Setup of an experimental rig for Microfiltration of urine and faecally contaminated urine

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Context

This is a project under the 'Reinvent the Toilet Challenge (RTTC)' which is funded by the Bill and Melinda Gates Foundation (BMGF). Objectives of RTTC include:

- To develop a new toilet technology for processing human waste without links to ;
  - water
  - energy
  - sewer lines
- Operation at a costs affordable to the **poor zones in developing countries**
- Removal of pathogens from human waste and recover valuable resources such as energy, clean water, and nutrients

Research objectives

This study aims to use pressure driven **microfiltration** membranes to determine the properties of stored urine and faecally contaminated urine (feed stock) for the purpose of contaminant removal and recovery water and nutrients.

This research focuses on 3 main objectives:

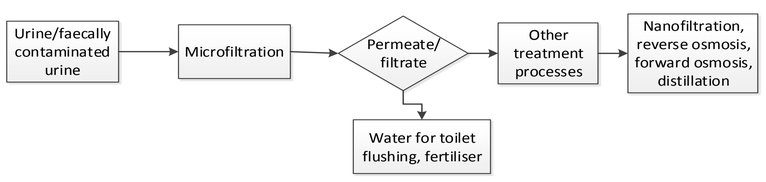
- Permeability of membranes during filtration of the feed stock
- Characterization of the feed stock and rejection of Contaminants
- Fouling and flux recovery after membrane cleaning.

Purpose

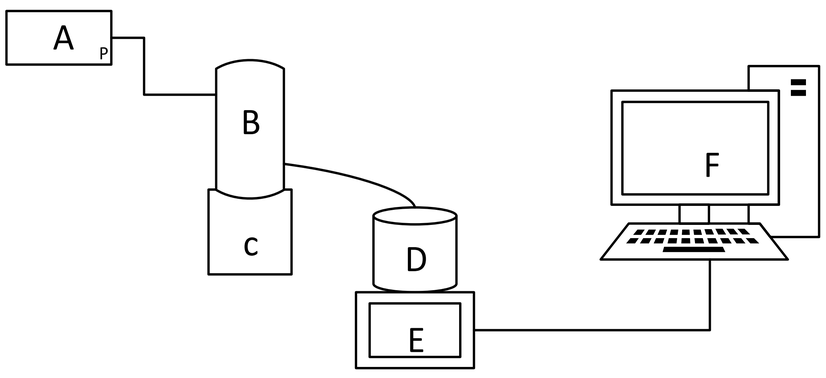
- Treatment of urine from urinals and from UDD toilets

UD-Toilet  Urinal 

- To remove organic contaminants and pathogens
- To optimise other treatment process.



Methods



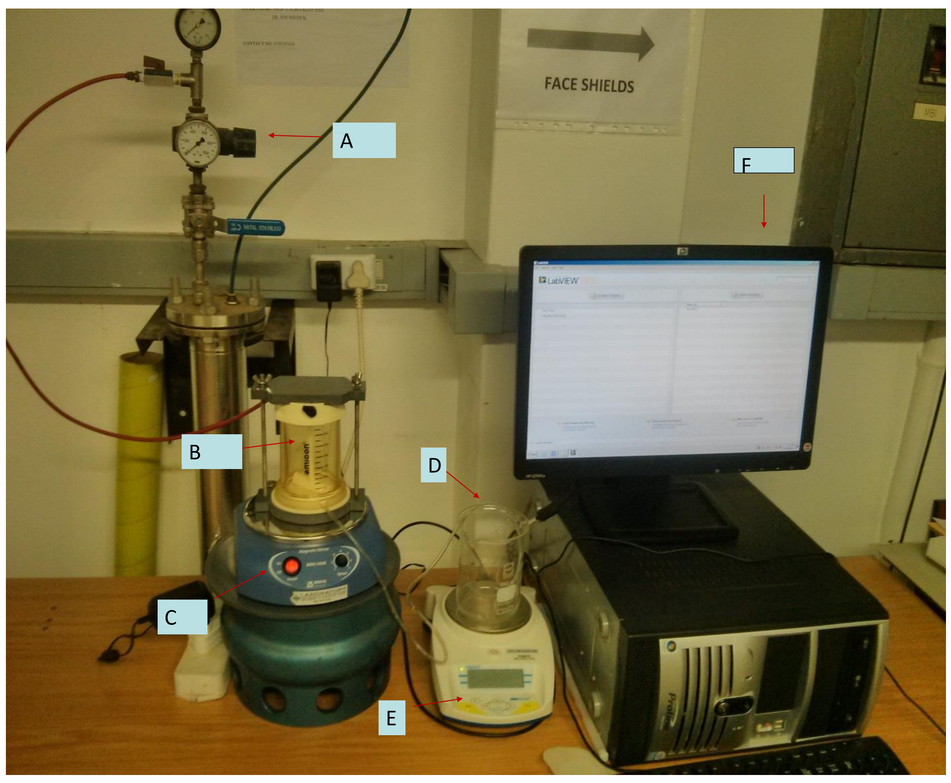
A	Pressure gauge
B	Stirred cell (Amicon cell)
C	Magnetic stirrer
D	Beaker
E	Mass balance
F	Pc

