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The particle size effect of Halexylon Salicornicum on thermal conductivity and dielectric constant of polyester resins- Halexylon Salicornicum composites

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***Abstract*---**Iraq is home to the Halexylon Salicornicum plant (HS). This study modifies thermal conductivity and dielectric constant of unsaturated polyester resin using HS as filler (UPE). Different HS filler particle sizes, including 6.5 mm (raw HS), 1.18mm, 250 m, 125 m, 75 m, and 50 m, are used to create HS- UPE composites. HS filler loading levels (1, 3, 5, 7, 10, 15, 20 and 25) (wt percent). All HS- UPE composites' thermal conductivity and dielectric constant are investigated. Study is done on how changes in frequency (from 500 Hz to 1 MHz) affect the dielectric constant of all composites. The thermal conductivity of HS- UPE composites falls as the concentration of HS filler increases and particle size reduces; it is at its lowest level at 25% weight. At 50 m particle size, the impact of particle size on heat conductivity of composites is clearly visible. When HS filler concentration rises and particle size falls, the dielectric constant of HS- UPE composites increases; it reaches its maximum value at 25% wt and 50m RH particle. On 50 m RH-RTV silicone composites, frequency variation has little impact.

***Keywords*---**Incompatibilities, Polyester resins, Halexylon Salicornicum, Related, Particle size.

Introduction

The unsaturated polyester resin (UPE) is simple to use, has various uses in daily life, and may be cured at room temperature. Lower cost, higher strength, good corrosion resistant, electrical and thermal properties [1]. Halexylon Salicornicum plant (HS) is a natural plant Middle East (Iraq) , Iran, Afghanistan, North West China. It is a much branched, perennial erec leafless shrub, woody at base [2]. HS plant may be used as natural filler to UPE matrix to enhancement thermal and

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electrical properties. Natural cellulose fibres from various biodegradable sources are used in several investigations. Hybrid composites made of polypropylene and unsaturated polyester were employed to strengthen the jute/bamboo natural fibres, and varied fibre loading and fibre ratios were used to study the dielectric characteristics [4]. The waste newspaper were used as besed based composites have been prepared in polyester resin matrix; the mechanical properties of composites were studied [5]. The Pharsalus vulgaris fiber were used as filler to reinforce unsaturated polyester composite, the electrical, thermal, and mechanical properties of hybrid natural fiber composite were studied; the result showed that regular decreasing of thermal conductivity when the filler increasing [6].

Methods

Table 1 displays composites of various compositions. The HS plant was found in the desert near Najaf, Iraq. Unsaturated polyester resin known as UPE matrix UESD is a readily accessible product provided by Swastik Interchem Pvt. Ltd. for composite laminates with broad use. Cobalt octoate (accelerator), and methyl-ethylketone peroxide (initiator) were also used; they were bought from Silmid England. Trivenii Interchm Pvt. Ltd., Mumbai, Maharashtra, India. After being completely cleaned to get rid of dirt, sand, and dust, rice husk was dried. HS was then ground using a blender mill before being sieved. (1, 3, 5, 7, 10, 15, 20 and 25 wt.%). The grinded HS was sieved into different HS particle size, which are equal to 6.5mm (raw HS), 1.18mm, 250 m, 125 m, 75 m, and 50 m. (percent). UPE and HS were blended using a manual mixing method. A mould is filled with the mixture, and it is left at room temperature for 24 hours. The circle-shaped thermal conductivity sample has a 13 cm diameter and a 1 cm thickness.

Table 1: Show the sample size distribution and HS weight percent

Samples	Samples	Samples	Samples	Samples	Samples	RH wt.%
RH size / 6.5 mm	1.18 mm	250 μm	125 μm	75 μm	50 μm	
A_1	B_1	C_1	D_1	E_1	F_1	1
A_2	B_2	C_2	D_2	E_2	F_2	3
A_3	B_3	C_3	D_3	E_3	F_3	5
A_4	B_4	C_4	D_4	E_4	F_4	7
A_5	B_5	C_5	D_5	E_5	F_5	10
A_6	B_6	C_6	D_6	E_6	F_6	15
A_7	B_7	C_7	D_7	E_7	F_7	20
A_8	B_8	C_8	D_8	E_8	F_8	25

By utilising a thermal coefficient metre called the YBF-3 (Hangzhou Dahua Yiqi Zhizao Co. Ltd., Korea), the thermal conductivity was investigated at a temperature of 50 °C [7]. By employing an HIOKI IM 3570 with an L2000 4-

terminal probe and an oscillation voltage of 1.0 V, dielectric measurement was carried out at room temperature (HIOKI Co., Japan). The dielectric constant sample is a circular with a 10 cm diameter and a 0.5 cm thickness.

