VOL. XXII. [MARCH, 1900.] NO. 3.

THE JOURNAL

OF THE

AMERICAN CHEMICAL SOCIETY.

SUBSTITUTES FOR HYDROCHLORIC ACID IN TESTING CARBONATES.

BY JOSEPH W. RICHARDS AND NORMAN S. POWELL.

Received January 23, 1900.

THE following experiments were undertaken in the hope of finding a satisfactory substitute for hydrochloric acid in producing effervescence with natural carbonates. It is well-known that hydrochloric acid is difficult to carry in a portable set of apparatus, and while it is entirely satisfactory to use it in the laboratory, yet it would be very desirable to have some solid material to replace it in a portable testing outfit.

The materials tested as substitutes were potassium acid sulphate, citric acid, tartaric acid, and oxalic acid. These were made into solutions of the strength of 4 parts of water to 1 part of salt or acid, or 20 per cent. solutions. This would correspond roughly to dissolving a piece the size of a pea in 1 cc. of water. Such a solution, in a test-tube, makes a suitable reagent. Oxalic acid, however, requires about twice as much water as above given for complete solution. Therefore this was of about 10 per cent. strength.

The carbonates tested were as follows: calcite, dolomite, magnesite, siderite, rhodochrosite, smithsonite, aragonite, witherite, strontianite, cerussite, barytocalcite, phosgenite, malachite. azurite, hydrozincite, lansfordite.

These were taken as representative of the common natural carbonates. Each mineral both as lump and powder was tested in cold, warm, and nearly boiling solutions of each reagent. For convenience in recording the results, the following numbers are used in the table to designate the degrees of effervescence.

0. No action.
1. Gas evolved in traces.
2. Gas evolved faintly, but plainly.
3. Gas evolved freely, not strongly.
4. Gas evolved strongly.
5. Gas evolved violently.

The results were, in general, that the powder was acted on more violently than the lump, and the action was stronger as the solution was warmer; but there were exceptions to these rules, which will be noted.

POTASSIUM ACID SULPHATE.

(20 per cent. solution.)

Cold: Nearly half the carbonates were unacted on, or acted on only in traces. *Warm:* All were acted upon, but cerussite, strontianite and phosgenite only faintly, and witherite in traces. In these four cases, the insolubility of the sulphates of the bases present explains the faint action. *Hot:* All were acted upon, the majority strongly, but cerussite and phosgenite yet faintly. and witherite only in traces, as before. With careful observation, this test should positively detect any carbonate with the possible exception of witherite.

The action of this reagent on *calcite*, *dolomite*, and *magnesite*, is interesting. In lukewarm solutions the powders effervesce as follows: calcite strongly, dolomite freely but not strongly, and magnesite only faintly. This corresponds to their order with hydrochloric acid. But when a *lump* of each is put into *hot* solution, nearly boiling, the order is reversed: Calcite effervesces freely, dolomite strongly, and magnesite violently. The differences are very easily noted, and make this test quite practicable for distinguishing between these minerals. For distinguishing calcite from dolomite, the action of the cold solution on the powder is also decisive: calcite powder effervesces strongly, at once; dolomite powder only faintly.

OXALIC ACID.

(10 per cent. solution.)

Cold: About half the carbonates were unacted upon. *Warm:* All were acted upon, but nearly half only faintly; only two strongly. *Hot:* All were acted upon, the majority freely, a few only faintly, only one violently. With ordinary care in observing, this test is satisfactory for all the carbonates tried.

With calcite, dolomite, and magnesite, the effervescence increased in the order given. In cold solution, calcite was unacted upon either in lump or powder; dolomite showed traces of gas; magnesite showed gas evolved plainly. In hot solution, calcite effervesced freely but not strongly, dolomite strongly, magnesite violently. The insolubility of calcium oxalate accounts, of course, for this behavior.

CITRIC ACID.

(20 per cent. solution.)

Cold: About half the carbonates were unacted on, or acted on only in traces. *Warm:* All were acted on, about one-third faintly, one-third freely, and one-third strongly. *Hot:* All were acted upon, only three (phosgenite, rhodochrosite, and azurite), as low as freely, the rest being strongly to violently affected.

We recommend this reagent as entirely satisfactory, for testing either lump or powder in hot solution. This reagent also distinguishes clearly calcite from dolomite, for in cold solution calcite effervesces faintly to freely, and dolomite is entirely unacted upon.

TARTARIC ACID.

(20 per cent. solution.)

