Usability Design for Expired and Failure Explosive through Sloping and Molding Methods with FAST dan HIRADC Perspective

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Abstract

Explosives come from natural resources, which were initially just ordinary materials or compounds that humans did not yet know the elements, functions, and effects of. With time, humans conducted research when they saw the reactions arising from natural chemical reduction's effects. This research developed as a refinement of explosive products from time to time according to the functions and benefits for the benefit of the development of a region or country. International crime has become a threat to countries around the world. The development of technology and the flow of information resulted in a new order of life in various dimensions. The circulation of weapons or conventional explosives that weapons manufacturers have made is in great demand by many countries, including the Indonesian nation, as a tool used and used by the Indonesian army to maintain security and maintain the sovereignty of the Unitary State of the Republic of Indonesia.

Adopting these problems, further research can be carried out on expired/failed explosives to be reused for their functions. The extermination that has been carried out so far poses a risk to the environment and living things. Explaining explosives using the sloping and molding method designed with FAST and HIRADC is expected to provide a solution to minimize risks to the environment and living creatures.

Keywords: sloping, molding, fast, hiradc

1. Introduction

Conventional weapons are weapons of mass destruction [1], resulting in mass damage and death, such as nuclear, biological, and chemical weapons—one of those conventional weapons that are the most dangerous in warfare and conflict [2]. The impact of deploying conventional weapons began to be felt and was very troubling after the war and conflict occurred. This is due to the conversion of land in former war areas, which are often converted by civil society into new settlements [3]. As a result of the remaining explosives deliberately left by the army in the past, many findings of explosives or weapons are still active and can cause explosive reactions, if not done carefully, have been reported by the public to the relevant parties to evacuate the findings [4].

Factors that cause transnational crime activities to be rampant include the development of globalization, human movement or migration, as well as the rapid development of technology, information, communication, and transportation, as well as unstable economic and political conditions that can also be a factor in the occurrence of transnational crimes [5]. Crime grows and develops in rhythm with the advancement of information technology and international transportation. All three crimes are caused by the rapidly developing social, political, economic, defense, security, and technological conditions in various countries as well as the domestic and foreign policies of the country that is the target of this crime [6]. With the frequent occurrence of transnational crimes, each country cooperates with other countries.

To overcome crime, transnational is because transnational crime involves not only one country but more than one country with different rules and regulations in handling a transnational crime case. This activity also requires close cooperation between organizations such as police, customs, border protection agencies, and regulatory services [7]. The circulation of conventional weapons or explosives that weapons manufacturers have made are in great demand by many countries, including the Indonesian nation, as a tool used and used by the Indonesian National Army to maintain security and maintain the sovereign territory of the Unitary State of the Republic of Indonesia [8].

In the strategic weapons used, there will be an expired or expired phase as a form of optimization of the functions and uses that have been made, there has not been any damage to those that cannot be used as a solution used today, namely by blasting, embalming, disposal in the open sea, and dissolution with chemical compounds, from the solution, carried out not a few negative impacts or losses both for the environment in which the destruction is carried out and personal, adopting from the problem can be done Further research into weapons or explosives that have been damaged or expired to be reused for their functions [9].

The purpose of this study was to decompose unusably and used explosives caused by technical and non-technical factors so that using the method studied made it easier to reuse explosives that previously could not be used to be used without changing the function of the explosives. In comparison, keeping the FAST design in mind (*Function Analysis System Technique*) and consider *Hazard Identification Risk Assessment and Determining Control* (HIRADC) as a form of risk assessment or hazard identification that aims to determine the application of risk management, risk control, and aspects of Field Work Health and Safety [10].

2. Methodology

In this research related to the processing of explosives, several scientific steps can be made as follows:

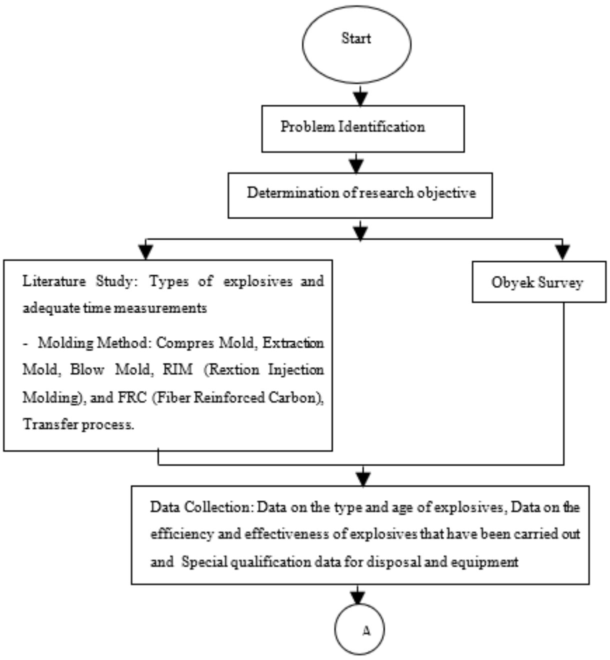

Fig. 1 Flow the research process

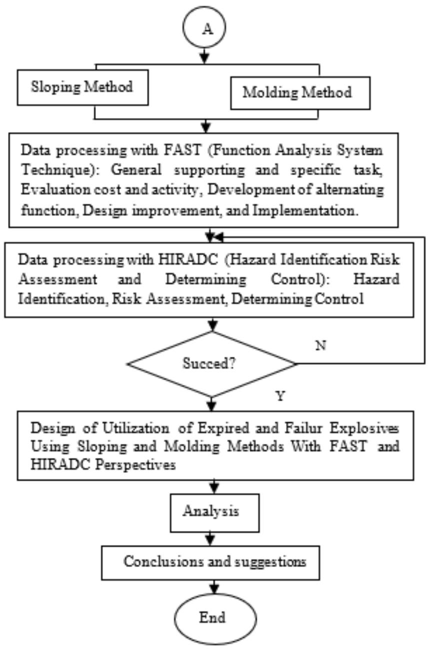

Fig. 1 Flow the research process (continues)

Implementation of the destruction of explosives/ammunition: Several methods are used, including blasting, disposal, dissolution, and distribution. From the implementation of the disposal method that has been carried out, some factors have adversely affected the environmental impact, high costs, and the space needed is very wide. The method of destruction of ammunition/explosives can be described as follows :

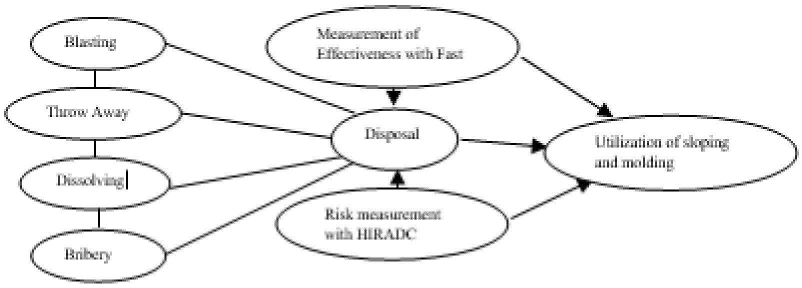

Fig. 2. Research Thinking Framework

Destruction by the blasting method is carried out by detonating in a large, open area. In addition, the result will be destroyed and will not result in harmful effects from the storage carried out so far will also be destroyed and safe. Still, side effects will occur if the conditions of destruction with this method are not carried out carefully and carefully considered. Extermination by the method of disposal Indonesia has determined the sea area as a disposal zone for weapons/explosives, one of which is the Bali Strait waters which have a depth of more than 200 meters so that it is suitable for use as a dumping ground for ammunition/explosives There are also weapons/explosives destroyed by disposal because this ammunition is very sensitive.

Destruction by the method of dissolution can be one of the ammunition removal methods that is rarely carried out because the effect of losses caused is very high. The costs spent on this destruction are considerable, so this method is a reference for the last solution if the volume written off is minimal. In the dissolution method, the chemicals used are acetone. Destruction by the method of culling the culling step is part of one of the steps in culling as an alternative to a small volume other than easy, fast, not spend much funds, and effective by burying explosives at a depth of ± 5-7 meters, which is then before landfilling the soil is carried out by applying raw salt followed by stockpiling.

Procedurally this method is one of the destruction solutions, but returning over a long period will still have a detrimental impact on the environment. Annihilation by sloping and molding methods of the methods of destruction of ammunition/explosives carried out so far is a way or alternative to eliminate a weapon/explosive that does not work/is damaged or experiences an expiration period which, if done storage for an extended period / cannot be determined can have risks that adversely affect both the personnel/crews of the storage warehouse and the material/warehouse as a storage area if the destruction is not carried out immediately, From the destruction methods described above it can be concluded that it is in the destruction of explosives.

What can be done for now is relatively safe, but the impact that will be caused and accepted in the long term will have a high risk both on the environment and humans. Therefore researchers are trying to use explosives that have entered the expired and failure period. This is done to reduce the risk of explosive destruction. The classification process in determining the treatment of ammunition must be carried out because each explosive has different systems and characteristics, so it must understand and know before carrying out destruction to avoid danger to both personnel and material, considering the nature of the ammunition is very sensitive and vulnerable to friction, impact, temperature, and humidity.

