

RHEOLOGY OF FRESH CEMENT AND CONCRETE

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ABSTRACT

Cement-based materials are of enormous technological importance and their satisfactory performance depends on being able to transport and mould them in the freshly mixed state. This article describes the rheology of fresh cement, mortar, concrete and related products in the context of practical situations, and deals with testing and measurement, together with the main features of their behaviour. It explores the links between rheology and technology, and identifies areas where these are weak and could benefit from further experimental and computational effort.

KEYWORDS: Cement; concrete; mortar; grout; composites; rheometry; viscoelasticity; thixotropy; modelling.

1. INTRODUCTION AND SCOPE

Portland cement is one of the leading manufactured commodities in the world. It is the principal inorganic binder, used in all kinds of products, and major fields of use are:

- Primary construction materials, mass and reinforced concrete, whether precast in a factory, cast in situ or sprayed onto a substrate
- Precast units for masonry (bricks, blocks and artificial stone)
- Masonry mortar for bedding the units
- Floor, wall and roof finishes, either applied plastic or precast as units
- Grout, pumped into fissured or porous ground strata to seal and strengthen, or around prepacked aggregate in an alternative form of in situ concrete construction
- Oil well cement, pumped into the annulus around the production pipe to seal against the surrounding strata
- Adhesive for ceramic tiles etc.

It so dominates the field of hydraulic binders (i.e. those capable of setting and hardening under water) that it is usually referred to simply as cement. For the purposes

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Yanrong Zhang



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Rheology of Fresh Cement-Based Materials Qiang Yuan, Caijun Shi, Dengwu Jiao, 2022-12-28 This book introduces fundamentals measurements and applications of rheology of fresh cement based materials The rheology of a fresh cement based material is one of its most important aspects characterizing its flow and deformation and governing the mixing placement and casting quality of a concrete This is the first book to bring the field together on an increasingly important topic as new types of cement based materials and new concrete technologies are developed It describes measurement equipment procedures and data interpretation of the rheology of cement paste and concrete as well as applications such as self compacting concrete pumping and 3D printing A range of other cement based materials such as fiber reinforced concrete cemented paste backfills and alkali activated cement are also examined Rheology of Fresh Cement Based Materials serves as a reference book for researchers and engineers and a textbook for advanced undergraduate and graduate students

Rheology of Fresh Cement and Concrete P.F.G. Banfill, 1990-09-27 This book brings together new research information on the flow behaviour of cementitious materials from the UK France Italy Germany Poland Finland USSR USA and Japan presented at the International Conference organised by the British Society of Rheology in March 1990

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The Rheology of Fresh Concrete G. H. Tattersall, P. F. G. Banfill, 1983 **Rheology of Fresh Cement and Concrete** P. F. G. Banfill, British Society of Rheology, 1991 Properties of Fresh Concrete H.J. Wierig, 2004-06-02 This book presents new information on concrete properties and production in the light of the widespread use of ready mixed concrete and new concreting materials This book forms the Proceedings of the RILEM Colloquium held in Hanover West Germany in October 1990 Papers from 18 countries in Europe North America and the Far East are included Portlandcement concrete

rheology and workability final report , **Simulation of Fresh Concrete Flow** Nicolas Roussel, Annika Gram, 2014-03-26 This work deals with numerical simulations of fresh concrete flows After the first introductory chapter dealing with the various physical phenomena involved in flows of fresh cementitious materials the aim of the second chapter is to give an overview of the work carried out on simulation of flow of cement based materials using computational fluid dynamics CFD This includes governing equations constitutive equations analytical and numerical solutions and examples showing simulations of testing mixing and castings The third chapter focuses on the application of Discrete Element Method DEM in simulating the flow of fresh concrete The fourth chapter is an introductory text about numerical errors both in CFD and DEM whereas the fifth and last chapter give some recent examples of numerical simulations developed by various authors in order to simulate the presence of grains or fibers in a non Newtonian cement matrix Active Rheology Control of Cementitious

Materials Geert De Schutter, Karel Lesage, 2023-01-18 This book reports on cutting edge research within the new field of active rheology control of cementitious materials presenting new ideas developed within the ERC Advanced Grant Project SmartCast hosted at Ghent University which extend the possibilities of admixtures and additions beyond current options The research presented here develops a new method of actively controlling the rheology of fresh concrete during casting operations by incorporating specially designed responsive components This results in real time changes to the rheological behaviour of the cementitious material allowing the user to intervene actively after the cementitious material has left the mixing phase This newly gained agility contributes to increased processing speed and placement reliability in the case of traditional casting methods and can also facilitate advanced 3D concrete printing The different routes followed to achieve this Active Rheology Control are explained within The book suits researchers and innovative practitioners and is the first comprehensive text to present these new findings The Open Access version of this book available at <http://www.taylorfrancis.com> has been made available under a Creative Commons Attribution Non Commercial No Derivatives 4.0 license

