



**21<sup>ST</sup>**   
WORLD  
**STERILIZATION**  
CONGRESS

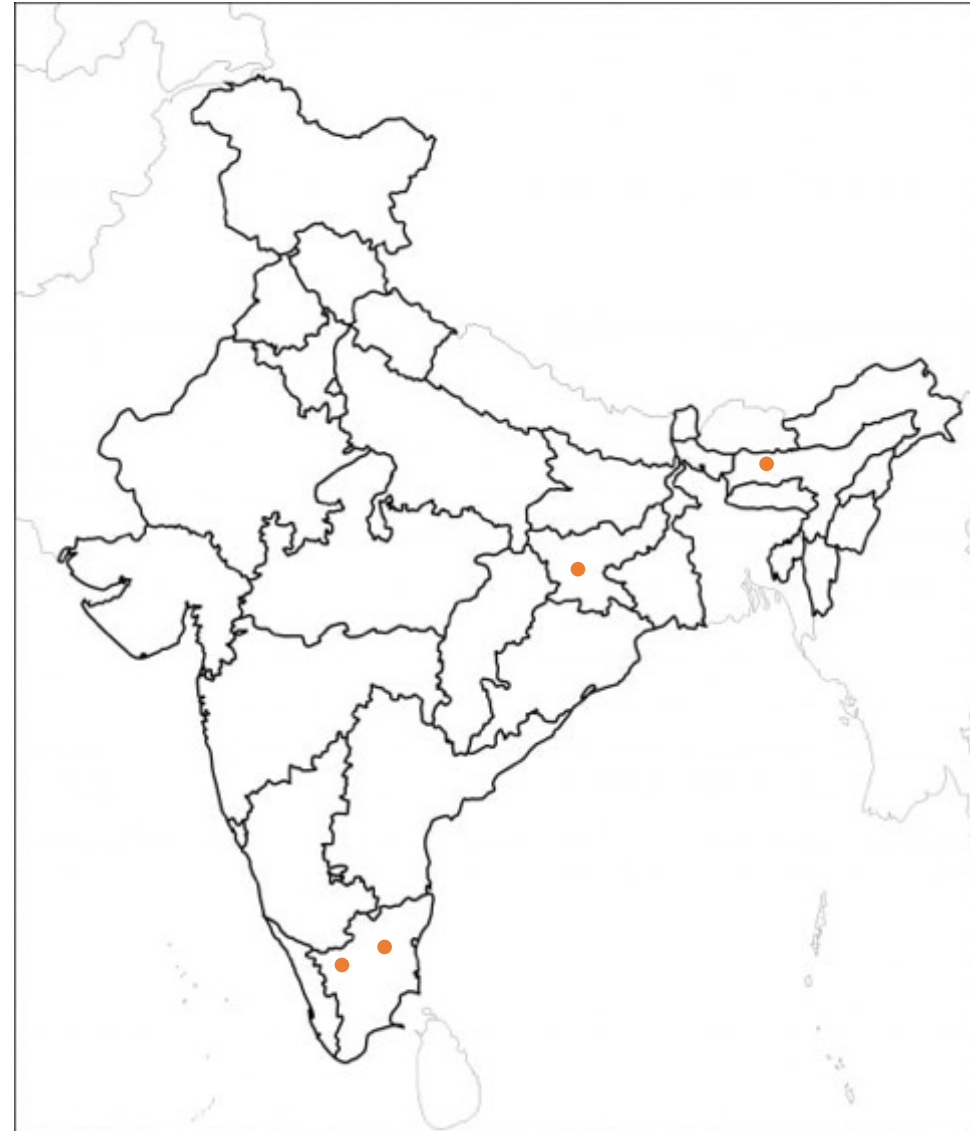
## ***Effect of fluid flow in cleaning hollow instruments***

