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(54) **Process for the beneficiation of carbonaceous matter employing high shear conditioning.**

(57) A process for the production of beneficiated coal and coal slurries having low ash, and sulfur involving admixing coal in an aqueous medium, under high shear agitation, with a polymerizable monomer, and a liquid organic carrier thereby rendering said coal highly hydrophobic and oleophilic.

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PROCESS FOR THE BENEFICIATION OF CARBONACEOUS MATTER EMPLOYING HIGH SHEAR CONDITIONING

This invention relates to the beneficiation of coal and more particularly to an improved process for the beneficiation of coal.

Known resources of coal and other solid carbonaceous fuel materials in the world are far greater than the known resources of petroleum and natural gas combined. Despite this enormous abundance of coal and related solid carbonaceous materials, reliance on these resources, particularly coal, as primary sources of energy, has been for the most part discouraged. The availability of cheaper, cleaner burning, more easily retrievable and transportable fuels, such as petroleum and natural gas, has in the past, cast coal to a largely supporting role in the energy field.

Current world events, however, have forced a new awareness of global energy requirements and of the availability of those resources which will adequately meet these needs. The realization that reserves of petroleum and natural gas are being rapidly depleted in conjunction with skyrocketing petroleum and natural gas prices and the unrest in the regions of the world which contain the largest quantities of these resources, has sparked a new interest in the utilization of solid carbonaceous materials, particularly coal, as primary energy sources.

As a result, enormous efforts are being extended to make coal and related solid carbonaceous materials equivalent or better sources of energy, than petroleum or natural gas. In the case of coal, for example, much of this effort is directed to overcoming the environmental problems associated with its production, transportation and combustion. For example, health and safety hazards associated with coal mining have been significantly reduced with the onset of new legislation governing coal mining. Furthermore, numerous techniques have been explored and developed to make coal cleaner burning, more suitable for burning and more readily transportable.

Gasification and liquefaction of coal are two such known techniques. Detailed descriptions of various coal gasifaction and liquefaction processes may be found, for example, in the Encyclopedia of Chemical Technology, Kirk-Othmer, Third Edition (1980) Volumne 11, pages 410-422 and 449-473. Typically, these techniques, however, require high energy input, as well as the utilization of high temperature and high pressure equipment, thereby reducing their widespread feasibility and value.

Processes to make coal more readily liquefiable have also been developed. One such process is disclosed in U.S. Patent No. 4,033,852 (Horowitz, et al.). This process involves chemically modifying a portion of the surface of the coal in a solvent media, the effect of which renders the coal more readily liquefiable in a solvent than natural forms of coal, thereby permitting recovery of a liquefiable viscous product by extraction.

In addition to gasification and liquefaction, other methods for converting coal to more convenient forms for burning and transporting are also known. For example, the preparation of coal-oil and coal-aqueous mixtures are described in the literature. Such liquid coal mixtures offer considerable advantages. In addition to being more readily transportable than dry solid coal, they are more easily storable, and less subject to the risks of explosion by spontaneous ignition. Moreover, providing coal in a fluid form makes it feasible for burning in conventional apparatus used for burning fuel oil. Such a capability can greatly facilitate the transition from fuel oil to coal as a primary energy source. Typical coal-oil and coal-aqueous mixtures and their preparation are disclosed in U.S. Patent No. 3,762,887, U.S. Patent No. 3,617,095, U.S. Patent No. 4,217,109, U.S. Patent No. 4,101,293 and British Patent No. 1,523,193.

Regardless, however, of the form in which the coal is ultimately employed, the coal or coal combustion products must be cleaned because they contain substantial amounts of sulfur, nitrogen compounds and mineral matter, including significant quantities of metal impurities. During combustion these materials enter the environment as sulfur dioxides, nitrogen oxides and compounds of metal impurities. If coal is to be accepted as a primary energy source, it must be cleaned to prevent pollution of the environment either by cleaning the combustion products of the coal or the coal prior to burning.

