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WATER PARMEABILITY OF CRASHED WEEE PLASTICS CEMENT COMPOSITES

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Development of cement composites from electric and electronic waste for application in building industry

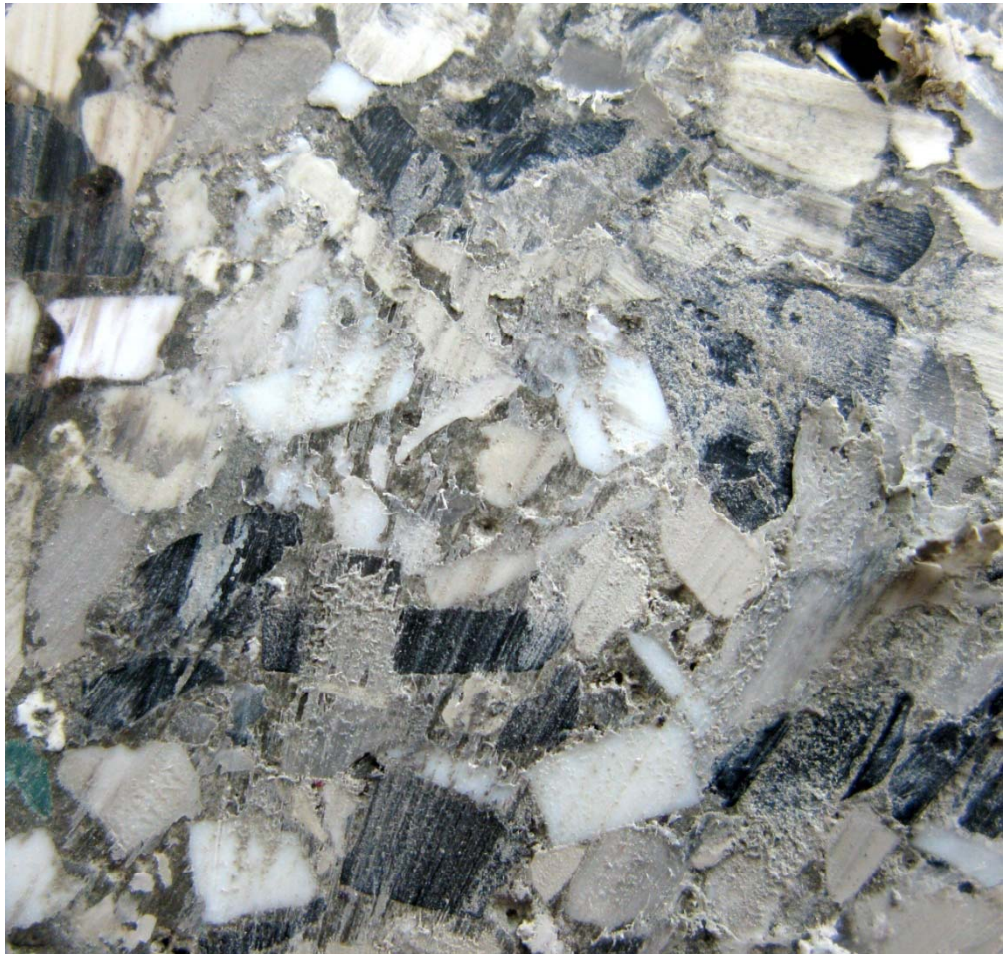
The objective of the project is a research and development of the environmentally positive building materials by utilisation of the crushed plastic waste materials produced at mechanical recycling the Waste Electrical and Electronic Equipment (WEEE) - as an aggregate.

The environment protection against the harmful components by the development of innovative technologies and procedures at the manipulation with WEEE is an overall goal of the project.

