

## Article

# Behavior and Performance Analysis of Fire Protection Materials Applied to Steel Structures According to Exposed Temperatures

Hyun Kang  and Oh-Sang Kweon <sup>\*</sup>

Korea Institute of Civil Engineering & Building Technology (KICT), 182-64 Mado-ro, Mado-myeon, Hwasong-si 18544, Gyeonggi-do, Republic of Korea; kanghy@kict.re.kr

<sup>\*</sup> Correspondence: oskweon@kict.re.kr; Tel.: +82-31-389-0546

**Abstract:** Spray-on fireproofing materials (SFRMs) and intumescent paints are commonly used to enhance the fire resistance of steel structures. Despite extensive studies on the performance of SFRMs and intumescent paints, there remains a significant lack of research on the material properties of certified products used in real-world applications, especially according to exposed temperatures. In this study, heating experiments were conducted to investigate the material properties of two widely used certified materials in Korea, focusing on their application thickness and exposure temperature. The experiments set target temperatures ranging from room temperature to 900 °C in increments of 100 °C. Additionally, various material properties, such as changes in shape and the insulation performance of the SFRM and intumescent paint, were observed at each temperature. Notably, the moisture content and discoloration depth of the SFRM displayed a consistent trend under different exposure temperatures, a material property that has not been previously reported. Furthermore, the insulation performance of the two materials differed by approximately 17% to 25% compared to an uncoated specimen exposed to the same temperature. The findings on the properties of SFRMs and intumescent paint relative to the exposure temperature presented in this study can serve as valuable data for selecting materials to improve fire resistance performance across various construction sites in the future. Additionally, they can act as key reference data in the diagnostic evaluation process for assessing the impact of fire on steel structures.

**Keywords:** steel frame structure; protection of steel; spray-on fireproofing material; intumescent paint; fire damage assessment



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## 1. Introduction

Fires in buildings cause numerous casualties, as demonstrated by past tragedies. These include the Grenfell Tower fire in 2017 and the 2022 Bronx apartment fire, which helped raise global awareness about building fires. After the Great Fire of London in 1666, the earliest regulations on building fires were promoted mainly by insurance companies who were more interested in protecting property. Later, related regulations were established with a focus on preserving life. Numerous researchers have conducted experimental and theoretical studies, and now, each country has fire resistance regulations for buildings. Each regulation requires different fire resistance performance standards for structural members depending on the use and scale of the building. If the required performance standards are not met, various strengthening methods are applied to secure fire resistance performance.

# Protection Of Materials And Structures From The Lo

**M Walker**



## **Protection Of Materials And Structures From The Lo:**

*Opportunities in Protection Materials Science and Technology for Future Army Applications* National Research Council, Division on Engineering and Physical Sciences, Board on Army Science and Technology, National Materials Advisory Board, Committee on Opportunities in Protection Materials Science and Technology for Future Army Applications, 2011-08-27

Armor plays a significant role in the protection of warriors. During the course of history, the introduction of new materials and improvements in the materials already used to construct armor has led to better protection and a reduction in the weight of the armor. But even with such advances in materials, the weight of the armor required to manage threats of ever increasing destructive capability presents a huge challenge. *Opportunities in Protection Materials Science and Technology for Future Army Applications* explores the current theoretical and experimental understanding of the key issues surrounding protection materials, identifies the major challenges and technical gaps for developing the future generation of lightweight protection materials, and recommends a path forward for their development. It examines multiscale shockwave energy transfer mechanisms and experimental approaches for their characterization over short timescales, as well as multiscale modeling techniques to predict mechanisms for dissipating energy. The report also considers exemplary threats and design philosophy for the three key applications of armor systems: 1) personnel protection including body armor and helmets; 2) vehicle armor; and 3) transparent armor. *Opportunities in Protection Materials Science and Technology for Future Army Applications* recommends that the Department of Defense (DoD) establish a defense initiative for protection materials by design (PMD) with associated funding lines for basic and applied research. The PMD initiative should include a combination of computational, experimental, and materials testing, characterization, and processing research conducted by government, industry, and academia.

