

**Experimental Study on the  
PMMA Combustion  
Restraining by **Ultrafine Water  
Mist** in Confined Space**

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# Water Mist



Over the past decade, water mist technology has been developed and regarded as a promising substitute because of its advantages: little pollution to environment (not destroying the ozone layer or bringing the green house effect), extinguishing fire quickly, consuming a small quantity of water and having little damage to the protected objects.

# Ultrafine Water Mist

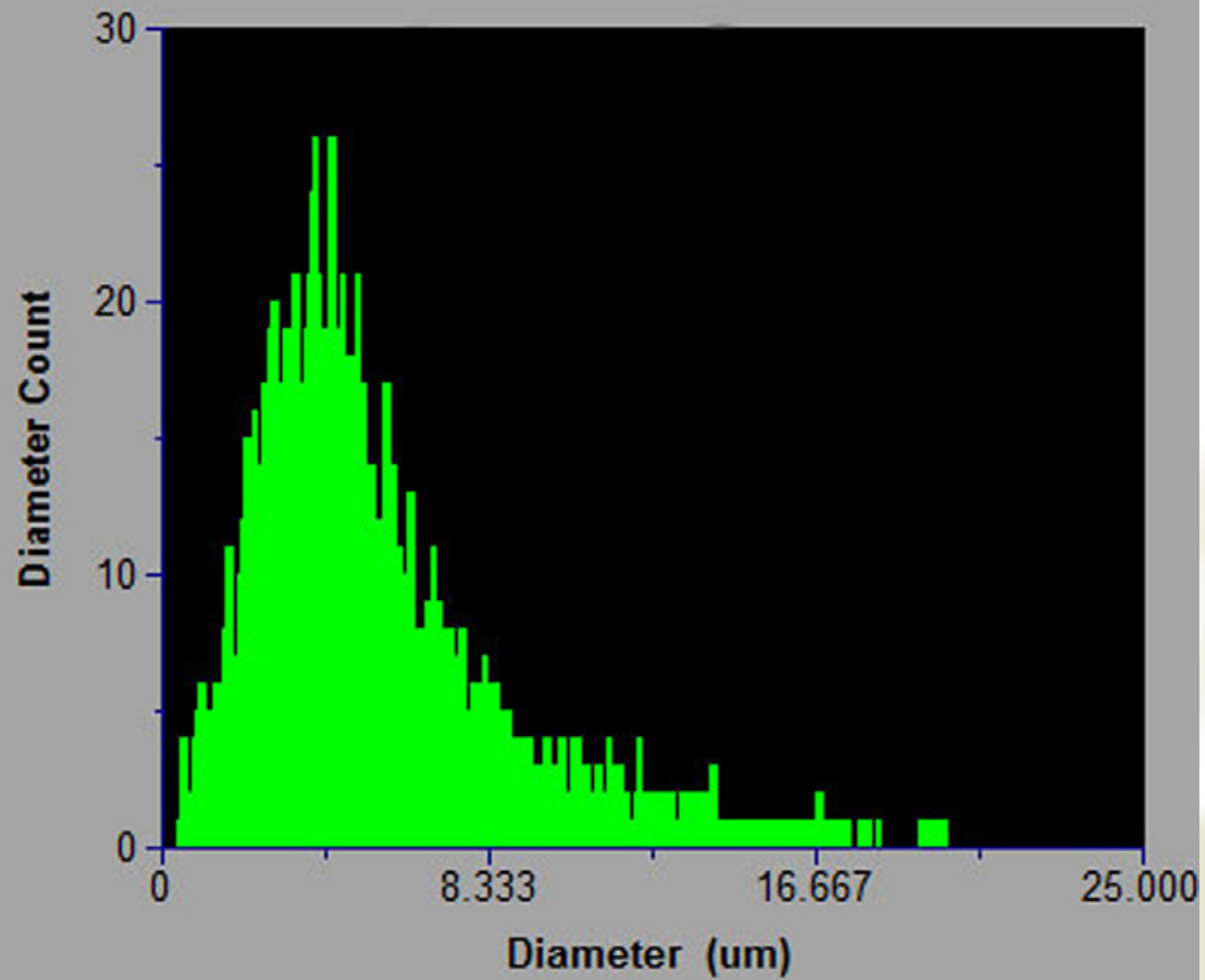


- ❖ Bypass the obstacles to reduce the power of the fire source
- ❖ Stay for a long period in the space
- ❖ the good heat-absorbing properties