Results and discussion

Thermal property:

By using the hot plat technique, the specimens' thermal conductivity was investigated. Fourir's law H. $H = -kA\frac{\partial - T}{\partial - x}$ --------------- (1)

Litter A is the test piece's, k is the thermal conductivity, and T/x is the temperature gradient [8]. The density, moisture content, temperature, direction of heat flow with regard to grain for fibrous materials, presence of imperfections in the material, and porosity have all been shown to affect the thermal conductivity of insulating materials [9]. As the concentration of HS is raised, the thermal conductivity for samples of all various particle sizes decreases, as illustrated in figure (1), The outcome is in accordance with [10], which may be the result of HS having superior siliceous material for the production of calcium silicate [11] and HS having poor heat conductivity [12]. Additionally, figure (1) demonstrates that the thermal conductivity of HS-UPE composites decreases with decreasing particle size. This may be because the smallest size of HS particle has more surface area and quantity, which results in more distribution and unformed in UPE matrix, impeding the flow of heat in composites [13].

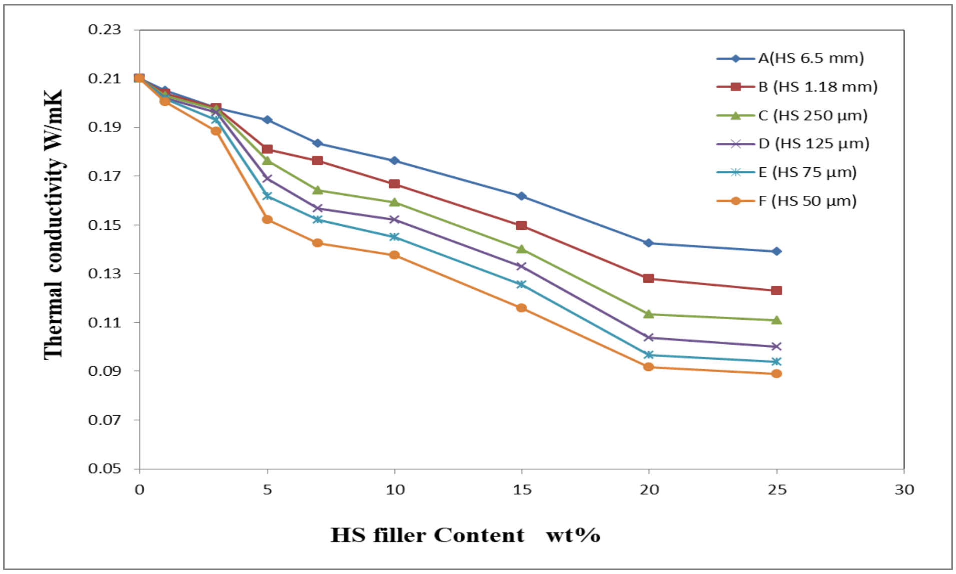

Figure 1: The concentration (in weight percent) and particle size of HS affect the thermal conductivity of HS-UPE composites.

Electrical property:

The specimens' dielectric constant has been examined. The permitivity of the material in relation to that of air or empty space, or 0, determines the dielectric constant, r [14], Equation (2)

$$\varepsilon_r = \frac{\varepsilon}{\varepsilon_0} \text{----------(2)}$$

Figure (2) demonstrates how increasing HS concentrations improve the dielectrc constant of HS-silicon composites at frequincy 500 Hz. The dielectric constant UPE composite increases with the addition of HS with a dielectric constant greater than the basic UPE, mostly because of the impact of HS dielectric constant [15]. The dielectric constant of HS is increased by silica, which also helps to partially create the composition of HS [16]. Additionally, it can be demonstrated that the dielectric constant in UPE rubber increases as the HS filler content does. At the maximum HS concentration of 20% wt, the greatest dielectrc constant of UPE composites with all various particle sizes of HS filler is found. The figure show the impact of particle size for dielectric constant on UPE composite. The dielectric constant value of the 50 m composite (F samples) is larger than that of the composite with large particles. The small size particle may be more distributed in the silicon matrix than the coarse particle, and it may also constrain the mobility of the UPE chain in small particle sized composites, according to two possible explanations for this discovery [17].