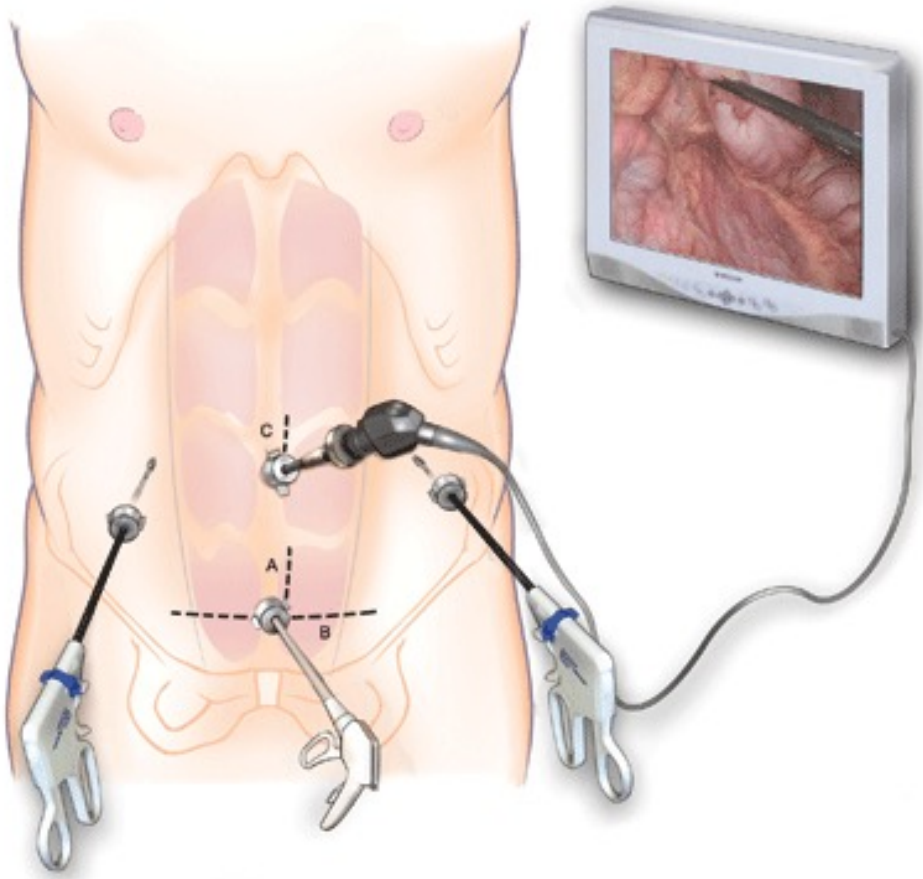
***For the development of a low-cost instrument washer***

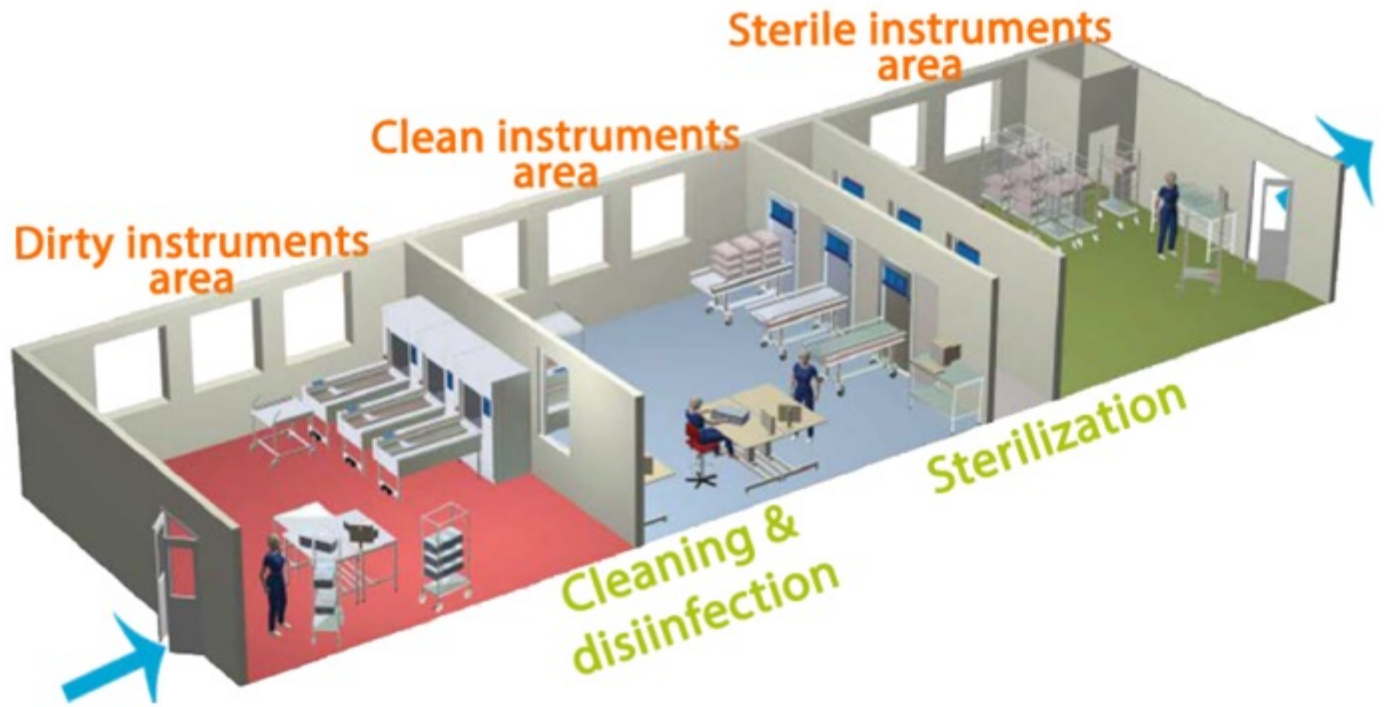
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17 / 20 NOVEMBER 2021  
CICG, GENEVA, SWITZERLAND

