EFFECT OF RAW MATERIALS ON LAMPBLACK GRADE GRAPHITE PROPERTIES

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Introduction

Artificial graphite grades based on lampblack are used for motor and generator brushes, rings and seals and other applications where a fine-grained material is required. The lampblack is "calcined" to reduce binder demand so the material can be baked without excessive shrinkage and breakage. Calcining is accomplished by hot mixing the lampblack with either tar or pitch, forming into suitable shapes for handling ease and baking to carbonize the binder. After carbonization, the calcine is milled to a fine powder and hot mixed with pitch and other additives. The mix is molded into plates or other shapes, baked and finally graphitized.

Each manufacturer uses a grade (or grades) of lampblack that satisfies the processing requirements of his production techniques and results in final grades having the appropriate properties required for each application. As with all industries, raw material costs and property changes force the evaluation of cheaper and different raw materials to determine if cost savings or property improvements can be obtained. This work describes the evaluation of a lower cost thermal black in lampblack brush grades. In addition, the use of a resin modified coal tar pitch binder was investigated to determine its effect on physical properties.

Raw Materials and Processing

Two blacks were used in this work as shown in Table 1. Black B, a lampblack typical of the kind used in brush grades, had an oil absorption of 12.7 gallons/100 lbs. Tar level, used in making the calcine mix, was 109 pph. The thermal black, Black A, had an oil absorption of 4.8 gallons/100 lbs. The tar level was 43 pph. The tar and black were mixed in a heated sigma blade mixer and formed into rods. The rods were heated rapidly to carbonize the binder. After calcining, the material was milled to a nominal 200 mesh size. Three pitch mixes were prepared from the two calcines. Calcine A was hot mixed with 48 pph #30 Medium pitch to form Mix M1. Two mixes were made from calcine B. Mix M2 was made with 70 pph #30 Medium pitch. In Mix M3, one-half of the pitch was replaced by a phenolic-furfural resin mixture. Total binder level in Mix M3 was virtually the same as Mix M2.

TABLE 1
BINDER LEVELS

Calcine	Black	Oil Absorption of Black gal/100 lbs	Tar Level, pph
A	A	4.8	43
B	B	12.7	109

Mix	Calcine	Pitch Level pph	Resin Level pph
M1	A	48	0
M2	B	70	0
M3	B	35	34.4

After mixing, the three mixes were cooled to room temperature, milled to 48 mesh size and blended. Each blended mix was molded to 10" x 4" x 2-1/2" plates at a variety of molding pressures to obtain a series of green densities. The green plates were packed into saggers with sand as the supporting medium and baked. They were finally graphitized in an Acheson furnace and tested for graphite properties.

Experimental Results

Graphite apparent density is shown as a function of green apparent density in Figure 1.

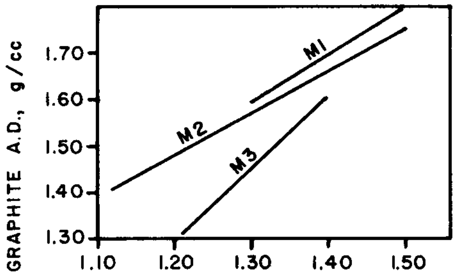

Fig 1. Effect of Raw Materials on A. D.

Black B produces graphites having the highest apparent densities. When resin is substituted for a portion of the pitch binder, the graphite apparent density decreases. These effects are due primarily to the weight loss during baking as shown in Table 2. The plates made from Mix M1 experienced the lowest weight loss during baking because of their lower pitch level. When resin is substituted for a portion of the pitch, weight loss during baking increases because of the lower coking value of the resin. These effects are reinforced by the volume changes during baking and graphitizing as shown in Figure 2.

