Study on The Explosion Field Temperature and Gas Products of FOX-7/RDX Based Aluminized Explosives

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1.Abstract

To investigate the effect of RDX on the explosion reaction mechanism of FOX-7 based aluminized explosives in vacuum environment, the explosion field temperature of FOX-7 based aluminized explosives and RDX/FOX-7 based aluminized explosives were measured in an isolated explosion chamber. The results show that adding RDX would increase the equilibrium temperature of explosion field of FOX-7-based aluminized explosives. The equilibrium temperature of FOX-7-based aluminized explosives and RDX/FOX-7-based aluminized explosives increases first and then decreases with the increasing of Al content, which shows the highest equilibrium temperature as the Al content is 30%. When the Al content is less than 25%, the explosion peak temperature of FOX-7-based aluminized explosives would increased by adding RDX, and when the aluminium content is more than 30%, the explosion peak temperature of FOX-7-based aluminized explosives can be reduced by adding RDX.

2.Experiment

2.1 The formulations of explosives

Explosives Number	ω/%			
	FOX-7	RDX	Al	Binder
XA15	80	0	15	5
XA20	75	0	20	5
XA25	70	0	25	5
XA30	65	0	30	5
XA35	60	0	35	5
HXA15	52	28	15	5
HXA20	48.75	26.25	20	5
HXA25	45.5	24.5	25	5
HXA30	42.25	22.75	30	5
HXA30	39	21	35	5

2.2 Experimental Procedure

suspending the sample in the chamber, where is 20 cm away from the top cap. Then, the detonator was connecting the detonator with the ignition device, and closing the upper cap of the experimental device. evacuating the chamber with a vacuum pump. Filling the explosion device was slowly with nitrogen; repeating the evacuating step to make sure the absolute pressure inside the device less than 100 Pa. Finally, the sample was detonated, and the signal data were recorded within 52 s by the temperature sensors. Then use Testo 350 gas analyzer to collect and quantitatively analyze the explosive gas products.

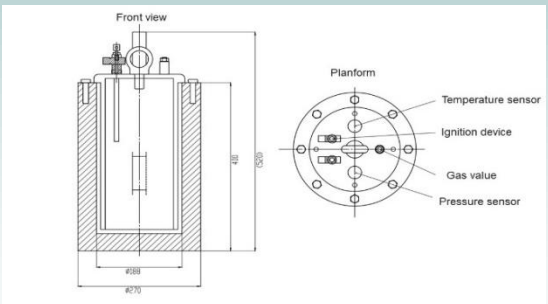

Fig.1 Schematic diagram of the explosives device

3. Results and discussion

3.1 Explosion Field Temperature

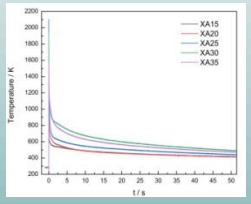

Fig.2. The explosion field temperature of FOX-7-based aluminized explosives

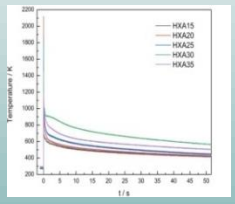

Fig.3. The explosion field temperature of FOX-7/RDX-based aluminized explosives

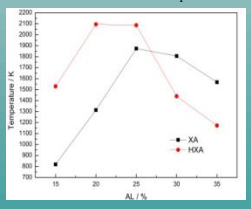

Fig.4. Comparison of equilibrium temperature between FOX-7 and RDX/FOX-7-based aluminized explosives

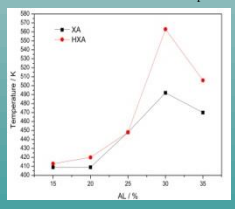

Fig.5. Comparison of peak temperature between FOX-7 and RDX/FOX-7-based aluminized explosives

3.2 Analysis of Gas Products

Explosives Number	φ / %					content of remainder oxygen element
	O_2	CO_2	CO	NO_2	NO	
XA15	0	2.19	39	0	0	43.88
XA20	0	4.74	36.1	0	0	45.58
XA25	0	2.19	37.9	0	0	42.28
XA30	0	2.58	35.2	0	0	40.36
XA35	0	1.64	30.6	0	0	33.88
HXA15	0	2.06	38.6	0	0	42.72
HXA20	0	4.0	34.3	0	0	42.3
HXA25	0	2.59	36.5	0	0	41.68
HXA30	0	0.25	35.6	0	0	36.1
HXA30	0	0.2	31.5	0	0	31.9

4. Conclusions

(1) When the Al content is 15~35%, the equilibrium temperature of FOX-7-based or RDX/FOX-7-based aluminized explosives increases first and then decreases with the increase of Al content. the highest equilibrium temperature occurred when the Al content is 30%.

(2) the equilibrium temperature of the RDX/FOX-7-based aluminized explosives is higher than that of the FOX-7-based aluminized explosives with same Al content, and the difference is obvious when the Al content is 30% and 35%.

(3) The peak temperature of the explosion field of FOX-7-based aluminized explosives and RDX/FOX-7-based aluminized explosives increased first and then decreased with the increase of aluminum content. The FOX-7-based aluminized explosives achieved the highest at 25% aluminum and the RDX/FOX-7-based aluminized explosives reached the highest at 20% aluminum.

(4) When the aluminum content is 15-25%, the peak temperature of the RDX/FOX-7-based aluminized explosives is significantly higher than that of the FOX-7-based aluminized explosives. When the aluminum content is above 30%, the peak temperature of the RDX/FOX-7-based aluminized explosives is significantly lower than that of the FOX-7-based aluminized explosives.

(4) The gas products indicates that the higher the temperature, the more beneficial the aluminum powder and oxidant are to the consumption of oxygen. The heat released by the reaction continues to maintain the high temperature environment and promotes the reaction between the aluminum powder and the oxidant.