SMART Project:  
Making minimally invasive surgery  
applicable to low resource settings  
through high quality medical  
devices









J.M.A. Zuidweg (2014) Cleaning of hollow instruments



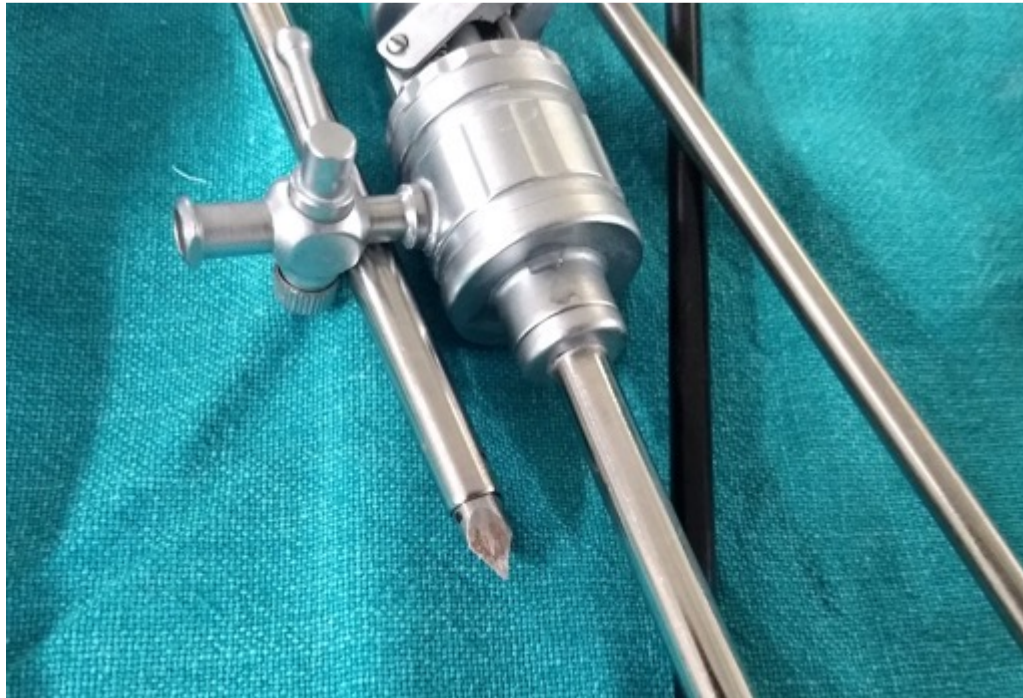
- Prepare patient
- Clean operating theatre
- Assist in surgery
- Post-op care
- Clean instruments