Measurement of effectiveness with Function Analysis System Technique (FAST) The implementation of the use of disposed of explosives needs to be measured for effectiveness in the application of analysis to the applied engineering function system because before the research is carried out, there needs to be activated in identifying functions, classifying functions, and function development Function identification includes the simplicity of the structure of thinking as in the reusable activities of explosives when they can be used in reprocessing why not do as long as they can understand and understand the characteristics and systems of the weapons/explosives used as objects.

3. RESULTS AND DISCUSSION

The explosives data that will be carried out by the sloping process are KB M 26 horn mines /anchors with a service life of 10 years, of some explosives that will be disposed of include ammunition that enters the expired period and experiences failure.

3.1 Sloping Method

Furthermore, the sloping method has a primary meaning of the word slope, which means slope. This is a basic technique when carrying out activities in removing explosives from ammunition by placing ammunition at an inclination angle of 30º Up to 45º. It is intended to make removing the contents of explosives from the ammunition easier. Before carrying out sloping activities, it must be ensured that the ammunition is safe after disassembly. When the position of the ammunition is at a predetermined angle, the sloping activity is ready to be carried out.

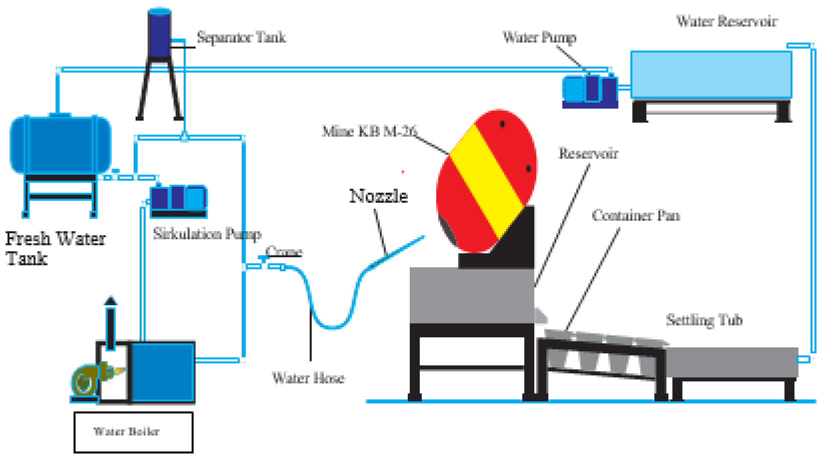

Fig. 3. Sloping Process

Image captions along with specifications related to the sloping method.

1. The freshwater tank is used for the process of removing the contents of the hand racks to be sloping with a specification of 1.5 M in length, 80 cm in width with a diameter of 0.8 meters and a height of 100 meters, with the calculation:
   $$½ \text{ X } d \text{ X } t = \pi r^2 \text{ X } (½) \text{ X } t = 22/7 \text{ X } (0{,}4)^2 \text{ X } ½ \text{ X } 1$$
   $$= 3{,}14 \text{ X } 0{,}16 \text{ X } 0{,}5 \text{ X } 1 = 0{,}251 \text{ m}^3 = 0{,}251 \text{ X } 10^3$$
   So that it can hold water with a volume of water 251 dm^3
2. The separator tank is used to reduce the vapor pressure on the pipe because when the heat is generated from the water boiler engine, the hotter the pressure is so that the installed pipe does not experience high pressure so that the pipe will break, with specifications of 1 M in length, 60 cm in width with a diameter of 0.6 meters and a height of 100 meters with calculations:
   $$½ \text{ X } d \text{ X } t = \pi r^2 \text{ X } (½) \text{ X } t = 22/7 \text{ X } (0{,}3)^2 \text{ X } ½ \text{ X } 1$$
   $$= 3{,}14 \text{ X } 0{,}9 \text{ X } 0{,}5 \text{ X } 1 = 1{,}413 \text{ m}^3 = 1{,}413 \text{ X } 10^3$$
   so that the steam capacity in the tank can hold the volume of water 141 m^3
3. The fuel tank is used for fuel to support the process of working a water boiler in the sloping process with a specification of 1 M in length, 100 meters in width with a diameter of 100 meters and a height of 100 meters, with the calculation:
   $$½ \text{ X } d \text{ X } t = \pi r^2 \text{ X } (½) \text{ X } t = 22/7 \text{ X } (0{,}5)^2 \text{ X } ½ \text{ X } 1$$
   $$= 3{,}14 \text{ X } 0{,}25 \text{ X } 0{,}5 \text{ X } 1 = 0{,}3925 \text{ m}^3 = 0{,}3925 \text{ X } 10^3$$
   So that it can accommodate fuel in the form of diesel with a volume of 392,5 Liter
4. The water tank is used to hold hot water that has been heated with a water boiler that functions to be sprayed to release explosive contents in the sloping process with specifications of 1 M in length, 100 meters in width with a diameter of 100 meters and a height of 100 meters, with calculations:
   $$½ \text{ X } d \text{ X } t = \pi r^2 \text{ X } (½) \text{ X } t = 22/7 \text{ X } (0{,}5)^2 \text{ X } ½ \text{ X } 1$$
   $$= 3{,}14 \text{ X } 0{,}25 \text{ X } 0{,}5 \text{ X } 1 = 0{,}3925 \text{ m}^3 = 0{,}3925 \text{ X } 10^3$$
   So that it can hold hot water for a volume of 393 dm^3