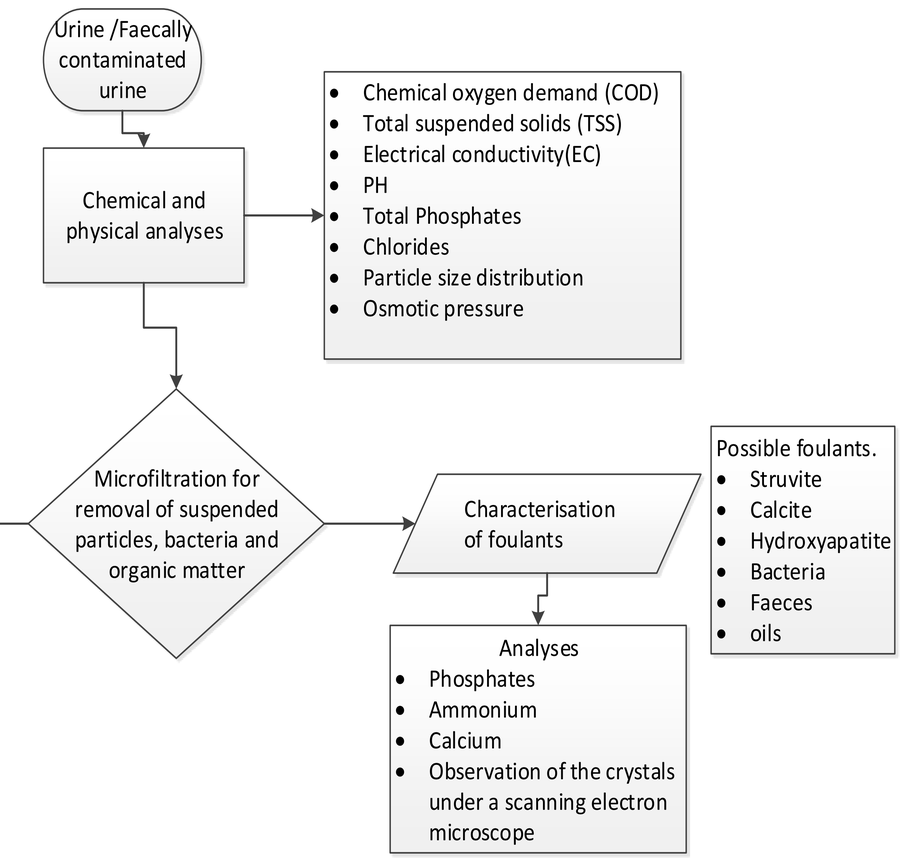
Materials

- PES membranes, NMWL 500 kDa,76 mm diameter
- Amicon stirred cell for holding the membrane
- Magnetic stirrer for stirring the Amicon cell
- Permeate weighing balance connected to the Pc
- Pc for continuous logging of data via Lab view software

