

Fire Source Accessibility of Water Mist Fire Suppression Improvement through Flow Method Control

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1. Introduction

Recently, nuclear power plants set CO₂ fire suppression system. However it is hard to establish and to maintain and it also has difficulties performing function test. Therefore, it needs to develop a new fire suppression system to replace the existing CO₂ fire suppression systems in nuclear power plant. In fact, already, there exist alternatives - gas fire suppression system or clean fire extinguishing agent, but it is hard to apply because it requires a highly complicated plan. However, water mist fire suppression system which has both water system and gas system uses small amount of water and droplet, so it is excellent at oxygen displacement and more suitable for nuclear power plant because it can avoid second damage caused by fire fighting water.

This paper explains about enclosure effect of water mist fire suppression. And it suggests a study direction about water mist fire source approach improvement and enclosure effect improvement, using flow method control of ventilation system.

2. Methods and Results

Here it explains the applicability to A, B, C class fire about water mist fire suppression system's enclosure effects, and suggests research direction. And it suggests a study direction about water mist combustible approach improvement.

2.1 Enclosure effects.

Enclosure effect means that the finest portion of the evaporating mist expands, extruding the air out of the compartment, which makes the gases become oxygen-depleted, and cools oxygen-depleted hot fire gases at the ceiling, and pushes them all down to floor level covering the fire source with water vapor, oxygen-depleted air, and water drops as shown Fig. 2 [1].

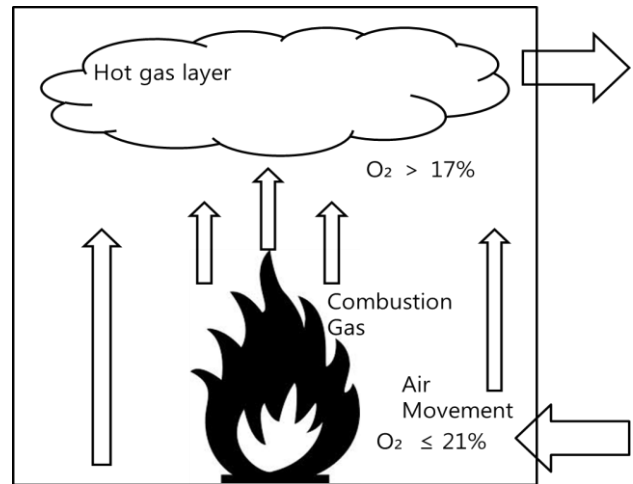


Fig. 1. Mixing hot gas layer.

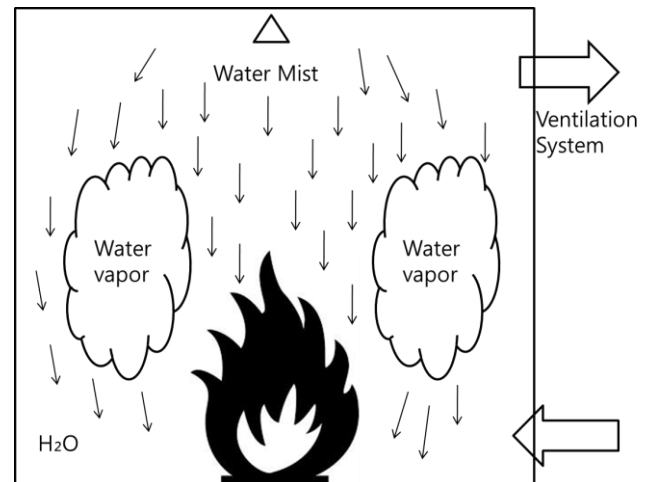


Fig. 2. Enclosure Effects.

2.2 Ventilation system control method suggestion when fire occurrence.

Commonly, when a fire breaks out, smoke and gases are made and rise upwards. It blocks water mist from getting to combustible. But if ventilation system is in the reverse direction, it forms air flow from top to bottom like direction of sprayed water mists, and that makes water mists get to combustible more easily, so it improves combustible accessibility. Also, it enhances enclosure effect by accelerating descending speed of water vapor which is cooled and pushed down by mists as shown Fig. 4.

