ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XI Issue I January 2024

Mono-Ammonium Phosphate Treated Blankets' Effectivity to Different Classes of Fires

Camagong, Jesric and Dinglasan, Mylene G

Philippine Christian University

DOI: https://doi.org/10.51244/IJRSI.2024.1101024

Received: 28 December 2023; Revised: 06 January 2024; Accepted: 10 January 2024; Published: 10 February 2024

ABSTRACT

According to Monaghan County Council, the fire begins when a flammable and combustible object is exposed to enough heat and has access to enough oxygen or another oxidizer. Fire aids in our daily activities and improves our quality of life. On the other hand, fires can potentially endanger human life. A large number of casualties are reported in the Philippines due to very simple causes, such as an unattended candle or an open stove, which significantly increases the number of resources lost in large-scale fires. Fires are necessary for our existence, yet numerous incidents have contradicted this notion, turning them into dangerous forces when left unattended with flammable objects. According to the concept of fire-extinguishing tools, the researchers hypothesized that the so-called mono-ammonium phosphate, a dry chemical present in the chemical composition and combination of fire extinguishers, could be used as a key component of alternative fire blankets to put out Classes A, B, D, and K fires. These fire blankets provide similar functions to the existing ones but offer convenience to the less fortunate people vulnerable to fire-related hazards. The researchers seek to determine the effectiveness of extinguishing different classes of fires using MAP Treated Blankets and the extent of the treated fire blanket in terms of quality and performance. The research procedure has 3 phases, the preparation of the MAP- Treated Blankets, Methods of Testing such as the Ability and Fire Retardancy Test, and lastly the Extinguishing Properties of MAP-Treated Blankets in terms of Quality and Performance. Results revealed that the MAP-treated Blanket was very effective as it perfectly extinguished different classes of fire such as Class A, B, D, and K. Also, it is very good in quality for it follows the British Kite mark Standard for the fire Blanket system, and the property such as cost-efficient, user and environmentally friendly.

Keywords: Fire; Fire blanket; Mono-ammonium phosphate; Retardant

INTRODUCTION

Fires started to play a big role in everyday survival. It facilitates daily tasks and improves every situation. From the food, we eat to how cooking is made possible by fire. From the warmth it provides in the winter to its capacity to produce light and energy, it fulfills our everyday needs. Despite these uses and advantages, fires can also be harmful to the environment, infrastructure, property, and human life. The scenario makes it possible to utilize fire-extinguishing equipment like fire extinguishers and fire blankets. As a result, the researchers devised the idea to swap out the current fire extinguishing apparatus for a fire blanket that is affordable, lightweight, useful, and sustainable. Researchers assess the effectiveness and quality of blankets treated with mono-ammonium phosphate to put out various fire classes. However, in this study, mono-ammonium phosphate will be employed as a fire retardant substance or coating for the fire blanket. Mono-ammonium phosphate is commonly used for commercial fertilizer, which plants rely on for healthy and

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XI Issue I January 2024

sustained growth. The purpose of this study is to ascertain the mono-ammonium phosphate-treated blanket's ability to put out various types of fires. Additionally, it aims to establish the degree or extent of the MAP-treated blankets in terms of their performance and quality. In addition to determining which kinds of fires the MAP-treated blankets can put out, the researchers are interested in learning how long it would take to put out different kinds of fires.

LITERATURE REVIEW

Mono-ammonium Phosphate

A popular source of both phosphorus (P) and nitrogen (N), mono ammonium phosphate (MAP) is composed of two ingredients commonly found in fertilizer products. It has the highest phosphorus content of any typical solid fertilize. For its non agricultural use, MAP is utilized in dry chemical fire extinguishers that are frequently seen in homes, workplaces, and schools. The finely ground MAP powder that is sprayed by the extinguisher spray covers the gasoline and quickly puts out the flames.

Extinguishing agent mono ammonium phosphate, which resembles yellow talc powder, is finely pulverized. Propeller is nitrogen gas. Although incredibly dirty, this extinguisher works especially well on class A, B, and C flames.

Classes of Fires

Class A Fires: "Ordinary" Fires Among the five major classifications of fires, class A fires occur most frequently. They arise from the spontaneous combustion of ordinary combustible materials such as paper, fabric, wood, rubbish, and light plastics. Since these unintentional fires occur frequently in a range of industries, it is advised to have sufficient protection against both "ordinary" fires and other conditions-specific fires.

Class B Fires: Liquids & Gases. Combustible liquids and gases, particularly fuels like petroleum or petroleum-derived materials like paint, kerosene, and gasoline, are the cause of class B fires. Class B fires are frequently caused by butane and propane, two more extremely flammable gasses.

