# Hydration characteristics of silica-alumina based cementitious materials composed of steel slag

Na Zhang[1], Le Wu[2], Xiaoming Liu[2], Yihe Zhang[1]

[1] Beijing Key Laboratory of Materials Utilization of Nonmetallic Minerals and Solid Wastes, National Circular Economy Engineering Laboratory, National Laboratory of Mineral Materials, School of Materials Science and Technology, China University of Geosciences, Beijing, 100083, China

[2] School of Metallurgical and Ecological Engineering, University of Science and Technology Beijing, Beijing, 100083, China

Keywords: Steel slag, silica-alumina based cementitious material, hydration products, phosphorus.

Presenting author email: nazhang@cugb.edu.cn

**Abstract**

Steel slag is a solid waste generated during the steel-making process. Using steel slag to produce construction materials is an effective way to largely consume this solid waste. However, the high content of $P_2O_5$ in steel slag leads to a serious retarding phenomenon in Portland cement, which limits the adding amount of steel slag in the traditional cement and concrete. In this research, with the guiding idea of isostructural effect of Si to P in silica-alumina based system, silica-alumina based cementitious materials composed of steel slag were developed according to different [$SiO_4$] polymerization degree of raw materials. It was found that the steel slag presented an obvious setting retarding effect on ordinary Portland cement, while it did not show the setting retarding effect on silica-alumina based cementitious materials. The compressive strength of silica-alumina based cementitious materials composed of 20-30% steel slag cured for 28 days reached 40 MPa. The hydration products of silica-alumina based cementitious materials composed of steel slag were mostly amorphous C-A-S-H gel, ettringite and $Ca(OH)_2$. As the predominant hydration products, the filamentous and needle-like ettringite and amorphous C-A-S-H gel play a positive role in promoting densification of the paste structure, resulting in strength development in the early hydration process. Moreover, it was observed that the phosphorus in steel slag was involved into the hydration reaction to form C-A-S-H gel. This study points out a promising direction for the proper utilization of steel slag in large quantities.

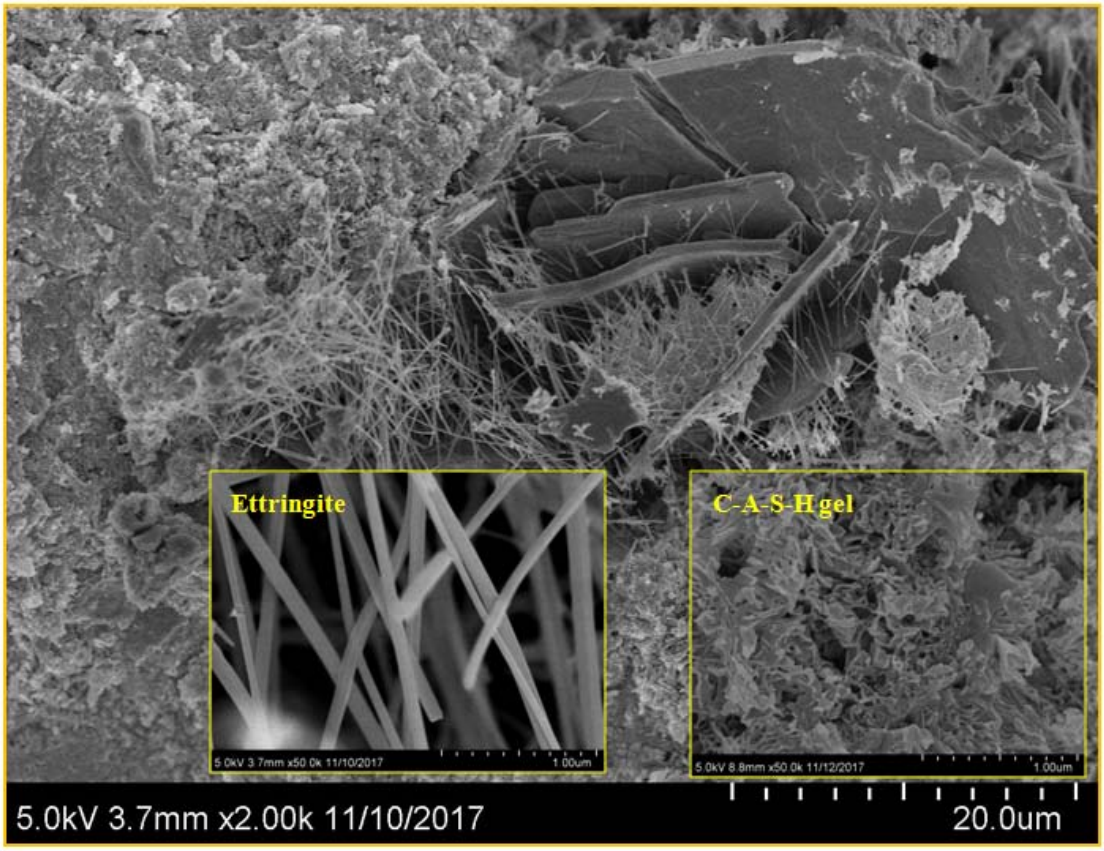


Figure 1 SEM image of hydration products of

silica-alumina based cementitious materials composed of steel slag.