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3rd Baltic Earth Conference

Earth system changes and Baltic Sea coasts
To be held in Jastarnia, Hel Peninsula, Poland, 1 to 5 June 2020
Held online, 2-3 June 2020

Conference Proceedings

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Acknowledgments

We sincerely thank the Polish Institute of Oceanology (IO-PAN) in Sopot, our local partner institution, for co-organizing this conference, in particular Jan Marcin Weslawski, Karol Kulinski and Beata Szymczycha for a dedicated and efficient collaboration in preparing the conference. Thank you to Silke Köppen of the International Baltic Earth Secretariat at Helmholtz-Zentrum Geesthacht for putting together this abstract volume and the programme booklet, next to taking care of the hundreds of other things necessary to make this conference a success. Unfortunately, the conference cannot be held as planned, but we will be Poland in 2022, at the Hotel Dom Zdrojowy, Jastarnia, Hel peninsula, Poland, for the 4th Baltic Earth Conference.
Preface

This proceedings volume contains all accepted abstracts for the 3rd Baltic Earth Conference, which was planned to take place in Jastarnia on the Hel peninsula, at the Polish coast. Unfortunately, due to the SARS-CoV-2 pandemic, we had to cancel the physical conference.

Instead, we will have an online conference on 2 and 3 June 2020. Although only a subset of oral and poster presentations submitted to this abstract volume will be available online, we stick to the tradition to present all accepted abstracts in this volume.

The conference covers the topics of Baltic Earth, and in particular highlights the Baltic Earth Grand Challenges, as defined by the Baltic Earth Science Plan, and the topics treated by the BEAR (Baltic Earth Assessment Reports). The grand topic of the conference „Earth system changes and Baltic Sea coasts“ refers to the manifold aspects of the changing Earth system of the Baltic Sea region, in the atmosphere, on land and in the sea. Climate change and the associated sea level rise, but also other human activities exert a particular pressure on the coasts of the southern Baltic Sea, of which the Hel peninsula and the Polish coasts in general are so typical. Land-sea interactions and human uses shape and modify the coasts all over the Baltic Sea.

The sessions reflect the Baltic Earth Grand Challenges and BEAR topics:

- Salinity dynamics
- Land-sea-atmosphere biogeochemical linkages
- Natural hazards and high impact events
- Sea level dynamics, coastal morphology and erosion
- Regional variability of water and energy exchanges
- Multiple drivers for regional Earth system changes
- Regional climate system modelling
- Climate change and its impacts
- New climate observation systems

We have received 110 abstracts from all over the Baltic Sea region. As usual, oral and poster abstracts will be treated equally in these proceedings; they are all sorted alphabetically within topics.

We trust that the online conference will be successful. It certainly cannot substitute a real conference where scientists come together. We hope it will be an exception, and we would like to invite you already now to the 4th Baltic Earth Conference, which will take place where the 3rd was planned: in Jastarnia on the Hel peninsula, at the Polish coast, 30 May – 3 June 2022! Please mark these dates in your calendar!

Markus Meier and Marcus Reckermann
On behalf of the Conference Committee and the Baltic Earth Science Steering Group
1. The ERA.Net-RUS Plus Project EI-GEO

EI-GEO is a multinational research project (Germany, Latvia, Russia) funded under the ERA.Net RUS Plus Call 2017. Aim of the project is the investigation whether geosynthetics in hydraulic engineering applications could be a source of microplastics (MPs) and other contaminants to the aquatic environment causing negative effects to aquatic organisms. Whereas the behavior of geosynthetics in landfill engineering is well studied and documented since decades, little is known on application in applications such as coastal protection or ballast layers for wind energy plants. However, due to the rapid expansion of offshore wind energy, rising water levels and more extreme weather conditions as a result of climate change more and more hydraulic engineering projects will be realized in the future. Applied methods are artificial ageing of geosynthetics in environmental simulation chambers, storage of samples under environmental condition for comparison with laboratory simulation, sample characterization by microscopic methods and ecotoxicological testing of water in contact with geosynthetics.
In parallel a case study at the Baltic Sea shore at Kaliningrad Oblast (Russia) will be performed. The aim of study is to estimate the level of pollution of the beaches by geosynthetic debris and identify the possible sources.

2. Project description

Geosynthetics are widely used in hydraulic engineering. Application areas are soil reinforcement, stabilization of ballast layers (e.g. for piles of offshore wind energy plants), waterproofing of dams and canals and scour protection. The application of geosynthetics in hydraulic engineering has huge economic benefits such as savings through substitution or reduction of selected soil materials, through ease of installation and increased speed of construction, life cycle cost savings through improved performance (by increased longevity or reduction of maintenance) and improved sustainability in terms of conserving natural environments as compared to alternative designs (Müller and Saathoff, 2015). It is commonly accepted that geosynthetics with proper stabilization with antioxidants (e.g. sterically hindered amines) will last in underwater constructions with limited oxygen supply and temperatures at constantly low levels for at least 100 years.
However, after end of service lifetime geosynthetics could be a source of plastic debris in aquatic systems. Further, additives, which are needed as plasticizers or antioxidants, could be emitted with detrimental influence on the environment (Wiewel and Lamoree, 2016). The loss of additives is intimately related to the ageing of the geosynthetic products. Those are the reasons that public authorities are concerned about the approvability of engineering projects using geosynthetics in aquatic systems.