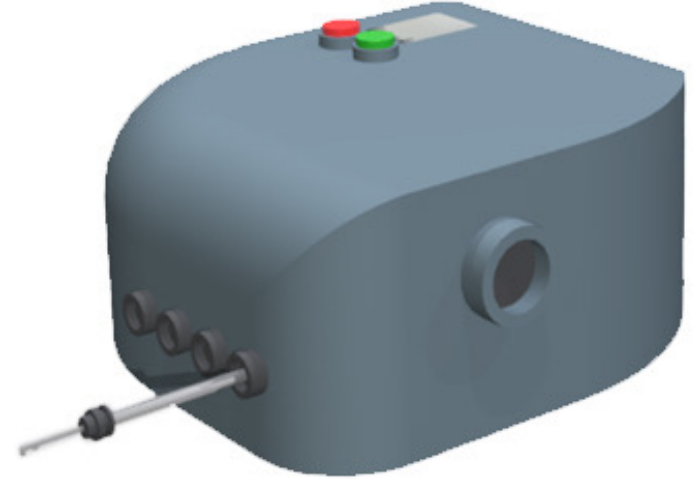


Design solution:

Low cost, robust laparoscopic instrument cleaner

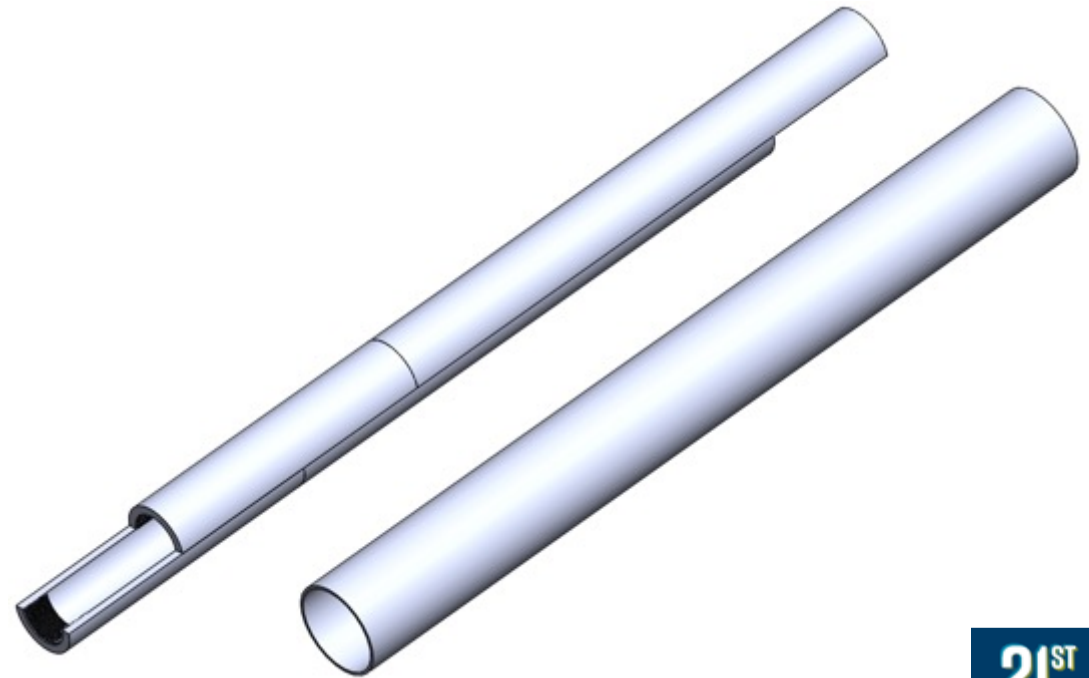
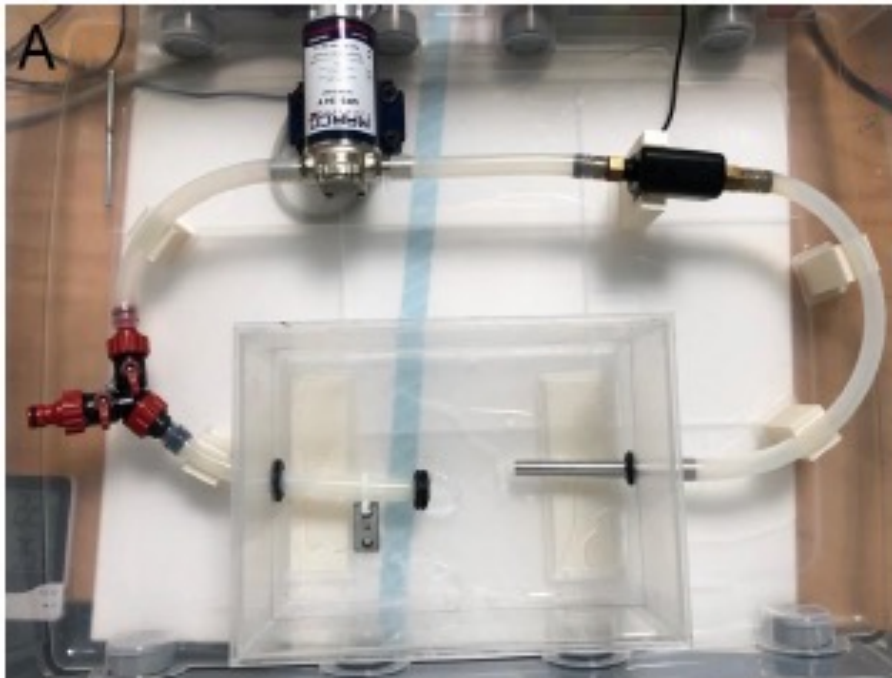
What are the design requirements?

