

TEST AND EVALUATION ON THE FIRE EXTINGUISHING USING THE REINFORCED EXTINGUISHING AGENCY

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Abstract

The purpose of this study is to test and evaluate the performance of the newly invented reinforced fire-extinguishing agency. There are three findings to pay attention to. First, when using the reinforced extinguishing agency, fire fighting distance will be expanded from 4 meters to 8 meters. Second, thanks to the reinforced extinguishing agency, citizens will be willing to help putting out the fire based on their cooperation. Third, the reinforced fire extinguisher will play a key role in minimizing the fatality of human life and property damages in the Korean society.

Introduction

In Korea, there are 561 casualties per year due to fire, and each individual risk is $1.2 \times 10^{-5}/\text{yr}$. There were 2,089 casualties in 2003, and each individual risk was $4.1 \times 10^{-5}/\text{yr}$. Total casualties' risk was $5.3 \times 10^{-5}/\text{yr}$ in the same year. As a reference, each individual risk was $1.92 \times 10^{-4}/\text{yr}$ in 2003 resulting from traffic accident (Lee, 2004b).

In Korea, the risk level of fire is one half of that of traffic accident. Each individual risk resulting from the fire in Korea is two times bigger than that of U.S. The number of fire accident is increasing every year by 4.2%. In 2003, the number of fire was 31,372 to include 8,474 of house fire, 3,416 of factory fire, 6,049 of car fire, 1,698 of shopping center fire, 2,056 of restaurant fire, 457 of business area fire, 675 of storage facility fire, 106 of school fire, etc. In short, there were 86 fires per day in 2003. Their damages were officially recorded as 150 million dollar. Yet, substantial damages would be much bigger than that, considering that many people's important memories were also burned out during the fire (Kim, 2004).

There are several significant steps to blow out the fire. First, when trying to quickly extinguish the fire, we should keep remaining flameproof for environmental reason in particular the moment toxic black smoke disappears. Second, when people are burned with the fire, it is important for us to cool their burned part of body and thus their burnings will be minimized. Third, when the fire is beyond control, we should rely on the fire extinguisher to rapidly control medium or large sized fire especially without directly approaching the fire. With the above reasons, many in the international community have tried to develop reinforced extinguishing agency particularly for the purpose of easily approaching the center of fire.

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When producing the fire extinguisher, It is required that the product should be no problem to use against every three kind of fire such as general fire, oil fire, and electric fire. However, many worried that reinforced extinguishing agency could not be applied to electric fire, because it came to add water to electric fire when used. After 30 years of research and experiment, however, it is very sure that the reinforced extinguishing agency can be applied to electric fire, if considering that the product requires only 100 milli liter solvent to extinguish the 20 liter petroleum fire.

In Japan, developing the liquid extinguishing agency has been strongly encouraged and supported, while each house is required to equip with extinguishing-tool fire extinguisher, which is a sort of liquid extinguisher (Lee, 1999). In the U.S., fire extinguishing chemicals, being liquid, are very popular in special factories and offices. In Korea, the Korea Fire Equipment Inspection Corporation (KFEIC) initially approved 3.5 liter fire extinguisher, being liquid, at the end of 2004 and thus liquid fire extinguisher came to be introduced in the Korean market.

Basic information

Characteristics of reinforced extinguishing agency

1) The speed of extinguishing fire

The reinforced extinguishing agency plays a role in swiftly extinguishing large and medium sized fire and then recovers environment by equipping with the system of no electricity source.

2) The ability of defending blaze

Both children and the aged can easily use the reinforced extinguishing agency. In addition, 100 liter reinforced extinguishing agency can extinguish the fire within 50 meter. In case of using the reinforced extinguishing agency before the fire spreads, it has a flameproof effect.

3) Merits of reinforced extinguishing agency

- (1) The reinforced extinguishing agency straightly infiltrates to the ignited place of fire.
- (2) The reinforced extinguishing agency prevents oxygen from ignitable material.
- (3) The reinforced extinguishing agency swiftly cools down the part of outbreaking fire.
- (4) The reinforced extinguishing agency has a flameproof effect.
- (5) The reinforced extinguishing agency is friendly to environment, because of its neutral character.

4) Merits during the use of reinforced extinguishing agency

- (1) To the men, the reinforced extinguishing agency minimizes physical burnings and stimulus, prevents toxic gas, allows taking breath, and others.
- (2) To the property, the reinforced extinguishing agency minimizes damages, protects fortunes, and produces no another burnings except ignited place of fire.