3.2 Grading Method

After carrying out the sloping process, the next step is grading; this step is carried out after pouring explosives from the sloping on the reservoir and storage pan, and settling tub; the following process is to dry for 3 X 24 hours to minimize the water content contained in explosives. This is done to facilitate the implementation of the dry explosives grinding process, breaking with tools made of materials that cannot cause sparks, such as wood, stone, and the like. After the sloping results are broken down, the next step is to carry out the grinding process. This process is carried out using select eyes made of brass because the tool must avoid friction that can cause sparks, and this grinding process is carried out to obtain an explosive texture in the form of powder. After the grinding process is declared complete, the next step is to carry out the melting process.

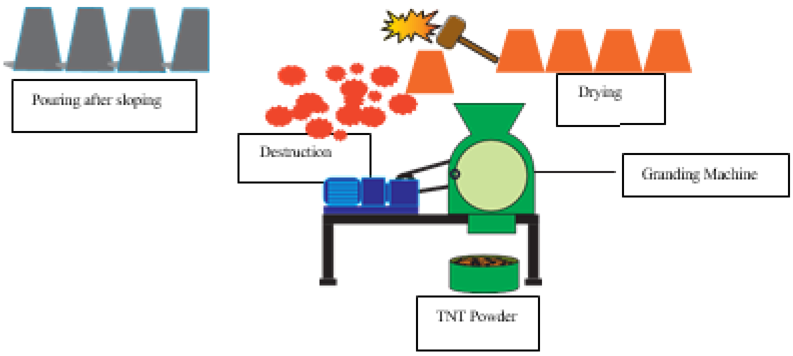

Fig. 4. Granding Process

1. In the pouring process with a specification of 1 M in length, 100 meters in width with a height of 1 meter, and a diameter of 0.4 meters, with the calculation:

$$½ \text{ X d X t} = \pi r^2 \text{ X } (½) \text{ X t} = 22/7 \text{ X } (0,2)^2 \text{ X } ½ \text{ X } 1$$
$$= 3,14 \text{ X } 0,4 \text{ X } 0,5 \text{ X } 1 = 0,628 \text{ m}^3 = 0,628 \text{ X } 10^3$$

So that the volume contained 393 dm^3

2. In the drying process with a specification of 0.9 meters in length, 0.8 meters in width, a height of 1 meter, and a diameter of 0.3 meters, with calculations

$$½ \text{ X d X t} = \pi r^2 \text{ X } (½) \text{ X t} = 22/7 \text{ X } (0,2)^2 \text{ X } ½ \text{ X } 1$$
$$= 3,14 \text{ X } 0,15 \text{ X } 0,5 \text{ X } 1 = 0,2355 \text{ m}^3 = 0,2355 \text{ X } 10^3$$

so that the volume contained 236 dm^3

3.3 Melting method

After the grinding process is declared complete, the next step is to carry out the melting process at the stage of the melting process; the same thing is done by warming up when sloping by heating the water boiler system until it reaches a boiling point of 100ºC.

