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Integrative Approach is the Answer to World's Emerging Challenges

TWAS Science Diplomacy Workshop

Sustainable Water Management

Trieste, Italy

Basic Research Group

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30 November – 4 December 2015

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SDG's Target on Water

Improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally

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Presentation Outline

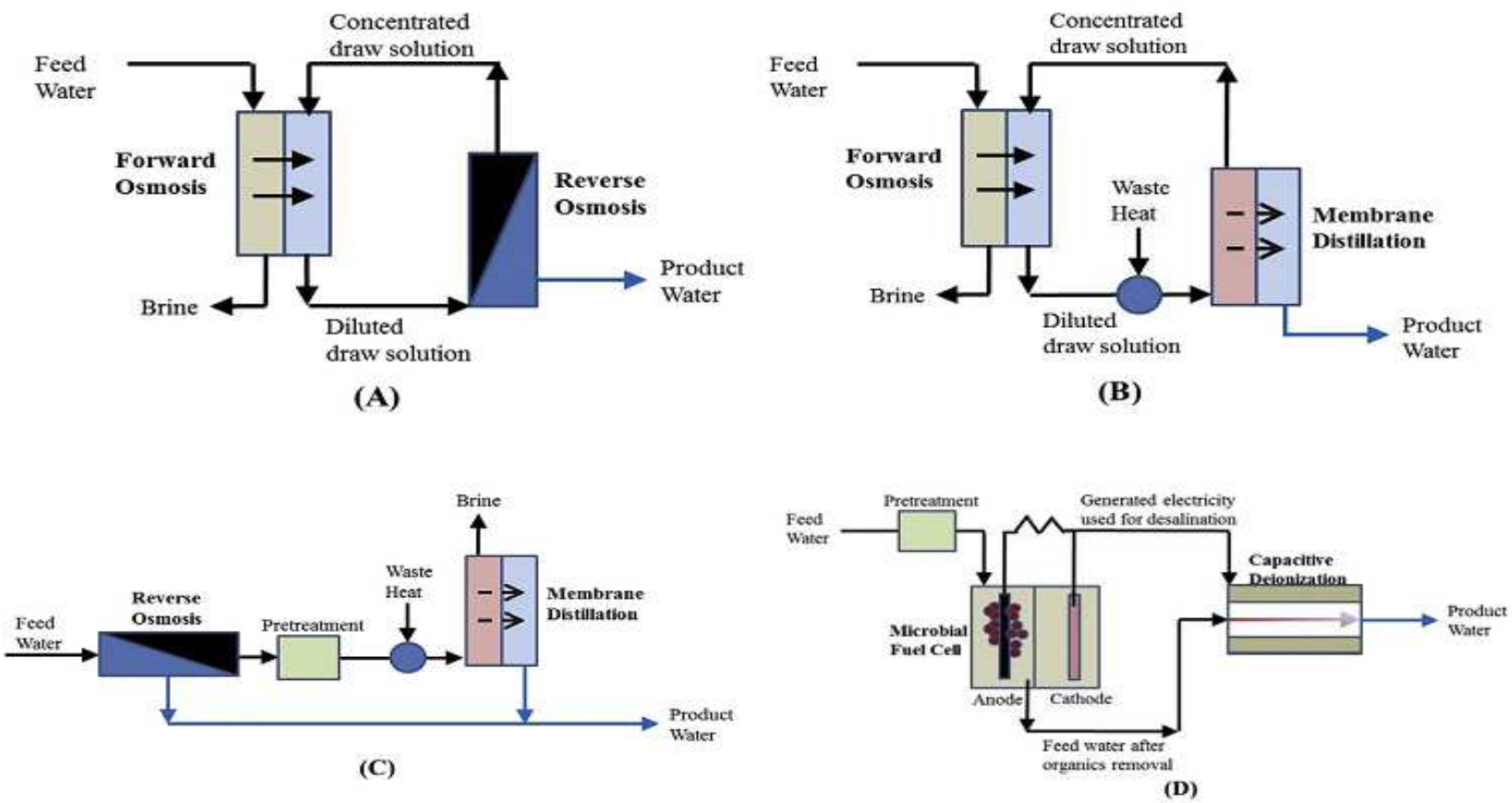
- *Access, Availability & Challenges*
- *Emerging technologies for water and waste treatment*
- *Sustainability issues*
- *Technical Approaches & Implementation*
- *Conclusions and Recommendations*

Access, Availability & Challenges

- Across the world today, water stress is already a big issue
- Lack of access to potable water in rural areas
- Rivers & lakes constitute only approx. 2% of the world's available fresh water and are unevenly distributed among the populace
- Information gap relating to water borne diseases prevalent in rural areas
- Lack of collaboration among universities, research institutes, industries and governmental organizations
- Problems associated with accessing data from operating facilities for research purposes
- Problems relating to recyclability, reusability and durability of existing technique

