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Use of Explosives: Classification and Regulation

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A B S T R A C T

Of the many qualifications of explosives, for some reason allowed for use by civilians. This study aims to analyze the classification and regulation of the use of explosives, using the literature study method. As a result, there are special rules from several institutions for the use of explosives in various fields.

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INTRODUCTION

Explosives are substances that undergo rapid and violent decomposition, resulting in the release of a large amount of energy as part of the process. These materials are essential in many fields, including warfare, mining, and construction, among others. The formulation and behavior of explosives relies on basic principles, where the mechanism of explosion involves complex molecular and electronic structural transformations. In-depth examination of explosives has important significance in forensic investigations, airport security protocols, and the determination of their exact chemical composition.

Given the thermal instability exhibited by most explosives, the detection and characterization of residual explosives requires the utilization of highly sensitive analytical methodologies. In addition, it should be noted that the production and utilization of explosives has witnessed a substantial increase during periods of conflict, underscoring the multifaceted role that explosives play beyond their destructive applications.

Different types of explosives differ in their chemical makeup and characteristics, with primary explosives such as mercury fulminate and lead styphnate, and secondary explosives such as nitroglycerin and TNT, exhibiting different chemical properties. The chemical reactions that occur in explosives produce a rapid generation of heat and gases, which ultimately leads to the creation of strong pressure fractions, thus distinguishing them from non-explosive materials. The classification of explosives can be done based on their specific chemical composition, which proves valuable in the analytical identification process.

The properties of explosives, such as density, enthalpy of formation, and speed of explosion, can vary significantly across various structural isomers containing elements such as carbon, hydrogen, nitrogen, and oxygen, thus influencing their overall behavior. By utilizing techniques such as mass spectrometry to analyze explosives such as TNT and RDX, differences in ionization patterns can be observed, which in turn helps in the detection and identification of these substances.

Explosives have a high degree of danger when used improperly due to their highly reactive nature to certain triggers such as heat, pressure, friction, or the initial explosion. When this trigger encounters an explosive, a rapid exothermic chemical reaction occurs, leading to rapid generation of gas, heat, and high pressure over a short period of time. As a result, the resulting explosion can generate great destruction and danger, bringing fatal potential to human life and the surrounding ecosystem. In addition, explosives have the capacity to inflict extensive and catastrophic structural damage, and can be exploited for illicit or terrorist activities, thus presenting a danger to the overall safety of the population. Therefore, it is imperative that the utilization, storage, and management of explosives is carried out with the utmost care and adherence to established safety protocols to reduce the likelihood of accidents and misuse that could endanger many people.

Given the catastrophic impact that may arise from improper handling of explosives, strict measures should be implemented to uphold public safety and

prevent potential disasters caused by their misuse. The complex nature of explosives requires a careful approach to their regulation and control, encompassing strict guidelines and strict enforcement mechanisms to prevent irregularities that could lead to devastating outcomes. Efforts to promote awareness and education regarding the safe management of explosives are essential in fostering a culture of responsibility and vigilance among the individuals involved in handling them, thus fostering a safe environment and preventing the grave harm associated with their misuse.

LITERATURE REVIEW

Chemical Classification of Explosives. Critical Reviews in Analytical Chemistry

Explosives can be classified by their chemical composition, providing a more relevant approach to chemical determination compared to speed or application-based classification commonly used in military/legal fields. This classification seeks to combine the dispersed chemical classifications of explosives found in the literature into a unique general classification, which may be useful to any researcher dealing with the identification of the analytical chemistry of explosives.

A Method and System For Explosive Classification and Identification

Methods and systems for classification and identification of explosives are provided to address the problem that classification and classification for each compound in explosion detection cannot be achieved, where the rate of change curve of the explosive fluorescence signal is divided into the degrading stage and the recovery stage, and the extracted characteristics are paired with a number of sequential models classifying the characteristics of the sample. This paper proposes a method of using fluorescence signal characteristics to classify and identify explosives, without specifying classification based on chemical content.

METHODOLOGY

In this article, the author uses the literature study method. The literature study research approach involves the systematic collection, analysis, and presentation of pre-existing information sourced from a variety of scholarly outlets, including books, articles, reports, and other forms of documentation. The fundamental purpose of conducting a literature study is to ascertain, compile, and present information related to the topic under investigation, all without the need for experimental procedures or direct observation. It is a methodological strategy that relies on the synthesis and interpretation of existing knowledge to advance understanding in the research domain.

