EPFL

Prototyping a sampling system for tyre particles in streams

Final presentation

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Goals

- Sample TRWP in natural waters

- Carriable system

- Affordable

- Easy adaptable

- Clogging management

- Avoid cross-contamination
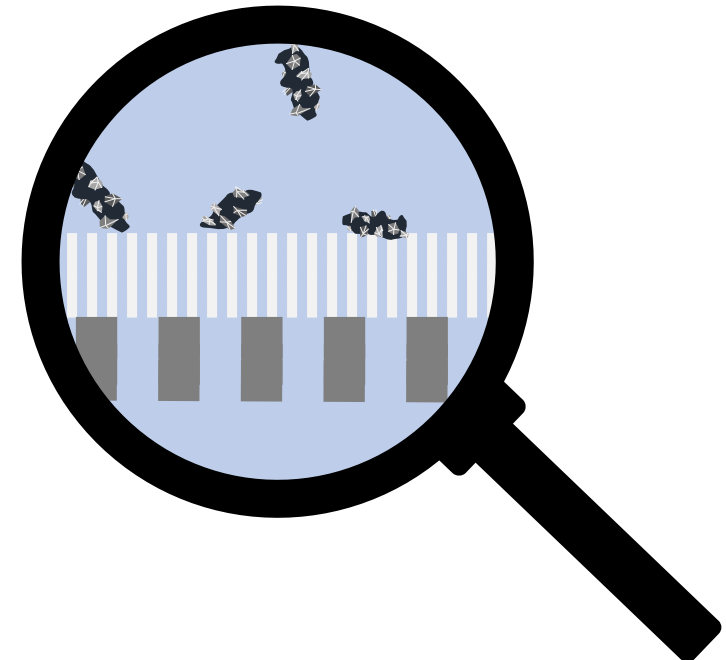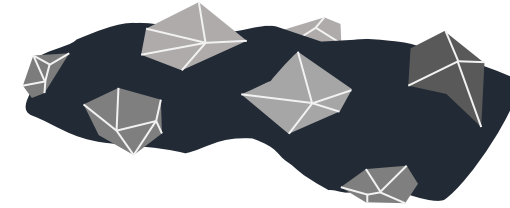
Methodology

- **Active sampling** using a pump and a flowmeter to know the volume

- **Choice of the components** based on:
  - Material (cross-contamination)
  - Price
  - Shipping time

