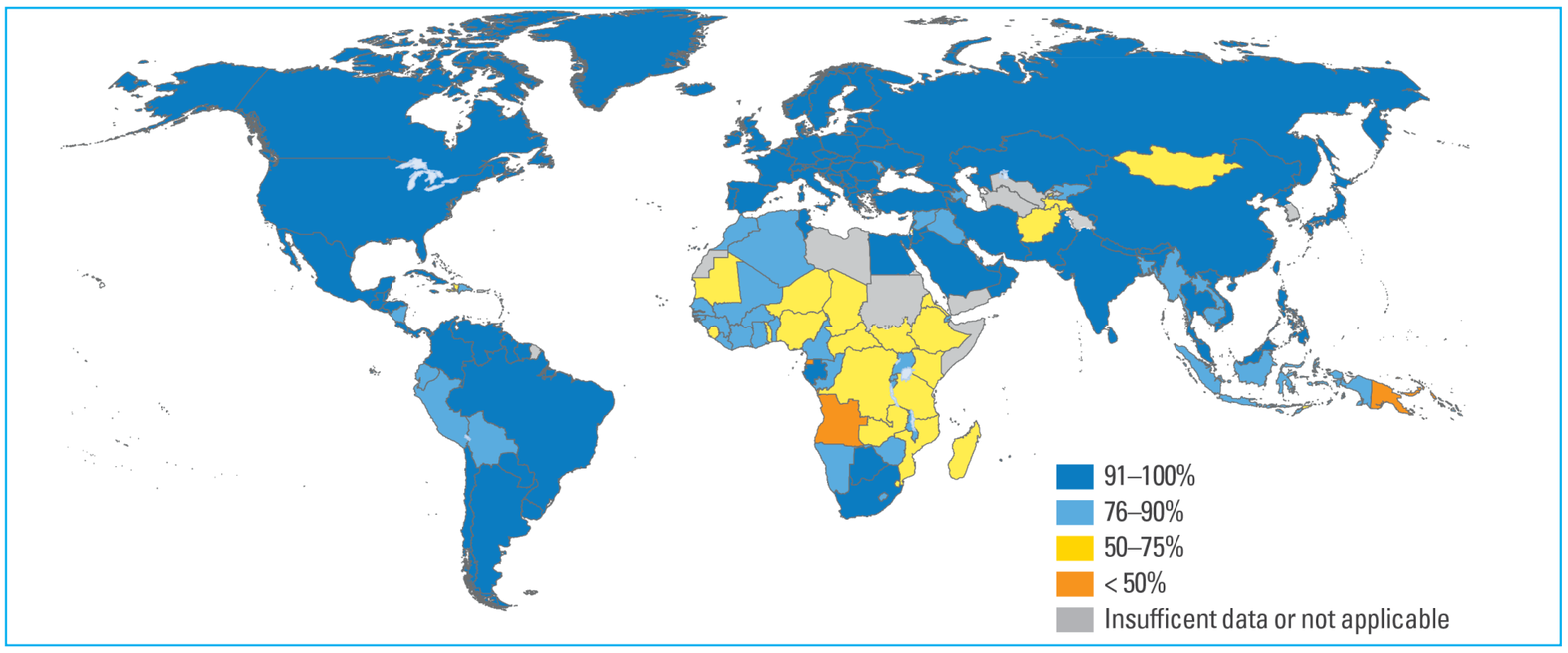
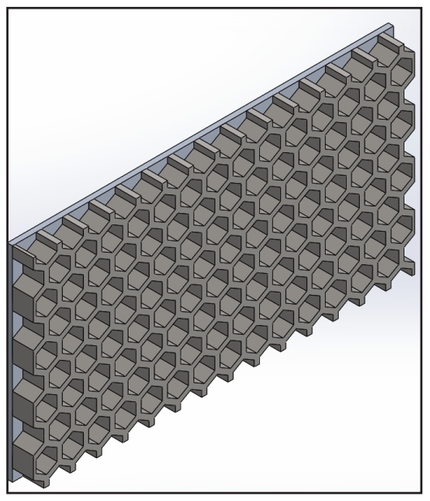
Graphene Enhanced Adsorption Desalination System

Currently almost one billion people across the world have no access to a safe potable drinking water. According to UN statistics, by 2030 the water demand will exceed the supply by 40%. This means that up to two-third of the world's inhabited areas would be water stressed. There are currently no commercially available small scale water desalination / purification units that could serve small communities with critical needs for potable water. Most desalination and purification units are centralized and consume a large amount of energy which contributes to the overall carbon footprint.



The research questions to be addressed by this project are:
1) Can new adsorbent systems be developed to allow efficient use of low grade energy for water desalination?
2) Can the technology be reduced in size of water desalination / purification units that to allow deployment on a small localised scale?
3) Could such a system utilise low grade, waste or renewable energy resources for a more sustainable environment?
4) How can sustainable water desalination units be produced that serve small communities at minimum installation and operational cost?