# Introduction



The interaction of ultra-fine water mist with oil flame





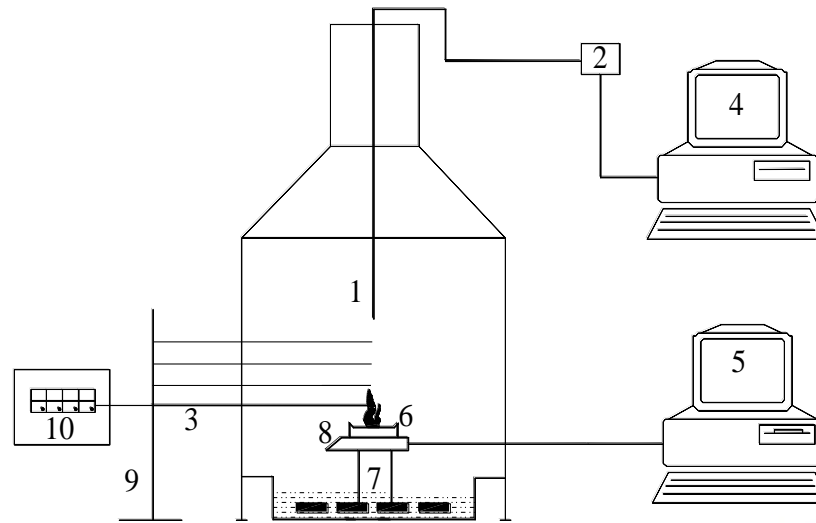
# Introduction

This paper will

- ❖ build the experimental platform
- ❖ measure related data
- ❖ sum up its impact factors

# Experimental platform and working condition

## 1 Experimental device



1.Smoke analyzer probe; 2.Smoke analyzer; 3.Thermocouple tree; 4.Smoke analyzer workstation; 5.Quality change acquisition workstation; 6.Burning containers; 7.Atomization pool and atomizer; 8.Electronic scale; 9.Thermocouples stent; 10.Digital temperature acquisition instrument

