Fire Retardants for Civil Structures

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Abstract

Aluminum hydroxide as a coating layer of (4mm) thickness was used to increase the fire retardancy for advanced composite material consist of polyvinyl chloride (PVC) reinforced by carbon fibers .The resultant composite was exposed to a direct gas torch flame with flame exposure intervals 10,15,20mm, and study the range of resistance of retardant material layer to the flames and protected the substrate . The Method of measuring the surface temperature opposite to the flame was used to determined the heat transferred to composite material.

Index terms— fire retardancy, advanced composite, inorganic retardants.

1 Introduction

fire retardant coating or paint is intended to delay ignition and reduce the surface burning rate of a combustible wood, cellulosic fiber or cellular plastic building material for a short period of time. It may be applied as a thick protective covering by trowel or as a fire-retardant paint by brush, spray, or roller. The reduction of burning rate usually depends on the applied thickness 1 . In the case of a fire-retardant paint exposed to fire, the paint may intumesce, forming an insulating blanket which retards surface ignition and reduces the burning rate of the combustible material on the coated side. Fire-retardant coatings will effectively reduce the burning rate of a combustible surface for a period of about10-15 minutes. Their use is particularly applicable in very low hazard occupancies not requiring sprinkler protection, where occupancy is not likely to change and the only hazard is that of exposed, interior finish materials 2 . Fire retardants commonly divided into four major groups: Inorganic FRs, Organ phosphorus FRs, Nitrogen-containing FRs and Halogenated organic FRs 3 . Inorganic flame retardants make up a large part of the market encompassing various aluminum, Authors ? ? : Technical Institute-Babylon, Iraq. E-mail : aliibrahim76@yahoo.com Authors ? ? : Materials Engineering College, Babylon University, Iraq. nitrogen, phosphorous, and boron compounds 4 . These widely used low cost materials have been around for centuries, proven to be effective flame retardants in fibers in clothing and fillers for textiles. The majority of these inorganic flame retardants work by diluting both the condensed and vapor phase of the polymer with non-flammable salts, acids and by-products such as water and alumina (Al_2O_3) 5 . Figure-1 shows the mode action for inorganic FRS.

2 Figure 1 : Mode of action for inorganic FRs

Polymeric plastic combustion occurs in the vapor phase. When a plastic is exposed to increased temperatures, the plastic undergoes pyrolysis. Potentially combustible vapors are slowly released at first. Since many polymers are substituted, the increase in surrounding temperatures can cause variations in connectivity among the monomer units 6 . Often, these variations in connectivity result in an overall weakening of the polymer structure and can encourage the release of more vapors and liquids, both flammable and nonflammable. As the heat source persists, the temperature of the polymer increases steadily 7 .

A II.

3 Materials and Method a) Materials Used

Aluminum hydroxide with particle size (1µ). Matrix material: polyvinyl chloride (PVC), this resin was supplied by Huntsman Advanced Materials (Switzerland) GmbH. Reinforcing material: Woven roving º) 45 -º 0 (carbon fibers was used as a reinforcing material, the company supplied these fibers is Hyfil lt, UK .

4 b) Preparation of Test Specimens

Specimen of thermal erosion test have a square shape, with dimensions (100×100×10mm).These Specimens consist of two layers: Fire retardant material layer with (4mm) thickness, and composite material layer with (6mm) thickness.

5 c) Thermal Erosion Test

Gas torch flame with temperature (2000ºC) was used in this test. The system (contains fire retardant material and composite material) was exposed to this flame under different exposure intervals (10 ,15, 20mm). Surface temperature method used here to calculate the amount of heat transmitted through fire retardant material and composite material. A transformation card (AD) which called Thermal monitoring and recording

6 Results and Discussion

IV.

7 Conclusions

Flame resistance of composite material will enhanced with addition retardant layer from Aluminum hydroxide. The resistance to flame spread will increased with increasing of exposed interval. The flame retardancy is increased as the flame temperature is decreased. The improvement in flame retardancy will increased with increased exposed interval to (15mm) as shown in Figure-3 Curve.2. As a result, when the exposed interval to flame increased to (15mm), the time necessary to break down of fire retardant layer will increase and the combustion gaseous will reduced and there will be a less plastic to burn due to water of hydration and protected glassy coating layer comes from Aluminum hydroxide 10 .