This research project explores:
1) Developing a new adsorbent coated plate heat exchanger with embossed adsorbent surface in order to optimize the heat and mass transfer performance of the adsorbent bed.
2) Physically mixing the adsorbent material with a super thermal conductive and light weight material (Graphene based materials).
3) Investigate the feasibility of replacing the plate heat exchanger metal sheet by a graphite based material for better thermal inertia.

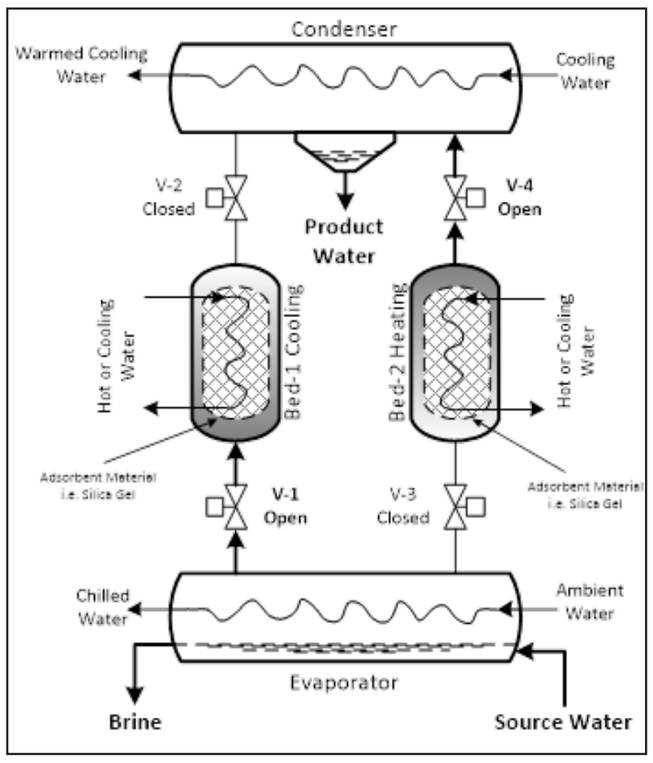


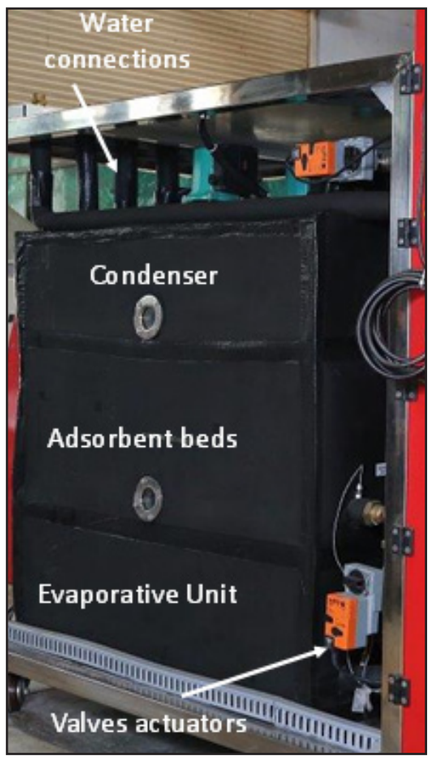
Proposal Summary:

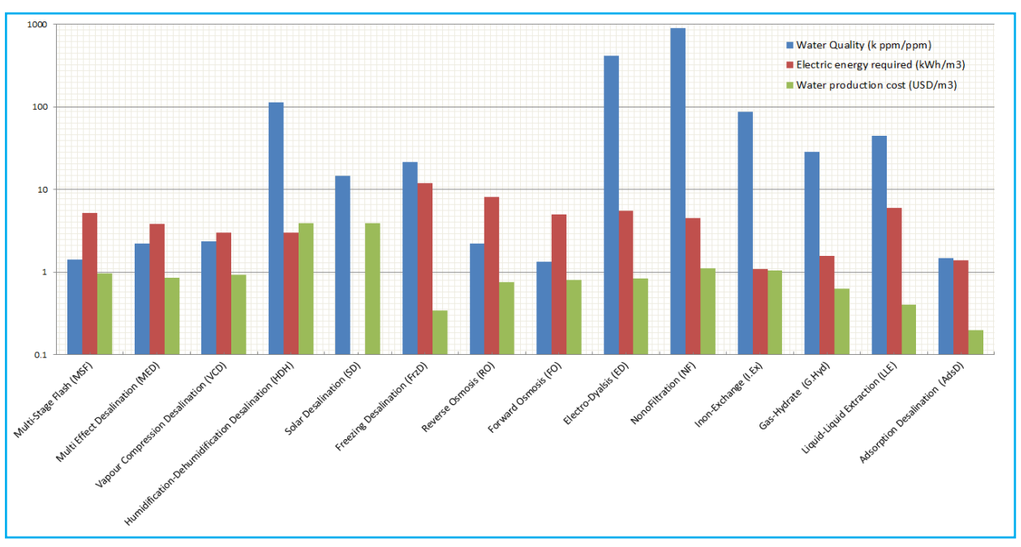
Adsorption desalination technology has shown proven trends of

