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Description

The present invention relates to a process for the preparation of stable coal-water mixtures. More precisely it relates to the production of coal-water mixtures with a high coal content, suitable for use as a substitute for fuel oil or metallurgical coke (e.g. in blast furnaces).

The increase in the price of oil, only slightly mitigated by the recent small reductions, as well as the prospects of possible scarcity of this raw material on the markets, have given a spur to the search for oil substitutes, or at least greater oil savings. For these reasons, major fuel-oil consuming sectors such as electricity generating authorities and the iron and steel industry are actively engaged in seeking alternative and fuel-saving solutions. As a result, oil-water, coal-oil, coal-water and coal-oil-water mixtures have been proposed.

In particular, coal is coming to play an ever more important role for use as auxiliary fuel injected into the blast furnace via the tuyeres.

Among the various solutions one of the most promising for replacing fuel oil, especially for maintaining regularity of blast-furnace operation and reducing production costs, is the use of coal-water mixes with a high coal content.

In this regard it has been found that mixtures containing from 70 to 80% coal are of special interest, both from the fuel consumption and blast-furnace operating quality aspects. However, some practical difficulties are encountered with mixtures of this kind, mainly concerning pumping and phase separation, with settlement of the coal on the bottom of the storage tanks.

In this respect, WO—A—83/00501 discloses a multistep process utilizing a first wet grinding and second final grinding in presence also of a suitable fluidising agent. Prescription of particle size obtainable is restricted to the teaching that a given percentage of solids must be finer than a specified particle size. Disclosed viscosities are in a range (1000 to 4000 cPs at 60 rpms, corresponding to 1300—5000 cPs at 30 rpms) which causes the slurries to be pumpable and sprayable with great difficulties.

More or less the same applies to EP—A—117742, which utilizes ground coal to prepare the slurry with water and dispersant, and obtains a too high viscosity (more than 1400 cPs).

WO—A—84/03297 discloses a process in which a non-specific multistep grinding (wet, or dry or any other way) is used to obtain a particular bimodal particle size distribution involving two different mean diameters. Also in this case the viscosity obtained is too high for the slurry to be easily pumped.

This invention proposes to eliminate these difficulties by providing a simple, cheap process for preparing coal-water mixture with a coal content of 70 to 80% which is easy to pump and is stable timewise.

According to this invention, coal is fed into a mill together with the quantity of water desired in the final mixture. Typically 70—80% (by weight) of coal is added to 20—30% of water. At this stage between 0,05 and 2% (by weight) of known fluidizing agents, such as humic acid based compounds or their derivatives or lignin sulphonates are added. Preferably, coal is finer than 3 mm in size.

Grinding must result in a coal-water mixture where the harmonic mean diameter of the coal particles is around 50 μm . It is also necessary that at least 60% and preferably at least 70% of the coal should be finer than 74 μm , while less than 10% should be coarser than 250 μm .

In some experiments carried out using a disc mill, it has been found useful to perform the grinding in two stages. While the final grading must be as indicated above, the first stage of grinding must provide a mixture in which the harmonic mean diameter of the coal particles is around 60 μm , at least 50% of the coal being finer than 74 μm , and less than 20% coarser than 250 μm .

Of course, the type of mill is not binding according to the invention. Typically a mixture produced in this manner containing 73% (by weight) of coal having a mean diameter of 54 μm , has an apparent viscosity of about 300 cP (Brookfield at 30 rpm).

This mixture is extremely stable. After 45 days the suspension is still of excellent quality, is readily pumpable and has a virtually negligible vertical concentration gradient.

It is important to note that the addition of fluidizing agents has a very marked effect, especially on the viscosity of the suspension. However, depending on the particle size and the total quantity of coal, maximum efficiency is attained with a given quantity of fluidizing agent, beyond which the viscosity may rise even markedly. In our experiments it has been seen that the maximum efficiency is attained for additions of between 0,3 and 1,3%.

The present invention will now be illustrated in relation to a series of practical experiments performed on a medium-high volatiles American coal commonly used in iron and steel making, having the following characteristics: volatile matter 30,8%, fixed carbon 64,2%, ash 5% (the percentages are calculated on a dry-weight basis).

The minus 3 mm coal was wet ground in a disc mill, as described above, feeding to the first mill the coal, water and additive in the quantities desired for the final suspension.

A mixture of activated salts of humic acid and phosphates was added at a fixed rate of 0,5%.