Experimental Conditions

- Feed streams : urine and faecally contaminated urine
- Room temperature
- Dead-end filtration mode
- Pressure of 20-70 kPa
- Clean membrane for each stream
- Fouled membrane cleaning using 0.1 M NaOH



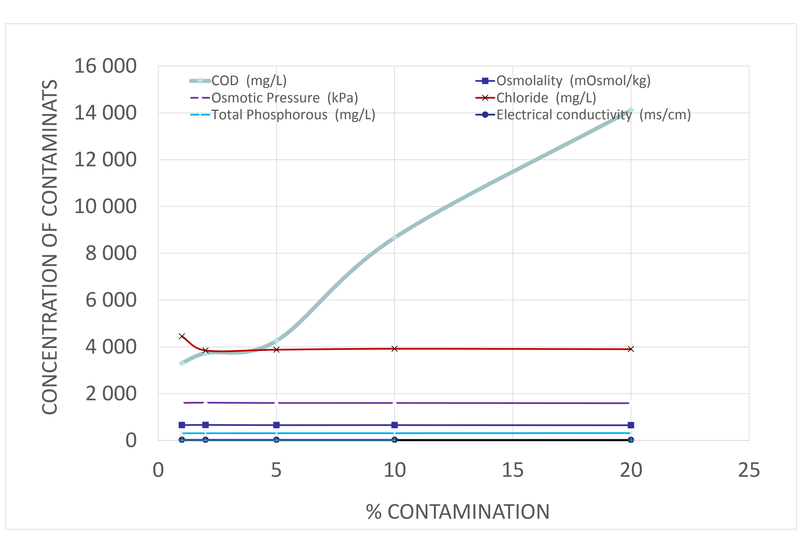


Characterization of the feedstock

Chemical analyses on urine and faecally contaminated urine

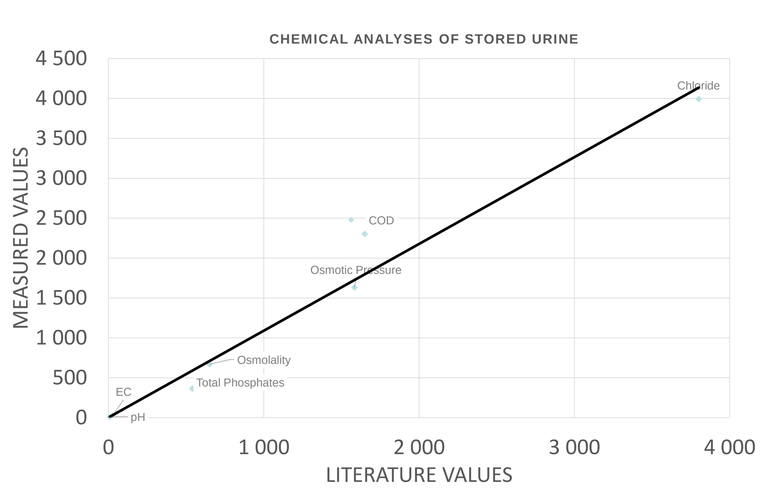
% of faecal contamination	Units	0	1	2	5	10	20
COD	mg/L	2 367	3 305	3 735	4 256	8 666	14 111
Osmolality	mOsmol/kg	650	658	663	656	657	652
Osmotic Pressure	kPa	1 631	1 604	1 616	1 600	1 601	1 590
Chloride	mg/L	3 800	4 450	3 847	3 880	3 920	3 903
Total Phosphorous	mg/L	540	308	309	310	311	315
Electrical conductivity	ms/cm	30	29	29	28	28	27
pH		8.6	8.7	8.7	8.7	8.7	8.7

Graphical presentation of faecally contaminated urine



Only COD increases with contamination

Graphical presentation of contaminants in urine



Experimental results compatible with literature

Outputs

- The set up of the experiment is completed and first experiments are on course.
- Faecal contamination increases the amount of COD in urine while there is no significant change in other parameters .
- It is expected that flux will increase with increase in transmembrane pressure and decrease with increase in time.
- Permeability of the membranes is also expected to decrease with fouling.

References

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