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The book covers the topic of geopolymers, in particular it highlights the relationship between structural differences as a result of variations during the geopolymer synthesis and its physical and chemical properties. In particular, the book describes the optimization of the thermal properties of geopolymers by adding micro-structural modifiers such as fibres and/or fillers into the geopolymer matrix. The range of fibres and fillers used in geopolymers, their impact on the microstructure and thermal properties is described in great detail. The book content will appeal to researchers, scientists, or engineers who are interested in geopolymer science and technology and its industrial applications.

A geopolymer is a solid aluminosilicate material usually formed by alkali hydroxide or alkali silicate activation of a solid precursor such as coal fly ash, calcined clay and/or metallurgical slag. Today the primary application of geopolymer technology is in the development of reduced-CO2 construction materials as an alternative to Portland-based cements. Geopolymers: structure, processing, properties and industrial applications reviews the latest research on and applications of these highly important materials. Part one discusses the synthesis and characterisation of geopolymers with chapters on topics such as fly ash chemistry and inorganic polymer cements, geopolymer precursor design, nanostructure/microstructure of metakaolin and fly ash geopolymers, and geopolymer synthesis kinetics. Part two reviews the manufacture and properties of geopolymers including accelerated ageing of geopolymers, chemical durability, engineering properties of geopolymer concrete, producing fire and heat-resistant geopolymers, utilisation of mining wastes and thermal properties of geopolymers. Part three covers applications of geopolymers with coverage of topics such as commercialisation of geopolymers for construction, as well as applications in waste management. With its distinguished editors and international team of contributors, Geopolymers: structure, processing, properties and industrial applications is a standard reference for scientists and engineers in industry and the academic sector, including practitioners in the cement and concrete industry as well as those involved in waste reduction and disposal. Discusses the synthesis and characterisation of geopolymers with chapters covering fly ash chemistry and inorganic polymer cements Assesses the application and commercialisation of geopolymers with particular focus on applications in waste management Reviews the latest research on and applications of these highly important materials

Geopolymer is an amorphous aluminosilicate binder which is produced by hydrothermal synthesis of aluminosilicates in the presence of concentrated alkaline or alkaline silicate solutions. It is an emerging construction material purported to provide an environmentally-friendly alternative to ordinary Portland cement (OPC) based concrete. Owing to its ceramic-like properties, geopolymer has been touted to be a highly fire resistant material. This claim is further supported by results from investigations of residual strength after thermal exposure. Some studies have found that geopolymers increase in strength after exposure to temperatures of 800°C. In contrast, several recent studies have shown a decrease in residual strength of geopolymers after a similar exposure. These contradictory observations are explored here. The study shows that two opposing processes are occurring simultaneously in geopolymers at elevated temperatures. Process (1) is further geopolymerization, and has the effect of increasing the strength. Process (2) is the damage due to thermal incompatibility which arises because of (i) the temperature gradient and (ii) different movements between matrix and inclusions. Process (2) is also a function of the brittleness level of the material. Whether the strength increases or decreases is dependent on which of the two processes is dominant in the specimen and the test conditions.The detailed examination of process (2) reveals a strong correlation between the degree of strength loss and the brittleness of geopolymers. This correlation suggests that geopolymers are quite brittle. For the first time, the brittleness of geopolymer concrete has been quantitatively determined and compared with OPC concrete. The comparatively high brittleness of geopolymer concrete is important for its fire resistance properties. The high brittleness will also require special structural design measures, similar to the design requirements for high strength concrete. With regard to the fire resistance of geopolymers, most research to date has investigated only residual strength, but the properties of geopolymer while hot have received less attention. Therefore, a number of tests to determine stress-strain curve, ultimate strength, elastic modulus and creep were undertaken in steady and transient heating conditions. In these tests, several critical features of the material's performance were observed: (1) geopolymers exhibit glass transition behaviour at elevated temperatures; (2) glass transition temperature is improved by the substitution of a sodium-based activator for the potassium-based activator; (3) below glass transition temperature there is a significant increase in hot strength and hot elastic modulus; (4) in the range of 250-550°C thermal transitional creep is absent as compared to OPC concrete. Data obtained from these measurements can serve as input for the development of constitutive models which are essential to predict the response of geopolymer concrete elements in fire. In addition to its deteriorating properties at high temperatures, concrete can also be damaged in fire by a phenomenon called spalling, which is particularly severe in high strength concrete. Since geopolymer is comparatively more brittle than high strength concrete, the issue of spalling in fire is further explored in the last part of this study. It was found that the spalling resistance of geopolymer concrete increases as maximum aggregate size increases. The increasing aggregate size results in an increase in fracture zone length (lp); this in turn reduces the flux of kinetic energy (due to pore pressure) that is released into the fracture front and thereby improves spalling resistance. This theory is further validated by the observation of a good correlation between lp and spalling resistance in this thesis. This study is the first to propose such a hypothesis on the effect of aggregate size on the spalling of concrete, both OPC and geopolymer, and contributes to a better understanding of spalling of concrete in fire.

