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ALLOYING OF GRAY IRON IN THE CUPOLA

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The invention relates to ferro alloy or metal briquettes for use as additions to the cupola charge for making gray iron, as well as the manufacture of such briquettes and the present application is a continuation in part of my pending application for Ferro alloy briquette and manufacture of same, Serial No. 513,953, filed December 11, 1943, now Patent No. 2,405,278.

It is customary in the manufacture of gray iron to make additions of various metals or ferro alloys such as chromium, silicon, manganese, copper, nickel, molybdenum, phosphorus, and the like to the cupola charge.

In order to produce the desired results it is necessary that a definite quantity of the desired metal product or ferro alloy be added to the charge or melt and it is therefore necessary that each piece or lump of the metal or ferroalloy addition will have a definite metallic content.

To this end it has long been common practice to form briquettes of a definite known weight of the desired metal or ferro alloy, in finely divided form, mixed with a binder such as Portland cement, clay, lime or similar material.

The use of pitch, tar, or a mixture thereof, as a binder in the production of briquettes of various materials is not new, but to the best of my knowledge neither of these materials has ever been actually used as a binder for briquettes of metals or ferro alloys that are subjected to temperatures higher than the melting or fusion point of the pitch or tar, and it has been generally believed by the steel industry that pitch or tar do not form suitable binding agents for such use because of the erroneous belief that they would immediately burn away in the furnace permitting the briquettes to disintegrate and exposing the readily oxidizable alloys to the oxidizing flames of the furnace so that they are lost in whole or at least in part.

As an example of the erroneous belief that pitch or tar is not a suitable binder for ferro alloy briquettes attention is called to Greiner Patent No. 1,551,554 of September 1, 1925, for a Process for smelting iron alloys.

It is therefore the object of the present invention to provide a briquette for cupola additions composed of one or more ferro alloys or metals in finely divided condition bound together by pitch or tar or a mixture thereof.

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Another object is the formation of a briquette of such metalliferous products bound together with pitch or tar under extreme pressure.

A still further object is to provide a method of producing a briquette of this character by mixing ferro alloy material with a small amount of hot pitch or tar and subjecting the same to a suitable pressure to form a briquette.

A further object of the invention is to provide a briquette of ferro alloys or metals that when added to the cupola charge will melt and alloy with the charge to which it is added and not lag behind in the cupola and become part of the following charge or charges as is the case with some briquettes.

The above objects, together with others apparent to those skilled in the art, or which may be later referred to, may be attained by carrying out the invention in the manner hereinafter described in detail.

In carrying out the invention to produce the briquettes from any desired ferroalloy such as silicon, manganese, chromium, phosphorus, or the like, the desired alloy or alloys may be in small pieces, or in finely divided condition, or a mixture of the two. To this I add a small, usually about 3 to 5 per cent by weight of pitch or tar or a mixture of the two, preferably having a high melting point, and preferably hot.

The ferroalloy and binder are intermixed and may be placed in a mold of suitable size and shape to produce the briquette desired and subjected to extreme pressure, preferably about two tons per square inch or the briquette may be formed in an extruding press with less pressure.

Actual commercial tests of the ferro alloy briquettes described herein were made under varying conditions to determine the silicon recovery as compared to the silicon recovery from standard silvery iron. These tests are as follows:

EXAMPLE 1

Cupola 72", using 17-ounce pressure; operation eight hours with a continuous stream of metal from the cupola. The test covers three days' operation and on the second day ferro silicon briquettes were substituted for silvery iron on the basis of contained silicon.

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Regular charge

100 lbs. Pig iron 2.55% Si	2.55 lbs. Si
150 lbs. Return scrap 1.60% Si	2.40 lbs. Si
735 lbs. Purchased scrap 1.70% Si	12.50 lbs. Si
15 lbs. Silvery iron 15.75% Si	2.36 lbs. Si
1,000 lbs.	19.81 lbs. Si
	1.98% Si

Briquette charge

100 lbs. Pig iron 2.55% Si	2.55 lbs. Si
150 lbs. Return scrap 1.60% Si	2.40 lbs. Si
745 lbs. Purchased scrap 1.70% Si	12.67 lbs. Si
5.5 lbs. Briquettes 46.5% Si	2.55 lbs. Si
1,000.5 lbs.	20.17 lbs. Si
	2.01% Si

Per cent silicon in ladle metal

Time of Test	Regular Charge	Briquette Charge	Regular Charge
7:00 A. M.	1.80	1.88	1.83
9:00 A. M.	1.76	1.81	1.74
11:00 A. M.	1.70	1.70	1.82
1:00 P. M.	1.83	1.81	1.86
3:00 P. M.	1.83	1.80	1.98

EXAMPLE 2

Cupola melting 16 tons per hour made four test runs as follows: Test "A" and "C" with silvery iron and "B" and "D" replacing silvery iron with ferro-silicon briquettes as described above. Two types of iron were made each day and the charges used were as follows:

	Soft Iron Mix lbs.	Pounds Si	Regular Mix lbs.	Pounds Si
Silvery Iron				
Bessemer Pig (Si 2.45%)	1,025	25.10	1,025	25.10
Returns (Si 2.10%)	1,320	27.70	970	20.40
Steel Scrap (Si 0.15%)	75	0.10	425	0.63
Silvery Pig (Si 10.47%)	80	8.38	80	8.38
Total	2,500	61.28	2,500	54.51
Silicon Briquettes				
Bessemer Pig (Si 2.45%)	1,025	25.10	1,025	25.10
Returns (Si 2.10%)	1,392	29.20	1,042	21.90
Steel Scrap (Si 0.15%)	75	0.11	425	0.63
Silicon (in briquette form)	8	8.00	8	8.00
Total	2,500	62.41	2,500	55.63

