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Fire Retardant and Resistant Cables: A Strategy for Effective Prevention of Fire Outbreak from Electrical Installations in Workshops in Technical Colleges in Rivers State

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ABSTRACT

This study on Fire retardant and resistant cables as a strategy for effective prevention of fire outbreaks from electrical installations in workshops in technical colleges in Rivers State were necessitated by the frequent fire outbreak from electrical installations in workshops in technical colleges. A research question and two null hypotheses guided the study. A descriptive survey research design was employed for the study. The population for this study consisted of 45 electrical teachers in four technical colleges in Rivers State. The entire population was studied without sampling since the size was not too large and was manageable. The instrument for data collection was a structured questionnaire titled 'Strategy for Effective Prevention of Fire Outbreak from Electrical Installation in Workshops'. The instrument was validated by two experts from the Departments of Industrial Technical Education and Educational Foundations at Ignatius Ajuru University of Education, Port Harcourt. Using the Cronbach alpha method to determine the reliability of the instrument, a reliability coefficient of 0.78 was obtained. The data collected for the study were analyzed using mean and standard deviation to answer the research questions and to determine the closeness of the respondents' mean ratings. The t-test was used to test the null hypotheses at a 0.05 level of significance. The findings of the study revealed that fire-resistant and retardant cables will be very effective strategies for the prevention of fire outbreaks from electrical installations in workshops in technical colleges. The findings also showed that years of experience had no significant influence on how fire-resistant and retardant cables will be very effective strategies for the prevention of fire outbreaks from electrical installations in workshops in technical colleges. Based on the findings of this study, it was recommended that fire-resistant and retardant cables should be used during the construction and renovation of workshops.

KEYWORDS

fire outbreak; technical colleges;
workshop; fire retardant; resistant cables

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INTRODUCTION

Technical Colleges play a pivotal role in providing training for skill acquisition in various occupations for paid and self-employment. Technical schools sometimes referred to as technical colleges or technical institutes, provide students with specific classes that prepare them for a particular career or trade. Technical colleges offer areas of study in several fields, such as welding, electrical works, building, radio and television, mechanical, maintenance work; mechanical craft practice, and pipefitting (Amadieke & Agwi, 2015). Technical colleges offer programs that can take anywhere from less than two years to up to four years, after which a certificate, diploma, or associate degree is awarded. Associate degrees that can be obtained through a technical college include an Associate of Arts, an Associate of Science, and an Associate of Applied Science.

A technical college program is made to prepare students who know what they want to do professionally and want to start working immediately. These colleges have the mandate to provide technical education programmes to individuals desirous of acquiring manipulative skills for self-reliance. One of the critical assets and beauty of technical colleges is the workshops.

The workshop serves as a training ground for students to acquire relevant skills in their field of occupation. A workshop refers to a room or building where tools and machines are kept and used for making or repairing things (Okala, 2015 in Nwakanma & Izundu, 2020). Technical college workshops include automobile, mechanical, metal, wood, building, electrical, and electronics workshops (Amadieke & Agwi, 2015). The operation and functionality of these workshops provide avenues and platforms for practical works; which enable students to acquire competencies in their areas of specialization. The most essential components of workshops are tools and equipment. Some of these tools and equipment utilize electrical energy for operation; which is why all technical college workshops are electrified.

The electrical installation of workshops requires careful planning, workable and safe methods of installation as well as experts in the fields of electrical drafting, design, drawing, and installation. According to Nwakanma and Paius (2022), an electrical installation is a group of items of electrical equipment that are permanently electrically connected and can be supplied with electricity from the works of an electricity entity or a generating source. Ephraim in Nwakanma and Paius (2022) defined electrical installation as any machinery, in or on any premises, used for the transmission of electricity from a point of control to a point of consumption anywhere on the premises, including any article forming part of such an electrical installation irrespective of whether or not it is part of the electrical circuit. The skillful, thoughtful, and masterful techniques employed in carrying out these installations in the workshops should guarantee the safety of human lives and the facilities therein. This is imperative for the prevention of fire outbreaks occasioned by poor, defective, and unprofessional techniques employed during electrical installations in the workshops.

