IWA World Water Congress & Exhibition

11 – 15 September 2022 | Copenhagen, Denmark

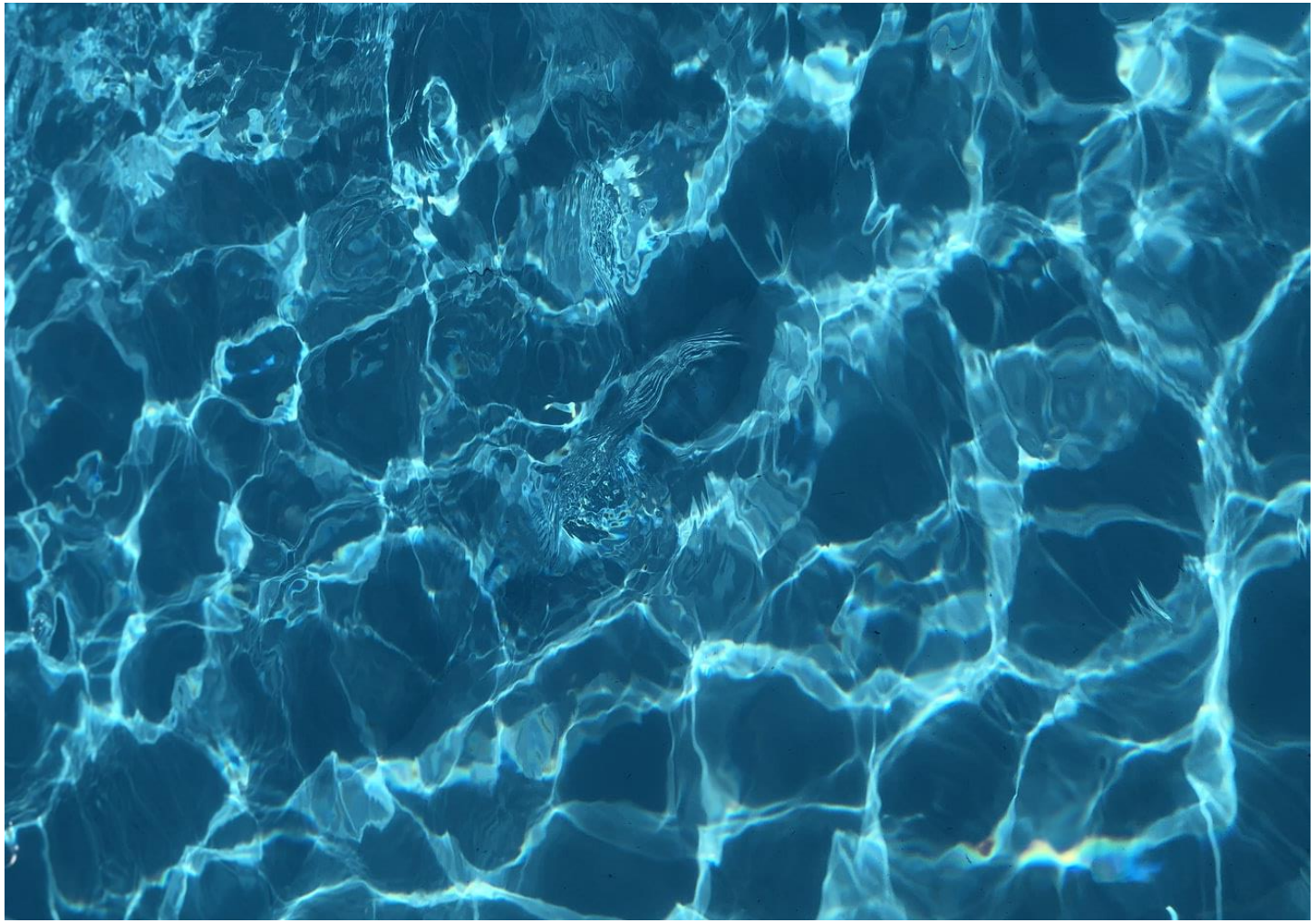
Reagent recovery from dairy industry wastewater through membrane processes

