EVALUATION OF CEMENT MIXTURES IN THE DESIGN PHASE FROM THE ASPECT OF WATER USE

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Introduction

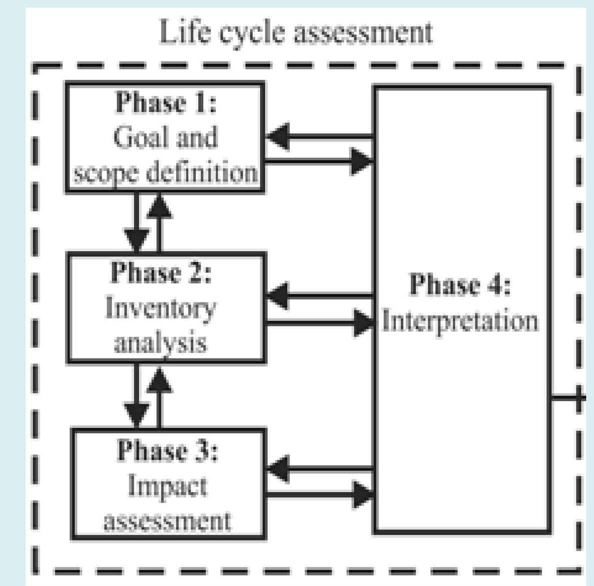
It is known that cements and concretes leave a big mark on the environment, lead to significant emissions of greenhouse gases (GHG) and affect water pollution. If the emissions generated by the cement industry were considered as emissions of one country, the cement industry would be the third in a row, after China and India [1]. Global cement production has quadrupled since 1990 until 2018. Of this, 75% of global cement production growth since 1990 has been produced in China [1]. In 2018 alone, over 4 billion tons of cement were produced globally, which released more than 1.5 billion tons of CO2.For the research needs, a comparison of floor coverings at the design stage was made to assess their impact during the life cycle. The research uses the life cycle analysis (LCA), a methodology that is the basis for analyzing the impacts during the life cycle of the analyzed construction products. The software package BEES, the National Institute of Standardization and Technology (NIST), the United States of America is used for the turn. Five types of floor coverings were analyzed, from the aspect of their impact on the environment and human health.

For the purposes of the research, five types of cement were compared, which are used in construction, in order to assess their impact on the environment in the design phase and make an assessment of which of the proposed is the most favorable from the ecological, especially the impact on water.

The methodology used in the research is life cycle analysis (LCA), which is the basis for assessing the impact of construction products on the environment. Due to the lack of national software for calculating environmental impacts, the research uses the software package BEES [17.], the National Institute of Standards and Technology (NIST). The program has a database of construction materials used in the United States, but it is possible to find products that are similar to those used in our area. In addition, it is possible to adjust the distances in the program, as well as the mode of transport from the production plant to the construction site, so it is possible to include emissions from transport. By evaluating their environmental performance, it would be possible to suggest a product with the best characteristics. Five types of cement were evaluated: (C1) 100% OPC, (C2) 20% Fly Weak, (S3) Anon IP Alternatives, (S4) Lafarge I, and (S5) New Cem 50. The cementitious materials evaluated in the study were shown in Table 1. The research was conducted with the intention to check whether, in the design phase of the facility, it is possible to evaluate cements from the aspect of their impact on the environment, impact on water, as a basic resource for human, plant and animal life on earth. The aim of the research is to consider the possibilities of application in the design phase of software packages in terms of checking the possibilities for environmental quality management, primarily the impact on water resources, in terms of water consumption, acidification and eutrophication potential, air quality, check the possibility of impact on water resources. and improve design. The parameters evaluated for cements in this study are presented in Table 2.

M e t h o d o l o g y

LCA methodoloy Research



Materijals-products those are valued

Table 1. Materials (constructionproducts) those are valued

Type of cement material	Units of measure	Oznaka u istraživanju
100% OPC	(m^3)	C1
20% Fly Slab	(m^3)	C2
Anon IP Alternatives	(m^3)	C3
Lafarge I	(m^3)	C4
New Cem 50	(m^3)	C5

Environmental

Evaluation parameters in research

Table 2. Evaluation parameters in research

No	Environmental parameters
1.	LCA Global Warming
2.	Environmental Impact- Environmental Performance
4.	Comparison of Acidification
5.	Comparison of Eutrofication
6.	Comparison of Water Intake

