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A Good Dry Powder to Suppress High Building Fires

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Abstract

In our daily life there are more and more super high buildings and now their fire safety have been paid more attention. Thence, a new material, magnesium hydroxide ($Mg(OH)_2$) was introduced and its possible application was discussed in this paper in order to protect constructions better. It was analyzed at three aspects including its advantages, physical and chemical properties and fire suppression effectiveness. $Mg(OH)_2$ powder is better because it is cleaner, more efficient and lower cost of production, store and transportation. A comparison of physical and chemical properties between magnesium compounds and other common commercial fire suppressant proved that $Mg(OH)_2$ powder absorbed more heat when they decomposed. In a bench-test, the $Mg(OH)_2$ powder is also more efficient than the common commercial BC powder and ABC Powder. The results have proved that $Mg(OH)_2$ powder is a kind of good, clean and high efficient powder to suppress tall building fires.

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1. Introduction

With the development of science and economy, constructions are higher and higher. Recently there are more and more super high buildings in many countries and regions, such as Petronas towers, Taipei 101 skyscraper and so on. And now fire safety of tall buildings have been paid more attention because fires increased, caused by terrorist attack, arson and so on^[1-2]. Now many problems have been proposed and

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solved. Chow and his co-workers^[3-4] have presented some fundamental concepts on fire safety of tall buildings and they pointed that the current laws of fire safety about high buildings were only appropriate for protecting constructions against accidental fires when they were not yet in use. Possible applications of chemical dry powders to suppress tall buildings fires have been described by Ni^[5].

More and more new materials are also applied to buildings, leading that the types of fires in buildings are various. Thence, finding new substitutes which are clean, high efficient and nontoxic are urgent, especially after Montreal protocol. Magnesium hydroxide ($Mg(OH)_2$) is one of them. And some scholars have researched it. For example: fire suppression effectiveness of $Mg(OH)_2$ have been described by Kuang^[6] in a bench-test, compared to commercial BC powder, while the effectiveness were also studied by Wang, et al.^[7], compared to ABC powders.

Now $Mg(OH)_2$ are not usually considered as a fire suppressant, but as flame retardant, so it is significant to study on the fire suppression effectiveness of $Mg(OH)_2$. Thence, the properties of $Mg(OH)_2$ powder will be discussed in this paper in order to prove that it is a good, high efficient powder.

2. Advantages

Now several kinds of fire suppression systems are applied in high buildings including water mist system, sprinkler system, gas protection system and dry powder system. In tall buildings it is difficult to transport water for sprinkler system and water mist system because the higher buildings are, the higher pressure needed to transport water and more difficult. When a fire happened, if the pressure of supplying water was not enough, the fire maybe not controlled in the initial stage by the water mist system and sprinkler system. Halon, IG-541, and so on are usually applied in gas protection systems. However, environment problems are paid more attention after Montreal protocol, and these materials are used less and less and even forbidden. Dry powders are environmentally friendly and high efficient to suppress fires. Some results are drawn as follows^[8]: Fire suppression efficiency of dry powders is 40 times of water, 40 times of foam, 4 times of CO_2 and 2.5 times of alkyl halide. Thence, there is a good application prospect for dry powders in tall builds.

At present there are many kinds of dry powders. Although many dry powders have been applied to suppress fires, few powders are low cost and low emission of toxic compounds. $Mg(OH)_2$ is one kind of what we want. In china magnesites are resourceful and the production process of $Mg(OH)_2$ is simple by magnesites while others are produced complicatedly, such as ammonium dihydrogen phosphate ($NH_4H_2PO_4$). $Mg(OH)_2$ is more environmentally friendly than the common commercial dry powders including $NH_4H_2PO_4$, potassium bicarbonate($KHCO_3$), sodium bicarbonate($NaHCO_3$) and so on. The decomposition product of $Mg(OH)_2$ is magnesium oxide(MgO) and MgO is stable and not bad for the equipment, but the decomposition products of other common commercial chemical powder are caustic, so they are harmful to the protected equipment. For example, the decomposition product of $NaHCO_3$ is sodium carbonate (Na_2CO_3), and Na_2CO_3 are caustic. At the aspect of store and transportation, the $Mg(OH)_2$ are also easier than other powders^[9-11].

In a word, $Mg(OH)_2$ have many advantages and is a kind of good dry powders for tall building fires.

3. Physical and chemical properties

Because physical and chemical properties have crucial effects on the fire suppression effectiveness, the properties of materials should be considered when they are applied to suppress fires. Thence, the physical and chemical properties of dry powders are crucial for the comparisons of the advantages and disadvantages of fire suppressant. So, in this section the properties of Magnesium hydroxide are compared to the common commercial dry powders (BC powder: $NaHCO_3$, $KHCO_3$; ABC powder: $NH_4H_2PO_4$).

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