AMENDED

APPLICATION ACCEPTED AND AMENDMENTS ALLOWED 27 - 11 - 87

41933

COMMONWEALTH OF AUSTRALIA

AUSTRALIAN PATENT OFFICE 29 JUL 1987

Patents Act 1952

CONVENTION APPLICATION FOR A STANDARD PATENT

We, CENTRO SVILUPPO MATERIALI S.p.A., of 100 Via di Castel Romano, Rome, Italy, hereby apply for the grant of a Standard Patent for an invention entitled

"HIGH SOLIDS CONTENT COAL-TAR MIXTURE"

which is described in the accompanying complete specification.

Details of basic application:-

Number of basic application:- 48710A85

Name of Convention country ir which basic application was filed:- Italy

Date of basic application:- 24 October 1985

Our address for service is: F.B. RICE & CO.,
28A Montague St,
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Dated this 20th day of July 1987

CENTRO SVILUPPO MATERIALI S.p.A.

By: _____
Registered Patent Attorney

LODGED AT SUB-OFFICE
21 JUL 1987
Sydney

TO: The Commissioner of Patents,
COMMONWEALTH OF AUSTRALIA

Commonwealth of Australia
The Patents Act 1952

DECLARATION IN SUPPORT

In support of the (Convention) Application made by: CENTRO SPERIMENTALE METALLURGICO SpA, of Via di Castel Romano 100-102, 00129 Rome, Italy

for a patent for an invention entitled: High Solids Content Coal-Tar Mixture

~~I~~(We) Carlo Pagliucci and Luigi Timossi

of and care of the applicant company do solemnly and sincerely declare as follows:

a) ~~I am~~ (We are) the applicant(s) for the patent

or

b) ~~I am~~ (We are) authorised by the applicant(s) for the patent to make this declaration on its behalf.

Delete the following if not a Convention Application.

The basic application(s) as defined by section 141 (1)(2) of the Act was (were) made

on 24 October 1985 in Italy

~~on~~ ~~in~~

~~on~~ ~~in~~

by Centro Sperimentale Metallurgico SpA (now Centro Sviluppo Materiali SpA)

The basic application(s) referred to in this paragraph is (are) the first application(s) made in a Convention country in respect of the invention the subject of the application.

a) ~~I am~~ (We are) the actual inventor(s) of the invention.

or see attached sheet

b)

~~I~~ (are) the actual inventor(s) of the invention and the facts upon which the applicant company is (~~are~~) entitled to make the application are as follows:

"The applicant is a company which would if a patent were granted upon application made by the actual inventors be entitled to have the patent assigned to it"

Declared at Rome this 26TH day of September 1989.

CENTRO SVILUPPO MATERIALI S.p.A.

X Signed ..... Status .....

Declarant's Name Carlo Pagliucci / Luigi Timossi

F. B. RICE & CO PATENT ATTORNEYS

This form is suitable for any type of Patent Application. No legalisation required.

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(12) PATENT ABRIDGMENT (11) Document No. AU-B-64370/86
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HIGH SOLIDS CONTENT FLUID COAL-TAR MIXTURE

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(56) Prior Art Documents
AU 553460 78343/81 C10L 5/00 C10L 1/32

(57) Claim

1. A coal-tar mixture obtained by grinding coal and tar together, wherein said mixture comprises at least 50 percent by weight of coal, as hereinbefore defined, particles having a grain-size distribution within the following range:

	+ 500 µm	0	% Weight
- 500	+ 250 µm	1-2	"
- 250	+ 88 µm	3-7	"
- 88	+ 44 µm	9-18	"
- 44	+ 11 µm	40-50	"
- 11	µm	30-45	"

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COMPLETE SPECIFICATION

(ORIGINAL)

Class Int. Class

Application Number : 64370/86.

Lodged :

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Accepted :

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Related Art :

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Complete Specification for the invention entitled:
HIGH SOLIDS CONTENT COAL-TAR MIXTURE

The following statement is a full description of this invention including the best method of performing it known to us:-

DESCRIPTION

This invention concerns a high-solids coal-tar mixture. More precisely it concerns the grain-size distribution of the coal that permits attainment of more than 50% solids (by weight) in the mixture without the use of additives.

The word coal in this description refers to any essentially solid carbonaceous fuel, such as coal, metallurgical coke, petroleum coke, semicoke, etc.