A fire outbreak is a sudden emergence of fire. Fire in its most common form can result in an inferno, which has the potential to cause physical damage through burning. The negative effects of fire include hazards to life and property, atmospheric pollution, and water contamination. Fires start when an inflammable or combustible material, in combination with a sufficient quantity of oxygen gas or another oxygen-rich compound is exposed to a source of heat or ambient temperature above the flash point. Fire cannot exist without these elements in place and the right proportions. For example, an inflammable liquid will start burning only if the fuel and oxygen are in the right proportion (Oballa, 2022).

The causes of fire outbreaks/disasters in workshops include carelessness, arson, and lighting. One of the careless behaviors that can cause fire outbreaks is faulty electrical wiring. This phenomenon is the main cause of fire disasters and is very common in workshops and domestic households. Most householders and contractors to save on costs; will opt to use thin cables in places where thicker cables ought to be used. This usually results in overheating, which ignites the insulation and sparks off a fire disaster (Oballa, 2022). This situation could be prevented when effective fire outbreak preventive strategies are implemented during electric power installations in workshops.

Strategies are measured and taken to ensure that things are done properly following set rules and objectives. A strategy is a carefully developed plan or method for achieving a goal or the skill in developing and undertaking such a plan or method. It is also seen as the arrangement, blueprint, design, game plan, ground plan, master plan, program, project, road map, scheme, and system employed to carry out certain activities. (Webster, 2022; Nwakanma& Paius, 2022). In carrying out electrical installation, certain strategies need to be observed and implemented to forestall or prevent the outbreak of fire. These strategies include the utilization of flame retardant and fire resistance cables, pest-protected cables, installation of fire detective devices, and application of effective wiring methods.

The utilization of flame retardant and fire resistance cables in electrical installation is a basic strategy for preventing fire outbreaks. Fire retardant cables according to Worth (2016), are designed to resist the spread of fire into a new area. They are also cabling that will not convey or propagate a flame as defined by the flame-retardant or propagation tests. Flame-retardant tests measure flame propagation for both horizontal and vertical applications.

There are also plenum cable flame tests for use in ducts, plenums, or other spaces used for environmental air distribution. The test measures flame spread and smoke generation in a simulated air-handling plenum. Cables used in plenums are required to have a more stringent test than that horizontal or vertical flame tests. Flame retardant cables according to Fugh (2016) are cables that will not operate as normally within fire conditions, but will actively prevent the fire from spreading. A good, flame-retardant material or cable will be able to sit in a flame without catching fire, and if the flame is of sufficient intensity that the insulation or sheath does catch fire, it will then self-extinguish as soon as the flame source is removed.

On the other hand, a fire-resistant or fire-rated cable is a cable that will continue to operate in the presence of a fire. Fire-resistant cables according to Dan (2013) are cables that can operate normally within fire conditions. When such cables come into contact with fire it does not burn (Ethan, 2015). Fire resistance cables do not allow a fire to spread. Fire-resistant cables can continue to operate as normal within fire conditions without setting fire to their surroundings. Both fire retardant and fire resistance cables are utilized in modern building projects even though it is very expensive to purchase.

According to Rederg (2015), there are enormous differences between flame-retardant cables and fire-resistive cables. Typically, flame-retardant cables resist the spread of fire into a new area, whereas fire-resistive cables maintain circuit integrity and continue to work for a specific time under defined conditions. These circuit integrity cables continue to operate in the presence of a fire and are sometimes called 1-hour or 2-hour fire-rated cables. The differences between these two ratings are essential for the critical circuits required for life safety requirements. Both have an important part to play in preserving the integrity of the environment during a fire incident and improving the chances of escape and survival.

