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REVISED RESULTS OBTAINED WITH CERTAIN DEHYDRATING AGENTS USED FOR DRYING GASES

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ABSTRACT

This paper is a revision of a former paper, and as a result of further study, it includes two revised values. New samples of anhydrous magnesium perchlorate, or Anhydrone, silica gel, and alumina were obtained and tested for dehydrating efficiency. The method used was similar to that described in the earlier paper, except that a drying tower replaced the U-tube and each desiccant was tested separately. No change of efficiency value was obtained with anhydrous magnesium percholorate, but new values for silica gel and alumina were found and replace the values originally given.

Following the publication of an earlier paper,[1] claims were made that certain of the desiccants that were tested were not truly representative.

Upon investigation, it was decided that three desiccants should be retested, namely silica gel, activated alumina, and anhydrous magnesium perchlorate. The procedure of testing the desiccants was similar to that originally used, except that a drying tower was substituted for a U-tube. The drying tower was 300 mm in height and was provided with inlet and outlet tubulatures and a ground-glass stopper for closing the top.

The silica gel used in the first tests was a commercial product passing a No. 60 United States Sieve and retained on a No. 200. It was activated by heating in the U-tube at 110° to 130° C, in vacuum, for 5 hours.

The gel used in these tests was furnished by the Davison Chemical Corporation, Baltimore, Md., and was marked 6956–160 (6–16 mesh). It was prepared for use in two tests by heating in the drying tower at 175° to 190° C for 4 hours while passing through it air dried by phosphorus pentoxide. In the remainder of the tests the silica gel was heated in an open vessel at 170° to 190° C for 4 hours and then quickly transferred to the drying tower, which previously had been heated at 105° C for several hours. The tower was immediately closed with the glass stopper; the other outlet was open to a phosphorus pentozide tube. When cool, the lower outlet was closed, and the tower was installed in the constant-temperature cabinet.

The alumina used in the first tests was a commercial product known as Hydralo. It was activated by heating in the U-tube at 150° to

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180° C for 6 hours while passing through it air dried by phosphorus pentoxide.

The alumina used in the last tests was furnished by the Aluminum Ore Co., East St. Louis, Ill., through the cooperation of R. B. Derr, of the Aluminum Company of America, Pittsburgh, Pa., and was marked Grade A (8–14 mesh). The material was activated by heating in an open vessel at 175° to 200° C for 4 hours by the same procedure used with the silica gel.

The anhydrous magnesium perchlorate ($Mg(ClO_4)_2$) was obtained from the chemical storeroom of the National Bureau of Standards and was approved personally by the manufacturer.

The new results obtained with silica gel (0.006 ml of residual water per liter of air) show a higher degree of efficiency than was previously obtained (0.03 mg/liter of air).

Similarly, the new results obtained with activated alumina (0.001 mg of residual water per liter of air) show higher efficiency than was indicated by the original tests (0.005 mg/liter of air).

In the case of the anhydrous magnesium perchlorate the new results duplicated the old results (0.002 mg/liter of air).

Apparently, the silica gel and the activated alumina used in the original tests were not representative of products most efficient as drying agents.

However, attention is called to the fact that for adsorption drying agents, it is quite natural to find varying degrees of drying efficiency with different lots of the same agent, depending on details of manufacture and subsequent treatment.

The new values are incorporated in table 1.

TABLE 1.—*Comparative efficiencies of various dehydrating agents*

Number of tests	Material	Volume of air per hour per milliliter of desiccant	Total volume of air per milliliter of desiccant	Residual water per liter of air	Values from published data [a]
		ml	*Liters*	*mg*	*mg/liter*
5	$CuSO_4$ (anhydrous)	36 to 50	0.45 to 0.7	2.8 (2.7 to 2.9)	1.7 at 30° C (7).
4	$CaCl_2$ (granular)	66 to 165	6.1 to 24.2	1.5 (1.4 to 1.6)	
3	$CaCl_2$ (tech. anhy.)	115 to 150	4.0 to 5.8	1.25 (1.23 to 1.27)	
6	$ZnCl_2$ (sticks)	120 to 335	0.8 to 2.1	0.98 (0.94 to 1.02)	0.95 at 30° C (4).
2	$Ba(ClO_4)_2$ (anhydrous).	26 to 36	2.3 to 3.7	0.82 (0.76 to 0.88)	0.29 at 27° C (19).
4	NaOH (sticks)	75 to 170	2.3 to 8.9	0.80 (0.78 to 0.83)	0.16 at 25° C (2).
3	$CaCl_2$ (anhydrous)	75 to 240	1.2 to 7.8	0.36 (0.33 to 0.38)	0.36 at 25° C (3).
3	$Mg(ClO_4)_2.3H_2O$	65 to 160	4.0 to 7.2	0.031 (0.028 to 0.033)	(20).
3	KOH (sticks)	55 to 65	3.2 to 7.2	0.014 (0.010 to 0.017)	0.002 at 25° C (2).
7	Silica gel	43 to 59	2.1 to 5.2	0.006 (0.002 to 0.01) [b]	
4	$CaSO_4$ (anhydrous)	75 to 150	1.2 to 18.5	0.005 (0.004 to 0.006)	0.005 at 25° C (10).
4	CaO	60 to 90	7.6 to 10.1	0.003 (0.003 to 0.004)	0.2 to 0.3 at 25° C (7).
4	$Mg(ClO_4)_2$ (anhydrous).	43 to 53	2.8 to 5.9	0.002 (0.0016 to 0.0024)	(20).
3	Al_2O_3	36 to 63	5.6 to 6.2	0.001 (0.0008 to 0.0012) [b]	0.003 at 25° C (7).
2	BaO	64 to 66	10.6 to 25	0.00065 (0.0006 to 0.0008)	less than 0.0003 at "ordinary temperature" (5).

[a] See literature references cited in the earlier paper.
[b] Revised values.

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