The use of auxiliary fuels injected at the tuyeres ensures great benefits as regards blast furnace productivity and energy consumption. However, fuel-oil, generally employed as auxiliary fuel, is a material whose cost and supply are dependent on nontechnical factors that may make its use unacceptable in plants such as the blast furnace operating in very delicate equilibrium. Other types of auxiliary fuels have thus been sought. Coal-water mixtures and coal-tar mixtures have been found interesting for a variety of reasons, essentially concerning cost, quality and availability.

Where coal-tar mixtures are concerned, one limitation to date has been the fact that when the coal content of the mixture exceeds 40% by weight, the apparent viscosity of the mixture increases very rapidly, with the result that at about 50% solids (by weight) the mixture is no longer pumpable. Furthermore, above 40% solids (by weight) the apparent viscosity of the coal-tar mixture also increases markledy with time. This is thought to be due to absorption of tar in the coal pores, thus considerably increasing the percentage coal (by volume) in the mixture.

Because of these difficulties, reported recently in papers S44 and S108 at the 103rd and 105th Meetings of the Iron and Steel Institute of Japan and published on transactions of ISIJ (April 1982 and April 1983), respectively, the coal content of the coal-tar mixtures used in industrial trials in Japan on a 5050 m^3 blast

furnace could not exceed 43% by weight (Proceedings, Fifth International Symposium on "Coal Slurry Combustion and Technology" 25-27 April 1983, Tampa, USA, Vol.1, pages 361 et seq.).

Contrary to what has been reported on the state of the art, however, it has been found surprisingly that a given coal grain-size distribution permits production of coal-tar mixtures containing more than 50% coal and having a viscosity such as to render the mixture easily pumpable and injectable, and without any marked variations with time.

According to this invention, minus 20 mm coal, selected from coking coals, difficult-to-coke coals, metallurgical coke and petroleum coke is fed to a mill together with the tar and ground to obtain the following grain-size distribution:

- plus 500	µm	0	(% weight)
- minus 500 plus 250	µm	1-2	"
- minus 250 plus 88	µm	3-7	"
- minus 88 plus 44	µm	9-18	"
- minus 44 plus 11	µm	40-50	"
- minus 11	µm	30-45	"

In this way, depending on the type of coal used, the actual grain-size distribution obtained and the quantity of coal in the mixture, the apparent viscosity (Haake MV II P, at 70°C, 1800s, 28 s^{-1}) is between 800 and 1200 cP approximately, with good stability up to fourteen days without stirring and up to about thirty days with gentle stirring.

The grain-size distribution according to the invention has enabled blast-furnace-proved coal-tar mixtures containing up to 53.1% coal (by weight) to be obtained; moreover, laboratory fluidity, stability, injectability and combustion tests indicate the possibility

of utilizing coal-tar mixtures containing at least 55% coal (by weight).

Attainment of the desired grain-size distribution must be studied, of course, on the basis of mill type, grinding parameters and the kind of coal employed. In any case, however, the grain-size distribution indicated above must be attained.

For the purpose of exemplification, without limiting the invention or claims thereto, indications are given below of conditions for two kinds of coal that have resulted in diverse types of mixtures.

EXAMPLE 1

A medium-high volatiles, bituminous coking coal having the following characteristics:

Grain-size analysis

(% weight)

	+ 15	mm	0
- 15	+ 8	mm	7.08
- 8	+ 2.83	mm	21.24
- 2.83	+ 1	mm	24.57
- 1	+ 0.25	mm	28.50
- 0.25		mm	18.61

Proximate analysis

(% weight)

Moisture	3.0
Ash (db)	8.3
Volatile matter (db)	28.2
Fixed C (db)	63.5

Ultimate analysis

(% wt dry basis - db)

Ash	8.3
C	83.5
H	4.4
S	0.9
N	1.2
O	1.7

Hardgrove Grinding Index (HGI) 95

and a tar having the following characteristics:

Chemical analysis

(% weight)

H_2O	5
C (db)	94.5
H (db)	4.5
S (db)	0.5

Xylene insolubles: 6%; Ash in insolubles 0.15%; LHV 36.98 MJ/kg; Specific gravity: 1.17 kg/dm^3; Apparent viscosity (70°C, 1800 s, 28 s^{-1}): 64 cP,

were fed together to a four-compartment 0.42 m^3 ball mill with a ball-load of 711 kg the size-grading of which was

Dia (mm):	16	18	20	25	30
% weight:	12	13	25	30	20

The mill was operated at 38 revolutions per minute (75% of critical speed) with a production rate of 100 kg/h.

