

SORPTION OF GAS BY MINERAL. VI.

By Jitsusaburo SAMESHIMA and Noriyoshi MORITA.

Received June 25th, 1935. Published October 28th, 1935.

The present report is a continuation of the preceding one. The sorptions of ammonia and carbon dioxide by sepiolite, talc, serpentine, asbestos, acid clay, bentonite, and vivianite are described in this paper.

Sepiolite. The sepiolite from Eskihi-Sher, Asia Minor, has been used. This is a light, porous, opaque mass of white colour. The composition of sepiolite is $H_4Mg_2Si_3O_{10}$. The results of the measurements are given in Tables 1, 2, 3, and 4.

The sepiolite sorbs either ammonia or carbon dioxide in a considerable amount. The sorption of gas by this substance resembles that by the silica gel or charcoal, and may be classified as "the sorption of silica gel type".

Talc. The mineral from Kaijoken, Mukden, Manchukuo, has been used. It is a translucent white mass of greasy lustre and the density is 2.86. The composition of talc is $H_2Mg_3Si_4O_{12}$. The weight loss on heating at 200°C. for 2.5 hours under evacuation was only 0.03%. The dried substance thus obtained sorbed 0.22 c.c. (N.T.P.) of ammonia and 0.02 c.c.

Table 1.

Sorption of Ammonia by Sepiolite.

Mode of dehydration: Heating at 350°C. for 30 minutes under evacuation.

Loss of weight by dehydration: 20.68%.

Time (min.)	Vol. (c.c.) of NH ₃ (N.T.P.) sorbed at 25°C. and 1 atm. press. by 1 g. of sepiolite
1	60.1
5	81.8
30	92.5
60	96.1
300	103.0
1500	110.8

Table 2.

Sorption of Ammonia by Sepiolite.

Mode of dehydration: Heating at 200°C. for 2.5 hours under evacuation.

Loss of weight by dehydration: 17.45%.

Time (min.)	Vol. (c.c.) of NH ₃ (N.T.P.) sorbed at 25°C. and 1 atm. press. by 1 g. of sepiolite
1	102.9
5	123.1
30	124.9
360	125.7
5760	127.0

Table 3.

Sorption of Carbon Dioxide by Sepiolite.

Mode of dehydration: Heating at 350°C. for 30 minutes under evacuation.

Loss of weight by dehydration: 21.34%.

Time (min.)	Vol. (c.c.) of CO ₂ (N.T.P.) sorbed at 25°C. and 1 atm. press. by 1 g. of sepiolite
1	14.4
30	15.6
300	16.6

Table 4.

Sorption of Carbon Dioxide by Sepiolite.

Mode of dehydration: Heating at 200°C. for 2.5 hours under evacuation.

Loss of weight by dehydration: 17.24%.

Time (min.)	Vol. (c.c.) of CO ₂ (N.T.P.) sorbed at 25°C. and 1 atm. press. by 1 g. of sepiolite
1	22.8
5	24.7
30	24.9
1380	25.2

(N.T.P.) of carbon dioxide at 25°C. and 1 atmospheric pressure of gases. The present sample of talc sorbs, therefore, neither ammonia nor carbon dioxide.

Serpentine. The locality of the mineral used is Chichibu, Saitama Prefecture, Japan. It is a greenish mass and the density is 2.84. The composition of serpentine is $\text{H}_4\text{Mg}_3\text{Si}_2\text{O}_9$. The amount of sorption of ammonia is given in Table 5.

The sample dehydrated in the manner given above has been tested for carbon dioxide. It sorbed only 0.32 c.c. (N.T.P.) of carbon dioxide during 300 minutes. Thus, the serpentine sorbs a small amount of ammonia but not carbon dioxide.

Asbestos. The asbestos of long fibres has been used in this experiment, the locality, however, is not known. The experimental results are given in Table 6.

Table 6.

Sorptions of Gases by Asbestos.

Mode of dehydration: Heating at 200°C. for 30 minutes under evacuation.

Loss of weight by dehydration: 3.1%.

Gas	Time (min.)	Pressure of gas (mm.)	Vol. (c.c.) of gas (N.T.P.) sorbed at 25°C. by 1 g. of asbestos
NH_3	1	754.4	9.51
	5	754.4	10.55
	30	754.5	11.03
	1230	760.5	11.64
	2890	760.3	11.80
CO_2	1	760.1	1.30
	60	759.4	1.46
	2900	766.1	1.70

Table 5.

