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OPTICAL PROPERTIES OF OXIDATED BLOWN ASPHALT FILMS

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الخواص الضوئية لغشاء منتفخ من الأسفلت المؤكسد

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تم تحضير عينات نقية منتفخة من الأسفلت بدرجات مختلفه من البترول ويحتوي على جزيئات خلال عملية التصنيع عند درجة نقاوة تصل إلى ٩٨٪ تركزت الدراسة على الخواص الضوئية من المدى الضوئي للأشعة فوق البنفسجية والضوء المرئي وكذلك الأشعة دون الحمراء. أظهرت هذه الدراسة . أن الامتصاص الأكبر يكون في مدى ٢٠٠ – ٧٠٠ ناتومتر وكذلك الانتقال في مدى الأشعة دون الحمراء لتحديد الانبعاث والامتصاص لهذه العينات عند درجات حرارة من ١٠ – ١٣٠°م . تم حساب معامل الامتصاص α والذي وجد أنه يتغير بين (٢,٣ – ٠,٠٥) ١٠^٦م^-١ في مدى طول موجي ٢٠٠ – ٧٠٠ نانومتر وأن معامل القتناء يتراوح بين (٧٠,٤٢ – ٢,٧٨) × ١٠^-٣ في المدى ٥٠٠ – ٧٠٠ ناتومتر ليدل على امتصاص الحافة .

Key words: Optical properties, Asphalt films

ABSTRACT

Films of purified blown asphalt of high grades of oil and the accompanied adulterated particles derived from its manufacturing process, that is, it was purified 98%. This study focused on optical properties in the wavelength area at UV, the VIS area and NIR area in order to determine absorption and transmission. The study paper indicated the high absorption of this material at UV area, VIS area at (200-700) nm, and the high transmission at the red area at (700-1050) nm in addition to the thermal stability at the range of temperature (10-130°C). Also, the absorption coefficient α which varies (2.3-0.05) x 10^6 m^{-1} has been calculated according to the wavelength (200-700) nm. According to the extinction coefficient which varies (36.65-70.4) x 10^{-3} m^{-1} at the wavelength ranges (200-500) nm and (70.42-2.78) x 10^{-3} m^{-1} at $\Delta\lambda$ (500-700) nm as to indicate absorption edge.

INTRODUCTION

Blown asphalt material can be extracted from the asphalt, the final product of crude oil, which, after being purified from mingled particles completely then undergo refining process from 7-12 times, for reason of expelling oils. Therefore, it is nearly 98% pure and thus called the oxidated blown asphalt. This material has been selected to give an impression from the first glance that it is of good absorption for the VIS spectrum and able to be used as absorption surface for solar energy purposes[1,2,3,4].

Thin films were prepared from asphalt with thickness varying as (3-120)μm on glass and mica slides, and the methods of spray[,6,7] using petroleum benzene as a solvent and method of casting by heating until liquidness point.

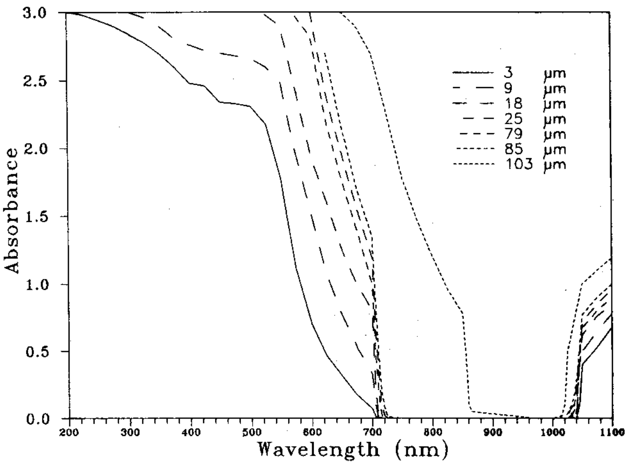

Fig. 1: Absorbance vs wavelength for different thickness films

The nature of optical properties has been dealt with through establishing the spectrum of transmittance and absorption, also reflection of the wavelength range from (200-1100) nm; i.e. NIR, VIS, UV of several different films of different thicknesses. Thermal stability for optical properties of these films, has also been studied.

