Objective and scope

- Several studies addressing the quantification of tyre and road wear particles generated by road transport in EU Countries concur to indicate that approximately 1 kg/person/year of tyre tread particles are lost during vehicle use. This quantifiable mass has prompted questions about the fraction of tyre and road wear particles (TRWP) that may reach the marine environment.

- In this context, ETRMA proactively launched a study, in March 2017, to build knowledge about TRWP fate and transportation up to the estuary and their potential contribution to microplastics in the marine environment.

- The study design and results have been evaluated by a scientific advisory board composed by experts from the Technical University of Berlin and INERIS (Institut National de l’Environnement Industriel et des Risques).

- In September 2018, the results of the final report on TRWP environmental fate assessment have been published on the peer-reviewed journal *Science of the Total Environment*.  

Methodology

- While plastics are generally characterized as having “low” densities, microplastics particles have different densities below or above that of freshwater (~1 g/cm³). Available literature show that, due to the aggregation of rubber and asphalt matters, TRWP have a density of ~1.8 g/cm³ higher than water this, along with other factors such as particle size (5μm to 350μm) and shape, particle settling, environmental degradation and weathering processes, biofilms etc, affects the mobility of the particles in the different environmental compartments.  


• Differently from other microplastics particles, TRWP particles cannot be univocally identified, also in consideration of the complex nature and variety of factors influencing its composition. Based on recent lab-scale studies, the mineral encrustation fraction from the road surface within TRWP is estimated to be approximately 50% w/w while the original polymeric fraction of TRWP is estimated to be approximately 25%.

• Since a large number of factors contributes to the fate and transport of TRWP, Cardno ChemRisk and Deltares have developed an integrated modelling approach to estimate the fate of TRWP from formation on roadways to transport to the estuary environment.

• This study adopts a sophisticated approach at a watershed scale (Seine and the Scheldt basins have been selected as representative watersheds). The model owe its robustness to the fact that the actual hydrological conditions could be considered (by using the E-HYPE European-scale hydrology model). The hydrological model has been integrated with a mass transport model (the open-source Delft3D-WAQ water quality model).

• The study shows the results of the mass balance for several scenarios varying most relevant parameters affecting the fate and transportation of the particles in the freshwater. The key parameters were identified through a sensitivity analysis and then, based on the results, they have been simultaneously varied to derive the probabilistic distribution of the results.

• This is why this study is closer to environmental reality in the approach and in the results compared to most of the studies published so far which are mainly based on theoretical calculations not taking into account the transportation phenomena.

Results

• The results of the probabilistic model indicate that only 2% to 5% of TRWP released may reach the estuaries.

• The most important parameters affecting the transportation of the TRWP to the estuary are their diameter and density.

• The results demonstrate the potential for appreciable capture and retention of TRWP prior to reaching the freshwater or even the estuary.

• Soil and freshwater sediments result to be important compartments that prevent the release of TRWP to marine waters for the watersheds analysed. In particular, the trapping efficiency of TRWP in freshwater results to be most likely about 90% and this is supported by the comparison with the average concentration of TRWP measured in the Seine sediments.

• The results on the trapping efficiency of TRWP in freshwater sediments are supported by the comparison with the average concentration of TRWP measured in the Seine sediments\(^4\). The Seine has been selected as one of the two considered watersheds in order to support the model outcome with observations in river sediments.