Lightweight aggregates

The WEEE crushed plastics - a relatively pure material, in which the polystyrene is a dominant component.
A thermal conductivity of the loose crushed plastics is comparable with thermal conductivities of materials with similar loose density moreover they are inert against the water

Crushed WEEE
plastics waste composite structure



Analysed composites types

Their properties result from a given crushed plastics grading and the used technology

- Mixture No. 1 - the naturally graded aggregate was used
- Mixture No. 2 - the grading was improved – missing fine aggregate fractions were added – good mechanical properties and homogeneity, suitable for products with higher thermal insulation properties and satisfactory mechanical resilience
- Mixture No. 3 - the added crushed plastic fine fractions were replaced with natural aggregate
- Mixture No. 4 - contained the superplastifier - good mechanical properties and homogeneity, good for lightened products with good mechanical properties

Water Permeability

- The water permeability of the crashed Electrical and Electronic Equipments (WEEE) plastic waste cement composites belongs to one of their critical material performance properties

- In practice their water permeability under low water hydrostatic pressure differences is important

- The low water pressures have the values close to the values characteristic for the water suction process. Hydrostatic pressure → capillarypressure

- The water absorption coefficient, which is a good characteristics of water permeability was determined for particular mixtures

Water absorption coefficients of crashed WEEE plastic waste-cement composites

Measurements – water suction tests on prisms with the 0.1/0.1 m base and the 0.05 m height.

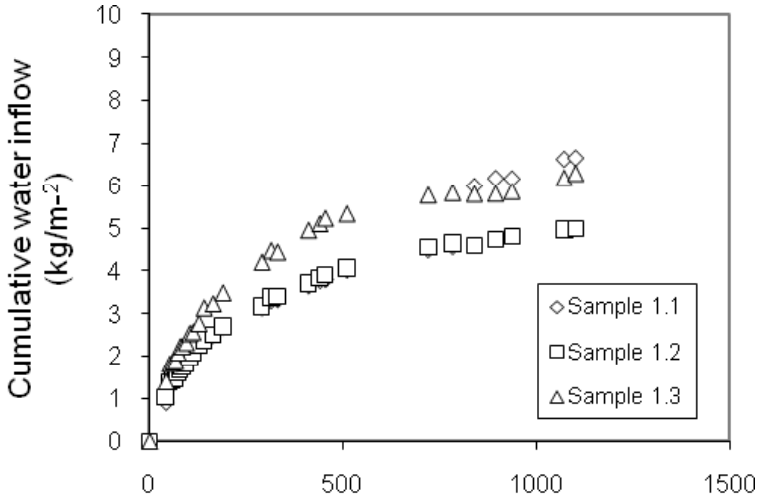
- The cumulative water intake per unit of inflow surface area (kg/m^2) is a function of the square root of time *t* :

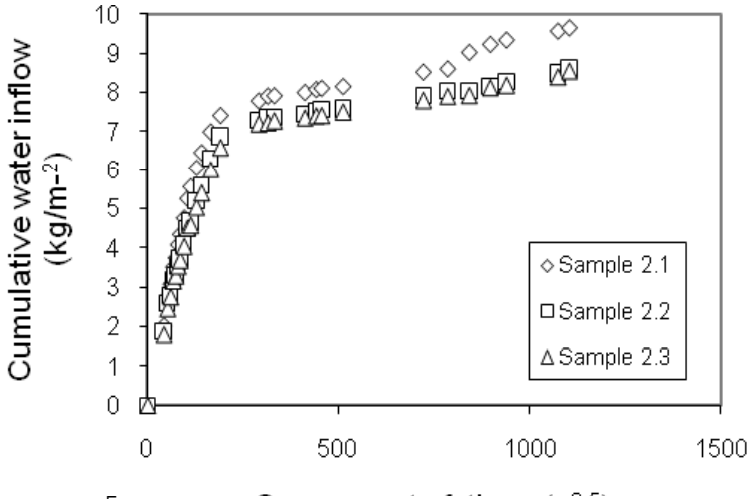
$$I = A_w \cdot \sqrt{t}$$

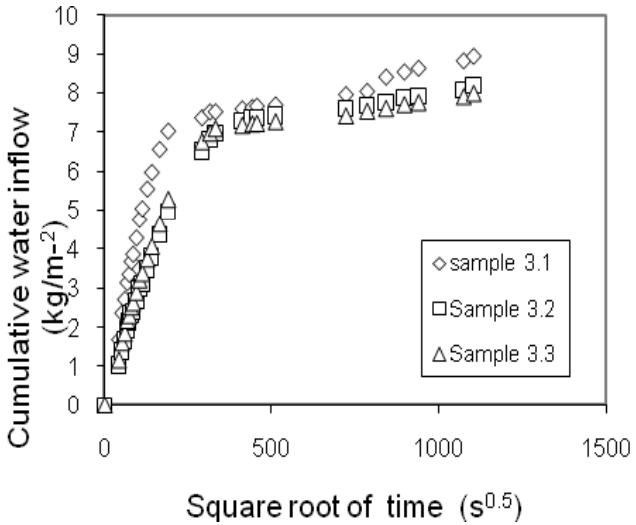
- The water absorption coefficient is then calculated according to equation:

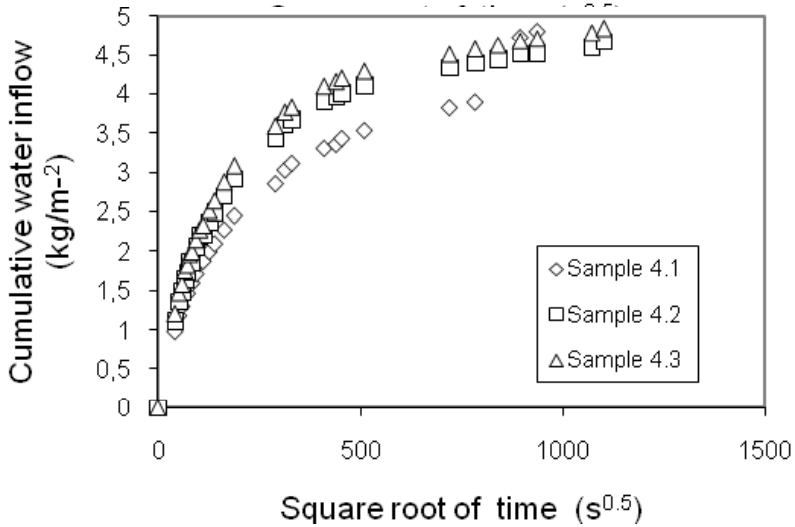
$$A_w = \frac{(m_1 - m_0)}{A \cdot \sqrt{t}}$$

