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CUPOLA MELTING OF CAST IRON

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1

This invention relates to the manufacture of cast iron, and more particularly to an improved process for melting cast iron in a cupola.

One of the principal limitations of conventional methods of cupola melting of iron is the sulfur increase resulting from absorption from the coke, a condition which limits the amounts of scrap and less expensive materials usable in the cupola charge and which frequently necessitates ladle desulfurization in order to maintain the sulfur content within specified limits. Another characteristic of the ordinary cupola procedure which places quality and economic restrictions on its use is that it does not decrease, and in some instances may increase, the phosphorus content of the metal charge, a fact which limits the extent to which the less expensive, high phosphorus irons can be used. A further limitation on the utility of conventional cupola melting processes resides in their inability to increase the carbon pick-up of the iron beyond a certain limited extent dependent upon the carbon content of the coke and metal charge, the result being that, when a high carbon iron is required, it is frequently necessary to use special materials such as lump graphite, pitch coke, special briquets and the like.

In addition to the more obvious advantages of cast irons which are low in sulfur and phosphorus and high in carbon, recent developments in the production of nodular graphite iron have placed further emphasis on the importance of the sulfur, phosphorus and carbon contents. Better alloy recovery and better control are obtained and the costly alloy is not consumed in desulfurizing, if the sulfur is low originally, while ductility advantages are realized more fully with a low phosphorus content. Since irons chemically suitable for nodular treatment currently require either electric furnace melting, large scale ladle desulfurization previous to alloy addition, or excessive and unpredictable loss of the special alloy, a less expensive, more direct method of obtaining molten metal of the desired characteristics would contribute materially to more economical production and greater use of nodular irons.

It is therefore one of the principal objects of the present invention to provide an improved process for melting cast iron in a cupola whereby low sulfur, low phosphorus, high carbon cast iron can be economically produced in a single melting operation.

Another object is to provide a novel procedure for the cupola melting of iron which will enable

2

the production of types of iron heretofore unproducible in a cupola and will permit economies by the use in the charge of cheaper metals previously limited in their utility because of their unfavorable chemistry.

A further object of the invention is to provide a method for melting cast iron in a cupola which is characterized by a higher melting temperature and a faster rate of melting than could be attained by operating the same cupola in the usual manner.

Still another object is to provide a cupola melting process which greatly increases the carbon pick-up of the iron in comparison with conventional procedures, and thus permits more economic production of low phosphorus iron from large proportions of steel scrap.

A still further object is to provide a process which is effective to desulfurize cast iron while it is being melted in a cupola, thereby avoiding the necessity for, and disadvantages incident to, subsequent desulfurization treatment in the ladle.

Another object is to provide an improved process for the cupola melting of cast iron which produces irons of high quality, including those suitable for nodular graphite treatment, directly and economically from starting materials having only a limited utility in ordinary cupola operations.

These and other objects, including minimization of losses of oxidizable elements in the cupola charge and the reduction of some elements from their oxides, will appear more fully as the description of the invention proceeds.

I have discovered that the addition of a relatively small amount of calcium carbide to the cupola charge is effective to produce results and advantages not heretofore attainable by conventional cupola melting procedures and is superior, particularly from the standpoint of economy, to the various special treatments which have been suggested for the purpose of attaining results similar to those obtained by the present invention.

Although it has long been recognized that improved desulfurization efficiency can be attained in the making of steel when a small concentration of calcium carbide is formed in, or added to, the slag, the practices employed in removing sulfur from steel are not applicable to the cupola melting of cast iron because the cupola, being a continuous, direct melting, shaft type furnace, has no open bath of molten metal which would permit manipulation of the slag. It has also

been proposed to use calcium carbide as a desulfurizing agent by adding it directly to molten cast iron in the ladle, but this ladle treatment not only increases the cost of manufacture, but requires additional handling and produces temperature losses and danger of slag inclusions, all of which are objectionable features. As far as I am aware, calcium carbide has never been used as a part of the cupola charge in the manner contemplated by the present invention.