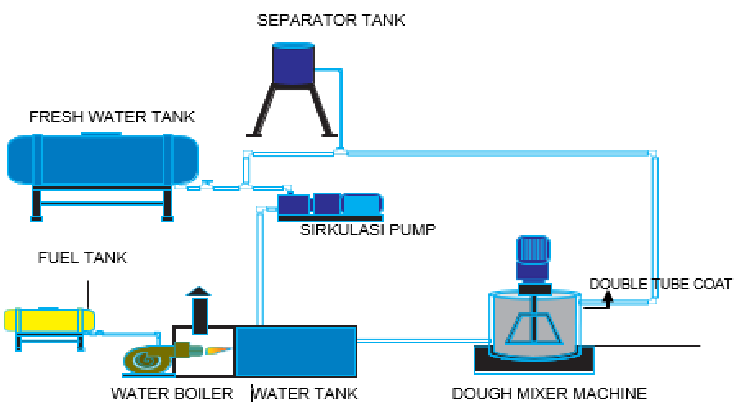

Fig. 5 Mealting Process

Image caption and specifications related to the melting method: the initial process is the same as the sloping process. The difference is the dough mixer machine is a coat double tube heater that changes the TNT powder, and it becomes melted, making it easier to do molding. After circulating the hot water, the next step is to insert the grinding explosive powder into the double mantle tube, then start the dough mixer machine with a rotation speed of 60 rpm until the powder is entirely in melting condition until reaches a texture that makes it easier to carry out the molding process.

3.4 Molding Method

After the molding process, the next step is printing, and three mold models are designed with different uses. In the molding method, it is necessary to prepare a mold or molding to form explosives according to the shape and size that has been designed. This molding process is carried out with the provision that in each filling on the mold, detail is always added as a booster to strengthen when detonating with a weight of 20% of the volume size of the mold. With the molding method: the initial process is the same as the sloping, grinding, and melting process, which is continued in the printing or molding process. The material used for molding is silicon rubber with a rubber elasticity of 198 lbs and copper iron with a metal type period of 4.7 newtons /m.

This is done to facilitate removal when it is dry. When the explosive results have been printed and are ready to be removed from the mold, the next step is to carry out drilling 2 cm deep at the midpoint of the diameter of the cross-section of the mold it is intended for the installation of the detonator when it is about to detonate. At the stage of the melting process, the same thing is done heating when sloping by heating the water boiler system until it reaches a boiling point of 100ºC. The initial process is the same as the sloping process. The difference is dough mixer machine is a coat double tube heater that converts TNT powder into melt, making it easier to mold.

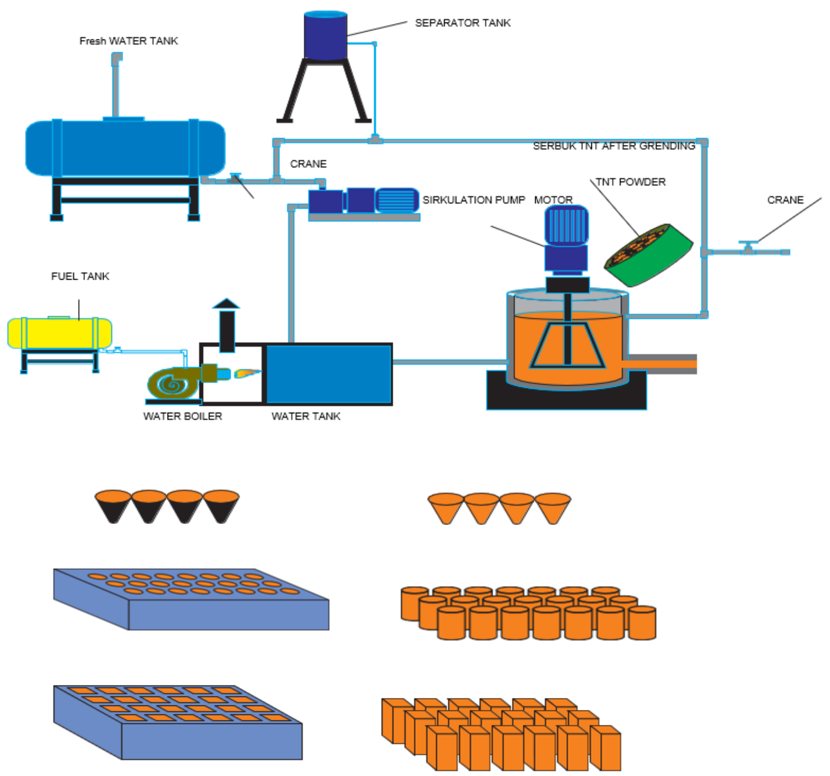

Fig. 6 Drawings of the molding technique process to the print out

Image captions and specifications related to the molding method: the initial process is the same as the sloping, grinding, and melting process, which is continued in the molding process. The material used for molding is silicon rubber material with a rubber elasticity of 198 lbs and copper iron with a metal type period of 4.7 newtons / m strength; this is done to facilitate release when It's dry. When the explosive results have been printed and are ready to be removed from the mold, the next step is to carry out drilling 2 cm deep at the midpoint of the diameter of the cross-section of the mold it is intended for the installation of the detonator when it is about to detonate. In the research on the use of explosives, for now, only 3 model designs can be carried out, including:

1. Block model design

The design of this beam model is intended when blasting the expected result. The purpose of forming the beam is usually used to break the chain, break the wall, and stretch the cliff. When carrying out the molding, it is necessary to add a booster in the form of a tetryl weighing 20% weight of TNT, which is printed as a reinforcement to explode triggered by a detonator.