Class C Fires: Electrical Fires. Electrical fires are classified as Class C fires and are frequently found in establishments with high electrical equipment usage, though they can happen in many different industries. Water is not a good remedy for electrical fires since non-conductive materials are needed to put out the flames. Because clean agent suppression won't leave residue or harm electrical equipment, it may be preferred in facilities with sensitive equipment.

Class D Fires: Metallic Fires. Although class D fires are less frequent than the other classes, they nonetheless need to be treated with extra care since they can be particularly challenging to put out. Metallic fires are caused by combustible substances that are frequently found in laboratories, such as aluminum, magnesium, titanium, and potassium.

Class K Fires: Grease Fires or Cooking Fires. Class K fires are specifically associated with the food service and restaurant industries, and they involve flammable liquids, much as Class B fires. The combustion of liquid cooking materials, such as oils, grease, and vegetable and animal fats, is the primary cause of these frequent fires.

Extinguishing Property of Fire Powders

Comparable investigations on the use of several chemical powders to put out fires were carried out. Several

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XI Issue I January 2024

studies support the effectiveness of environmentally friendly powders in putting out fires, a few of which are included below.

An analogous investigation, named "Experimental and numerical simulation research on fire suppression efficiency of dry powder mediums containing molybdenum flame retardant additive," was carried out with a different type of fire powder. In this work, the fire extinguishing efficiency of a novel composite ultra-fine dry powder extinguishing agent comprising ammonium molyb date ((NH4)2MoO4) is investigated. The results of the cup burner experiment demonstrate that when the mass fraction of (NH4)2 MoO4 increases, there is a pattern of increase followed by decrease in the flame temperature drop and flame height variation rate, and a trend of decrease followed by increase in the MEC and extinguishing time. The results show that when the mass fraction of (NH4)2 MoO4 is 7%, the composite dry powder exhibits the best fire extinguishing efficiency. Furthermore, the pyrolysis data obtained from TGA and DSC indicate that a 7% addition greatly increases the degree of thermal degradation. The ANSYS-FLUENT program establishes a simplified simulation model of the cup burner to examine the variation of temperature and particle motion trajectory based on the gas-solid two-phase flow theory and multi-phase flow model. The simulation findings show that, once within the cup burner, the ultra-fine dry powder mediums have good dispersibility. This can reach the fully submerged state more quickly, and the experimental results are consistent with the flame temperature throughout the fire suppression stage. The application of fire extinguishing media in the field of fire protection is primarily developed in this article from a process safety standpoint.

Another study comparing the Effectivity of Melamine Phosphate with Mono Ammonium Phosphate was conducted. Melamine phosphate was used as an extinguishing component in a novel kind of multipurpose dry powders (MP dry powders) that were made via the ball-milling process. To compare the extinguishing properties of MP dry powders with commercially available conventional ammonium phosphate dry powders, extinguishing studies, such as wood crib fire tests and pool fire tests, were carried out in addition to testing the powders' primary physical attributes. The characteristics of thermal breakdown of Thermo gravimetric (TG) and differential scanning calorimetry (DSC) were used to study melamine phosphate. The bulk density of MP dry powders is less than the necessary value, according to the results, and the other primary physical characteristics meet Chinese Standards requirements. In studies involving wood crib fires and pool fires, MP dry powders outperform commercially available ammonium phosphate dry powders in terms of extinguishing efficacy. Lastly, the extinguishing processes were examined based on melamine phosphate's thermal breakdown characteristics.

The study "Performance improvement of the dry chemical-based fire extinguishers using nano calcium silicate synthesized from bio-waste" examined the use of nano calcium silicate (n Ca2SiO4), a chemical agent that can be used in a fire-extinguishing mixture that includes ABC dry powder, that was made from clam shells and rice husks.The effectiveness of extinguishing fires was assessed using Class A and B fires. Based on several characteristics, including extinguishing time, amount of extinguishing agent utilized, fire temperature reduction rate, powder coating on the fuel, and reburn incident, the produced mixture was compared with commercial mono-ammonium phosphate powder.It was discovered that although commercial mono-ammonium phosphate powder took 11 and 11.33 seconds to put out Class A and B flames, respectively, the mixture of n Ca2SiO4 and ABC dry powder could do it in 10.67 and 9 seconds, respectively. Therefore, compared to commercial mono-ammonium phosphate powder (Class B alone), the combination of n Ca2SiO4 and ABC dry powder was more efficient and used less. The results of this investigation show that n Ca2SiO4 can effectively enhance the functionality of fire extinguishers that use dry chemicals.

The study focuses on applying mono-ammonium phosphate to fire blankets and tests it on all fire classes, with the exception of Class C fire. Even though studies showed that employing other powders was more effective than using MAP, the researchers nonetheless took environmental sustainability and chemical safety

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XI Issue I January 2024

into consideration. The study employed MAP as a therapy for fire blankets and evaluated its efficacy in extinguishing frequent laboratory fires in schools, given that MAP is not believed to pose a health risk to humans.

