LEAD INDUSTRIES ASSOCIATION, INC.
292 MADISON AVENUE
NEW YORK 17, N. Y.

January 21, 1963

To Members of the Lead Industries Association, Inc.:

The attached supplement to our technical data book, "Lead in the Ceramic Industries," has just been published by the Lead Industries Association. It is being mailed to all persons who now have this looseleaf data book. A press release describing the new supplement, along with a copy, is going to appropriate trade journals.

Use of lead in glazed brick has shown considerable growth in recent years, particularly the low-temperature, "accent" brick. Several million of these brick have been sold in the past few years, and the outlook is for ever increasing demand from architects and builders.

The supplement was prepared by Jerome Smith of our staff, through the cooperation of T. D. Carnahan of B. F. Drakenfeld & Co., with the assistance of the Ceramics Technical Committee.

Very truly yours,

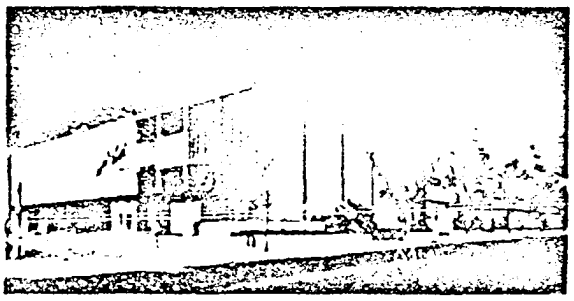
R. L. Zeigler

Executive Vice President

RLZ:mk
Enc.

Look Ahead with Lead

USE OF LEAD IN GLAZING BRICK*



Brilliant shades of red accent the facade of this Lord & Taylor building in Garden City, New York. Glazes high in lead content were used to give the brick permanent, maintenance-free protection from the weather.

Glazes on structural clay products are not new. Structural clay facing tile have been glazed for years. However, the demand for glazed brick—especially the brightly colored "accent" brick—has increased only in comparatively recent times.

In the past, a limited color range was produced in brick by the regulation of kiln temperatures and atmospheres. These colors were continued, however, to the variety obtainable from natural brick shades. A really complete color palette on brick can be achieved only by using ceramic color oxides. (Color oxides can be and have been added to the brick in bulk, and satisfactory colors are obtained in this manner, but the high cost of the stains makes this impractical.)

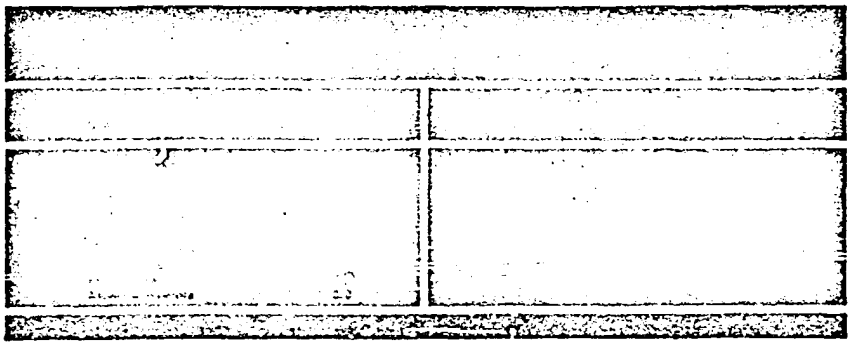
Glazing is the most practical method of achieving weather-resistant, maintenance-free complete color coatings, and glazes high in lead are required for the accent colors. The reason: only lead glazes offer the needed combination of low firing temperatures and good glazing properties.

LEAD'S ROLE IN THE GLAZE

Lead is the most versatile of the fluxing compounds. Its use in glazes, as well as in other ceramic products, frequently depends on more than its high fluxing power. Lead helps to make the glazing operation a relatively foolproof procedure. With it, a single formulation will form a suitable glaze over a wide temperature or "long firing" range.