RESULTS AND DISCUSSION

The preliminary measurement of the absorption spectrum shown in Fig. (1) has indicated that films absorb the UV wave completely at the range (200-350) nm and absorb the VIS spectrum in a huge manner; especially the nearest to UV area.

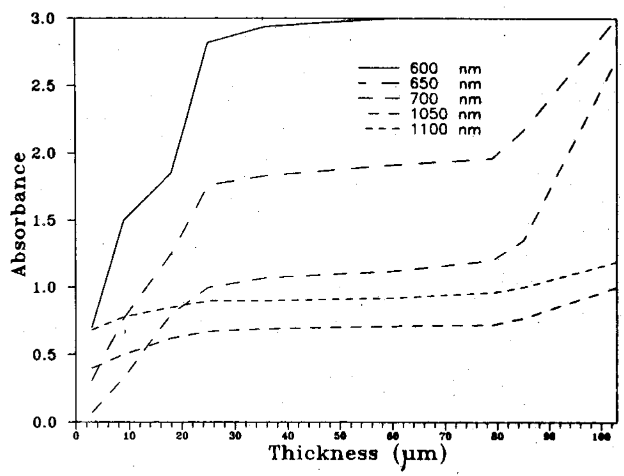

Fig. 2: Absorbance vs thickness for different wavelengths

The absorption starts to lessen every time we approach the red colour frequency where it becomes zero at the range (700-725) nm as long as the film thickness does not accede 80 µm. Then the absorption increases again at the range of NIR waves at 1025 nm.

Looking at the Fig. (2) which explains the absorption variability with thickness of the film, one can confine three areas for each special definition unit in the view of the physics. When the thickness is less than 25 mm, one can notice that the relation of absorption with the thickness of the film be consecutively with positive clear increase. When it be between (25-80) mm the variability will be slight, the case for which one can say or make an approach that absorption is semi-established value and the increase is slight.

As for third area, the absorption increases rapidly when the thickness >80 µm and the wavelength at the absorption edge increases too; this increase of absorption continues and the wavelength of the absorption edge simultaneously will increase the thickness until the absorption point reaches 100% for the whole of the spectrum (200-1100) µm. Here, in fact, these films is converted to black opaque object

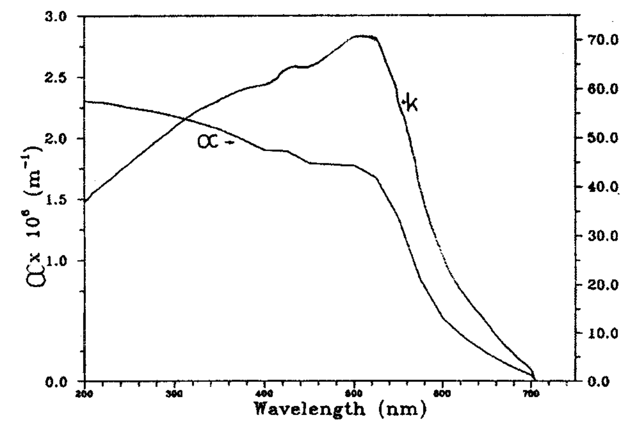

Fig. 3: α and K vs wavelength for a film with 3 µm thickness

absorbs all frequencies dropped onto it. In Fig. (2) we can notice that the target fundamental variations of the positive increase of absorption occurs at the wavelength indicated the approach of absorption to zero point.