No guidelines could be found in norms and standards

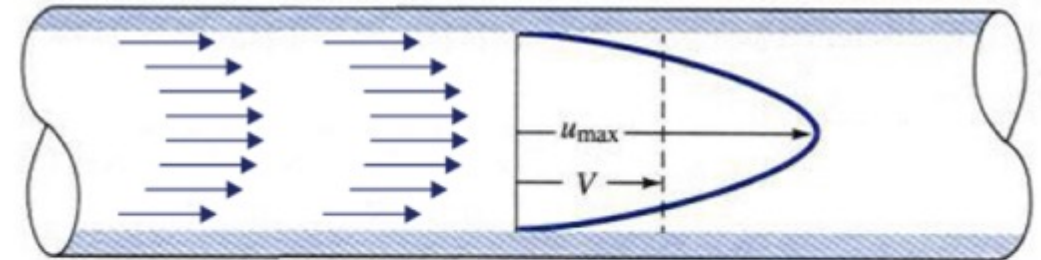


Aim:

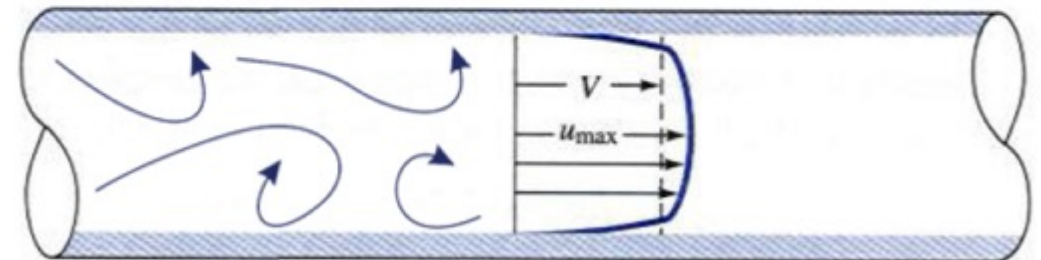
Determine the flow required to remove a test soil from hollow tubes



- Wall shear stress dominant mechanical force during cleaning
- Wall shear increases with turbulent flow at higher flow speeds