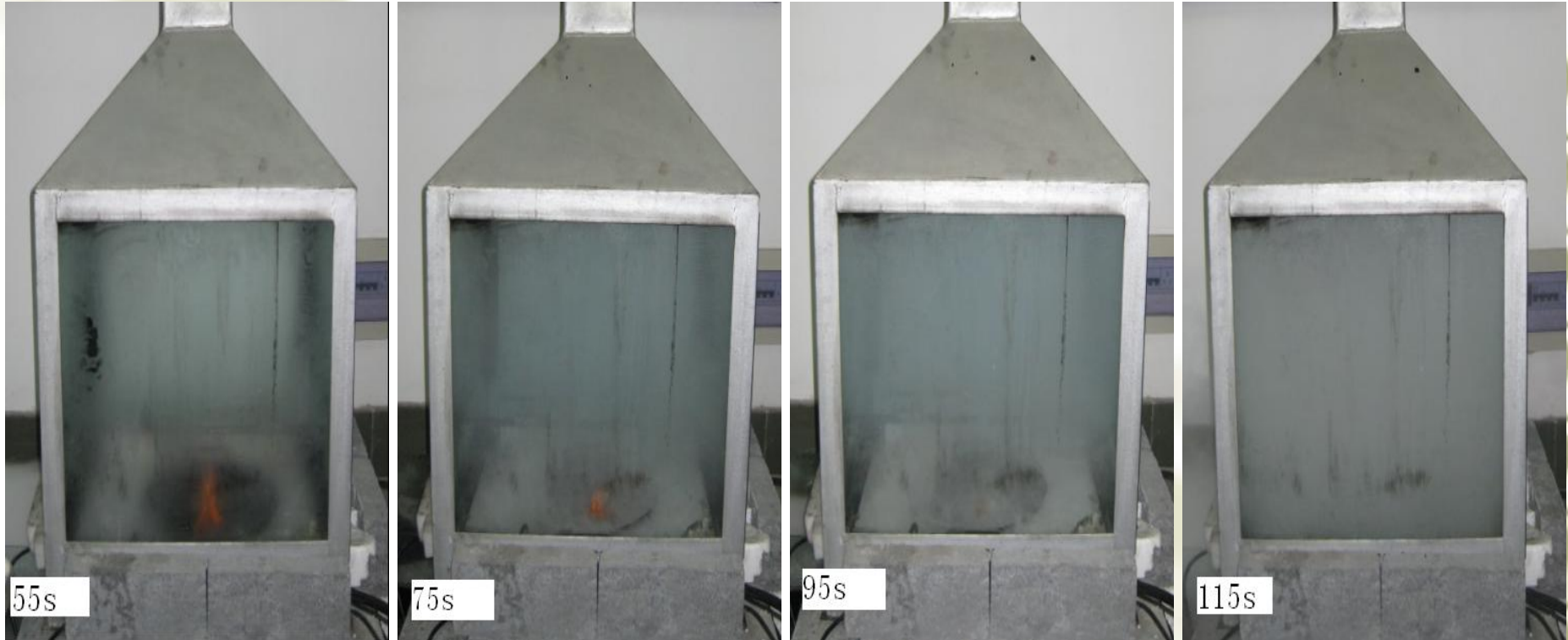
Fig. 1 Schematic of the experimental compartment

# Experimental platform and working condition

## 2 Experimental cases

Case Number	fuel quantity (g)	discharging or not	mist flux (ml/min)	preignition time (s)	discharging time (s)
1	367	N	—	—	—
2	240	Y	150	25	50
3	240	Y	150	65	50
4	330	Y	50	65	55
5	330	Y	150	65	55
6	342	Y	150	80	40
7	342	Y	150	80	80
8	367	Y	200	50	60

