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ScienceDirect

Procedia Engineering 135 (2016) 217 – 220

Procedia Engineering

www.elsevier.com/locate/procedia

Char Trace Analysis of Composite Wood Floor under Different Heating Conditions

Ling Liu*, Yi-xiang Liu, Zheng Xing

The Armed Police Academy, Langfang 065000, China

Abstract

Under different heating conditions, the composite wood floor and pine carbonization samples were prepared, and the charring surface morphology, crack width, carbonization depth and average charring rate were compared and analyzed. The results show that under the thermal radiation condition, the carbonization of composite wood floor is the most serious, and cracks distributed radially; under the arc condition, the compound wood floor is difficult to ignite, and the carbonization layer is shallow; small amount spilled gasoline combustion has little effect on carbonization degree, but the char is obvious at the corner; at the same heating condition, the carbonization degree of pine was more serious than the composite wood floor, and the carbonized surface morphology had significant differences.

Peer-review under responsibility of the organizing committee of ICPFFPE 2015

Keywords: char trace, composite wood floor, carbonization rate, fire investigation

1. Introduction

Composite wood floor is a common material for building decoration. Fire investigator can judge the occurrence, development and spread of the fire, and the type of heat source according to the char trace analysis. At present, there are systematic researches on the properties of natural wood, while the research on the composite wood floors mainly focused on fire behavior and combustion performance. This paper studied the changes of composite wood floor char trace under different heating conditions, which includes carbonization trace pattern, carbonization crack width, carbonization crack depth and carbonization rate, and compared with the natural pine char trace. Fire investigators can reference the experimental results.

2. Materials and methods

The experimental materials were commercially available composite wood floor and pine, the main wood raw material, the sample size is 100mm ×100 mm. The carbonization samples were prepared under different heating conditions:

(1) flame burn charring samples were prepared using fire material comprehensive experiment station, and the fire temperature was 700-800℃, the time was 5min;

(2) gasoline combustion charring samples were prepared using fire material comprehensive experiment station by 5mL gasoline on the samples surface, the flame temperature was 700-800℃, the time was 5min;

* Corresponding author.
E-mail address: 50088198@qq.com

Peer-review under responsibility of the organizing committee of ICPFFPE 2015
doi:10.1016/j.proeng.2016.01.112

(3) radiation heat charring samples were prepared by 1.5kW thermal radiation source, and the surface temperature is about 730℃, the samples were placed in 3cm distance from the heat heating source for 5min;

(4) electric arc burn charring samples were prepared using fire material comprehensive experiment station, and the reaction time was 3min.

The surface macro morphology of carbonized samples was observed and recorded, the surface micro morphology magnified 20 times was observed and recorded by stereo microscope, the crack width was measured by vernier caliper, and the carbonization depth was determined by wood carbonization depth analyzer. Five measurement points were measured of each sample and the average values were recorded. At last, according to the formula v=H/t, the average charring rate was calculated, V, charring rate (mm/min); h, carbonization depth (mm); t, carbonization time (min).

3. The influence of heating condition on the charring trace

3.1 Flame burn charring trace analysis

Under the heating condition of open flame, the charring sample morphology was shown in Figure 1. The surface of composite wood floor charred completely, and the charring layer was relatively flat, the facing layer had tilted peeling phenomenon, the carbonization crack was fine; pine sample carbonization crack was wide, charring surface showed massive charring trace, and accompanied by fine small cracks. The carbonization morphology difference is mainly due to the different structures, pine is natural fiber materials, the carbonization degree mainly depends on its density and the heating direction to the material structure axis, while composite wood floor is mainly formed by the grassroots level density board and polymer facing layer, the structure is uniform, and the carbonization degree is lighter.

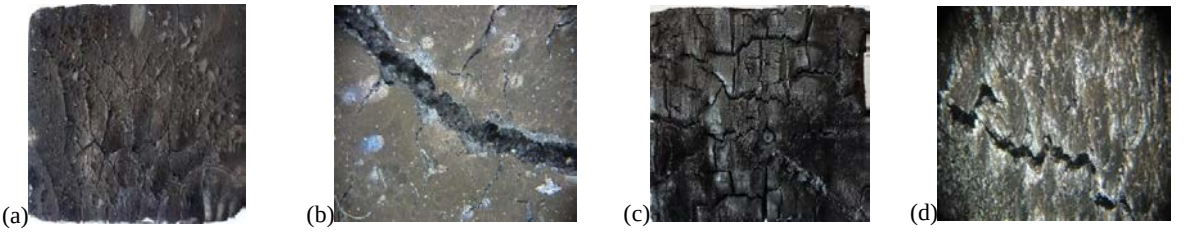

Fig.1 Charring trace of flame burning samples for (a) composite wood floor macro figure; (b)composite wood floor micro figure (20X); (c)Pine macro figure; (d)Pine micro figure (20X)

3.2 Analysis of gasoline combustion carbonization sample pattern

The gasoline combustion samples carbonization pattern was shown in figure 2. A small amount of gasoline has not obvious effect on the carbonization sample patterns. The carbonization degree in the composite wood floor samples center was slight, and the carbonization degree was serious on the edge, there were some epidermal tilted off phenomenon on the sample surface; the carbonization degree of pine sample was similar to gasoline combustion sample, and the charring degree on the surface was slightly lighter, while obviously grave on the edge, there were part of loss during the ignition. Reasons for this phenomenon are mainly: (1) in the edge and corner, it is more easily to penetrate the liquid, and the liquid produced wicking, and then the combustion is intensified; (2) in the corner of the plate, the contact area on oxygen is larger, and the loss is more serious. In the fire scene, fire investigators should focus on the seams and edges of wooden floor corner to find the liquid low burn traces.

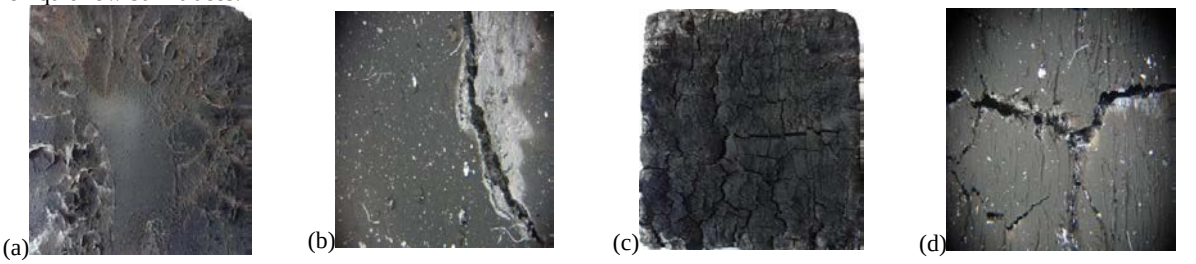

Fig.2 Gasoline combustion carbonization pattern for (a) composite wood floor macro figure;(b)composite wood floor micro figure(20X);(c)Pine macro figure;(d)Pine micro figure(20X)