocel, 15% Glycerine in water	50 Dosed at 14%: 50% Undosed and Coated	58	989	11	10	31	525
1.7% Methocel, 15% Glycerine in water	60 Dosed at 12%: 40% Undosed and Coated	57	99	11	11	36	569
1.7% Methocel, 15% Glycerine in water	60 Dosed at 14%: 40% Undosed and Coated	24	99	13	10	31	553
1.7% Methocel, 15% Glycerine in water	70 Dosed at 12%: 30% Undosed and Coated	71	100	10	10	27	576
1.7% Methocel, 15% Glycerine in water	70 Dosed at 14%: 30% Undosed and Coated	87	100	9	11	12	451
5% Starch in water	50 Dosed at 12%: 50% Undosed and Coated	38	95	14	11	29	541
5% Starch in water	50 Dosed at 14%: 50% Undosed and Coated	52	97	12	11	31	537

*VA10—visual ash after 10 min.;
VA20—visual ash after 20 min.;
TT70VA—time to 70% visual ash (min.);
TT380—time to 380° F. (min.);
TO380—time over 380° F. (min);
PCT—Peak Cooking Temperature

[0040] Embodiments of the preferred briquet coatings typically comprise both a coating agent and a thickener. Exemplary coating agents include corn syrup, glycerin, other polyols, starch and mixtures thereof. Exemplary thickeners include methocel, sodium alginate, guar gum, xanthan gum, agar, carrageenans, chitosan, pectin, cellulose derivatives, modified food starches, gum tragarcanth, locust bean gum, gellan gum, gum Arabic, and cellulosic gums and mixtures thereof. For example, sodium alginate/corn syrup, sodium alginate/glycerin, and methocel/glycerin and starch are combinations that performed well as shown in the Tables above.

[0041] The effect of the coating on the overall mixture of coated and uncoated briquets can be varied by changing the proportion of coated briquets in the mix: mixtures of mostly uncoated briquets behave like uncoated briquets; mixtures in a 1:1 ratio of coated to uncoated briquets exhibit properties midway between the properties of coated and uncoated briquets. Depending on the level of briquet dosing, embodiments of the present invention may contain ratios of dosed charcoal briquets to coated charcoal briquets ranging from 1:1 to 9:1.

[0042] Additionally, there appears to be a balance between the amount of solvent loaded onto the dosed briquets and the burn properties associated with the resulting mixture of dosed and undosed briquets. To illustrate this, sodium alginate/glycerine coated briquets were prepared and dosed at an 18% level by weight and a 14% level by weight. Each were combined in a 1:1 ratio with undosed briquets and burned. The 18% solvent dosed briquets burned very quickly and burned off the coating quickly, which decreased the time over 380° F. compared to the 14% solvent dosed briquets mixture.

[0043] The solvent level on the dosed briquets needs to be above a minimum threshold, about 10% solvent by weight, in order to light. Solvent levels on the dosed briquets can be increased up to 18% as the percent of dosed briquets (i.e., ratio of dosed uncoated briquets to undosed coated briquets) in the mix is reduced. The lighting behavior of the mixed pile is different from the behavior of the uniformly dosed pile, but lighting can still be achieved with a lower level of solvent overall, resulting in solvent savings.

[0044] In another embodiment, the surface of the briquets could be partially covered with a coating and the uncoated portion could be dosed with solvent, to achieve an effect similar to coating the complete surface of a portion of the briquets. In this application the coating needs to remain active and coherent through the full ignition of the briquets.

[0045] Importantly, the inventors have found that the use of coatings can alter the VOC emission levels during the combustion of the briquets. Coatings could also be employed to add flavor or smoke aromas to the briquets. Important properties of the coatings include the imperviousness of the coatings and their resistance to abrasion and damage due to handling. Coating compositions that include additives or thickeners that improve their ruggedness are desirable.

Polymer Coatings

[0046] Various polymer-based coatings (aka polymer films) were investigated. Experiments were developed to investigate the effect of the nature of the polymer such as, molecular weight, architecture, filler concentration, cross link density, etc., as well as the area and thickness of the polymer films to try and discover what properties result in a good barrier to solvent penetration.

[0047] A barrier test method was developed and a new parameter called a Solvent Transport Factor (STF) was created to rank and screen different coating formulations for barrier properties. The rate of vapor loss is measured by using a polymer film of known surface area and a sealed diffusion cell. The sealed diffusion cell is a cylindrical screw cap septum vial, which has a cap with an opening. Approximately 1 ml of solvent is pipetted into the bottom of the cylindrical vial to provide a saturated headspace of vapor and the polymer film under study is affixed to the top of the vial by screwing the cap on the vial and sealing the side of the vial with Teflon tape to minimize loss of solvent through evaporation and weight loss is measured as a function of time.