In carrying out the process of the present invention, calcium carbide, preferably in the form of lumps from ½ inch to 3 inches in size, is mixed with the coke of the cupola charge in an amount such that the carbide constitutes between about 1% and 7% by weight of the metal portion of the charge. The amount of calcium carbide required for any particular charge will depend primarily upon the character of the metal, coke and other flux being used and the desired chemistry of the final metal, but may also be influenced by such other conditions as the desired temperature and rate of melting. Under ordinary or normal conditions of raw material quality and metal specification, from 2% to 4% calcium carbide will usually be sufficient for all practical purposes. However, when extremely low sulfurs, high carbons or high temperatures are desired, or when unusually high sulfur starting materials are used, from 4% to 7% calcium carbide may be necessary. On the other hand, when the metal charge is low in sulfur, as in the case of an all pig iron charge, from 1% to 3% carbide will suffice in most cases. A tabular summary of the conditions and results of a number of specific heats will be given hereinafter to indicate in detail how the invention may be applied in practice to various charge materials for the attainment of various results.

Although the carbide can be added with each individual coke charge, it has been found that maximum effectiveness is not realized until the carbide reaches the bed under the charges being melted, thereby producing a "lag" of approximately ten charges, depending upon the size of the charges in relation to the cupola diameter, the melting rate, etc. For example, in operating a 23 inch diameter cupola with 100 lb. metal charges, and adding the calcium carbide with each charge, the maximum temperature and highest carbon and lowest sulfur levels were reached after from eight to ten charges had been melted, equivalent to 30 minutes melting time or about 30–40 inches of charge descent. Accordingly, in order to compensate for this "lag" and to obtain the maximum effects with optimum uniformity, it is preferable to omit the carbide from the lower half of the bed, say for a distance of about 20 inches above the tuyères, to distribute it uniformly throughout the coke in the upper half of the bed, and then add it with each coke charge or "split" until about the tenth charge from the last, i. e., until approximately 30 minutes from the end of the heat.

While the process of the present invention is applicable to any cupola or other type of direct melting, shaft type furnace, all of the improved results and advantages thereof are realized most completely when the process is carried out in a basic lined cupola wherein slags of high basicity can be maintained. For example, a cupola lined with dead burned magnesite brick laid with magnesite mortar has been found to produce excellent results. Dolomite refractories were equally successful chemically, although somewhat inferior to magnesite from a refractory standpoint. Heats run in a conventional acid lined cupola produced the same effects as those attained in the basic lined cupola, but to a less degree.

Whereas cupola melting of cast iron in the usual manner normally produces an increase of about .05% in the sulfur content of the molten iron in comparison with that of the metal charge, because of absorption of sulfur from the coke, the use of calcium carbide in the cupola charge in accordance with the present invention has removed as much as .187% sulfur from a high sulfur scrap charge which would be otherwise worthless. With metal charges of conventional character, the addition of carbide has produced cast irons having a sulfur content only a fraction as high as that resulting from normal cupola melting procedures. As an example of the extent to which desulfurization can be carried by the present process, it will appear from the data hereinafter set forth that cast iron having a sulfur content as low as .009% has been produced by the use of calcium carbide in the cupola charge, a result heretofore attainable only by the most expensive basic electric process. In the above mentioned case where .187% sulfur was removed, 5% calcium carbide was added to the coke with an all scrap charge having an initial sulfur content of .287%, while the .009% sulfur content resulted from an all pig iron charge and a 6% addition of calcium carbide. Such desulfurization efficiency permits the use of more high sulfur scrap by foundries and extends the field of utility of the cupola in duplex steel making.

In addition to highly efficient desulfurization, another advantage of the use of calcium carbide in the cupola melting of cast iron which is of great economic importance is the substantially increased carbon pick-up which results therefrom and which in turn provides indirectly the additional effect of lowering the phosphorus content, because increased carbon absorption permits the use of larger proportions of less expensive, low phosphorus steel scrap with the attendant considerable saving in cost. As will also appear hereinafter, the increase in carbon pick-up incident to the use of calcium carbide in the cupola charge is sufficient to produce cast iron containing over 3.20% carbon from all steel charges. As an example of the economic importance of the phosphorus content, the following figures represent the comparative costs per gross ton, including freight, of pig iron, cast iron scrap and steel scrap of different phosphorus contents as delivered at the same foundry:

	Phosphorus Content	Total Cost Per Ton
	Percent	
Low phosphorus pig iron	.05	$63.50
Medium phosphorus pig iron	.20	55.00
Southern high phosphorus pig iron	.75	39.00
Cast iron scrap	.20–.80	37.00
Steel scrap	.05	32.65

In order to determine the economies obtainable by use of the present process due to its increased carbon pick-up, a cost comparison was made between the production of a 3.5% carbon cast iron of a very low sulfur and phosphorus content from an all steel charge to which 3% calcium carbide was added in a basic lined cupola, and the production of iron of similar analysis (except for a much higher sulfur content) from two different conventional charges in a conventional

cupola. The comparative metal costs were as follows:

Heat I.—Basic lined cupola with 3% calcium carbide added

[Sulfur .026%—melting temperature 2,900° F.]

