

Article

Experimental Study and Modeling of the Effect of ESDD/NSDD on AC Flashover of SiR Outdoor Insulators

Mohammed El Amine Slama ^{1,*}, Adnan Krzma ^{1,2}, Maurizio Albano ¹  and Abderrahmane Manu Haddad ¹ 

- ¹ Advanced High Voltage Engineering Centre, School of Engineering, Cardiff University, Queen's Buildings, The Parade, Cardiff CF24 3AA, UK; salamasek@elmengib.edu.ly (A.K.); albanom@cardiff.ac.uk (M.A.); haddad@cardiff.ac.uk (A.M.H.)
 - ² Department of Electrical and Computer Engineering, Faculty of Engineering, Elmergib University, Khoms P.O. Box 40414, Libya
- * Correspondence: slamame@cardiff.ac.uk

Abstract: Pollution flashover occurs when soluble and nonsoluble materials cover the surface of an insulator, and this may ultimately cause a reduction in its performance. In this paper, the common type of sodium chloride (NaCl) was used as a soluble pollutant (ESDD) and kaolin as a nonsoluble pollutant (NSDD). Samples of silicone rubber (SiR) insulators were selected for this study and fabricated at the Advanced High Voltage Engineering Research Centre (AHIVEC) at Cardiff University. The samples were preconditioned and polluted according to standard specifications. Additionally, the AC voltage ramp technique was used to achieve flashover (FOV) voltage with different pollution levels. The aim of this work was to investigate the effect of nonsoluble materials on flashover characteristics to understand their interaction with dry-band arcs by using FOV electrical equations and experimental data. The test results show that the FOV voltage of the silicone rubber insulator substantially decreased with the increase in both ESDD and NSDD values. It was also identified from these results that the dry-band arcs were considerably influenced by both ESDD and NSDD levels. This impact can be quantified by determining the variation of discharge parameters (N , n). Based on the FOV equations and experimental data, a mathematical model was suggested, taking into account the effect of both ESDD and NSDD.

Keywords: pollution insulators; nonsoluble deposit density; flashover characteristics; arc parameters



Citation: Slama, M.E.A.; Krzma, A.; Albano, M.; Haddad, A.M. Experimental Study and Modeling of the Effect of ESDD/NSDD on AC Flashover of SiR Outdoor Insulators. *Energies* **2022**, *15*, 3782. <https://doi.org/10.3390/en15103782>

Academic Editors: Zhijun Zhang and Huosheng Zheng

Received: 12 April 2022
Accepted: 13 May 2022
Published: 20 May 2022

Publisher's Note: MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.



Copyright: © 2022 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<http://creativecommons.org/licenses/by/4.0/>).

1. Introduction

One of the major problems facing HV electrical grid engineers is the disturbance generated by insulator arcing due to pollution flashover (FOV), especially in harsh environments [1,2]. Pollution FOV of insulators is a complex phenomenon and has become a significant aspect in the design of HV overhead lines and substations [2,3]. This phenomenon can be affected by many parameters such as insulator material, insulator profile, pollution level, and atmospheric conditions (air pressure, temperature, humidity, fog, rain, snow, ice, etc.) [1,3–6].

The chemical constitution of the pollution layer is one of the key factors affecting the FOV characteristics and performance of insulators [7,8]. Sodium chloride (NaCl) is commonly utilized as the key reference indicator for conductive pollution materials [9,10]. The pollution degree is defined by the equivalent salt deposit density (ESDD) and represents the concentration of NaCl that, when dissolved in demineralized water, gives the same volumetric conductivity as that of the natural deposit removed from a given surface of the insulator divided by the area of the surface, generally expressed in mg/cm^2 . However, in the real field, the pollution constitution depends on the local environment where NaCl is not the predominant salt, as established by many researchers [7,8,11–15]. On the other hand, the pollution layer contains insoluble materials consisting mainly of ferrite, silica, and alumina [4,9,13,15–18]. The pollution index for insoluble or nonsoluble materials is

Experimental Study And Mathematical Modeling Of Flashover

S Baum



Experimental Study And Mathematical Modeling Of Flashover:

If you ally obsession such a referred **Experimental Study And Mathematical Modeling Of Flashover** ebook that will provide you worth, acquire the definitely best seller from us currently from several preferred authors. If you want to funny books, lots of novels, tale, jokes, and more fictions collections are moreover launched, from best seller to one of the most current released.

