Influencing Factors Analysis of Ammunition Storage in Reef Environment and Countermeasures

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Abstract. To explore the characteristics of ammunition storage environment in islands of West China Sea and South China Sea and the mechanism of environmental factors affecting ammunition quality change and propose countermeasures, the characteristics of high temperature and humidity, high salt spray and ammunition storage in the sand islands and reefs in southwest China were analysed. During the process of ammunition storage in the west and south China sea islands environment, its quality is affected by many complex factors, among which temperature, humidity and salt fog are the most important factors that result in the change of ammunition quality. For the environment characteristic and the actual situation of the reef storage, some measures are put forward by increasing environmental monitoring equipment and accurately recording the environment parameter, improving the ammunition storage surrounding natural environment, strengthening warehouse construction to improve the heat insulation and moisture proof ability, and strictly implementing the storage environment inspection. The countermeasures proposed can effectively improve the quality of ammunition storage, prolong the life of ammunition and ensure the reliability of ammunition.

1. Introduction
Islands and reefs in West and South China Sea have a typical tropical maritime monsoon climate with sufficient sunshine, high temperature, abundant precipitation and high humidity. At the same time, due to the influence of the Marine environment, the salt fog is very large. The environmental characteristics of high temperature, high humidity and high salt fog have an extremely adverse effect on the storage of ammunition. However, most of the ammunition storage warehouses of the garrison troops on the islands and reefs are mainly on the ground, which are greatly affected by the atmospheric precipitation and humid air, and the humidity control conditions are relatively poor. Therefore, the ammunition storage security is greatly threatened [1].

2. Environmental factors affecting the quality of ammunition
Equipment support statistics show that about half of the total malfunctions of ammunition equipment are caused by environmental factors. There are many environmental factors affecting the safety of ammunition, such as temperature, humidity, salt spray, corrosive gases, microorganisms, shock, vibration and electromagnetic radiation. Temperature, humidity and salt spray are the main affecting factors in the reef environment. The influence of these three factors on ammunition quality is described below.

2.1. Temperature characteristics and influence on ammunition quality
Temperature is the most important and universal environmental factor that affects the quality of ammunition, and it is also one of the external factors that ammunition must be tested in the reef environment. According to the related data, in the various environmental factors that caused the ground-
to-air missile failure, temperature is up to 40% of them. Ammunition is stored on tropical and subtropical islands and reefs at low latitudes, and it will encounter harsh and high temperature environment in summer, and the maximum temperature of its stored environment may reach 50℃ or even above. The average annual temperature, historical low and historical high monthly average temperature in some regions of West and South China Sea are shown in Table 1.

Table 1 Average Temperature of Some Area

| Area         | The historical average temperature | The lowest monthly average on record | The highest monthly average on record |
|--------------|------------------------------------|-------------------------------------|--------------------------------------|
| Haikou       | 23.2-25.4                          | 13.2                                | 30.0                                 |
| Sanya        | 25.0-27.2                          | 18.6                                | 30.3                                 |
| Yongxing island | 26.1-27.9                        | 21.2                                | 30.4                                 |
| coral island | 26.4-28.0                          | 21.6                                | 31.0                                 |
| Taiping island | 27.7-29.4                      | 25.5                                | 31.9                                 |

The research shows that the high temperature environment (more than 30℃), low temperature environment (less than -12℃) and the drastic temperature change (generally more than 10℃) will affect all kinds of ammunition materials [2]. For the environment of West and South China Sea islands, the influence of temperature on ammunition quality is also reflected in the following two aspects:

The first one is the effect of high temperature on the quality of ammunition. High temperature will make the remaining solvent, camphor and water in the propellant volatile, nitro-glycerine exudes, affecting the chemical stability. For example, if the temperature exceeds 44℃, the yellow phosphorus will melt and leak out of the shell, resulting in combustion accidents. High temperature will also make the polymer material in ammunition degradation and crosslinking reaction, so that its performance gradually deteriorated. In addition, high temperature is a stress method to reduce the reliability of electronic and magnetic components. With the rise of temperature, the chemical and physical activities of the material increase, resulting in the increase of the failure rate of the product. For example, in the case of uniform heating, it will cause aging, insulation damage, oxidation, etc., which will lead to product performance degradation and failure.

The other one is the effect of temperature change on ammunition quality. The change of temperature will cause the change of the crystal shape of ammonium nitrate in ammonium nitrate explosive, resulting in the change of volume, mutual extrusion and caking, resulting in the change of charge density, poor structural uniformity, reduced sensitivity, difficult initiation, and even semi-explosion or non-explosion. Temperature changes also accelerate the aging of polymer materials. In addition, the fluctuation and alternations of temperature will cause the change of relative humidity, thus producing the synergistic effect of temperature and humidity. Especially when there is rust layer on the surface of ammunition metal element, the synergistic effect of temperature and humidity should be more obvious, so as to accelerate the corrosion of metal. In the sealed state, when the temperature drops, the relative humidity will rise. Some studies show that the relative humidity is between 65% and 70%, and when the temperature drops to 6℃, condensation will occur. The rise of temperature will also accelerate the decomposition rate of ammunition charge and increase the escape rate of volatile components in charge, thus affecting the reliability and safety of ammunition and reducing the storage life of ammunition. For other materials in ammunition, the increase in temperature will accelerate the aging of the non-metallic materials, and may cause the cartridge to lose its tightness due to gas expansion and the loss of ammunition protective oil, thus shortening the storage life of ammunition.

2.2. Humidity characteristics and influence on ammunition quality

In Islands region of West and South China Sea, there are higher annual temperature, full sunlight, and concentrated rainfall, so relative humidity above 80% all the year round. From nearly a decade of humidity record, annual average relative humidity was between 75% ~ 90%, in rainy season the highest monthly average relative humidity of 88%, too more than ammunition requirements of relative humidity.

