



# Sulfate Attack On Concrete

**Nayef Ghasem, Redhouane Henda**

A red circular graphic with a gradient, appearing as a stylized arrow or a partial circle, located to the right of the author names.

## **Sulfate Attack On Concrete:**

**Sulfate Attack on Concrete** J. Marchand, Ivan Odler, Jan P. Skalny, 2001-10-11 Sulfate Attack on Concrete provides a comprehensive reference to this important subject It covers a short history of concrete deterioration due to sulfate attack the origin of sulfates in concrete the importance of appropriate concrete processing forms and physical chemical mechanisms of concrete deterioration due to sulfates preventative measures standardisation and numerous case histories This book is an essential reference for industry practitioners involved in concrete science and engineering and also for academics and researchers of materials science and concrete technology *Materials Science of Concrete* Jacques Marchand, Jan P. Skalny, 1999 This volume contains ten invited presentations on the topic of sulfate attack caused by external sulfate sources The discussions concentrate on chemical and physical mechanistic aspects of the applicable sulfate to paste reactions and on the interrelationships between the internal e g paste composition pore solution concrete matrix permeability and external e g composition of aggressive medium temperataure and humidity curing practices variables

**External Sulfate Attack of Concrete** Federico Macias Aguayo Jr., 2016 Sulfate attack of concrete is perhaps the least understood of the major durability mechanisms plaguing reinforced concrete infrastructures Many studies have attempted to better understand the underlying mechanisms in which the various modes of deterioration by sulfate attack manifest however several controversies still exist Moreover ASTM C 1012 2012 which is the most commonly referred standardized laboratory test method to determine sulfate resistance of blended portland cement mixtures does not always link well to field performance and may take up to 18 months to complete The research program presented in this dissertation investigates various issues pertaining to the mechanisms testing methods and factors influencing external sulfate attack The primary focus of this research study was to investigate and propose a reliable and innovative accelerated test method to evaluate the sulfate performance using concrete specimens The research program was divided into the following four key components 1 design a method that can obtain results within a reasonable timeframe less than six months 2 design a method that uses concrete specimens and thus links more closely to field performance 3 develop a better understanding on the role and mechanisms of sulfate attack on concrete through a comprehensive research program including field and laboratory investigations and 4 investigate the use of calcium sulfate gypsum used as an additive to mitigate the potential of sulfate attack in blended portland cement mixtures using high calcium fly ash The findings in this dissertation led to the development of a potential accelerated test method for determining sulfate resistance by vacuum impregnating concrete or mortar samples with sulfate solution to accelerate the ingress and onset of chemical reactions between the hydrated cement paste and sulfate ion  $\text{SO}_4^{2-}$  The effects of binder type water to cementitious ratio w/cm curing regime sulfate type and concentration are examined In comparison to the conventional ASTM C 1012 method results showed a higher rate of expansion with significant distress observed in samples subjected to the accelerated test method and placed in a 5%  $\text{Na}_2\text{SO}_4$  solution Similar trends but at a relatively lower expansion rate were

also observed in samples placed in a 0.89% Na<sub>2</sub>SO<sub>4</sub> solution. Physical measurements, chemical analysis and microstructural studies were performed periodically on the specimens.

#### **External Sulphate Attack - Field Aspects and Lab Tests**

Esperanza Menéndez, Véronique Baroghel-Bouny, 2019-09-17. This volume gathers contributions from the final workshop of the RILEM TC 251-SRT Sulfate Resistance Testing on External Sulfate Attack (TESA 2018) held on May 24-25, 2018, at IETcc CSIC Madrid, Spain. One of the Technical Committee's main events, it addressed various aspects of external sulfate attack in concrete structures and test methods. The workshop promoted technical discussions and debates on ideas on these topics with a focus on evaluating the resistance of concrete exposed to ESA. It also provided a forum for participants from around the globe to share their experiences and research on concrete structures affected by external sulfate attack and on test methods. The book discusses the latest advances in research related to ESA and new developments in test methods and features real-world case studies of concrete structures affected by external sulfate attack in various countries. It also presents new studies linking field cases and lab tests, including 12 contributions on 3 main themes: mechanisms of alteration in external sulfate attack, field aspects of external sulfate attack, and testing to evaluate the resistance of concrete to external sulfate attack.

#### **Resistance to Sulfate Attack of Concrete Using Special Cements as Compared with Concrete**

**Using Type V Sulfate-resisting Cement**, 1961. *Aspects of Sulfate Attack on Concrete*. A. de Sousa Coutinho, 1979. This paper discusses three aspects of sulfate attack on concrete that are important in understanding the development of sulfate-resisting concretes. These are the importance of a precipitated layer of reaction products at the surface of the concrete, the role of aggregate type in the formation of ettringite, and the importance of the alkalinity of the medium in which the ettringite is formed. It is shown that alumina of kaolinized feldspar reacts with sulfates in a supersaturated lime medium, giving rise to expansive ettringite. It is also shown that lowering the concentration of lime in the medium inhibits expansion; this is accomplished by replacing 40% or more of the cement with pozzolan.

#### **Sulfate Attack on Concrete**

Menashi David Cohen, 1991. **Fly Ash Increases Resistance of Concrete to Sulfate Attack**. James T. Dikeou, 1975. *Investigation of Sulfate Attack on Concrete*. John Donald Whitaker, 1992. **Sodium Sulfate Attack on Concrete**. Dominic Langelier, 2015.

