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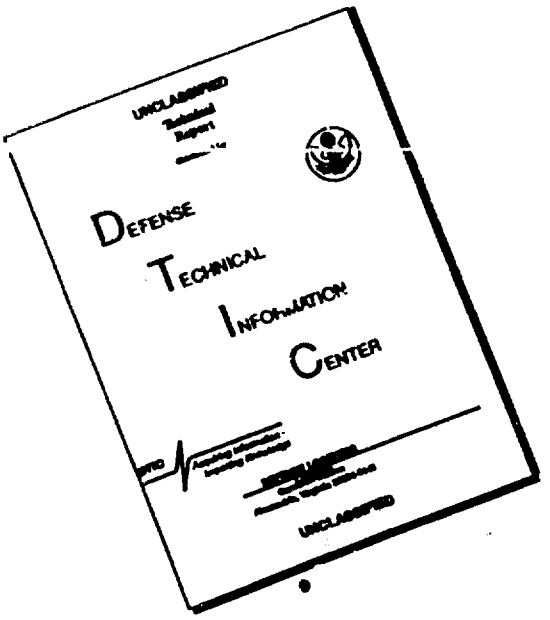

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ACCELERATED METHOD OF MEASURING THE CONCENTRATION OF NATURAL AEROSOLS IN A SOLID DISPERSION PHASE WITH HIGH ATMOSPHERIC HUMIDITY

By: S. P. Belyayev

Determination of the weight concentration of aerosols under natural conditions possesses a number of specific characteristics. The concentration of natural aerosols is ordinarily subjected to sharp oscillations; therefore, a more detailed study requires minimum sampling time. The frequent appearance of an excess of moisture in the atmosphere places special demands on the filter material: first, in filtrating under increased humidity the filter must be sufficiently firm, and secondly, the filter should be easily and rapidly brought to a constant weight.[1]

1. The filter is brought to a constant weight by drying it so that variations in the weight of the filter due to the presence of adsorbed moisture are brought within previously established limits.

Paper filters have a large filtration resistance (about 60 mm Hg at a rate of 6 cm/sec) and a low mechanical strength when wetted, are quite hygroscopic and are difficult to bring to a constant weight. Fiber filters stuffed in glass adapters[2]

2. GOST 5609-50. State Publishing House of Standards, Moscow, 1961.

have greater mechanical strength than paper filters and are easier to bring to a constant weight, making it possible to cut the minimum required sampling time 2-1/2 times. However, despite the high filtration rate (up to 1.5 m/sec with a resistance of 60-100 mm Hg), the passage of air through the filters due to the small filtration area is not very large and the time required to bring the filter to a constant weight is too great.

Type AFA-V-18 filters, made of FPP fabric and widely used at the present time for aerosol weight analyses, possess only slight gyroscopicity, are practically 100% effective at filtration rates of up to 2 m/sec (with a resistance of about 30 mm Hg), have a sufficiently large filtration area and considerable mechanical strength with filtration of a humid medium.

Due to the low gyroscopicity of the filters and the possibility of passing a large volume of air through them, the minimum required sampling time can be reduced fifteenfold over the time required using fiber filters. One natural disadvantage of the filter is the change in its properties when heated to more than 60°, which introduces familiar difficulties in reducing the filter to a constant weight using standard methods.

Preliminary experiments have indicated that after drying the weight of the filters decreases (even though they are hydrophobic) and the original weight is restored only gradually when they are maintained in the laboratory atmosphere. For example, immediately after a 10-minute drying at 60° the weight of the filter (an average from 10 experiments) decreases to 1.2 mg (0.2% of total weight) immediately after drying, after 5 min. the weight deficit is 0.5 mg, 0.3 mg after 3 hrs. and 0.2 mg after 24 hrs. In other words, the weight of the filter is practically stabilized after 5 min. and changes only slightly after that. Consequently, in order to step up the process considerably there is no need to maintain the filters until the original weight is restored - it suffices to continue the drying operation (heating then maintaining under laboratory conditions) until and after sampling. However, in this case a drying temperature should be selected which permits restoration of the original filtration properties of the filters after drying.

The test apparatus used to check the relative effectiveness of filters subjected and not subjected to the influence of increased temperature is shown in Fig. 1.

Aerosol samples were taken from a fume cabinet, using an aerosol generator to maintain a sufficiently high concentration of glycerin drops with a mean diameter of 2 microns. The glycerin fog is alternately filtered through a control filter (not subjected to the influence of high temperature) and a working filter (subjected to this influence). An ultramicroscope is used to determine passage through the filter.

In working with a filter subjected in advance to a temperature of 75°, accelerated passage of particles was observed (Table 1). At the same time, passage through a filter subjected to a temperature of 57° remained practically the same as passage through the control filter.

Thus moisture can evaporate from the filter material at 57°. At normal barometric pressure evaporation under such temperature conditions is quite slow and it would be advisable to decrease the pressure somewhat in order to speed up drying.