The coefficient of absorption and extinction has been calculated, shown in Fig. (3) where coefficients of absorption varies with the wavelength in spectrum field UV, VIS, behaving like absorption spectrum; this is normal as in the following equation:

$$\alpha = 2.303 \frac{A}{t}$$

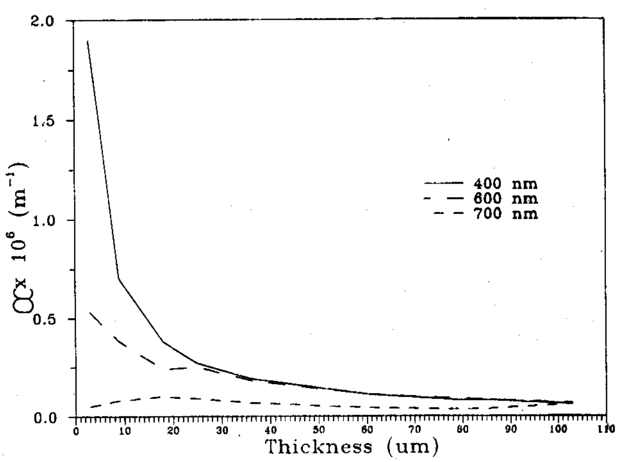

Fig. 4-a: Absorbtion coefficient vs thickness for different wavelengths

where the consecutive proportional factors is clear between A, α which represents the absorption when t value is established; (t thickness of the film).

One can notice α is of fundamental value for most of the spectrum values it approaches α value in some semi-conducting films[9,10]; even more to extend to a wider range of wavelengths that covers most of the VIS spectrum. Such it surpasses most of these films. If α value be compared with some of its values in respect of polymers[11] in particular, the molecular general structure of the blown asphalt looks like the polymers structure, we can notice that it is of large value, the case of which it is important for solar applications. In Fig. (4-A) which is regarded as an indication

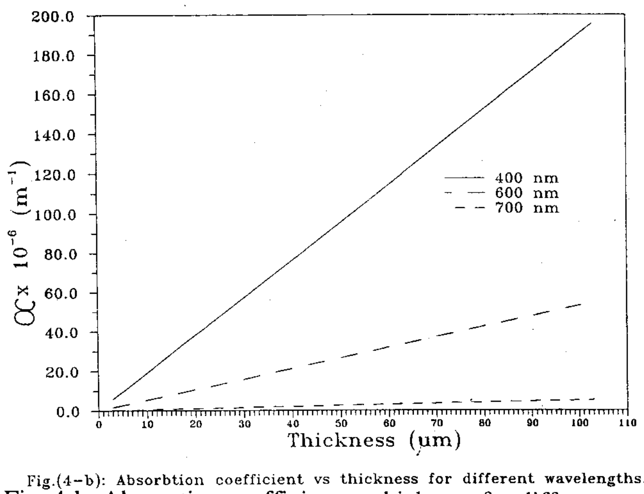

Fig. 4-b: Absorption coefficient vs thickness for different wavelengths

of absorption coefficient with the thickness of the film in fact, this is a curve can be explained by mathematics by the formentioned equation which indicates the successive relationship between α and A and the converse relationship with t. Since the proportion of variability at the absorption value is slight if compared with the variability of the

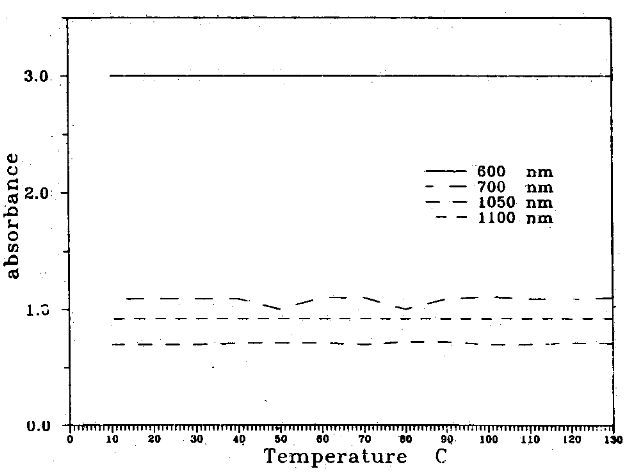

Fig. 5: Absorbance vs temperature for different wavelengths

thickness, the α lessen acutely together with the increase of t. This curve cannot be explained in physics, because the variability of α with t is considered to be linear because α is of qualitative established value of the material and is not

