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Fireproofing Performance Research of Water Curtain

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Abstract: The experimentation and numerical simulating have been done to validate the fireproofing performance of big water curtain. The breadth and highness of water curtain is 15m and 12.5m. The dimension of fire space: 18m×15m×12.5m (length×breadth×highness). The dimension of no fire space: 42m×15m×12.5m (length×breadth×highness). The result shows that: water curtain can prevent fire propagating and drops in temperature clearly; the water curtain fireproofing is feasible and effective; flux and thickness of the water curtain and the diameter of drip have major influence upon effect of the water curtain fireproofing. The conclusion of this paper should be helpful for the fireproofing water curtain design.

Introduction

For special used broad and high room, fireproofing design is a difficult working, for room fireproofing delimitation interface can not be set with normal method. For big room, water curtain can be used for fireproofing interface, when fireproofing coil curtain can't be set [4-6]. Water curtain can be used for not only fireproofing interface but also cooling other type fireproofing division interface and enhancing fireproofing performance, part imperceptible drip can take greatness heat and drop the temperature of fire field. Therefore, water curtain fireproofing division system was used broad in fireproofing designing.

In this paper, series fact ruler experimentations and numerical simulating have been done for broad and high fireproofing water curtain, and the situation of temperature variety and smoke spreading has been detected. The infection of different drip size and water flux to flame and smoke spreading has been analyzed. Then the parameter of water curtain fireproofing division system has been decided. The results could be reference to big room fireproofing water curtain system designing.

Experiment

Experiment space has been divided two parts by water curtain, one is fire field space and the other space has no fire. The dimension of the two parts is as below:

The dimension of fire space: 18m×15m×12.5m（length×breadth×highness）;

The dimension of no fire space: 42m×15m×12.5m（length×breadth×highness）.

Water spray heads has been set as three rows, with 0.8m row space between, 1.8m spray heads space between and interleaving lay in each rows. In the experiment procedure, the water flux is 100 m3/h each row. When three rows starting up the same time, the water flux is 300 m3/h, and the water curtain breadth is broader than 5m. The spray head is the type ELO-231 which is produced by USA Tyco corp., which fluid coefficient is 162, working press is 1.8bar and flux is 217 L/min.

The fire fountain is at the center of the fire space, with 5m highness between the floor and the fire point. Reference with the related specification of the IMO 《the experiment method of fixed part water fire fighting system》, the fire power is set as 6MW, which produced by light diesel oil combustion which is showed as fig 1.

The lay of temperature measure points is showed as picture 2 in which two measure face is parallel with the water curtain central face and has 6.5 m distance between the measure face and the water curtain central face. The height of temperature measure points is 4 m of underlayer, 8 m of middle layer and 12 m of upper layer and the space between measure points is 3.5m. In the water curtain central vertical face of the water curtain, there are three temperature measure points at each side, which is set horizontally with 4.5 m space. So there are twenty four temperature measure points.

The series experiments has been done with four conditions which are no water curtain, one row water curtain starting up, two rows water curtain starting up and three rows water curtain starting up. The experiment time is 15 min, and the temperature variety has been tracked record in the procedure of experiment.

Fig. 1 Flame

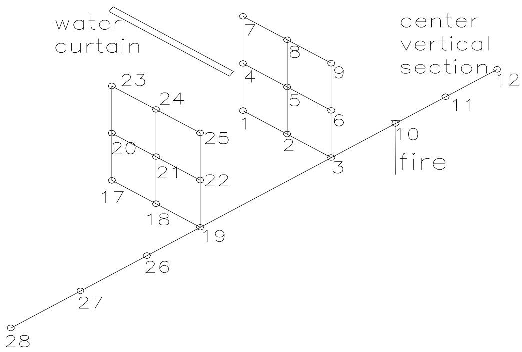

Fig. 2 Temperature measure points

With the analyzing of experiment results, the temperature variety of highest temperature measure points of the two sides of water curtain has been showed in graph 3 and graph 4. The temperature variety of representative measure points of two sides of water curtain has also been showed in graph 5~20.