TABLE 2

WEIGHT LOSS DURING BAKING AND GRAPHITIZATION

Mix	% Weight Loss Green-Baked	Baked Graphitized	Green-Graphitized
M1	10.1	2.3	12.4
M2	12.5	2.1	14.6
M3	14.5	2.7	17.2

Volume shrinkage is comparable for Mixes M1 and M2. However, M3, containing resin in place of a portion of the pitch, does not shrink as much.

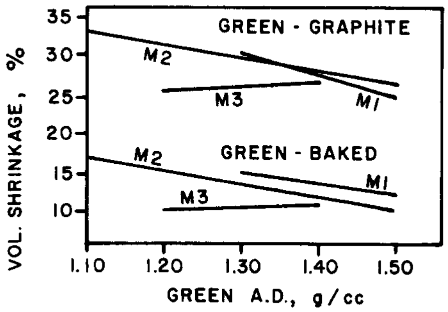

Fig. 2 Effect of Raw Materials on Vol. Shrinkage

When pitch is used along as a binder, volume shrinkage generally decreases at higher densities and the slope of the curve is negative. As resin is substituted for a portion of the pitch, the slope of the shrinkage-density line changes from a negative value to zero and, as shown for very high substitutions, to a positive value.

Electrical resistivity is strongly controlled by the amount and type of binder used in the mix as shown in Figure 3. As binder level increases (M1 versus M2) electrical resistivity decreases, presumably because binder carbon is a better conductor of electricity than the black. Substitution of resin for pitch increases resistivity (M2 versus M3). Since resin carbon does not graphitize as well as pitch carbon, its resistivity is higher.

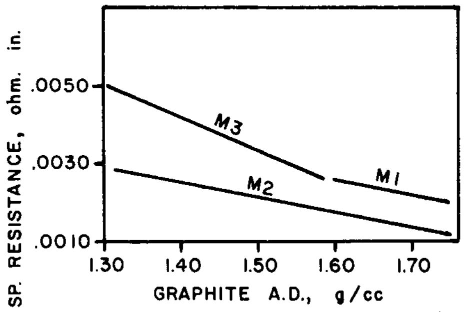

Fig. 3 Effect of Raw Materials on Sp. Resistance

Flexural strength is also affected by amount of binder as shown in Figure 4. Higher pitch levels (M1 versus M2) result in higher strengths. Substituting resin for pitch (M2 versus M3) decreases strength.

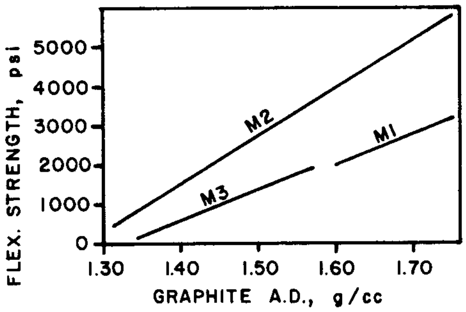

Fig. 4 Effect of Raw Materials on Flex Strength

Increasing binder level in the mix increases the scleroscope hardness (M1 versus M2) as does the substitution of resin for a portion of the pitch (M2 versus M3), as shown in Figure 5. Upon graphitization, resins form glassy carbons which are very hard. This is reflected in the results obtained from M3.

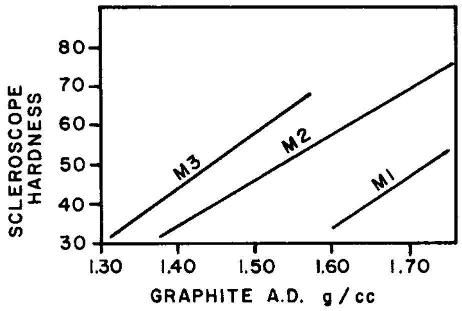

Fig. 5 Effect of Raw Materials on Hardness

Conclusions

The results of the work presented here show that one can produce lampblack grades with a variety of properties by varying the type of black and the ratio of resin/pitch used as binder. Thus, it is possible to design a mix to produce a graphite with specified levels of physical properties.