Rubén Rodríguez-Alegre, LEITAT Technological Center / Universitat Politécnica de Catalunya, Spain

inspiring change

INDEX

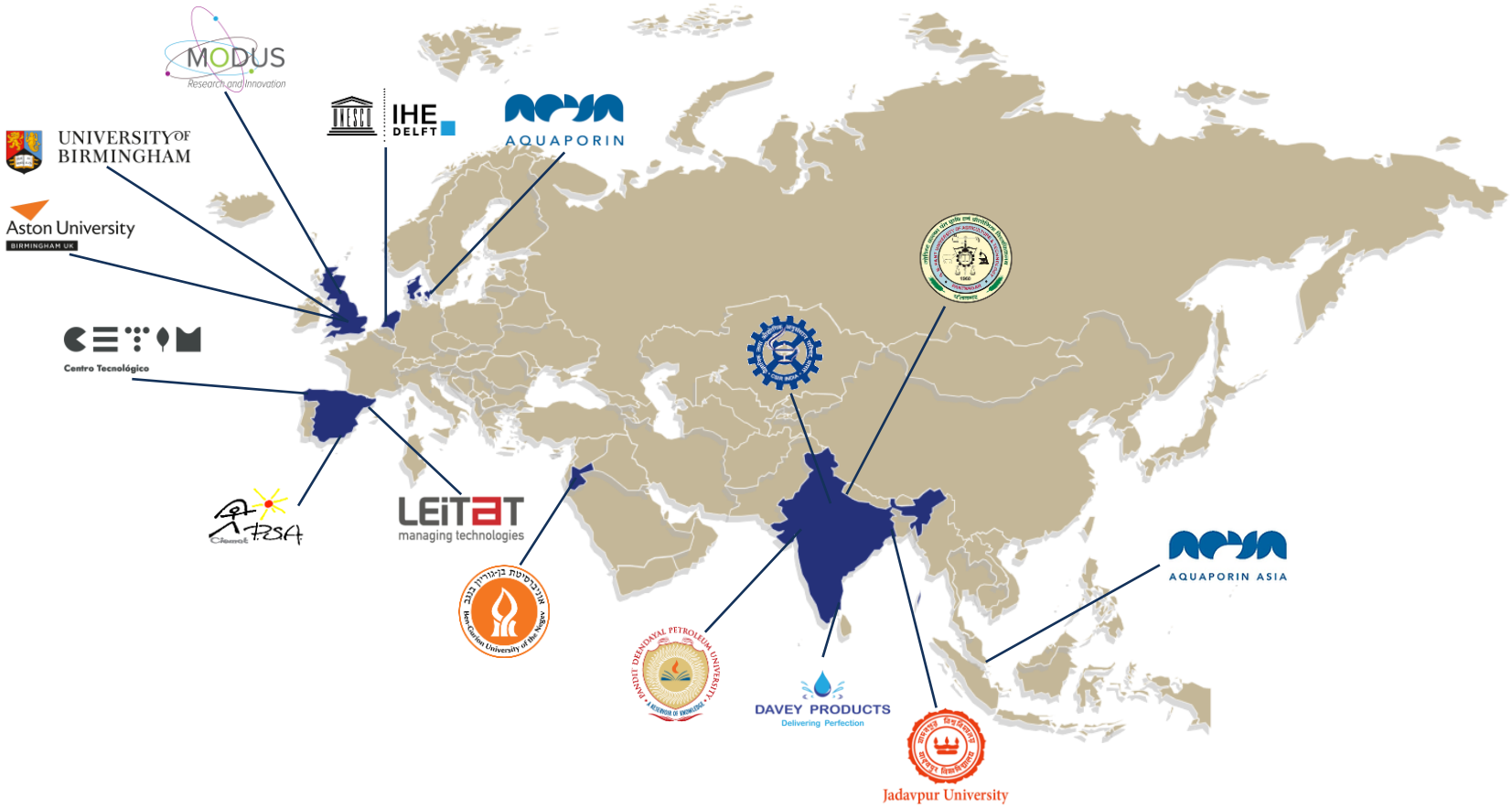
- Introduction
- Methodology
- Results
- Conclusions