From the graph, it has been tested that the water curtain has good heat insulation function and can cool down the temperature of fire field. In the experiment with no water curtain, the temperature of the highest measure point is higher than 250 ℃ in the fire space room, and 160 ℃ in no fire room. In the procedure of experiment, the temperature rise rapidly in the experiment space. After water curtain starting up, the temperature rising rate is slow down. When experiment is over after 15 minutes, water curtain was stopped, fire fountain crushed out, and temperature of measure points drops quickly in fire space. In no fire space, temperature of measure points rises slowly and reached to 20~30 ℃, and there are 130℃ drop of upper layer temperature between no water curtain experiment and experiment with water curtain.

Table 1 The highest temperature at every condition

Test condition	No water curtain	One row water curtain	Two rows water curtain	Three rows water curtain
Highest temperature of fire space	250	225	190	175
Highest temperature of no fire space		32	20	18

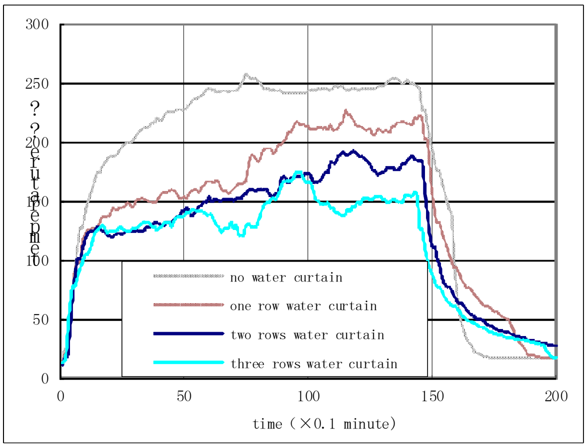

Fig. 3 The highest temperature of fire space

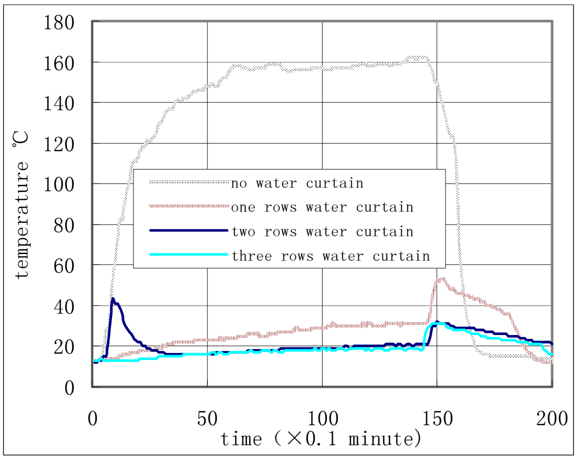

Fig. 4 The highest temperature of no fire space

Numerical calculating and analysis

Series numerical calculating have done, which diameter of drip change from 500 μ m to 3000 μ m, the flux of water curtain is 300m3/h, and fire lasts out at 900 second. The results is listed at table 2. The temperature field is show as fig 5~8.

Table 2 The temperature of middle point on the other side of fire

diameter of drip (μ m)	500	1000	1500	2000	2500	3000
temperature of middle point on the other side of the fire (℃)	21	27	38.1	47.2	55.6	60