- **3D Printing**:
  - «Fast» designing
  - Iterative approach

Iterative approach 3D design & printing

Testing

OK
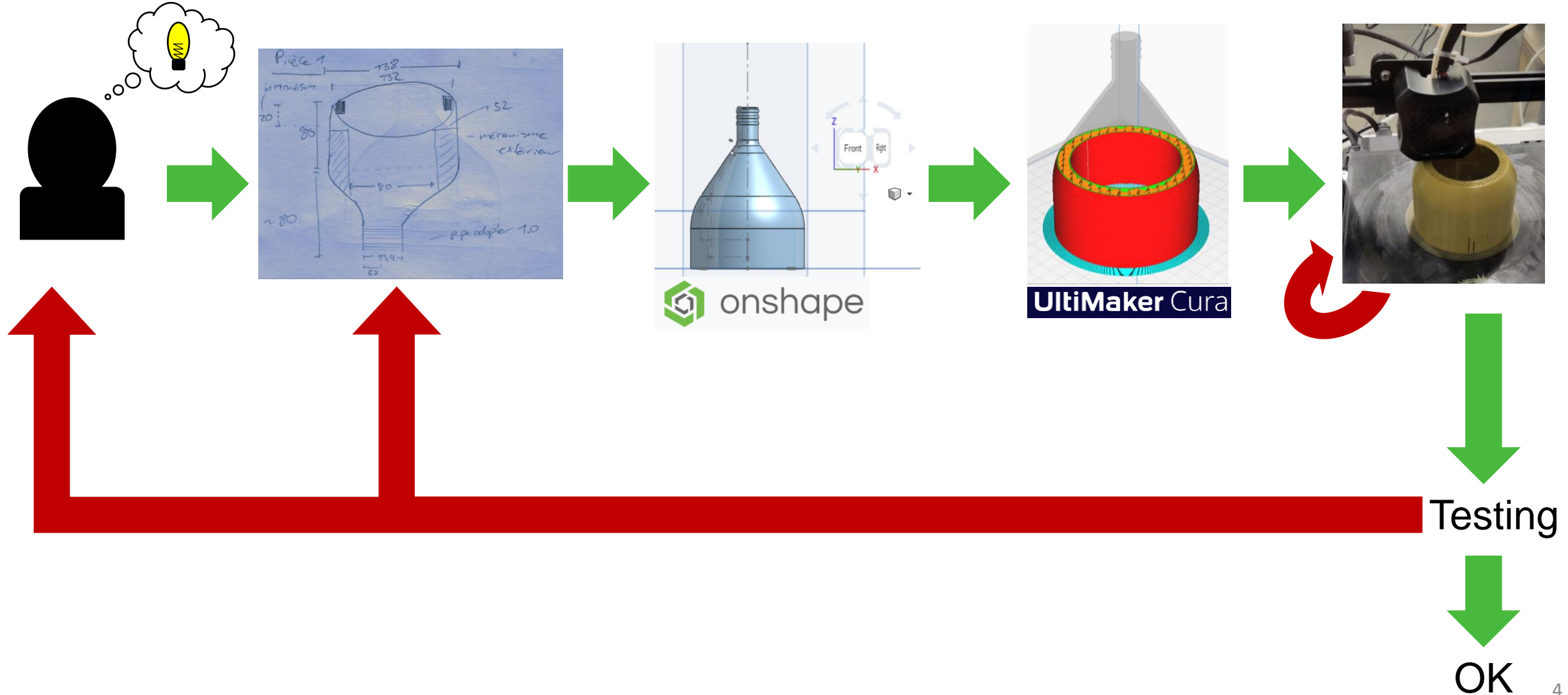
System entry

- Submerged to pump the water

- **1mm mesh size** kitchen sieve: Avoids the entry of leaves, branches, stones,…

- **Large surface** (Ø 20cm) to delay clogging

- Only part in the water to **ease the manipulation** of the other components

- Several holes to attach it (ropes, weights,…) and maintain it under water
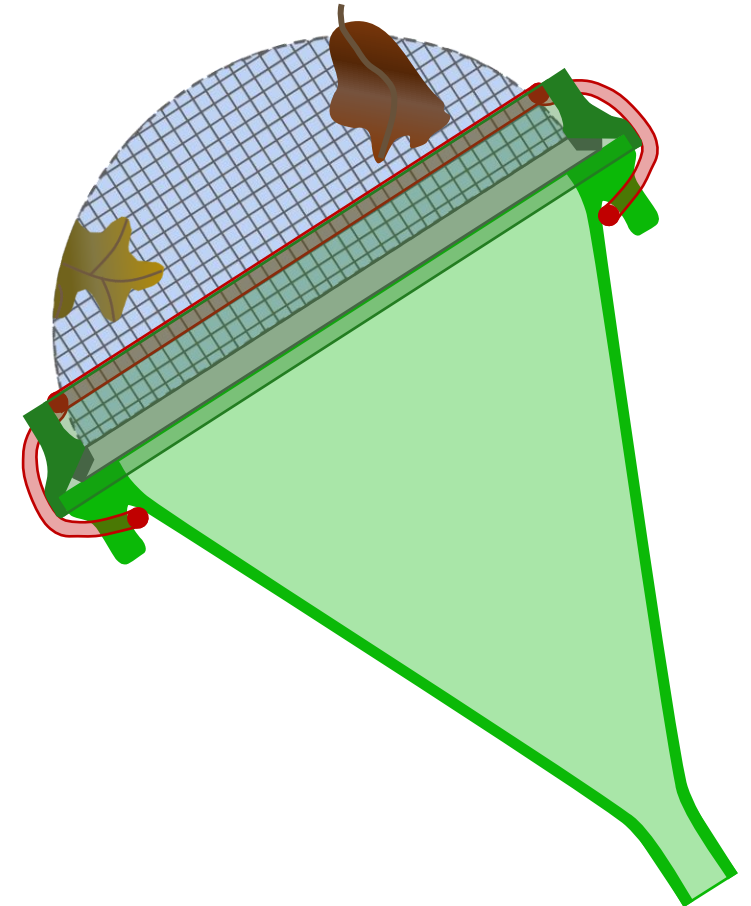
System entry