RESEARCH FRAMEWORK

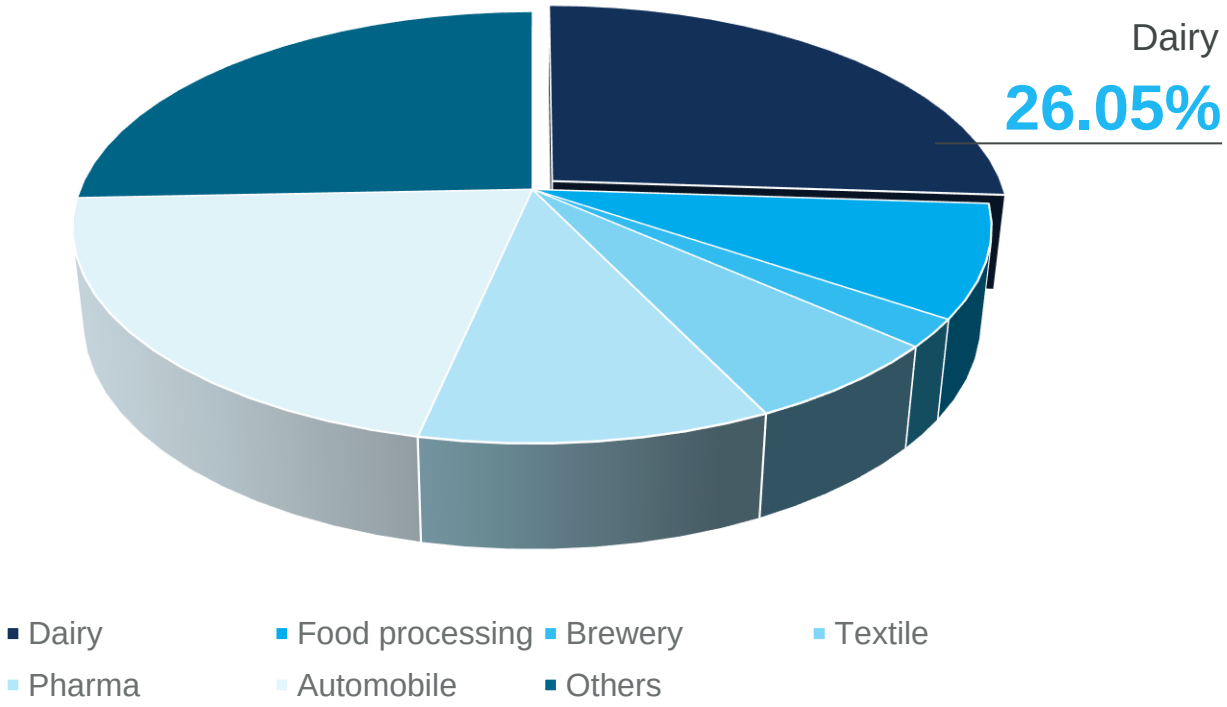
bIo-mimetic and phyto-techNologies DesIgned for low-cost purficAtion and recycling of water

(INDIA-H_2O)