Concrete is a construction material used in the majority of existing structures such as bridges, dams, buildings, etc. In some cases, the structures are exposed to sulfates which attack and deteriorate the concrete due to chemical reaction. The resistance of concrete to sulfate attack is typically represented by the expansion of concrete or mortar bars which are fully submerged in sulfate solution described in the ASTM C 1012 standard. This exposure is poorly representative of the conditions to which concrete is exposed in the field, since in most situations concrete is only partially submerged and in many cases subjected to cyclic exposure to sulfates. Furthermore, the parameter tested in the standard, i.e., expansion, does not necessarily represent the damage to the concrete. For these reasons, the objective of this research was to investigate sulfate attack under different exposure conditions which are more representative of those found in the field. The quantification of

damage was done by looking at different transport properties and changes to those properties since they directly correspond to the mechanism in which the sulfate enters the concrete *SP-317 Sulfate Attack on Concrete* Mohamed T. Bassuoni, Doug Hooton, Thanos Drimalas, 2017-06-12 **Sulfate Attack on Concrete** Mohamed T. Bassuoni, R. Douglas Hooton, Thanos Drimalas, 2017 *Laboratory and Field Evaluations of External Sulfate Attack in Concrete* Thanos Drimalas, Texas. Department of Transportation, United States. Federal Highway Administration, 2011 **Accelerated Sulfate Attack on Concrete in a Hot Climate** FF. Wafa, 1994 An accelerated experimental investigation was conducted to study the effect of high sulfate concentration on concrete compressive strength The effect of sulfate exposure on concrete compressive strength was evaluated by immersing concrete specimens 100 mm cubes in a 10% magnesium sulfate solution The variable parameters were the type of cement mixture proportions curing period and period of sulfate attack Test results showed that the use of a high W/C ratio with Type I cement produced weak concrete with a loss of compressive strength up to 50% after 15 months of sulfate exposure Using a rich mixture with Type V cement and a low W/C ratio produced dense impermeable concrete that showed no losses of strength even after 15 months of sulfate exposure in a hot humid environment

*Construction Materials* J.M. Illston, Peter Domone, 2001-08-30 Thoroughly revised and updated the third edition of this popular textbook continues to provide a comprehensive coverage of the main construction materials for undergraduate students of civil engineering and construction related courses It creates an understanding of materials and how they perform through a knowledge of their chemical and physical structure leading to an ability to judge their behaviour in service and construction Materials covered include metals and alloys concrete bituminous materials brickwork and blockwork polymers and fibre composites Each material is discussed in terms of structure strength and failure durability deformation practice and processing The sections on concrete polymers and fibre composites have been significantly revised Descriptions of important properties are related back to the structure and forward to basic practical considerations With its wealth of illustrations and reader friendly style and layout *Construction Materials* **Principles of Chemical Engineering Processes** Nayef Ghasem, Redhouane Henda, 2008-09-19 Written in a clear concise style *Principles of Chemical Engineering Processes* provides an introduction to the basic principles and calculation techniques that are fundamental to the field The text focuses on problems in material and energy balances in relation to chemical reactors and introduces software that employs numerical methods to solve these problems Upon mastery of this material readers will be able to Understand basic processing terminology batch semibatch continuous purge and recycle and standard operations reaction distillation absorption extraction and filtration Draw and fully label a flowchart for a given process description Choose a convenient basis for calculation for both single and multiple unit processes Identify possible subsystems for which material and energy balances might be written Perform a degree of freedom analysis for the overall system and each possible subsystem formulating the appropriate material and energy balance equations Apply the first law of thermodynamics calculate energy

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Significance of Tests and Properties of Concrete and Concrete-making Materials Joseph F. Lamond, J. H. Pielert, 2006

*PRO 35: International RILEM Workshop on International Sulfate Attack and Delayed Ettringite Formation* Karen Scrivener, Jan Skalny, 2002      **Service Life of Drainage Pipe** Lester H. Gabriel, 1998 The synthesis describes the current state of the practice regarding state transportation agency standards and strategies that determine and define the service life of drainage pipe Information for the synthesis was collected by surveying state transportation agencies and by conducting a literature search Avant propos      **Significance of Tests and Properties of Concrete and Concrete-making Materials** Paul Klieger, 1994

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web sep 2 2023 the complete set of welding symbols is published by the american national standards institute ansi and the american welding society aws elementary symbols elementary symbols are usually added to the reference line their purpose is to indicate the type of weld you can usually find them marked at the midpoint

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web certified welding inspector cwi listed below is helpful information for this selected aws certification including what it is education and experience prerequisites technical references exam requirements and preparation suggestions renewal and recertification information and faqs

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web for example 9603xxxw means that the welder was certified in march of 1996 the next three digits of the number are unique and the last letter of the cw number indicates that the certification is for a welder guide to interpreting abbreviations on

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web is 1 3 of the us gdp welding is a 34 billion industry labor represented more than 70 of welding related expenditures 22 4 billion in 2000 there are more than welders working in us the average age of welders in today s workforce is it is estimated that there will be a shortage of

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web welding processes 4 volume 2 of the american welding society s welding handbook 8th edition presents in 1 for further information on the categorization of the welding joining cutting and allied processes see appendix a 2 at the time of the preparation of this chapter the referenced codes and other standards were valid

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