RESEARCH RESULTS

In the process of initiating a research effort in literature, the main step involves identifying a specific problem or topic that one wants to explore and deliberate. This critical step serves as the foundation of all research efforts in literature. Once the problem or topic has been described, the next step involves starting a search to unearth information that is relevant and relevant to the

identified subject matter. This search for information can lead researchers to traverse a myriad of sources such as books, articles, journals, and mass media platforms, to gather a comprehensive understanding of the chosen topic.

In addition, delving into the domain of literary studies requires a careful review of theories related to the topic or difficulty under investigation. This effort helps in explaining the contextual background and theoretical framework underlying the research effort. In addition, for scientific work to achieve academic rigor, it is essential to build a strong theoretical foundation that includes the basic concepts described in the study. This is achieved through careful curation and analysis of relevant library sources that contribute to the theoretical foundation of this research.

After identifying the required type of library resources, the next step involves engaging in a comprehensive examination and analysis of the selected library materials. This in-depth scrutiny is indispensable for understanding the prominent and relevant information embedded in the selected resources. Following the assimilation of related literature, the next phase entails conducting a rigorous review of the information collected. This phase entails a complex process of parsing, analyzing, and interpreting data to derive conclusions and related findings that contribute to the research narrative.

Ultimately, the peak phase of literature study revolves around presenting research findings in a written format. These presentations may include direct quotes, paraphrases, or summaries taken from the library sources being analyzed. It is imperative that all sources used in research efforts are recognized and listed in the bibliography to uphold academic integrity and reduce the risk of unintentional plagiarism.

DISCUSSION

Explosives can be categorized according to a variety of criteria, with one of the most common methods being classification based on chemical composition. This method involves consolidating dispersed classification systems into more general classification schemes that aid in the identification of the analytical chemistry of explosives. Another classification method focuses on the thermal acceleration aging test, which assigns explosives to one of four classes based on the main material affecting the test result. In addition, techniques for classifying and identifying explosives use fluorescence signal characteristics to ascertain the specific type of explosive detected, thus streamlining the overall classification process.

In the field of safety inspection, explosives are classified through the extraction of features from radiation data in conjunction with the utilization of X-ray transmission technology. This process led to the establishment of standards for categorizing solid explosives based on signals detected during inspections. These diverse classification methods play different roles in different aspects of explosives analysis and identification, contributing to a comprehensive understanding of these hazardous materials.

Explosives can be classified based on their characteristics and usefulness into several main types. Here is the general classification of explosives:

1. High Explosives (PE): This type of explosive has a high detonation rate, resulting in a very powerful and fast explosion. They are used in applications that require large explosions and damaging effects, such as in the military or mining.
2. Low Explosives (LE): These explosives have a slower detonation rate than high explosives. They are commonly used in applications that require constant pressure or thrust, such as in fireworks or gun propellant.
3. Sensitized Explosives: This type of explosive is a mixture of high and low explosives designed to provide a more sensitive reaction to stimuli. They are used in applications that require a certain precision and stability.
4. Primary Explosives: These explosives are highly sensitive and are used as initiations to detonate other, less sensitive explosives.
5. Secondary Explosives: These are more stable explosives and require initiation of primary explosives to detonate.

Explosives can be categorized based on their chemical content through various methods. One common approach is the classification of explosives according to the presence of certain key ingredients that play an important role in aging tests. This method resulted in the identification of four different classes of explosives: those containing nitrates, those containing low-melting point substances, those containing volatile substances, and those lacking essential components. Alternative classification systems focus on the chemical makeup of explosives by consolidating diverse chemical classifications into a comprehensive framework.

This method proved invaluable to researchers involved in the identification of the analytical chemistry of explosives. For example, primary explosives such as mercury fulinterest and secondary explosives such as TNT, RDX, and PETN represent examples of explosives with varying chemical compositions. Using this classification system, a deeper understanding of the characteristics and reactions of different types of explosives can be achieved based on their unique chemical composition. This knowledge is instrumental in improving our understanding of the nature and character exhibited by explosives in various scenarios.

The classification of explosives based on the thermal acceleration aging test is part of the procedure for assessing the shelf life and stability of explosives. This process involves the exposure of explosives to artificially increased heat conditions to speed up degradation reactions that occur during storage over long periods of time. The following is a comprehensive explanation of the classification of explosives based on the thermal acceleration aging test:

1. Thermal Stability: Explosives are classified based on how stable they are to heat. The thermal acceleration aging test shows how quickly explosives will degrade or react when exposed to heat. Stable explosives will retain their composition and properties longer than less stable ones.