Lead bearing glazes exhibit low surface tension and hence excellent ability to cover porous bricks and even to heal over imperfections in the brick—or pinholes and blisters that form in the glaze during firing. In contrast, lead-free glazes frequently crawl or pull

*The assistance of Mr. Thomas D. Carnahan, R. E. Drakenfeld & Co., Inc., Washington, Pennsylvania, in the preparation of this section is gratefully acknowledged.



away from certain areas of the brick, leaving an incomplete surface cover. These factors, plus lead's compatibility with almost all known color oxides, account for the wide use of this versatile material in ceramic glazes.

TYPES OF GLAZE

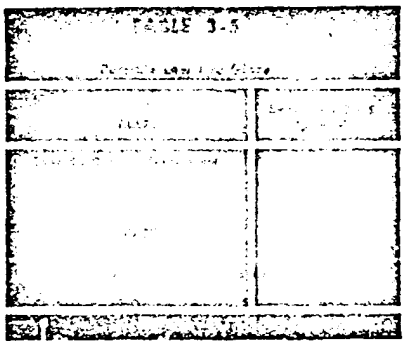
Glazes for brick may be defined or classified as "high firing" or "low firing." Those that mature at or near the curing temperature of the brick are called high firing glazes. Low firing glazes are designed to fire several hundred degrees below brick curing or "burning" temperatures.

High Fire

One advantage of high firing glazes is that they can be sprayed on the "green" brick and fired along with the body – an economical, one-fire operation. However, because of greater flexibility a two-fire system is sometimes used with high fire glazes (but is more commonly reserved for low-fire operations). In this case, the glaze is applied and fired on an already matured brick. The temperature range of high fire glazes is about 1850 F to 2100 F, and is naturally determined by the firing characteristics of the clay body.

No single glaze formulation is satisfactory for the range of clays and firing conditions encountered in the brick industry. Instead, glazes are usually formulated to suit specific chemistry and conditions attendant to each application. For example, each glaze must be formulated to fit the thermal expansion of each clay body, and here, as in other areas, lead accommodates the formulator. It provides him with an excellent means of control over the expansion properties of his glaze.

The high fire glazes are generally lower in lead content and in some instances are lead free. Due to the higher refractoriness and surface tension of high fire, lead-free glazes, however, they do not exhibit the same ability to heal over imperfections; therefore, engobes are sometimes sprayed on first to assure coverage of cracks and blemishes.



Low Fire

Low fire glazes are designed to fire in the 1600 F to 1700 F range and have high lead content. These glazes are suitable for a wide range of clay compositions as used in structural clay wares, and most of the common stains may be used with them – any incompatibility being due to the presence of oxides and compounds other than lead. For low fire glazes, the recommended firing procedure is to bring the brick up to the temperature as fast as possible and then to cool slowly. Firing cycles as short as 16 hours have been used successfully.

COLORS

A wide selection of basic colors is available in both the high and low fire glazes; this includes a wide range of greens, blues, browns, yellows, blacks and whites. Certain high-intensity reds and oranges, based on the cadmium-selenium pigments can only be obtained in the low fire glazes. These glazes, properly used, give a brilliant range of colors which cannot be even approached by any other coloring method.

Since volatility of the cadmium-selenium pigments is a function of time and temperature, it is recommended that these glazes be fired as quickly as possible and at as low a temperature as possible. Also, it is extremely important that these glazes be fired in an oxidizing atmosphere and never in a kiln where salt glazing has been done. Even trace quantities of chlorine in the kiln atmosphere will first turn a cadmium-selenium based glaze black and then cause complete loss of color. Copper fumes, too, will blacken the glaze — as may aluminum or iron when present in sufficient quantity.

ONE FIRE VERSUS TWO-FIRE GLAZING

One-firing is attractive economically since it eliminates the second firing and a glost kiln. However, there are technical difficulties inherent in the one-fire operation as well as production scheduling problems. Small quantity demands from architects and builders for a variety of colors can be handled more satisfactorily with the two fire process. Furthermore, such small scale "to order" production is better handled in small shuttle type kilns with lower fuel and maintenance costs.

Two-firing has other advantages as well. "Clinker" bricks — rough and chipped brick that are normally the brickmaker's scrap, can become profitable items. The esthetic effects possible with glazed rough surface brick have been found to be particularly appealing to architect and building-owner alike. Glazed "clinker" brick have actually been specified for some jobs. Another advantage is that greater flexibility in car setting exists in the two-fire system. And, with low firing glazes, the brickmaker is now able to extend his color palette to include the highly desirable cadmium-selenium colors as well.