5) Merits during the management of reinforced extinguishing agency

The quality of reinforced extinguishing agency is perfectly steady before fire outbreak, so the reinforced extinguishing agency is always ready for fire. Even 20 degree below zero, it works well. After fire, people can go back to their normal life thanks to the reinforced extinguishing agency.

6) Merits during the misuse of reinforced extinguishing agency

- (1) To the men, the reinforced extinguishing agency is fewer stimuli oriented. Without fire, the reinforced extinguishing agency does not produce chemical action.



(2) To the property, the reinforced extinguishing agency is like spreading water during its misuse. So, we can use rag to get rid of it.

Characteristics of reinforced fire extinguisher

The reinforced fire extinguisher can spray its material up to 11 meter. Regardless of powder or gas, the reinforced fire extinguisher has several merits like below.

First, the reinforced fire extinguisher has easy access to the fire place. In the case of fire breaking, it is never easy for anyone to access to the fire place. In particular, it is much more difficult to access within 10 meter around the fire, because of heat in airtight space. In this situation, the reinforced fire extinguisher can spray its extinguishing material from the distance and thus cools down the fire without closely approaching the fire. By decreasing the distance from the fire, the reinforced fire extinguisher finally puts out the fire.

Second, the reinforced fire extinguisher has its potential ability to put out the fire. In case of fire, floor, wall, and ceiling are suddenly surrounded by fire. In the meantime, the reinforced extinguishing agency has solubility in water. After being sprayed, the reinforced agency makes a membrane of blocking oxygen, sticking to floor, wall and ceiling. At the same time, the reinforced agency cools down the indoor temperature into normal one by cooling effect. As imperfectly-burned toxic gas decreases, the black gas turns into white vapor. One minute after starting fire extinguishing by the reinforced agency, it is very evident that the fire will not recur, when considering that smoke around fire place disappears.