100% steel scrap, 2,000 lbs. at $32.65 per ton	$29.20
2.80% silicon as 75% FeSi, 75 lbs. at 10½ cents per lb	7.88
3.0% calcium carbide, 60 lbs. at 6 cents per lb	3.60
Additional cost of basic lining, fluxes, etc	2.40
	$43.08

Heat II.—Conventional cupola

[Sulfur .090%—melting temperature 2,750° F.]

80% low phosphorus pig (1.50% Si), 1,600 lbs. at $63.50 per ton	$45.40
20% steel scrap, 400 lbs. at $32.65 per ton	5.83
1.40% silicon as 75% FeSi, 37.4 lbs. at 10½ cents per lb	3.93
	$55.16

Heat III.—Conventional cupola

[Sulfur .070%—melting temperature 2,700° F.]

100% low phosphorus pig (1.50% Si), 2,000 lbs. at $63.50 per ton	$56.60
1.10% silicon as 75% FeSi, 30 lbs. at 10½ cents per lb	3.15
	$59.75

As will be seen from these figures, after adding the cost of the calcium carbide, additional silicon, basic lining, fluxes, etc., the all steel-calcium carbide heat according to the present process had a cost advantage of approximately $12.00 net per ton of metal over the currently conventional charges and procedure. If the temperatures and sulfur contents of Heats II and III were adjusted to meet those of Heat I, the cost advantage of the latter would be even greater. For example, to lower the sulfur content of Heat II from .090% to .026% would require a ladle treatment costing from $1.00 to $3.00 per ton, while to deliver the cast iron at the same temperature after desulfurization would involve the additional cost of producing a 200° F. increase in temperature.

The production of an increased melting temperature is another advantage of the process of the present invention, particularly in comparison with the net temperature loss which results when ladle desulfurization is necessary of molten cast iron produced in accordance with conventional cupola practice. Although it was well known that to increase the amount of ordinary flux in

the cupola charge would effect a substantial decrease in the melting temperature, it has been found that the addition of calcium carbide to the charge brings about a material increase in the melting temperature, in addition to the other reactions produced. For example, whereas an increase in the amount of ordinary flux by 7% (based on the weight of the iron charge) normally decreases the melting temperature from 30° to 80° F., the addition of from 5% to 7% of calcium carbide, likewise based on the weight of the metal charge, produces an increase in the melting temperature of over 100° F. The temperature increases obtained by the use of calcium carbide result in temperatures well above the maximum normally obtainable in the same cupola even under optimum conditions of conventional operation, and are attained without requiring structural modification of the cupola or subsequent heating in a bath type furnace, expedients that would ordinarily be required in order to reach the same temperature without the use of calcium carbide.

Below the maximum temperature limit, increases in melting temperature in the conventional cupola normally require increased quantities of fuel and a sacrifice of output. On the contrary, the addition of small percentages of calcium carbide to the charge produces an increased temperature with an actual decrease in quantity of fuel required and an increase in output. For example, a 7% addition of calcium carbide with each coke charge permits reduction of the coke from 17% of the metal charge to from 4 to 6% thereof, while at the same time producing a 20° F. higher temperature and a 40% increase in melting rate.

In order to indicate the scope and manner of practical application of the present invention, the following tabulation sets forth the conditions and results of a number of typical heats wherein cast iron was melted in a basic lined cupola in the presence of a small amount of calcium carbide. In this table, the percentages of carbide, flux and coke are all based on the weight of the metal charge, while the figures given as to the amounts of sulfur, carbon, silicon, manganese and phosphorus in the charge and in the final product are the averages of from three to seven analytical determinations.