Figure-3 Curve.3 represents the thermal erosion test for composite material with retardant surface layer at exposed interval (20 mm),where this increment in exposed interval will rise the time of break down for Aluminum hydroxide layer and substrate composite material 11 . From figures , the better results obtained with large exposed interval (20 mm).

releases water of hydration from its chemical structure . Therefore, the substrate (composite material) will protect and the fire spread will decrease 9 [1]

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2

Figure 1: Figure 2 :

3

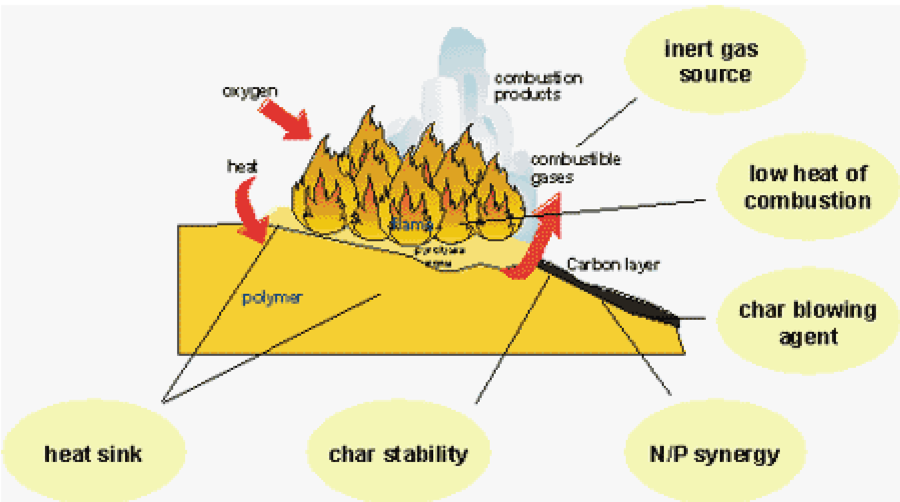
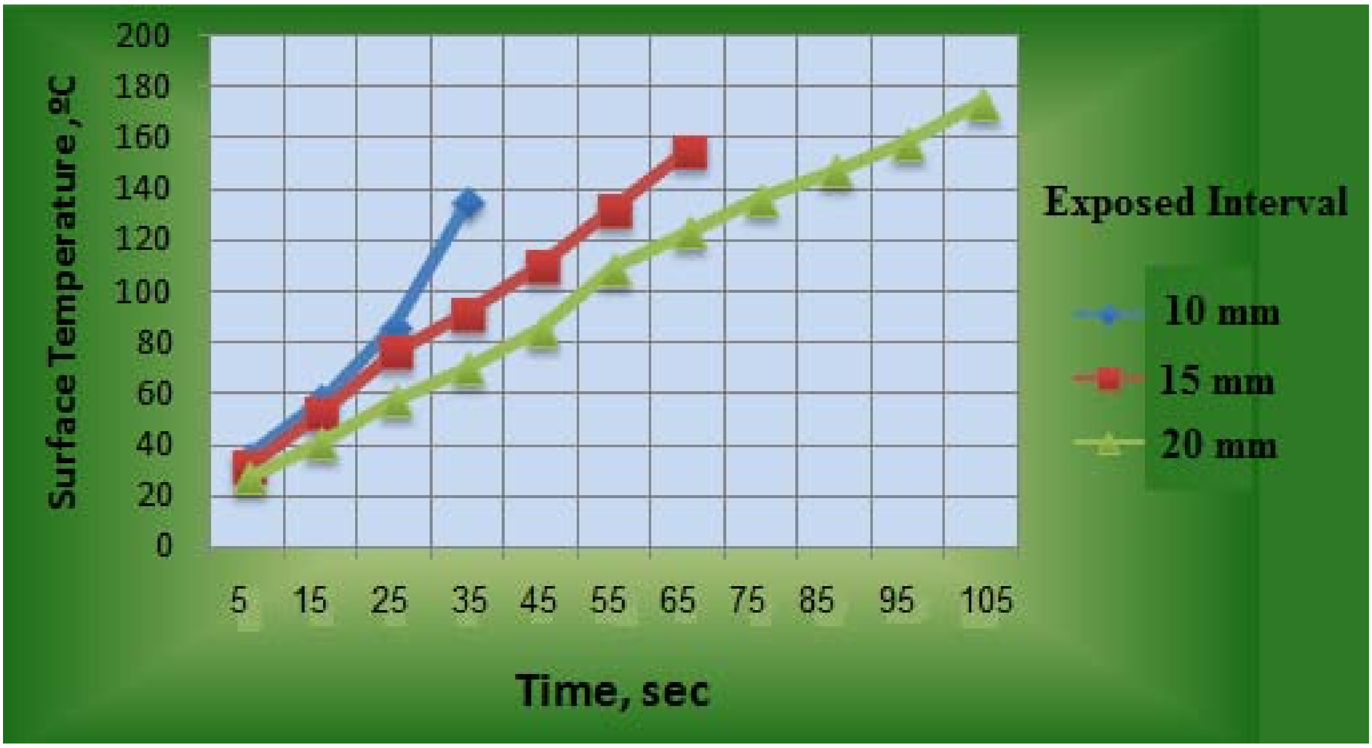


