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Analysis and Combing of the Damage Effectiveness of Ammunition in Service of Armored Equipment

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Abstract

This paper analyzes the damage effectiveness of armored equipment and ammunition for armored equipment, and on the basis of the existing ballistics and damage models and data research results of weapons and ammunition in the main combat directions in a certain period of time in the future, fully considers the more complex and close to the real battlefield environment and the law of target combat application, and deepens the research on target damage standards, target vulnerability, damage models and damage laws. Find out the effectiveness base of equipment to achieve different combat objectives for different combat objectives under close to actual combat conditions, and provide technical support for the combat use and firepower application of armored equipment and ammunition series.

Keywords

Armored Equipment; Active Ammunition; Damage Effectiveness; Analysis.

1. Introduction

In the past 20 years, fruitful results have been achieved in the construction of ammunition for armored equipment, and the range, power and accuracy of ammunition have been greatly improved. It is very important to scientifically evaluate their destructive effectiveness so as to rationally use them and give full play to the combat effectiveness of armored equipment. At present, the warhead power index is commonly used to measure its performance in the damage assessment work, but these indicators cannot fully characterize its ability to damage the combat target, although the warhead has reached the corresponding technical indicators, but whether it can effectively destroy the target in actual combat is unknown. In fact, it mainly focuses on the assessment of the static damage effect of the target target, which cannot truly reflect the actual strike effectiveness of the equipment, and the fire strike evaluation module developed on this basis cannot accurately calculate the consumption and damage effect of combat ammunition, which is not conducive to the implementation of the combat and support plan of the troops.

The research in this paper provides a basis for the combat use and ammunition support of armored equipment and ammunition series, provides a basis for the improvement of armored equipment fire charges, and ensures the combat effectiveness of armored equipment and ammunition.

2. Relevant Research Progress

The ammunition series in this project are all armored equipment ammunition, so this research work focuses on the damage effectiveness evaluation of armored equipment ammunition, and the current research status of damage effectiveness evaluation technology of armored equipment ammunition at home and abroad is as follows:

2.1 Research Status of the Power Field of Anti-explosive Bombs

(1) Research status of fragmentation power field

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Explosives are the energy source of the lethality of the anti-explosive bomb, and when the explosive explodes, it produces a high-pressure, high-density shock wave, which breaks the material of the projectile body, which is the cause of the formation of fragments, and the fragments produced have extremely high speed and great kinetic energy, which is the basic source of damage to the anti-explosive bomb. These high-speed fragments scatter in all directions, which can have a great destructive effect on surrounding people, buildings, equipment, etc. Amold W. and Rottenkolber E studied the rupture performance of different shell materials and different shell structure sizes, so as to obtain how the number of fragments can change through subsequent treatment under the same thickness of different shell materials, and the fragmentation mechanism was analyzed theoretically, and the relationship between shear strain and material strength was discussed.

(2) The research status of shock wave field

After the projectile explodes, the energy is mainly divided into two parts, one part is acting on the projectile material, so that the shape of the projectile material changes, and the kinetic energy conversion is completed, and the projectile material with kinetic energy has the lethality to the surrounding objects; The other part causes the detonation to expand rapidly, thereby compressing the surrounding air and generating shock waves, which spread to the surrounding areas at high speed and have a destructive effect on surrounding personnel, buildings, and equipment. The magnitude of the shock wave damage is mainly related to two parameters: shock wave overpressure and specific impulse, and under normal circumstances, there are three criteria for shock wave damage caused by explosion: overpressure criterion, impulse criterion, and overpressure-impulse criterion.

(3) Fragmentation and shock wave composite power field analysis

Normally, after the warhead explodes, a large number of fragments and shock waves will be generated, which are the two main sources of damage. The initial shock wave velocity of the explosion is greater than the fragmentation velocity, and the shock wave is in front of the fragment. After a period of time, the speed of the shock wave decreases, and the fragments will gradually catch up with the shock wave, and when the two meet, it will have a coupling effect on the target, and the damage effect will change. After a large number of experimental studies, before and after the encounter between the shock wave and the fragment, the order of the action of the shock wave and the fragment on the target is different, and the damage effect on the target is different.

2.2 Research Status of Target Vulnerability

The research on the lethal effect of ammunition first began in 1860, when live ammunition was mainly used to shoot at targets such as the deck and side panels of ships with certain defensive properties, so as to study the damage effect. The current research is mainly focused on how to improve the damage ability of ammunition, and the research on the target damage resistance (target vulnerability) is relatively small, and the research in this area is scattered separately and does not form a system, only after the Second World War, the research on the damage resistance is really valued, and the study of the target vulnerability really appears. Domestic research on equipment vulnerability and damage assessment, warhead power simulation, and other aspects began about the 80s of the last century, and from the perspective of time, it is later than the research in this field by foreign counterparts.

2.3 Research Status of Damage Assessment Theory

In the middle of the last century, United States, United Kingdom, France and the Netherlands began to study battlefield operation assessment and repair, Daniel D. Wilke and Dennis K. McCarthy proposed the "automatic damage assessment, reporting and deployment" damage assessment method, which is characterized by extracting the damage data in the database and comparing the damage data collected at the scene, so as to determine the damage level. The research in related fields in China began in the eighties of the last century, because the Chinese army could not go through real battlefield experience like the United States army, and could not obtain real damage data on the battlefield, so it could only use simulation technology to conduct damage assessment research.