The results obtained are reported in the following table:

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Test	Percent finer than 74 μ m	Percent coal in mixture	Apparent viscosity cP (30 rpm Brook.)	Static stability test. Penetration time (PT) (in secs) after weeks (W)						Assessment
				0 _w	1 _w	2 _w	3 _w	4 _w	5 _w	
1	49.8	65	250	.3						Poor stability
		73	350	.5						Poor stability
2	54.4	70	200	.5						Poor stability
3	58.4	68	110	.3						Poor stability
4	63.7	66	150	.3	.3	.5	1	1.5	3	Good
		76	1400	1	2	2	4	5	6	Satisfactory
5	69.9	65	280	.3	.3	.3	.5	.8	1.5	Good
		70	355	.3	.3	.4	.5	1	2	Good
6	72.1	69	500	.5	.5	.9	1.2	1.6	2.4	Good
		76	450	.5	.5	.5	.8	1.3	1.8	Very good
7	75.2	69	284	.3	.3	.3	.4	.6	.9	Very good
		77	450	.3	.3	.5	.6	.8	.1	Very good

The static stability of the mixtures over the course of time is indicated by the variation in the number of seconds required for a 20 g rod 3 mm in diameter to penetrate under its own weight through a 180 mm depth of mixture stored in the undisturbed state. In the first three tests the coal had all settled out after one week, so penetration of the rod was stopped by the coal layer. The assessment was made as objectively as possible, being based on the ratio of the penetration time after five weeks compared with that when the mixture had just been made up (zero weeks). With a ratio of less than 4 the stability of the mixture was considered very good, while if it was between 4 and 10 it was classed as good. Of course, viscosity also has a bearing on the assessment, stable mixtures with a viscosity of less than about 500 cP being classed as good. This is why Test 4 was considered to be only satisfactory, because although its stability was good its viscosity was 1400 cP. As is evident from the Table, as soon as more than 60% of the coal is finer than 74 μ m, time-stable mixtures with good viscosities are obtained. In this description the average diameter of the particles is calculated as the harmonic and not the arithmetic mean.

The mixtures thus prepared are suitable for substituting fuel oil and similar petroleum derivatives in applications such as, for instance, fuel in thermal-electric power stations or as auxiliary fuel for injection into blast furnaces via the tuyeres. The mixtures appear to be very interesting for the latter application, not only from the economic point of view but also because they permit particularly uniform efficient blast-furnace operation.

Claims

1. Process for the preparation of a stable and pumpable coal-water mixtures containing from 70 to 80% coal (by weight), known fluidizing agents amounting to between 0,05 and 2% (by weight) and water, balance to 100%, characterized by the combination of the following two steps:
 - grinding all the coal together with the water and the fluidizing agent in the same proportions required for the final mixture;
 - carrying out said grinding to the point where the harmonic mean diameter of coal particles is around 50 μ m and at least 60% of the coal is finer than 74 μ m while less than 10% is coarser than 250 μ m.
2. Process according to Claim 1, characterized in that at least 70% of the coal has after grinding a particle size of less than 74 μ m.

Patentansprüche

1. Verfahren zur Herstellung eines stabilen und pumpbaren Kohle/Wassergemisches, das 70 bis 80%

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Kohle (Gew.), bekannte Fluidisierungsmittel in einem Anteil zwischen 0,05 und 2 Gew.-%, sowie dem Rest, bis auf 100%, Wasser enthält, gekennzeichnet durch die Kombination der folgenden beiden Schritte:

Vermahlen der gesamten Kohle zusammen mit dem Wasser und dem Fluidisierungsmittel in den gleichen für das Endgemisch erforderlichen Anteilen;

- 5 Durchführung diese Vermahlens bis zu einem Punkt, wo der harmonische mittlere Durchmesser der Kohlepartikel um 50 µm beträgt und wenigstens 60% der Kohle feiner als 74 µm sind, während weniger als 10% grober als 250 µm sind.

2. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß wenigstens 70% der Kohle nach dem Vermahlen eine Partikelgröße von weniger als 74 µm aufweisen.

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Revendications

1. Procédé pour la préparation d'un mélange eau-charbon stable et apte à être pompé, contenant 70 à 80% (en poids) de charbon, des agents de fluidisation à raison de 0,05 à 2% (en poids) et de l'eau pour

- 15 compléter à 100%, caractérisé par la combinaison des deux étapes suivantes:

broyage de tout le charbon avec l'eau et l'agent de fluidisation dans les mêmes proportions que celles requises pour le mélange final;

mise en oeuvre dudit broyage jusqu'au moment où le diamètre moyen harmonique des particules de charbon se situe aux environs de 50 µm et au moins 60% du charbon présente une dimension inférieure à

- 20 74 µm, tandis que moins de 10% du charbon présente une dimension plus grossière que 250 µm.

2. Procédé selon la revendication 1 caractérisé en ce qu'au moins 70% du charbon présente une dimension de particules de moins de 74 µm, après broyage.

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