Chemical Flag

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Colourful demonstrations using salts like copper sulphate, potassium permanganate, potassium dichromate and immiscible binary liquid mixtures like water-chloroform, water-ether, water-pet-ether and water-carbon-tetrachloride etc., are often quite fascinating. In what can be called as a patriotic extension to a ternary immiscible liquid system, the present experiment effectively brings out this idea which can appeal to even layman as the *Chemical Flag (Figure 1).*

The three liquids of different densities (in g/cc) used are chloroform (1.56), water (1) and petroleum ether (0.7).

Preparation of Coloured Solutions[1]:

[1] Our concentrations are approximate and are to be suitably adjusted to obtain the appropriate colour intensity.

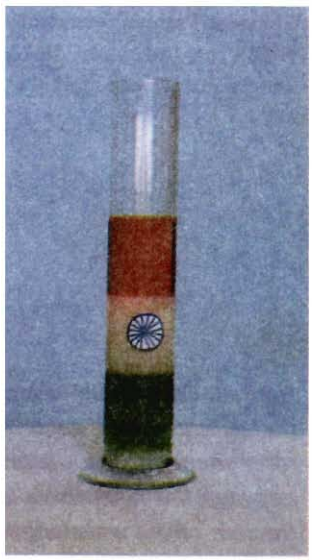
For Green Colour: 0.3% solution of p-nitroso-N,N-dimethyl aniline [a derivative for N, N-dimethylaniline prepared by M Sc students] in chloroform.

For Saffron Colour: 0.15% Solution of 1-phenylazo-2-naphthol [Azo dye test for primary aromatic amines] in petroleum ether (60–80°C).

For White Colour: 0.3% Sodium thiosulphate in water to which a drop of concentrated HCl is added, which produces colloidal sulphur.

All the three coloured solutions are taken in equal volumes (presently 50ml of each solution is used).

Figure 1. Chemical Flag.



Building the Indian National Chemical Flag

The first building block in this is the green solution, which is carefully added in a measuring cylinder (250ml). It is necessary to clean up the upper portion of the measuring cylinder using a filter paper before the addition of the next solution. Otherwise, a yellowish tinge would be introduced to this aqueous layer.

The second step is to introduce a well stirred colloidal sulphur in water which forms the middle layer.

The final top layer is the solution of orange dye in petroleum ether which gives the saffron colour to the chemical flag.

Lastly the *blue chakra* is drawn on a white paper and attached from outside the measuring cylinder in such a way that it is exactly at the centre of the white layer.

The flag so prepared is stable for several hours.

The Tunnel Effect

Arnold Sommerfeld was one of the greatest teachers of physics in this century (apart from his own eminence as a physicist). Here, in his book on optics, he refers to the fundamental work of J C Bose.

The experiment becomes very simple with Hertz waves. In the Bose Institute[1] in Calcutta the following set-up is demonstrated: two asphalt prisms 1 and 2, *Figure 1*, are placed opposite each other at a distance of several centimeters. The waves are incident perpendicularly to 1 and are 'totally reflected' on the back face of 1. Still, one obtains distinct signals in a receiver placed behind 2 and these increase in strength as the distance between the prism faces is decreased.

[1] The botanist Sir Jagadis Bose in his younger years imitated experiments of classical optics with short Hertz waves, e.g. λ=20cm. See Collected Physical Papers, especially No.VI of the year 1897, Longmans, Green and Co., 1927.

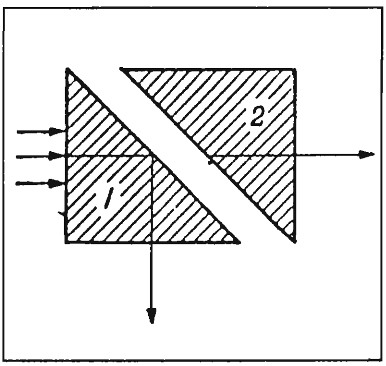


Figure 1. Experiment to prove that Hertz waves enter the rarer medium. The distance between the two prisms is a fraction of the wavelength.

From: *Optics*
by A Sommerfeld
Academic Press
New York, 1954
pp.32–33.