

Review of the doctoral thesis

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The doctoral thesis of Gianmarco Taveri titled “Geopolymers incorporating wastes and composites processing” is dealing with the preparation of the geopolymer composites from the fly ash and borosilicate glass. The motivation of this thesis is the strong public demand for the replacement of the Portland cement causing production of about 8% of the worldwide CO₂ production.

The theoretical part of the thesis, as the longest part, covers the whole field of geopolymers, such as: history, alkali-activation, utilization of fly ash, possible applications, etc. During the history, the waterglass for geopolymerization reaction was replaced by the waste municipal glass. The author suggests, that waste municipal glass can be replaced by the waste borosilicate glass, prepared from the broken chemical vials, to even better performance of final geopolymer.

During the experimental work, the fly ash with borosilicate glass were stirred in six different ratios, mixed with different amount of water and NaOH solution and cured at 85°C for 1-3 days. For the improvement of the fracture toughness of the final geopolymer, some suspensions were mixed with cellulose fibres as well. All the resulted geopolymer bodies were then mechanically tested. The author also proposes a novel hydro-pressure sintering experiment, where the curing of the mixture at raised temperatures was replaced with the mechanical pressure (variation of the cold-sintering process). It was found, that fly ash with 55 wt.% of borosilicate glass activated in 13M NaOH solution possesses 25% higher flexural strength in 3-point bending test than other literature data. The composites with the cellulose addition possess the fracture toughness of 0.7 MPa m^{-1/2} in line with the results of other authors.

To address the issues of the thesis, I have to mention the overall low graphical level of the thesis, where at least blue-yellow printscreens from EDS should be replaced with more representative graphs. The other issue is the labelling of chapters, where the chapter “Results and Discussion” is followed by chapter “Discussion”. I suppose that the later label should be renamed as “final remarks” or something analogical.

Nevertheless, the doctoral thesis is written in clear language and it contains many valuable results, which is supported by the fact of 6 publications of the applicant on this topic. Therefore I would like to recommend Ing. Gianmarco Taveri for the award of Ph.D. title.



For the defence of the doctoral thesis, I have the following questions:

- 1) Why do you apply the 1 hour long ultrasonication? Don't you think, that fibres can be destroyed during such long ultrasonication? What was the power level used for ultrasonication? The SEM pictures at Fig. 35 are taken before or after ultrasonication?
- 2) Geopolymers should degrade slower than Portland cement. However, you prepare the geopolymer composite reinforced with cotton fibres. What will happen with such fibres over time? Do you think, that performance of such composite will be degraded by time?
- 3) The SEM picture on page 72 shows the Ti-based particle. However, there is no evidence of titan-based compounds in table 4. What was the detection limit, or why there is no trace of Ti?
- 4) Fig. 48 shows microstructure with inserted detail. The scale bar on insert detail seems unrealistic, is it right ?

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