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A Study on Ignition Suppression Effect of Sound Component in Sound Fire Extinguisher

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Abstract:

Since modern society is highly dependent on the information network, the conflagration of information network dense facilities causes huge economic losses. There is a risk of ignition due to accumulation of polymerizing heat due to electrical characteristics in information network densification facilities. Therefore, in addition to the existing extinguishment method in which the fire extinguishing agent is sprayed when conflagration occurs, preventive measures for separate ignition suppression are required. In this study, we tried to confirm that sound fire extinguisher is effective to suppress ignition by supplying sound component before conflagration. Match ignition experimental results applying the heating crucible measurement, ignition was performed at an average temperature of 109℃ when no sound was supplied, and ignition was performed at an average of 129℃ when the sound was supplied. Also, if the sound was not supplied, the match took about 38 seconds from 60℃ to the ignition, while it took 173 seconds from 60℃ to the ignition when the sound was supplied. Even if the sound was supplied very close, the match and ambient temperature did not rise to the ignition point. These results show that the sound component of Sound Fire Extinguisher suppresses ignition and prevents conflagration.

Keyword: Conflagration, Ignition Point, Sound Fire Extinguisher, Sound Component, Ignition Suppression

1. INTRODUCTION

Conflagration from the past has caused enormous damage to mankind. The 'Great Fire of Rome', which overtook Rome in 64 AD, is known as one of the most famous conflagrations in history. Rapid and rapid development of civilization also changed the conflagration aspect. The increasingly complicated society has received a complex information network in the building, and it has become necessary to conflagration of special facilities such as IDC (Internet Data Center) and cable tunnel, which are more dense information networks. A large conflagration occurred on Samsung SDS IDC on April 20, 2014, causing the information networks of Samsung affiliates to be paralyzed. As a result, a large number of people continued to fail to receive financial services provided by Samsung. Also, conflagration occurred in the underground cable tunnel of KT AHYUN BUILDING on November 24, 2018, causing paralysis of the network, causing the financial system to become paralyzed. In today's highly dependent information network, the conflagration of the information network can lead to a massive economic loss and a deterioration in the quality of life [1-2].

Information and communication facilities and lines are affected by electrical characteristics, so there is a risk that heat accumulates and ignition can occur if the equipment is crowded. However, most information networks are managed unmanned or managed remotely, which makes it difficult to prepare for signs of conflagration, and there is no other measure except spraying the extinguishing agent after conflagration even if it detects signs. The application of extinguishment facility is very limited in the case of ducts where information communication lines and electric lines are densely connected. Therefore, the dense facility of the information network requires a precautionary measure to suppress ignition, in addition to the existing extinguishment method of spraying water or extinguishing agent after conflagration.

Sound Fire Extinguisher, which is actively researched at the Sori Sound Engineering Research Institute (SSERI), uses the characteristics of sound energy. Therefore, even before conflagration occurs, it is anticipated that it can be used for conflagration prevention by suppressing ignition by spraying sound energy to information and communication facilities. In particular, Sound Fire Extinguisher can be installed in ducting facilities where existing extinguishment facility is difficult to apply. Even if spraying sound energy from time to time when it detects heat, it does not damage information and communication facilities [3-10].

In this study, we tried to confirm whether the sound component of Sound Fire Extinguisher can suppress the ignition that is concerned in the information network dense facility through experiments. Chapter 2 describes the ignition point and the ignition feature of the match to be used in the experiment. Chapter 3 explains experiments and results, and Chapter 4 concludes with conclusions.