Long term stability of geotextiles is usually investigated related to mechanical stability, which must fulfill certain requirements after ageing. Different methodologies are available (e.g. elevated temperature or pressure) to accelerate ageing in the laboratory. Mechanical properties, tensile strength, investigation on chemical oxidation reaction by infrared spectroscopy and residual content of stabilizers are typical parameters tested with aged samples. Investigation of the possible environmental impact of the application of geosynthetics in aquatic systems is therefore hardly possible with virgin polymer material. Consequently, the polymers must be artificially aged, best with environmental simulation chambers enabling accelerated ageing. In the case of geosynthetics in hydraulic engineering beside oxidation, mechanical stress (e.g. by tidal fluctuations, wave action, abrasion by sand) and microbiological interactions (formation of biofilms, etc.) play significant roles and must be considered.
Moreover, the chemical composition and small size make MPs effective sorbent of persistent organic pollutants (POPs) which may be transferred to biota, enhancing regularly occurring bioaccumulation. Despite these concerns, the impact of MPs and their role as vectors mediating POP transport and bioaccumulation in aquatic food webs is largely unknown.

It can be expected that geotextiles degradation processes are similar to processes of other plastics reaching the marine environment because they are made from the same types of polymers. Plastic waste exposed to environmental conditions begins to degrade slowly generating a large number of macro-, micro-, and nanoparticles. One of the key factors, which determines the fate of microplastics in the environment is the density of polymers. Specific density of microplastic can vary significantly depending of a polymer type, technological processes of its production, additives, weathering and biofouling (Morét-Ferguson et al., 2010, Chubarenko et al., 2016), but with time, most of floating plastics become negatively buoyant as well due to biofouling or adhesion of denser particles, and sink to the sea floor (Morét-Ferguson et al., 2010, Lobelle and Cunliffe, 2011). Thus, the seabed becomes the ultimate repository for microplastic particles and fibers (Woodall et al., Barnes et al., 2009).
Evaluation of the contamination level is complicated not only because of difficulty of the sampling of bottom sediment, but also due to hardness of the extraction of small plastic particles from marine deposits.

Construction with geosynthetics has various advantages but it has to be ensured that there is no negative environmental impact from the application of...
geosynthetics in hydraulic engineering. It is expected that any effect will be visible only on the long-term because the virgin raw material used for the production of geosynthetics has almost no release of particles or substance relevant to the environment (Holmes et al., 2014). Therefore, accelerated ageing is performed to derive requirements for geosynthetics in hydraulic engineering. All testing will be performed with these artificially aged geosynthetics. Partly from improper material selection and partly from non-professional handling and debris from geosynthetic material can be found on the shore today. Field studies with sampling and monitoring at the shore of the Kaliningrad Oblast (Russia) will help to evaluate the magnitude of this pollution and are therefore a work package of the project.

3. Experimental results

Autoclave tests (Robertson, 2013) were performed in a pure oxygen atmosphere with pressures of 10, 20 and 50 bar at a temperature of 80 °C and durations in the range of 7 to 42 days. The evaluation of the results is ongoing.

![Image](image.png)

Figure 1. Test sample of geosynthetics (Naue Secutex R601). Left: Virgin sample (surface weight 600 g/m²). Right: after artificial ageing in autoclave (80°C, p(O2) = 30 bar, 21 days) and checking on tensile testing machine (Zwick).

4. Identification of ecotoxicity tests and preliminary results

Literature analysis of existing studies on plastic leachate toxicity was done in order to identify type of the tests and testorganisms. It was resumed that there are only few marine testorganisms that correspond environmental conditions of the Baltic Sea and more often freshwater organism tests are used in leachate ecotoxicity assessment. For comparability reasons several freshwater organism tests were chosen in order to study ecotoxicity of geosynthetics. Preliminary results of H. azteca tests showed that leachates cause negative effect on growth of testorganism.

5. Results of field study

In 2018, the 13 coastal constructions on the shore of the Kaliningrad Oblast (Russia) in which geosynthetic materials are used, were investigated. These structures were built over the past 10 years and protect 7 km of the shore. All of them are potential sources of contamination of the environment with plastic debris.

Monitoring of the beaches of the South-Eastern Baltic by continuous visual scanning showed that fragments of geosynthetic materials from the coastal and engineering structures are unevenly distributed. It was revealed that the greatest visible effect in the pollution of beaches is made by the remnants of woven textiles (big bags / bags), actively breaking up into fibers. These fibers migrate along the coast, settling on the beach and at the bottom. Fragments of nonwoven geotextiles from the coastal protection structures were also found (Esiukova et al., 2018).

6. Acknowledgements

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