

# High-performance Concrete Containing Waste Vitrified Tiles

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# Introduction.

- The production of construction and demolition waste (CDW) raised almost up to 42 % in 2019 in Czech Republic. From 2017, the numbers are similarly high, ranging around 40 %. However, in recent years there appears increasing tendency of recycling and reusing CDW. There are studies dealing with the possibilities of the CDW utilization and management of processing it.
- Building materials create almost a half of worldwide produced materials. Due to the rapid industrial development the problems are appearing all over the world such as decreasing sources of non-renewable resources and environmental impact connected with the extraction, manufacturing and transporting these materials. At the same time, it is necessary not to omit the associated processes, which release exhaust gases such as carbon dioxide, or processes associated with the end of life of these raw materials and materials produced from them. The problem of the necessity of landfilling these used materials is connected as well.
- Sustainable development and the entire global problem with environmental impacts is related with the volume of produced concrete and the buildings made from this material. Replacing of primary raw materials needed to create concrete mixtures is convenient because of saving the primary sources and the energy resources required to obtain these raw materials. Concrete is the most used produced material in the world. The high production is the reason of the studies searching for alternative components such as natural aggregates substitutes or cement replacement.



# Results.

- ***Water absorption***

- Due to similar character of the concrete mixtures it was expected the similar value of water absorption. All the mixtures values are ranging around 3 %.

- ***Compressive strength***

- The values are ranging 112.89 – 122.42 MPa, highest results were achieved by the mixture containing 75 % and 25 % of vitrified tiles. The reference samples HPC showed slightly lower values. The lowest values have the concrete mixture containing 50% of waste vitrified tiles. However, the value is still high up to 94.61 % compared to the REF HPC sample.

- ***Flexural strength***

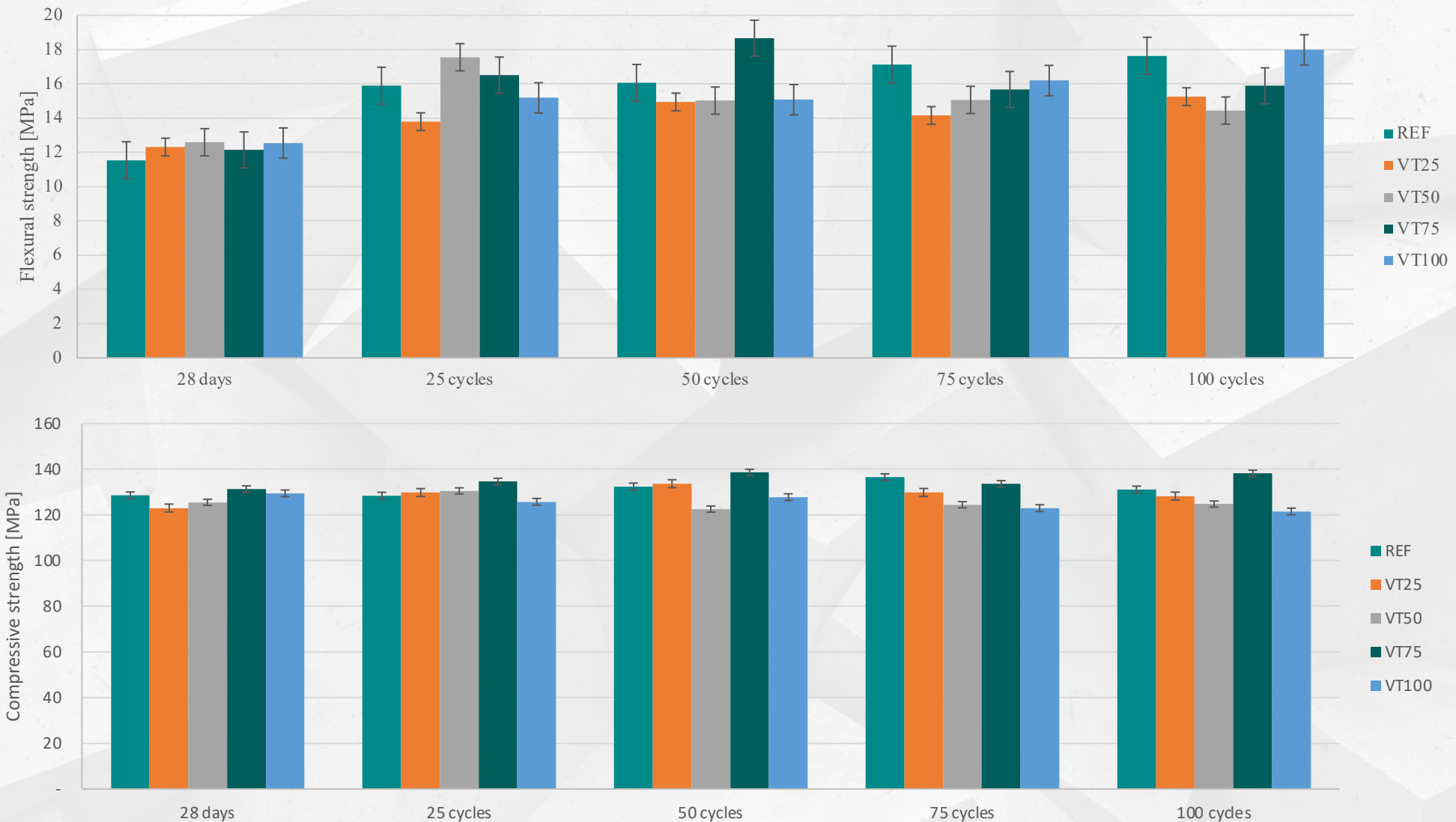
- The highest values were measured on the mixtures containing 50 % and 100 % of waste vitrified tiles substitution. In the comparison with the reference samples, the lowest value has the mixture VT 25 which is observed in the most measured parameters (compressive strength on the fragments of blocks and water absorption).