RESEARCH FRAMEWORK

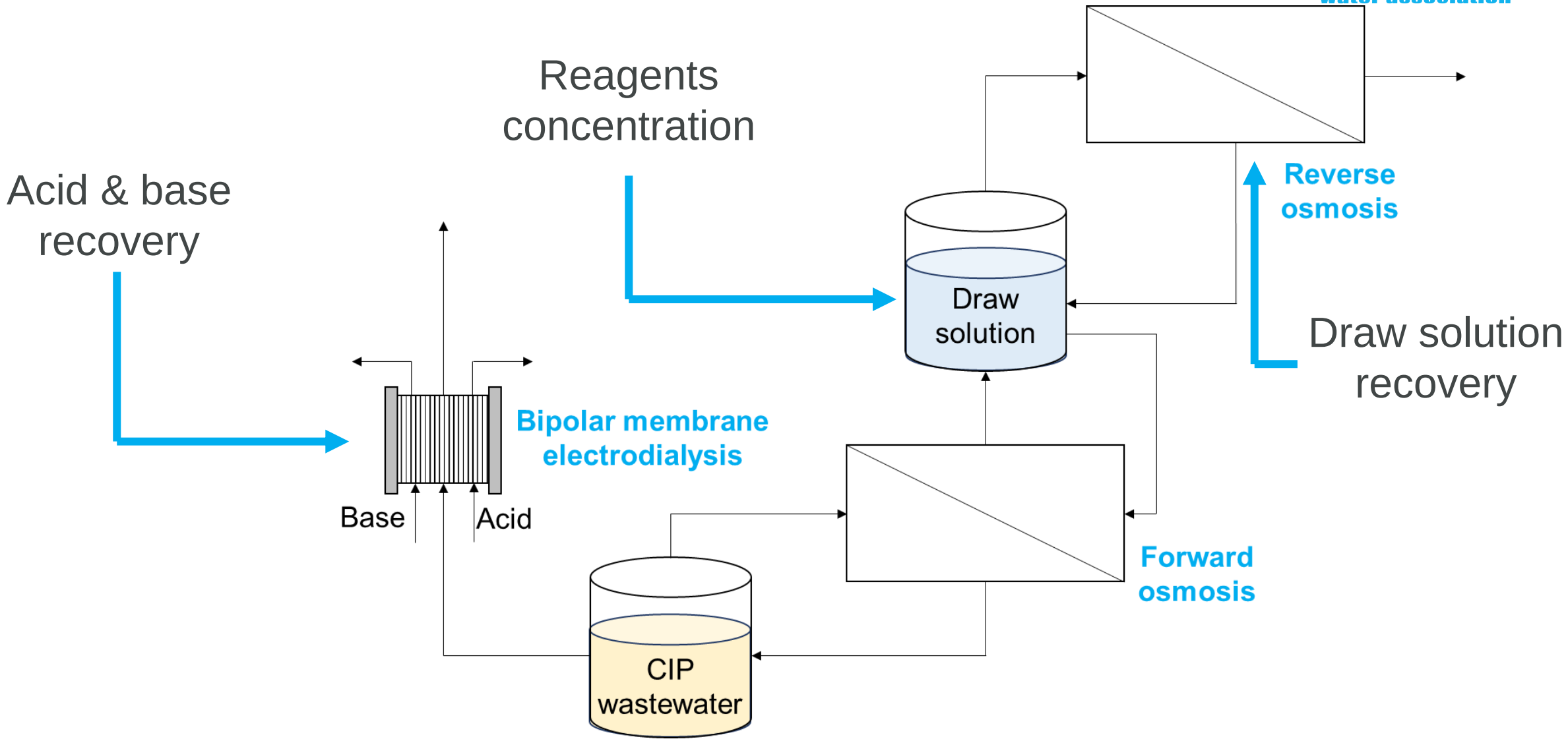
- India is ranked 1st in milk production contributing 26% of global milk production.
- Cleaning-in-place (CIP) requires large quantities of water in the dairy industry (nearly 75% of the total water required)
- Three stage process: basic cleaning, acid cleaning and detergent