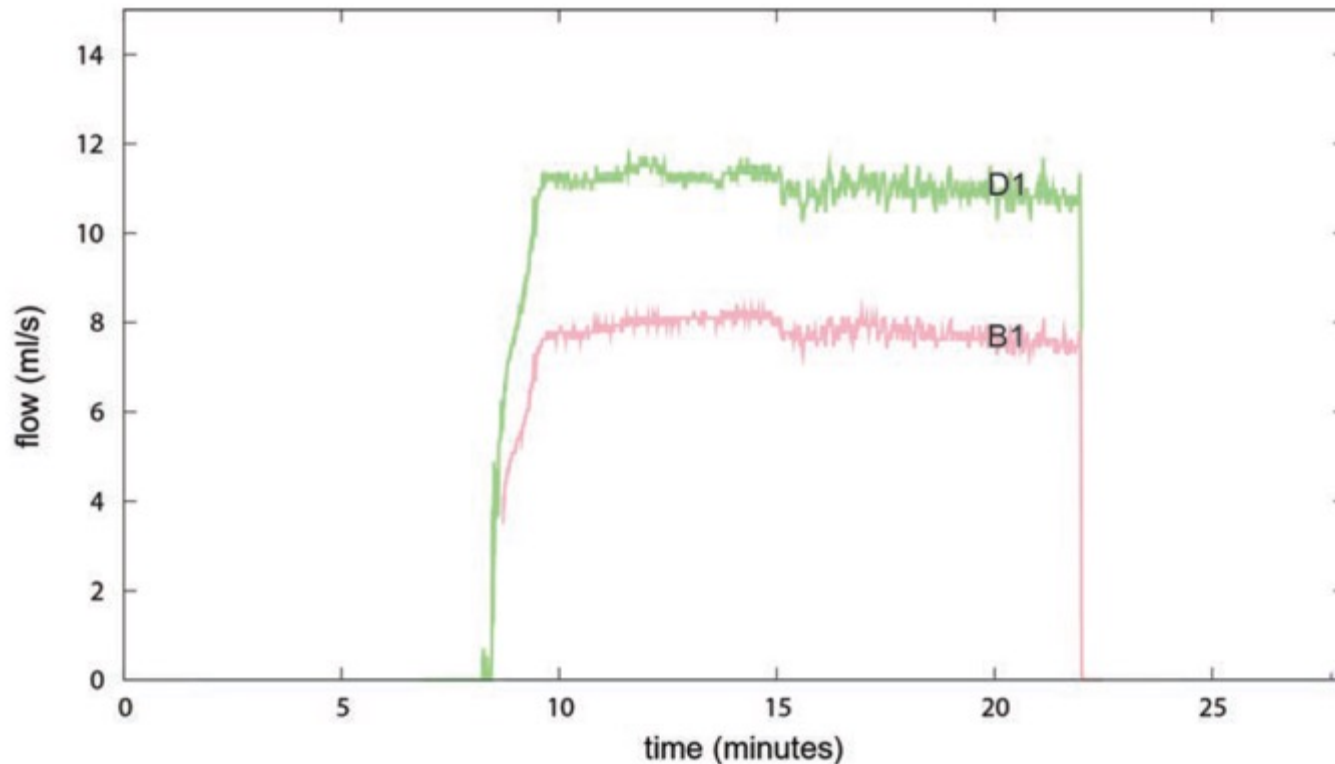
Laminar flow



Turbulent flow

- Flow speeds

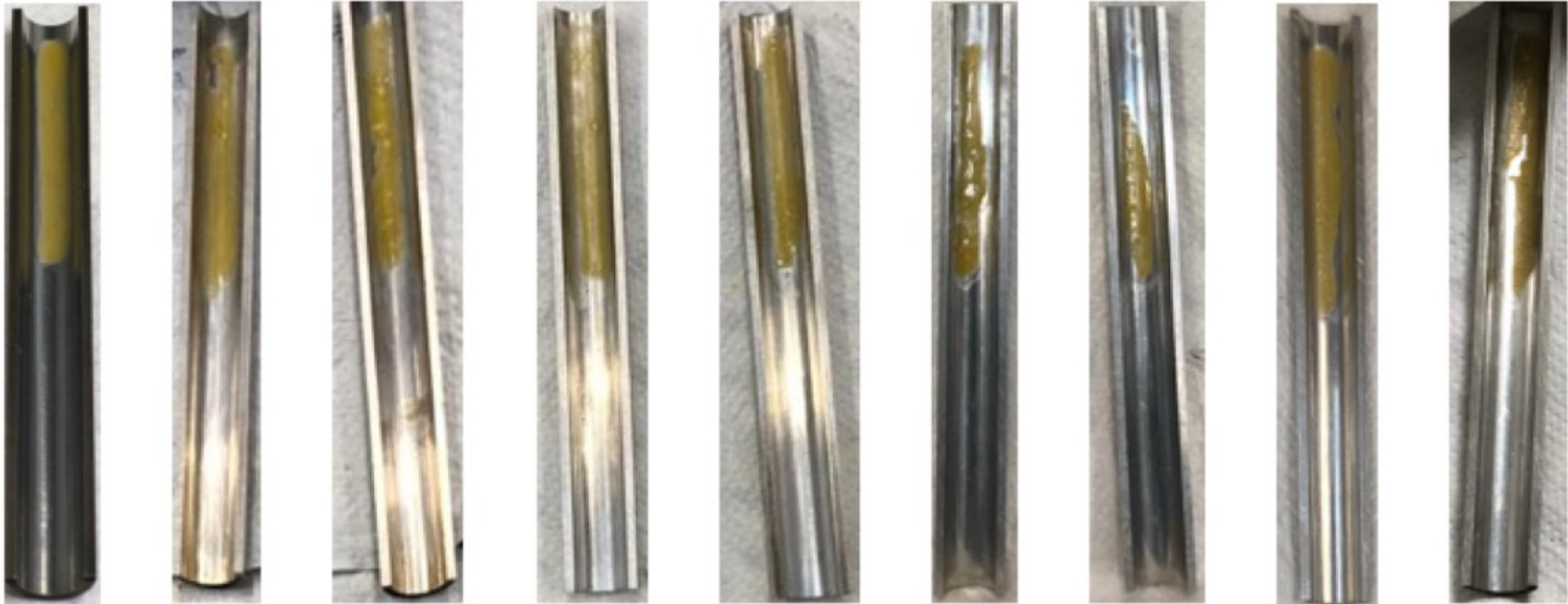
- Measurements performed in a WD in Rotterdam
- Flow speeds of 0.3 L/min to 0.9 L/min found in a commercial WD