You may not be perplexed to enjoy all ebook collections Experimental Study And Mathematical Modeling Of Flashover that we will unconditionally offer. It is not vis--vis the costs. Its approximately what you dependence currently. This Experimental Study And Mathematical Modeling Of Flashover, as one of the most working sellers here will categorically be in the middle of the best options to review.

<https://matrix.jamesarcher.co/About/uploaded-files/index.jsp/Step%20By%20Step%20Emotional%20Intelligence%20For%20Kids.pdf>

Table of Contents Experimental Study And Mathematical Modeling Of Flashover

1. Understanding the eBook Experimental Study And Mathematical Modeling Of Flashover
 - The Rise of Digital Reading Experimental Study And Mathematical Modeling Of Flashover
 - Advantages of eBooks Over Traditional Books
2. Identifying Experimental Study And Mathematical Modeling Of Flashover
 - 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 Experimental Study And Mathematical Modeling Of Flashover
 - User-Friendly Interface
4. Exploring eBook Recommendations from Experimental Study And Mathematical Modeling Of Flashover
 - Personalized Recommendations

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

- 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

Experimental Study And Mathematical Modeling Of Flashover Introduction

In the digital age, access to information has become easier than ever before. The ability to download Experimental Study And Mathematical Modeling Of Flashover has revolutionized the way we consume written content. Whether you are a student looking for course material, an avid reader searching for your next favorite book, or a professional seeking research papers, the option to download Experimental Study And Mathematical Modeling Of Flashover has opened up a world of possibilities. Downloading Experimental Study And Mathematical Modeling Of Flashover provides numerous advantages over physical copies of books and documents. Firstly, it is incredibly convenient. Gone are the days of carrying around heavy textbooks or bulky folders filled with papers. With the click of a button, you can gain immediate access to valuable resources on any device. This convenience allows for efficient studying, researching, and reading on the go. Moreover, the cost-effective nature of downloading Experimental Study And Mathematical Modeling Of Flashover has democratized knowledge.

Traditional books and academic journals can be expensive, making it difficult for individuals with limited financial resources to access information. By offering free PDF downloads, publishers and authors are enabling a wider audience to benefit from their work. This inclusivity promotes equal opportunities for learning and personal growth. There are numerous websites and platforms where individuals can download Experimental Study And Mathematical Modeling Of Flashover. These websites range from academic databases offering research papers and journals to online libraries with an expansive collection of books from various genres. Many authors and publishers also upload their work to specific websites, granting readers access to their content without any charge. These platforms not only provide access to existing literature but also serve as an excellent platform for undiscovered authors to share their work with the world. However, it is essential to be cautious while downloading Experimental Study And Mathematical Modeling Of Flashover. Some websites may offer pirated or illegally obtained copies of copyrighted material. Engaging in such activities not only violates copyright laws but also undermines the efforts of authors, publishers, and researchers. To ensure ethical downloading, it is advisable to utilize reputable websites that prioritize the legal distribution of content. When downloading Experimental Study And Mathematical Modeling Of

Flashover, users should also consider the potential security risks associated with online platforms. Malicious actors may exploit vulnerabilities in unprotected websites to distribute malware or steal personal information. To protect themselves, individuals should ensure their devices have reliable antivirus software installed and validate the legitimacy of the websites they are downloading from. In conclusion, the ability to download Experimental Study And Mathematical Modeling Of Flashover has transformed the way we access information. With the convenience, cost-effectiveness, and accessibility it offers, free PDF downloads have become a popular choice for students, researchers, and book lovers worldwide. However, it is crucial to engage in ethical downloading practices and prioritize personal security when utilizing online platforms. By doing so, individuals can make the most of the vast array of free PDF resources available and embark on a journey of continuous learning and intellectual growth.