Rheology and Processing of Construction Materials Viktor Mechtcherine, Kamal Khayat, Egor Secieru, 2019-08-24 This book gathers the peer reviewed contributions presented at two parallel closely interconnected events on advanced construction materials and processes namely the 2nd International RILEM Conference on Rheology and Processing of Construction Materials RheoCon2 and the 9th International RILEM Symposium on Self Compacting Concrete SCC9 held in Dresden Germany on 8-11 September 2019 The papers discuss various aspects of research on the development testing and applications of cement based and other building materials together with their specific rheological properties Furthermore the papers cover the latest findings in the fast growing field of self compacting concrete addressing topics including components properties and characterization chemical admixtures effect of binders incl geopolymers calcined clay etc and mixture design laboratory and in situ rheological testing constitutive models and flow modelling numerical simulations mixing processing and casting processes and additive manufacturing 3D printing Also presenting case studies the book is of interest to researchers graduate students and industry specialists such as material suppliers consultants and construction experts

Advanced Concrete Technology 2 John Newman, B S Choo, 2003-10-31 Based on the Institute of Concrete Technology s Advanced Concrete Technology Course these four volumes are a comprehensive educational and reference resource for the concrete materials technologist An expert international team of authors from research academia and industry has been brought together to produce this unique series Each volume deals with a different aspect of the subject constituent materials properties processes and testing and quality With worked examples case studies and illustrations throughout the books will be a key reference for the concrete specialist for years to come Expert international authorship ensures the series is authoritative Case studies and worked examples help the reader apply their knowledge to practice Comprehensive coverage of the subject gives the reader all the necessary reference material

Study on Microstructure and Rheological Properties

of Cement-Chemical Admixtures-Water Dispersion System at Early Stage Yanrong Zhang, 2017-07-25 This thesis studies the effects of superplasticizers polyacrylate latexes and asphalt emulsions which differ in molecular particle size from nanometers to microns on the rheological properties of fresh cement pastes FCPs as well as the action mechanisms involved It systematically investigates the rheological properties and microstructure of cement based materials and elucidates the adsorption behaviors of polycarboxylate polymers with different functional groups and their effects on cement hydration Moreover it reveals how the working mechanism of naphthalene sulfonate formaldehyde NSF differs from that of polycarboxylate ether based PCE superplasticizers Lastly it develops a conceptual microstructure model and two rheological equations These findings lend theoretical support to the development of new chemical admixtures and new higher performance cement based composites

Towards a Sustainable Management of Mine Wastes Mostafa Benzaazoua, Yassine Taha, 2020-03-06 The need for efficient and sustainable management methods of mine waste is continuously growing all around the world These waste products often present serious management problems due to their more or less significant amounts and possible environmental threats This Special Issue highlights the recent and new trends in sustainable mine waste management techniques Currently it is essential to sustainably manage mine waste considering social economic environmental and technical aspects In this Special Issue insights related to the following issues are highlighted the problems around mine waste the fine characterization of mine waste the latest available technical and environmental solutions to efficiently manage mine waste including treatment and processing before disposal and high value element recovery with the view of moving towards defining effective low cost and ecofriendly methods the recycling of mine waste products as alternative resources in different sectors and finally laboratory pilot and or industrial scale studies related to these topics of research Scientists and industry and governance stakeholders have to face these new challenges to find the best management practices for the future

Theory and Applications of Colloidal Suspension Rheology Norman J. Wagner, Jan Mewis, 2021-04-15 An essential text on practical application theory and simulation written by an international coalition of experts in the field and edited by the authors of Colloidal Suspension Rheology This up to date work builds upon the prior work as a valuable guide to formulation and processing as well as fundamental rheology of colloidal suspensions Thematically theory and simulation are connected to industrial application by consideration of colloidal interactions particle properties and suspension microstructure Important classes of model suspensions including gels glasses and soft particles are covered so as to develop a deeper understanding of industrial systems ranging from carbon black slurries paints and coatings asphalt cement and mine tailings to natural suspensions such as biocolloids protein solutions and blood Systematically presenting the established facts in this multidisciplinary field this book is the perfect aid for academic researchers graduate students and industrial practitioners alike

Advances in Experimental and Computational Rheology Maria Teresa Cidade, João Miguel Nóbrega, 2019-08-05 This book is a printed edition of the Special Issue Advances

in Experimental and Computational Rheology that was published in Fluids **The Rheology of Fresh Concrete and Its Effect on the Shotcrete Process** Virgilio Augusto Ghio,1993 **Proceedings of the 3rd International Conference on Building Innovations** Volodymyr Onyshchenko,Gulchohra Mammadova,Svitlana Sivitska,Akif Gasimov,2021-09-22 This book gathers the latest advances innovations and applications in the field of building design and construction by focusing on new design solutions for buildings and new technologies creation for construction as presented by researchers and engineers at the 3rd International Conference Building Innovations ICBI held in Poltava Baku Ukraine Azerbaijan on June 1 2 2020 It covers highly diverse topics including structures operation repairing and thermal modernization in existing buildings and urban planning features machines and mechanisms for construction as well as efficient economy and energy conservation issues in construction The contributions which were selected by means of a rigorous international peer review process highlight numerous exciting ideas that will spur novel research directions and foster multidisciplinary collaborations

Report 24: Workability and Rheology of Fresh Concrete: Compendium of Tests - Report of RILEM Technical Committee TC 145-WSM Peter J.M. Bartos,Mohammed Sonebi,Adil K. Tamimi,2002 **Handbook of Adhesive Raw Materials** Ernest W. Flick,1989-12-31 Contains descriptions of more than 2 200 materials available to the adhesives industry The book includes Supplier Addresses and a Trade Name Index Projected 1995 adhesives sales are 12 billion with steady growth and expansion into new areas Journal of Research of the National Institute of Standards and Technology ,1999

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