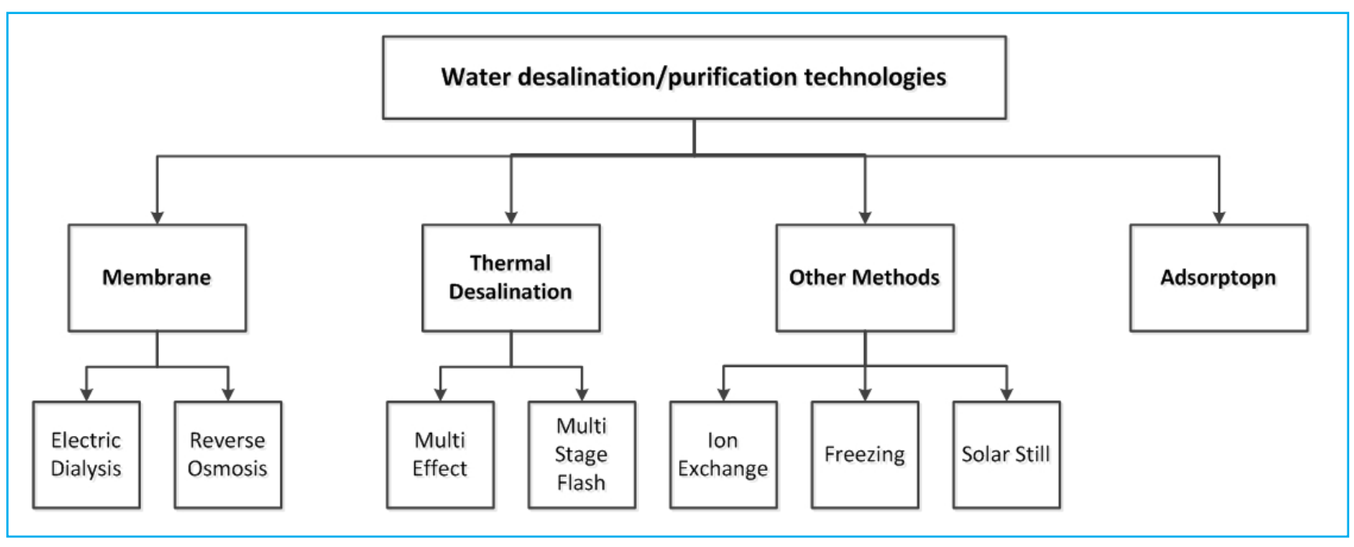
1) low energy consumption,
2) high water quality (produced water salinity ÷ feed water salinity),
3) lowest cost of produced water,

Adsorption desalination / purification is a thermal driven technology using fairly low grade heat, below 100°C, which is suitable for utilizing solar thermal energy for hot climates where this technology is mostly needed. One of the main advantages of adsorption water desalination / purification is a by-product of cooling that can be useful in other applications. Such a system typically suffers from a large physical foot print and weight that limit its portability and hence lowering the capability of serving small size communities. In centralised water desalination / purification plants, using a developed version of adsorption system increases the plants' productivity as well as its effectiveness. The energy utilisation effectiveness is a key parameter in controlling the potable water price, which is a major concern in developing nations where current energy resources including renewable and thermal resources are limited.









The University of Huddersfield team has already applied to NERC (Natural Environment Research Council) £800k & British Council £200k with an international partner to carry out the project in-house.
1) The Turbocharger Research Institute (TRI) has been awarded £35k internal QR funding to develop an adsorption unit for cooling and water desalination / purification research, which will provide baseline data for the proposed project. Construction of this is currently in progress.
2) Both TRI and Product Design have senior personnel have been working on related research for developing heat exchange systems including application of graphene based materials. There is the potential for further PhD and/or Post Doctoral research on this topic, particularly as the Product Design research team currently investigates application of Graphene / Graphite for cooling applications for medical product development.
3) TRI has a team of researchers and technical capacity to carry out the research on developing the adsorption system for cooling and water desalination / purification, with two research fellows experienced in the field. The Product Design team based in IDL (Innovative Design Lab) includes specialists in innovation, new product development, 3D printing technologies, and use of Graphene.
4) The Material and Catalysis group at the University of Huddersfield has the capacity to test different working substances which could potentially be used in the adsorption research.

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