# Experimental process

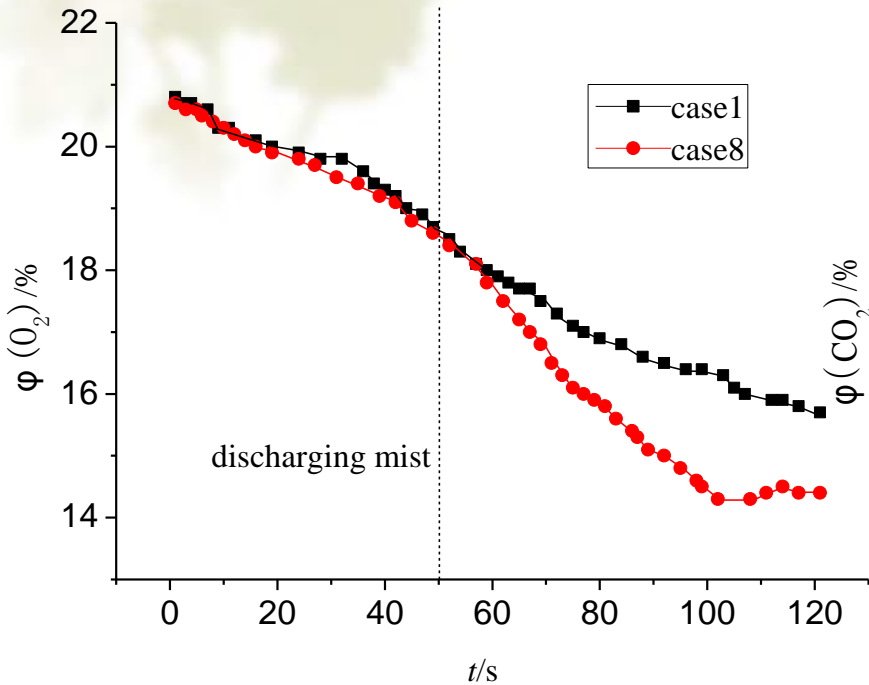


the process of PMMA combustion restraining by ultra-fine water mist

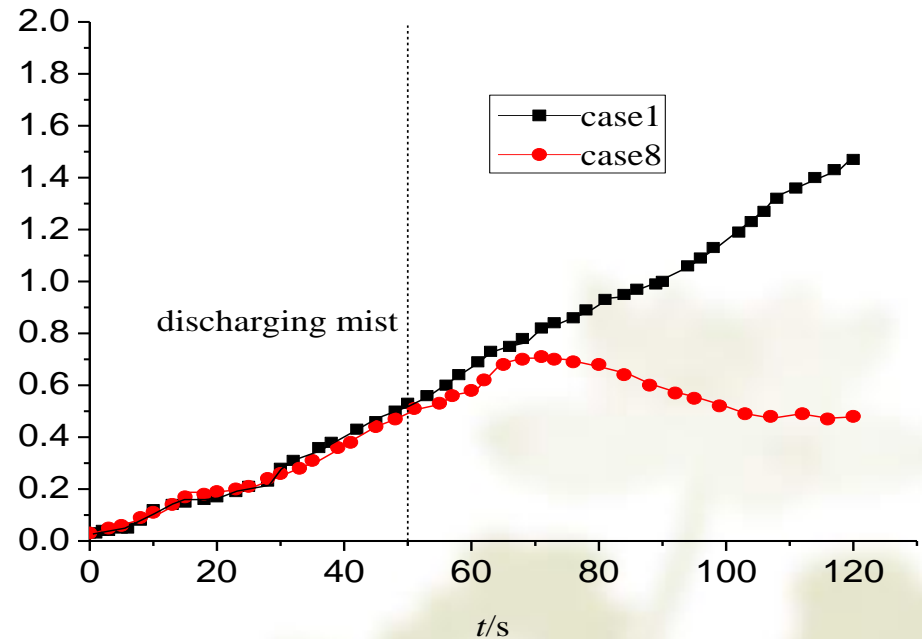
# Experimental process

- ❖ It includes the scene at 55s, 75s, 95s, 115s.
- ❖ The ultra-fine water mist was discharged at 50s. Because the water mass concentration was between 3~4%, it had a function of combustion-supporting, and the flame of PMMA became larger at a short time.
- ❖ After 2~5s, along with the increasing of the discharging time, the flame of the combustible PMMA gradually became small, and then extinguished at 104s.
- ❖ At the same time, ultra fine water mist was diffused gradually in the confined space.
- ❖ At last, the confined space was full of ultra fine water mist, and the visibility was also reduced.

