TECHNIQUE FOR MAKING SCHUMANN-PLATES.

By P. N. KALIA, M.Sc.,
Research Scholar, Physics Department, Government College, Lahore.

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In our work with the vacuum spectrograph of this laboratory we have had considerable difficulties with the photographic plates imported from Europe. The plates by themselves may be of excellent quality but the long delay caused in using them on account of the time taken for transit, considerably reduces their efficiency. The lasting qualities of the plates are also impaired by the high temperature and great humidity prevalent in India. And therefore unless a regular supply of imported plates is maintained it is unsafe to spend labour and time over an exposure on undependable plates in a vacuum spectrograph adjusted after many difficulties. Our own view, based on several years' experience in this line is that the only satisfactory arrangement is to employ Schumann plates prepared in the laboratory. The procedure employed in their manufacture is essentially the same as that described by Schumann but certain modifications and precautions become necessary due to Indian climate, in order to produce a really serviceable article. We are giving the process here in detail to help other workers who may care to prepare them by themselves.

Process.

It is desirable to set apart a room for making the plates, one which is as free from dust as possible, and provided with at least one ruby light lantern. It is not safe to assume that the red light provided by an ordinary glass is quite suitable and it is therefore advisable to examine it with a direct vision spectroscope before using it. Solutions of red dyes in water put in a glass jar and surrounding an electric lamp will be found to be very useful, since the strength of the dye is easily adjustable. It will be found convenient to cover the working table with paper as this provides a cleaner place than may otherwise be available.

Following solutions are made in two flasks :—

A	Potassium Bromide	9·0 grams.
	Gelatine *	4·5 grams.
	Distilled Water	60 c.c.
B	Silver Nitrate	11·25 grms.
	Distilled Water	60 c.c.

The gelatine swells up in about half an hour or less, after which the flasks are put in water at a temperature of 50°-60° C. As soon as the gelatine dissolves completely, further operation must be carried out only in red light. Small quantities at a time of Solution B are then poured in the flask containing the Solution A and each time the flask is thoroughly shaken up, until the whole of B is poured out, and then a final shaking is administered. The flask is then immersed in a water-bath at 55°-60°C, where it quietly rests for half an hour. The larger granules of the silver bromide settle down on the sides of the flask and the emulsion is carefully transferred into a clean porcelain dish without disturbing the precipitate. The dish is covered up and put over ice shavings kept in an ice box. It remains there for about three hours, after which on uncovering the dish, the emulsion will be found to have hardened. It is cut out into small pieces with a horn spatula or a piece of celluloid plate, and spread over a piece of muslin cloth. The hard emulsion may be covered up with another piece of muslin and the whole is tied to form a bag. This bag is then hung up in a jar of about five litres capacity, filled with water not above 14°C. Ordinary tap water may be used provided it is filtered and not too hard, and changed at least ten times every 15 minutes. After the washing which is intended to remove the soluble salts, have been completed, the bag is squeezed to remove the adhering water. A beaker containing 950 c.c. of freshly and well-boiled water cooled to 55°C is kept ready, and as soon as the washing is completed the bag is suspended in the water. The emulsion mixes rapidly with water and is stirred with a glass rod. The funnels plugged with glass wool of such compactness that water will trickle out at the rate of two drops per second, are then arranged one above the other, and the emulsion is then filtered through these and collected in a large flat dish. After remaining undisturbed in the dish for about an hour the emulsion is carefully siphoned

* The only variety of gelatine which should be used is "Nelson photographic gelatine No. 1." It is best to get it direct from the manufacturers "Nelson, Dale & Co., Limited, Warwick, England," and store in a dessicator. We wish to thank Messrs. Nelson, Dale & Co., for their gift of a quantity of gelatine. On one occasion they were good enough to despatch gelatine by Air-Mail at their own cost.

out in a beaker disturbing the precipitated granules as little as possible. The emulsion is now ready to be used for coating.

The process of coating the plates requires special care and attention, particularly in a hot and humid climate. As a general rule the plates prepared during winter give better results and last longer than those prepared during June to September months in the Punjab, when the average temperature in the working-room ranges between 35° to 40°C. with very high humidity. The working conditions are fairly trying but adopting special precautions these can be fully overcome. The glass plates used for coating must be very carefully cleaned, particularly if they have been used before for photographic purposes. After cleaning them in the ordinary way they are placed for about an hour in a strong nitric acid bath and then washed with water and finally dried and polished with clean muslin cloth. When the glass plates are very thin and fragile it is safer to polish them by putting them over a flat surface covered with a fresh piece of blotting paper. It is also advisable in hot weather to avoid touching the plates directly with fingers as they are likely to be contaminated with grease. Schumann in his paper recommends a bevelling of the edges which permits the plates to hold the solution. In this laboratory we have never found this to be necessary and the plates are therefore only thoroughly cleaned before coating. A glass table of any suitable length depending upon the number of plates to be coated, of height about 10 cms and of breadth about 2 cms. less than the length of the glass plates, is then very carefully levelled. The plates are