Cold: Only three carbonates were unacted upon, smithsonite, rhodochrosite, and phosgenite; about half were acted on faintly, the rest freely, one strongly. *Warm:* All were acted upon, one-third faintly, one-third freely, one-third strongly. *Hot:* All acted upon, only rhodochrosite and phosgenite as low as *freely*

		Potassium Hydrosulphate. 20 % solution.			Citric Acid. 20 % solution.			Tartaric Acid. 20 % solution.			Oxalic Acid. 10 % sol. with excess of undissolved acid.		
		Cold	Warm	Hot	Cold	Warm	Hot	Cold	Warm	Hot	Cold	Warm	Hot
Calcite	Lump	1 then stops	2	3	1–2	3½	4	2–3	3½	4½	0	1	3
	Powder	4 at once	4	4	2–3	4	5	3–3½	4	4½	0	2	3½
Dolomite	Lump	1 then stops	2	4	0	2	4	1½–1	2	4	1	2	3
	Powder	2	3	4	0	3	4	1	2	4½	1	3	4
Magnesite	Lump	2	3	5	2–1	2	4	2–1	2	4	2–1	3	4
	Powder	1	2	5	0	2	4	1	2	4½	1–2	3	5
Cerussite	Lump	2–1–0	2	3	1	2	4	1–2	3	4½	1	2	3½
	Powder	1	1	2	3–0	3	4	2–2½	2½	4	1	3	3½
Smithsonite	Lump	0	2	3½	0	2	4–3½	0	2	4	0	2	4
	Powder	1	3	4½	0	2	4	0	2	4½	2	3	4½
Witherite	Lump	0	1	1	2	3	4	2½	3	4½	4–1	2	4
	Powder	1	1	1	3	4	5	3	4	5	4–1	2	4
Strontianite	Lump	3–1	1	3–1	1	3	4	2	3	4	1	3	4
	Powder	3	2	3	2	3½	4	3	4	5	3	4	4½
Barytocalcite	Lump	2½–2	3	3½	2	3	4	2½	4	5	3–1	2½	4
	Powder	3	3½	4	3	4	5	3	4½	5+	3–1	3	4
Siderite	Lump	1	2	3–2	1	3	4–3½	2	2½	3½–3	0	2½	3½–3
	Powder	1	2½	3	1½	3	4	1	3	4	0	3	4½
Malachite	Lump	3	4	4½	2	3	4	2½	3	4	2½	3	4
	Powder	3½	4½	5	3	4	5	3	4	5	3	4	4½
Azurite	Lump	2½	3½	4½	0	2	3½	0	2	3½–3	1	2	3–2
	Powder	3½	4½	5	0	3	4	2	3	4	3–2	3	3
Hydrozincite	Lump	3	4	5	3	3½	4½	2	2	3½–3	1½	2	3–2
	Powder	3½	4	5	3½	4½	5	3	3	4	1	2	2½
Arazonite	Lump	2½–2	2	3½–3	3	3½	4½–4	2	3½	4½	2–1–0	2	4–3
	Powder	3	3½	4	3	4½	5	3	4	5	3	3½	4½
Phosgenite	Lump	1	1	2	0	2	3	0	2	3–2	1	2	3–2
	Powder	2	2	2½	0	3	4–3	1	3	3½	2	2½	3–2
Lansfordite	Lump	3	4	5	3½	4	5	3½	4	5	3½	4	5
	Powder	4	4½	5	4	4½	5	4	4½	5	4	4½	5
Rhodochrosite	Lump	1	2½	3–2	1	2½	3	0	2½	3½–2	1	2	3–2
	Powder	0	2	3½	0	2	3½–3	0	2½	3½–3	0	2	3½–3

5. Violently. 4. Strongly. 3. Freely, not strong. 2. Faintly, but plainly. 1. In traces. 0. No action.

not strongly, the rest being about half *strongly* and half *violently* affected. This reagent is satisfactory even in warm solution, and still better in hot solution.

Unlike citric acid, it causes dolomite to effervesce in traces even in the cold, while calcite is made to effervesce freely. The distinction is therefore not quite so sharp as with citric acid.

CONCLUSION.

Tartaric acid is the best of the four reagents; citric acid is a close second. Both give satisfactory results in every case tested, using lump or powder in hot solution. Oxalic acid also gives effervescence in every case, in hot solution, and is indeed a practicable reagent, but not so strong as the preceding. Potassium acid sulphate is satisfactory except in the cases of witherite and phosgenite; the rest average low, but the effervescence is sufficient to be easily observed. Bearing these exceptions in mind, it can be used if the other reagents are not at hand.

Some sulphides also effervesce with each of the reagents, giving off hydrogen sulphide, as with hydrochloric acid, and the odor of the gas coming off should therefore be tested, to make sure that the material is not a sulphide.

LEHIGH UNIVERSITY,
January 18, 1900.

REGULATIONS FOR THE TESTING OF THERMOMETERS.[1]

[As Adopted by the Physikalisch-Technische Reichsanstalt, April 1, 1898.]

I. PRELIMINARY REMARKS.

1. Glass thermometers filled with mercury, alcohol, toluene, or any other suitable liquid will be accepted for testing. They will be distinguished as:

a. Standard normal thermometers [*Haupt-Normalthermometer*];

b. Thermometers for scientific purposes (laboratory thermometers);

c. Thermometers for meteorological purposes and for estimating altitudes by boiling-point determinations;

d. Thermometers for technical purposes (factory thermometers);

---

[1] Translated for the use of the Committee on Standards and for the Journal of the Society by C. E. Linebarger.