



# 2ND INTERNATIONAL SYMPOSIUM K-FORCE 2019

Tirana, September 9, 2019

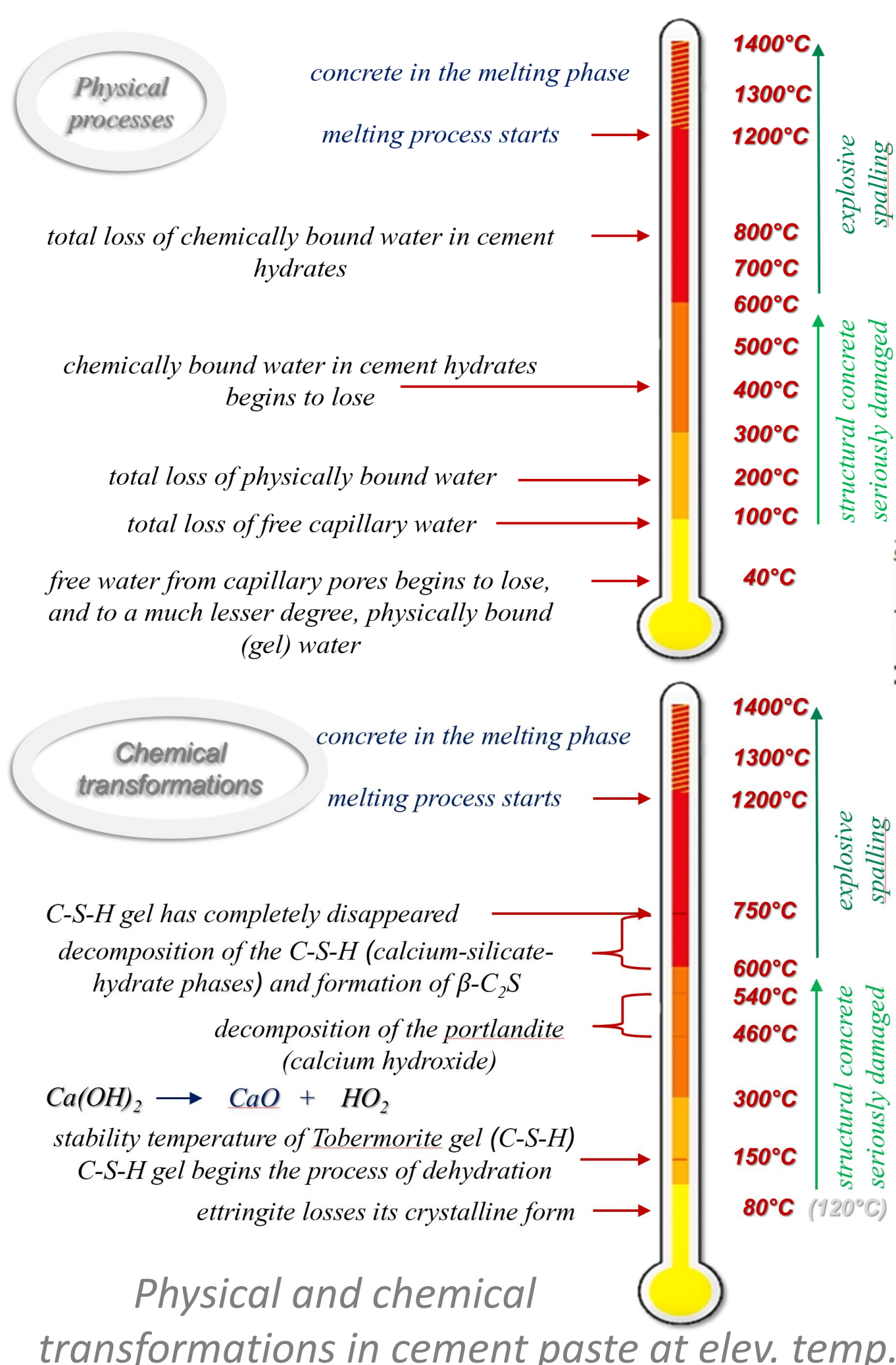
## EFFECTS OF HIGH TEMPERATURES ON CONCRETE MICROSTRUCTURE