Accordingly, physical as well as chemical coal cleaning (beneficiation) processes have been explored. In general, physical coal cleaning processes involve pulverizing the coal to release the impurities, wherein the fineness of the coal generally governs the degree to which the impurities are released. However, because the costs of preparing the coal rise exponentially with the amount of fines to be treated, there is an economic optimum in size reduction. Moreover, grinding coal even to extremely fine sizes may not be effective in removing all the impurities. Based on the physical properties that effect the separation of the coal from the impurities, physical coal cleaning methods are generally divided into four categories: gravity, flotation, magnetic and electrical methods. In contrast to physical coal cleaning, chemical coal cleaning techniques are in a very early stage of development. Known chemical coal cleaning techniques include, for example, oxidative desulfurization of coal (sulfur is converted to a water-soluble form by air oxidation), ferric salt leaching (oxidation of pyritic sulfur with ferric sulfate), and hydrogen peroxide-sulfuric acid leaching. Other methods are also disclosed in the above-noted reference to the Encyclopedia of Chemical Technology, Volume 6, pages 314-322.

While it is obvious from the foregoing that enormous efforts have been made to make coal a more utilizable source of energy, further work and improvements are still necessary and desirable before coal, coal mixtures and other solid carbonaceous fuel sources are accepted on a wide scale as primary sources of energy.

In accordance with the present invention a process is provided for beneficiating coal comprising admixing coal in an aqueous medium, under high shear admixing conditions with a polymerizable monomer, and a liquid organic carrier, thereby rendering said coal hydrophobic and oleophilic.

U.S. Patent No. 4,304,573 discloses a highly desirable process for beneficiating coal which involves surface treating particles of coal in an aqueous medium with a surface treating admixture comprising a polymerizable monomer, a polymerization catalyst and a liquid organic carrier, thereby rendering said coal particles hydrophobic and oleophilic. The process provides a highly beneficiated coal product of relatively low water content which can be even further dehydrated (dried) to a remarkable degree without the use of thermal energy. The ash content of the coal prepared by the process is reduced to low levels and mineral sulfur compounds present are also removed. Moreover, the final coal product has enhanced BTU content and can be burned as a solid or combined with fuel oil or water to produce highly desirable beneficiated coal mixtures or slurries which are readily transportable and cleanly burned.

It has now been surprisingly discovered that if the aqueous coal slurry is admixed, under high shear admixing conditions, with a polymerizable monomer and a liquid organic carrier and then further water washed under high shear admixing conditions, highly improved yields of beneficiated coal are realized.

As used herein, the term "beneficiation" is intended to include methods for cleaning or otherwise removing impurities from a substrate, such as coal and to the recovery of coal from coal streams, such as, for example, the recovery of coal from waste streams in coal processing operations and the concentration or dewatering of coal streams or slurries such as, for example, by the removal of water in, for example, coal slurry pipelines.

Any type coal can be employed in the process of the present invention. Typically, these include, for example, bituminous coal, sub-bituminous coal, anthracite, low rank coal, such as lignite and the like. Other solid carbonaceous fuel materials, such as oil shale, tar sands, coke, graphite, mine tailings, coal from refuse piles, coal processing fines, vertical retort residues, coal fines from mine ponds or tailings, concentrated coal pipeline streams, carbonaceous fecal matter and the like are also contemplated for treatment by the process herein. Thus, for the purposes of this invention, the term "coal" is also intended to include these kinds of other solid carbonaceous fuel materials or streams.

The process of the present invention has been found to be particularly well suited for the beneficiation of coal fines and low rank coals which generally are not readily adaptable to cleaning. In accordance with the discovery herein, these types of carbonaceous material, as well as the others recited, are readily beneficiated and moreover recovered in increased yields.

In carrying out the present invention, wherein for example, raw mined coal is employed as the feedstock, it is initially preferred to reduce raw mined coal or other solid carbonaceous material to a fine diameter size and to remove unwanted rock, heavy ash and the like materials collected in the mining operation. Thus, the coal is pulverized and initially cleaned, usually in the presence of water, wherein the coal is suspended and/or sufficiently wetted to permit fluid flow. The coal is pulverized employing conventional equipment such as, for example, ball or rod mills, breakers and the like. It may also be desirable, although not necessary to the present process, to employ certain water conditioning (treating) additives in the pulverization operation. Such additives assist in rendering the ash more hydrophilic, which facilitates the separation thereof, in a manner that will be discussed hereinafter. Thus, typical additives which are useful for purposes of this invention include conventional inorganic and organic dispersants, surfactants, and/or wetting agents. Preferred additives for this purpose include sodium carbonate, sodium pyrophosphate and the like.

