A METHOD OF PREPARING DIFFUSING SCREENS
OF DEFINITE NEBULOSITIES FOR VISIBILITY
METERS

BY C. S. KARVE, M.SC., PH.D.

(Department of Physics, S. P. College, Poona)

Received November 10, 1945

(Communicated by Diwan Bahadur Dr. K. R. Ramanathan, F.A.S.C.)

The most important factor which determines the maximum distance of objects which can be seen and distinguished under natural conditions is the scattering and absorbing power of the suspended matter in the atmosphere. In the two most common visibility-meters in general use, those of Wigand and Bennett, the visibility of an object is generally determined by interposing a diffusing screen of such nebulosity in front of the eye that the object is just indistinguishable from the background. In the course of a critical examination of these instruments it was found that a common defect of these instruments was the variability of the diffusing screens used in them and their want of standardisation. In order to make a reproducible visibility meter, it was considered necessary to develop a method of preparing standardised diffusing screens of different nebulosities. The present note describes briefly the method that was worked out to achieve this.

In brief, the method consists in coating a glass plate with a definite thickness of a gelatine emulsion containing a uniform fine-grained white precipitate of barium sulphate in suspension. The nebulosity of the screen can be varied within limits by varying the concentration or the thickness of the emulsion. At first, the attempt was made to produce the precipitate in the gelatine of commercial photographic plates from which the silver salts had been removed, but as the plates usually available in the Indian market are hardened, the precipitate could not be formed in them in a uniform and reproducible manner.

The method of preparing the emulsions and coating the glass plates as follows:—

The following three solutions were prepared:—

(1) Gelatine . . . . 5 gm. in 100 c.c. of water.
(2) BaCl$_2$ . . . . 2.44 gm. do.
(3) Potash Alum . . . 9.5 gm. do.

405
The gelatine used was of French Gold Label quality and had a pH value of 5.8 to 6.0. The Barium Chloride solution was added to the gelatine solution in a beaker and after thorough stirring with a glass stirrer, the mixture was kept at a constant temperature of 35°C. An approximately equivalent quantity of alum solution was quickly added and the mixture again well stirred for another three minutes. A definite quantity of this Barium Sulphate emulsion was then poured on a chemically clean glass plate kept perfectly level and distributed uniformly over the plate by means of a clean glass rod. The plate was immediately placed in a chamber maintained at 16°C to 18°C. After the emulsion had set, it was dried in a dust-free chamber at a temperature not exceeding 20°C.

To make reproducible screens, it is important to keep the temperature at which the emulsion is formed nearly the same and mix the alum solution in the same manner (e.g., in one lot) to the Barium Chloride solution.

It was found that for a definite strength of the gelatine solution, there is an upper limit to the amount of Barium Sulphate that can be held in colloidal form and beyond this limit the particles become too large. For a 5 per cent. solution of gelatine, the maximum amount of BaSO₄ was about 0.002 gm. per c.c. With a stronger solution of gelatine the mixture became too viscous to spread uniformly over the plate.

Plates prepared in the above manner with 20 c.c. of emulsion spread over a cabinet size plate were found to have the following values of transparency when measured with a Lummer-Brodhun Photometer.

<table>
<thead>
<tr>
<th>BaSO₄ spread per sq. cm.</th>
<th>Transparency per cent.</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.1 × 10⁻⁶ gm.</td>
<td>82.0</td>
</tr>
<tr>
<td>1.8 × 10⁻⁶ gm.</td>
<td>75.6</td>
</tr>
<tr>
<td>2.0 × 10⁻⁶ gm.</td>
<td>67.0</td>
</tr>
</tbody>
</table>

To get greater opacities, filters can be combined in series.

The lowest limit of transparency in this method happens to be earlier due to the hardening action of potash alum on the BaSO₄ grain. In order to remove this defect similar plates were also prepared by preparing BaSO₄ emulsion by the action of Sodium Sulphate on Barium Chloride. Following strengths of different constituents were used.

(1) Gelatine .. 10 gm. dissolved in 100 c.c.
(2) BaCl₂ .. 2.44 gm. .. do.
(3) Na₂SO₄ .. 1.42 gm. .. do.
The emulsion was always prepared at 35° C. The transparencies obtained for different concentrations are given in Table II.

**TABLE II**

<table>
<thead>
<tr>
<th>BaSO₄ spread per sq. cm.</th>
<th>Transparency per cent.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1 × 10⁻⁴ gm.</td>
<td>72.8</td>
</tr>
<tr>
<td>4.2 × 10⁻⁴ gm.</td>
<td>65.8</td>
</tr>
<tr>
<td>8.4 × 10⁻⁴ gm.</td>
<td>57.0</td>
</tr>
<tr>
<td>12.6 × 10⁻⁴ gm.</td>
<td>48.3</td>
</tr>
<tr>
<td>16.8 × 10⁻⁴ gm.</td>
<td>40.7</td>
</tr>
</tbody>
</table>

Although the lowest limit of transparency which is 41 per cent. in this method can be extended further by using gelatine solution of higher strength still it is not safe to do so. The reason is that such a solution has to be prepared at about 50° C. and it is found that the transparency of the plates changes rapidly when the emulsion is prepared between 40° C. and 60° C.

I have to thank Dr. K. R. Ramanathan, M.A., D.Sc., for the suggestion of the problem and his interest in the work. My warmest thanks are due to my friend Dr. J. V. Karandikar, M.Sc., Dr. Eng. (Berlin), for his useful technical suggestions in preparing the diffusing screens. Lastly, I must also record my thanks to Principal G. R. Paranjpe, Royal Institute of Science, Bombay, for kindly allowing me the facilities of the Photographic Laboratory of his Institute.

**SUMMARY**

A new method of preparing diffusing screens of different nebulosities by coating good glass plates by an emulsion of Barium Sulphate formed in gelatine, is described. The BaSO₄ emulsion is prepared in two ways. In the first method BaCl₂ and potash alum are used while in the second, BaCl₂ and Na₂SO₄ are used. In the former process the lowest limit of transparency is soon reached while in the other it can be extended further. The transparency of these screens is measured with a Lummer-Brodhun Photometer. The results of the measurements show that the screens obtained by this process are reproducible and follow the law of additivity.