- ***Freeze-thaw resistance***

- The samples were tested in the sets of three samples. Each sample was tested in the flexural strength and compressive strength. Samples were exposed to 25, 50, 75 and 100 freeze-thaw cycles to confirm the ability of high-performance concrete to resist freeze-thaw cycles. The results validate that there is no negative effect to this quality caused by the addition of new material – waste vitrified tiles



# Results.





# Conclusion.

- Four mixtures containing different amount (25 %, 50 %, 75 % and 100 %) of waste vitrified tiles as a substitutional material were designed and tested (mixtures VT25, VT50, VT75 and VT100). All the results were compared with the reference sample REF (high-performance concrete made from primary raw materials). The water absorption values of all tested samples were around 3 %. The flexural strength was tested and VT50 and VT100 showed the highest results. The measured force and calculated strength were higher than the values of the REF. Similar numbers were evaluated on the samples after compressive strength experiment. However, the highest results were provided by VT25 and VT75 (cubes) and VT50 and VT100 (fragments of blocks). All these results were higher than results of REF.
- The freeze-thaw resistance was verified. The freezing cycles don't have the impact to the results. The compressive strength of the samples made from the mixtures containing 25, 50, 75 and 100 % substitution of silica fume by waste vitrified tiles was ranging 91 – 105 % compared to the reference sample. The flexural strength achieved 116 % compared to the reference sample after 50 freeze-thaw cycles, rest of the samples were ranging from 82 % up to mentioned 116 %. When omitted maximal and minimal, the average value was 99 % compared to the REF.
- Based on the experiments and the results, it is possible to say that the proposed mixtures are suitable for further testing and verification of their properties, which so far confirm the possibility of their use as HPC. The similarity of the resulting properties of the tested mixtures containing waste tiles with the reference mixture is given mainly by the composition of used waste vitrified tiles.



# Thank you for your attention!

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