Analysis of heats

Test	A		B		C		D	
Sample Number	#1	#2	#1	#2	#1	#2	#1	#2
Silicon, per cent	2.32	1.71	2.32	1.88	2.31	1.90	2.37	2.02
Total Carbon	3.60	3.33	3.55	3.39	3.56	3.41	3.65	3.55
Tensile, p. s. i.	22,930	36,090	25,950	29,770	23,380	29,800	17,550	29,850
Transverse	3,500	4,300	3,480	4,090	3,920	4,670	2,920	4,270
Deflection (In.)	.188	.183	.190	.183	.192	.200	.172	.179
Brinnel	149	197	163	179	156	179	137	187

EXAMPLE 3

Cupola 48", blast pressure 9 ounces,
2.8 lbs. Si added per ton in the ladle=.12% .12%

SILVERY IRON CHARGE

1,050 lbs. Steel scrap, .14% Si	1.47 lbs. Si
95 lbs. Silvery iron, 15.75% Si	14.96 lbs. Si
40 lbs. Spiegel iron, 1.23% Si	.49 lbs. Si
315 lbs. Return scrap, 1.50% Si	4.73 lbs. Si
1,500 lbs. Total	21.65 lbs. Si
	1.45% Si
	1.57% Si

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BRIQUETTE IRON CHARGE

1,050 lbs. Steel scrap, 0.14% Si	1.47 lbs. Si
30 lbs. Briquettes (OFA), 46.5% Si	13.95 lbs. Si
40 lbs. Spiegel iron, 1.23% Si	.49 lbs. Si
380 lbs. Return scrap, 1.50% Si	5.70 lbs. Si
1,500 lbs. Total	21.61 lbs. Si
	1.40% Si
	1.52% Si

Test No.	Si Charge	No. Charges	Analysis C	Si	S	P	Mn
A	Silvery	22	3.17	1.50			.84
B	Briquettes	19	3.11	1.54	.070	.108	.84
C	Silvery	20	3.05	1.51	.074	.099	.89
D	Briquettes	22	3.08	1.49	.068	.096	.82

Test No.	Tensile, p. s. i.	Transverse	Deflection
A	54,300	00	.322
B	52,120	3015	.330
C	44,000	2835	.279
D	50,890	3605	.391

EXAMPLE 4

[Cupola 48", blast pressure 12 ounces.]

	Charge Pitch Briquettes, Pounds	Pounds Si	Pounds Cr
Pig Iron (Si 2.50%)	1,000	25.00	
Return Scrap (Si 2.60%, Cr 2.90%)	700	18.20	20.3
Purchased Scrap (Si 1.80%)	205	3.70	
Chromium Briquettes	75		44.0
Silicon Briquettes	20	10.00	
	2,000	56.90	64.3

Charge other briquettes

[Same charge as above for pitch briquettes.]

	Analysis Pitch Briquettes		Other Briquettes	
	Si per cent	Cr per cent	Si per cent	Cr per cent
1st Charge	2.50	2.85	2.33	2.23
2nd Charge	2.72	2.90	2.39	2.46
3rd Charge	2.66	2.87	2.56	2.70
4th Charge	2.59	2.85	2.71	3.15
5th Charge	2.65	2.85	2.90	3.40
6th Charge—Regular No Chrome	2.20	0.40	2.75	1.22
7th Regular Charge	2.19	0.15	2.70	.70

The above tests prove that recovery of silicon from the product made according to this invention successfully meet the requirements for a ferro-alloy briquette for use in the cupola.

I claim:

1. The method of alloying gray iron in the cupola which consists in mixing only ferro-alloy fragments and about 5% of a binder taken from a group consisting of tar and pitch and forming the mixture into highly compressed briquettes,

adding the briquettes to the cupola charge and melting the charge in the cupola to produce alloyed gray iron.

2. The method of alloying gray iron in the cupola which consists in mixing only ferro alloy fragments and about 5% of a binder taken from a group consisting of hot tar and pitch and forming the mixture into highly compressed briquettes, adding the briquettes to the cupola charge and melting the charge in the cupola to produce alloyed gray iron.

3. The method of alloying gray iron in the cupola which consists in mixing only ferro-alloy fragments and about 5% of a binder consisting of hot, high melting point tar and forming the mixture into highly compressed briquettes, charging the briquettes with pig iron and scrap into the cupola and melting the charge in the cupola to produce alloyed gray iron.

4. The method of alloying gray iron in the cupola which consists in mixing only ferro-alloy fragments and about 5% of a binder consisting of hot, high melting point pitch and forming the mixture into highly compressed briquettes, charging the briquettes with pig iron and scrap into the cupola and melting the charge in the cupola to produce alloyed gray iron.

5. The method of alloying gray iron in the cupola which consists in mixing only fragments of ferro alloys taken from a group consisting of chromium, silicon, manganese, copper, nickel, molybdenum and phosphorus, and about 5% of a binder taken from a group consisting of tar and pitch and forming the mixture into highly compressed briquettes, adding the briquettes to the cupola charge and melting the charge in the cupola to produce alloyed gray iron.

CALBERT L. VANCE.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,551,554	Greiner	Sept. 1, 1925

FOREIGN PATENTS

Number	Country	Date
157,947	Great Britain	Jan. 10, 1921