R e s u l t s

Environemtal Performance

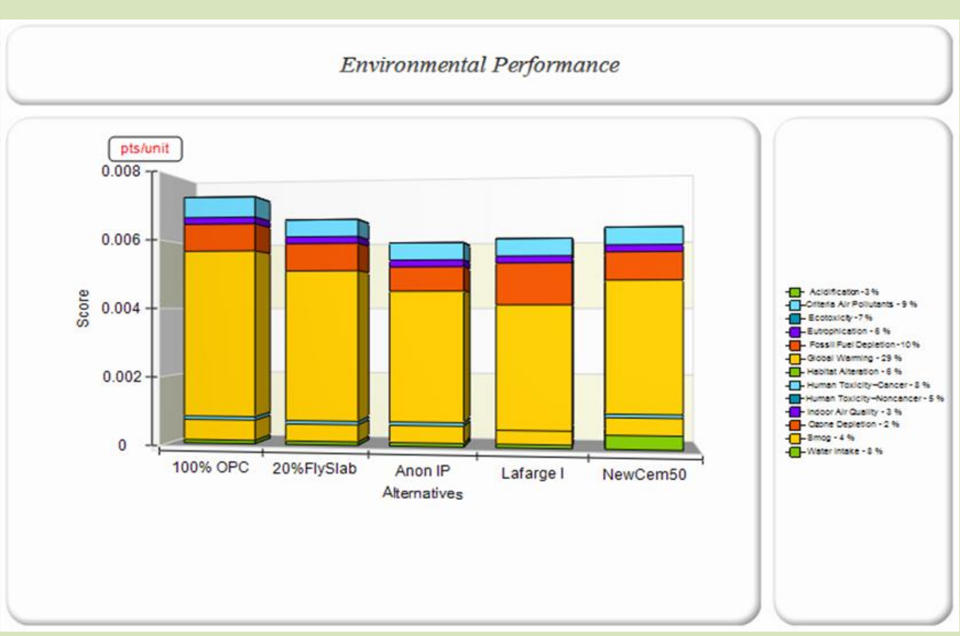
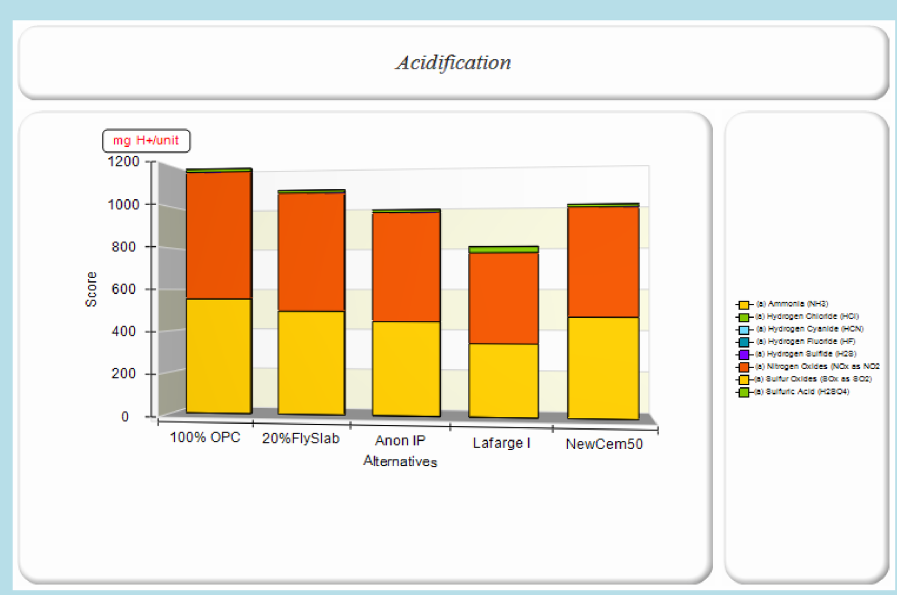


