METHODS OF THE CHEMISTS OF THE UNITED STATES STEEL CORPORATION FOR THE SAMPLING AND ANALYSIS OF PIG IRON

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UNITED STATES STEEL CORPORATION

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United States Steel Corporation

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SAMPLING AND ANALYSIS

OF

PIG IRON

PUBLISHED BY
CARNEGIE STEEL COMPANY
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PITTSBURGH, PENNA.

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PREFACE.

This pamphlet is intended to supersede one of a similar title, published by the Carnegie Steel Company, and first issued in 1912. Inasmuch as the methods for the sampling and analysis of pig iron have undergone considerable changes since the appearance of the former pamphlet, many of the methods as given therein may no longer be considered as representing good modern practice. A committee chosen from the chemists employed by the various subsidiary companies of the United States Steel Corporation was therefore appointed to revise and, if necessary, rewrite this pamphlet.

At its first meeting this committee decided that the pamphlet should be rewritten. In order to acquire complete knowledge of the latest practices, and for guidance in its work, the committee solicited the chemists of the various Works of the Corporation for recommendations concerning methods and operations that might be considered improvements over those appearing in the original edition. These recommendations have been given due consideration in the preparation of this pamphlet.

The committee of chemists under whose direction this pamphlet is produced is composed of the following persons: W. B. N. Hawk, Chief Chemist, Lorain Works, The National Tube Company; William Brady, Chief Chemist, South Works, Illinois Steel Company; and H. E. Campbell, Chief Chemist, Clairton Works, Carnegie Steel Company.

SAMPLING.

INTRODUCTORY REMARKS.

Rapid determination of the constituent elements of pig iron, with the exception of sulphur by the volumetric method, is susceptible of a very satisfactory degree of accuracy. With respect to sulphur the volumetric method is the only one, up to the present, by which the determination can be made within the time limits fixed upon the iron laboratory. The degree of accuracy attainable in a volumetric determination of sulphur, however, is largely dependent upon the grade of the iron and the condition under which the test is taken. A method of sampling molten iron which produces a highly chilled test, such as the water shot method, is not desirable, because such a condition in a test piece is conducive to low results when sulphur is determined thereon by the volumetric method. This is due to the fact that, upon dissolution of chilled iron in hydrochloric acid, volatile organic sulphur compounds are formed, which are lost in the process of volumetric determination on account of the inability of the absorbent solutions employed to retain them. The use of such chilled tests makes it necessary to anneal the sample previous to making the determination for sulphur, an operation that lengthens the time of and complicates the determination and is, therefore, to be avoided.

Inasmuch as the condition of chill is the predominant influence which causes the formation of non-absorbable gases, it is evident that a successful method for sampling molten iron should yield a test piece which is free from this objectionable condition. The method of casting in sand meets these requirements, and it has been found, moreover, that a sand cast sample gives an accurate measure of the sulphur content by the volumetric method. However, owing to the danger of contamination from the sand, this sand test is not suitable for the determination of silicon, nor has any method, practical for routine work, been devised for combining sand tests from different parts of a cast into one representative analytical sample.

The methods for sampling which are recommended herein, viz., the plate test method and the mould test method, do not give tests which are

entirely free from chill. However, the rate of cooling is not too rapid, evidently, to prevent certain transformations that take place on slow cooling, for it has been shown by a series of comparative tests by a number of chemists of the Corporation that there is a very satisfactory agreement in sulphur values as obtained by the evolution method on samples taken by these methods and by the sand cast method. Therefore, it has been decided to adopt these methods as standard procedure where molten iron is to be sampled.

SAMPLING OF MOLTEN METAL FROM THE BLAST FURNACE.

APPLIANCES FOR SAMPLING.

A spoon, or ladle, and either moulds or an iron plate are employed in taking samples of pig iron in the molten state. The spoon is similar to or the same as that employed about the furnaces regularly in taking fracture tests.

DESCRIPTION OF MOULDS AND PLATES.

Two forms of moulds are recommended, and the use of either is sanctioned. These moulds are made of cast iron, and are illustrated in detail, with dimensions, in figures 1 and 2. Both, it will be noted, are designed so that pieces of approximately the same size may be broken from different tests, thus making it convenient to combine individual tests into one representative sample of any body of molten metal.

The mould in figure 1 gives a test which may be conveniently broken into small pieces suitable for crushing. The number of the furnace may be cast in the mould with Roman numerals, or if the furnace is designated in another way, some other suitable symbol may be used. The two ridges shown in the test in this figure indicate that the test is taken from furnace No. 2.

The mould in figure No. 2 furnishes a test which may be either drilled or crushed. If the sample is to be crushed, the notched prolongation "T" is broken and crushed, and the main body of the test is reserved for the furnaceman's fracture test. The furnace number may be cast in this mould, but not so conveniently as the mould described above and only in the main body of the test.

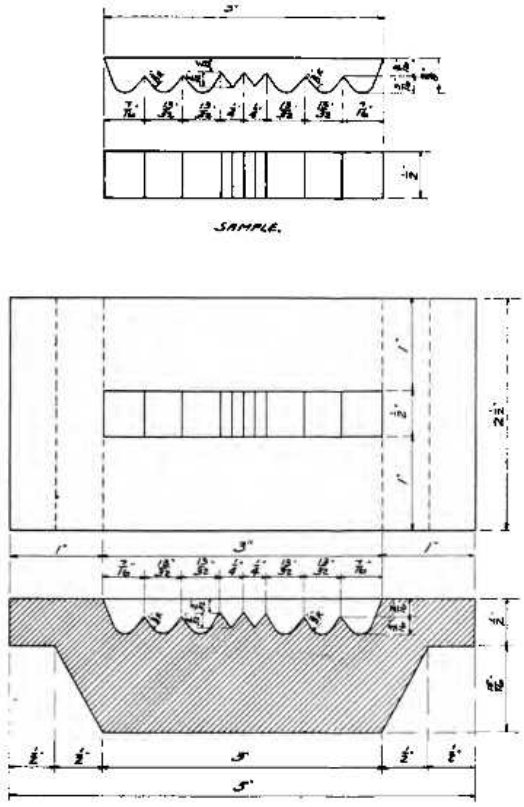

FIG. 1. TEST PIECE AND MOULD FOR SAMPLING MOLTEN PIG IRON FOR CHEMICAL ANALYSIS.