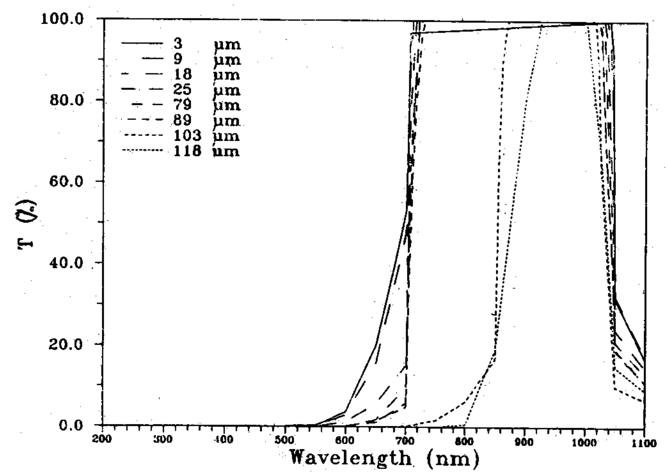

Fig. 6: Transmittance vs wavelength for different thickness films

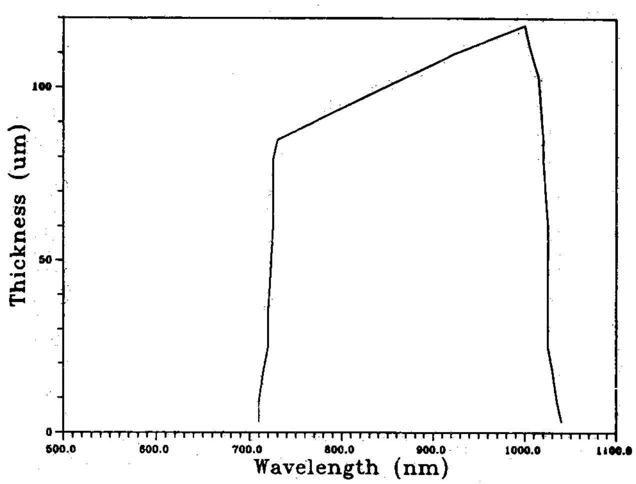

Fig. 7: Thickness vs wavelength for T (100%)

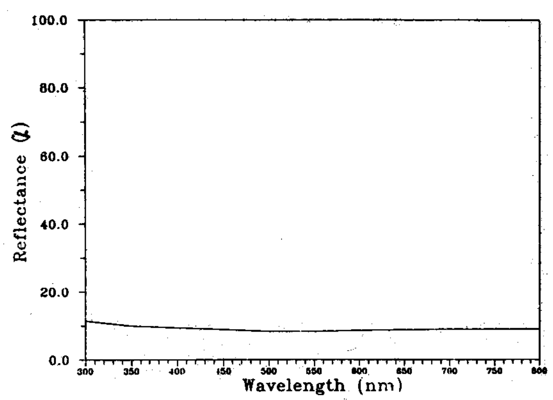

Fig. 8: Reflectance vs wavelengths

changed with t. If its physical variability is to be known together with the thickness, we should, then neglect the aforesaid equation, where the relationship will be successive between α, t; a multiple value of its qualitative value of the material as shown in Fig. (4-B). Also the same thing to K.

Due to the fact that the research for the optical properties of the blown asphalt derived from the wish to use it in solar collectors applications, we should determine its thermal stability; its optical properties stability in particular when temperature changes as shown in Fig. (5), where one can notice its fundamental heat stability on all spectrum ranges and non availability of absorption, with changing temperature to 10°C when the weather be cold, even at 130°C when the weather is very hot, water can be boiled into the solar collector. Fig. (6) represents transmittance spectrum and its variability with the wavelength.

The fundamental transmittance of those films at red area of the spectrum can be noticed; which changes when the thickness of the film be varying; it lessens every time. The thickness increases, and becomes more acute as in Fig. (7) yet it remains centralized with transmittance 100% at the wavelength NIR.

In the latter relationship (Fig. 8) and farther to the optical properties and the establish the reflection which is deemed to be slight if compared with absorption and transition; the character from which preference to use this material for solar collectors is determined.

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