Free water uptakes for Crushed WEEE plastics waste composites No. 1 - 4

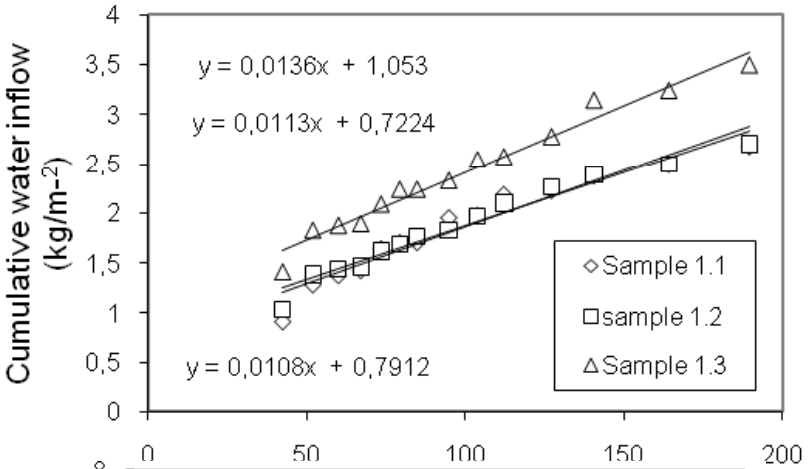


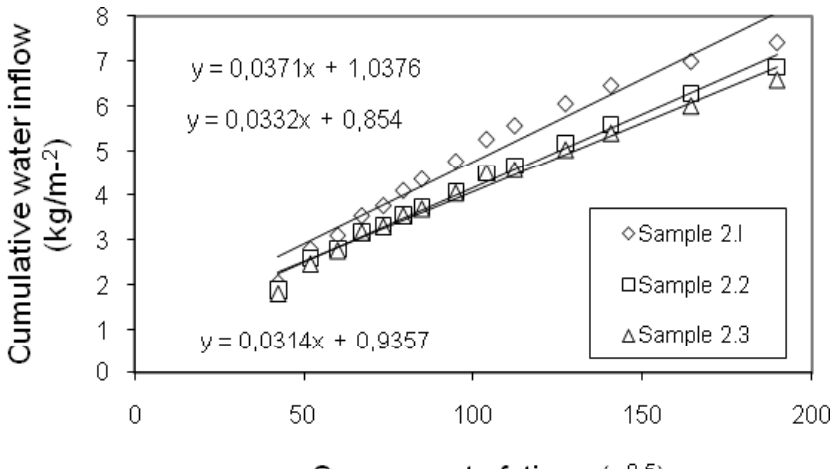


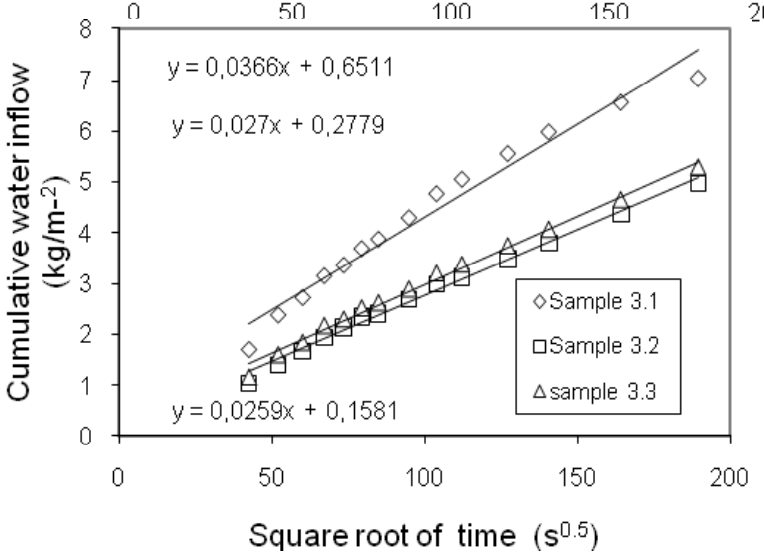


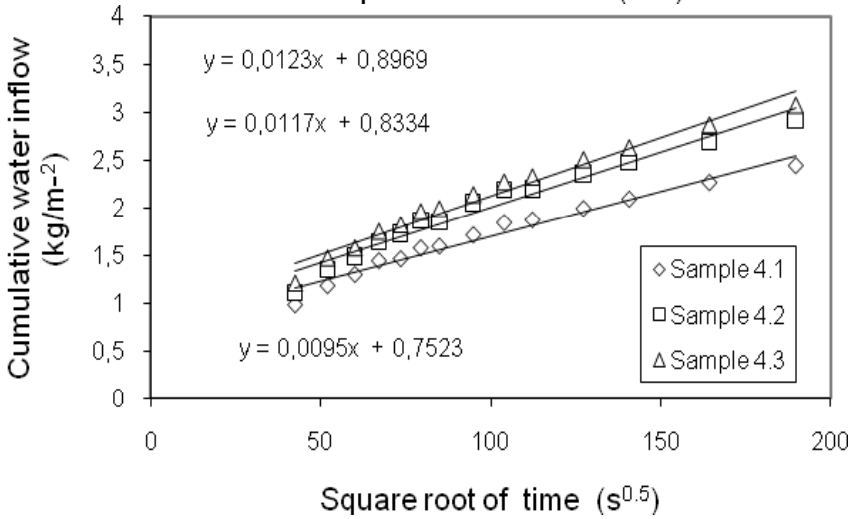


Determination of water absorption coefficients for crushed WEEE plastics waste composites No. 1 - 4









Bulk density and water absorption coefficient of particular crushed WEEE plastics waste composite types

Sample No.	Bulk density (kg/m^3)	Water absorption coefficient ($kg/m^2\ s^{-0.5}$)
1.1	1147	0.0113
1.2	1175	0.0108
1.3	1014	0.0136
Mean	**1112**	**0.012**
2.1	1134	0.0371
2.2	1103	0.0332
2.3	1096	0.0314
Mean	**1111**	**0.034**
3.1	1505	0.0366
3.2	1512	0.0259
3.3	1492	0.027
Mean	**1503**	**0.030**
4.1	1729	0.0095
4.2	1627	0.0117
4.3	1564	0.0123
Mean	**1640**	**0.0123**

Conclusions

- The water absorption coefficient is good characteristics of the crushed plastics cement composites water permeability

- The material mixture without fine aggregate fractions and the mixture with dense matrix reach the low water absorption coefficient values close to 0.01 $kg/m^2\ s^{0.5}$

- The water permeability is determined by the aggregate grains grading and the quality of the contact zone between the cement matrix and the aggregate surface

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Thank you for your attention