(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 124 488**
A1

(12) # EUROPEAN PATENT APPLICATION

(21) Application number: **84830057.0**

(22) Date of filing: **06.03.84**

(51) Int. Cl.³: **C 10 L 1/32**

(30) Priority: **29.04.83 IT 4818583**

(43) Date of publication of application: **07.11.84 Bulletin 84/45**

(84) Designated Contracting States: **AT BE CH DE FR GB LI LU NL SE**

(71) Applicant: **CENTRO SPERIMENTALE METALLURGICO S.p.A., P.O. Box 10747 Via di Castel Romano 100-102, I-00129 Roma (IT)**

(72) Inventor: **Palumbo, Luigi, Via Eusebio Chini n. 22, I-00147 Roma (IT)**
Inventor: **Malgarini, Giansilvio, Viale Africa n. 3, I-00144 Roma (IT)**

(74) Representative: **Mariani, Giulio, c/o Centro Sperimentale Metallurgico SpA P.O. BOX 10747, I-00100 Roma Eur (IT)**

(54) **process for preparation of stable coal-water mixtures.**

(57) A specific type of wet grinding of coal utilizing the total quantity of water needed for the final mixture, plus appropriate additives, furnishes a very stable product that is especially suitable for use as fuel.

EP 0 124 488 A1

Process for preparation of stable coal-water mixtures.

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.

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 preferably finer than 3 mm in size, 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 derivates or lignin sulphonates are added.

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 the experiments carried out, it has been found useful to perform the grinding in two stages in a disc mill. 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 readly 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:

xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

Test	Percent finer than 74 μm	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 μm, time-stable mixtures with good viscosities are obtained. Of course, if mixtures with very high stability are not needed, because they are to be used immediately after being prepared, then it is not necessary to grind the coal any finer than 50% minus 74 μm. 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.

C L A I M S

1. Process for the preparation of stable coal-water mixtures suitable for use as fuel, in which there is between 70% and 80% coal (by weight), characterized by the fact that the coal is ground together with the water in the proportions desired for the final mixture, plus a small quantity of known fluidizing agents amounting to between 0,05 and 2% (by weight), the grinding being carried to the point where at least 50% of the coal is finer than 74 μm.

2. Process as per Claim 1, characterized by the fact that the grinding is performed in two stages, during the first of which the coal is fed together with the water and the additives in the proportions desired for the final mixture, thus obtaining a mixture in which at least 50% of the coal is finer than 74 μm, and less than 20% is coarser than 250 μm.

3. Process as per Claim 2, characterized by the fact that the coal feed is finer than 3 mm.

4. Process as per Claim 2, characterized by the fact that after the aforesaid grinding the coal particles have a harmonic mean diameter of around 60 μm.

5. Process as per Claim 1, characterized by the fact that after the second grinding at least 70% of the coal has a particle size of less than 74 μm.

6. Process as per Claim 5, characterized by the fact that after the second grinding the coal particles have a harmonic mean diameter of around 50 μm.

00124488

European Patent Office

EUROPEAN SEARCH REPORT

Application number

EP 84 83 0057

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
Y	DE-C- 398 155 (PLAUSON) * Claims 1,2 *	1	C 10 L 1/32
P,Y	EP-A-0 092 353 (ATLANTIC RESEARCH) * Claims 1,18; page 3, lines 11-17 *	1,5	

TECHNICAL FIELDS SEARCHED (Int. Cl. ³)

C 10 L

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	21-08-1984	DE HERDT O.C.E.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document