### INTRODUCTION

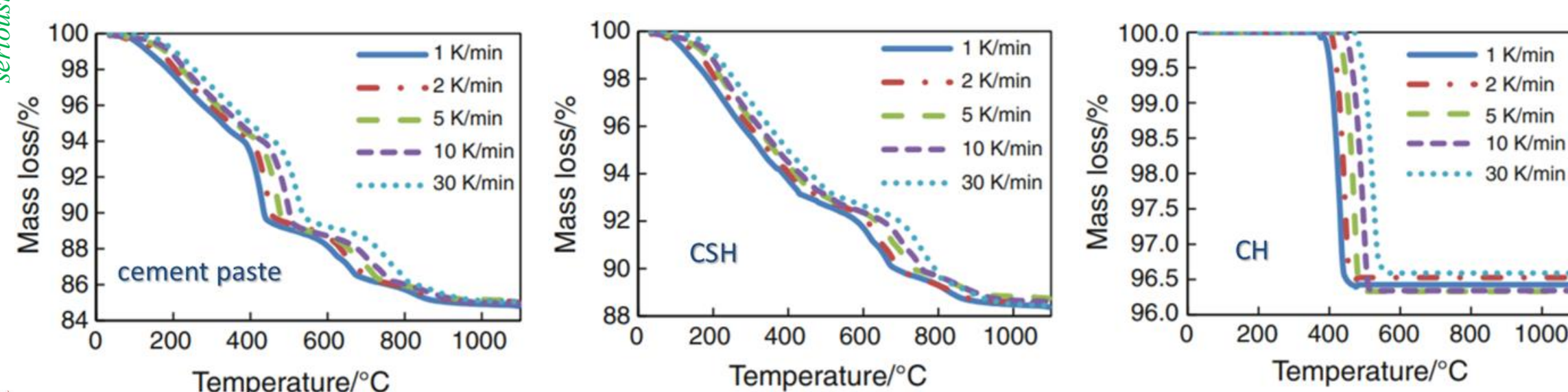
The paper presents an analysis of the effect of elevated temperatures on concrete, with an emphasis on microstructural changes in the hydrated cement paste. The physical and chemical processes in the cement paste due to the increase of temperature are described. Research has shown that the first changes in the cement matrix occur at a temperature of 300°C, and that the microcracks appear at temperatures of 500°C. Intensive microcrack development occurs at 700°C, while at temperatures of about 900°C some particles of hydration products completely cracked. Reducing the degree of degradation of cement paste is possible by applying certain types of addition.

### CORE IDEA OF THE RESEARCH

Exposure of the cement paste to elevated temperatures leads to its dehydration, which results in a decrease in strength and an increase in pore pressure in the paste. It can result as explosive spalling of concrete.



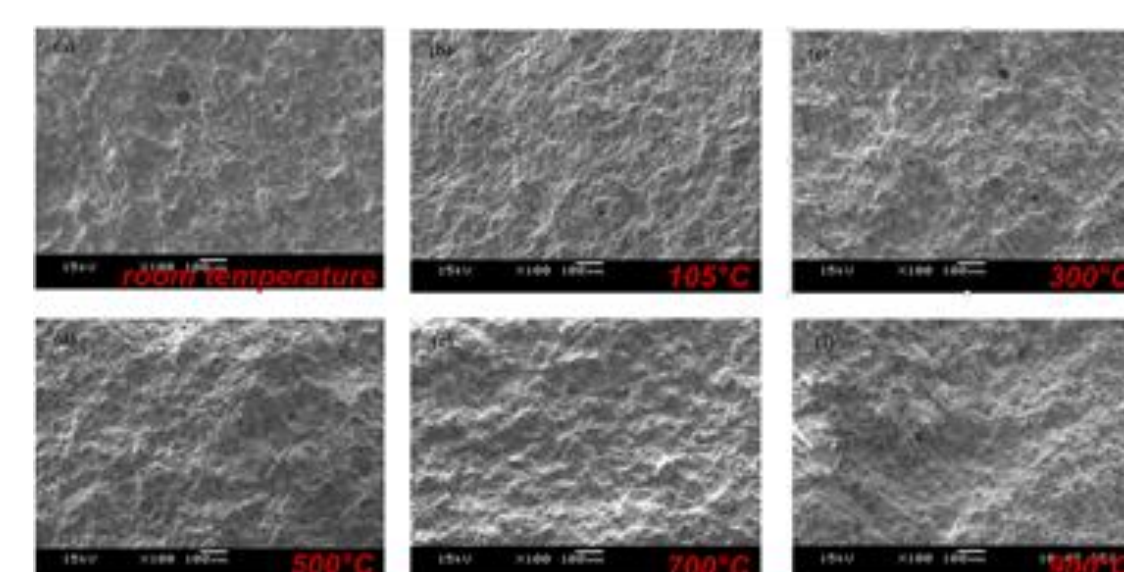
According to experimental research on cement paste dehydration at high temperatures, range of the temperature corresponding to the dehydration of the cement paste varies with the heating rate. It was found that for the samples of the cement paste with different heating rate, the dehydration starts at the same temperature, but ends at different temperature.



