A Study of the Optical Properties of the Local Glass and Compared with the Imported Glass in Iraq

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دراسة الخواص البصرية للزجاج المحلي ومقارنتها مع الأنواع الأخرى المستوردة في العراق

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الخلاصة

تم اختيار عدة نماذج من الزجاج المحلي والمستورد وذات المنشاء (الإيراني،الماليزي،الصيني)المتوفرة في الأسواق العراقية،تم قياس شدة الإشعاع النافذة مع تغير السمك لغرض تحديد الصفات البصرية (الانعكاسية،معامل الانكسار،النفاذية ،الامتصاصية) وقد تبين أن الزجاج المحلي الذي تدخل السيليكات بنسبة كبيرة في تركيبه،يمتلك اقل معامل امتصاصية مقارنة بالأنواع الأخرى المستوردة،وكذلك إن معامل الانكسار يعتمد على سمك الألواح بالإضافة إلى ذلك فان الزجاج المحلي يمتلك انعكاسية أعلى مقارنة مع الأنواع الأخرى

كلمات مفتاحيه: الزجاج ، الخصائص البصرية، معامل الامتصاص

Abstract

Several samples were selected from local and imported glass (Iranian, Malaysian and Chinese) available in the Iraqi market. The light intensity was measured with the change in the thickness to find optical characteristics (reflectivity, refractive index, transmittance, and absorbance). It has been found that the soda-lime-glass, which contain a large amount of silica in its composition, having less amount absorption compared with the imported kinds. The refractive index is independent

of the thickness of the glass plates .The Iraqi glass has high reflectance compared for example with the chinese glass.

Key words : glass, optical properties, absorption coefficient

Introduction

Glass is a uniform material of arguable phase, usually produced when the viscous molten material cools very rapidly to below its glass transition temperature, without sufficient time for a regular crystal lattice to form. The most familiar form of glass is the silica-based material used for household objects such as light bulbs and windows. Glass is a biologically inactive material that can be formed into smooth and impervious surfaces. Under tension, glass is brittle and will break into sharp shards. Under compression, pure glass can withstand a great amount of force. The properties of glass can be modified or changed with the addition of other compounds or heat treatment. Most glass formulations contain about 70–72 % by weight of silicon dioxide (SiO_2). The most common form of glass is soda-lime glass, which contains nearly 30 % sodium and calcium oxides or carbonates [1]. Pyrex is borosilicate glass containing about 10 % boric oxide. Lead crystal is a form of lead glass that contains a minimum of 24 % lead oxide. The major raw material of glass is sand or "quartz sand" that contains almost 100 % crystalline silica in the form of quartz. Although it is almost pure quartz, it may still contain a small amount (less than 1 %) of iron oxides that would color the glass, so this sand is usually depleted before production to reduce the iron oxide amount to less than 0.05 %. Large natural single crystals of quartz are pure silicon dioxide, and upon crushing are used for high quality specialty glasses. Synthetic amorphous silica, an almost 100 % pure form of quartz, is the raw material for the most expensive specialty glasses. The most common method for glass production is using molten tin, where the molten glass floats on top of the tin, thus giving it the name "float glass" The measure of the proportion absorbed is the absorptance. The measure of the proportion transmitted is the transmittance. Each quality is expressed as a fraction of the total quantity of light in the beam. If the intensity of the beam is represented by the numerical I, reflectance by R, absorptance by A and transmittance by T, intensity may be expressed as follows [2]:

$$R + A + T = I \quad \ldots\ldots\ldots\ldots (1)$$

Optical properties are concerned with the behavior of glass toward light, the visible spectrum that extends like the rainbow from violet on one end to red on the other. However, as the term is usually employed, optical refers also to behavior towards the infrared and ultraviolet regions of spectrum. The infrared region lies next to the red end of the visible spectrum and the ultraviolet is on the opposite end of the visible region next to the blue. The greatest physical difference between these bands of energy spectrum is in the wavelength. Most glass is transparent, or, to be more accurate, partially transparent. Complete transparency would imply no reflection and no absorption. No glass achieves this uncompromised state but most glass transmits most of the light that lands on it. For this reason it is easy and convenient to classify glass loosely as a transparent material [1]. This selectivity carries over into the ultraviolet and infrared regions. A number of special-purpose compositions have been designed to transmit either ultraviolet or infrared while absorbing visible light. These glasses are black in appearance. Also some glasses are designed to absorb infrared and transmit visible the heat absorbing filters such as are found on film projectors. The purpose of these filters is to get as lighter as possible on the screen while keeping the slide or film as cool as possible so the film doesn't melt. The bending (or refraction) of light when it passes through glass is the phenomenon that makes lenses possible. In a lens all the rays that pass through the glass are refracted by the lens and brought to focus at a single point. The measure of this difference in refractive index is the dispersion coefficient. Several hundreds of glass compositions are produced for optical uses alone. A metallic coating will produce the maximum reflectance a front surface mirror for instance. Other coatings show selective reflectance, such as the heat-shielding glass that reflects a high proportion of infrared but transmits a high proportion of visible. In this work optical properties have been
performed for most types of glass in Iraq

Experimental work

At first, our choice of the samples were from the Iraqi markets. We selected
samples produced in Iraq (before 2003), Iran, Malaysia and china. then we cut the samples in to 4x4 cm sections, finally cleaning the sample in three
stages
1- The samples were immersed in water and detergent powder for 10 minutes in
An ultrasonic device
2- The samples were immersed in pure water for 10 minutes in ultrasonic device
3- The samples were immersed in Acetone fluid for 10 minutes and dried by
cotton fabric, and air blower . After all samples were cleaned , the measurements started . First we measured variation of intensity of white light versus variation in thickness for all samples. In the Second step we calculate the refractive index using the traveling microscope method

Results and discussion

From the result obtained in fig(1) which represent the variation of thickness versus natural logarithm of intensity , the slope can be used to calculate the absorption coefficient of the glass. fig. (1) illustrate the Iraqi glass which has less much absorption coefficient than any type of glass. This behavior is attributed to the type of original material where the Iraqi glass depends on the natural silica ,but nearly all imported glass is product from recycling glass as well as the treatment temperature of the glass was deferent [2]. The Iranian glass like the Iraqi glass in this behavior, but the Malaysian and Chinese glass have small absorption coefficient. This is attributed to temperature at production of glass and addition some materials such as lead oxide and aluminum oxide [3,4]. Fig (2) illustrates the variation refractive index with thickness. From this refractive index dependent on the thickness for Iraqi glass, but the imported glass shows constant variation with the thickness over 3.7 mm. This behavior agrees with the results from Fig(1). This refers to the packing density and high reflectance where it has few vacancies and defects [5]. Where as the density of import glass are is less than from Iraqi glass because of the addition small ratio from other materials [6,4]. Fig (3) shows the variation reflectance with incident light intensity .The

reflectance of Iraqi glass was 0.017 , Iranian was 0.01, Malaysia was 0.006 and the Chinas glass 0.0024.From this results we conclude that this behavior agrees with the above results.