Heat No.	Metal Charge	Calcium Carbide	Flux		Coke	Temperature (°F.)	
			Limestone	Fluorspar		Max. Level	Convent.
			Percent	*Percent*			
1	High sulfur remelt	5% (Charge)	5	2	14% foundry	2,740	2,720
2	do	6% (Bed)	5	3	do	2,815	2,720
3	do	3% (Bed)	5	3	do	2,780	2,720
4	All steel	6% (Bed)	5	3	16% foundry	2,935	2,800
5	do	3% (Bed)	5	3	do	2,920	2,800
6	do	1½% (Bed)	5	3	do	2,880	2,800
7	70% steel, 30% pig	6% (Bed)	5	2	17% high sulfur	2,900	2,750
8	do	do	5	2	do	2,920	2,750
9	Pig iron	5% (Charge)	5	2	14% foundry	2,730	2,700
10	do	6% (Bed)	5	3	do	2,780	2,760
11	70% steel, 30% pig	7% (Charge)		1	17% high sulfur	2,870	2,750
12	do	do		1	12 high sulfur	2,880	(1)
13	do	do		1	9% high sulfur	2,900	(1)
14	do	do		1	6% high sulfur	2,880	(1)
15	do	do		1	4% foundry	2,820	(1)

[1] No adequate basis available for estimating.

(Charge) indicates that all of the calcium carbide was added with the individual coke charges.

(Bed) indicates that some of the calcium carbide was distributed with the coke in the top half of the bed and the remainder was added with the coke charges until ten charges from the end of the heat.

Maximum temperature level was the stream temperature averaged for three optical pyrometer readings after overcoming the chilling effects of a cold trough, etc.

Convent. indicates the approximate temperature that would be expected from the same charge, omitting the calcium carbide, melted in a conventional acid lined cupola, based on experience and the literature.

Heat No.	Percent Sulfur Content			Percent Carbon Content			Percent Other Elements (Final)		
	Charge	Final	Convent.	Charge	Final	Convent.	Silicon	Manganese	Phosphorus
1	.287	.100	.250+	2.20	2.89	2.70	1.79	.81	.25
2	.134	.016	.159	2.30	3.83	2.80	1.85	.72	.03
3	.119	.031	.140	2.48	3.62	3.00	2.31	.89	.03
4	.050	.025	.140	.20	3.52	2.20	2.67	.88	.02
5	.050	.026	.140	.20	3.50	2.20	2.41	.89	.03
6	.050	.047	.140	.20	3.19	2.20	2.40	.85	.02
7	.060	.032	.230	1.20	3.30	2.40	2.13	.74	.22
8	.060	.037	.230	1.20	3.65	2.40	2.10	.68	.04
9	.030	.010	.070	4.20	4.17	3.70	2.37	.11	.03
10	.030	.009	.070	4.20	4.23	3.70	1.98	.14	.04
11	.060	.059	.230	1.20	3.30	2.40	2.06	.74	.31
12	.060	.111	(1)	1.20	2.64	(1)	1.98	.72	.31
13	.060	.116	(1)	1.20	2.60	(1)	1.86	.71	.26
14	.060	.172	(1)	1.20	2.39	(1)	1.99	.66	.31
15	.060	.085	(1)	1.20	2.75	(1)	2.03	.71	.19

[1] No adequate basis available for estimating.

Convent. indicates the approximate analysis that would be expected from the same charge, omitting the calcium carbide, melted in a conventional acid lined cupola, based on experience and the literature.

The properties of the two types of coke used in the heats of the above tabulation were as follows:

	Foundry Coke	High Sulfur Coke
Sulfur, percent	.65–.85	2.0
Volatile, do	.60–1.00	5.0
Ash, do	9.0–10.5	14.0
True Specific Gravity	1.85–1.95	1.97
Apparent Specific Gravity	.95–1.05	.98
Porosity, percent	48.0–51.0	50.5
Shatter Test, 2" plus, do	81.0–86.0	83.5
Ash Composition:		
SiO_2, percent	52	40
Fe_2O_3, do	10	24
Al_2O_3, do	30	20
CaO, do	2.3	10
MgO, do	1.3	
Sulfates, do		5