Tratos' cable as shown in figure 1 is an example of fire retardant and resistant cables that are recently used in public buildings from schools to hospitals, underground and overground railway stations, retail and leisure venues as well as offshore vessels and hazardous environments such as Oil & Gas platforms. The manufacturer of these cables complies with the latest Standards and Codes of Practice covering fire detection, alarm systems, emergency lighting, or other vital power supplies. The cables encompass a range of low smoke and fume cables, designed and tested to resist flame propagation and spread and offering low toxicity, smoke and acid gas generation.

FIGURE 1: Tratos' cables

Fire retardant and resistance cables are manufactured in accordance with the following British Standards:

- BS 7211 Electric cables. Thermosetting insulated and thermoplastic sheathed cables for voltages up to and including 450/750 V for electric power and lighting and having low emission of smoke and corrosive gases when affected by the fire.

- BS 7629 Electric cables. Specification for 300/500 V fire-resistant screened cables having low emission of smoke and corrosive gases when affected by fire Multicore and multipair cables.
- BS 7846 Electric cables. Thermosetting insulated, armored, fire-resistant cables of rated voltage 600/1000 V, having low emission of smoke and corrosive gases when affected by the fire.
- Fire retardant and resistance cables according to Greg (2016) pass through the following criteria:
- Fire integrity
- Resistance to combustion
- Flame retardant
- Low flame propagation and flame spread
- Low toxicity and smoke
- Low acid gas generation
- Combined with Pliability to easy installation

Both flame-retardant and flame-resistant cables are used for the same eventuality but behave very differently in the event of a fire. Investing in these types of cables would greatly improve the safety provided for everyone involved (Danga, 2022). In the context of this study, Fire retardant and resistant cables are cables designed to resist the spread of fire and continue to operate in the presence of a fire. The utilization of this type of cable during the construction or renovation of workshops could prevent fire outbreaks from electrical installations.

STATEMENT OF THE PROBLEM

The functionality of workshops is the life wire of skill training and acquisition in technical colleges all over the world. It is not only a training ground for both the teacher and students but is also an environment for practical activities in one occupation or the other.

However, the incessant cases of fire outbreaks in electrical installations in workshops in technical colleges in Nigeria and especially in Rivers State remain unpleasant. Adams (2016) observed that the frequent fire outbreak in electrical installations in workshops in technical colleges in Rivers State usually disrupts academic activities and practical work by teachers and students alike in those colleges. Sometimes the workshops remain out of use for weeks if not months since some of the items destroyed by fire are very much expensive to be replaced. The replacement of these electrical installations and other tools, equipment, and materials which are sometimes worth millions of naira, now and again is counterproductive and detrimental to the government and the colleges.

Undoubtedly, the constant closure of workshops as a result of the destruction caused by fire outbreaks from electrical installations could adversely affect the acquisition of relevant and appropriate skills by students of technical colleges. This situation may be a result of the lack of application of current and existing strategies for the effective prevention of fire outbreaks from electrical installations. The present researchers worried about this ugly situation, hence sought to examine the use of fire retardant and resistant cables as a strategy for effective prevention of fire outbreaks from electrical installations in technical colleges' workshops in Rivers State.

PURPOSE OF THE STUDY

The purpose of this study was to examine the use of fire retardant and resistant cables as a strategy for the effective prevention of fire outbreaks from electrical installations in workshops in technical colleges in Rivers State

RESEARCH QUESTIONS

The following research question guided the study:

(1) how effective will the use of fire retardant and resistant cables prevent fire outbreaks from electrical installations in workshops.

HYPOTHESES

The following null hypotheses were tested at 0.05 level of significance:

(1) there is no significant difference in the mean ratings of respondents on the use of fire retardant and resistant cables as a strategy for effective prevention of fire outbreaks from electrical installations in workshops in technical colleges in Rivers State based on years of experience (0 – 10 years and 11year – above).