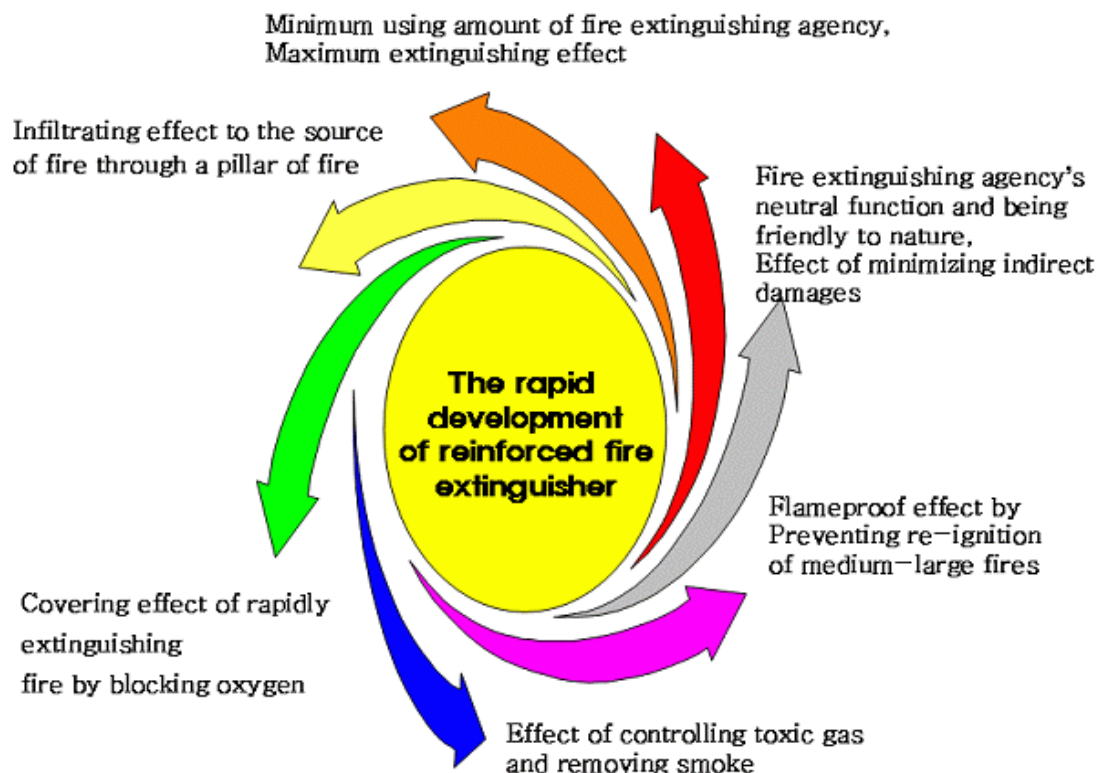


Figure 1. The rapid development of reinforced fire extinguisher

Third, the reinforced fire extinguisher discourages the outbreak of toxic gas and then changes it into vapor. Before facing the fire, the reinforced fire extinguisher smells ammonia. Because of this, the reinforced fire extinguisher can maximize the effect of cooling down. When it is injected through the fire, it will have chemical action and then disappears.

Fourth, the reinforced fire extinguisher is friendly to nature, and its extinguishing agency has neutral characteristics in terms of component. In addition, because the reinforced extinguishing agency is friendly to nature, it will have fewer damages to the fire place, when it is used as fire extinguisher. Just after using the reinforced fire extinguisher, office workers will not have much difficulty to work for their office again, and the environment around fire will be improved by spraying water. In short, office workers continue to work for their office even after putting out the fire, when using the reinforced fire extinguisher.

Characteristics of extinguishing-tool-style fire extinguisher

Fire is outbroken around kitchen, living room, and bedroom in house or apartment. In this case, fire extinguisher, which is light weight, should be promptly accessed by children and the aged.

It is extinguishing-tool-style fire extinguisher that children and the aged most need in this emergency situation. In Japan, the U.S., and some European countries, this kind of fire extinguisher is available in home. Those countries believe that extinguishing-tool-style fire extinguisher is most effective one to put out the fire of early stage. The weight of extinguishing-tool-style fire extinguisher is 450 gram, containing 320 millimeter liquid. By using these components, extinguishing-tool-style fire extinguisher can extinguish the fire around 5 meters within 11 seconds.

Extinguishing-tool-style fire extinguisher can blow out many kinds of fire such as cushioning fire, curtain fire, garbage can fire, frying pan fire, gas stove fire, etc. at home. In particular, when considering that extinguishing-tool-style fire extinguisher plays a role in putting out the fire from big gas stove in living room, the small fire extinguisher should have most excellent function to put out the fire.

Fire extinguishing test and its evaluation

This paper had a demonstration to officially test the reinforced extinguishing agency on track and field in Yonsei University on November 17, 2004. Many attendees watched it such as the President of Yonsei University, many professionals in fire studies, other college authorities, and guests of honor from outside.

The demonstration had 12 kinds of experiment. The examples are followings; A demonstration on automatic extinguishing system of subway vehicle as the first time in the world, a demonstration on extinguishing of flame-radiator-style fire-extinguisher, a demonstration on extinguishing of cooling-electrical machinery-style fire extinguisher, a demonstration of extinguishing of newly-developed-office-style fire extinguisher, a demonstration by home-sprayer-style fire extinguisher, a demonstration by kitchen-specialized fire extinguisher, a demonstration on checking out complete extinction from the toxic of tire fire, a demonstration on checking out flameproof to prevent mountain fire, a demonstration on 100 liter fire extinguishing equipment, a demonstration on mannequin (clothes) fire, a demonstration on had extinguishing system of subway vehicle, a demonstration on no-electric-power fire extinguishing by using 300 liter water, etc. (Lee, 2004a).

The first test - a demonstration on fire extinguishing by attaching automatic fire extinguishing system to top of subway electric train

One quarter of the same size model of real subway electric train was sprayed by four liter gasoline. When indoor temperature became 65 degree, a temperature sensor detected it and thus automatic fire extinguishing system could operate. Within 3 seconds, the fire on subway



electric train came to be automatically extinct, since 2 liter of reinforced extinguishing agency fell down from the ceiling of subway electric train.



- a. Maximizing fire in subway electric train
- b. One second after automatic fire extinguishing
- c. Three seconds after automatic fire extinguishing

Figure 2. A demonstration on automatic fire extinguishing of subway electric train

The evaluation on the first test

- 1) The reinforced extinguishing agency, being 2 liter, is proven to blow out the fire and prevent oxygen within 3 seconds after automatically sensing the fire.
- 2) The reinforced extinguishing agency can suppress toxic gas produced by the fire and thus save human life especially by avoiding suffocation.
- 3) White smoke, produced during the process of extinguishing the fire, is vapor. The vapor is harmless to human life and rather cools down the inside of fire place. The fact that the vapor disappears in 30 seconds means that cooling down the fire place is done completely.
- 4) The reinforced extinguishing agency plays a role in cooling down the fire place by promptly turning the temperature of fire place into normal one.