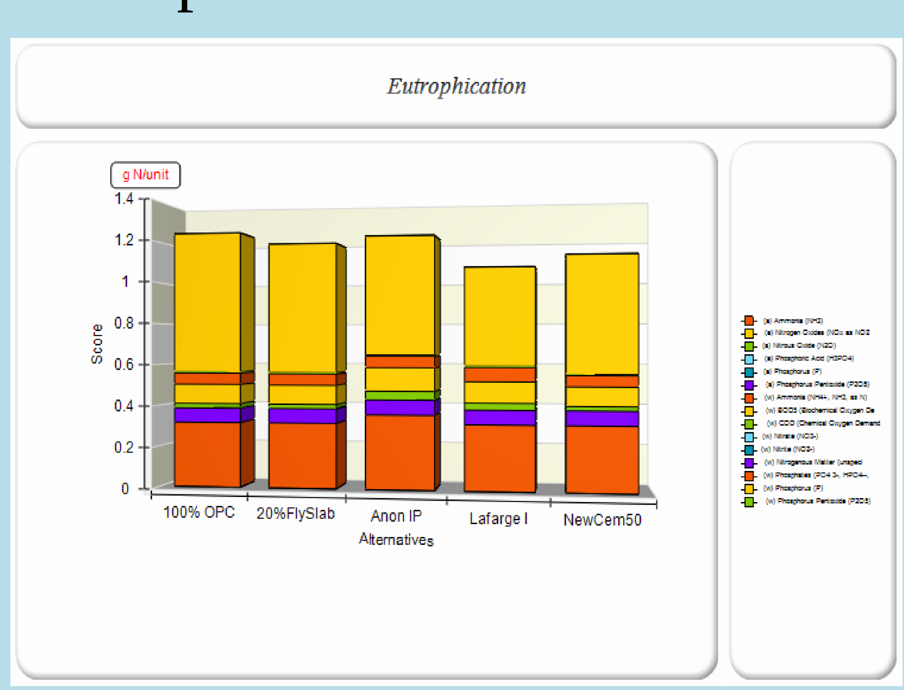
Table 5. Comparison of total environmental performance of cement materials

Environmental Performance					
Category	(C1) 100%OPC	(C2) 20% Fly Slab	(C3) Anon IP	(C4) Lafage I	(C5) New Cem 50
Acidification - 3%	0.0000	0.0000	0.0000	0.0000	0.0000
Criteria Air Pollutants - 9%	0.0006	0.0005	0.0005	0.0005	0.0005
Ecotoxicity - 7%	0.0000	0.0000	0.0000	0.0000	0.0000
Eutrophication - 6%	0.0002	0.0002	0.0002	0.0002	0.0002
Fossil Fuel Depletion - 10%	0.0008	0.0008	0.0007	0.0012	0.0008
Global Warming - 29%	0.0049	0.0044	0.0038	0.0036	0.0038
Habitata Alteration - 6%	0.0000	0.0000	0.0000	0.0000	0.0000
Human Toxicity- Cancer -8%	0.0001	0.0001	0.0001	0.0000	0.0001
Human Toxicity- Nocancer - 5%	0.0000	0.0000	0.0000	0.0000	0.0000
Indor Air Quality - 3%	0.0000	0.0000	0.0000	0.0000	0.0000
Ozon Depletion - 2%	0.0000	0.0000	0.0000	0.0000	0.0000
Smog - 4%	0.0006	0.0005	0.0005	0.0004	0.0005
Water Intake - 8%	0.0001	0.0001	0.0001	0.0001	0.0004
Suma	0.0073	0.0066	0.0059	0.0060	0.0063