(2) there is no significant difference in the mean ratings of respondents on the use of fire retardant and resistant cables as a strategy for effective prevention of fire outbreaks from electrical installations in workshops in technical colleges in Rivers State based on location (urban and rural).

METHOD

This study adopted a descriptive survey research design. The population for this study consists of 45 electrical teachers in four technical colleges in Rivers State namely, Government Technical College, Port Harcourt, Ahuoda, Tombia and Ele-Ogu. The entire population was used as a sample size since the population is not too large and is manageable. Hence, no sampling technique was used for this study. The instrument for data collection was a structured questionnaire titled: Fire Retardant and resistance Cables as A Strategy for Effective Prevention of Fire Outbreak in Electrical Installations in Workshops. (FRRPFOWQ). It contains 10 items on a four-point rating scale of Very Effective (VE), Effective (E), Ineffective (I), and Very Ineffective (VI). The instrument was validated by two experts from the Department of Technical Education; Ignatius Ajuru University of Education. The reliability of the instrument was established using a pilot test involving 20 teachers of technical colleges in Bayelsa State; Data collected for the pilot study were analyzed with Cronbach alpha. A reliability coefficient of 0.78 was obtained. The researcher through the support of research assistants sent and retrieved 45 copies of the questionnaire for analysis. The data collected for the study were analyzed using the arithmetic mean and standard deviation to answer the research questions and determine the closeness of the responses to the means respectively. The z-test statistical tool was used to test the null hypotheses at a 0.05 level of significance. A null hypothesis was rejected where the calculated p-value was less than the 0.05 level of significance, it meant that there was a significant difference between mean scores. Conversely, where the calculated p-value was greater than or equal to the level of significance (0.05), it meant that there was no significant difference and the hypothesis was accepted.

RESULT

Data analyzed for the research question and hypotheses were presented in tables 1 to 3.

Research Question 1: How effective will the use of fire retardant and resistant cables prevent fire outbreaks from electrical installations in workshops?

Data collected in respect of research question 1 was analyzed and presented in Table 1.

TABLE 1: Respondents mean ratings on the effectiveness of fire retardant and resistance cables for the prevention of fire outbreaks.

S/No	Fire Retardant and Resistance Cables	Mean	SD	Remarks
1	Ability to resist heat	3.51	0.46	VE
2	Ability to resist the growth of a fire	3.56	0.51	VE
3	Ability to resist the igniting of a fire	3.71	0.45	VE
4	Ability to act like non-oxidants	3.54	0.54	VE
5	Inability to propagate flame	3.53	0.61	VE
6	Ability to promote circuit integrity	3.55	0.43	VE
7	Ability to maintain its functionality despite increase in heat	3.50	0.53	VE
8	Ability to limit smoke generation	3.59	0.56	VE
9	Ability to limit toxicity emission	3.51	0.51	VE
10	Ability to limit acid gas emission	3.61	0.62	VE
	Cluster Mean	**3.56**	**0.52**	**VE**

Table 1 shows that all the items have a cluster Mean of 3.56, which means that teachers in technical colleges agreed that the use of fire retardant and resistance cables will be very effective for the prevention of fire outbreaks from electrical installations in workshops in technical colleges in Rivers State. The standard deviation of 0.52 shows that the respondents are homogenous in their responses.

Hypothesis 1: There is no significant difference in the mean ratings of respondents on the use of fire retardant and resistant cables as a strategy for effective prevention of fire outbreaks from electrical installations in workshops and technical colleges in Rivers State based on years of experience (0 – 10 years and 11year – above).

Data obtained in respect of hypothesis 1 were analyzed and presented in Table 2.

TABLE 2: Summary of z-test comparison of the mean ratings on the effectiveness of fire retardant and resistance cables for the prevention of fire outbreaks.