The second test - Checking out if remaining smoke produced during the period of extinguishing used tire is toxic



- a. The moment of maximizing the fire
- b. In the process of extinguishing the fire by 3.5 liter fire extinguisher
- c. Immediately checking out remaining fire after putting out the fire

Figure 3. Checking out if remaining smoke produced during the period of extinguishing used tire is toxic

It was testified that produced smoke within 10 seconds after using 1 liter reinforced extinguishing agency is harmless to the humans, particularly after maximizing the toxic gas from 7 burning used-tires with gasoline.

The evaluation on the second test

- 1) It was very sure that because toxic gas becomes vapor after extinguishing the fire, the humans have no problem to take breath the air.
- 2) It was certified that 1 liter extinguishing agency can put out the fire and minimizes indirect effect of fire through cooling down, preventing oxygen supply, and flameproof.
- 3) It was proven that extinguishing liquid does not contain toxic in particular after completely putting out the fire but is friendly to natural environment.

The third test - Extinguishing big fire

Each set of wood is 1m■1m■2m cubic and four sets were displayed. Under each set of wood, there was 2 liter gasoline. Gasoline fire was set out. The test was to put out the most maximizing fire from gasoline and wood by using the reinforced extinguishing agency containing the pressure of nitrogen without a source of electricity. The most maximizing fire was up to 10 meter, while the reinforced extinguishing agency was thin stream water.

The length of hose was 25 meter, and nitrogen added pressure was 9.8(Kgf/cm²) during its spraying. The water stream was 6 milli meter nozzle in its diameter, which reaches up to 15 meters. It was shown that the fire was extinguished within 20 seconds and black smoke during the fire turned into white vapor.

The spending amount of reinforced extinguishing agency was about 20 liters, which can put out the 4m■4m■8m fire. Putting out this sizable fire has been approved by the Korea Fire Equipment Inspection Corporation as A class (for timber) fire extinguisher's ability.



- a. The moment of maximizing the fire
- b. In the process of extinguishing the fire by 100 liter fire extinguisher
- c. Immediately touching out remaining fire after putting out the fire

Figure 4. Test on A class fire extinguisher's ability of putting out 4m■4m■8m fire

The evaluation on the third test

- 1) It was testified that any place touched by the reinforced extinguishing agency cannot be easily refired any more thanks to its flameproof characteristic.
- 2) The fact that heat was not felt from burned fire after completely extinguishing means the reinforced extinguishing agency's excellent effect of cooling down
- 3) It was verified that just 20 liter liquid of 100 liter fire extinguisher, which was used for 4m■4m■8m fire, can completely control the flame
- 4) It was shown that the moment the reinforced extinguishing agency touched down the fire, the fire was absolutely put out. In short, the reinforced extinguishing agency could straightly infiltrate into the source of fire and then produced oxygen blockade.

Conclusion

The reinforced extinguishing agency or its fire extinguisher will have a huge impact on our Korean society like followings.

First, when using the reinforced extinguishing agency, fire extinguishing distance will be expanded from 4 meters to 8 meters. Whereas vapor-style fire extinguisher or powder-style fire extinguisher puts out the fire around 4 meters, the reinforced fire extinguisher blow out the fire around 11 meters. If considering that the fire on the first floor or second floor in the buildings is usually within 11 meters, the reinforced fire extinguisher can effectively protect human life and reduce property damages from the fire.

Second, thanks to the reinforced extinguishing agency, citizens will be willing to help extinguishing the fire based on their cooperation. By using fire extinguisher used by many now, it is very hard for citizens to attempt to put out the fire, because it cannot easily access to the fire. However, citizens can attempt to put out the fire from the distance of more than 10 meters, when using the reinforced fire extinguisher. Thus, citizens will be more cooperative to fight against fire, in particular by relying on the positive function of the reinforced fire extinguisher.

Third, the reinforced fire extinguisher will play a key role in minimizing the fatality of human life and property damages caused by the fire in the Korean society. As an example, the fatality of human life and property damages by the fire in Japan has been much decreased, after encouraging each home to equip with liquid-style fire extinguisher. So, the reinforced fire extinguisher will be contributed to the improvement of fire loss in terms of human life and property damages very much in Korea in the near future.

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