In heats 1, 2 and 3 of the table, high sulfur scrap charges were melted which ordinarily could not be used in conventional cupola operations. The low sulfur contents obtained indicate the powerful desulfurizing capacity of the calcium carbide when added within the cupola. Heats 4, 5 and 6, wherein all steel charges were melted, illustrate the greatly increased carbon pick-up combined with desulfurization which provides a new method of producing a low phosphorus, low sulfur iron. In heats 7 and 8, 70% steel charges were melted with a high sulfur coke which would normally produce an iron having over .230% sulfur and less than 2.40% carbon, and would therefore be considered unsuitable for cupola use. However, with aid of a 6% addition of calcium carbide in these two heats, very low sulfurs of .032% and .037% were obtained along with sufficiently high carbons of 3.30% and 3.65%. Heats 9 and 10, using charges of all pig iron, produced the extremely low final sulfur contents of .010% and .009% directly from the cupola, as effective a desulfurization as could be obtained by any of the more expensive melting methods. Heats 11, 12, 13 and 14, using a 7% carbide addition and a high sulfur, low quality coke, show that, as the amount of coke was reduced in steps from 17% to 6%, the sulfur content increased and carbon content decreased, but the temperature level was maintained and the melting rate was increased 40%. These results indicate that, where the final sulfur and carbon contents are not of paramount importance, greater utilization can be made of the thermal advantages of calcium carbide by substituting it for a portion of the coke. Heat 15 is an example of a successful melt made with a 7% carbide addition and a foundry coke charge amounting to only 4% of the metal charge. In the latter instance, the temperature and chemistry were comparable with, and the output was greater than, the results that would have been obtained using 15–20% coke without the carbide.

As indicated in the foregoing tabulation, in some of the heats all of the calcium carbide was added with the individual coke charges, while in other heats the carbide was uniformly distributed with the coke in the top half of the bed and then added with each coke charge until about ten charges from the end of the heat. For example, in heat 5, after 130 lbs. of the bed coke had been laid, 2 lbs. of calcium carbide were added with each 16 lbs. of coke for eighteen buckets to complete the bed. After "lighting off" and "burning the bed," the cupola was charged, 2 lbs. of carbide being added to each of the first five coke charges, but none to the last ten. There was thus added to the coke a total of 46 lbs. of carbide, or approximately 3% of the total metal charge of 1500 lbs.

As pointed out above, all of the heats tabulated were carried out in a basic lined cupola. Other heats have been made, however, using calcium carbide in a conventional acid lined cupola and have produced the same results in kind, but not to the same degree, as those realized in the basic lined cupola. For example, a 70% steel, 30% pig iron charge melted in an acid lined cupola with a 4% addition of carbide experienced a .100% sulfur instead of .130%, a 2.82% carbon instead of 2.50%, and a temperature increase from an average of 2780° to 2860° F.

The reactions resulting from introduction of calcium carbide into the cupola charge which account for the simultaneous temperature increase, sulfur reduction and carbon pick-up are not yet fully understood. Whether the reaction takes place from continual contact of molten metal with carbide in the basin of the cupola, from the local reducing effect of hydrocarbon gases produced from the decomposition of the carbide from atmospheric moisture, from contact of metal drops with the unmelted carbide, or from a surface reaction between the carbide and the iron oxide in the slag drops, is debatable. It is also possible, of course, that a combination of several reactions may occur. However, the delayed effect and the presence of some unconsumed carbide in the "bottom drop" of some heats has led to the conclusion that the carbide

is not immediately melted or decomposed, a conclusion which is also supported by the fact that locating all of the carbide in the cupola basin produced some of all of the effects obtainable by the use of carbide, but not to the extent experienced when all the carbide was distributed throughout the coke bed, and the further fact that carbide briquets have proved less effective than bare lump carbide.

From the experiences encountered in practicing the process of the present invention, it would seem that the principal effect derived from the use of calcium carbide results from a reaction at the surface of the carbide with the molten iron and slag, a reaction which seems more active at the higher temperatures obtained in the melting zone. Apparently, metal drops impinging on the surface of the carbide lumps at a temperature of from 2000° to 3000° F. absorb carbon from the carbide while the carbide absorbs sulfur from the metal. The reaction appears to be exothermic and thereby superheats the metal drops. The decomposition product of the carbide, calcium oxide, would then contribute to slag basicity and retain as calcium sulfide the sulfur absorbed from the metal. It also seems likely that slag drops impinging on the surface of the carbide produce a reaction reducing the iron and other oxides, and also absorb the calcium oxide from the decomposed carbide, and possibly some calcium carbide. Such a slag, with increased basicity, decreased iron oxide and some residual calcium carbide, would have considerable capacity to absorb sulfur during its further descent and after contacting the metal in the basin of the cupola.

The experience with coke reductions suggests that carbide might simply burn in the presence of air if sufficiently heated and if initiated or catalyzed by one of these other reactions. Of course, any carbide prematurely decomposed by reaction with moisture would produce the very reducing acetylene gas and basic calcium oxide with conceivably similar results. Likewise, any unconsumed carbide that might reach the basin could still continue its effect, but with decreased efficiency.

