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REPORT NO. 324/4

LETTER FROM ELECTRO METALLURGICAL COMPANY

MARCH 25, 1936

WATERTOWN ARSENAL
WATERTOWN, MASS.

F. A. Form No. 34.

Frankford Arsenal—6-3-36—1000

Report No. 324/4
Watertown Arsenal

ELECTRO METALLURGICAL COMPANY

Unit of Union Carbide and Carbon Corporation

UCC

324/4

MANUFACTURERS "ELECTROMET" BRAND
FERRO-ALLOYS AND OTHER ELECTRO METALLURGICAL PRODUCTS

CARBIDE AND CARBON BUILDING
30 EAST 42ND STREET, NEW YORK

March 25, 1936

The Commanding Officer
Watertown Arsenal
Watertown, Mass.

Attention: Walter G. Donald, First Lieutenant, Ordnance Dept.

Gentlemen:

Your letter of March 18 in reference to the use of zirconium addressed to our Dr. A. B. Kinzel, has been referred to us for attention. We do not know whether we can give you all the information you would like to have as we are not thoroughly familiar with the details of what you propose to do which will, of course, to a large extent determine the methods you should use.

We note that you wish information on the proper way to introduce zirconium as a deoxidizer in steel. We note further that you state that any previous attempts to do this at the Arsenal resulted in an almost complete loss of the zirconium added. From this it is not entirely clear to us whether you simply wish to deoxidize the steel or whether you wish to have some zirconium remain in the finished steel as an alloying element. If it is your intention to simply deoxidize the steel with a zirconium alloy then, of course, you would add only enough to take care of the deoxidation and you would not expect to find any in the finished steel.

Zirconium is a very reactive metal and when added to a steel that has not been thoroughly deoxidized it quickly reacts with the oxides present and a large portion, if not all of it, is slagged off. Where only deoxidation is required there is, of course, no objection to this and, as a matter of fact, in many cases it is highly desirable to remove all of the products of the deoxidation reactions.

When zirconium is to be used as a deoxidizer all of it should be added in the ladle. As a rule, it is not necessary to use more than about .10% zirconium, the usual limits being from about .06 to .15% depending on the melting process used and the composition of the steel to

be made. It also depends to some extent on the type of zirconium alloy used for making the additions. When a silicon-zirconium alloy, which is relatively high in silicon, is used, account must be taken of the silicon in this alloy as otherwise the specified maximum silicon content of the finished steel may be exceeded.

It has been found very satisfactory to add zirconium alloy to the ladle by placing the required amount of the crushed zirconium alloy in a paper bag and throwing this into the ladle after the bottom of it has become covered with a layer of molten steel. It can also be introduced by wrapping it in a thin sheet of steel and plunging this below the level of the molten steel bath.

If it is desired to have some zirconium remain in the steel, your procedure might have to be varied somewhat, particularly in those cases where you wish to add a substantial amount of zirconium.

Under date of February 25, 1936 we wrote to Mr. Eugene J. Ash, Associate Metallurgist at the Arsenal, as follows:

> "I have your letter of February 20 in reference to making experimental armor plate compositions containing various amounts of zirconium. We note that you expect to make these experimental compositions in a 60 lb. acid lined induction furnace and that you expect to use a 50% ferrozirconium for adding the zirconium to the melt. As zirconium is a very active deoxidizer it should be added as late in the melting operation as possible in order to prevent excessive loss of zirconium.
>
> The smaller amounts you contemplate using can undoubtedly be added shortly before pouring without any difficulty whatever. It might be well to put the zirconium in a small metal can tied to the end of a steel rod and plunge this under the surface of the steel in order to prevent excessive loss. In those cases where you want to add as much as 2% zirconium it may be necessary for you to allow some time for all of the ferrozirconium to go into solution. If the material is in lump form and the amount of slag on your experimental melt is small, you can probably add it direct and obtain a fair recovery. On the other hand, you might find it necessary to crush it fairly fine and to put it in a metal container.
>
> You will probably have to do a little experimental work to determine just what excess of zirconium it will be necessary

for you to add to obtain the percentages you wish in the finished steel. In the case of the smaller amounts your recovery will probably be quite low unless the steel is very thoroughly deoxidized before the ferro-zirconium is added. In the case of the larger amounts, the recovery should be quite high unless an unnecessarily long time is allowed for the zirconium to go into solution.

We hope that these rather general suggestions will be of some help to you in making these experimental heats. We are enclosing herewith the methods developed and used in our Laboratories for the determination of zirconium in plain carbon and alloy steels. We believe these methods are described in sufficient detail for your needs but if they are not, please feel free to call on us for any additional help you may require."

We believe that you would be interested in a number of technical papers which have been presented before various engineering societies as these give much information regarding the effects to be obtained from the use of zirconium, the proper method of adding it, and various other details in which we are sure you would be interested. Unfortunately we do not have extra copies of any of these papers available but you can obtain them, we believe, in your own library or in the Boston library. The more important of these papers are:

"Some Effects of Zirconium in Steel," by F. M. Becket, Transactions of the American Electrochemical Society, Spring Meeting, May 5, 1923.

"A Melting Record of Three Acid Open-Hearth Heats," by W. E. Griffiths and C. E. Meissner. Paper presented before Tenth Annual Convention of the American Society of Steel Treating, Philadelphia, Pa., October 8 - 12th, 1928.

"Some Effects of Zirconium in Steel," by A. L. Feild, Transactions of the American Institute of Mining and Metallurgical Engineers, 1923, Vol. LXIX, pp. 848 - 883.

"Effects of Zirconium on Hot Rolling Properties of High Sulphur Steels and Occurrence of Zirconium Sulphide," by A. L. Feild, Transactions of the American Institute of Mining and Metallurgical Engineers, 1924, Vol. LXX, pp 201 - 223.

We trust that the above will be of some help to you but if the information is not in sufficient detail for your needs, please advise us and we will do our best to give you additional information.

Very truly yours

ELECTRO METALLURGICAL COMPANY

G. K. Herzog

GKH:MVG

G. K. Herzog