Figure 2: Figure 3 :



Surface Temperature ,ºC
200
180
160
140
120
100
80
60
40
20
0
5
15
25
35
45
55
65
75
85
95
105
Time, sec
Exposed Interval
10 mm
15 mm
20 mm

Figure 3:

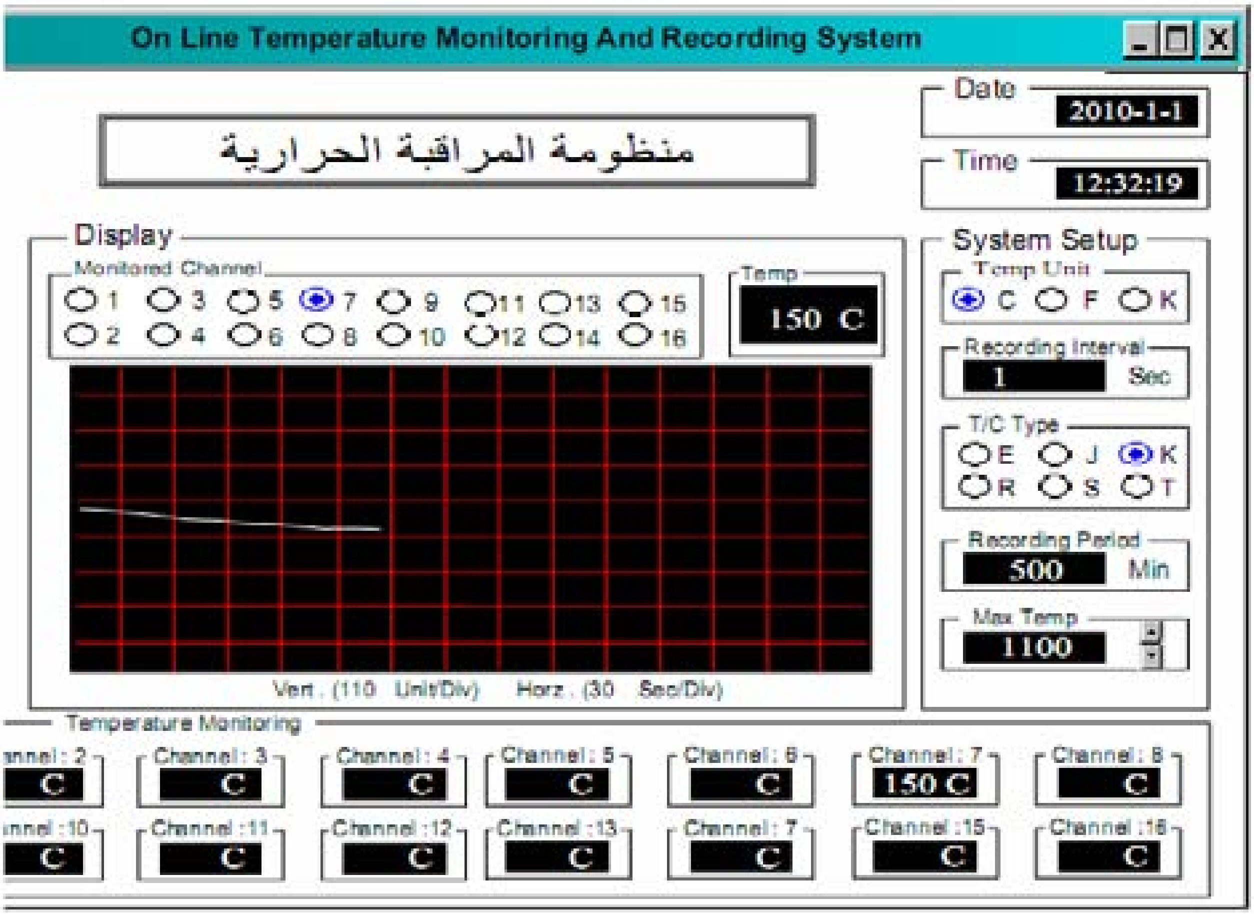

On Line Temperature Monitoring And Recording System
منظومة المراقبة الحرارية
Date
2010-1-1
Time
12:32:19
Display
Monitored Channel
1 3 5 7 9 11 13 15
2 4 6 8 10 12 14 16
Temp
150 C
Vert . (110 Unit/Div) Horz . (30 Sec/Div)
System Setup
Temp Unit
C F K
Recording Interval
1 Sec
T/C Type
E J K
R S T
Recording Period
500 Min
Max Temp
1100
Temperature Monitoring
Channel : 3
Channel : 4
Channel : 5
Channel : 6
Channel : 7
150 C
Channel : 8
Channel :11
Channel :12
Channel :13
Channel : 7
Channel :15
Channel :16

Figure 4: C

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