EFFECT OF DUST ON TRANSMITTIVITY OF GLASS

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Abstract
This paper deals with the effect of accumulated dust on different locations in Baghdad on the transmittance of glass covers during the whole month of July. We found that the lowest transmittance for the samples are those which were placed south and west of Baghdad. Therefore, it is advisable to place the solar cells towards the north and east of Baghdad. And also we find the characterize elemental particle size and composition by different techniques. The x-ray diffraction detected six minerals those are calcite and quartz, present as a major components, dolomite, kaolinite, gypsum and plagioclase present as minor component. EDX detected some normal elements presented in our soil.

Keywords: Effect of Dust, transmittance of glass.

1. INTRODUCTION
The interest in converting the solar energy into heat energy by using the solar cells started after the middle of last century. Many works have been conducted to increase the efficiency of these solar cells [1-3]. Iraq is one of the countries that is severely exposed to the dust phenomena during March to August due to topography of the land and a low rainfall and also We have chosen these months because it has the highest annual variation of total (dust, sand, storms, rising dust and suspended dust). During these months about 75% of total annual dust events occur [4]. Since the dust has great influence on the performance of solar collectors, many attempts have been done to study the dust phenomena in Iraq [5-8]. In order to overcome dust problems in solar energy systems, it is necessary to know as much as possible about the dust and dust variations during these time [9-11]. When we talk about dust we must keep in mind fine particles in a size range between a quarter of a micron and about 10 microns. These particles may have, besides their different sizes, different chemical contents and different shapes, all these facts together determine their behavior.

There are three main crystalline forms of silica, quartz, crystobalite, and tridymite. Occupational exposures to the three substances are regulate by Occupational Safety and Health Administration (OSHA), a regulatory containing 0.1% or greater quartz must be labeled as a potential carcinogen(4). Other fine powder are less harmful to human health such as calcite. But the high contain of calcite in the PM 2.5 fraction suggests that potentially toxic effect and may be also extend into the smaller airways and then lung parenchyma (5)

All the samples were collected within Baghdad city area.

2. EXPERIMENTAL PROCEDURE
Sixteen sheet glass samples with dimensions of 50x50mm and 3mm thickness and density of 2.481gm/cm³ were prepared by the "State Establishment of Glass Factory", Rumadi, Iraq. The chemical analyses of the samples were performed in the laboratories of the "Directorate General of the Geological Survey and minerals investigation are shown in Table 1

Table 1: Composition of glass sample.

<table>
<thead>
<tr>
<th>Constituents</th>
<th>Percentage %</th>
</tr>
</thead>
<tbody>
<tr>
<td>SiO₂</td>
<td>71.90</td>
</tr>
<tr>
<td>A₁₂O₃</td>
<td>1.79</td>
</tr>
<tr>
<td>Fe₂O₃</td>
<td>0.120</td>
</tr>
<tr>
<td>Re₂O₃</td>
<td>1.86</td>
</tr>
<tr>
<td>CaO</td>
<td>6.90</td>
</tr>
<tr>
<td>MgO</td>
<td>4.23</td>
</tr>
<tr>
<td>Na₂O</td>
<td>15.04</td>
</tr>
<tr>
<td>K₂O</td>
<td>0.07</td>
</tr>
<tr>
<td>SO₃</td>
<td>0.19</td>
</tr>
</tbody>
</table>

The method of preparation of glass samples was described briefly elsewhere [12].
For samples were placed north of Baghdad. The same number was placed south, east and west of Baghdad. All the glass samples were inclined with an angle of 45° to the horizontal, this is because the loss in the transmitted energy is less by 1.3% than when it is horizontal [1]. The transmittance of the samples were measured weekly for one month to see the effect of accumulated dust. The transmittance was measured by using Pye Unicam spectrophotometer types sp8-250 and sp3-300 with reflectance unit SI240. The transmittance (T) values were calculated after measuring the absorbance (A) from the following relationship [12].