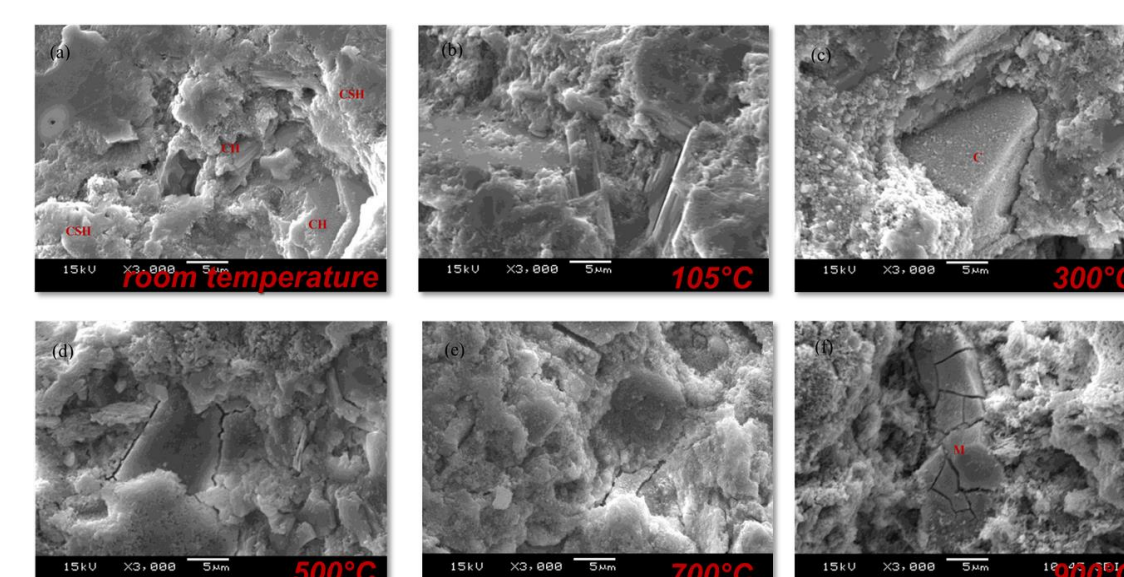
The mass loss of cement paste, CSH and CH under different heating rates

### Microstructural analysis using SEM

- ambient temperature** - CH and C-S-H crystals remained intact
- 105°C** - slight increase in surface toughness, but without any other changes
- 300°C** - the degradation of hydration products started
- 500°C** - the microcracks appeared at their interface, with propagation between the anhydrous phases and the paste matrix
- 700°C** - microcracks got more intense and the paste porosity increased
- 900°C** - some particles are totally cracked



SEM images of fractured surfaces of cement paste in 100× magnification



SEM images of fractured surfaces of cement paste in 3000× magnification

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Gordana BROČETA<sup>1</sup> Asst. prof., PhD, University of Banja Luka, Faculty of Architecture, Civil Engineering and Geodesy, B&H, e-mail: gordana.broceta@aggf.unibl.org

Marina LATINOVIĆ<sup>2</sup> Asst., MA CE, University of Banja Luka, Faculty of Architecture, Civil Engineering and Geodesy, B&H, e-mail: marina.latinovic@aggf.unibl.org

Žarko LAZIĆ<sup>3</sup> MA CE, Civil Engineering Institute Ltd. Banja Luka, B&H, e-mail: zarkolazic87@live.com

Dragana ZELJIĆ<sup>4</sup> Asst., MA CE, University of Banja Luka, Faculty of Architecture, Civil Engineering and Geodesy, B&H, e-mail: dragana.zeljic@aggf.unibl.org

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