✅

- Good compatibility between funnel, sieve and sieve holder
- Components well maintained by the elastic rope
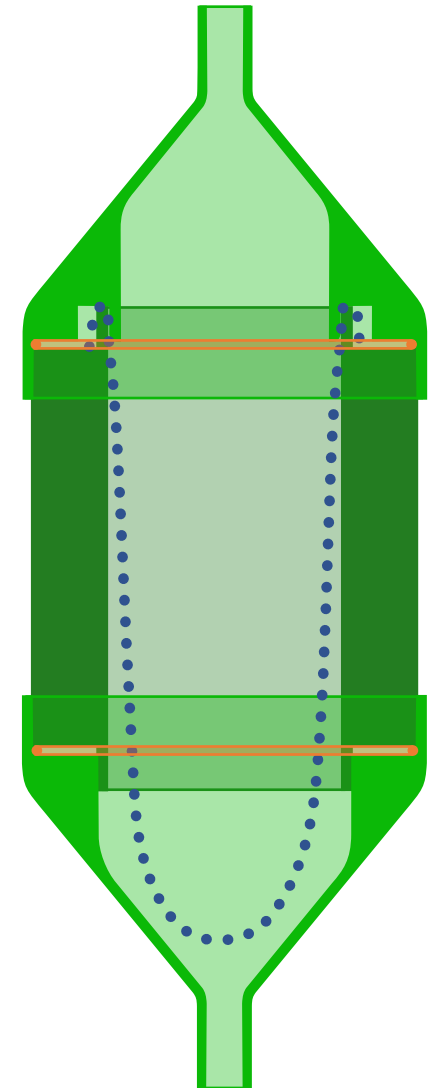- Waterproof connection between piece and pipes

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- Surface could be increased to reduce even more clogging (⚠3D printers are limited in size)
- Solidity of the pipe connector part could be increased to avoid breakage

Preflitration unit

- Remove sand, organic matter and large microplastics
- Holds **300µm mesh size** filter «bags», that have a large surface (delay clogging)
- Quick locking system to allow field manipulations
- 2 sealing O-rings for air and water tightness

Preflitration unit

✅

- Waterproof connection between pieces & pipes
- Filter bag is well hold and easily removable

🔄

- Waterproofness and airtightness are not sufficient, they could be improved by:
    - Choosing larger and more flexible seals
    - Adapt the locking mechanism, if possible with screw threads
- Infill (3D printing) must be sufficient to avoid pieces to get waterlogged
- Once tightness is improved, the design can be optimized for the manipulation
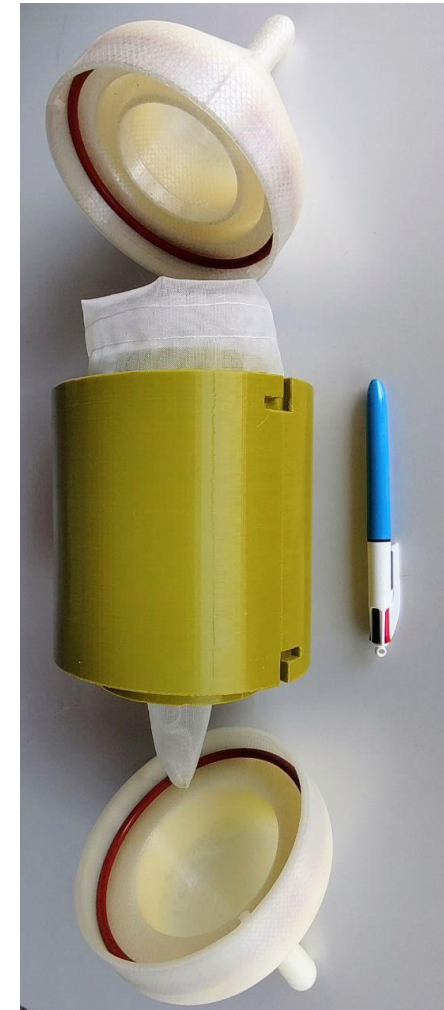
Preflitration module