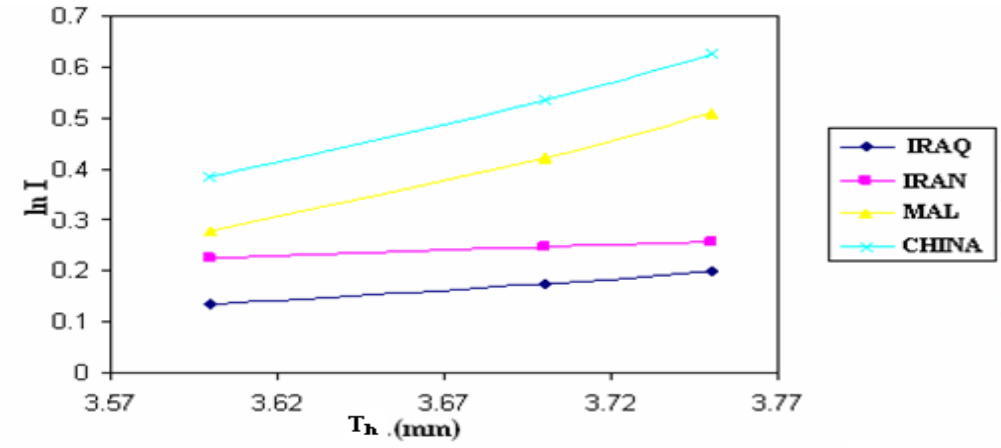

Fig (1) variation ln I with thickness

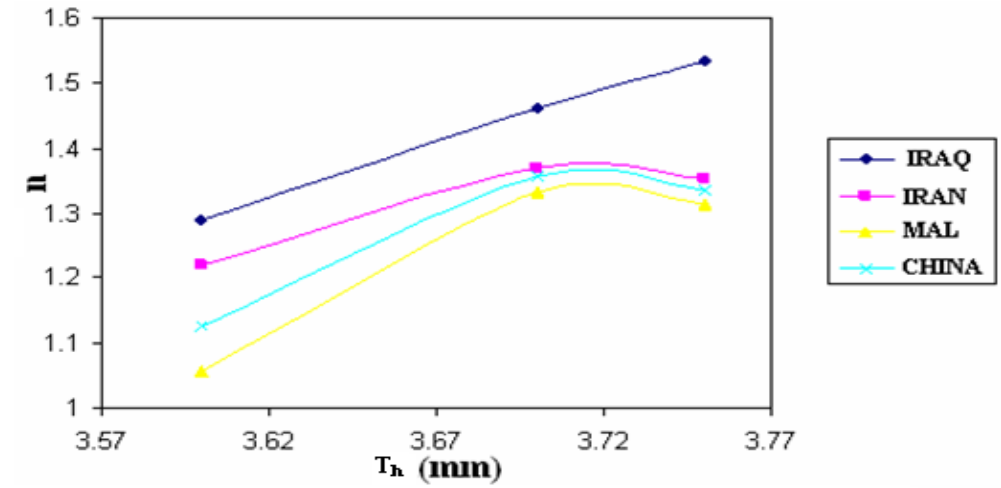

Fig (2) variation of refractive index with thickness

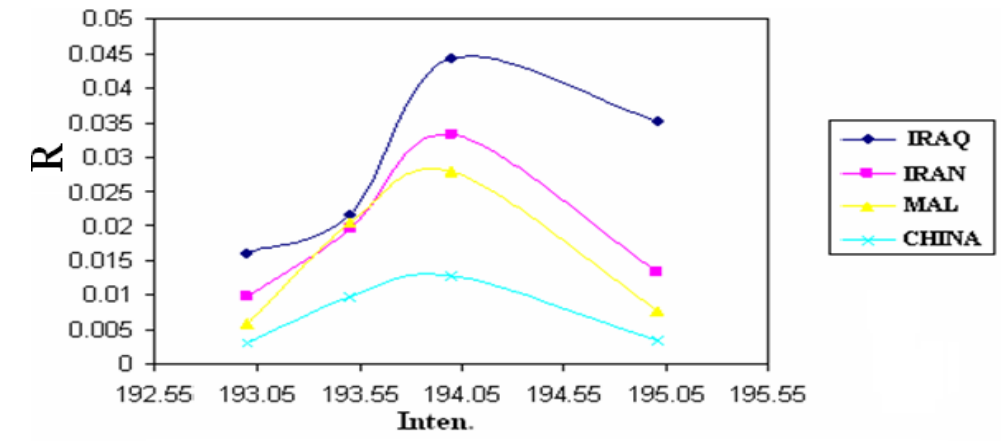

Fig.(3) variation of reflectance with incident intensity

Conclusion

In this work was study the optical properties of local glass and compare with varieties of imported glass. Local glass has been found that the best of imported glass, but it needs to develop and to heat treatment or addition of some of the material for the purpose of controlling the characteristics.

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