

An Experimental Study on The Effect of Ammonia on The Fatigue of Building Construction Personnel at Work

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ABSTRACT

Whether the construction environment is safe or not is the most important issue in the process of project construction. By analysing the current research status of construction safety, we point out the current problems, such as the lack of attention to the toxicity of the construction materials themselves may cause harm to the construction personnel, and conduct an experimental study on the effect of ammonia on the fatigue of the construction personnel to verify this conjecture, the higher the concentration of ammonia in the same period of time the stronger the fatigue degree of the construction personnel, and at the same time the higher the concentration of ammonia in the masonry volume is less. Finally, it is hoped that new green building materials can be developed to solve such problems, but in the process of research and development will be faced with some difficulties such as high cost, unstable supply, and increased technical difficulties in construction, and so on.

KEYWORDS

Construction safety, construction materials, project management.

1. INTRODUCTION

With the rapid development of China's urban modernisation, the construction industry has gradually become the pillar industry of China's national economy, and the construction safety issue has been widely concerned by all parties. In recent years, frequent safety problems have occurred in engineering projects, resulting in workers' physical injury or even loss of life, slowing down the construction progress while consuming a large amount of property. In construction safety accidents, human physiological and psychological fatigue is the main cause of unsafe behaviour. In addition to their own factors, human physiological and psychological fatigue is more due to the influence of the operating environment. This study selected the environment of the ammonia factor for the experiment, ammonia exists in the concrete when the temperature and humidity and other environmental factors change, ammonia substances will be converted into ammonia released from the wall into the indoor air, at the same time, indoor decoration materials containing ammonia additives and whiteners, furniture manufacturing process will be used in the process of containing urea-formaldehyde resin adhesive, will slowly release a certain amount of ammonia, into the Indoor air. It is important to reduce the occurrence of safety accidents by analysing the impact of ammonia on the fatigue of construction workers.

2. THE SIGNIFICANCE OF CONSTRUCTION SAFETY

Construction safety is an important part of building construction work. In the process of building construction, enterprises need to put safety in the first place, focusing on the protection of the personal safety of construction personnel, while ensuring the quality of construction, so as to ensure the quality and quantity to complete the building construction project. In the construction process of human life and property safety is the most important. From the point of view of life for all people, there is nothing more important than life, each person has only one life, once lost can not start again. From the perspective of property, for ordinary workers, work is their only source of income, once injured they may not be able to get income for a long time, and also have to bear the huge medical expenses. For the business owner, they are responsible for the payout as well as the delay in the schedule and the pressure of outside opinion. The popularisation of construction safety is to reduce the probability of safety accidents, to find and solve the crisis in the first time, so as to protect the life safety of construction workers, to avoid the waste of resources, to achieve the purpose of completing the construction project on time, and to improve the economic efficiency of the enterprise. [1] But the current research in this area is mainly focused on the management of workers and equipment for the construction materials itself is not too much research.

2.1. Current research on construction safety

Research is mainly concentrated in the management such as safety equipment and protective measures are not in place, some construction sites are equipped with serious aging of safety equipment does not have the protective function, some construction sites directly lack the necessary personal protective equipment. There are also some construction sites where the safety warning signs are not clear enough to effectively remind the construction workers to pay attention to safety and warn of potential hazardous areas or dangerous objects. Construction personnel lack of safety awareness, most of the construction personnel in the early work will pay attention to construction safety issues, but with the construction progress, some of the construction personnel's work safety awareness gradually decline, often ignoring the details of the safety issues. At the same time, there are some construction workers did not carry out safety behaviour training, resulting in their inability to distinguish whether the construction site is safe. All parties responsible for the main management system is not perfect, personnel responsibility is not clear at present part of the construction enterprise's construction department, supervisory departments responsible for the main management system is not sound enough, the existing system can not guarantee the realisation of a full range of construction management, resulting in staff in the implementation of the safety management system is not serious enough. [2] These are indeed some of the problems that often exist on the construction site, but I think there are still some problems that have been overlooked for example, the construction materials themselves have toxicity, may not be able to cause any major impact on the human body in the short term but in the long run it will lead to some major diseases and even threaten life. Some skilled labourers are likely to leave the industry, which will add to the shortage of construction personnel.

2.2. Construction materials are toxic

Meng Xu through the study of "housing construction and municipal infrastructure projects endangering production safety construction processes, equipment and materials out of the catalogue (the first batch)" found that from 2015 to the present, Beijing, Shanghai, Qingdao and other cities of housing and urban and rural construction departments issued documents one after another, banned asphalt type waterproofing roll-roofing hot-melt process, and pointed out that the process is prone to fire accidents, and will produce carcinogenic substances that are detrimental to the human body in the Underground confined space, poorly ventilated space, flammable materials near the waterproofing project shall not be used. [3] In fact, it is common knowledge that construction materials are toxic,

and people usually don't move into a freshly renovated house right away, they usually open the windows to ventilate for several months before moving in. However, during the construction process workers must stay in the toxic environment for a long time every day, which will cause great harm to them. National regulations have been introduced to reduce the incidence of such things and to optimise construction processes, equipment and materials.