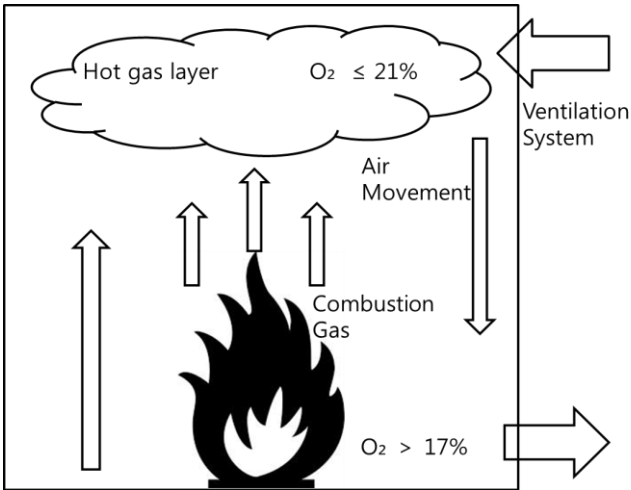


Fig. 3. Mixing hot gas layer in the reverse ventilation system.

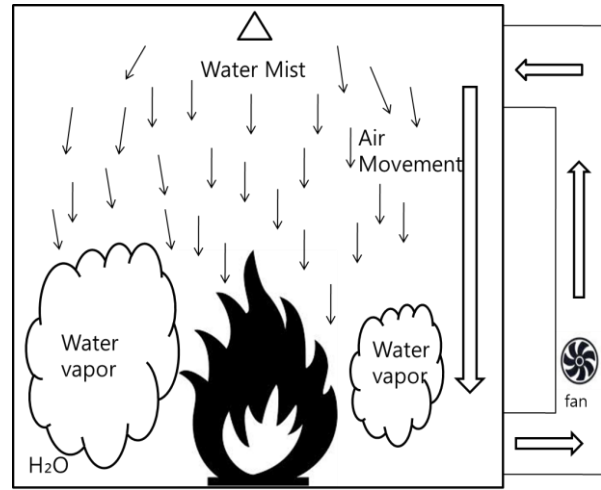


Fig. 5. Ventilation system to recirculation.

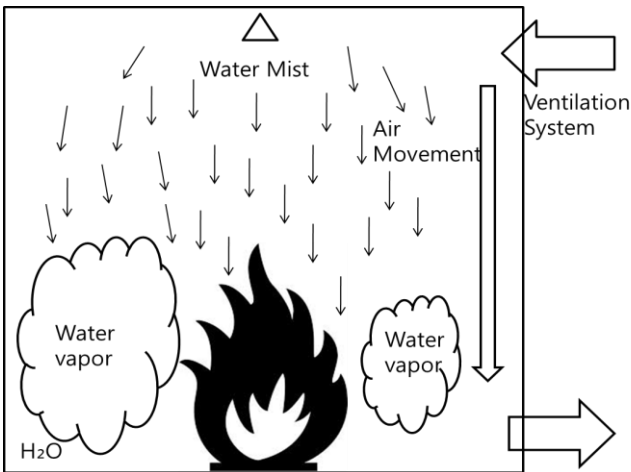


Fig. 4. Ventilation system to reverse direction.

2.3 Recirculation flow method suggestion when closed space fire.

When a fire occurs, most of parts of a nuclear power plant stop forced ventilation system, and then these parts become closed space. Recirculation makes air currents while it keeps the space closed. It makes descending air currents like water mists, and that also makes water mists get to combustible more easily, so it improves combustible accessibility. Also, the same effect as a inert gas injection causes can be expected because it pushes down low oxygen density gases as shown Fig. 5.

3. Conclusions

Water mist fire suppression can be influenced by various variable. And flow and direction of ventilation system are important variable. Expectations of the plan for more fire source ventilation system is as in the following. It enhances enclosure effects of water mists, so it improves extinguish performance. Also the same effect as a inert gas injection causes can be achieved. Lastly, it is considered that combustible accessibility of water mists will increase because of descending air currents.

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