An excellent one-volume resource for understanding the most important current issues in the research and advances in materials science for environmental and energy technologies This proceedings volume contains a collection of 20 papers from the 2016 Materials Science and Technology (MS&T'16) meeting held in Salt Lake City, UT, from October 24-27 of that year. These conference symposia provided a forum for scientists, engineers, and technologists to discuss and exchange state-of-the-art ideas, information, and technology on advanced methods and approaches for processing, synthesis, characterization, and applications of ceramics, glasses, and composites. Topics covered include: the 8th International Symposium on Green and Sustainable Technologies for Materials Manufacturing Processing; Materials Issues in Nuclear Waste Management in the 21st Century; Construction and Building Materials for a Better Environment; Materials for Nuclear Applications and Extreme Environments; Nanotechnology for Energy, Healthcare, and Industry; and Materials for Processes for CO2 Capture, Conversion and Sequestration. Logically organized and carefully selected articles give insight into advances in materials science for environmental and energy technologies. Incorporates the latest developments related to advances in materials science for environmental and energy technologies Advances in Materials Science for Environmental and Energy Technologies VI: Ceramic Transactions Volume 262 is ideal for academics in mechanical and chemical engineering, materials and or ceramics, chemistry departments and for those working in government laboratories.

This proceedings contains a collection of 24 papers from The American Ceramic Society’s 41st International Conference on Advanced Ceramics and Composites, held in Daytona Beach, Florida, January 22-27, 2017. This issue includes papers presented in the following symposia: • Symposium 3 14th International Symposium on Solid Oxide Fuel Cells (SOFC) • Symposium 8 11th International Symposium on Advanced Processing & Manufacturing Technologies for Structural & Multifunctional Materials and Systems • Symposium 11 Advanced Materials and Innovative Processing ideas for the Production Root Technology • Symposium 12 Materials for Extreme Environments: Ultrahigh Temperature Ceramics (UHTCs) and Nano-laminated Ternary Carbides and Nitrides (MAX Phases) • Symposium 13 Advanced Materials for Sustainable Nuclear Fission and Fusion Energy • Symposium 14 Crystalline Materials for Electrical, Optical and Medical Applications • Symposium 15 Additive Manufacturing and 3D Printing Technologies • Focused Session 1 Geopolymers, Chemically Bonded Ceramics, Eco-friendly and Sustainable Materials

Cement-based materials have been used by humans nearly since the dawn of civilization. The Egyptians used lime and gypsum cement to bind their aggregate materials, mud and straw, resulting in bricks that are used for building their famous Egyptian pyramids (between 3000 and 2500 BC). Hydrated cement is a cement material bonded together with water and used for building construction; it is characterized by acceptable chemical, physical, thermal, mechanical, and structural stability. It plays a main role in the creation of vessels for storage, roads to travel on, weather-resistant structure for protection, inert hard stabilizer for hazardous wastes, and so on. Due to the composition of these materials and their advantages, it has been practiced in different applications. Cement is an essential component of making concrete, the single most prevalent building material used worldwide for construction, skyscrapers, highways, tunnels, bridges, hydraulic dams, and railway ties. Besides their numerous desired properties, there are some undesirable features. To overcome these disadvantages, several studies were established to prepare, improve, and evaluate innovative cement-based materials. Despite its oldness and deep research, every year several methods and materials evolve and so do cement technology. This book intends to provide a comprehensive overview on recent advances in the evaluation of these materials.

Fly ash based geopolymeric binders have potential for a wide range of high temperature applications and it is receiving more attention due to their economic and environmental advantages. This kind of Geopolymeric materials possess intrinsic fire resistance due to their rigid 3-D aluminosilicate structure. Geopolymer specimens remains dimensionally stable at high temperature and provides good compressive strength also. The percentage of Na2O and SiO2/Na2O ratio affect development of internal pore structure of Geopolymers and subsequently its performance at elevated temperature. The characterisation of internal pore structure can be made by using simple experimentation like measuring water absorption, apparent porosity and water sorptivity as well as some sophisticated mineralogical and microstructure studies like SEM, XRD, MIP etc. also. This book records a huge experimental observations and explained intricate behavioural aspects of fly ash based geopolymer exposed elevated temperature. It will help the researchers and technologists to produce high temperature resistant geopolymer for different engineering applications.

What can be done about the major concerns of our Global Economy on energy, global warming, sustainable development, user-friendly processes, and green chemistry? Here is an important contribution to the mastering of these phenomena today. Written by Joseph Davidovits, the inventor and founder of geopolymer science, it is an introduction to the subject for the newcomers, students, engineers and professionals. You will find science, chemistry, formulas and very practical information (including patents' excerpts) covering: - The mineral polymer concept: silicones and geopolymers, - Macromolecular structure of natural silicates and aluminosilicates, - Scientific Tools, X-rays, FTIR, NMR, - The synthesis of mineral geopolymers, Poly(siloxonate) and polysilicate, soluble silicate, Chemistry of (Na, K)oligo-sialates: hydrous alumino-silicate gels and zeolites, Kaolinite / Hydrosodalite-based geopolymer, Metakaolin MK-750-based geopolymer, Calcium-based geopolymer, Rock-based geopolymer, Silica-based geopolymer, Fly ash-based geopolymer, Phosphate-based geopolymer, Organic-mineral geopolymer, - Properties: physical, chemical and long-term durability, - Applications: Quality controls, Development of user-friendly systems, Castable geopolymer, industrial and decorative applications, Geopolymer / fiber composites, Foamed geopolymer, Geopolymers in ceramic processing, Manufacture of geopolymer cement, Geopolymer concrete, Geopolymers in toxic and radioactive waste management. It is a textbook, a reference book instead of being a collection of scientific papers. Each chapter is followed by a bibliography of the relevant published literature including 75 patents, 120 tables, 360 figures, 550references, 700 authors cited, representing the most up to date contributions of the scientific community. The industrial applications of geopolymers with engineering procedures and design of processes are also covered in this book.