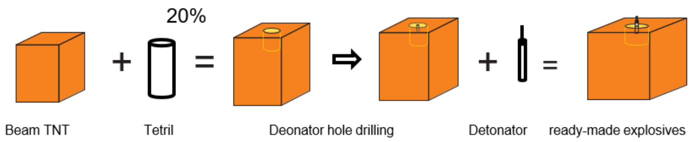

Fig. 7. Beam Model

The description of the picture above has several stages as follows:

a. Beams TNT that have undergone a molding process.
b. The addition of tetryl as a booster or booster supports the detonator's detonation.
c. Results after tetryl being in a TNT block.
d. Drilling holes carry out the TNT beam to lay the detonator's position.
e. BeamTNT, along with a detonator.

2. Cone Model Design

The following design is the design of the cone model, and this cone-like model is intended when to blast the expected results when an explosion occurs. It can make a hole in the plain of the specified object so that the expected results are appropriate. When carrying out the molding, it is necessary to add a booster in the form of a tetryl weighing 20% weight of TNT, which is printed as a reinforcement to explode triggered by a detonator.

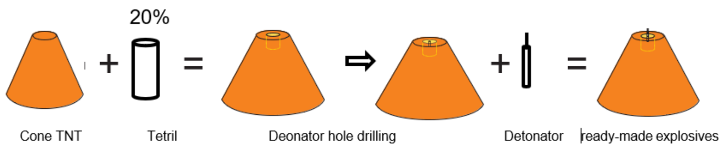

Fig. 8. Cone Model

The description of the picture above has several stages as follows:

a. Cone TNT beams that have undergone a molding process.
b. The addition of tetryl as a booster or booster supports the detonator's detonation.
c. Results after tetryl being in a cone TNT.
d. On the cone, TNT is carried out by drilling holes to lay the detonator's position.
e. Cone TNT along with detonator.

3. Cylinder Model Design

The following design, namely the cylinder model, this cylindrical model aims to break up objects that have rock contours, such as mines, mountains, and the like. It is expected that when the explosive results can destroy and split the most significant part of an object in question. When carrying out molding, it is necessary to add a booster in the form of a tetryl weighing 20% weight of TNT, which is printed as a reinforcement to explode triggered by a detonator.

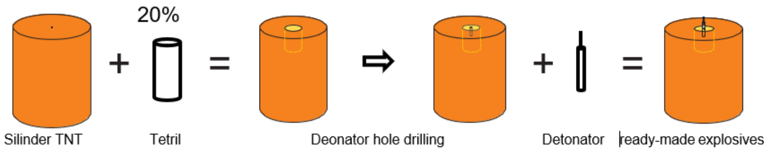

Fig. 9. Cylinder Model

The description of the picture above has several stages as follows:

a. Cylinder TNT has undergone a molding process.
b. The addition of tetryl as a booster or booster supports the detonator's detonation.
c. Results after tetryl being in a cylinder TNT.
d. On the cylinder, TNT is carried out by drilling holes to lay the detonator's position.
e. Cylinder TNT along with detonator.

3.5 Fast Method (Function Analysis System Technique)

1. Operating Process Chart (OPC) Sloping & Molding

In the implementation of the use of explosives, the FAST steps that must be carried out are *General supporting and specific task*s, including Coordinates with PIC (personnel in charge) warehouse and quality control personnel to retrieve ammunition data and ensure ammunition is carried out disposal then preparation of personnel who are cooperating to carry out ammunition disassembly using *special tools* in carrying out disassembly. Prepare means of transportation such as forklift to transport mines from the warehouse to the place of disassembly and trucks to transport ammunition to the sloping workshop. We are preparing fuel oil for the following sloping process, carrying out the sloping process Continued to carry out the grending process. Ended the molding process.