\[ A = \log\left(\frac{1}{T}\right) \]

A 10gm of the measuring sample were placed into a tall water filled measuring cylinder, and shaking very well for few minutes and left for 24h to settle all the coarse particles, then a glass slide was attached to thin wire and immersed at a depth of 10 cm and left for 300h. Then removed and dry at room temperature. X-ray diffraction analysis was used to qualitatively determine the presence of any crystalline compounds in the dust samples. Scherrer method was applied to estimate the crystallite size of the fine powder. EDX current with Pd tube applied to detect the light and heavy el

3. RESULTS AND DISCUSSION

Figure 1 represents the transmittance change with the wavelength range (250 – 2750) nm of the glass clean dust-free and has been using the same glass for the four models that the experiment took place.

![Figure 1 Variation of transmittance with wavelength for clean glass](image)

The results of transmittance measurement for samples placed north, south, west and east of Baghdad are shown in figures 2,3,4, and 5, respectively. One can see that the lowest transmittances for the samples are those which were placed south and west of Baghdad. This is due to the dust laden south western wind traverses the western desert prior to entering the Iraqi borders and due to two great belts of mobile sand which constitute the major local sources of mobile sand. The most active one is the western belt which falls across the Iraqi-Jordanian borders [4]. The second belt is situated south west across the Iraqi-Saudi border. So, it is advisable to place the solar cell covered by glass sheets towards the north and east of Baghdad.

![Figure 2 Variation of transmittance with wavelength as function of time for sample 1 (north)](image)

![Figure 3 Variation of transmittance with wavelength as function of time for sample 2 (south)](image)
Fig.2, 3, 4 and 5 shows the amount of transmittance for the same glass used in Fig.1. for a period of four weeks, the figures shows decrease in the amount of transmittance from week to week due to the accumulation of dust on the sample with the increase of time.

There are in all shapes a jump in the wavelength (500)nm, we believe that this result of manufacturing defects in the glass.

Three bulk dust samples are shown in Table {1}. The particles distribution variable from area to area, this because of the direction of the storm and as we know that the coarse particle will fallen first depending on the wind speed, wile the finer particle taking along time to settle depend on its size. The sizes which affect the respirable system seem to bee in low concentration in precipitated dust, but this not mean that this size are the real amounts present in atmosphere as airborne. X-ray diffraction pattern showed that the bulk dust PM53 containing quartz (SiO$_2$), calcite (CaCO$_3$), dolomite (CaMg(CO$_3$)$_2$), kaolinite (Al$_2$(Si$_2$O$_5$(OH)$_2$)) and plagioclase (NaAlSi$_3$O$_8$CaAl$_2$Si$_2$O$_8$). This composition reflects the nature mineral in Iraq or within the area. The smallest size obtained by this method was 1µm at a time of 480m.

<table>
<thead>
<tr>
<th>Mineral</th>
<th>2θ</th>
<th>hkl</th>
<th>Size (nm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quartz</td>
<td>20.83</td>
<td>100</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>26.66</td>
<td>101</td>
<td>55</td>
</tr>
<tr>
<td>Calcite</td>
<td>23.02</td>
<td>102</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>29.35</td>
<td>104</td>
<td>20</td>
</tr>
</tbody>
</table>

One of the famous methods to measure the crystalline size is Scheerer method. The values of the crystallite size of quartz and calcite are shown in Table 2.
These values are less than PM 2.5 which means that the air at that time was at risk. The data of the EDX analysis of the dust samples are quite familiar in local soil such as Si, Ca, S, Fe, K.

4. CONCLUSIONS
We conclude from above study which concerned the effect of accumulation dust for 4 weeks on transmittance of glass as following:
- Less transmittance is for glass thread south and west of Baghdad.
- This research is recommended developing solar cell toward the north or east of Baghdad to get the highest transmittance, which is the best for solar cell.

References