Whatever may be the nature of the reactions in question, it has been established that the addition of small percentages of calcium carbide to the cupola charge results in improved desulfurization, greater carbon pick-up and an increased melting temperature, all of which effects are of decided advantage and benefit in the cupola melting of cast iron.

Other results of the use of calcium carbide in accordance with the present invention which may be of advantage in special applications include the production of a more thoroughly deoxidized iron, decreased loss of oxidizable elements, and the reduction of some elements from their oxides. It has been suggested that variations in the residual iron oxide content of cast iron have a considerable effect on graphitization and subsequent properties of the iron, and various special reducing materials have been offered commercially for the purpose of producing a more thoroughly deoxidized iron from the cupola. The decreased amount of iron oxide in the slag produced by the present process indicates that calcium carbide is far more powerful in deoxidation effectiveness than any of the special reducing materials now available. As indicative of the effect of the present invention in minimizing losses of oxidizable elements in the cupola charge, it is noted that the heats represented by the foregoing tabulation, particularly those numbered 2–10, experienced considerably lower losses of silicon and manganese than comparable heats made without the use of calcium carbide, and only half the losses in many cases, a result which is consistent with the more thoroughly deoxidized iron and the lower slag iron oxide. In addition to the economic advantage resulting from reduced consumption of silicon and manganese, the decreased loss of oxidizable elements incident to the present process points to the possibility of using some of the more readily oxidizable alloys in the cupola which ordinarily experience excessive loss. That the strong reducing action of the calcium carbide may be utilized in the cupola or in other shaft type furnaces, such as the blast furnace, to deliberately reduce certain alloys from their oxides is suggested by the fact that as much as .005% magnesium, which is one of the more difficult elements to reduce, has been obtained in iron melted in accordance with the present invention by chemical reduction of the magnesium oxide refractories. It is also possible that, with the aid of carbide, the reduction of certain metal oxides might be obtained either in furnaces of simpler construction, at a faster rate, or with greater efficiency.

There is thus provided by the present invention an improved process for the cupola melting of cast iron which produces benefits and advantages unattainable by the various procedures previously practiced, and which makes possible substantial savings in cost because of the capacity of the process to function with relatively low cost starting materials having only a limited utility in conventional cupola operations. Among the more important results flowing from addition of relatively small amounts of calcium carbide to the cupola charge in accordance with the invention are the following: greatly increased carbon pick-up which permits more economic production of low phosphorus iron from large proportions of steel scrap; desulfurization directly within the cupola sufficient to permit economic reclamation of low cost, high sulfur materials; increased melting temperature beyond the maximum attainable in the conventional cupola, and increased melting rate; decreased loss of oxidizable elements, reduction of some elements from their oxides and a more thoroughly deoxidized cupola iron. It will be evident that the present invention thus materially extends the field of utility of cupola melting of iron and makes it possible to obtain in the cupola results which differ in both kind and degree from those heretofore realized.

Although a number of specific examples have been given herein of the manner in which the invention may be carried out in practice, it will be understood that these examples are illustrative only and are not intended to represent the full scope of the inventive concept. Reference is therefore to be had to the appended claims for a definition of the limits of the invention.

What is claimed is:

1. The method of melting iron metal which comprises the steps of introducing into a shaft type furnace above the melting zone thereof a charge containing coke, iron metal and calcium carbide in solid form, and melting the metal portion of the charge by combustion of the coke in the presence of the calcium carbide so that the drops of molten metal and slag contact di-

rectly with solid carbide surfaces in the melting zone.

2. The method of claim 1 wherein the amount of calcium carbide in the charge is from 1% to 7% by weight of the metal portion of the charge.

3. A process of producing low sulfur, high carbon cast iron directly from a cupola, without subsequent treatment, which comprises the steps of introducing into a cupola at a point substantially above the melting zone thereof charges containing iron metal, coke and calcium carbide in solid form, melting the metal portion of the charges by combustion of the coke in the presence of the calcium carbide, and utilizing the products of combustion to heat the carbide during descent of the charges to the melting zone.

4. The process of claim 3 wherein the calcium carbide is mixed with the coke portion of the charges and constitutes from 1% to 7% by weight of the metal portion of the charges.

5. The process of claim 3 wherein the metal portion of the charges has a sulfur content in excess of .1%.

6. The process of claim 3 wherein the metal portion of the charges contains over 50% steel.

7. The process of claim 3 wherein the cupola is provided with a basic lining.

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