[0048] Loss of solvent through various polymer films were studied as a function of time and different films were ranked according to their STF. Loss of solvent through an empty film was also studied as a reference. STF is defined as follows:

$$STF = \frac{(\text{Loss of solvent through barrier film})}{(\text{Loss of solvent through an empty cell})}$$

measured by dividing the slope of the diffusion curve with a film barrier by the slope of the diffusion curve without a film barrier.

Molecular Weight

[0049] Higher molecular weight polymers were found to provide a better barrier. Two different molecular weight Polyacrylic acids (PAA) were used for testing. PAA, AR6 which is about 500K g/mole and PAA, AR7H which is about 1.2M g/mole were compared. As shown in FIG. **2**, the PAA AR6 had a higher STF than the PAA AR 7H indicating that more number of repeat units in the polymer backbone is important.

Polymer Backbone

[0050] STF was measured for polymers having different backbone architecture including, Methocel, Polyacrylic acid, Alginates, Polystyrene sulfonate, and Polyvinyl alcohol. The backbone structures are shown in FIG. **3**. As shown in Table 5, barrier properties improved with decreasing hydrophobicity in the polymer. Table 5 shows the polymers ordered from lowest hydrophobicity to highest and their respective STF. Polyacrylic acid, Methocel and Polyvinyl alcohol had very good barrier properties with STF's less than 0.05. Based on these results, briquets coated with PAA and Methocel were prepared and tested.

TABLE 5

Polymer	STF
Polyacrylic Acid (AR 7H~1M	0.00436
Poly-Vinyl Alcohol-Aicello	0.00456
Polyacrylic Acid (AR6~0.5M)	0.00873
Poly-Vinyl Alcohol-Monosol	0.01309
Alginate (S1100)	0.01745
Methylcellulose (A4M~2M)	0.04799
Sulfonated Poly Styrene	0.1396

[0051] STF values could not be obtained for certain polymers using the barrier test method developed above because certain polymers, such as starch, cannot be cast on a glass surface, thus no initial screening step was conducted for these coatings.

Migration Studies

[0052] A jar test was developed evaluate a coating's ability to block solvent from entering a briquet. The jar test was conducted as follows: a 1:1 ratio of dosed, uncoated briquets with solvent loading of 14% to undosed, coated briquets was used in a tightly sealed jar and put in a constant temperature room (70° F., 50% relative humidity). The total number of briquets in each jar was 24; 12 were dosed with 14% solvent and uncoated and the other 12 were undosed and coated. The polymers which were tested via this method were different starches along with PAA and Methocel. Weight gain of the coated briquets was measured as a function of time. A control with no coating was also used for comparison. The amount of solvent gained by coated briquets was monitored via weight gain for 100 days. The solvent gain for t=1 year was predicted by modeling the weight gain curves generated from the 100 day moniting and compared with the control.

[0053] The effect of starch type, molecular weight and modification were examined as shown in Table 6 below. As shown in FIG. **4**, Polar Tex 12640, which is a high molecular weight, crosslinked waxy maize type starch, performed better than any other starch tested.

TABLE 6

Starch Sample	Starch Type	Mol. Wt.	Modification
EXP 5370	waxy maize	Moderate	Nonionic
EXP 5371	Tapioca	Moderate	nonionic
EXP 5649	waxy maize	Low	nonionic
EXP 5420	waxy maize	Moderate	hydrophobic
EXP 5514	waxy maize	High	crosslinked
EXP 5642	Maize	High	none
Polar Tex 12640	waxy maize	High	Cross-linked

[0054] As shown in FIG. **5**, non-starch coatings Methocel and PAA also performed well using the jar test. Table 7 shows the weight gain values obtained from modeling the Control and the best performing coatings, Polyacrylic acid-AR6 (obtained from Akzo Nobel), Polar Tex 12640 (obtained from Cargill) and Methocel, A4M (obtained from Dow).

TABLE 7

Polymer	Predicted Solvent Gain (time = 1 year)
Control	7%
Polar Tex 12640	2.18%
Polyacrylic Acid AR6	1.64%
Methocel	4.19%

[0055] Equilibration studies and burn tests were conducted with briquets coated with the Polyacrylic acid-AR6-Akzo Nobel, Polar Tex 12640-Cargill and Methocel, A4M-Dow. Coating effects on the overall mixture of coated and uncoated briquets can be varied by changing the proportion of coated briquets in the mix. First a 1:1 ratio was examined at two solvent loadings (12% and 14%). Second a 7:3 ratio was examined at two different solvent loadings (12% and 14%). For each experiment a total of 42 briquets (at the various ratios and solvent loadings) were placed in a bag and were kept in a constant temperature room (70° F., 50% relative humidity), allowed to equilibrate for one week, and then burnt. During burning, the following parameters were measured: the percent of visual ash at 10 minutes also referred to as the ease of ignition (EOI); the time until the briquets exhibited about 70% visual ash (TT70VA); the time it took for the cooking surface to reach 380° F. (TT380); the time the cooking surface remained over 380° F. (T0380); the peak cooking temperature (PCT) which is the highest cooking temperature attained, and the percent weight gain in 1 week.