3. EXPERIMENTAL STUDY ON THE EFFECT OF AMMONIA ON THE FATIGUE OF CONSTRUCTION PERSONNEL OPERATIONS

In this paper, the effect of ammonia on the fatigue of construction personnel is selected as the research object. Through the experiment to get the construction personnel in different concentrations of ammonia operating efficiency and physical state data, so as to get whether the ammonia will have an impact on the construction personnel and the extent of the impact, and put forward relevant measures to solve the problem.

3.1. Research content

3.1.1. Measurement of ammonia gas in the working environment during the main construction stage of building structures

Ammonia mainly exists in construction materials. Such as concrete containing urea antifreeze added, especially in winter, will be added to the concrete wall with a large number of urea and ammonia as the main raw material of concrete antifreeze, when the temperature and humidity and other environmental factors change, ammonia substances will be converted into ammonia gas from the wall released into the indoor air. Interior decorative materials containing ammonia additives and whitening agents, furniture manufacturing process will be used to contain urea-formaldehyde resin adhesives, will slowly release a certain amount of ammonia into the indoor air.

3.1.2. Experiment on the effect of ammonia on the fatigue of construction personnel operations

Design physiological experiments, using the rate of change of heart rate indicators and Figure 1 Chinese Journal of Traditional Chinese Medicine (formerly China Journal of Medicine) June 2019, Vol. 34, No. 6 CJTCMP, June 2019, Vol. 34, No. 6 (excerpts) to measure the degree of operational fatigue of the subjects in the experiment, and to analyse the impact of different concentrations of ammonia operating environment on the operational fatigue of construction personnel. An experimental environment with sufficient light, suitable temperature, and no interference from other harmful gases was selected as the experimental site. Since the degree of work fatigue is affected by individual factors such as gender, age, health status and work proficiency of the workers, nine male masonry workers with good health and no bad habits were selected as experimental subjects in order to avoid the interference of the above factors on the experimental results. The age distribution of the experimental subjects was 30 to 40 years old, and they had a high level of operational proficiency. In order to avoid the interference of other factors on the subjects' heart rate and other physiological indexes, the subjects were not allowed to carry out strenuous physical load activities, or take drugs or food that may cause abnormal cardiovascular function during the day before the experiment. Nine subjects were randomly divided into experimental groups A, B, and C, with three subjects in each group. The working time of the masonry operation was the same, the workload was not specified, and the subjects used the same building materials and tools such as cement mortar in the operation. The ammonia concentration in the working environment was set for each experimental group. The ammonia concentration in the working environment of experimental groups A, B and C was set to be 0 ppm, 5 ppm and 10 ppm respectively. During the experiment, the heart rate indicators of the subjects were measured by heart rate tester, and the frequency of the measurement was once every 5 minutes for a total of 7 measurements. After the masonry operation, the subjects were investigated in Figure

1, and the heart rate index values of the subjects were measured at 10min, 20min, and 30min after the end of the operation activity.

Appendix A(Normative Appendix) : Fatigue Self-assessment Scale (FSAS)

Name: _____ Gender: _____ Age: _____ When to complete the form: _____

Guidance: The following text is a set of declarative sentences that describe the performance of fatigue. To assess your fatigue status. After you read it carefully, draw a "✓" in each box according to how you have felt in the last 1-2 weeks.

		None or even	A little of the time	Half the time and most of the time	Almost all the time
1	My limbs feel limp and tired	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2	I feel like I can't concentrate	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3	Fatigue brings my mood down	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4	Fatigue makes me bored with what I am doing and not want to do it anymore	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5	I feel tired and always want to lie down and rest	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6	My mind feels sluggish	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7	I feel muscle weakness in my extremities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8	Fatigue makes me less efficient at work or study	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9	I feel weak	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10	I feel not thinking clearly	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Figure 1.

