Design Project – SIE 2023

Prototyping a sampling system for tyre particles in streams

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Context
Tyre and Road Wear Particles (TRWP):
- High contribution to global plastic pollution: up to 30% [1] in natural waters
- 508 t/y [2] introduced to the Lake Geneva Watershed (estimation)
- Formed by erosion of tyres on road: up to 4.7 kg/cap/y [3]
- Mainly: Rubber + Styrene Butadiene + Toxic additives + Mineral crust [1]
- Cylindrical: 40μm x 10μm [1]
- No universal sampling method exists

Goal
Designing a sampling prototype that is:
- Specific to TRWP in freshwater
- Affordable
- Carriable by hand
- Easily adaptable
- Resilient to clogging & cross-contamination

System inlet
- 1mm mesh size
- Large surface (Ø 20cm)
- Only part in the water to ease the manipulation of the other components
- Avoids the entry of leaves, branches, stones,…

Prefiltration unit
- 300μm mesh size (Ø 7cm)
- Dissolvable filter (nitrate cellulose)
- 2 sealing O-rings for tightness
- Collection of the TRWP for lab analysis

Filtration unit
- 8μm mesh size (Ø 7cm)
- Allows the calculation of the TRWP concentration in the sample

Flowmeter
- Measuring the sampled volume
- Accurate volume, clogging management

Pump
- Runs on battery to ensure the autonomy on the field
- Downstream of the filtration unit & in suction mode to avoid cross-contamination

Challenges
- Water- and airtightness are crucial
- Important head losses due to the various components
- Quality materials are expensive
- 3D design & 3D printing are time consuming

Conclusion
- Individual parts are working and global concept seems good
- Adjustments are necessary, especially regarding sealing & locking
- All parts are easily adaptable for improvements
- Further lab tests required before field sampling

References:
[1] Sommer & al., Tire Abrasion as a Major Source of Microplastics in the Environment, 2018