FAQs About Experimental Study And Mathematical Modeling Of Flashover Books

What is a Experimental Study And Mathematical Modeling Of Flashover PDF? A PDF (Portable Document Format) is a file format developed by Adobe that preserves the layout and formatting of a document, regardless of the software, hardware, or operating system used to view or print it. **How do I create a Experimental Study And Mathematical Modeling Of Flashover PDF?** There are several ways to create a PDF: Use software like Adobe Acrobat, Microsoft Word, or Google Docs, which often have built-in PDF creation tools. Print to PDF: Many applications and operating systems have a "Print to PDF" option that allows you to save a document as a PDF file instead of printing it on paper. Online converters: There are various online tools that can convert different file types to PDF. **How do I edit a Experimental Study And Mathematical Modeling Of Flashover PDF?** Editing a PDF can be done with software like Adobe Acrobat, which allows direct editing of text, images, and other elements within the PDF. Some free tools, like PDFescape or Smallpdf, also offer basic editing capabilities. **How do I convert a Experimental Study And Mathematical Modeling Of Flashover PDF to another file format?** There are multiple ways to convert a PDF to another format: Use online converters like Smallpdf, Zamzar, or Adobe Acrobats export feature to convert PDFs to formats like Word, Excel, JPEG, etc. Software like Adobe Acrobat, Microsoft Word, or other PDF editors may have options to export or save PDFs in different formats. **How do I password-protect a Experimental Study And Mathematical Modeling Of Flashover PDF?** Most PDF editing software allows you to add password protection. In Adobe Acrobat, for instance, you can go to "File" -> "Properties" -> "Security" to set a password to restrict access or editing capabilities. Are there any free alternatives to Adobe Acrobat for working with PDFs? Yes, there are many free alternatives for working with PDFs, such as: LibreOffice: Offers PDF editing features. PDFsam: Allows splitting, merging, and editing PDFs. Foxit Reader: Provides basic PDF viewing and editing capabilities. How

do I compress a PDF file? You can use online tools like Smallpdf, ILovePDF, or desktop software like Adobe Acrobat to compress PDF files without significant quality loss. Compression reduces the file size, making it easier to share and download. Can I fill out forms in a PDF file? Yes, most PDF viewers/editors like Adobe Acrobat, Preview (on Mac), or various online tools allow you to fill out forms in PDF files by selecting text fields and entering information. Are there any restrictions when working with PDFs? Some PDFs might have restrictions set by their creator, such as password protection, editing restrictions, or print restrictions. Breaking these restrictions might require specific software or tools, which may or may not be legal depending on the circumstances and local laws.

Find Experimental Study And Mathematical Modeling Of Flashover :

step by step emotional intelligence for kids

framework teen self help guide

habit building planner novel

career planning for teens advanced strategies

self help mindset ebook

manual book rhyming story collection

quick start alphabet learning workbook

young adult life skills step by step

fitness training manual framework

step by step digital literacy manual

social media literacy ebook

novel public speaking skills guide

english grammar manual global trend

novel smartphone troubleshooting manual

leadership handbook award winning

Experimental Study And Mathematical Modeling Of Flashover :