Acidification



Eutrophication



Water Intake

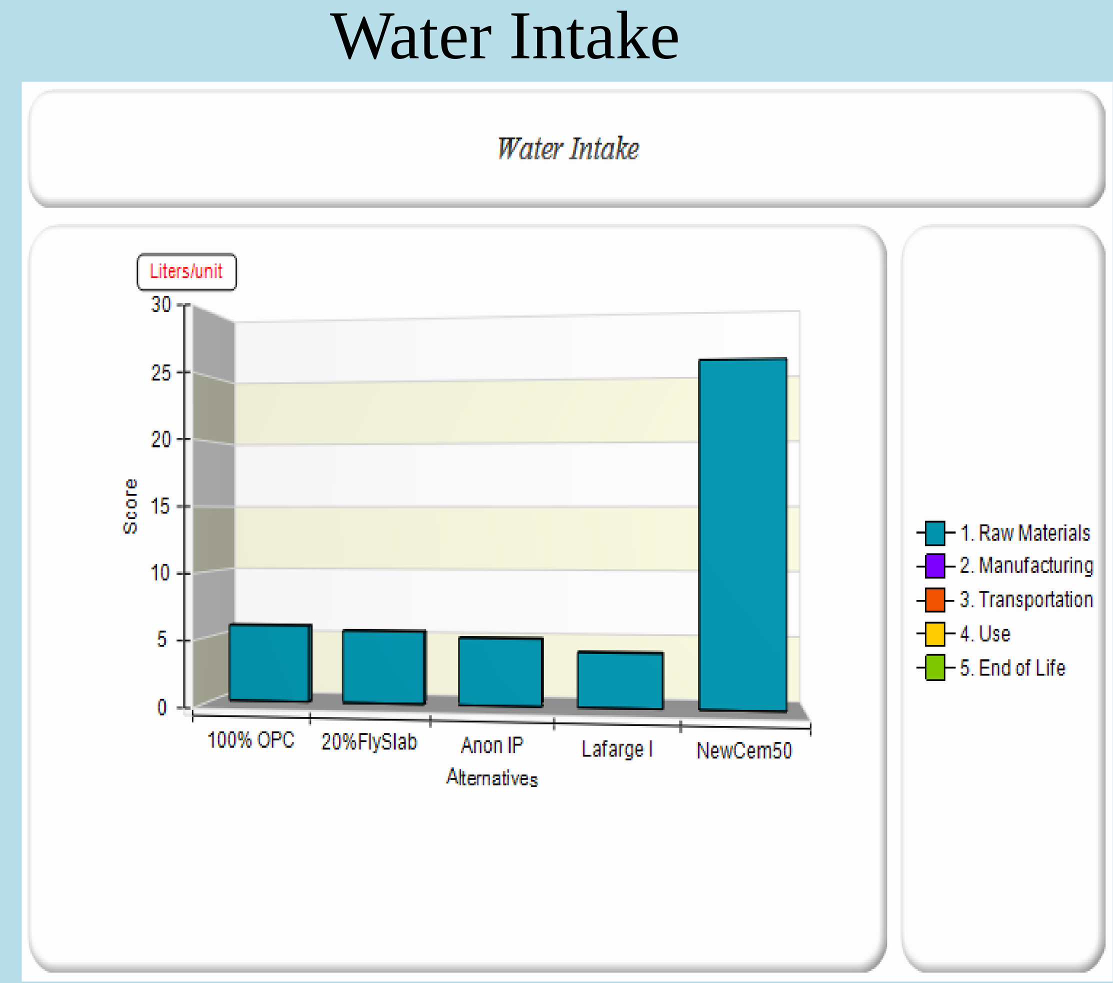


Table 10. Comparison of LCA Water Intake

LCA Water Intake					
Category	(C1) 100%OPC	(C2) 20% Fly Slab	(C3) Anon IP	(C4) Lafage I	(C5) New Cem 50
Raw Materials	5.8500	5.5000	5.0600	4.0800	25.8000
Manufacturing	0.0000	0.0000	0.0000	0.0000	0.0000
Transportation	0.0000	0.0000	0.0000	0.0000	0.0000
Use	0.0000	0.0000	0.0000	0.0000	0.0000
End of Life	0.0000	0.0000	0.0000	0.0000	0.0000
Sum	5.8500	5.5000	5.0600	4.0800	25.8000

Conclusion

The construction sector is the largest consumer of natural resources with a large impact on the environment. Cement is one of the building materials, with a significant share in construction. The research specifically analyzed the aspect of the impact of cement on Water Footprin, the potential for Acidification and Eutrophication, which is very significant when water consumption and water pollution are analyzed. The next step to be taken is to create tools that could be recommended already in the design phase of the facility, the type of cement or concrete, but from the aspect of impact on the environment and human health, Water Footprint and other potentials related to water impact. The research includes an analysis of the impact during the life cycle of five types of cement, from the ecological aspect. The phases of the life cycle from the exploitation of raw materials, processing, transport, installation, use are included. Five types of cement were evaluated: (C1) 100% OPC, (C2) 20% Fly Weak, (S3) Anon IP, (S4) Lafage I, and (S5) New Cem 50. Cement has the best parameters after the analysis.) Lafage I, then (C2) 20% Fly Weak, and (C5) New Cem 50, and (C2) 20% Fly Weak with approximate values, and the greatest impact on the environment and water resources has (C1) 100% OPC.

This research has shown that with the help of software tools it is possible to evaluate building materials from the ecological aspect and its impact on water resources.

The research indicates the need for national software that would help designers to make the right decision when choosing construction materials. The existence of national software for calculation and evaluation of construction products in the design phase provides a tool for designers to evaluate building materials aspect. The national software would bring the information closer and concretize the potential problems that arise due to the application of some construction material in the designers.

The Development Strategy of the Construction Material Industry of the Federation of Bosnia and Herzegovina [18] recommends increasing the use of concrete for road construction. From the above, it was very useful to analyze the Water Footprint for cement plants, and then get a clear picture of which of the existing cement plants has the potential for sustainable expansion of production.

References:

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