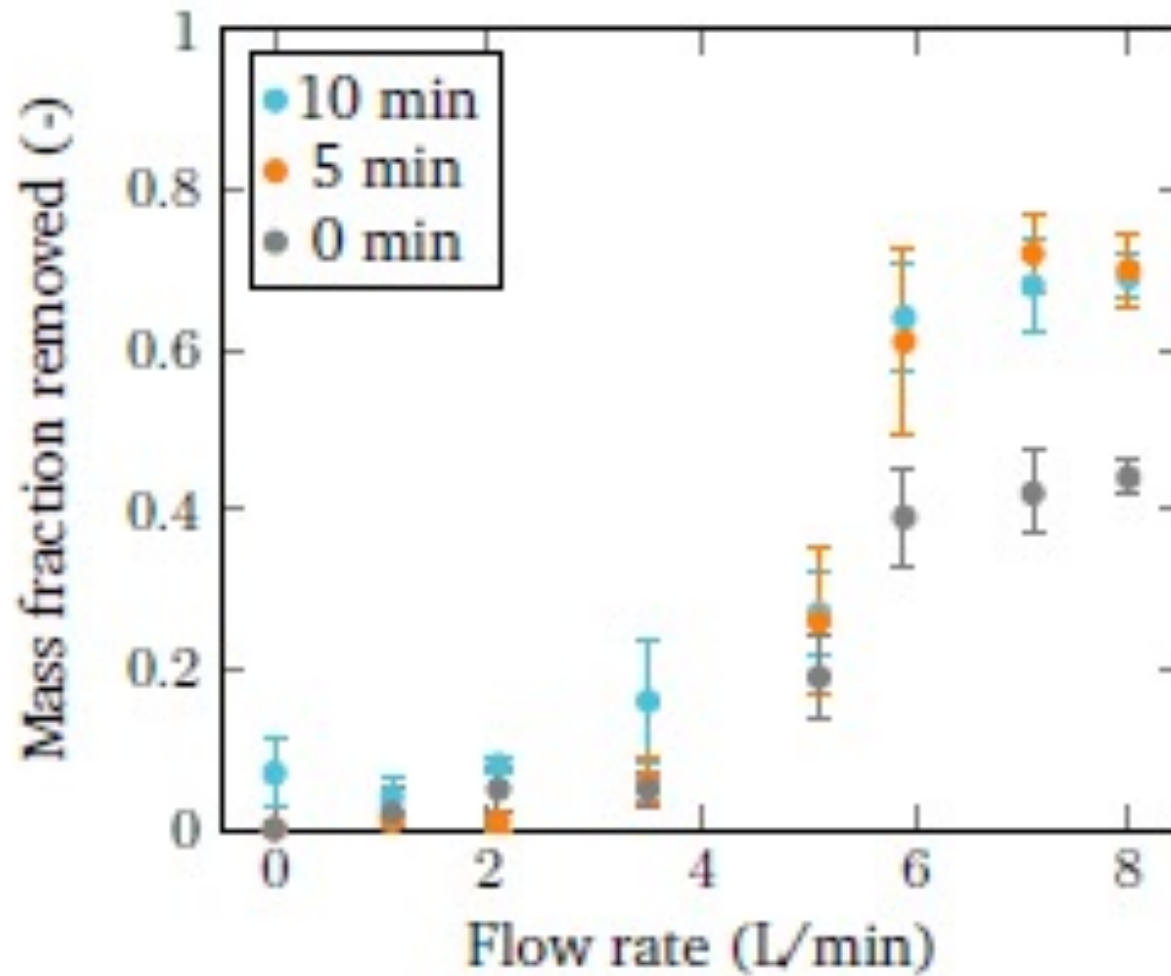
- D1: 6 mm trocar
- B1: 2mm suction tube