METHODOLOGY

Preparation of the Mono-Ammonium Phosphate Treated Blankets

The researchers bought every ingredient from the market, including cornstarch, cotton fabric, and mono-ammonium phosphate. The mixture of the Mono-Ammonium Phosphate, Cornstarch, and Water was made using a straightforward procedure. It was heated to the consistency of glue.

The combination was kept out until it achieved the perfect temperature, which prevented it from solidifying because of its coldness and allowed it to stick to itself even in a warm state. Under the sun, it took 30 to 60 minutes to dry. A thick Mono Ammonium Phosphate Treated Blanket was created by sewing together two blankets that were created by repeating the technique.

Methods of Testing

The researchers performed both the ability and fire Retardancy tests twice. The kinds of fire that the mono-ammonium phosphate-treated blankets can put out were determined by the ability test. While the Retardancy test measured how long the blanket takes to stop repelling after being exposed to fire

Extinguishing Properties of Mono-Ammonium Phosphate Treated Blankets in Terms of Quality and Effectivity to extinguish fires.

The effectiveness and fire-extinguishing qualities of blankets treated with mono-ammonium phosphate have been evaluated through direct observation. The researchers created a survey questionnaire with two sections to assess the extinguishing ability of blankets treated with mono-ammonium phosphate: a respondent profile and a 5-point Likert scale that was approved by administrators, general service office workers, and fire experts. Following the validation procedure, the researchers carried out a survey to evaluate the efficacy and fire-extinguishing qualities of blankets treated with mono-ammonium phosphate. The respondents were picked purposefully in order to focus on specific traits of an interest population that will best enable them to reply to the research questions. The General Services Office, administrators, faculty, staff, and students were among the thirty (30) respondents who assisted the researchers in determining the extent of the MAP-treated blankets in terms of Quality and Performance.

Statistical Treatment of Data

A weighted mean was applied to the collected data. Business Dictionary (2019) states that a number based on its proportional relevance multiplies the average of each item. After adding up the results, the total is divided by the weighted average. An enormous amount of weighted averages was used in descriptive statistical analysis. This is done to gauge the quality and effectiveness of the blankets treated with mono ammonium phosphate's extinguishing property.

Point Likert Scale for the Extinguishing Property of Mono-ammonium Phosphate Treated Blankets in Terms of Quality and Effectivity to Extinguish Fires

Assigned Weight	Scale	Verbal Interpretation	Description
5	4.5-5	Strongly Agree	Extremely Effective/Very Good
4	3.5-4.49	Agree	Very Effective/ Good

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XI Issue I January 2024

3	2.5-3.49	Moderately Agree	Moderately Effective/Acceptable
2	1.5-2.49	Disagree	Very Poor
1	1.49 – 1.00	Strongly Disagree	Not at all effective/Very poor

RESULTS AND DISCUSSION

Methods of testing and research instrument have been utilized to determine the extent of the Mono-Ammonium Phosphate treated blankets in terms of Quality and Performance. Whereas, it shows that the MAP- treated Blankets are extremely effective in Performance and Very Good in quality. All classes of fires that have been tested such as A, B, D and K are perfectly extinguished by the MAP treated Blanket.

Table 1. Time to Extinguish different classes of Fire

Classes of Fire	**The time it takes to extinguish the different classes of fire by the MAP Treated Blankets**
Class A	6.01 sec.
Class B	11.24 sec.
Class D	22.64 secs.
Class K	25.98 secs.

Table 1 shows that all classes of fires tested are extinguished perfectly and Class A being the fastest which then followed by Class B, D and K respectively.

Table 2. Extinguishing Property of MAP-treated Blankets in Terms of Quality

Extinguishing Property of Mono-Ammonium Phosphate Treated Blankets in terms of QUALITY		
Number	Weighted Mean	Verbal Interpretation
1	4.4	Very Good
2	4.63	Very Good
3	4.43	Very Good
4	4.53	Very Good
5	4.5	Very Good
OVER-ALL QUALITY	4.498	Very Good

According to Table 2, MAP- Treated Blankets are extremely good in terms of quality, including economic value, user-friendliness, and environmental friendliness. They are also very good in terms of size and materials required. The dimensions of the fire blanket, which must be at least 1.0 m x 1.0 m, the materials the researchers employ, such as a fire retardant coating, and the testing process are all based on the British Kite mark standard for fire blanket systems.