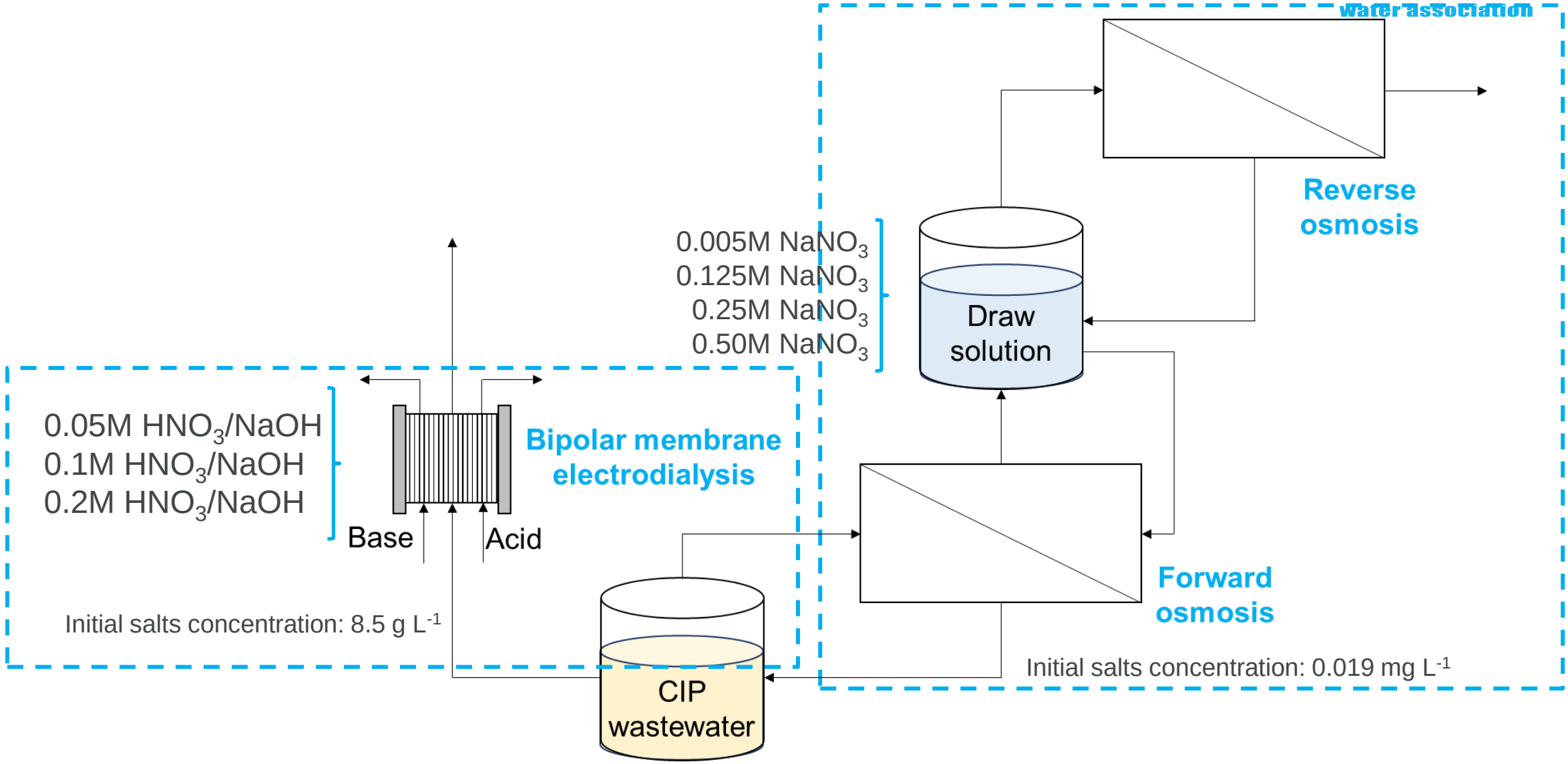
SUSTAINABLE DEVELOPMENT GOALS

the international water association

METHODOLOGY: EXPERIMENTAL SET-UP



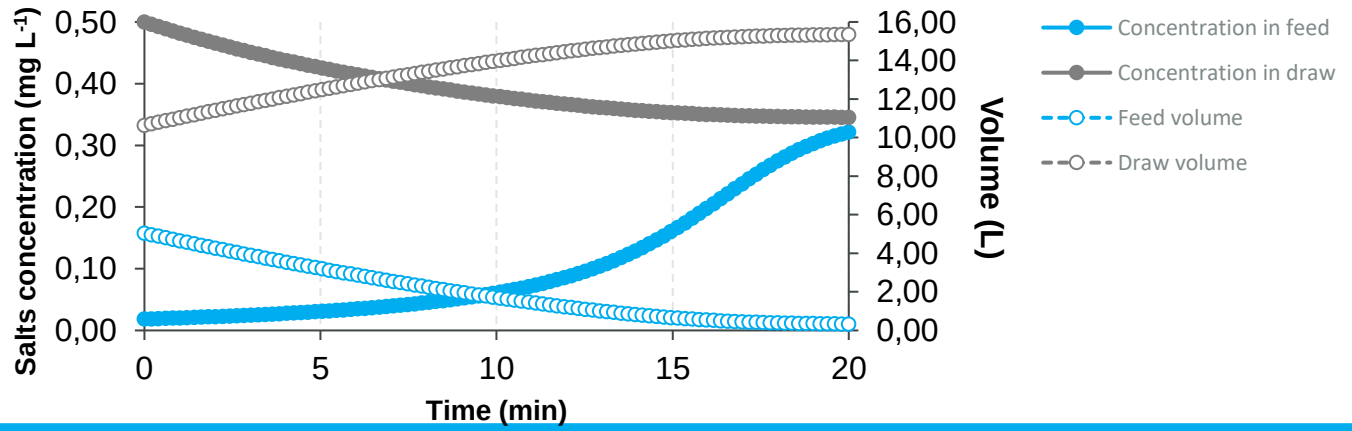
METHODOLOGY: EXPERIMENTAL SET-UP



RESULTS: FORWARD OSMOSIS

$$SEC\left(\frac{Kwh}{m^3}\right) = \frac{\Delta P \cdot Q_{feed}}{Q_p}$$

Experimental conditions	C^0_{draw} [mol/m³]	C^f_{draw} [mol/m³]	C^0_{feed} [mol/m³]	Q_p [m³/h]	ΔP [Pa]	SEC [kWh/m³]
0.005M $NaNO_3$	50	41	18	0.00098	3.67 10^3	0.0324
0.125M $NaNO_3$	125	100	18	0.00274	3.67 10^3	0.0108
0.25M $NaNO_3$	250	180	18	0.00616	3.67 10^3	0.0046
0.50M $NaNO_3$	500	370	18	0.01540	3.67 10^3	0.0018



