

drochloric acid. The contents of the beaker were then boiled, after the first action was completed, until the chromate and permanganate were reduced. An addition of 10 cc. of nitric acid (1.20) followed, and the analysis was carried out exactly as given for chromium-nickel steels, using twenty-four grams of citric acid. The results obtained are given in Table 4. Sulphuric acid was added as in the process for steels.

TABLE 4.

Per cent. of Metals.			Gram of Nickel.		
Ni.	Mn.	Cr.	Fe.	Added.	Found.
41	20	10	30	0.2059	0.2058
20.6	40	20	20	0.1029	0.10228
15	60	15	10	0.0750	0.0752
1.5	95.5	1	2	0.00749	0.00762
0.25	94.9	2	2.9	0.00124	0.00122
—	94.9	2	4	None	0.00006

Table 4 gives evidence of the fact that nickel can be accurately determined in the presence of large percentages of chromium and manganese, if the conditions herein given are carefully observed. In the hands of a practised operator no difficulty was experienced in the analysis when as much as 95 per cent. of manganese was in solution with but 0.25 per cent. of nickel.

LABORATORY OF PARK STEEL CO. WORKS OF  
THE CRUCIBLE STEEL CO. OF AMERICA.

## THE DETERMINATION OF SILICA AND ALUMINA IN IRON ORES.

BY G. W. DEAN.

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Further experience with the method which was described in this Journal last year<sup>1</sup> has led to its modification in two or three important particulars. It has been found that the ore may be ignited directly instead of separating and igniting the residue from digestion with hydrochloric acid. It has also been found that a porcelain crucible is the most suitable for the ignition, since the ore is less liable to be overheated and the alumina rendered insoluble. When the determination of alumina is not required, the use of stannous chloride aids greatly in dissolving the ore. It has also been found that by heating the ore with sulphur it is partly reduced in such a manner that it is more easily soluble in hydrochloric acid and the whole method can be used when it is desired to determine both silica and alumina. The methods which are now used are as follows:

*Determination of Silica Alone.* Weigh 0.5 g. of the finely pulverized ore (100 mesh), transfer to a 20 cc. porcelain crucible, cover and heat over a Dangler burner until the contents of the crucible are dull red, raise the temperature for a few seconds and then remove the crucible from the source of the heat. The whole operation should take not more than two or three minutes. Transfer the ignited ore when cold to a beaker, add 20 cc. strong hydrochloric acid containing one gram of stannous chloride

<sup>1</sup> This Journal, 28, 882.

in 225 cc. Boil vigorously until solution is apparently complete and for five or ten minutes longer. Twenty or thirty minutes will usually be enough. If the ore is very difficult to dissolve, a stronger solution of stannous chloride, or more of the same solution may be used. Dilute slightly, filter, and wash thoroughly first with dilute hydrochloric acid and then with water. Ignite and weigh the silica as usual.

2. *Determination of both Silica and Alumina.* Weigh 0.5 g. of the finely pulverized ore (100 mesh), transfer to a 20 cc. porcelain crucible and place on top 0.25 to 0.40 g. of sulphur, heat gradually until the ore is dull red and then raise the temperature slightly for ten seconds. Transfer to a beaker, pulverize the mass with a glass rod, add 25 cc. of hydrochloric acid and boil vigorously for fifteen minutes. Then add enough nitric acid to clear the solution and decompose the sulphides and boil vigorously for another five or ten minutes, repeating the addition of nitric acid and boiling if required. If dark particles remain undissolved after this treatment, it is probable that further treatment will not decompose them. Dilute, filter, wash and determine the silica, as before, and in the filtrate determine the alumina by any one of the various methods which are suitable. In this method the ignited mass is treated with hydrochloric acid first to gain the advantage of the reducing action of the hydrogen sulphide liberated from the sulphide of iron formed by the action of the sulphur. If the nitric acid is added at first, the advantage of this reducing action, is lost and the oxides of iron are often very difficult to dissolve.