# Results and discussion

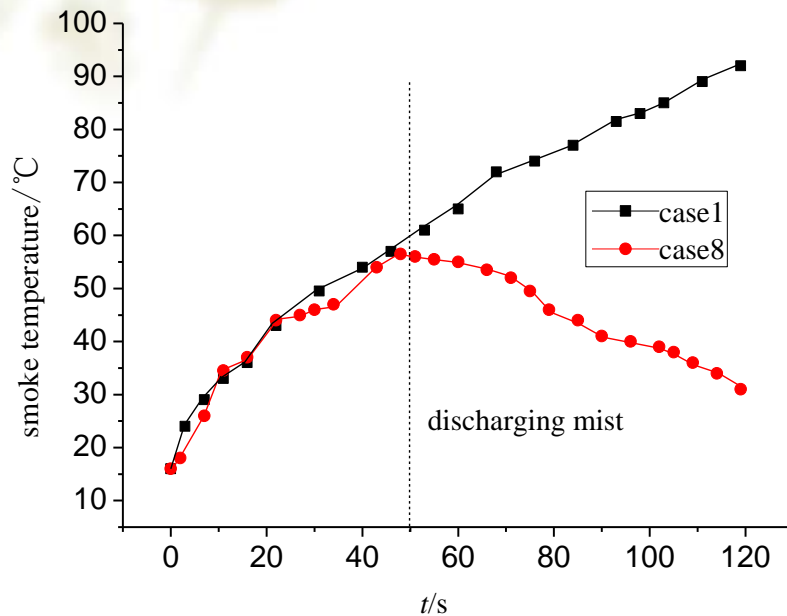


**Fig. 3** Oxygen volume fraction variation curve with and without ultra-fine water mist

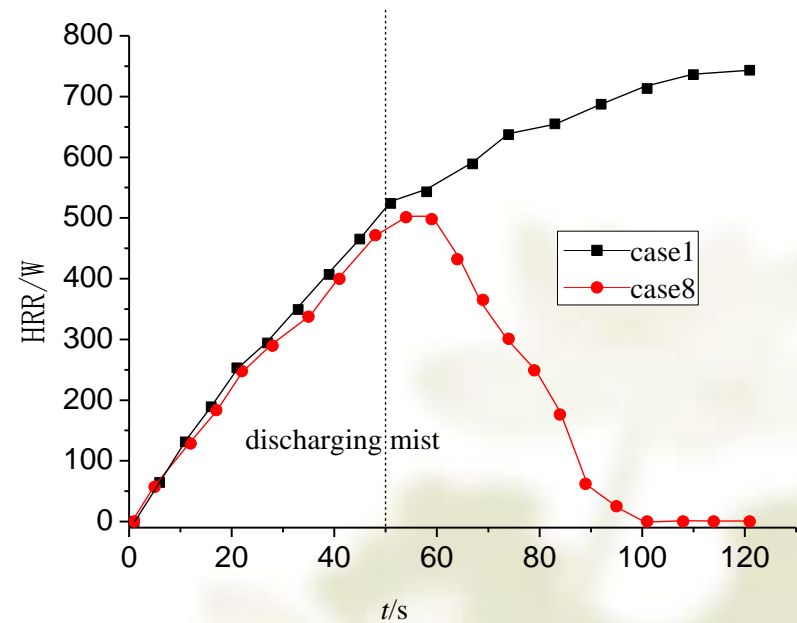


**Fig. 4** Carbon dioxide volume fraction variation curve with and without ultra-fine water mist

# Results and discussion



**Fig. 5** Smoke temperature variation curve with and without ultra-fine water mist

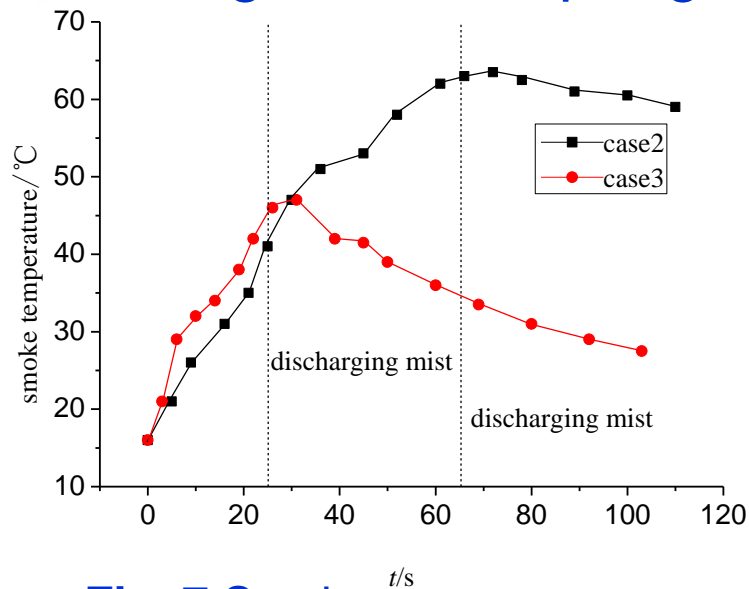