The influence of humidity on ammunition storage is mainly reflected in the following two aspects:
The first one is the effect on the corrosion of ammunition metal. When the relative humidity of the storage environment is higher than the critical relative humidity of the ammunition, the chemical corrosion of the ammunition metal elements turns into electrochemical corrosion, and the corrosion rate will change suddenly [3].

The second one is the effect on ammunition charge. Due to the high humidity in ammunition storage environment, it is easy to cause the hygroscopic solution of charge, the failure of electronic components, and the deterioration and mildew of non-metallic parts. Especially after deliquescence of internal charge, its combustion performance will be affected, causing difficulty in ignition, decreasing combustion rate, weakening flame power, and even being unable to be ignited in serious cases, which will bring various adverse effects on the service performance.

2.3. Influence of salt spray on ammunition quality
Salt spray is a very small fluid, and fine particles dissolve in the weather and spread into fog [4]. The influence of salt spray on the quality of ammunition is mainly reflected in the corrosion and destruction effect:

Salt spray contains various salts, the main component of which is sodium chloride. Chloride ion has a strong penetration ability, can easily penetrate the metal protective film. At the same time, the cathode surface with a protective film is easy to adsorb chloride ions with little hydration energy, because sodium chloride is a strong electrolyte with high conductivity, which can accelerate the electrode reaction and activate the anode. And, the chloride ion itself has a small ion radius and a strong penetrating ability, which destroys the blunt property of the metal and causes corrosion. Because metallic interior more or less exists impurity, the material between each layer of electroplating piece metal is different, so the potential difference exists between different metals. When electrolytes are present, they form microcells of metals of different potentials (or between metals and impurities), resulting in electron transfer.

Under the reef environment, ammunition is susceptible to the extremely harsh salt spray environment formed by seawater. It is found that strong acid salt fog environment can easily lead to electrochemical corrosion. In addition, salt deposition can also lead to mechanical components and components of the moving parts of the blockage or stuck phenomenon [5].

3. Ammunition storage countermeasures
At present, the West and South China Sea islands and reefs mainly use ground storage for ammunition storage. It is important to pay attention to the invasion of ammunition storage in the reef environment, such as humidity, sun exposure and salt spray. These factors will affect the accuracy and safety of ammunition firing and may also cause additional wear and tear on weapons. According to the characteristics of ground ammunition storage, the following three measures are proposed.

3.1. Improve ammunition storage environment
First, we will increase environmental monitoring equipment. Mainly environmental climate observation measurement equipment will be installed in a technical area, not only for the weather conditions of the observation records of the basic data such as temperature and humidity, air pressure, salt fog index, chemical gas concentration data, the administrator around the warehouse itself should also be measured. According to the results of dynamic measurement data, reasonable ventilation time, duration, frequency should be confirmed.

Second, we will improve the surrounding natural environment. Through planting trees and grass, greening the environment and shading, to improve the ambient temperature of the warehouse and the ability of water storage and moisture retention. At the same time can block the wind and rain, weaken the direct wind to the warehouse, reducing the rapid spread of harmful gases in the air.

3.2. Strengthening the construction of warehouse conditions
It is to strengthen the ability of storehouse heat insulation. Building a light colour and strong reflection awning outside the doors and windows, to keep out the sun, and reduce the absorption of solar radiant
heat of the warehouse doors and windows, eliminate the deformation caused by long-term exposure, strengthen the maintenance of doors and windows, ventilation holes to improve the overall tightness of the warehouse.

The second is to improve the storage moisture-proof capacity. Doing the waterproof treatment of the storeroom roof waterproof layer and the paint outside the wall to prevent the rain water leakage and reduce the water absorption of the wall when it rains. For the stack position of the warehouse, it is regularly treated with drying and moisture-proof. For the seriously deformed and cracked pillow wood, it should be replaced in time, and the moisture content should be reasonably adjusted to keep it in good technical condition. Ensure that all storeroom is equipped with a cooling type explosion-proof dehumidifier and installed at the door of the storeroom air curtain machine. When entering and exiting the storeroom, the inner and outer temperature and humidity of the storeroom are isolated, so that the manager can reasonably use mechanical equipment to adjust the storeroom temperature and humidity.

3.3. Strictly implement the service rules and regulations

Ammunition storage should strictly implement checking, and if there is any problem, it must be carefully solved.

First, the storage environment inspection should be strengthened, and the weather information should be focused. The temperature and humidity of the storage environment should be controlled by means of ventilation and dehumidification, sealing and moisture isolation, and auxiliary moisture absorption. When ammunition is stored in normal time, it should not be close to high-power equipment. The packing drum shall be inspected regularly for tightness, and the inspection shall be conducted with a special seal ability detector. If sealing is found to be poor, an air-filled nitrogen cylinder shall be immediately used to dehumidify the container.

Second, when using the ammunition, it is strictly prohibited to put it in the place where it is exposed to direct sunlight, to avoid the aging of the photoelectric devices caused by strong ultraviolet rays.

4. Conclusion

Based on the analysis and research of the problems existing in the ammunition storage in the island environment, it is concluded that the temperature and humidity and salt spray corrosion are the most important and direct causes of the ammunition performance degradation in the storage process. Therefore, the ammunition warehouse should take reasonable control measures according to the climatic characteristics and its own conditions, adjust measures to local conditions and improve the reliability of ammunition storage. Practice has shown that the storage of ammunition on islands and reefs needs to improve the storage environment, strengthen the construction of warehouses and implement rules and regulations, so as to ensure the quality of ammunition stored on islands and reefs.

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