The coal-aqueous slurry formed in the pulverization operation is typically one having a coal to water ratio of from about 0.5:1 to about 1:5 and preferably about 1:3

parts by weight, respectively. If utilized, the water treating additives, hereinbefore described, are employed in small amounts, usually, for example, from about 0.25 to about 5%, based on the weight of dry coal. While it is generally recognized that more impurities are liberated as the size of the coal is reduced, the law of diminishing returns applies in that there is an economic optimum which governs the degree of pulverization. In any event, for the purposes of this invention, it is generally desirable to crush the coal to a particle size of from about 48 to about less than 325 mesh, preferably about 80% of the particles being of about a 200 mesh size (Tyler Standard Screen Size).

In accordance with the discovery herein, the aqueous coal slurry is initially contacted and admixed under ambient conditions and under high shear mixing conditions, with a polymerizable monomer and a liquid organic carrier, such as fuel oil, toluene, etc.

For the purposes of this invention, high shear mixing requires the vigorous admixture, high agitation, or mixing or turbulence of the materials, such as in a high speed mixing (Waring blendor, for example) or other device adapted to impart high shear mixing or agitation such as a ball mill. Preferably, the condition of high shear exceeds about 1000 reciprocal seconds and most preferably exceeds about 4500 reciprocal seconds.

Any polymerizable monomer can be employed in the surface treating polymerization reaction medium. While it is more convenient to utilize monomers which are liquid at ambient temperature and pressure, gaseous monomers which contain olefinic unsaturation permitting polymerization with the same or different molecules can also be used. Thus, monomers intended to be employed herein may be characterized by the formula XHC=CHX' wherein X and X' each may be hydrogen or any of a wide variety of organic radicals or inorganic substituents.

Illustratively, such monomers include ethylene, propylene, butylene, tetrapropylene, isoprene, butadiene, such as 1,4-butadiene, pentadiene, dicyclopentadiene, octadiene, olefinic petroleum fractions, styrene, vinyltoluene, vinylchloride, acrylonitrile, methacrylonitrile, acrylamide, methacrylamide, N-methylolacrylamide, acrolein, maleic acid, maleic anhydride, fumaric acid, abietic acid and the like.

A preferred class of monomers for the purposes of the present invention are unsaturated carboxylic acids, esters, anhydrides or salts thereof, particularly those included within the formula $R\overset{\overset{O}{\|}}{C}{-}OR'$ wherein R is an olefinically unsaturated organic radical, preferably containing from about 2 to about 30 carbon atoms, and R' is hydrogen, a salt-forming cation such as alkali metal, alkaline earth metal or ammonium cation, or a saturated or ethylenically unsaturated hydrocarbyl radical, preferably containing from 1 to about 30 carbon atoms, either unsubstituted or substituted with one or more halogen atoms, carboxylic acid groups and/or hydroxyl groups in which the hydroxyl hydrogens may be replaced with saturated and/or unsaturated acyl groups, the latter preferably containing from about 8 to about 30 carbon atoms. Specific monomers conforming to the foregoing structural formula include unsaturated fatty acids such as oleic acid, linoleic acid, linolenic, ricinoleic, mono-, di- and tri-glycerides, and other esters of unsaturated fatty acids, acrylic acid, methacrylic acid, methylacrylate, ethyacrylate, ethylhexylacrylate, tertiarybutylacrylate, oleylacrylate, methylmethacrylate, oleylmethacrylate, stearylacrylate, stearylmethacrylate, laurylmethacrylate, vinylacetate, vinylstearate, vinylmyristate, vinyllaurate, unsaturated vegetable seed oil, soybean oil, rosin acids, dehydrated castor oil, linseed oil, olive oil, peanut oil, tall oil, corn oil and the like. For the purposes of this invention, tall oil and corn oil have been found to provide particularly advantageous results. Corn oil is especially preferred. Moreover, it is to be clearly understood that compositions containing compounds within the foregoing formula and in addition containing, for example, saturated fatty acids such as palmitic, stearic etc. are also contemplated herein. Also contemplated herein as monomers are aliphatic and/or polymeric petroleum materials.

The amount of polymerizable monomer will vary depending upon the degree of surface treatment desired. In general, however, monomer amounts of from about 0.005 to about 0.1%, by weight, of the dry coal are used.

