FLAME COLOURATION BY MANGANESE

By

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I. FLAME COLOURATION BY MANGANESE

In table 1 are shown substances which give colouration to the flame of the Bunsen's burner along with their flame colour. In text-books of mineralogy manganese is not listed among them.

TABLE 1.

Flame colour	Substance
Yellow	Na
Violet	K
Scarlet	Li, Sr
Yellowish red	Ca
Yellowish green	Ba, PO_4, MoO_3
Green	CuO, TeO, ZnO, B_2O_3, Tl
Blue	As. Sb, Se, Te, Pb, $CuCl_2$, $CuBr_2$

A piece of manganese mineral, mounted on a loop of platinum wire, imparts at first a yellowish green and then a bright green colour to the flame of the Bunsen's burner. The mineral must have been moistened with hydrochloric acid before insertion in the flame. With nitric or sulphuric acid it gives no flame colouration. Such green colour seems to arise from the band spectrums characteristic to the chloride of manganese. A. MITSCHERLICH[1] reported the green spectrum line of chloride of manganese, and O. VOGEL[2] showed six bands in the green part of the spectrum between 600 $\mu\mu$

(1) A. MITSCHERLICH: Pogg. Ann., **116**, 499 (1862).
(2) O. VOGEL: Zs. f. anorg. Chem., **5**, 42 (1893).

and 500 $\mu\mu$ of wave lengths. All these papers, however, reported the flame colouration in the high temperature flame of the oxyacetylene burner or others. The colouration given by manganese in the flame of the Bunsen's burner and the alcohol lamp appears well worth recording, since manganese is not listed in the table of the flame-colouring elements.

II. FLAME COLOURATION GIVEN BY MANGANESE MINERALS

A few milligrams of manganese mineral were moistened with hydrochloric acid and were inserted in the oxidizing flame of the Bunsen's burner by means of a loop of platinum wire. Minerals which were difficult of decomposition by acid showed no marked flame colouration even when they contained plenty of manganese. For such resistant minerals the borax-bead test was preferable. In table 2 are shown the qualitative results of these tests performed on some manganese minerals collected in Japan.

III. INTERFERENCE OF OTHER FLAME COLOURS

As already shown in table 1 green colouration of the flame can be observed with materials containing Ba, P, B, Mo, Zn, CuO, Tl, etc.

Flame colouration by barium continues much longer and is more intense than that of manganese. Phosphoric oxide and boric oxide give similar green colours but they are obtained preferably when moistened with sulphuric acid, while flame colour by manganese can only be seen with hydrochloric acid. The splendid blue colour, shown by copper when wet with hydrochloric acid, can not be mistaken for the green colour given by manganese.

Green flame colours of Zn, Mo, TeO differ considerably from that of manganese in intensity and duration.

Interference of other constituents which also give flame colouration is not very serious. Only the blue flame colour of $CuCl_2$ and the yellow colour of natrium impede the detection of the green colour of manganese. The violet colour of potassium and the reddish yellow colour of calcium do not interfere. They appear side by side with the green flame of manganese. It is interesting that the flame colour test alone enables one to discriminate each calcite, mangancalcite and rhodochrosite.

TABLE 2.

No.	Mineral	Locality	Flame colouration		Borax bead test
			Bunsen's burner	Alcohol lamp	
1	Wad	Todoroki Mine	+++	++	+++
2	Todorokite	,,	+++	++	+++
3	Cupriferous wad	Teiné Mine	(−)	(−)	++ (1)
4	Cellular pyrolusite	Meppu Mine	++	+	+++
5	Massive pyrolusite	,,	+++	++	+++
6	Manganite	Yunosawa Mine	+++	++	+++
7	Manganosite	Manako Mine	+++	++	+++
8	Manganiferous limonite	Todoroki Mine	(−)	(−)	+
9	Penwithite	Kaso Mine	++	+	++
10	Alabandite	Yakumo Mine	+++	++	+++ (2)
11	,,	Kaso Mine	+++	+	+++
12	Rhodochrosite	Inakuraisi Mine	+++	++	+++
13	,,	Ôgane Mine	+++	++	+++
14	Rhodochrosite	Yunosawa Mine	+++	++	+++ (3)
15	Mangancalcite	Todoroki Mine	++	+	+++
16	,,	Teiné Mine	+	(−)	++ (4)
17	Irontephroite	Kaso Mine	+	+	++
18	Inesite	Todoroki Mi e	++	+	++
19	,,	Rendaizi Mine	+	+	++ (5)
20	Rhodonite	Ozaku, near the Kaso Mine	(−)	(−)	++
21	Spessartite	Kaso Mine	(−)	( )	++
22	Manganax nite	Obira Mine	(−)	(−)	+

* +++ strong, ++ moderate, + weak, (−) negative.

* Remarks 1. Covered by the flame colour of Cu.
2. Odour of hydrogensulphide.
3. Mixed with the flame colour of Ca.
4. Covered by the flame colour of Ca.
5. Mixed with the flame colour of Ca.

IV. FLAME COLOURATION AS A METHOD OF DETECTION OF MANGANESE

For the detection of manganese there are not a few excellent methods of which the borax-bead test, the soda-bead test, the sodium-persulphate test, and the sodiumbismuthate test are the most common. Of these four methods only the borax-bead test requires a considerable quantity of manganese, the other three tests being so delicate that they require only a bit of specimen. The flame colour test of manganese is less sharp than the borax-bead test, being successful only in the case of a content of manganese as high as 10%. With minerals not decomposable by hydrochloric acid, it is impossible to see the green flame, though the manganese content exceeds 20%.

The necessity of a high percentage of manganese to give green colouration is the characteristic feature of the flame colour test and the advantage of this method will also be found in this point.