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RESEARCH ARTICLE

Using of nanotechnology to improve the performance of the aircraft tires against flammable

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Abstract

The aim of this study to use magnesium hydroxide ($Mg(OH)_2$, 99%, 10 nm) as a nano-filler to increase the thermal resistance of the planes tires were mixing magnesium hydroxide parts, variety (5-20 wt.%) with basic batch tire and then exposing the material generated to direct flame-generated from oxy-acetylene torch (~3000 ºC) with a constant exposure distance to flame (10mm). Surface opposite method was used to measure the heat transmitted through the tire material. The results indicated that have been obtained from the test improved resistance of tire flammable by adding magnesium hydroxide and increase the proportion of added hydroxide.

INTRODUCTION

Flame retardants defined as a chemical has the ability to withstand direct flame as it works to prevent the entry into the material, as well as prevent the spread of flame and even extinguished completely[1-2]. The summation can be during or after the fabrication of the stuffs to be protected from burning. The development of the flame retardants allowed the safe usage of fabrics that cause a flammable behavior by reducing flammability and reduce the rate of burning[3-5]. The most flame retardants consist of phosphorus, antimony, chlorine, bromine, boron and nitrogen[5]. Flame retardants commonly divided into four major groups: **Inorganic FRs:** A small group of inorganic compounds is suitable for use as a flame retardant in plastics and the most important antimony trioxide Containing Halogen, aluminum hydroxide, which operates within the range of thermal (180ºC-200ºC), Zinc Sulfide, magnesium hydroxide which extent of thermal (300 ºC-330ºC), and zinc borate[6-10]. The occurrence of this kind of flame retardant to heat it does not evaporate, but disintegrates and free gas is flammable water vapor and carbon dioxide, such as carbon and carbon dioxide sulfur and hydrogen chloride and other gases[11-12]. Brings out more of these compound reactions endothermic reactions). Mechanism of action based on the disintegration at high temperatures, leading to the freeing of the gas is flammable at reducing mixture of flammable gases and then the surface of the plastic isolated from Contact with oxygen as well as the glass layer protector on substrat that prevents oxygen and temperature effects. This group represents more or less (50%) of the worldwide output of materials obstructing the fire size[13-17].

Phosphorus-containing FRs: Generally includes phosphate esters, ammonium Orthophosphates, ammonium Polyphosphates, and red Phosphorus. These retardants are oxidized during combustion to phosphorus oxide, which turns into a phosphoric acid on its interaction with water[18]. This acid stimulate the water put up and taken out of the bottom layer of the material decomposed thermally leading to char, thus increasing the carbonate waste as well as reducing the emission of combustible gases. Working phosphorous compounds in the solid state, it can also operate in a gaseous state when they contain halogenated compounds. These represent Group ratio (20) % of world production[19-22]. **Nitrogen-containing FRs:** Also known as organic flame retardants. Freed gases from these retardants make material swell, leading to the formation of the surface insulating layer. Of the most important compounds of this group is melamine and its derivatives. Used these constraints obstacles for a specific number of polymers[23-24]. **Halogenated organic FRs:** These retardants include, in particular elemental bromine and chlorine. Its working principle depends on the chemical intervention with the radical chain mechanism, which takes place in the gaseous state during combustion. Halogenated flame retardants Working to remove the high energy, hydrogen (H) and hydrogen (OH), which break loose during the combustion process through union with retardant[25-30].

2. Methodology

2.1.Materials: Magnesium hydroxide ($Mg(OH)_2$, 99%, 10 nm) and was supplied by US Research Nanomaterials, Inc. ;Natural rubber as a matrix material with many additives illustrated in Table.1 used in rubber batch. Natural rubber was supplied by Ba Phuc Rubber Company.
2.2.The Batch: The batch was prepared from NR with addition of magnesium hydroxide with (5-20)wt.% .

2.3. Surface flammability test:
ASTM E 162 standard test method for surface flammability was used .Radiant heat energy source represented in oxy- acetylene torch with ~3000 ºC was used in this test with exposed distance equal to 10mm. The system was exposed to this flame under an exposure distance 10mm. A transformation card (AD) which called Thermal monitoring and recording system (see Fig.1) was used to observed and saved temperatures with time (in seconds). Temperatures measured by thermocouple type-K in opposite surface. Samples of surface flammability test have a dimensions (100×100×10mm).