Catalysts and/or free-radical initiators may be employed in the beneficiation process of the present invention. That is, these catalysts and/or initiators may be added to the admixture during the afore-described high shear admixing of the aqueous coal slurry with the monomer and organic carrier.

Thus, catalysts which may be employed in the beneficiation process of the present invention are any such materials commonly used in polymerization reactions. These include, for example, anionic, cationic or free radical catalysts. Free radical catalysts or catalyst systems (also referred to as addition polymerization catalysts, vinyl polymerization catalysts or polymerization initiators) are preferred herein. Thus, illustratively, free radical catalysts contemplated herein include for example, inorganic and organic peroxides such as benzoyl peroxide, methylethyl ketone peroxide, tert-butylhydroperoxide, hydrogen peroxide, ammonium persulfate, di-tert-butylperoxide, tert-butyl-perbenzoate, peracetic acid and including such non-peroxy free-radical initiators as the diazo compounds such as 1,1'-bisazoisobutyronitrile and the like.

Typically, for the purposes of this invention, if utilized, any catalytic amount (e.g. 1 pound per ton of dry coal feed) of the foregoing described catalysts can be used.

Free radical initiators which function to help initiate the free radical reaction, may also be used herein alone or in combination with the heretofore identified catalysts. For the purposes herein, any of those disclosed in the prior art, such as those disclosed, for example, in U.S. Patent No. 4,033,852, incorporated by reference herein, may be used. Specifically, some of these initiators include, for example, water soluble salts, such as sodium perchlorate and perborate, sodium persulfate, potassium persulfate, ammonium persulfate, silver nitrate, water soluble salts of noble metals such as platinum and gold, sulfites, nitrites and other compounds containing the like oxidizing anions, and water soluble salts of iron, nickel chromium, copper, mercury, aluminum, cobalt, manganese, zinc, arsenic, antimony, tin, cadmium, and the like. Particularly preferred initiators herein are the water soluble copper salts, i.e. cuprous and cupric salts, such as copper acetate, copper sulfate and copper nitrate. Most advantageous results have been obtained herein with cupric nitrate, $Cu(NO_3)_2$. Further initiators contemplated herein are disclosed in copending U.S. patent application Serial No. 230,063 filed January 29, 1981 incorporated herein by reference. Among others, these initiators include metal salts of organic moities, typically metal salts of organic acids or compositions containing organic acids, such as naphthenates, tallates, octanoates, etc. and other organic soluble metal salts, said metals including copper, chromium, mercury, aluminum, If employed, the amounts of free radical initiator contemplated herein are any catalytic amount and generally are within the range of from about 10-1000 ppm (parts per million) of the metal portion of the initiator preferably 10-200 ppm, based on the amount of dry coal.

The beneficiation process herein also includes a liquid organic carrier. This liquid organic carrier is utilized to facilitate contact of the surface of the coal particles with the polymerization reaction medium. Thus, liquid organic carriers included within the scope of this invention are, for example, fuel oil, such as No. 2 or No. 6 fuel oils, other hydrocarbons including benzene, toluene, xylene, hydrocarbons fractions, such as naphtha and medium boiling petroleum fractions (boiling point 100°-180°C); dimethylformamide, tetrahydrofuran, tetrahydrofurfuryl alcohol, dimethylsulfoxide, methanol, ethanol, isopropyl alcohol, acetone, methylethyl ketone, ethyl acetate and the like and mixtures thereof. For the purposes of this invention, fuel oil is a preferred carrier.

The amounts of liquid organic carrier, such as fuel oil, utilized in the surface treatment reaction herein are generally in the range of from about 0.25 to about 5% by weight, based on the weight of dry coal.

The beneficiation process of the present process is carried out in an aqueous medium. The amount of water employed for this purpose is generally from about 65% to about 95%, by weight, based on the weight of coal slurry.

The beneficiation process conditions will, of course, vary, depending upon the specific ingredients employed and results desired. Generally, however, any conditions, polymerization or otherwise, which result in the formation of a hydrophobic or oleophilic surface on the coal can be utilized. More specifically, typical conditions include, for example, temperatures in the range of from about 10°C to about 90°C, atmospheric to nearly atmospheric pressure conditions. High shear admixing is generally carried out from about 0.25 to about 5 minutes, preferably from about 0.5 to about 1 minute.

