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DEPARTMENT OF COMMERCE
BUREAU OF STANDARDS
WASHINGTON

Letter
Circular
LC-395

December 9, 1933.

Preparation and Colorimetric Properties of a Magnesium-Oxide Reflectance Standard.

The smoke from magnesium freely burning in air deposited on a satisfactory base forms a uniform, fine-grained, diffusing surface of high reflectance. By observing a few simple precautions, this surface of magnesium oxide (MgO) may be made reproducible; hence, it serves as a convenient and reliable standard.

1. The magnesium should be obtained in the form of turnings or chips. "Magnesium shavings for Grignard Reactions" as supplied by the Special Chemicals Company, Highland Park, Illinois, have been used. Suitable material may also be obtained of the American Magnesium Corporation, Niagara Falls, New York, the Aluminum Company of America, Oliver Building, Pittsburgh, Pennsylvania, Sterling Products Company, Easton, Pennsylvania, and others.

2. The oxide must be deposited on a surface not affected in air by the heat from the burning magnesium. A satisfactory base may be made of (a) aluminum, (b) silver-plated copper, (c) block porcelain, or (d) sheet steel coated with white vitreous enamel. Milk or opal glass is often unsatisfactory because it easily cracks from heating. Depolished surfaces are better than polished because the oxide adheres better; for the same reason metallic surfaces are usually to be preferred to non-metallic. Surfaces of reflectance high and uniform throughout the spectrum are better than dark or chromatic surfaces because with the former a thinner layer of oxide is trustworthy. The thinner layer is desirable apart from speed of preparation because it does not chip off so readily.

3. Place a small quantity (about 5 g) of the chips on a refractory dish and ignite them with a hand blow torch or bunsen burner. Work the unignited chips beneath the flame until a slowly burning ball or clinker is formed; this gives a steady stream of smoke.

4. Place the surface to be coated about 8 to 10 cms above the flame and tilted about 30 degrees from the horizontal. Use of smaller distances results in a coarse-grained deposit and risks contamination by possible impurities in the magnesium (3,)*.

(*) Numbers in parentheses, sometimes followed by a page number, indicate references in the bibliography.

5. Move either the combustion dish or the surface being coated from side to side in order to obtain a uniform deposit.

6. When the clinker has to be turned over or broken in order to permit the magnesium to burn completely, the surface being coated should be temporarily removed, since the burst of flame is likely to carry up large dust particles.

7. Repeat the operation several times until a sufficient deposit is obtained. The layer should be so thick that further increase produces no sensible change in reflectance; the critical thickness is about half a millimeter (4, p. 17). Do not attempt to burn a large charge of magnesium at one time. Rather, build up the required thickness by a large number of small charges. In cases where it is inconvenient to measure the thickness of the coating place a small dot of india ink on the original surface near the edge, then deposit oxide until the spot cannot be seen in good illumination. If the original surface is dark, put on one coat of MgO first; a deposit of black smoke (from a candle or smoky gas flame) in a small spot near the edge, then supplies a similar test.

8. It is advantageous to direct a very gentle air current onto the burning metal; this guards against formation of the yellowish magnesium nitride (3) due to insufficient supply of oxygen. A strong or irregular air current makes more difficult the preparation of a satisfactory uniform surface.

9. The operation should be carried out under a well ventilated hood in order to dispose of the excess oxide.

10. The operator's eyes should be protected from the high intensities of visible and ultraviolet light by suitable goggles (4, p. 30), or other means.

11. Magnesium ribbon may be used instead of turnings or chips for small surfaces, but it requires careful manipulation to produce a uniform coating for large surfaces because of the irregular burning.

The properties of a surface so prepared are as follows:

1. It is nearly as good a diffusor as any surface (1, p. 59; 2).

2. Its light reflectance of about 0.97 (1, 4, 5) is nearly as high as that of any surface (1, p. 59).

3. The reflectance varies with wave length in the visible spectrum by less than one per cent (2, 4).

4. Its reflectance is nearly, if not perfectly, constant with time (4, p. 33).

5. The apparent reflectance for 45-degree incidence and normal viewing (standard conditions adopted by the International Commission on Illumination, Cambridge, 1931) is 1.00 (4, p. 29).

6. It is extremely fragile.

The first five properties listed make this reproducible surface a convenient reference standard of reflectance; its usefulness is limited by the sixth property (fragility) which usually prevents it from being used as a working standard. However, if the MgO is deposited in a trough so that the edges are protected from chipping off, and if the deposit is kept covered when not in use, the surface will last indefinitely.

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RKW:MEB:ESB
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DEPARTMENT OF COMMERCE
BUREAU OF STANDARDS
WASHINGTON, D.C.

Letter
Circular
(Superseding LC-143)
LC-396

December 11, 1933

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