2. Shelf Life: This classification is based on the estimated time during which explosives can still be safely used after thermal aging. Explosives with a longer shelf life are considered better for long-term storage.
3. Sensitivity to Initiation: The thermal acceleration aging test can also reveal changes in the sensitivity of explosives to initiation. Explosives that become more sensitive after thermal aging are considered riskier and require special handling.
4. Chemical Composition: This classification deals with changes in the chemical composition of explosives after thermal aging. Some explosives may undergo decomposition or chemical changes that result in less stable or more sensitive products.
5. Physical Characteristics: The thermal acceleration aging test also affects physical characteristics such as crystallinity, density, and texture. Explosives that undergo significant physical changes may no longer be suitable for certain applications.
6. Behavior Under Load: This classification evaluates how explosives behave under load after thermal aging, including changes in mechanical strength and elasticity.
7. Degradation Products: During thermal aging, explosives can produce degradation products that can be harmful or affect the effectiveness of explosives. This classification considers the type and quantity of degradation products produced.

The thermal acceleration aging test is an important part of the explosive's quality assurance and safety process. By understanding how explosives will react to hot conditions over a long period of time, manufacturers and users can make more informed decisions about the storage, handling, and use of explosives to ensure their safety and effectiveness.

The classification of explosives based on the characteristics of fluorescence signals is carried out by analyzing the pattern of light emission produced by explosives when excited with a particular light source. Fluorescence is a phenomenon in which a molecule absorbs light energy and then re-emits some of that energy in the form of light with a longer wavelength. The characteristics of fluorescence signals produced by explosives can include several aspects, such as emission spectrum, peak intensity, fluorescence lifetime, and Stokes shift.

Steps in the classification of explosives by fluorescence:

1. Sample Preparation: Explosives must be prepared in an appropriate form in order to be tested. This may involve the creation of a solution or placement of the sample in an unreacted matrix.
2. Excitation: Explosives are excited using a light source of a specific wavelength. These wavelengths are usually in the ultraviolet range or visible light close to ultraviolet.
3. Emission Spectrum Measurement: Once excited, explosives will emit light at different wavelengths. This emission spectrum is measured using a fluorescence spectrophotometer.

4. Data Analysis: Emission spectrum data is analyzed to identify the distinctive features of explosives. These include peak emission wavelengths, relative intensities, and forms of the emission spectrum.
5. Classification: Based on the data obtained, explosives can be classified or categories based on the similarity of fluorescence characteristics. This allows identification and distinction between different types of explosives.
6. Use of Standard Libraries: To improve classification accuracy, measurement results can be compared with databases or standard libraries that contain fluorescence profiles of known explosives.
7. Correlation with Chemical Properties: Often, the fluorescence characteristics of explosives are also correlated with their chemical structure and physicochemical properties. This helps in understanding the mechanism of fluorescence and provides additional information useful for classification.

This classification is particularly useful in forensic and security applications, where rapid detection and identification of explosives is essential. The unique fluorescence characteristics for each explosive allow law enforcement and security technicians to identify hazardous materials quickly and accurately.

Explosives such as Trinitrotoluene (TNT), C4, Semtex, and RDX (Cyclonite) fall into the category of high-power explosives and are usually subject to strict regulations due to their potential involvement in military operations or acts of terrorism. Nevertheless, under certain circumstances, these types of explosives may find legitimate and controlled applications among civilians, such as in activities such as construction, mining operations, and controlled demolition work. TNT, for example, despite its primary association with military objectives, also sees utilization in the civilian sector for tasks such as controlled demolition and mining practices, which necessitate the acquisition of special permits and adherence to strict regulatory protocols.

C4, on the other hand, is rarely used outside the military or law enforcement domain due to its outstanding stability and high potential. Its use by civilians is subject to strict restrictions and constant supervision to ensure safety and prevent unauthorized or illicit activities.

Semtex, like C4, is classified as a powerful plastic explosive typically associated with military operations or terrorist activities. Civil applications are highly restricted and subject to strict controls. The use of Semtex outside of military or official contexts is limited due to its high destructive potential and security concerns. Regulations surrounding the use of Semtex require compliance with certain government protocols, which include obtaining the necessary permits, undergoing appropriate training on safe handling procedures, and adhering to established safety guidelines. The management of Semtex in a civilian environment is essential to prevent accidents, misuse or unauthorized access to these hazardous materials.

RDX, on the other hand, is commonly incorporated into commercial explosive mixes and is used in various industries such as mining and crushing operations. Access to RDX by civilians is usually facilitated through products

containing RDX in approved formulations intended for industrial use. The availability of RDX to non-military entities is subject to strict control and oversight to minimize the risks associated with its powerful explosive properties. The use of regulated RDX in civil applications requires adherence to specific guidelines and precautions to ensure safety and prevent potential hazards.