[0056] The burn testing results of the four experiments are shown in Table 8. Both the Polar Tex 12640-Cargill and Methocel, A4M-Dow based coatings burnt completely with no odor issues etc. The Polyacrylic acid-AR6-Akzo Nobel coating failed to burn completely. As shown in Table 8 surface coating impacts burn performance and extends cook times by 15-20%. It was additionally observed that the coatings produced aesthetically pleasing, shiny briquets.

TABLE 8

Polymer	% Dosed:% Coated	Dosing	EOI (%)	TT70VA (min.)	TT380 (min.)	TO380 (min.)	PCT (Deg. F.)	% wt. gain (1 week)
Methocel	50:50	12	35	15	13	32	578	0.32
Methocel	50:50	14	65	11	11	27	511	0.43
Methocel	70:30	12	58	11	13	25	504	0.39
Methocel	70:30	14	70	10	10	25	500	0.5
Starch	50:50	12	36	17	13	29	499	0.27
Starch	50:50	14	50	13	12	26	481	0.29
Starch	70:30	12	67	11	10	27	503	0.29
Starch	70:30	14	70	10	10	25	506	0.34
Control	100:00	12	71	10	10	25	523	N/A

* EOI %—ease of ignition measured as the percent of visual ash at 10 minutes;
TT70VA—time to 70% visual ash (min.);
TT380—time to 380° F. (min);
TO380—time over 380° F. (min.);
PCT—Peak Cooking Temperature

[0057] While the present invention has been described with reference to what are presently considered to be the preferred embodiments, it is to be understood that the invention is not limited to these embodiments. To the contrary, the invention is intended to cover various modifications and equivalent arrangements included within the spirit and scope of the appended claims.

1. A combination of charcoal heating materials comprising:

a plurality of dosed charcoal heating materials dosed with between about 12% to about 18% lighter fluid; and

a plurality of coated charcoal heating materials substantially free of lighter fluid having a coating that substantially prevents the transfer of lighter fluid from the dosed charcoal heating materials to the coated charcoal heating materials; and

wherein the ratio of dosed charcoal heating materials to coated charcoal heating materials is between 1:1 and 9:1.

2. The combination of charcoal heating materials recited in claim **1**, wherein the dosed charcoal heating materials and the coated charcoal heating materials are in the form of charcoal briquets, lump charcoal or mixtures thereof.

3. The combination of charcoal heating materials recited in claim **1**, wherein the coating comprises a coating agent, a thickener or mixtures thereof.

4. The combination of charcoal heating materials recited in claim **3**, wherein the coating agent is selected from the group consisting of corn syrup, glycerin, non-glycerin polyols, starch and mixtures thereof.

5. The combination of charcoal heating materials recited in claim **3**, wherein the thickener is selected from the group consisting of methocel, sodium alginate, guar gum, xanthan gum, agar, carrageenans, chitosan, pectin, cellulose derivatives, modified food starches, gum tragarcanth, locust bean gum, gellan gum, gum Arabic, and cellulosic gums and mixtures thereof.

6. The combination of charcoal heating materials recited in claim **3**, wherein the coating comprises from 0% to about 32% by weight of coating agent and from about 0% to about 5% by weight of thickener.

7. The combination of charcoal heating materials recited in claim **1**, wherein the ratio of dosed charcoal heating material to coated charcoal heating material is between about 1:3 to about 3:1.

8. The combination of charcoal heating materials recited in claim **1**, wherein the coating is a polymer.

9. The combination of charcoal heating materials recited in claim **8**, wherein the coating has a Solvent Transport Factor (STF) of between 0 and 0.05.

10. The combination of charcoal heating materials recited in claim **8**, wherein the polymer has a molecular weight of at least 500,000 g/mole.

11. The combination of charcoal heating materials recited in claim **8**, wherein the polymer is selected from the group consisting of starches, celluslosics, gums and acrylics.

10. The combination of charcoal heating materials recited in claim **8**, wherein the polymer is hydrophilic.

11. The combination of charcoal heating materials recited in claim **10**, wherein the polymer is a starch selected from the group consisting of maize, tapioca, and waxy maize.

12. The combination of charcoal heating materials recited in claim **11**, wherein the starch is a high molecular weight, cross-linked, waxy maize type starch.

13. The combination of charcoal heating materials recited in claim **1**, wherein the coating is Methocel.

14. The combination of charcoal heating materials recited in claim **1**, wherein the cook time is increased as compared to a traditional pile of briquets.

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