

Superplasticizers and Other Chemical Admixtures in Concrete

Proceedings
Thirteenth International Conference
Milan, Italy

July 2022

Denny Coffetti
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American Concrete Institute

SP-354

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Superplasticizers and Other
Chemical Admixtures in Concrete—
Conference Proceedings

Sponsored by
ACI Committees 212, 236, 238, and 239

Thirteenth International Conference
Milan, Italy
July 10-13, 2022

Editors:
Denny Coffetti,
Luigi Coppola, and
Terence Holland



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SP-354

First printing, June 2022

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Editorial production: Gail Tatum

ISBN-13: 978-1-64195-185-2

Preface

In May 1978, the Canada Centre for Mineral and Energy Technology (CANMET), in association with the American Concrete Institute (ACI) sponsored a 3-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 ACI, sponsored a second 3-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 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. The 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 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 an 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 conference 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 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, 2015, the COIC in association with ACI sponsored the Eleventh International Conference on Superplasticizers and Other Chemical Admixtures in concrete in Ottawa, ON, 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 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 as ACI SP-329. The proceedings were published as ACI SP-302. Also, 54 additional papers were presented at the conference, and were published in the Supplementary Papers Volume.

In July, 2022, after a postponement for the COVID-19 pandemic, the ACI Italy Chapter and the University of Bergamo, Italy, sponsored the Thirteenth International Conference on Superplasticizers and Other Chemical Admixtures in Concrete in Milan, Italy. The proceedings of the conference consisting of 35 refereed papers were published by ACI as SP-354. In addition to the refereed papers, about 20 other papers were presented at the conference, and were published in a supplementary papers volume.

The main topics of the papers presented at the conference are related to superplasticizers, accelerating admixtures, retarding admixtures, air-entraining agents, shrinkage-reducing agents, superabsorbent polymers, and self-healing admixtures, and their influence on the properties of the concrete in fresh and hardened state. These properties include: workability, slump-loss, time of setting, heat of hydration, strength, durability, shrinkage and creep of the concrete mixtures.

Thanks are extended to the reviewers for the valuable efforts in reviewing all the manuscripts published in the conference proceedings and in the supplementary volume.

The guidance from Dr. V. M. Malhotra and Prof. M. Collepardi, the Honorary Chairpersons of the conference, is sincerely appreciated.

Also acknowledged is the support of ACI International for the publication of the proceedings (ACI SP 354).

The Editors
Dr. Denny Coffetti
Prof. Luigi Coppola
Dr. Terence Holland

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Experimental and theoretical investigation on the adsorbed layer thickness of PCE comb polymers

Johann Plank, Johannes Stecher, Constantin Tiemeyer

Synopsis: The dosage-dependent development of the adsorbed layer thickness (ALT) of two polycondensate (BNS, AFS), four polycarboxylate (23MPEG6, 45MPEG6, 52IPEG2, 52IPEG6) and one phosphate comb polymer (45MPEG-P3) was investigated via dynamic light scattering technique using cationic polystyrene nanoparticles as substrate. It was found that polycondensates develop very thin adsorbed layers [0.3 - 0.6 nm ($1.2 - 2.4 \times 10^{-8}$ in)] whereas PCEs produce layers of $\sim 2.5 - 8$ nm ($9.8 - 31 \times 10^{-8}$ in). These values are larger than those reported previously from AFM and XPS measurements, but correlate well with results from molecular dynamics simulations. For PCE molecules, the side chain length exercises the most significant effect on the adsorbed layer thickness while the grafting density has less impact. Furthermore, stronger anchor groups such as the phosphate copolymer produce more dense polymer layers and hence higher ALT values which explain their excellent dispersing effectiveness. Spread flow tests using cement paste revealed a relatively close relationship between paste fluidity and ALT.

Keywords: Polycarboxylate; Superplasticizer; Adsorption; Cement; Steric hindrance; Adsorbed conformation; Molecular dynamics (MD) simulation; Dynamic light scattering (DLS); Nanoparticles