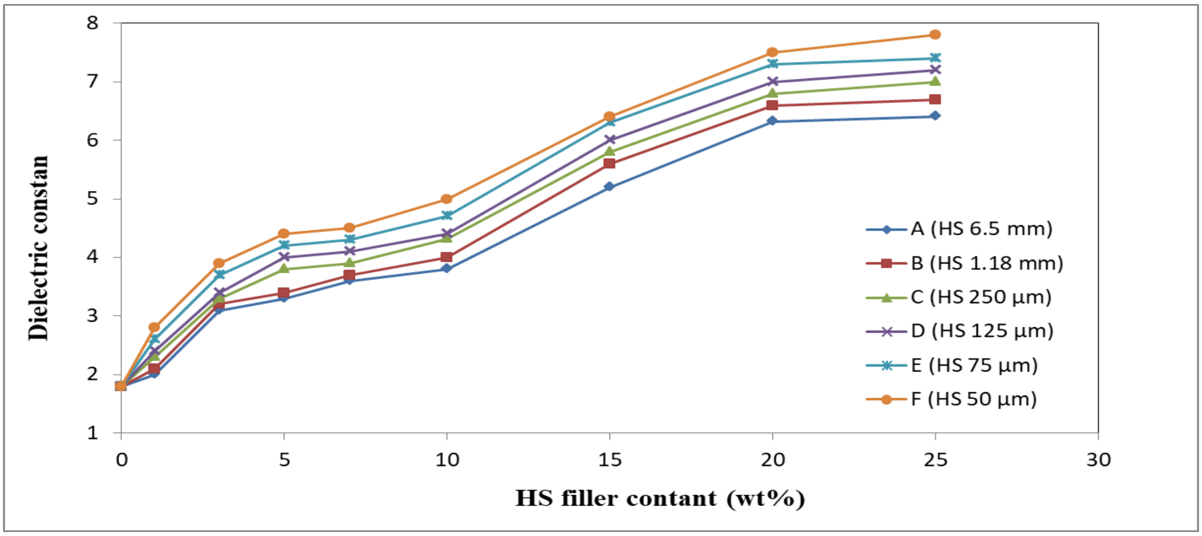

Figure 2: The concentration (in weight percentage) and particle size of HS affect the dielectric constant of HS-UPE composites.

Figure 3 depicts the fluctuation in silicon composite's dielectrc constant as a function of frequency with a 20% HS concentration. As frequency increases in the (500–1M) HZ range, the dielectric constant falls. This tendency may be explained by the fact that composite materials generally have large dislocation densities around the contact. In turn, the delectric constant is influenced by the quantity of charge carriers present throughout the material, their rate of relaxation, and the frequency of the applied electric field. Since the measurement temperatures are kept constant, their impact on the charge carriers' relaxation durations is disregarded. Lighter electronic species will predominate in charge transfer across. Because a network might begin to link filler particles and detach the UPE matrix, the electrical properties of the filler practically entirely predominated in this scenario [18, 19, 20].

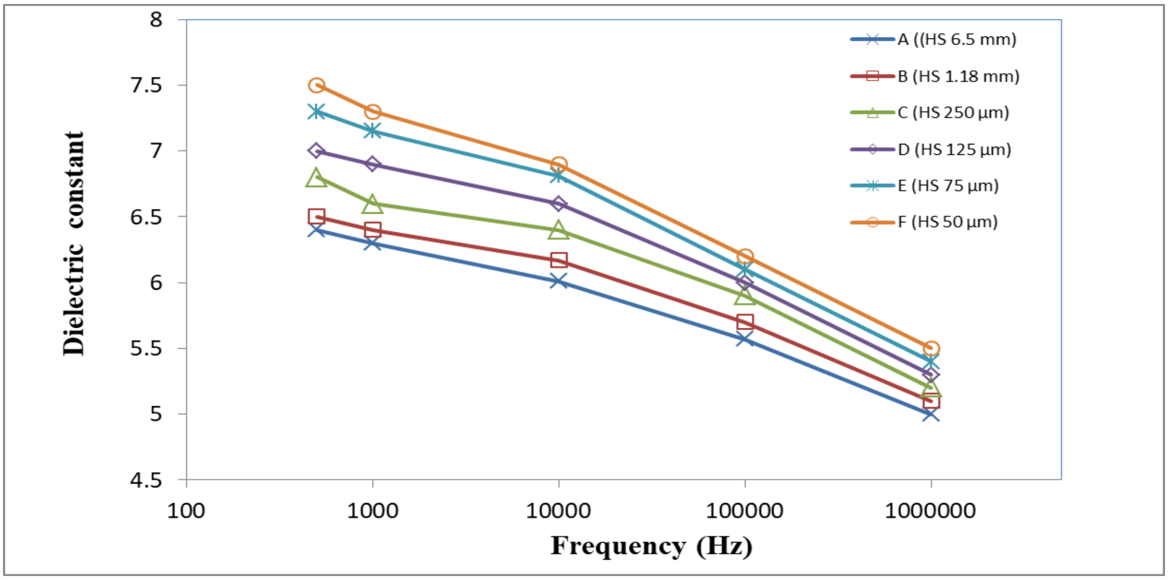

Figure 3: HS-UPE composites with a 20% wt HS filler

Conclusions

According to the findings of this investigation, The HS filler quantity and particle size have a significant impact on the thermal and electrical properties of HS-UPE composites.

1-The thermal conductivity of UPE composites can be lowered by increasing the concentration (wt percent) of HS filler in the RH filler. The effect of reducing HS filler particle size is similar to that of reducing HS filler concentration.

2- A higher concentration of HS filler and a smaller particle size of HS filler can increase the dielectric constant of UPE composites.

3-For UPE composites of smallest HS particle size, the highest frequency has little impact on dielectric constant.

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