2. IGNITION POINT & IGNITION FEATURE OF MATCHES

2.1 flash point & ignition point

The flash point is the lowest temperature at which combustible can start combustion through contact with the source of ignition. On the other hand, the ignition point is the lowest temperature at which combustible can start combustion by accumulating heat inside without contact with the source of ignition. The difference between a flash point and an ignition point is with or without a source of ignition. In general, an ignition point is much higher than a flash point. The ignition points of some substances are yellow phosphorous 30 ~ 60℃, celluloid 180℃, gasoline 257 ~ 300℃, wood 410℃. The factors affecting the ignition point are the temperature and pressure, the flow rate of the heated air, the heating speed, and the size (shape) of the combustible. If the ignition is suppressed, the ignition point becomes higher. In the case of the information network dense facility, the heat of polymerization generated due to the electrical characteristics accumulates, and the combustible of the information communication facilities and lines is ignited. The Sound Fire Extinguisher's sound component consists of low frequencies below 100 Hz. This is expected to suppress ignition by reducing combustible and its ambient temperature and suppressing the accumulation of heat in the combustible [11-14].

2.2 Ignition feature of matches

Matches is an ignition agent applied to the end of a wood or paper. matches are ignited using frictional heat. matches were invented in the 1600s due to the discovery of phosphorus. The phosphorus was found to ignite at very low temperatures, ignition at about 60℃ for yellow phosphorous and about 230 ℃ for red phosphorus. Early matches consisted of applying sulfur to the end of a piece of wood, rubbing against paper with phosphorus to create fire. However, the fire was so easily attached that it was dangerous. In addition, there was a side effect such as phosphorus necrosis which damages the human body. Since then, development of low toxicity ignition agent has developed into safe matches of today. Matches differ from ignition point depending on the combination of ignition agent and the amount of ignition agent. The ignition point of the head of the match is 100 ~ 200℃ depending on the composition. And the ignition point of wood pieces reaching the body is about 400 ~ 500℃ [14].

3. EXPERIMENTS AND RESULTS

The experiment compares the difference in temperature at ignition by applying heat to the matches by dividing the sound component of the Sound Fire Extinguisher with and without the sound component. Through these experiments, we tried to confirm the effect that the sound component of Sound Fire Extinguisher suppress combustible ignition. In the experiment, the ignition point measurement method, heating crucible measurement, was applied. A portable burner was used to heat the stainless steel tableware and the temperature was measured to ignition the heat accumulated in the fixed matches on the stainless steel tableware. Matches in one box were used to measure the ignition phenomenon as much as possible under the same experimental conditions. Temperature changes around the matches and ignition point measurements of matches were recorded using FLIROne, a thermal imaging camera, and Galaxy Note 4, a smartphone. The temperature was measured near the head of the match. The experimental environment is shown in Figure 1.

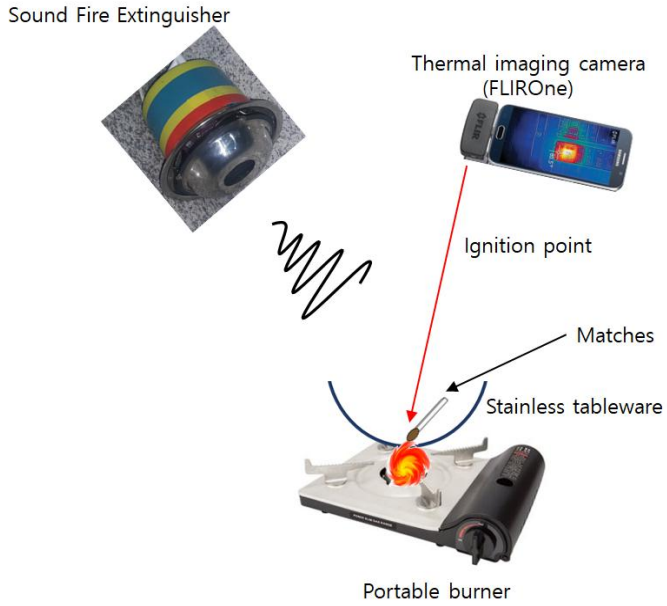

Fig 1. Experiment environment

Since ignition is closely related to the transfer of heat, it can be greatly affected by the surroundings. The thermal imaging camera is also a non-contact type measuring device, and errors may occur depending on the measurement position and distance. In order to maintain the same environment for the measurement of the ignition point, a thermal imaging camera and a smartphone were fixed and measured. During the experiment, all the windows were closed and the laboratory access was controlled. Figure 2 shows the experimental and thermal images.