3.1.3. Experimental data

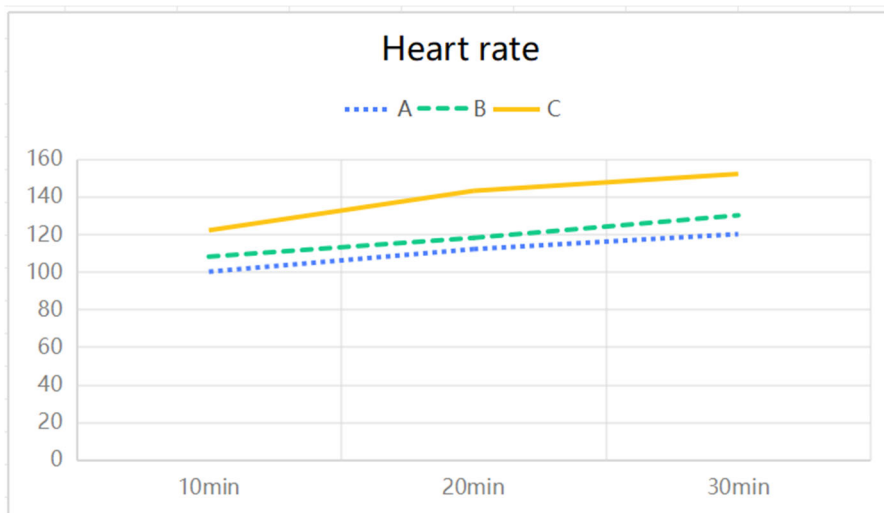


Figure 2

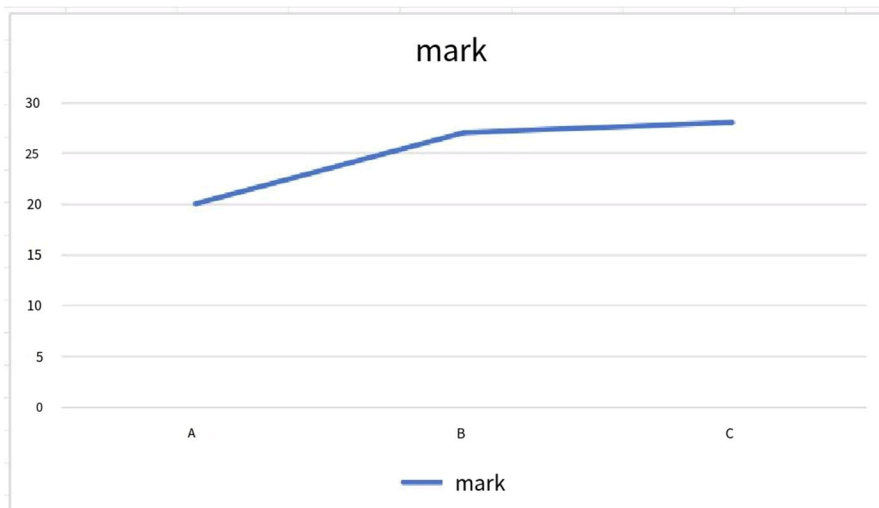


Figure 3.

3.2. Analysing experimental data

The heart rate data and the construction workers' work fatigue self-evaluation scale data were plotted in line graphs Figure2 and Figure3, and by observing the trend of the line graphs, it was concluded that the higher the concentration of ammonia the stronger the fatigue of the workers, and at the same time, the higher the concentration of ammonia the lower the amount of masonry.

4. NEW GREEN BUILDING MATERIALS

4.1. Conjecture of new green building materials

Natural materials: such as wood, bamboo, crop fibre materials. These materials are produced in nature, non-toxic and odourless and can also evolve the air to bring people a more comfortable living experience. New chemical materials: research and development of some low-pollution irritating odour chemical materials such as volatile organic compounds (VOC) content of low paint and adhesives, will not cause pollution to indoor air quality.

4.2. Problems in the development and application of new green building materials

Firstly, high cost. The development and production process of new building materials usually requires a large amount of capital investment and technical support. Therefore its production cost is also high. This makes the market price of new building materials higher than that of traditional building materials. The construction cost may increase as a result. Second, unstable supply. The production and supply chain of new building materials are not mature enough, and there may be unstable supply. Third, the difficulty of construction technology increases. New construction materials often have unique properties and performance that require special construction techniques and experience. Most construction teams are unable to work with these materials. Fourth, risk and uncertainty. There may be some risk and uncertainty in the performance and use of new building materials. Although new construction materials have been developed and tested, they may still have problems or fail to meet expectations in actual application. [4] Even though there are many problems we still need to work hard on the development and application of new green building materials.

4.3. Advantages of new green building materials

First, protect the environment. The use of new green building materials can reduce the negative impact on the environment. Traditional building materials such as cement, steel and so on in the production process has produced a lot of pollution to the environment, while in the construction process will also produce air pollution. And new green building materials usually use renewable and recyclable materials. Second, improve safety and comfort. New green building materials can improve the quality of indoor environment and enhance the safety and comfort of living. Many traditional building materials contain hazardous substances, such as formaldehyde and benzene, and long-term exposure to these substances poses potential risks to human health. Green materials usually use non-toxic and harmless materials that do not release harmful substances. They can also reduce the harm to construction workers during the construction process. [5]

5. CONCLUSION

Construction safety occupies an important position in the construction process because it is related to the safety of people's lives and property. We must improve the research on construction safety as much as possible to reduce the occurrence of accidents. This paper proves that some construction materials can have a negative impact on the human body by conducting an experimental study on the effect of ammonia on the fatigue of building construction personnel working. Meanwhile, the

development of new green construction materials should be continued in the future to reduce the content of toxic substances in construction materials.

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