

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

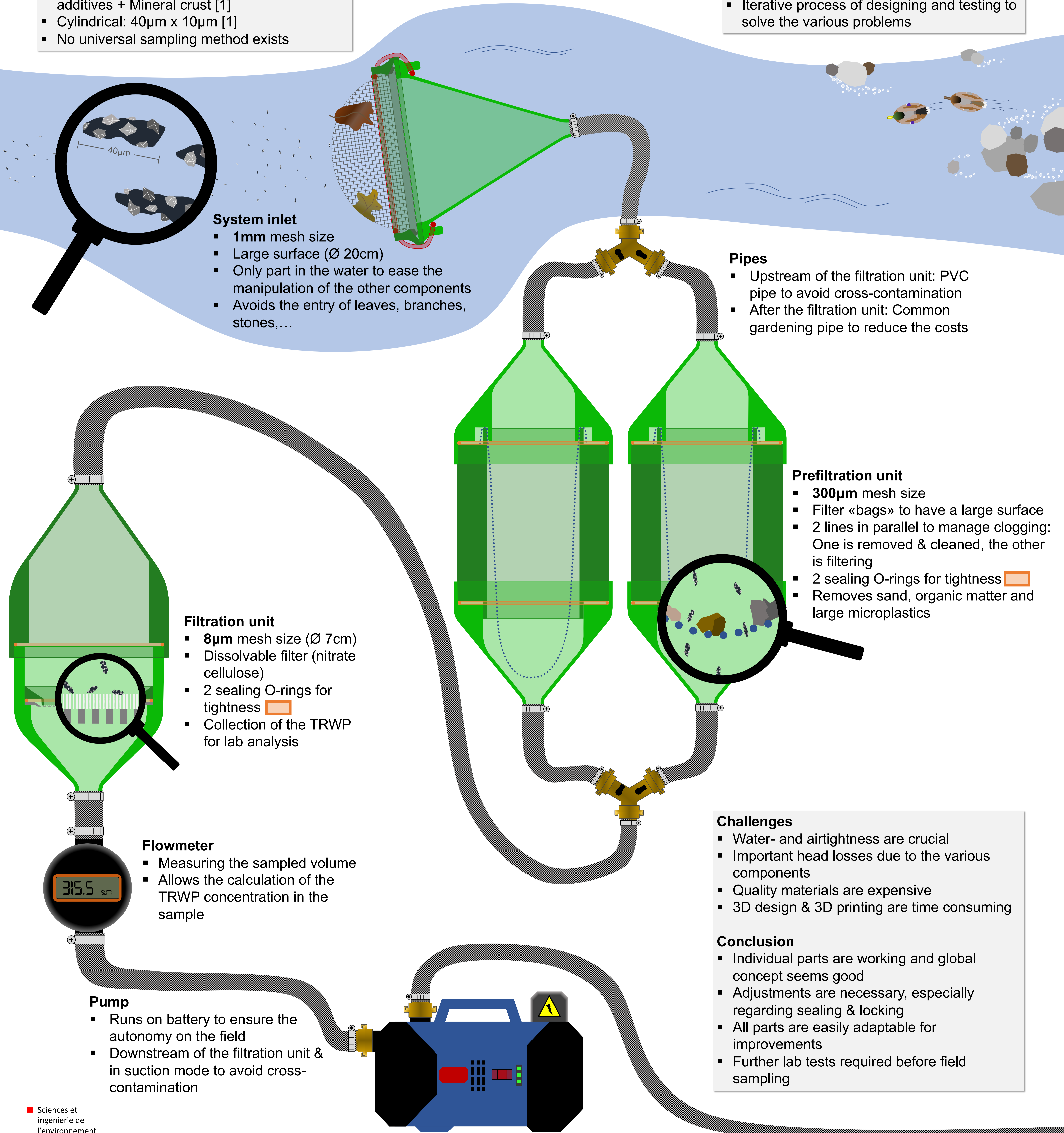
Goal

Designing a sampling prototype that is:

- Specific to TRWP in freshwater
- Affordable
- Carriable by hand
- Easily adaptable
- Resilient to clogging & cross-contamination

Methodology

- Pump vs net: Adaptable filter mesh size, larger & accurate volume, clogging management
- Design & **3D printing** of specific pieces
- Compromise between **price and material** for purchased pieces
- Cautious material choice to prevent **cross-contamination**
- Iterative process of designing and testing to solve the various problems



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,...

Pipes

- Upstream of the filtration unit: PVC pipe to avoid cross-contamination
- After the filtration unit: Common gardening pipe to reduce the costs

Prefiltration unit

- **300µm** mesh size
- Filter «bags» to have a large surface
- 2 lines in parallel to manage clogging: One is removed & cleaned, the other is filtering
- 2 sealing O-rings for tightness
- Removes sand, organic matter and large microplastics

Filtration unit

- **8µm** mesh size (Ø 7cm)
- Dissolvable filter (nitrate cellulose)
- 2 sealing O-rings for tightness
- Collection of the TRWP for lab analysis

Flowmeter

- Measuring the sampled volume
- Allows the calculation of the TRWP concentration in the sample

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