PROPERTIES OF LOW FIRE GLAZES

Due to interfacial action between the glaze and the brick body, low firing lead glazes have good craze resistance. Several types of brick surfaced with these low fire glazes have passed autoclave pressures of 150 lb. per sq. in. for 5 hours without crazing. Sometimes certain brick with high water absorption will craze. These brick are, in general, more difficult to glaze with resultant good fit.

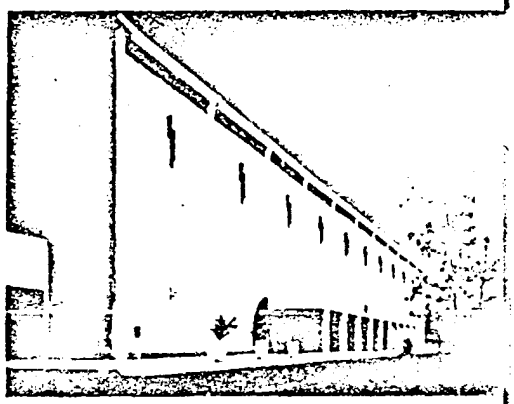
Microcrazing is common with the bright reds, oranges and yellows. High expansion glazes result from the combination of ingredients required for compatibility with these stains; thus a dense pattern of tiny crazes develops. Brick with these colors have been installed in buildings for a decade or more, and although microcrazing has been present, no trouble has been encountered or is anticipated.

Durable to Weather

The weather resistance of a building's surface is determined by two factors – its ability to withstand chemical attack, and mechanical deterioration. Some of the first low firing glazes were formulated without sufficient development work and were relatively low in weather resistance. Apparent color fading occurred on some of these low acid-resistant glazes. The elements (wind, hail, rain, industrial atmospheres, etc.) actually attacked and etched the glaze surface, forming tiny pits which gave the appearance of color fading. However, ceramic colors resist fading, because glaze stains are stable inorganic compounds.

Laid up in buildings over the years, these brick have shown some weather deterioration. Surprisingly, in a number of cases building owners have expressed

Today, architects use color as an important part of their total design concept. Vivid colors, such as the reds found in the glazed brick on this famous Atlanta department store were made possible through the use of lead.



pleasure with the weathered brick. In any case, the low temperature glazes now produced exhibit superior acid and weather resistance.

Weathering is known to be a function of acid attack on the glaze and it is therefore important that the glaze be acid-resistant. There are no test specifications specifically for low fire glazes, and existing A.S.T.M. "Tentative Specifications for Ceramic Glazed Facing Tile and Brick" have been used by the industry to test the quality of both high and low fire glazes. Another test used is 50 cycles of freezing and thawing, but for the most part the number and types of tests employed vary with the manufacturers' interests.

Frost damage is a controversial problem. It is true that certain brick can absorb large quantities of water. Under these circumstances, it is possible for the glazes to craze due to body expansion. A good conservative recommendation would be to use hard burned brick. However, no failures in the field from frost damage have been observed. The only failures of the spalling type that have been experienced have been due to the presence of magnesium and calcium oxides in the brick. These oxides are hygroscopic and, when in contact with water, will expand. If the oxide is close to the glaze surface it will flake off or spall off the glaze. Clearly, this type of failure is not related to the glaze. Better grinding of the clay to obtain a finer particle size, and more intimate mixing are ways to minimize this problem.

PROCESSING

Milled lead glazes are available to brick manufacturers where milling equipment is not available. In such instances, thorough mixing of the prepared glaze slip prior to spraying is required in order to obtain the desired glaze properties -- in both the fired and unfired state.

In spraying, extremely heavy coating should be avoided, since such coatings tend to crawl or separate during firing. Fired thickness of the glaze is normally in the range of 0.007-8 in. and is obtained with an application weight of approximately 20 to 25 lb. per 1000 brick on a dry weight basis.

Color fidelity is not considered a necessity in glazed brick as with the wall tile industry, and in fact producers of glazed brick agree that some variation in color is desirable.