- Flow rates between 0 and 8 L/min
  - Laminar to turbulent
- Soaking times
  - 0 – 5 – 10 min
- Selection of test soils
  - Egg yolk as a pilot
  - Blood Test Soil (Pfeiffer)

# Effect of Flow Rate

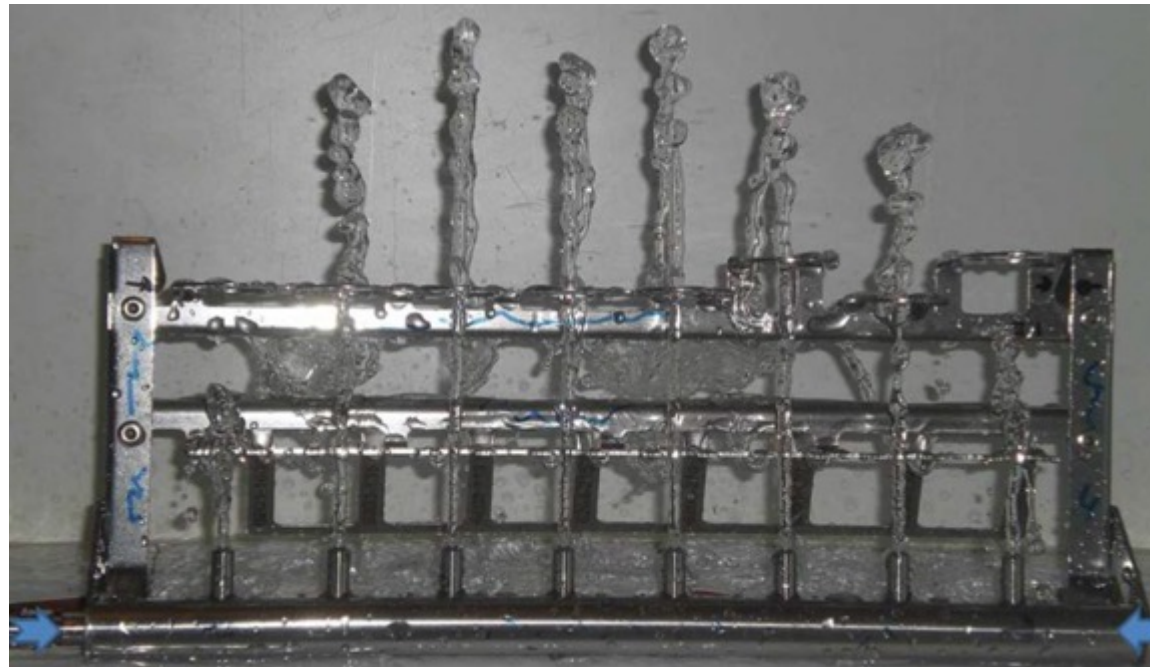






- A high amount of debris can be removed by increasing flow speed
  - Turbulent flow increases debris removal
- The shear stress induced by the flow rate should be taken into account for adequate cleaning of hollow medical instruments

- Results could be used as cleaning validation
  - Unequal flow distribution
  - Instrument blockages



- Blood Test Soil (Pfeiffer)
- Use of detergent
- Complex geometry pieces

