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## Background

The use of glazes is familiar in many everyday articles, however, the technology involved in composition and application is complex and diverse. Many, almost an infinite, number of variations are possible within many generic types e.g. clear, glossy, matt, coloured, textured.

## Glaze Systems

Glazes are usually mostly comprised of a glassy material. In the case of opaque and matt glazes the glassy matrix contains crystalline matter. Certain glazes which contain large amounts of crystalline matter, deliberately grown in-situ to develop special properties, are described as glass-ceramic glazes. Opacity is occasionally produced by a phenomenon described as glass in glass phase separation.

## Glaze Components

Although several glass-forming systems exist, ceramic glazes are almost exclusively based on alumino-silicate glass systems. The main glass forming oxide, silica ( $\text{SiO}_2$ ) is modified by the addition of a range of other oxides. The modifiers act to alter thermal, chemical, and physical properties, (table 1).

Table 1. Common components of a ceramic glaze.

<b>Glass Formers</b>	<b>Intermediates</b>	<b>Modifiers (Melters)</b>
$\text{SiO}_2$	$\text{Al}_2\text{O}_3$	$\text{BaO}$
	$\text{ZrO}_2$	$\text{CaO}$
	$\text{TiO}_2$	$\text{SrO}$
		$\text{ZnO}$
		$\text{PbO}$
		$\text{Na}_2\text{O}$
		$\text{K}_2\text{O}$
		$\text{Li}_2\text{O}$
		$\text{Bi}_2\text{O}_3$
		$\text{B}_2\text{O}_3$

## Raw and Fritted Glazes

Glazes are (regardless of colour, process/product type, and final surface texture) described as raw or fritted. Raw glazes are combinations of natural and synthetic materials such as feldspars, clays, quartz, carbonates and oxides of suitable composition to produce the final glaze. Fritted glazes contain a proportion of pre-melted glass or frit used when firing or compositional demands dictate the raw glazes cannot be made.

## Glaze Application

The glaze materials are usually applied as a water-based suspension by spraying or dipping methods. Mechanisation is common though many craft and manual techniques persist.

In some cases, dry and electrostatic methods are used.

Glazes are applied to many varied substrates including table and giftware, sanitaryware, tiles, electrical porcelain, engineering ceramics and refractories. They are also applied to unusual substrates such as cement and graphite.

## **Firing of Ceramic Glazes**

Conventional glazes are not fired below 950°C and may be fired as high as 1430°C depending on the application in question. In most cases, oxidising conditions are used but for certain products reducing conditions are required.

## **Key Properties**

There are no fixed properties for glazes as their composition and use is so varied. The application of glaze may be purely for aesthetic reasons, functional purposes or both. One of the most common functional reasons is to provide an impermeable barrier to an otherwise porous ceramic body, as is the case with the common tea or coffee cup, while at the same time providing a visually pleasing surface to the article.

The following properties are considered of importance, depending on the application and product/process types.

## **Thermal expansion**

Glazes are normally required to be in compression in the fired state to avoid the fault of crazing, a differential of between 0.02% and 0.04% at around 550°C is normally recommended. Excessive compression can lead to the fault known as peeling.

## **Colour**

The colours available will depend upon the firing temperature, the chemistry of the base glaze, and the composition of the chosen colour.

## **Durability**

Depending on the application, chemical and physical durability may be of importance. Various tests are employed for the different product types to assess durability.

## **Maturing Range**

Glazes must mature within an appropriate temperature and time interval. There must also be a suitable range over which maturity is reached in order to allow for process variables. This dictates the choice of glaze and the materials used to produce the glaze batch for a particular product.

## **Applications**

Glazes are used in many applications. Some of these include:

- Sanitaryware – toilets, basins, bath tubs etc
- Tableware – dinner plates, crockery, ceramic cups and mugs etc.
- Tiles – wall and floor tiles
- Ornaments – giftware, figurines etc
- Electrical porcelains
- Refractories

## **For more information**

Ceram Research Ltd

<http://www.azom.com/keyservices.asp?supplierID=188>