

## **Properties of Flameworking glass and the effectiveness of heat affecting the glass during the formation stages**

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### **The Abstract:**

Glass Rods and Tubes are used to form Glass products using Lampworking Techniques. Borosilicate glass and Soda-lime glass are the most common used glass in forming with lampworking, usually Borosilicate glass is used in Blow forming, while Soda-lime Glass is used in forming with sold rods. Both those types of glass are forming from a group of chemical elements, which their chemical interaction between each other affect groups of natural and chemical elements that each type of those glass are unique with it.

The chemical composition and physical properties of glass and their relationship to the heat resulting from the flame torch are an important factor influencing the mechanisms of formation, thus affecting the achievement of the aesthetic and use requirements of the glass products formed from them, as well as on the final form of the product Therefore, it is important to study these glass types' properties and the flame of the torch and the heat produced from it during the heat forming process.

And here comes the problem of research in the reduction of the glass production system with lampworking restructuring techniques due to the lack of sufficient information on the properties of glass and factors affecting lampworking glass during heat formation. The aim of the research is to identify the factors affecting the lampworking glass and to show the effect of heat on the glass product during the formation stages. The research assumes that identifying the factors associated with the heat formation of lampworking glass increases the ability to employ them to meet the requirements for the good composition of these products. And this research has discussed several axes including: (Types of flameworking glass, raw materials compromising glass and explain the chemical interaction between each other, Factors impacting flameworking glass during heat forming, The chemistry of the flame and its effect on the glass used in formation, Annealing systems, Thermal properties of some of flameworking glass and their using specs during forming), And the paper has reached some results, including: (Identifying the most important factors affecting the flameworking glass during heat formation process, Show the effect of the chemistry of the flame on the properties of transparent and coloured glass during their forming stages, specify the Thermal properties of some types of flameworking glass that is most commonly used and their using specs while heat forming).

**Key words:**

Types of Flame working Glass-Thermal properties of Glass-Types of torch Flames for Lampworking/Flameworking

**- Introduction :**

Among the most common types of glass used in thermoforming are borosilicate glass and soda lime glass. Borosilicate glass is often used in blow molding processes, and soda lime glass is used in solid forming processes (M.1, p.51). These two types form a group of chemical elements, the way they interact with each other affects a set of natural and chemical properties that are unique to each of these types.

In addition to the effect of the interactions of the chemical elements present in the raw materials on the glass tubes and columns during its production, which is evident in the colored columns and tubes as one of the most important factors in which the effect of the interactions between the chemical elements appears; The heat generated by the torch flame has a significant impact on the forming processes of glass tubes and columns, as well as on the final shape of the product, hence the importance of studying the raw materials of the torch glass, as well as studying the flame of the thermal torch and the effect of the resulting heat on the glass during shaping.

**- Types of glass used in thermoforming:**

There are many types of glass used in the different techniques of glass formation, but the glass used in the thermal torch forming processes is limited to two basic types:

A- Borosilicate Glass: The working temperature range is located at high temperatures between 1100°C to approximately 1600°C, and borosilicate glass is called “hard glass” because of its high resistance to sudden thermal changes because it contains high levels of silica with boron oxide. P.2, p.53) Its chemical composition is often as follows (p.2, p.26):

Silica SiO<sub>2</sub> 60-80%

Boron oxide B<sub>2</sub>O<sub>3</sub> 10-25%

Al<sub>2</sub>O<sub>3</sub> aluminum oxide 1-4%

The borosilicate glass used in molding on the burner is often in the form of glass tubes of various diameters, and the tubes are made of transparent or colored glass, and it can also be found in the form of transparent or colored glass columns.

B- Soft Glass: It is the glass whose operating rate is at relatively low temperatures. Two main types fall under it: soda lime glass and lead glass. The most well known of the two is the soda lime glass.

Soda-Lime glass is the most common and least expensive type of glass. Because of the low price of the raw materials that go into its composition and the large quantities produced from it. Mostly it contains the following combination ratios (M.10):

Silica SiO<sub>2</sub> 60-75%

Sodium oxide Na<sub>2</sub>O 12-18%

CaO 5-12%

In addition to a small percentage of aluminum oxide  $Al_2O_3$  and magnesium oxide  $MgO$  and others.

The soda lime glass used in molding on the burner is often in the form of glass columns of various thicknesses, and colored or transparent columns are used in the formation, and the transparent columns may be used to cover or encapsulate the colored glass that has been formed; To protect it from discoloration or deformation due to the heat of the flame. There are also glass tubes from it, but they are used in the formation of small products, and their use does not require high durability, as they are not only sensitive after forming, but also during forming.

## Results and Recommendations:

### First: Results:

- 1- The interpretation of the movement of interactions between the constituent elements of the thermal torch glass mixture helps to understand how to benefit from them in forming processes to avoid production defects.
- 2- Finding the relationship between the most important factors affecting torch glass during thermoforming (surface tension - thermal compatibility - crystallization), and the types of glass formed by thermal torch; To avoid basic problems in the formation processes.
- 3- The effect of the chemistry of the thermal torch flame (oxidizing - neutral - reducing) on the properties of glass (transparent - colored) during its thermoforming stages.
- 4- The thermal properties of some of the most common types of torch glass and the specifications of their use when shaping were determined.

### Second: Recommendations:

- The need to complete the research paths that are concerned with studying the properties of the torch glass and how to benefit from them in the implementation of glass products formed by the thermal torch.
- Developing plans to activate the paths of cooperation between specialized academic bodies (Department of Glass) with the labor market in the fields of glass production by thermal torch, in order to identify the most important problems and develop appropriate solutions to them.
- Motivating specialized graduates to adopt the establishment of their own production units working in the field of glass production by thermal torches as one of the small industries projects.

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