**Fig. 6** Heat release rate variation curve with and without ultra-fine water mist

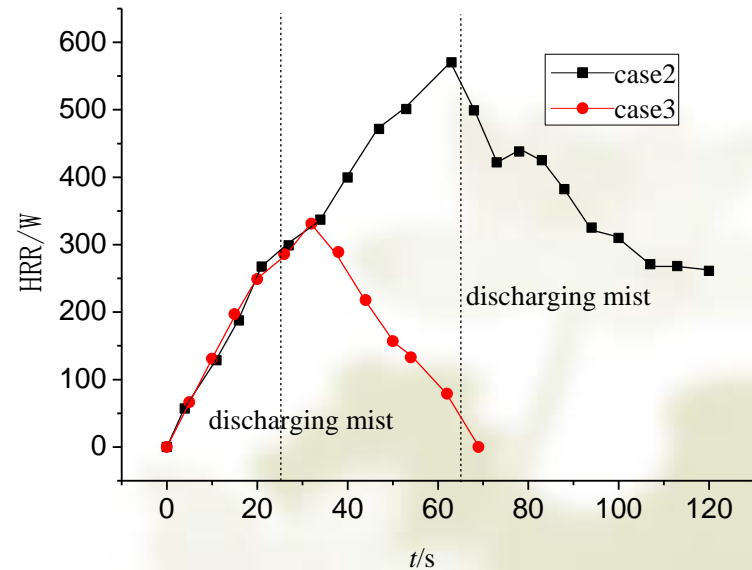
# Results and discussion

## Related factors analysis

### 1 Restraining effects of preignition time



**Fig. 7** Smoke temperature variation curve at different preignition time



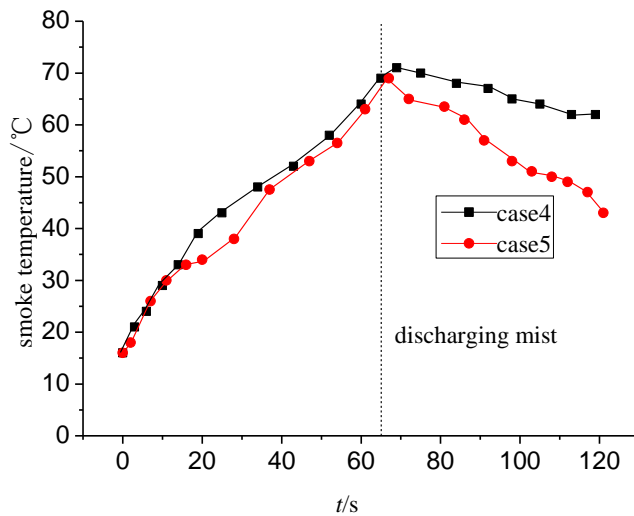
**Fig. 8** Heat release rate variation curve at different preignition time