3. Results and Discussion

Table.1: Materials content in the rubber batch

Compounding ingredients	pphr
Natural Rubber -NR	100
Zinc Oxide	5
Stearic acid	2
Carbon Black (N-330)	35
Sulfur	2.25
MBS	1.2
DPPD	1
RFR	1

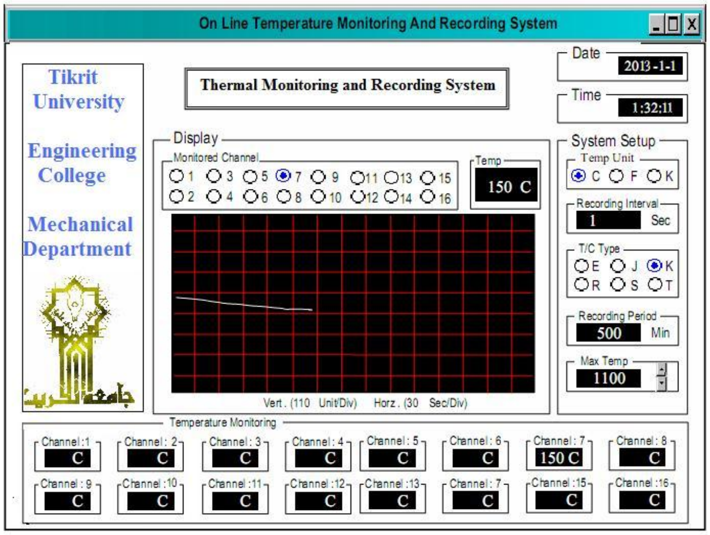

Fig.1 : Thermal monitoring and recording system

Fig.2 represent surface flammability test vs. exposed time to torch .The curve.1 with 5wt.% $Mg(OH)_2$ show that the temperature of opposite surface to flame begins to increase with increasing time of exposed to flame and during this time , $Mg(OH)_2$ During this $Mg(OH)_2$ will absorb heat and decomposed as following equation:

$$Mg(OH)_2 + heat \rightarrow MgO + H_2O \qquad (1)$$

This reaction is endothermic which decreased surface temperature , and generates free gas (water vapor) in addition to magnesium oxide which is a ceramic materials with high melting temperature. Therefore, the flammability of tire will decrease. This process (heat absorption and decomposition) will improved as the content of $Mg(OH)_2$ increased to 10wt.% as shown in Curve.2, where the heat reached to rubber will decreased combined with increased free vapor gas and MgO content. Curve.3 represent surface flammability test with 15wt.% $Mg(OH)_2$. As observed from this figure ,the resistance to flame will increased due to decreased amount of heat reached to rubber .The endothermic reaction will continue increased with 20wt.% $Mg(OH)_2$ (Curve.4) ,until failure of tier.

4. Conclusions

From the results obtained from surface flammability test ,we note that improve retardant resistance to flame after the addition of magnesium hydroxide compared to burning temperature of rubber due to forming free gases and high elevated temperature oxide. And increased resistance to flame with increasing the proportion of hydroxide added.

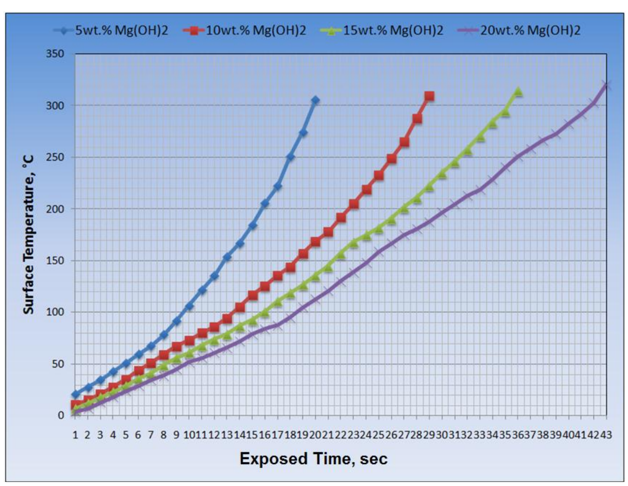

Fig.2: Surface flammability test vs. exposed time

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