After having been subjected to this afore-mentioned initially high shear admixing step, the resultant coal particles become hydrophobic and oleophilic and float to the surface of the liquid mass. The ash, still remaining hydrophilic, tends to settle and is removed to the water phase. Thus, the coal which results is extremely hydrophobic and oleophilic and consequently readily floats and separates from the aqueous phase, providing a ready water washing and for high recoveries of coal. The floating hydrophobic coal is also readily seperable from the queous phase (for example, a skimming screen may be used for the separation), which contains ash, sulfur and other impurities which have been removed from the coal. While it is not completely understood and while not wishing to be bound to any theory, it is believed that the treatment involves the formation of a polymeric organic coating on the surface of the coal by molecular grafting of polymeric side chains on the coal molecules.

In the practice of the present invention, the surface treated coal is then preferably subjected to at least one further wash step wherein the coal phase or phases are redispersed, under high shear agitation, as a slurry in fresh wash water.

The aqueous washings may be carried out with the treated coal slurry in the presence of simply water at temperatures of, for example, about 10° to about 90°C, preferably about 30°C, employing from about 99 to about 65 weight percent water, based on the weight of dry coal feed. Alternatively, additional amounts of any or all of the heretofore described surface treating ingredients i.e. polymerizable monomer, catalyst, initiator, liquid organic carrier, may also be added to the wash water. Moreover, the washing conditions e.g. temperatures, contact time, etc., utilized when these ingredients are employed can be the same as if only water is present or the washing conditions can be the same as those described heretofore with respect to surface treatment of the coal with the surface treating mixture. Of course, water conditioning additives may also be utilized during the washing steps, if desired.

After washing and/or additional surface treatment, the beneficiated coal may be dried to low water levels simply by mechanical means, such as by centrifugation, pressure or vacuum filtration etc., thus avoiding the necessity for costly thermal energy to remove residual water. The beneficiated coal prepared by the process of this invention, as hereinbefore described, generally contains from about 0.5% to about 10.0% by weight ash, based on the weight or dry coal. Moreover, the sulfur content is from about 0.1% to about 4% by weight, preferably about 0.3 to about 2%, based on the weight of dry coal and the water content is from about 2% to about 25%, preferably from about 2% to about 15% by weight, based on the weight of dry coal. Recoveries of beneficiated coal are in the range of from about 85 to about 99%.

At this point, the beneficiated coal can be used as a high energy content, ash and sulfur reduced, fuel product. This beneficiated fuel product can be utilized in a direct firing burner apparatus. Alternatively, the beneficiated particulate coal can be blended with a carrier such as oil and/or water to provide a highly stable and beneficiated coal slurry, such as a coal-oil mixture (COM) or coal-aqueous mixture (CAM).

In order that those skilled in the art may better understand how the present invention may be practiced, the following examples are given by way of illustration and not by way of limitation.

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Examples 1 and 2

Vertical retort residue containing 63.1% ash and 32.1% carbon is ball milled for 40 min. in aqueous slurry. Reagents (toluene, H_2O_2, $Cu(NO_3)_2$, and corn oil) are mixed with the slurry after the ball milling. In Example 1 the reagents are mixed in by hand stirring. In Example 2 the reagents are added and slurry is then subjected to 10 min. of high shear in a Waring Blendor, Model No. 5011G, at high speed, according to the present invention. The aqueous phase containing the high ash fraction, is separated from the toluene phase, containing the high carbon fraction, by the use of a separatory funnel. The high carbon product is cleaned in each case by adding more water and reseparating in the funnel. In Example 1, the water added is mixed in by shaking. In Example 2, the water added is mixed in for 2 min. of Waring Blendor, Model No. 5011G at high speed. Cleaning is repeated until the aqueous phase is quite free of suspended particles.