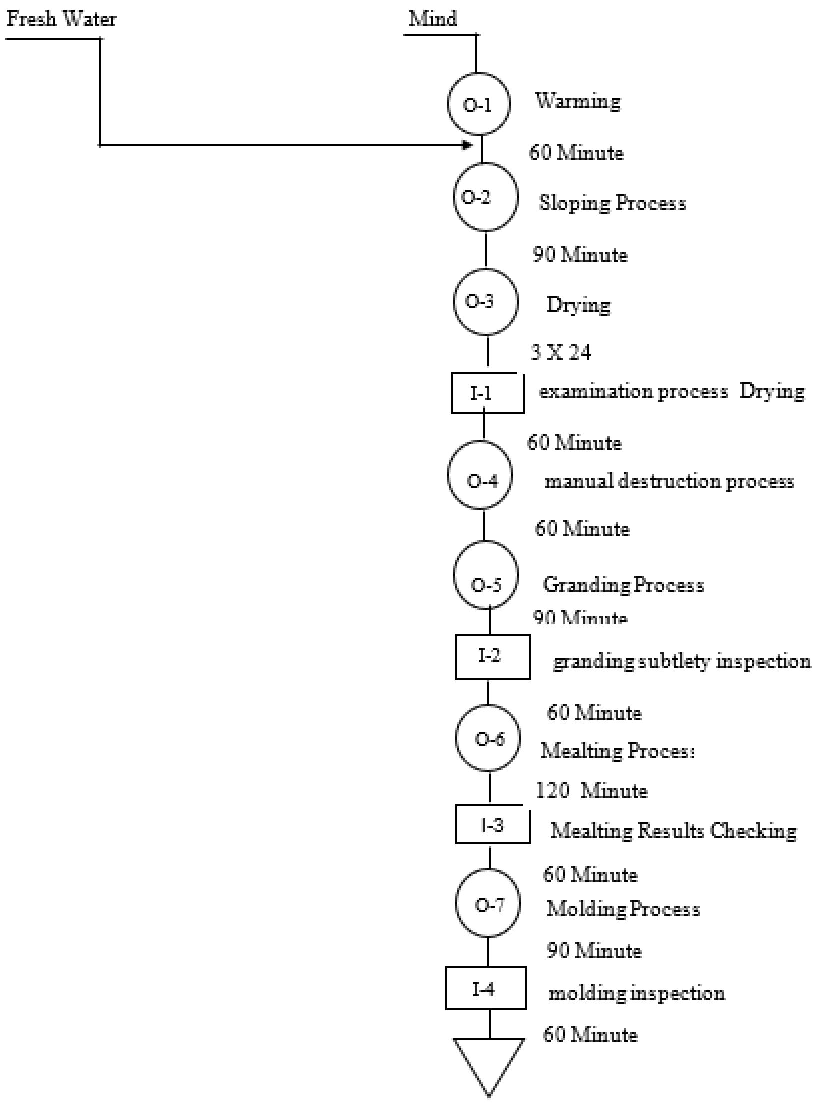

Fig. 10 *OPC Sloping & Molding*

Process	Sum	Time
○	7	4.830
▭	4	240
▽	1	-
⧇	0	-

Fig. 11 OPC Summary

2. Identification of Explosive Utilization

The use of explosives is carried out not to change the essential function of ammunition but to develop its function alternately in the sense that explosives that originally only functioned to explode in the sea can be transferred functions can be detonated on land by going through a process that has been designed function. Design improvements were made to expand the model in the use of explosives in various ways but with the same functions and benefits as well as maximum results. In implementing explosives, the design is essential considering that the risks associated with explosives are very high to maintain safe conditions for both personnel and the environment in their use. By continuing to carry out the procedures that have been made and established to minimize the risk of work accidents in its implementation.

3. Identify the Basic Functions of Explosives

The essential function of explosives contained in ammunition can be developed its function alternately in the sense that explosives that initially only functioned to explode in the sea can be transferred functions that can be carried out detonating on land by going through a process that has been designed to function, as a weapon that functions in the sea that has the reliability and range of a strong detonation in waters it is necessary to have special treatment in maintenance and maintenance and determining the service life. When it enters the service life, this marine gun will be converted into functions with special treatment in maintenance and determining the service life. When it enters the service life, this marine weapon will be converted into function in the use that was originally used on the sea to be used on land.

4. Explosive Conversion Design

Implementing the conversion that has been carried out gets results designed for the same functions and benefits that distinguish the blasting medium. The utilization of explosives requires development in design improvements. This is done to multiply the reference of models with the same functions and benefits to the maximum. The use of explosives is implemented when there are explosives that have entered the end of their use. It is necessary to use them. The function that has only been detonated so far while the function can still be used properly so that utilization is essential for the efficiency of explosives so that in its implementation, the process of utilizing explosives has been carried out.