Government-Sponsored Programs on Structures Technology, 1997      Mechanics of Wave-Seabed-Structure Interactions Dong-Sheng Jeng, 2018-04-26

An in depth look at the mechanics of combined stresses imposed on the seabed from wave action and marine infrastructure      *Polymer Matrix Composites: Materials Usage, Design, and Analysis* Composite Materials Handbook - 17 (CMH-17), 2012-07-10

The third volume of this six volume compendium provides methodologies and lessons learned for the design, analysis, manufacture, and field support of fiber reinforced polymeric matrix composite structures. It also provides guidance on material and process specifications and procedures for using the data that is presented in Volume 2. The information provided is consistent with the guidance provided in Volume 1 and is an extensive compilation of the current knowledge and experiences of engineers and scientists from industry, government, and academia who are active in composites. The Composite Materials Handbook, referred to by industry groups as CMH 17, is a six volume engineering reference tool that contains over 1 000 records of the latest test data for polymer matrix, metal matrix, ceramic matrix, and structural sandwich composites. CMH 17 provides information and guidance necessary to design and fabricate end items from composite materials. It includes properties of composite materials that meet specific data requirements, as

well as guidelines for design analysis material selection manufacturing quality control and repair The primary purpose of the handbook is to standardize engineering methodologies related to testing data reduction and reporting of property data for current and emerging composite materials It is used by engineers worldwide in designing and fabricating products made from composite materials

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*Incorporating Sustainable Practice in Mechanics and Structures of Materials* Sam Fragomeni,Srikanth Venkatesan,2010-11-18 Incorporating Sustainable Practice in Mechanics of Structures and Materials is a collection of peer reviewed papers presented at the 21st Australasian Conference on the Mechanics of Structures and Materials ACMSM21 Victoria University Melbourne Australia 7th 10th of December 2010 The contributions from academics researchers and practisin Guidelines for the Design and Construction of Flexible Revetments Incorporating Geotextiles in Marine Environments ,1992 **Lees' Loss Prevention in the Process Industries** Frank Lees,2012-11-05 Safety in the process industries is critical for those who work with chemicals and hazardous substances or processes The field of loss prevention is and continues to be of supreme importance to countless companies municipalities and governments around the world and Lees is a detailed reference to defending against hazards Recognized as the standard work for chemical and process engineering safety professionals it provides the most complete collection of information on the theory practice design elements equipment regulations and laws covering the field of process safety An entire library of alternative books and cross referencing systems would be needed to replace or improve upon it but everything of importance to safety professionals engineers and managers can be found in this all encompassing three volume reference instead The process safety encyclopedia trusted worldwide for over 30 years Now available in print and online to aid searchability and portability Over 3 600 print pages cover the full scope of process safety and loss prevention compiling theory practice standards legislation case studies and lessons learned in one resource as opposed to multiple sources *Flight-vehicle Materials, Structures, and Dynamics: New and projected aeronautical and space systems, design concepts, and loads* ,1994 **Bureau of Ships Journal** United States. Navy Department. Bureau of Ships,1956 **Municipal and County Engineering** ,1912 **Water & Sewage Works** ,1912 Vols 76 include Reference and data section for 1929 1929 called Water works and sewerage data section *2018 CFR Annual Digital e-Book Edition, 40 Protection of Environment - Parts 61 to 62* Office of The Federal Register,2018-07-01 Publication ,1927 *Mechanism and Pharmacodynamic Material Basis of Neurodegenerative Disease Therapies* Zhi Sun,Erxi Wu,Yi Wang,2023-08-25 Neurodegenerative diseases are debilitating disorders defined as