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2.4 Research Status of Damage Assessment Software

The research of damage assessment software is mainly based on developed countries such as United States, Germany, the former Soviet Union, etc., and in these countries, there are universities, experimental companies, technology companies and other units involved in the research, most of which are funded by the military. China's damage assessment research began in the eighties of the last century, due to a variety of conditions, and United States, Russia and other military powers in this field of research, there is still a great distance, specifically in the target damage assessment technology research is relatively backward, the relevant algorithm research is immature, damage effect estimation evaluation system and damage effectiveness evaluation system construction is weak, but because of the important significance of research in this field, the military attaches great importance to it, I believe that research in this field will continue to invest.

2.5 Progress in the Assessment of the Damage of Our Troops

In the static power field of the guided killing and detonation warhead, the formation law of the fragmentation field, the spatial distribution law of the fragmentation field, the distribution law of the shock wave overpressure, the verification of the static power test and the model correction were carried out. Guided kills were established.

3. Analysis of the Key Directions in the Next Step

Based on the above analysis, in the next step, we will focus on the output of high-accuracy performance evaluation results based on typical scenarios and different shooting conditions. The key research contents are as follows:

3.1 Research on the Damage Effect of Armored Equipment and Ammunition

The fragmentation mass distribution of the warhead of the relevant ammunition was studied and analyzed, and the spatial velocity distribution of the fragmentation was obtained by using the spherical target and fragmentation velocity test, and the ultimate penetration velocity test of the laboratory fragments on the equivalent targets of different targets was combined to establish the dynamic destruction field model of the ammunition. Through the data mining technology, the relationship between the performance parameters of the anti-explosive ammunition and the materials and structure of the ammunition is mined, the feature vector of the experimental data is established, and the theoretical model of the correction is verified.

3.2 Experimental Research on the Damage Effect of Armored Equipment and Ammunition Series

Based on the power of the warhead, the vulnerability of the target and the characteristics of the ammunition use, the test method of the damage effect of the armored equipment ammunition series is carried out simultaneously, which is used to guide the dynamic damage effect test of the armored equipment ammunition series, and the model verification and correction of the damage criterion and the damage effect simulation model parameters of the relevant typical targets are completed through the analysis of the damage effect test data.

3.3 Research on the Combat Application of Armored Equipment and Ammunition

Mainly combined with the combat mission and technical characteristics of armored equipment and armored equipment ammunition series, according to the main combat directions (mainly Taiwan and India) in a certain period of time in the future, carry out research on the combat mission list of armored equipment in the main combat directions, study and select typical combat scenarios in plateau and plain environments (including urban operations, etc.) and typical combat target types of armored equipment and ammunition strikes, and construct the mapping relationship between typical combat scenarios, typical combat operations and ammunition effectiveness, which can be used as ammunition damage effectiveness evaluation tests. Performance evaluation simulations and inputs for performance evaluation.

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3.4 Research and Development of Simulation for the Evaluation of the Damage Effectiveness of Armored Equipment and Ammunition

Based on the research results of artillery shooting command, ammunition combat application, ammunition damage effect analysis, typical target analysis, etc., it is planned to carry out research on the evaluation of artillery ammunition damage effectiveness, and establish a new artillery ammunition damage effectiveness evaluation model, in order to innovate the traditional ammunition effectiveness evaluation model.

3.5 Experimental Research on the Damage Effectiveness of Armored Equipment and Ammunition

Based on the research results of ammunition damage effect, typical targets, artillery firing command, and ammunition combat application, the test method of damage evaluation of armored equipment and ammunition series was carried out, and the results of relevant firepower implementation plans and target settings were applied to the combat test plan, and the relevant test data collection was completed in combination with the test, and the model inspection and correction of the damage criterion and damage effectiveness simulation model parameters of the relevant typical targets were completed.

3.6 Preparation of Damage Effectiveness Assessment of Armored Equipment and Ammunition Series

Carry out research on the content and format of the preparation requirements for the evaluation of ammunition damage effectiveness, and through the content and format of the research specification manual, it will be coordinated with the firepower plan, and the results will be convenient for the troops to consult and use, which is conducive to the generation of combat effectiveness.

4. Conclusion

The research in this paper provides a basis for the combat use and ammunition support of armored equipment and ammunition series, provides a basis for the improvement of armored equipment fire charges, and ensures the combat effectiveness of armored equipment and ammunition.This paper analyzes the damage effectiveness of armored equipment and ammunition for armored equipment, and on the basis of the existing ballistics and damage models and data research results of weapons and ammunition in the main combat directions in a certain period of time in the future, fully considers the more complex and close to the real battlefield environment and the law of target combat application, and deepens the research on target damage standards, target vulnerability, damage models and damage laws. Find out the effectiveness base of equipment to achieve different combat objectives for different combat objectives under close to actual combat conditions.

References

[1] Almost 1,500 pieces of Ukrainian armored equipment destroyed - Russian Defense Ministry (Part 2)[J].Interfax : Russia & CIS Military Newswire,2022.

[2] Kun X ,Yongping J ,Youduo P , et al.Research on high quality mesh method of armored umbilical cable for deep sea equipment[J].Ocean Engineering,2021,221.

[3] Southern Military District receives some 80 items of new, upgraded armored equipment in 2019[J].Interfax : Russia & CIS Military Newswire,2019.

[4] Li C ,Xu D ,Jiao Q , et al.Maintainability Test Method of Army Armored Equipment based on Small Sample Size[J].International Journal of Performability Engineering,2019,15(1):200-208.

[5] Yi L ,Bin Z ,Zhiqiang S .Research on lightning numerical simulation of wheeled armored vehicle with the enclosure and cables.[J].Journal of Physics: Conference Series,2019,1237(2):022185 (6pp).