Experimental study on the breaking of A-IX-2 explosive by submerged cavitation water jet

Yao-xuan Zhang, Peng Lian, Chao Kang, Song Chen*
(Xi'an modern chemistry research institute, Xi'an 710065, China PR)

Introduction

The de-military treatment of scrapped ammunition is a thorny issue for all countries in the peacetime. How to safely empty explosives from the ammunition shell is the primary problem faced by the ammunition green treatment technology, which directly affects the subsequent recovery and reuse of explosives. ammunitions filled with the pressed and casted explosives, such as A-IX-2, PBX, etc. can not because of the high melting point. In the past, this kind of ammunitions only can be destroyed through incineration in open air, so that it will cause environmental pollution and the waste of resources. This method is contrary to the environmental protection concept "reduce, recycle, and reuse". Cavitation water jet is a preferable method to uses a jet of 20 to 30 MPa to generate a large number of cavitation bubbles through the cavitation nozzle with a special structure, which would safely and effectively empty explosives from the ammunition.

Experiment

the submerged cavitation water jet device shown in Fig. 1 was set up. The device is mainly composed of a sprinkler head, a sample clamping and rotating device, a pressure gauge, a high-pressure pump, a water storage tank, and an explosive filtering device. The pressure of the high-pressure pump is adjustable and the distance between the sprinkler head and the explosive is adjustable. During the experiment, the explosive sample 1 is firstly fixed on the clamping and rotating device 3. The water in storage tank 8 is sent to the high-pressure pump 6 through a water pipeline 7, and pressurized to a specified pressure value. Then it is sprayed on the surface of the sample at high speed through a cavitation sprinkler head 2. After filtered by the explosive filtering device 5, the explosive particles with different sizes are obtained.

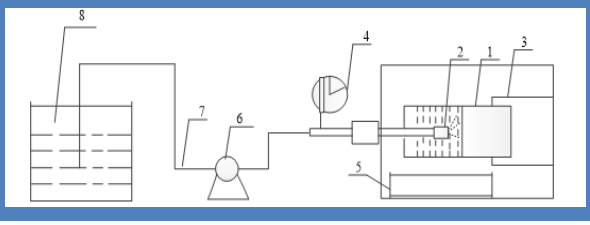

Fig.1 Device diagram of breaking A-IX-2 explosive sample by submerged cavitation water jet
1—explosive sample, 2—sprinkler head, 3—clamping & rotating device, 4—pressure gauge, 5—explosive filtering device, 6—high-pressure pump, 7—water pipeline, 8—water storage tank.

Results

The breaking effect of submerged cavitation water jet to A-IX-2 explosive and its broken explosive particles are shown in Fig. 2. It can been that, the sample is completely broken. The size of the maximum particle size does not exceed 3 cm.

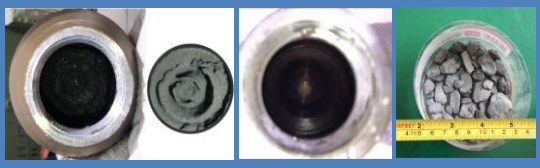

Fig.2 Breaking effect

It can be considered that the breaking of the explosive surface by cavitation water jets is mainly the combined action of micro-jets and shock waves generated by the collapse of cavitation bubbles. The submerged cavitation water jet contains a large number of cavitation bubbles, which collapses on the explosive's surface due to a force imbalance. Along with the generation of micro-jets and impacts, a local high-pressure region is formed on or near the explosive's surface, resulting in extremely high stress concentrations. It may be the reason that the explosive's surface is broken. The diagram of breaking process is shown in Fig. 3.

Fig.4 shows the internal temperatures of A-IX-2 explosive during the whole impact process..

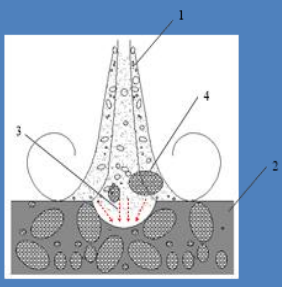

Fig.3 Breaking mechanism

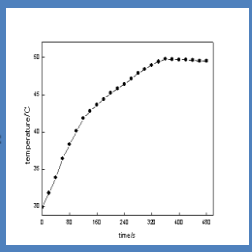

Fig.4 Temperatures of A-IX-2 explosive in the jet impact process

Conclusions

The submerged cavitation water jet is available to use to empty ammunition charged A-IX-2 explosive and the maximum particle size is no more than 3cm. The fragmentation of the explosive by the submerged cavitation water jets is mainly caused by the combined action of micro-jets and shock waves generated by the collapse of cavitation bubbles. A-IX-2 explosive has two temperature rising stage during the impact of the cavitation water jet.. The temperature change of the whole process is about 20 ° C.