FIGURE 1

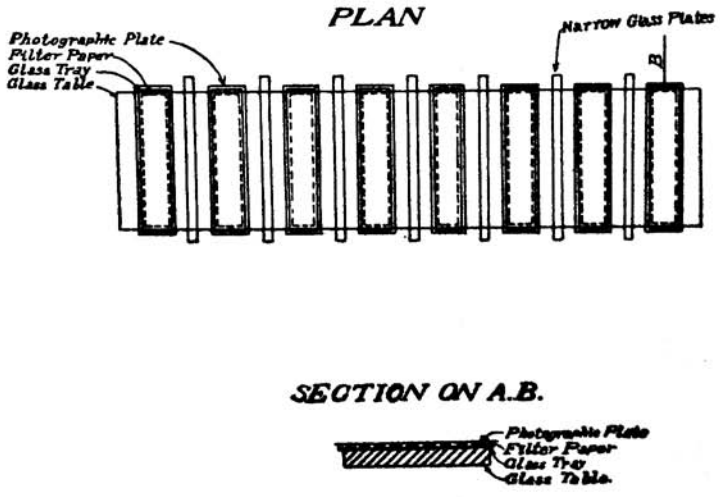

FIGURE 2.

arranged over this in a line leaving a spacing of about three cms. between any two plates, the two other edges projecting outside by one centimetre each from the table (figure 1). When the plates to be coated are of extra-thin glass it is necessary to adopt a slightly different procedure. A glass plate which would not easily bend is cut of a size slightly smaller than the sides of the thin glass plate, and covered with a wet strip of filter paper. The thin glass-plate is then placed over it (figure 2). Due to capillary forces the plate adheres to the paper and does not curve. All the thin-glass plates must be treated in this manner and put over the levelled glass table as before. Narrow glass strips are then inserted in the spaces between the plates and occupy the whole width of the glass-table. These strips would be found very useful as a safeguard against the spreading of emulsion accidentally spilled, from one plate to another, and ruining the whole batch. As stated before, the plates should not be touched directly with hand when they are arranged on the table. We have invariably employed thin rubber gloves, used by surgeons, on such occasions and found them very convenient. The plates are arranged while the emulsion is being prepared. The coating is best done by means of a pipette, each plate requiring 1·35 c.c. of emulsion per square inch. Great care should be observed while pouring the emulsion, which should pass out of the pipette as slowly as possible, avoiding the formation of bubbles. It is not necessary to move the pipette to different points on the plate for the emulsion spreads itself equally in all directions. For greater stability of the hand the elbow may be supported. After the plates have been coated they are allowed to stand undisturbed for three to four hours, in the dust free room, for the silver bromide to settle out.

The draining of the supernatant liquid is the most delicate part of the whole process. But the manner by which we do this here seems to us to be most satisfactory and leaves very little to chance or skill for success. A glass tube a few centimeters longer than the height of the table, and sealed at both ends is carefully held against the projecting side of the plate, and allowed to touch the layer of the liquid. The supernatant liquid trickles down slowly and the same process is repeated with the other plates. After the draining has continued for about three minutes a small bit of plate-glass about 2 mm or less thick is placed under the other end of the base of the glass-plate by very slowly tilting it. The tilt is increased by inserting another similar glass-plate underneath after another 3 minutes. The plates dry rapidly and after a few minutes the ends can be supported by corks about 2 cms. high. The main idea in taking all these precautions is to avoid the flow of the thin film of the silver-bromide, which is easily carried along by the supernatant liquid if the flow is too rapid. This movement is particularly noticeable when the working temperature is high, and spoils the quality of the plates. The plates remain tilted on corks for two or three minutes, and are then brought in a vertical position by holding along the edges,

the lower end being always kept down. The backing glass-plate may be removed now, and the plate is leaned, film side downwards against a wooden-rod attached to a board covered with filter paper. As soon as the plates are dry they can be packed, and stored. Due to the special sensitive nature of the photographic film, the plates must be packed face to face, without, however, the film surfaces touching each other. This can be done by inserting narrow strips of thin filter paper held along the edges by a very minute quantity of beeswax between a batch of two plates. The method of placing the plates face to face and still keeping them apart by filter paper is specially useful in hot weather when beeswax is likely to melt and spoil the surface of the plates. The plates should be stored in a cool and dry place. A box containing some calcium chloride may be profitably used. Fresh plates are not very sensitive, but improve rapidly and can be used to the best advantage after about a fortnight.

Developing.

Any good developer may be used, but the following would be found very satisfactory :—

Metol	5 gms.
Hydroquinone...	24 gms.
Sodium Sulphite (cryst)	180 gms.
Sodium Carbonate (cryst)	320 gms.
Potassium Bromide	2·4 gms.
Water to make	4,000 c.c.

Development temperature should be as low as possible but not below 15°C. The plate is fixed in hypo solution and then washed for a few minutes in running water.

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