We used the hygroscopic filter drying method proposed by F. P. Dorosh, with a vacuum desiccator (Fig. 2). The filters were placed in the upper section of the desiccator, in which a residual pressure of 20-30 mm Hg was created using a fore pump. The heating element consisted of a 200-w electric bulb which rapidly heated the desiccator but possessed very little thermal inertia. The desired temperature inside the desiccator was maintained automatically using a contact thermometer.

In order to determine the time required to bring the filters to a constant weight in the desiccator, air containing capillary moisture was passed through the filter. Then the filter was placed in the vacuum desiccator for a certain period of time (at a temperature of 57° and a residual pressure of 20-30 mm), then kept for 5-10 min. in the laboratory.

Thus it was established that if the quantity of moisture adsorbed in the filter is equal to half the weight of the filter, the filters can be kept in the desiccator for 5 min. to bring them to a constant weight. If the weight of the moisture equals the weight of the filter, 10 min. is required, and if the weight of the moisture is equal to twice the weight of the filter (which can be considered maximum moistening of the filter), 15 min. is required. Therefore, it can be recommended that the filters be dried in the desiccator for 15 min. The results of tests on filters kept in a desiccator for 15 min., followed by another 5 min. in the laboratory, are shown in Table 2. It is evident from this Table that changes in the weight of the filter before and after the test did not exceed 0.1 mg, i.e., they were within limits prescribed by the All-Union State Standard for fiber filters.

It should also be noted that filters should be brought to a constant weight not in weighing bottles (or in any other airtight containers) but in completely open sublayers protected against contamination, since it is much more difficult to bring weighing bottles to a constant weight than filters.

The proposed method of analyzing the concentration of aerosols in the presence of excess moisture, using AFA-V-18 filters, makes it possible to reduce three- to fivefold the time required to bring the FPP filters to a constant weight compared to the time required using the method of A. I. Vronskiy and V. B. Latushkina.

Table 1

Checking the effectiveness of AFA-V-18 filters after they are brought to a constant weight in a vacuum desiccator.

Test No.	No. of particles after filtration (per minute)		Temperature (in degrees) in bringing the working filter to a constant weight
	Working Filter	Control filter[1]	
1	2	6	Was not heated
2	More than 100	14	75
3	60	3	75
4	More than 100	10	75
5	92	23	75
6	More than 100	16	75
7	More than 100	4	75
8	30	35	57
9	29	16	57
10	11	60	57
11	22	13	57
12	5	22	57

[1] The control filter was not brought to a constant weight.

Table 2

Results of bringing AFA-V-18 filters to a constant weight in a vacuum desiccator after moistening them

Test No.	Initial weight of the filter (in g)	Quantity of moist air passing through the filter (in liters)	Temperature of the moist air (in degrees)	Weight of the filter after filtration of the moist air (in g)	Weight of the filter after bringing it to a constant weight (in g)
1	0.086	—	—	—	0.086
2	0.086	75	22	0.128	0.086
3	0.086	75	25	0.132	0.086
4	0.086	75	24	0.158	0.086
5	0.086	75	25	0.167	0.086
6	0.090	75	24	0.123	0.090
7	0.090	75	25	0.108	0.090
8	0.090	75	24	0.152	0.090

BIBLIOGRAPHY

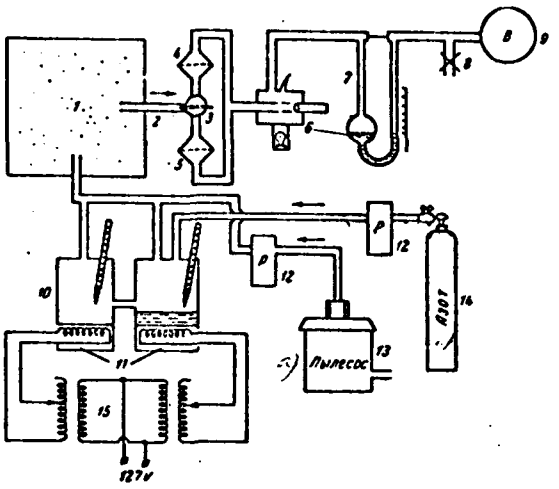

Figure 1: Test apparatus to check the relative effectiveness of filters.

1) Fume cabinet; 2) Intake tube; 3) 3-way cock; 4) Working filter; 5) Control filter; 6) Ultramicroscope; 7) Capillary flow meter; 8) Flow regulator; 9) Blower; 10) Glycerin fog generator; 11) Heaters; 12) Flow meters; 13) Dust collector; 14) Nitrogen tank; 15) Autotransformers.

a - Dust collector; b - Nitrogen.

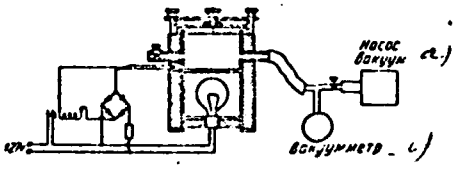

Figure 2: Vacuum desiccator.

a - Vacuum pump; b - Vacuum gauge.