Sorption of Ammonia by Serpentine.

Mode of dehydration: Heating at 200°C. for 2.5 hours under evacuation.

Loss of weight by dehydration: 0.41%.

Time (min.)	Vol. (c.c.) of NH_3 (N.T.P.) sorbed at 25°C. and 1 atm. press. by 1 g. of serpentine
1	1.32
5	1.84
30	2.34
1500	2.85

Table 7.

Sorptions of Gases by Acid Clay.

Mode of dehydration: Heating at 200°C. for 1 hour under evacuation.

Loss of weight by dehydration: 20.59%.

Gas	Time (min.)	Pressure of gas (mm.)	Vol. (c.c.) of gas (N.T.P.) sorbed at 25°C. by 1 g. of acid clay
NH_3	1	769.3	34.37
	10	769.3	68.05
	30	769.3	72.70
	60	769.2	73.49
	1450	760.8	76.28
CO_2	1	765.4	2.81
	10	765.4	2.97
	160	765.1	3.02
	1620	762.0	3.04

Acid Clay. The sample from Itoigawa, Niigata Prefecture, Japan, has been used. It is a mass of yellowish white colour. The results of measurements are shown in Table 7.

Thus acid clay sorbs a great amount of ammonia but only a small amount of carbon dioxide. It is, therefore, probable that the ammonia combines with the dewatered sample of acid clay, and compounds are formed between them.

Bentonite. The bentonite from Rock River, Wyoming, U.S.A., has been used in the present experiment. It is a greenish yellow mass. The Japanese bentonite was already tested and described in one of the former reports.⁽¹⁾ The results of the sorption measurements of the American bentonite are shown in Table 8.

It seems that the present sample of bentonite shows the same behaviour toward ammonia and carbon dioxide with the Japanese acid clay. It may combine chemically with ammonia. The Japanese bentonite, when elutriated or dialysed, sorbs many kinds of gases as shown in the former paper.

Vivianite. The mineral from Ashio Mine, Tochigi Prefecture, Japan, has

Table 8.

Sorptions of Gases by Bentonite.

Mode of dehydration: Heating at 200°C. for 2.5 hours under evacuation.

Loss of weight by dehydration: 7.35%.

Gas	Time (min.)	Vol. (c.c.) of gas (N.T.P.) sorbed at 25°C. and 1 atm. press. by 1 g. of bentonite
NH ₃	1	32.5
	5	41.8
	30	43.6
	360	45.4
	1440	46.1
CO ₂	5	0.6
	480	1.0

Table 9.

Sorptions of Gases by Vivianite.

Mode of dehydration: Heating at 200°C. for 30 minutes under evacuation.

Loss of weight by dehydration: 23.66%.

Gas	Time (min.)	Pressure of gas (mm.)	Vol. (c.c.) of gas (N.T.P.) sorbed at 25°C. by 1 g. of vivianite
NH ₃	2	766.4	2.46
	60	766.2	2.94
	3210	757.3	3.52
CO ₂	5	761.9	0.33
	330	761.9	1.29
	2880	765.5	1.29

(1) Sameshima and Hemmi, this Bulletin, 9 (1934), 38.

been used. It is a transparent crystal of dark blue colour and vitreous lustre. The composition of vivianite is $\text{Fe}_3\text{P}_2\text{O}_8 \cdot 8\text{H}_2\text{O}$, from which the water content is calculated to be 28.7%. On heating at 200°C . the crystal takes an opaque black colour. The results are given in Table 9.

Summary.

(1) The sorptions of ammonia and carbon dioxide under one atmospheric pressure at 25°C . by the dehydrated samples of sepiolite, talc, serpentine, asbestos, acid clay, bentonite, and vivianite have been measured.

(2) Sepiolite sorbs either ammonia or carbon dioxide in a considerable amount. It is already known that this mineral sorbs various kinds of gases and that this is a sorbent of silica gel type.

(3) Acid clay and bentonite sorb ammonia but no carbon dioxide. Asbestos sorbs some amount of ammonia.

(4) Talc, serpentine, and vivianite sorb neither ammonia nor carbon dioxide.

*Chemical Institute, Faculty of Science,
Tokyo Imperial University.*