Teachers' Years of Experience	N	$\bar{X}$	SD	α	df	t-cal	p-value	Decision
0 – 10	28	3.49	0.11	0.05	43	0.41	0.061	Not Significant
11 - above	17	3.51	0.12					

Data in Table 2 show that the respondents do not differ significantly in their mean ratings on the use of fire retardant and resistance cables as an effective strategy for the prevention of fire outbreaks from electrical installations in workshops in technical colleges in Rivers State based on years of experience, with mean scores of 3.49 and 3.51 while the corresponding standard deviations are 0.11 and 0.12. The Table indicated a t-value of 0.41, at the degree of freedom of 195, and a p-value of 0.061. Testing at the alpha level of 0.05, the p-value is not significant since the p-value is greater than the alpha value (0.05). Therefore, the null hypothesis is not rejected.

Hypothesis 2: There is no significant difference in the mean ratings of respondents on the use of fire retardant and resistant cables as a strategy for effective prevention of fire outbreaks from electrical installations in workshops and technical colleges in Rivers State based on location (urban and rural).

Data obtained in respect of hypothesis 2 were analyzed and presented in Table 3.

TABLE 3: Summary of z-test comparison of the mean ratings on the effectiveness of pests-protected cables for the prevention of fire outbreaks.

Location of Teachers	N	$\bar{X}$	SD	α	df	t-cal	p-value	Decision
Urban	29	3.58	0.51	0.05	43	0.39	0.071	Not Significant
Rural	16	3.54	0.52					

Data in Table 3 shows that the respondents do not differ significantly in their mean ratings on the use of pests protected cables as an effective strategy for the prevention of fire outbreaks from electrical installations in workshops in technical colleges in Rivers State based on location, with mean scores of 3.58 and 3.54 while the corresponding standard deviation is 0.51 and 0.52. The Table indicated a z-value of 0.39, at the degree of freedom of 195, and a p-value of 0.071. Testing at the alpha level of 0.05. The p-value is not significant since the p-value is greater than the alpha value (0.05). Therefore, the null hypothesis is not rejected.

DISCUSSION

The finding of the study reveals that fire retardant and resistance cables is a strategy for effective prevention of fire outbreak from electrical installations in technical colleges in Rivers State. The study shows that cables resist heat, growth or spread of fire, resist the igniting of fire, is non-oxidants, maintain circuit integrity, limit smoke, toxicity, and gas generation among others. This study in agreement with that of Greg (2016) who posited that that fire retardant and resistance cables are good in fire integrity resistance to combustion, flame retardant, low flame propagation and flames spread, low toxicity and smoke, low acid gas generation and combined with Pliability to ease installation. The study also agrees with that of Worth (2016), who stated that the cables are designed to resist the spread of fire into a new area. They are also cabling that will not convey or propagate a flame as defined by the flame-retardant or propagation tests. The study is also in consonant with that of Rederg (2015), who noted that typical flame-retardant cables resist the spread of fire into a new area, whereas fire-resistive cables maintain circuit integrity and continue to work for a specific time under defined conditions. These circuit integrity cables continue to operate in the presence of a fire and are sometimes called 1-hour or 2-hour fire-rated cables. Rederg revealed that the difference between these two ratings are essential for the critical circuits required for life safety requirements. Both have an important part to play in preserving the integrity of the environment during a fire incident and improving the chances of escape and survival. The analysis of the hypothesis revealed that There is no significant difference in the mean ratings of respondents on the use of fire retardant and resistance cables as a strategy for effective prevention of fire outbreaks from electrical installations in workshops in technical colleges in Rivers State based on years of experience and location.

CONCLUSION

On the basis of the findings of the study, it was concluded that the use of fire retardant and resistant cables will be a strategy for the effective prevention of fire outbreaks from electrical installations in workshops in Technical Colleges in Rivers State

RECOMMENDATIONS

On the basis of the findings of the study and the conclusion reached, it was recommended that:

(1) fire retardant and resistant cables should be used by contractors during the construction and renovation of workshops.

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