RESULTS: REVERSE OSMOSIS

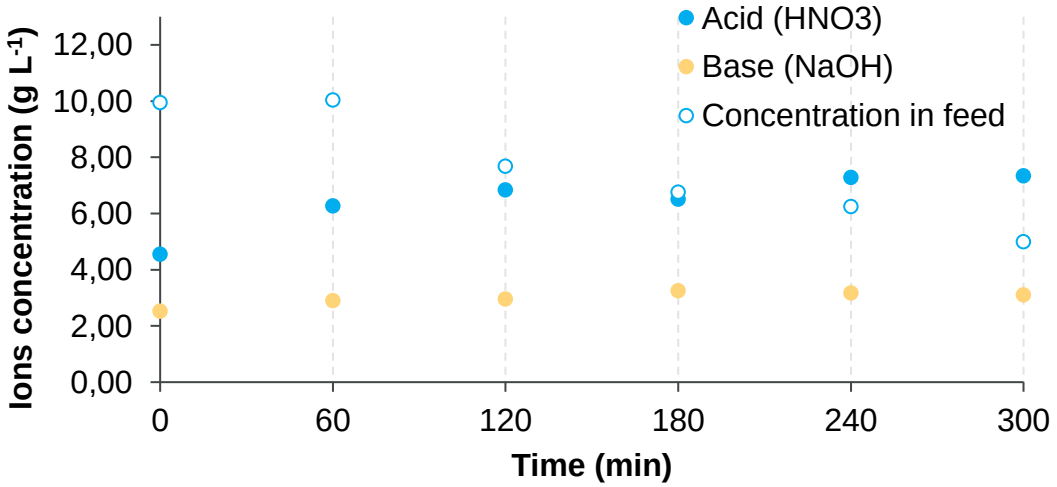
$$SEC\left(\frac{Kwh}{m^3}\right) = \frac{\Delta P \cdot Q_{feed}}{Q_p}$$

Experimental conditions	C^0_{draw} [mol/m³]	C^f_{draw} [mol/m³]	C_{perm} [mol/m³]	Q_p [l/h]	ΔP [bar]	SEC [kWh/m³]
0.125M $NaNO_3$	100	121	12.7	5.2	10.4	45.3
0.25M $NaNO_3$	180	234	22.5	5.42	14.2	58.5
0.50M $NaNO_3$	370	606	8.19	5.1	23.6	102.5

RESULTS: BIPOLAR MEMBRANE ELECTRODIALYSIS

$$CEE\left(\frac{kWh}{m^3}\right) = \frac{N \cdot I \cdot V}{Q_p}$$

Experimental conditions	% conc. HNO_3	% conc. NaOH	N	Voltage [V]	Intensity [A]	Q_p (m^3/h)	SEC [kWh/m^3]
0.05M HNO_3/NaOH	61.38	23.03	30	9.02	0.09	$3\ 10^{-5}$	3.59
0.1M HNO_3/NaOH	182.82	77.83	30	9.02	0.09	$3\ 10^{-5}$	16.48
0.2M HNO_3/NaOH	6.77	-55.33	30	9.02	0.12	$3\ 10^{-5}$	4.59



CONCLUSIONS

- According to Forward Osmosis and Reverse Osmosis results, SEC and permeate quality, the optimal concentration of draw solution is 0.125 M $NaNO_3$.
- In Electrodialysis tests, the best performance was reported for an initial concentration of 0.05 M for both acid and base as draw solution.
- In Electrodialysis, The concentration of $NaNO_3$ was reduced by 75%.
- The work done so far, yields promising results in the concentration and extraction of cleaning reagents for reuse in dairy industry.

THANK YOU

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 820906 and the Indian Department of Biotechnology.