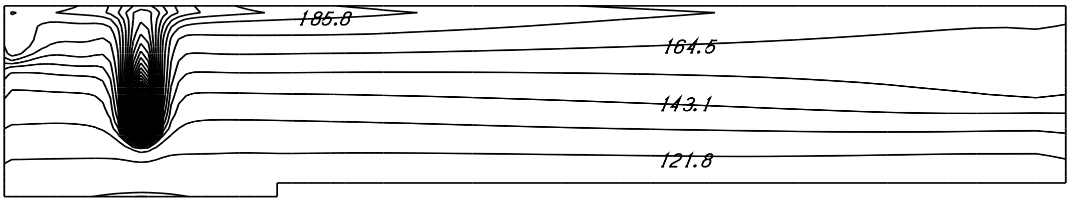

Fig. 5 No water curtain

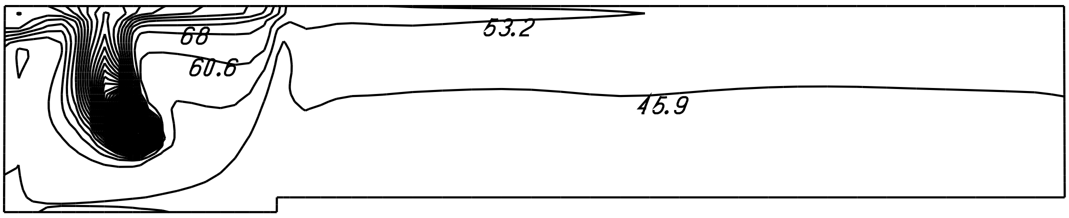

Fig. 6 One row water curtain

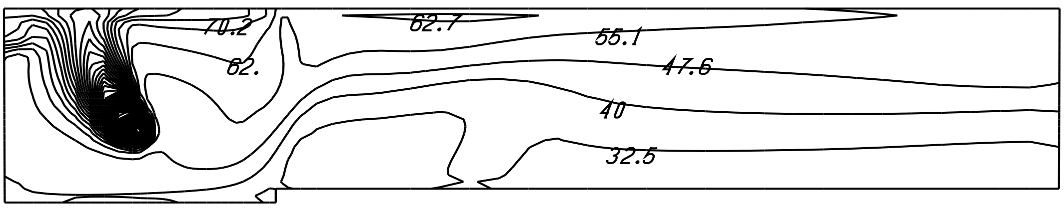

Fig. 7 Two rows water curtain

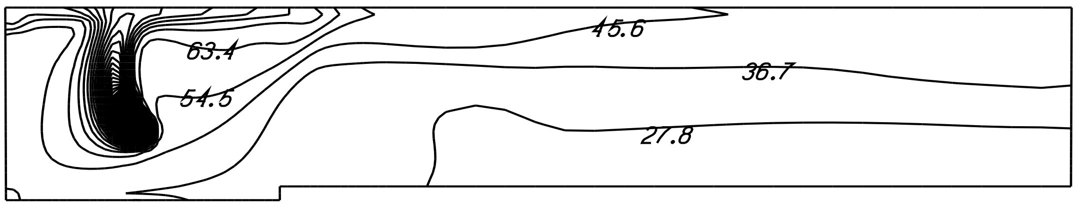

Fig. 8 Three rows water curtain

From the results of experiment and numerical calculating, the performance of heat insulation and temperature drop of water curtain become better with the thickness widen and the diameter of drip diminish. when no water curtain, the temperature field takes on layers situation in the experiment space, namely the temperature is equal at the same height. The upper layer temperature is higher than the middle layer and the middle layer temperature is higher than lower layer. This situation is accord with the assumption of layer temperature field in fire zone model. In the experiment, the smoke fluid and distribution is accord with smoke inherent disciplinarian. In the space portrait section face, each measure points temperature value are obvious different along with which difference distances to flame, which is showed as fig 5 to fig 8.

Conclusion

1. Water curtain could prevent effectively fire spreading and has obvious temperature drop and heat insulation performance. The main facts are water curtain flux, thickness and drip density which effect water curtain fireproofing performance.

2. When no water curtain, the temperature field takes on layers situation, and smoke fluid and distribution is accord with it’ s inherent disciplinarian, which is accord with the assumption of layers temperature field of fire zone model. When water curtain starting up, the temperature field in the no fire space has no layer situation because of water curtain disturbing effect.

3. When the solid fireproofing curtain couldn’ t be set in big room, the fireproofing water curtain is feasible. From the result of the experiment, the parameter of the water curtain is reasonable and effective. The result could be reference when designing the big room fireproofing water curtain system.

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