Table 3. Performance in extinguishing different classes of fires

Extinguishing Property of Mono-Ammonium Phosphate Treated Blankets in Terms of PERFORMANCE		
Number	Weighted Mean	Verbal Interpretation
1	3.73	Very Effective

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XI Issue I January 2024

2	4.43	Extremely Effective
3	4.43	Extremely Effective
4	4.6	Extremely Effective
5	4.17	Very Effective
Over-all Performance	4.272	Extremely Effective

It could be gleaned from Table 3; the extinguishing property of Mono-Ammonium phosphate-treated blankets in terms of Performance is extremely effective. Ability testing was used to determine if the MAP-Treated Blankets could extinguish the different classes of fires. As the testing procedure was done Class A, the MAP- Treated Blankets leaving it extremely effective extinguished B, D, and K.

Table 4. Overall Extinguishing Property of Mono-Ammonium Phosphate Treated Blankets

Overall Extinguishing Property of Mono-Ammonium Phosphate Treated Blankets to Different Classes of Fires		
In terms of	Weighted Mean	Verbal Interpretation
Quality	4.272	Very Good
Performance	4.498	Extremely Effective
Over-all	4.385	Extremely Effective

Table 4 shows that the Overall rating of the Mono-Ammonium Phosphate Treated blankets is extremely effective with a weighted Mean of 4.385. The overall rating is the combination of the Extinguishing Property of Mono-Ammonium Phosphate Treated Blankets in terms of Quality and Performance.

It is evident that MAP treated blanket is effective in extinguishing Class A, B, D and K fires and was rated by the participants/observers Extremely effective. As cited in a literature although incredibly dirty, this extinguisher works especially well on class A, B, and C flames. When comparing the speed at which the MAP Treated Blankets put out the various kinds of fires, Class A fire took the shortest, taking just 6.01 seconds to completely put out. The participants and observers evaluated the material's quality as extremely good, taking into account the fact that MAP is thought to be non-toxic to humans. The MAP-treated blanket received an overall rating of Extremely effective.

CONCLUSIONS AND RECOMMENDATIONS

The ability test result demonstrates that MAP-treated blankets perfectly put out Class A, B, D, and K fires. MAP- Treated Blankets are excellent in terms of quality, such as economic value, user- and environmentally friendly, size, and the materials needed. Class A is the fastest class of fire that was extinguished perfectly by the MAP Treated, followed by Class B, Class D, and finally Class K. The effectiveness of blankets treated with mono-ammonium phosphate to put out fires is quite good. The MAP-Treated Blankets were tested for their capacity to put out the various fire classifications. The MAP- Treated Blankets were exceptionally effective during the testing process, extinguishing Class A, B, D, and K fires. Since it did not catch fire when exposed to a fuel source, the Retardancy test further demonstrates the effectiveness of MAP- Treated Blanket as extinguishing equipment. With a weighted Mean rating of 4.385, the blankets treated with mono-ammonium phosphate receive an overall rating of exceptional effectiveness. The total evaluation is based on the quality and effectiveness of the blankets treated with mono-phosphate as well as their extinguishing properties.

Class C Fires should be tested, according to the researchers, in order to show conclusively that the Mono Ammonium Phosphate Treated Blanket can put out particular types of fires. Because they involve

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XI Issue I January 2024

electricity, Class C Fires require greater safety procedures than other classes, but by putting it in the testing and subjecting the blanket to these classes of fires, it can considerably reinforce the findings.

ACKNOWLEDGEMENT

First and foremost, the researchers would like to express their deepest gratitude to God Almighty, for all the wisdom, grace, mercy and unfailing love. This paper won't be accomplished without His guidance in doing the research paper. Additionally, thanks to everyone who took part in the study's execution, especially the Bureau of Fire Paco firefighter. We once again extend our sincere gratitude to the teachers, students, and non-teaching staff who gave their time to observe.

REFERENCES

1. What is fire? (n.d.). Retrieved January 21, 2019, from https://monaghan.ie/firebuildingcontrol/what-is-fire/
2. Monoammonium Phosphate (MAP). (n.d.). Retrieved January 20, 2019, from https://www.ipni.net/specifics-en
3. Purposive Sampling. (2012). Retrieved January 19, 2019, from http://dissertation.laerd.com/purposive-sampling.php
4. Mono ammonium Phospahte(2023) The Mossaic Company https://www.cropnutrition.com/resource-library/monoammonium-phosphate-map/
5. What Are the 5 Different Classes of Fires? Retrieved January 19, 2019 https://vanguard-fire.com/
6. SONG Fudang, DU Zhiming, CONG Xiaomin, ZHAO Linshuang, YAN Ye, and LI Linming 2014, Experimental study on fires extinguishing properties of melamine Published by Elsevier Ltd., 535 – 542
7. Nuttabodee Viriyawattana and Sura chat Sinworn 2023 Performance improvement of the dry chemical-based fire extinguishers using nanocalcium silicate synthesised from biowaste, Journal of Fire Science https://journals.sagepub.com/doi/full/10.1177/07349041231168553