Get 100% Reliable Mathxl Answers Easily 24/7 Online 2022 Oct 1, 2022 — Are you looking for mathxl answers? You are at right place we will help you with mathxl answer keys and help you to be successful in your ... MathXL Answers on Homework for Smart Students Need MathXL answers? Know the truth about the answer keys and learn ... There's a popular myth that

you can find ready answers to MathXL questions online. MathXL 2.1,2.2 MathXL 2.1,2.2 quiz for University students. Find other quizzes for and more on Quizizz for free! How to Get 100% Accurate MathXL Answers Effortlessly Are you searching for MathXL answers yet don't have a source? Here is the complete solution for you to Unleash your academic potential. MATHXL 1.1, 1.2, 1.3 MATHXL 1.1, 1.2, 1.3 quiz for University students. Find other quizzes for Mathematics and more on Quizizz for free! MathXL Answers One of our trusted tutors will get to work to provide answers to MathXL questions that you paid for. ... MathXL quizzes, test, exercises, or even an entire class. MATHXL ANSWERS Get Outstanding Mathxl Answers To Boost Your Grade. We Provide The Answers Almost For Free. Let's Connect You To The Best Expert To Answer Your Mathxl ... 5.5-5.7 MathXL Practice Quiz Flashcards 5.5-5.7 MathXL Practice Quiz · Flashcards · Learn · Test · Match · Q-Chat. MathXL Answers From Our Top Math Assignment Writers Not so many students find correct MathXL answers online, but you have a chance to be one of them. Don't hesitate to contact us today to solve your problem. Mathxl quiz answers extension Discover videos related to Mathxl quiz answers extension on TikTok. A Dog's Purpose (2017) A dog looks to discover his purpose in life over the course of several lifetimes and owners. A Dog's Purpose (film) A Dog's Purpose is a 2017 American family comedy-drama adventure film directed by Lasse Hallström and written by W. Bruce Cameron, Cathryn Michon, ... A Novel for Humans (A Dog's Purpose, 1) This moving and beautifully crafted story teaches us that love never dies, that our true friends are always with us, and that every creature on earth is born ... Watch A Dog's Purpose | Prime Video A dog looks to discover his purpose in life by showing humans how to laugh and love over the course of several lifetimes and owners. 20,2221 h 39 min2017. A Dog's Purpose This moving and beautifully crafted story teaches us that love never dies, that our true friends are always with us, and that every creature on earth is born ... A Dog's Purpose A Dog's Purpose is a 2010 novel written by American author W. Bruce Cameron. It chronicles a dog's journey through four lives via reincarnation and how he ... A Dog's Purpose A devoted dog (Josh Gad) discovers the meaning of its own existence through the lives of the humans it teaches to laugh and love. A Dog's Purpose #1 This story teaches us that love never dies, that our true friends are always with us, and that every creature on earth is born with a purpose. GenresFiction ... 2004 us national chemistry olympiad - local section exam Local Sections may use an answer sheet of their own choice. The full examination consists of 60 multiple-choice questions representing a fairly wide range of ... 2004 U. S. NATIONAL CHEMISTRY OLYMPIAD Part I of this test is designed to be taken with a Scantron® answer sheet on which the student records his or her responses. Only this. Scantron sheet is graded ... Organic-Chemistry-ACS-sample-Questions.pdf ACS Examination guide (Selected Questions). Organic Chemistry. Nomenclature. 1. What is the IUPAC names for this compound? a) 1-tert-butyl-2-butanol b) 5,5 ... National Norms | ACS Exams High School Exams · General Chemistry Exams · General Organic Biochemistry Exams · Analytical Chemistry Exams · Organic Chemistry Exams · Physical Chemistry Exams ... ACS Exams Questions: 70. Time: 110. Stock Code: OR16. Title: 2016 Organic Chemistry Exam - Exam for two-semester Organic Chemistry. Norm: View PDF. Questions: 70. Time: ... Acs Review

2004 | PDF Acs Review 2004 - Free ebook download as PDF File (.pdf) or read book online for free. Organic Chemistry 2004 ACS. ACS Exam Review 2004-4-23-21 - YouTube ACS Organic Chemistry I Final Exam Review Session - YouTube Exam Archives: 3311 (OChem I) ACS organic chem final May 1, 2007 — I am taking my organic chem final next week. Its national exam written by ACS. Just wonder have any of you taken it before. How hard is it?