Two mixtures were made, A and B, with solids concentrations of about 43% and about 53% respectively.

The characteristics of these mixtures were as follows:

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		Mixture A	Mixture B
	Percent coal (by weight)	42.8	51.6
	Grain-size distribution		
	+ 500 µm	0.4	0
5.	- 500 + 250 µm	0.2	1.8
	- 250 + 88 µm	5.6	3.2
	- 88 + 44 µm	8.9	9.3
	- 44 + 11 µm	34.5	43.9
	- 11 µm	50.4	41.8
10.	Apparent viscosity cP (70°C, 1800s, 28 s^{-1})	645	928
	Pumpability MPa/100m (1" pipe, V=0.05 m/s)	---	0.14

EXAMPLE 2

15. Coke fines having the following characteristics:

Grain-size analysis

(% weight)

	+ 15	mm	0.46
-15	+ 8	mm	0.10
- 8	+ 2.83	mm	19.95
- 2.83	+ 1	mm	35.20
- 1	+ 0.25	mm	26.60
- 0.25		mm	17.69

Proximate analysis

(%weight db)

Carbon	84
Volatile matter	2.40
Ash	13.60

was charged together with the Example 1 tar to the same mill and was

ground as per Example 1, but at a production rate of 50 kg/h. The mixtures obtained - C and D - with target solids concentrations of 44 and 53%, had the following characteristics:

		Mixture C	Mixture D
Percent coke (by weight)		44.3	53.1
Grain-size distribution			
	+ 500 µm	11.2	0
- 500	+ 250 µm	1.3	0.9
- 250	+ 88 µm	6.5	5.9
- 88	+ 44 µm	13.8	17.9
- 44	+ 11 µm	30.7	43.1
- 11	µm	36.5	32.2
Apparent viscosity cP (70°C, 1800s, 28 s^{-1})		1090	950

Static stability, understood as being the ability of the mixture to maintain the carbonaceous solids part in suspension and to prevent it from settling out, was measured on Mixtures B and D. The test is made with a 3 mm diameter steel cylinder weighing 30 g, the measurement reported being that length of a cylinder which cannot penetrate a depth of 180 mm of mixture in the undisturbed state.

Put another way, if the solid part of the mixture does not separate out, the test cylinder penetrates completely into the mixture. If, on the other hand, solids separate out and are deposited on the bottom of the test container, the layer which forms prevents the cylinder from penetrating completely. The number of millimetres of cylinder protruding above the free surface of the mixture provides the measure of the stability of the mixture.

The values found for Mixtures B and D are as follows:

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Static stability test: mm not penetrated after w weeks

Mixture	0w	1w	2w	3w
B	0	3	3	3
D	0	0	0	0

As is evident from these examples, grinding conditions influence grain-size distribution of the ground solid; only if the grain-size distribution falls within the ranges specified as per the invention are mixtures obtained with characteristics suitable for blast-furnace use, especially as regards pumpability and viscosity, which must be such as to permit pipeline transport of the mixture within a radius of several kilometers, followed by its injection at the blast-furnace tuyeres.

A Type B mixture has been produced in a 3.5 t/h pilot plant in a one-week campaign and the resulting mixture injected without trouble at two tuyeres of a medium sized blast furnace a short distance away, producing 5500 tHM/24 h. Mixture flow rate was between 500 and 100 kg/h per tuyere; blast characteristics were: T = 1200°C, Moisture 15 g/m^3N; O_2: 21%.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A coal-tar mixture obtained by grinding coal and tar together, wherein said mixture comprises at least 50 percent by weight of coal, as hereinbefore defined, particles having a grain-size distribution within the following range:

	+ 500 µm	0	% Weight
- 500	+ 250 µm	1-2	"
- 250	+ 88 µm	3-7	"
- 88	+ 44 µm	9-18	"
- 44	+ 11 µm	40-50	"
- 11	µm	30-45	"

2. A coal-tar mixture as claimed in claim 1, wherein said mixture possesses an apparent viscosity of 70°C of between 800 and 1200 cP.

3. A coal-tar mixture substantially as hereinbefore defined with reference to any one of the accompanying examples.

DATED this 9th day of November 1989

CENTRO SVILUPPO MATERIALI SpA
Patent Attorneys for the
Applicant:

F.B. RICE & CO.