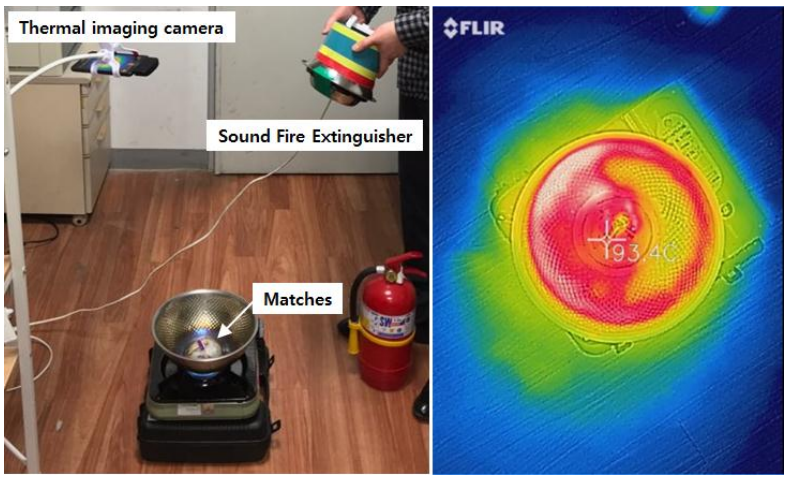

Fig 2. Experiment scene and thermal image recording screen

The results of the temperature change and ignition point measurement are shown in Figure 3. In Figure 3, the time from the temperature of 60℃ to the ignition was 38 seconds when no sound was supplied, whereas the time required for the temperature to rise to the ignition point when the sound was supplied at a distance of 90 cm was 173 seconds. The ignition point was 97℃ when no sound was supplied, whereas the ignition point was 142℃ when sound was supplied. When the sound is supplied, the ignition point rises by 45℃ compared with the case where no sound is supplied. On the other hand, when the sound is supplied at a distance of 60 cm, the temperature is maintained at 90℃ or lower, and the temperature does not rise to the ignition point.

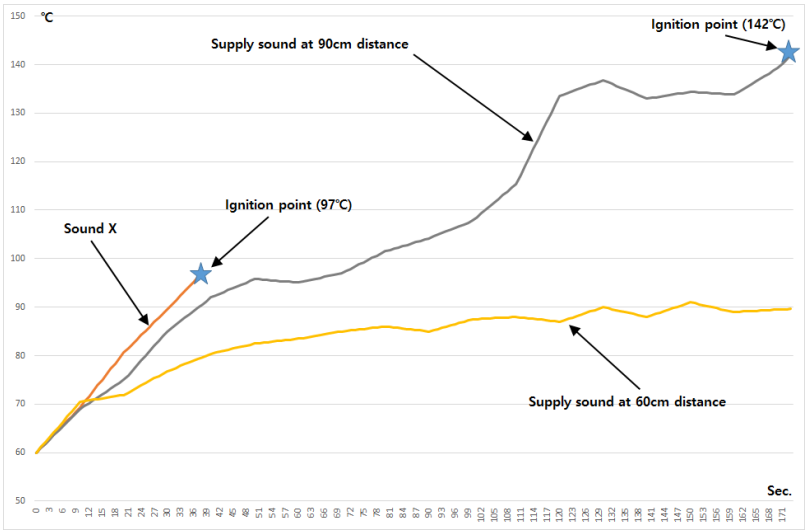

Fig 3. Measurement result of temperature change

Figure 4 shows the results of 10 measurements of the ignition point when no sound was supplied and when the sound was supplied. Figure 4 shows that when no sound was supplied, the ignition point was 97℃ to 120℃ with an average of 109℃. On the other hand, when the sound component is supplied to the Sound Fire Extinguisher at a distance of 90 cm, the ignition point is 107 ° to 145℃., and the ignition point is increased by 20℃. when the sound is supplied.

