



The Institute of Rock Structure and Mechanics of Academy of Sciences of the Czech Republic, v.v.i

Definition of a Geopolymer Matrix

Tomáš Hanzlíček
Ivana Perná

Institute of Rock Structure and Mechanics of
Academy of Sciences of the Czech Republic
V Holešovičkách 41, 18209 Praha 8
Czech Republic



Why?

- In present time doesn't exist **an internationally respected** and used definition of geopolymer matrix and materials.
- The geopolymer matrix are usually classified according to the norms of common binders (eg. Portland cement or plaster) which doesn't respect characteristic geopolymer matrix properties.
- The solidified geopolymer materials (a combination of matrix and fillers) and their properties differ from concrete, stones or ceramic but are judged by the norms of these materials.
- The definitions and specified geopolymer norms are essential for:
 - a) understanding
 - b) classification
 - c) testing and quality control



Geopolymer matrix

- An X-ray amorphous three-dimensional (3D) alumino-silicate network which at a normal pressure and ambient temperature forms water-insoluble solids.
- Such a 3D network is formed by an alkalization of thermally treated clay materials with aqueous alkali or alkaline-earth metal solutions.
- The solid substance (**matrix**) that forms is the result of polymerization processes occurring in the highly hydrated parts of thermally treated alumino-silicates.



Fillers

- The materials surrounded by the matrix and enclosed in it, not forming a demonstrable chemical bond with the matrix.
- Examples: silica sand, crushed stone, scrap glass, mica chips, paper, wood substance, straw etc



Additives

- Materials that are an inseparable part of the matrix, i.e. whose parts significantly interact with the alumino-silicate base of the matrix
- Examples: blast-furnace slags, coal, wood and straw ashes, natural volcanic ashes or also other materials such as amorphous silica (silica fume but also diatomaceous earth etc.).



Composite geopolymer matrix

- **Composite geopolymer matrix** is formed by an alkalization of thermally treated clay materials and the additives with aqueous alkali or alkaline-earth metal solutions.
- Behaves like the actual geopolymer matrix, i.e. it gives rise to a predominantly amorphous three-dimensional network, which forms water-insoluble solids, with the chemical bonds being entered by another component besides the alumino-silicate base.
- Other than an amorphous part, such a composite geopolymer network may contain also portions of the crystalline substances which are components of the additives.



Geopolymer solid - pure clay matrix

- A **geopolymer solid** prepared from a **pure clay matrix** changes its properties and quality based on the kind and type of the filler and depends on the clay base of the matrix, or more specifically on the type of the kaolinitic material in terms of the organization of the crystal lattice, particle size and the extent of the previous thermal treatment of the clay component.



Geopolymer solid - composite geopolymer matrix

- A **geopolymer solid** prepared from a **composite geopolymer matrix** is, in addition to the already-mentioned influences, considerably affected in terms of its properties and qualities by the substance of the additive and its proportions, which partially or entirely enter the geopolymerization and along with the aluminum-silicate base form an amorphous 3D network with a crystal portion of the additive.



Conclusion

- Presented definitions serve mainly for opening of a discussion.
- In the course of a transfer of laboratory work to (semi-)industrial level the definitions and norms are essential for a clarification of material types:
 - What is geopolymer?
 - Which properties and behavior could we expect?



Thank you for your attention

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