

Superplasticizers and Other Chemical Admixtures in Concrete

Proceedings
Twelfth International Conference
Beijing, China

October 2018

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American Concrete Institute

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Preface

In May 1978, the Canada Centre for Mineral and Energy Technology (CANMET), in association with the American Concrete Institute (ACI) sponsored a three-day conference in Ottawa, ON, Canada on the use of superplasticizers in concrete. Selected papers from the conference were published as ACI SP-62.

In 1981, CANMET again in association with the ACI, sponsored a second three-day International conference in Ottawa on the use of the superplasticizers in concrete. Proceedings of the conference were published as ACI SP-68. The purpose of the third international conference in Ottawa in 1989 was to review the progress made since the meetings in 1978 and 1981, and to bring together representatives of the chemical admixtures, cement, and concrete industries to exchange information and delineate new areas of needed research. The scope of this conference was expanded to include chemical admixtures other than superplasticizers. Proceedings of the conference were published as ACI SP-119.

In October 1994, CANMET in association with the ACI and several other organizations sponsored the fourth conference in Montreal, QC. Canada. The objective of this conference was to bring attention to new developments in chemical admixture since the last conference in 1989. Proceedings of the conference were published as ACI SP-148.

In October 1997, the Committee for the Organization of CANMET/ACI International Conference, (ACI Council), in association with the ACI and several cement and concrete organizations in Italy, sponsored the fifth conference in Rome, Italy. The conference was aimed at transferring technology in the fast -moving field of chemical admixtures. The proceedings of the conference were published as ACI SP-173.

In October 2000, Committee for the Organization of CANMET/ACI International Conferences, (ACI Council), in association with several organizations in Canada and France, sponsored the sixth conference in Nice, France. More than 50 papers from more than 20 countries were received and reviewed by the ACI review panel, and 37 were accepted for publication in the proceedings of the conference. The proceedings were published as ACI SP-195

In October 2003, The Committee for the Organization of CANMET/ACI International Conferences (ACI Council) in association with several organizations in Canada and Germany, sponsored the seventh conference in Berlin, Germany. The conference attracted more than 275 delegates and proceedings of the conference consisting of 39 papers, were published as ACI SP-217.

In October 2006, the Committee for the Organization of CANMET/ACI International Conferences, (ACI Council), sponsored the eighth conferences in Sorrento, Italy. More than 60 papers from more than 25 countries were received, and peer reviewed by the CANMET/ACI review panel in Budapest, and 36 were accepted for publication as ACI SP-239.

In October 2009, the Committee for the Organization of International Conferences (COIC) (formerly CANMET/ACI International Conferences) sponsored the ninth ACI International Conference in Seville, Spain. More than 50 papers from more than 20 countries were received and peer reviewed, and 35 were accepted for publication in the proceedings of the conference. The proceedings were published as ACI SP-262.

In October 28 to 31 2012, COIC sponsored the Tenth International Conference on Superplasticizers and Other Chemical Admixtures in Concrete in Prague, Czech Republic. More than 70 papers from all over the world were peer reviewed, and 33 were accepted

for publication in the proceedings of the conference. The proceedings were published as ACI SP-288.

In July 10-13, 2015, the COIC in association with ACI sponsored the Eleventh International Conference on Superplasticizers and Other Chemical Admixtures in concrete in Ottawa, Canada. More than 60 papers from the world over were peer reviewed, and 28 were accepted for publication in the proceedings of the conference. Also, additional papers were presented at the conference that were published in the Supplementary Papers Volume.

In October 28-31, 2018, the Chinese Ceramic Society and the China Academy of Building Research (CABR), Beijing China, in association with ACI, sponsored the Twelfth International Conference on Superplasticizers and other Chemical Admixtures in Concrete in Beijing China. More than 80 papers from all over the world were received and peer reviewed. A total of 36 refereed papers were accepted for publication in the proceedings of the conference. The proceedings were published by the ACI as SP 329. Also, 54 additional papers were presented at the conference, and were published in the Supplementary Papers Volume.

The organizers of the conference were the Chinese Ceramic Society, Beijing and the Committee for the Organization of International Conferences (formerly CANMET/ACI Conferences).

Thanks are extended to the members of the technical papers review panel that met in Hainan island, China from March 4 to 10, 2018. The panel members were selected from Canada, China, Italy, Norway, Switzerland, the U.K. and the U.S.A. Without their dedicated effort and work, it would not have been possible to publish the proceedings for distribution at the conference. Co-operation of the authors in accepting the reviewers' suggestions and in revising the draft manuscripts accordingly are greatly appreciated.

Guidance and great support for organization of the conference from Dr. V. M. Malhotra, Prof. Changwen Miao, the Honorary Chairpersons of the conference, are sincerely appreciated.

The support of CABR for the administrative work associated with the review of the papers, and the conference is gratefully acknowledged. Also, acknowledged is their support for the publication of the proceedings (ACI SP 329).

Prof. Ziming Wang, Secretary General of the Conference

Prof. Jiaping Liu and Prof. Johann Plank, Chairpersons, Scientific Committee of the Conference

Dr. Terence C. Holland, Chairperson, Paper Review Panel

Prof. Jing Huang, Vice Director of the Organizing Committee

Editors

The Twelfth International Conference on Superplasticizers and Other Chemicals Admixtures, Beijing, China, October 28-31, 2018.

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Influences of Star-Shaped Polycarboxylate Superplasticizers with Different Arm Lengths on Their Performances in Cement Paste

by Xiao Liu, Guanghong Lai, Qian Xu, Jianan Guan, Ziming Wang, and Huiqun Li

A series of star-shaped polycarboxylate superplasticizers (SPCEs) possessing different arm lengths were synthesized by changing the amount of chain transfer agent in the polymerization stage. The molecular structure information was determined by ¹H Nuclear Magnetic Resonance (¹H NMR) and gel permeation chromatography (GPC). The effects of arm length on the adsorption behavior in cement pastes, and the rheological properties, zeta potential and hydration heat of cement pastes were also evaluated. SPCE with moderate arm length exhibited prominent dispersing capacity, low surface tension, strong adsorption; the arm length was directly proportional to hydration delay and reduction. Furthermore, the moderate arm length exactly corresponded to strong hydrophilicity, suggesting that the high-performance superplasticizer was designed towards as hydrophilic as possible. The aim of this study is to provide a theoretical guidance from viewpoint of surface-interface physicochemistry in designing a superplasticizer with great potential applications in concrete engineering requiring good workability and other performances.

Keywords: polycarboxylate superplasticizer; molecular design; star-shape; arm length; cement paste; dispersion; adsorption; interface.

INTRODUCTION

Nowadays, the demands for the application of concrete admixture have increased due to the development of high-performance concrete, and thus, the researchers have devoted their efforts to exploring excellent concrete admixtures which can significantly improve the workability, strength and durability of concrete.¹ Polycarboxylate superplasticizer (PCE), a novel admixture invented in 1980s, are widely applied in concrete engineering by advantages of high water-reducing capability, good slump retention, environmentally friendly production and adjustable molecular structure.²⁻⁴

With the development of researches in the field of PCE, some researchers found that the performances of PCE are closely related to its molecular structure. Consequently, it is of great significance to probe structure-property relationship of PCE by the molecular