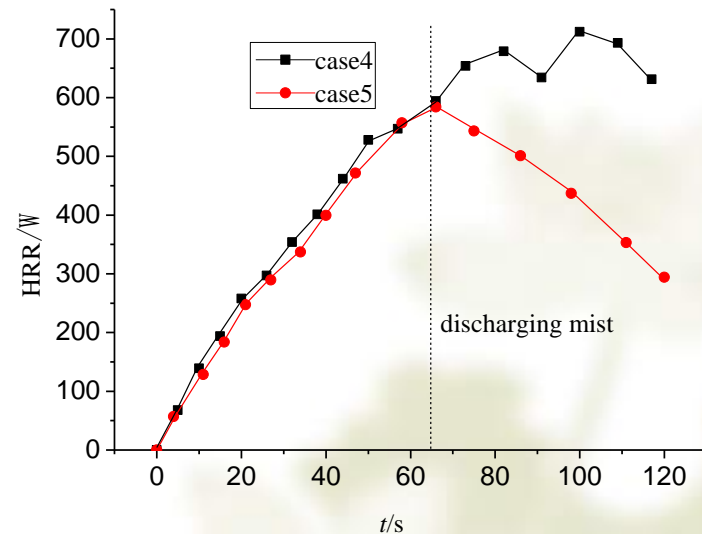
# Results and discussion

## Related factors analysis

### 2 Restraining effects of mist flux



**Fig. 9** Smoke temperature variation curve at different mist flux

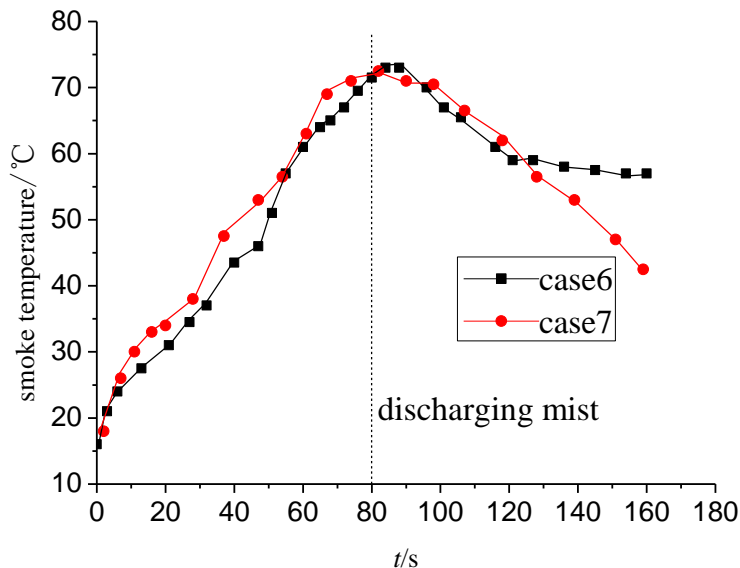


**Fig. 10** Heat release rate variation curve at different mist flux

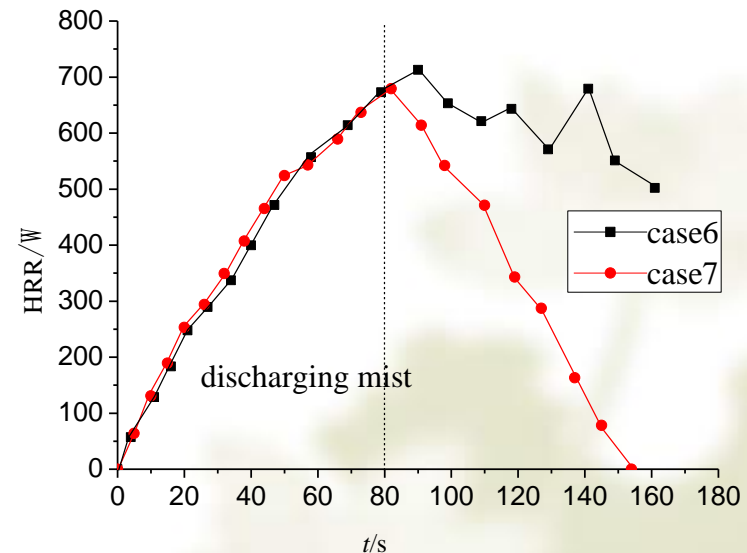
# Results and discussion

## Related factors analysis

### 3 Restraining effects of discharging time



**Fig. 11** Smoke temperature variation curve at different discharging time



**Fig. 12** Heat release rate variation curve at different discharging time

# CONCLUSIONS

- ❖ The concentration of **oxygen** decreased continuously, the concentration of **carbon dioxide** decreased slowly until becoming stable.
- ❖ The ultra fine water mist suppression system was related to the **preignition time, the mist flux, the discharging time** and so on.
- ❖ For the sufficient mist flux, the shorter the preignition time was, the better to suppress the PMMA flame.
- ❖ When the preignition time and the mist flux was feasible, the more the discharging time was, the better to extinguish the PMMA flame.

That's all.

Thank you.