The ash and carbon contents and carbon recovery for the products after filtration and drying are as follows:

		Product		
Example	Blendor Shear	%Ash	%Carbon	% Carbon Recovery in Product
1	No	23.4	72.3	61.7
2	Yes	23.4	72.3	94.6

Examples 3 and 4

Black Mesa Pipeline centrate contains approximately 18% solids which consists of pigmentary size particles of coal. The ash content averages 24%. Reagents (fuel oil, H_2O_2, $Cu(NO_3)_2$ and tall oil) are mixed with the aqueous slurry. In Example 3 the reagents are mixed in by hand stirring. In Example 4 the reagents are added and the slurry is subjected to 60 seconds of high shear in a Waring Blendor, according to the present invention. The slurry is then transferred to a flotation cell and a frother (methyl isobutyl carbinol) is added. The coal is then removed as a froth from the aqueous phase which contains the majority of the ash. The froth is then cleaned again by adding fresh water to the unit and refloating. Cleaning is repeated until the aqueous phase is quite free of suspended particles. The ash contents and the coal recovery for the products after filtration and drying are as follows:

Example	Blendor Shear	feed %Ash	product %Carbon	%Coal Recovery in Product
3	No	23.97	5.9	50.1
4	Yes	23.97	4.7	99.6

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Example 5

Indianhead lignite does not respond at all to standard flotation - zero carbon recovery. However, by adding the reagents (fuel oil, H_2O_2, $Cu(NO_3)_2$ and corn oil) to the lignite before subjecting the lignite to comminution in the ball mill, the coal recovery is increased.

The coal is crushed 100% - 30 mesh and ground with the reagents and water in a ball mill for 15 minutes at 33% solids. The slurry is then transferred to a flotation cell and a frother (methyl isobutyl carbinol) is added. The coal is then removed as a froth from the aqueous phase which contains the majority of the ash. The froth is then cleaned again by adding fresh water to the unit and refloating. Cleaning is repeated until the aqueous phase is quite free of suspended particles. The ash contents before and after beneficiation and the coal recovery in the product after filtration and drying are as follows:

Feed %ash	Product %ash	%Coal Recovery
9.0	7.8	67.4

WHAT IS CLAIMED IS:

1. A process for beneficiating coal comprising admixing coal in an aqueous medium, under high shear admixing conditions with a polymerizable monomer, and a liquid organic carrier, thereby rendering said coal hydrophobic and oleophilic.

2. A process according to claim 1 further comprising subjecting the hydrophobic and oleophilic coal to at least one water washing, the water washing comprising admixing said hydrophobic and oleophilic coal with water under high shear admixing conditions to form a coal froth phase and an aqueous phase and recovering the coal froth phase.

3. The process according to claim 2 wherein at least one of the water washings is carried out in the presence of a polmerizable monomer, a polymerization catalyst, a liquid organic carrier or mixtures thereof.

4. The process according to any of claims 1 - 3 wherein the polymerizable monomer is comprised of a compound having the formula $RC(=O)-OR'$ wherein R is an olefinically unsaturated radical, R' is selected from hydrogen, a salt forming cation, a saturated or ethylenically unsaturated hydrocarbyl radical, the hydrocarbyl radical being unsubstituted or substituted with one or more members selected from halogen, carboxylic acid groups, hydroxyl groups, or hydroxyl groups in which the hydroxy hydrogen atom is replaced with a saturated or unsaturated acyl group or a combination or saturated and unsaturated acyl groups and mixtures thereof.

5. The process according to claim 4 wherein the polymerizable monomer is tall oil, corn oil or mixtures thereof.

6. The process according to any of claims 1 to 4 wherein a polymerization catalyst, a free radical initiator or mixtures thereof is admixed with the coal, aqueous medium polymerizable monomer and liquid organic carrier under high shear admixing.

7. The process according to claim 6 wherein the free radical initiator is an inorganic water soluble metal salt, organic metal salt or mixtures thereof, wherein the metal is iron, zinc, antimony, arsenic, copper, tin, cadmium, silver, gold, platinum, chromium, mercury, aluminum, cobalt, nickel or lead.

8. The process according to claim 6 or 7 wherein the free radical initiator is cupric nitrate, corn oil or hydrogen peroxide.

9. The process according to any of claims 1 to 8 wherein the coal is pulverized in the presence of water.

10. The process according to any of claims 1 to 9 wherein the liquid organic carrier is fuel oil, benzene, toluene, xylene, naphtha and medium boiling petroleum fractions, dimethylformamide, tetrahydrofuran, tetrahydrofurfuryl alcohol, dimethylsulfoxide, methanol, ethanol, isopropyl alcohol, acetone methylethyl ketone, ethyl acetate or mixtures thereof.

11. The process of any of claims 1 to 10 wherein the coal is low rank coal, vertical retort residues, coal fines or concentrated coal pipeline streams.

12. The process according to any of claims 1 to 11 wherein the water further contains a water conditioning additive.