The utilization of these explosives by civilians must always comply with relevant government regulations to reduce risks and maintain public safety. This entails procuring the necessary licenses, undergoing training to ensure proper handling procedures, and following safety laws and standards to prevent accidents or accidental damage. The sale and distribution of Semtex and RDX in many jurisdictions is closely monitored and restricted to authorized entities to prevent unauthorized use or illicit activities. This regulatory framework around the civilian use of explosives is designed to enforce security measures and prevent potential threats to individuals and communities.

In Indonesia, the use of explosives by civil society is managed by various regulations that emphasize the importance of strict security, supervision and control measures. This regulation covers various aspects relating to the manufacture, distribution, storage, and utilization of explosives to ensure the safe execution of all explosives-related activities in accordance with the law.

One of the main regulations that oversees explosives in Indonesia is Law No. 3 of 2002 on State Defense, which mandates that the use of explosives must be in line with the interests of the nation's defense and security. In addition, Presidential Decree Number 125 of 1999 concerning Explosives establishes a structure to oversee the management of explosives.

The regulation of the Minister of Defense plays an important role in regulating explosives in the country. For example, the Regulation of the Minister of Defense of the Republic of Indonesia No. 7 of 2010 concerning Training and Development of Strategic Industries in the Field of Main Equipment of Weapon Systems and Main Tools of Military Equipment Systems covers explosives among other fields. This regulation regulates the formation and progress of industries related to explosives, which includes technical and administrative elements.

Another related regulation is Government Regulation Number 58 of 2010 concerning Control of Explosives in the Public Interest. This regulation oversees the use of explosives in civil activities such as construction, mining, and other public projects. In this regulation it is stipulated that only authorized business entities are allowed to engage in activities involving explosives.

Entities wishing to utilize explosives must have a valid Trading Business License (SIUP) and Company Registration Certificate (TDP). They are also required to provide a Taxpayer Identification Number (NPWP) and proof of having fulfilled tax obligations for the past three years. In addition, proof of ownership or control of a warehouse that meets the technical requirements for storing explosives is mandatory.

Business entities should also employ competent professionals who are knowledgeable in explosives and surveillance planning for explosives handling. A thorough understanding of the regulations and ownership of blasting

certificates issued by the Ministry of Energy and Mineral Resources, or the National Police of the Republic of Indonesia is essential.

In terms of supervision, the Ministry of Defense cooperates with the Military Headquarters and the National Police of the Republic of Indonesia to regulate activities involving the production, procurement, storage, possession, distribution, export, utilization, and disposal of explosives.

To further enhance oversight, the government has established an Explosives Control and Surveillance Team (Tim Washandak) responsible for reviewing and assessing permit applications and conducting on-site inspections.

Members of the public who wish to use explosives for specific purposes must adhere to a strict permit application process. This procedure requires the submission of relevant documentation to the competent institution and meeting all specified technical criteria.

Engaging in unauthorized use of explosives or not complying with existing regulations can result in severe legal consequences, including imprisonment. This illustrates the Indonesian government's commitment to regulating the use of explosives to prevent misuse.

CONCLUSIONS AND RECOMMENDATIONS

Categorization and control of explosive utilization is essential to enforce safety and regulatory compliance in their utilization. In the realm of civilian use of explosives, as outlined in Indonesian law, important aspects require contemplation. Strict control measures are essential to ensure that the production, deployment, storage and application of explosives are carried out accurately and in harmony with the law. This is done to prevent misuse and accidents that can endanger lives and assets. Strict permit prerequisites must be met by business entities or individuals who wish to use explosives, including possession of legal documentation such as SIUP, TDP, and NPWP. In addition, they must have proficient experts and certifications provided by sanctioning bodies.

There is a comprehensive surveillance system, with collaboration between the Ministry of Defence, the military, and the Police to oversee the entire spectrum of activities related to explosives, from manufacture to disposal. Washandak forces have also been set up to authenticate and assess permit requests and conduct on-site inspections. The unauthorized use of explosives or their misuse in violation of regulations can lead to severe legal repercussions, including potential imprisonment. This underscores the government's sincere commitment to enforcing regulations to safeguard people's welfare. As a result, a well-defined and strict classification and regulatory framework for the use of explosives is indispensable to maintain security, thwart abuse, and ensure that activities involving explosives are carried out appropriately and carefully.

ADVANCED RESEARCH

Each study inevitably faces certain limitations, underscoring the need for more sophisticated research efforts aimed at delving deeper into the subject matter. This underscores the importance of conducting a more comprehensive analysis that goes beyond surface-level findings. In addition, it is imperative to

initiate additional research initiatives aimed at exploring broader dimensions in the topic of overarching discussion, thereby enriching our understanding, and broadening the scope of knowledge in the field.

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