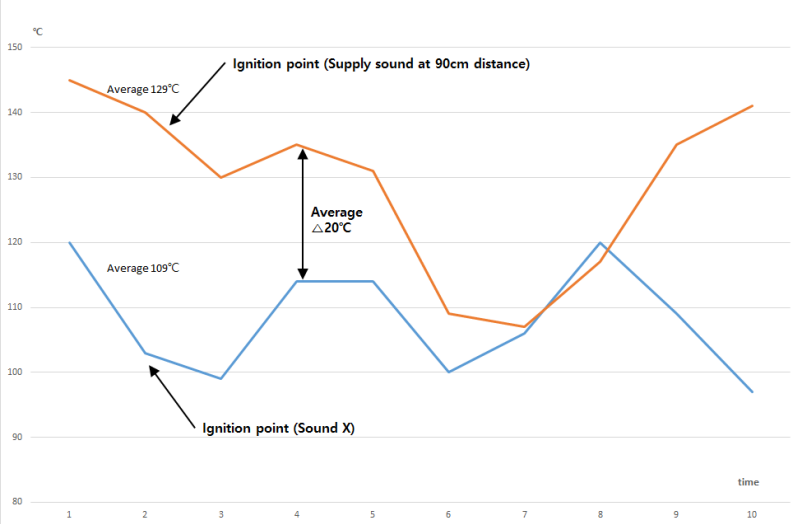

Fig 4. Measurement result of ignition point of matches

The results of this experiment show that the sound component of the Sound Fire Extinguisher affects the surroundings of the matches and matches, which can increase the ignition point by as much as 20℃, although the ignition point of the match may vary depending on the composition of the ignition agent or its state. As a result, the Sound Fire Extinguisher sound component can help prevent conflagration by suppressing heat accumulation and suppression of ignition.

4. CONCLUSION

The development of human civilization has made complex information networks more dense, and it is necessary to prepare conflagration for facilities such as IDC (internet data center) and cable tunnel, which are information network dense facilities. In the modern world, where information network is highly dependent, conflagration in the information network dense facility causes huge economic loss. Existing extinguishment facilities are available after conflagration occurs in the information network. However, in the case of the information network dense facility, there is a possibility of ignition by accumulating heat due to the electrical characteristics. Therefore, it is necessary to use conflation precautionary measure through ignition suppression.

In this study, it was experimentally confirmed whether a sound component of less than 100Hz spraying by Sound Fire Extinguisher can suppress combustible ignition. The experiment was applied to compare the ignition point and the temperature change when the sound is provided and the sound is not provided by applying the heating crucible measurement which measures the ignition point. Experiments with matches showed that the time taken to reach the ignition point from 60 ℃ was 38 seconds when sound was not provided, whereas it took 173 seconds to provide sound and 135 seconds longer than when no sound was provided. In addition, when the sound was not provided, the ignition point averaged 109℃, whereas when it was provided with sound, it averaged 129℃, which was about 20℃ higher than when no sound was provided. In particular, when sound was supplied from a match near (60 cm), the temperature did not rise above 90℃ and the ignition point was not reached. These results show that the sound component of the Sound Fire Extinguisher affects the periphery of the combustible and the combustible itself, which can help prevent conflagration by suppressing the ignition. The ignition point is subject to great environmental impact and measurement errors may be sufficient. However, a significant difference in the mean ignition point by 20 ℃ over several measurements indicates that the sound component of the Sound Fire Extinguisher has an ignition suppression effect.

The sound component of the Sound Fire Extinguisher is energy that does not damage the facility even if it spraying it, and it is hoped that it will be utilized for conflagration prevention by contributing to national security by actively researching practical use.

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