The methods have been applied to the determination of silica in the following ores: (1) Arizona hematite; (2) Wyoming low grade hematite; (3) Alabama limonite; (4) Alabama hematite; (5) Magnanite from Llano County, Texas; (6) Michigan Magnetite; (7) Michigan hematite; (8) Mesabi limonite; (9) Mesabi decomposed hematite; (10) Swedish hematite; (11) Swedish magnetite; (12) Highly aluminiferous hematite from Baraboo iron district; (13) Hematite from Port Arthur field in Canada; (14) Bog iron from Nova Scotia. The results are as follows:

	Determinations are in duplicate.		Per cent. silica by above method
	Per cent. silica by Na <sub>2</sub> CO <sub>3</sub> fusion	Per cent. silica by Hydro- fluoric acid method	
1.	12.06—12.20	12.08—12.10	12.09—12.13
2.	21.27—21.22	21.11—21.20	21.26—21.23
3.	13.77—13.63	13.69—13.72	13.73—13.62
4.	11.99—11.82	11.88—11.94	11.92—11.83
5.	14.28—14.33	14.32—14.31	14.36—14.41
6.	9.91—9.99	9.82—9.89	9.80—9.81
7.	10.55—10.40	10.49— . . .	10.50—10.52
8.	8.02—8.00	8.15—8.10	7.99—8.08
9.	17.82—17.74	17.85—17.77	17.86—17.88
10.	7.09—7.13	7.00—7.04	7.06—7.01
11.	6.72—6.81	6.72—6.67	6.74—6.77
12.	31.12—31.18	31.09—31.12	31.08—31.11
13.	4.44—4.52	4.40—4.52	4.38—4.40
14.	2.06—2.05	2.08—2.03	2.09—2.00

It is evident from the above that the method gives accurate results when applied to a great variety of ores.

EAC CLAIRE, WISCONSIN.

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## A NEW SHAKING DEVICE FOR THE CHEMICAL LABORATORY.

BY J. M. CAMP.

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Among the various pieces of apparatus going to make up the equipment of the modern laboratory, it is the purpose of this article to describe the latest appliance, in the shape of a shaking device. It was designed and is particularly adapted for the purpose of hastening the precipitation of phosphorus by the well-known and almost exclusively used molybdic acid method, and in the solution of steels or pig irons for carbon combustion. But it is equally useful where agitation is desired in a flask for either dissolving or precipitating. As can be seen from the photograph, it consists of a frame supporting a vertical shaft, which is revolved by a six-inch pulley wheel. The upper part of the shaft is bent slightly from the perpendicular. Encircling the bent portion of the shaft is a hub which in turn supports a flat disc on which the flasks to be shaken are attached. The hub and disc are prevented from turning, when the shaft is revolved, by suitable teeth on the underside of the hub meshing into corresponding teeth on the top of the supporting frame.

On revolving the shaft the motion of the disc is ideal for the purpose intended, and can be best likened to the simultaneous pitching and tossing of the deck of a ship in a tumultuous sea. With each revolution of the shaft a wave travels around the flask or flasks on the disc exactly as in hand shaking, and by increasing or diminishing the number of revolutions the number and intensity of the wave movement is controlled. To obtain the maximum agitation and still retain the solutions in the flasks, without corking, from one hundred to one hundred and forty revolutions per minute has been found satisfactory. The disc is made to hold six flasks, any one of which can be placed in or removed from the machine in a fraction of a second. The gripping device is movable, up or down, enabling it to be quickly adjusted to hold any size flask from a six ounce to a twenty-four ounce Florence or Erlenmeyer. The electrical power required to operate it is twelve hundredths of an ampere on 250 volts, about the equivalent of the one twenty-fifth horse power, or less than the average desk fan motor is consuming, so that with the proper counter shaft to give the desired number of revolutions, any source of power may be used.

Heat can be applied to the apparatus if desired by means of a circular