loss of function or progressive destructing structure of the nervous system with high prevalence among the aging population. These diseases mainly include Alzheimer's disease (AD), Parkinson's disease (PD), Huntington's disease (HD), and amyotrophic lateral sclerosis (ALS). They are significantly associated with age and degeneration, becoming a devastating global health issue as a result of the growth of mean life expectancy worldwide. Few or no effective treatments are available for age-related neurodegenerative diseases, causing large socioeconomic and personal costs. The last 15 years have seen a boom in the use and integration of omic approaches such as genomic, transcriptomic, epigenomic, and metabolomic techniques to study neurodegenerative disease in an unprecedented way. While to date no therapy based on these approaches is available to cure neurodegenerative diseases, therefore it is necessary to search for new safe and effective drug candidates and treatment strategies. In this Research Topic, our prime focus would be on the use and integration of omic approaches to study biomarkers, pathogenesis, disease progression, and new therapeutic targets of neurodegenerative diseases so as to search for new safe and effective drug candidates. Bureau of Ships Journal, 1956      *Railway Age*, 1941

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## **Table of Contents Protection Of Materials And Structures From The Lo**

1. Understanding the eBook Protection Of Materials And Structures From The Lo
  - The Rise of Digital Reading Protection Of Materials And Structures From The Lo
  - Advantages of eBooks Over Traditional Books
2. Identifying Protection Of Materials And Structures From The Lo
  - Exploring Different Genres
  - Considering Fiction vs. Non-Fiction
  - Determining Your Reading Goals
3. Choosing the Right eBook Platform
  - Popular eBook Platforms
  - Features to Look for in an Protection Of Materials And Structures From The Lo
  - User-Friendly Interface
4. Exploring eBook Recommendations from Protection Of Materials And Structures From The Lo
  - Personalized Recommendations
  - Protection Of Materials And Structures From The Lo User Reviews and Ratings

- Protection Of Materials And Structures From The Lo and Bestseller Lists
- 5. Accessing Protection Of Materials And Structures From The Lo Free and Paid eBooks
  - Protection Of Materials And Structures From The Lo Public Domain eBooks
  - Protection Of Materials And Structures From The Lo eBook Subscription Services
  - Protection Of Materials And Structures From The Lo Budget-Friendly Options
- 6. Navigating Protection Of Materials And Structures From The Lo eBook Formats
  - ePub, PDF, MOBI, and More
  - Protection Of Materials And Structures From The Lo Compatibility with Devices
  - Protection Of Materials And Structures From The Lo Enhanced eBook Features
- 7. Enhancing Your Reading Experience
  - Adjustable Fonts and Text Sizes of Protection Of Materials And Structures From The Lo
  - Highlighting and Note-Taking Protection Of Materials And Structures From The Lo
  - Interactive Elements Protection Of Materials And Structures From The Lo
- 8. Staying Engaged with Protection Of Materials And Structures From The Lo
  - Joining Online Reading Communities
  - Participating in Virtual Book Clubs
  - Following Authors and Publishers Protection Of Materials And Structures From The Lo
- 9. Balancing eBooks and Physical Books Protection Of Materials And Structures From The Lo
  - Benefits of a Digital Library
  - Creating a Diverse Reading Collection Protection Of Materials And Structures From The Lo
- 10. Overcoming Reading Challenges
  - Dealing with Digital Eye Strain
  - Minimizing Distractions
  - Managing Screen Time
- 11. Cultivating a Reading Routine Protection Of Materials And Structures From The Lo
  - Setting Reading Goals Protection Of Materials And Structures From The Lo
  - Carving Out Dedicated Reading Time
- 12. Sourcing Reliable Information of Protection Of Materials And Structures From The Lo
  - Fact-Checking eBook Content of Protection Of Materials And Structures From The Lo
  - Distinguishing Credible Sources

13. Promoting Lifelong Learning
  - Utilizing eBooks for Skill Development
  - Exploring Educational eBooks
14. Embracing eBook Trends
  - Integration of Multimedia Elements
  - Interactive and Gamified eBooks

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