- 2 pre-filtration lines in parallel to manage clogging:

- One can be removed and cleaned while the other continues to filter

- Works well:
  - Concept is good and should allow to sample for any required period of time
  - Simple valve system

- Possible problem: filled with air after cleaning
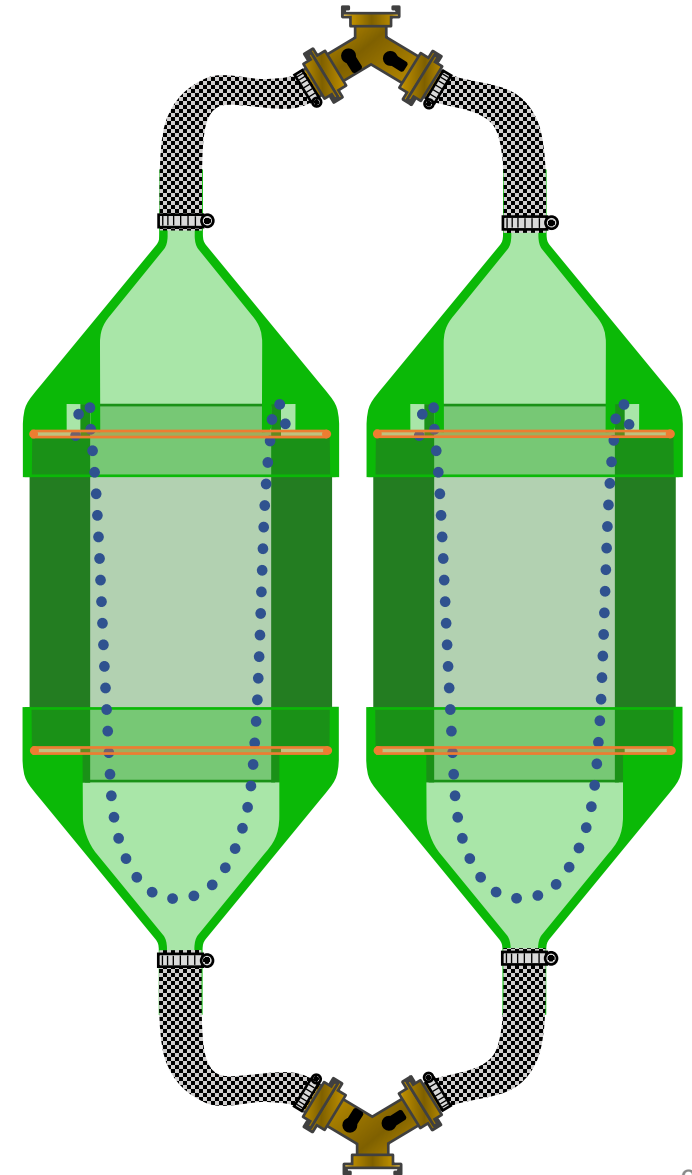
Filtration unit