It is necessary to have an evaluation to determine that what has been planned, designed, and implemented goes according to what has been prepared for maximum and optimal results. The use of explosives is intended to reduce the risk of harm caused by storing deprecated explosives and reduce the impact of damage caused by the use carried out.

3.6 Hiiradc (Hazard Identification Risk Assessment and Determining Control)

The HIRADC steps taken can be described as follows: Hazard identification is a potential hazard in a process carried out to recognize all situations or events that have the potential to cause work accidents and occupational diseases that may arise in the workplace So that preventive and control measures are immediately taken so as not to cause losses to institutions and workers. The next step is to perform risk assessment which is the process of evaluating the high-low level of risk that arises by taking into account the results of estimating the level of frequency and severity so that later it is classified into the level of risk of no danger, low danger, medium danger.

Serious hazard or danger is so high that the results of the identification of potential hazards and this risk assessment indicate that in these parts of the ammunition storage warehouse, there is a potential danger that can cause work accidents and cause disease as a result of employment. The next activity is *determining control*. This is done to control hazards and risks in a work situation by considering the hierarchy of elimination control, substitution, isolation, engineering control, marking or warning administrative control, and PPE (*Personal Protective Equipment*) as personal protective equipment so that in planning the use of explosives dispose of is obliged to carry out and comply with the procedures and provisions stipulated.

The hired method described above can be seen in determining control to reduce the risk of work accidents. It can be analyzed that the hazards contained in the ammunition storage warehouse are jobs that have a high level of risk, where any risk posed or caused in the event of an accident or accident, whether intentional or not, will result in fatality and significant losses for both personal, material as well as the surrounding environment. In research, utilization can be compared to the level of effectiveness and efficiency closely related to the concept of productivity by comparing the outputs produced against the inputs used in achieving predetermined goals or targets.

The more significant the contribution of output to achieving goals, the more effective the program or activity that has been planned. The results of the utilization that have been carried out can be compared to the effectiveness and efficiency between disposal and the use of explosives. The destruction of explosives/disposal will involve many elements of units co-opted in the implementation of disposal. The results carried out in the implementation of the destruction are successful by destroying/removing explosives without any residue, but please note that the implementation of the destruction will require *a cost* that is not small. The effect caused after the implementation of destruction is very high post-disposal, in the form of losses, both landing on environmental impacts.

The condition of the land that is used as the object of destruction will be barren and challenging to replant and cannot be decomposed because the land surface has been polluted. At the same time, for living things around humans, it is possible to experience losses such as damage to the dwelling due to vibrations produced from the disposal. Sound effects and explosion vibrations cause pain to the surrounding community. If the destruction is carried out at sea, pollution to the marine ecosystem will be threatened even though the state has determined which area to dump explosives for the explosives dump. Still, no one can predict the reaction if the explosives are sunk into the sea.

In the process of implementing land and sea transportation to transport high-risk explosives both for the crew and side by side during the transportation trip, considering the temperature-sensitive nature of the explosives, impact pressure, and electromagnetic waves, as well as factors that can affect the reaction of explosives. Explosives also have lasting properties that will not be destroyed at any time as long as the physical form is still a solid object because the explosive will be wiped out if, in a chemical reaction, it turns into a gas (utilizing a combustion process). The use of explosives can be carried out internally and only involves personnel with the qualifications of content explosives.

The costs and activities carried out and incurred are much more effective and efficient. The utilization results can be used again according to their functions and use, such as military exercises, mines, helping to make access roads by splitting cliffs, etc.

4. Conclusion

Based on the results of research that has been carried out on the Design of Utilization of Expired and Failur Explosives Using the Sloping and Molding method with a FAST and HIRADC perspective, it can be concluded: Any ammunition that has entered the expired period or has suffered damage to the function or body failure disposal or destruction must be carried out as soon as possible in a safe manner to avoid chemical reactions, radiation caused by ammunition and the adverse effects caused by ammunition and the dangers posed can be fatal both for personal and environmental. Only some can be used in the disposal of ammunition because the content of each ammunition and the work system (security) are different/different.

The implementation of the use of explosives requires detailed and accurate supporting components and professional personnel who are competent. It is necessary to carefully analyze the engineering system and the application of disposal implementation to avoid failures in the process of disposal. The method applied to this utilization research is an effort to provide solutions to the problem of destruction or disposal of explosives and environmental pollution. The method used in this utilization to make it easier to carry out disposal or destruction In the implementation of the use of explosives, it must be able to calculate the anticipation in identifying hazards and can assess the level of risk of a current job so that it will get an idea of which work priorities can be controlled by the danger first.

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