- Holds the 8µm mesh size filter (Ø 7cm) to collect the TRWP
- Small sieve of ~0.5mm mesh size to support the filter
- Filter in nitrate cellulose, dissolvable in acids (Lab protocol)
- 2 sealing O-rings for water and air tightness
- Small plastic piece to maintain the filter during sampling
- Quick locking mecanism
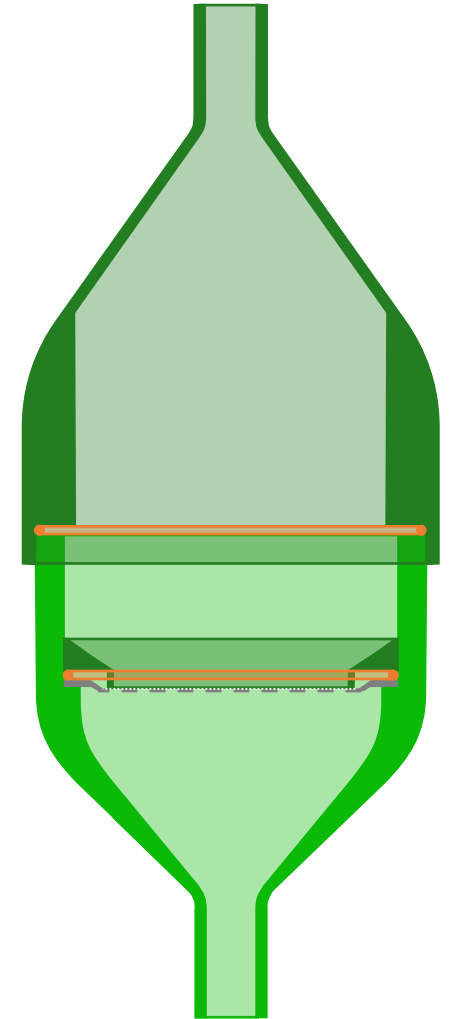
Filtration unit

✓

- Good compatibility between the bottom piece, small sieve and filter holder
- Waterproof connection between piece and pipes

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- As for the prefiltration, waterproofness and airtightness must be improved, as well as the infill
- With pressure, water can bypass the filter, despite the seal
- More ergonomic shape
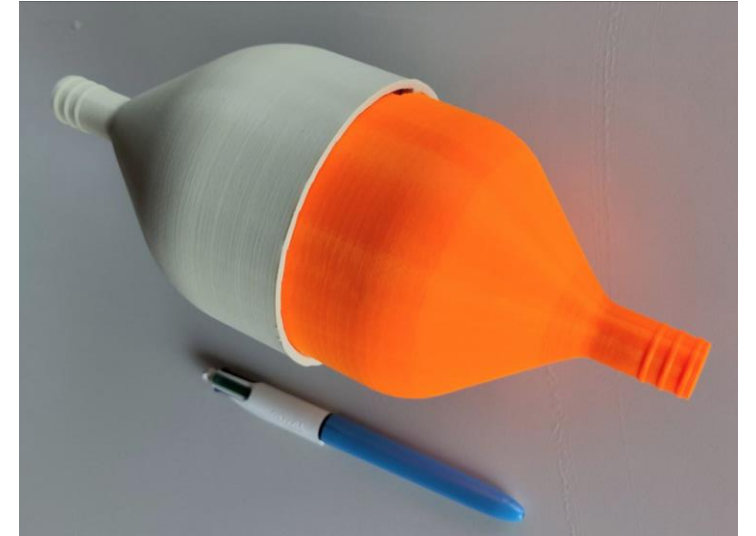
General improvements

Compromises between **materials and price** have always been sought but with more budget, the following components could be improved:

- **Pipes**: Used pipes are basic ones and pumping pipes would be more resistant and generate less head losses

- **3D printing filament**: The filament used for printing is PLA (most common, easy to use and cheap one) but other filament such as polycarbonate could be more adapted to water and pressure applications

Final remarks

- Flowmeter & pump are good enough for this stage of prototype
- 3D designing and printing is time consuming, but **extremely helpful** in prototyping
- One semester is very short to have a functional system, but it allows to **identify the most critical points**
- Lab tests with a **blank and a known TRWP mass** have to be carried out before the first field test

Work Sharing

All the pieces design are accessible via the following GitHub repository:

https://github.com/Lucky1805/SamplingPrototype_PiecesDesign

The .pdf file (SamplingPrototype_PiecesDesign.pfd)contains the sketch and the ONSHAPE links to each individual piece.

The poster and this presentation are also available on the GitHub and should allow to find all the necessary information to adapt the different components.

Thanks a lot for the collaboration