Emerging technologies for water and waste treatment

- GIS application
- Membrane based Technologies: e.g. aquaporin membranes, nano-composite membranes, nanotube membranes, graphene-based membranes, semi-batch RO, membrane distillation and forward osmosis



Emerging technologies for water and waste treatment

- **Green Technology: constructed wetlands, phyto-remediation and bioremediation**

Emerging technologies for water and waste treatment

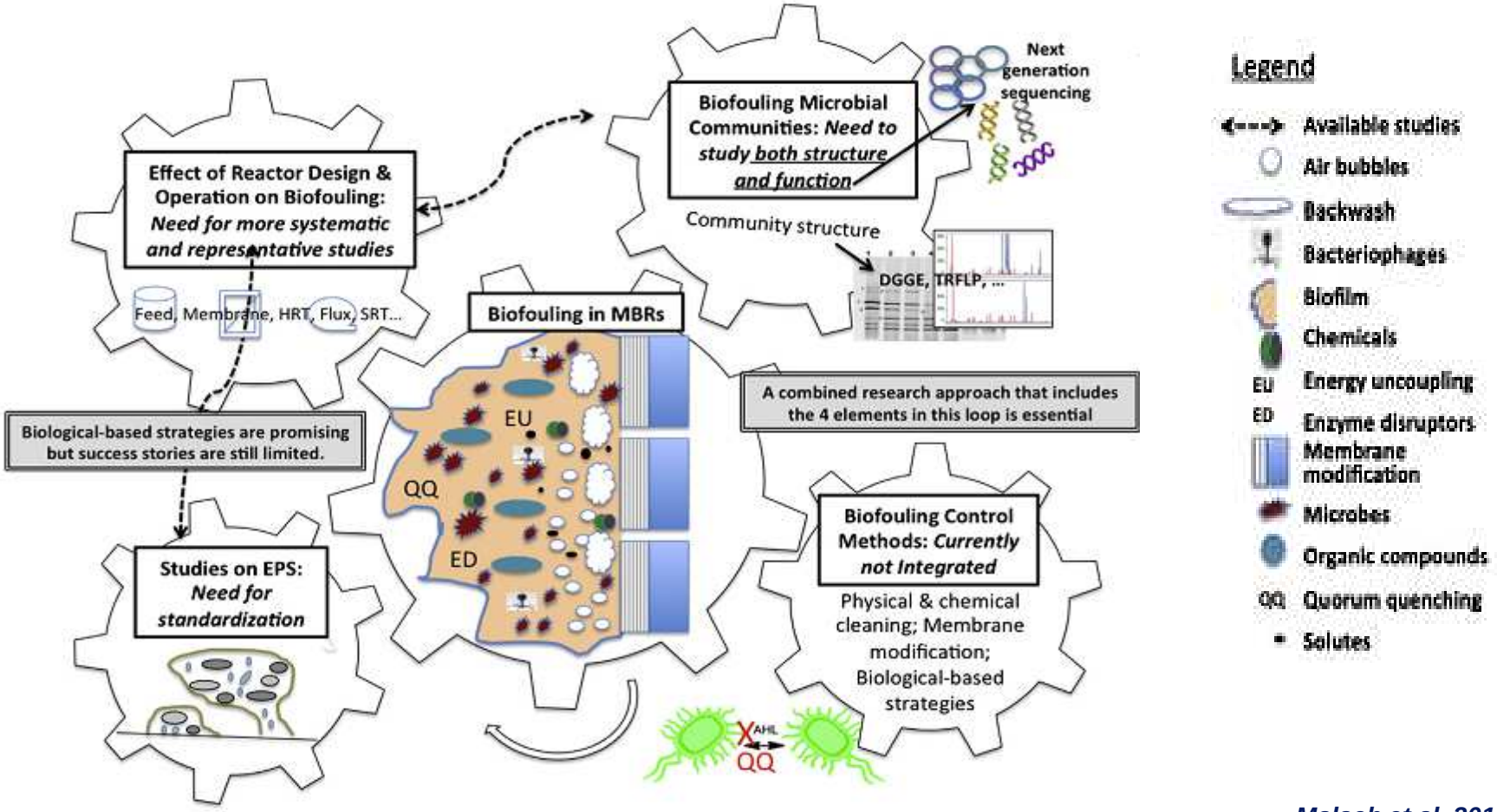
- **Nanotechnology: CNTs, MOFs, Functionalized materials for adsorptive removal of contaminants from water and so on**

- **Molecular Techniques: DNA sequencing of micro-pollutants, quorum sensing and quenching, and analysis of foulants communities**

- **Geophysical & Geochemical Techniques: Resistivity and Seismic surveys for groundwater detection, sustainability and vulnerability measurement**

Emerging technologies for water and waste treatment

- **Integrative solutions**: combination of the various techniques for effective water treatment and management. water & wastewater treatment and reuse



Malaeb et al. 2014

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Sustainability Issues

- Emerging technologies for water treatment are very expensive and energy intensive to adopt in developing countries
- Emerging Contaminants: A Major Challenge for Water Treatment Facilities
- Failure to optimize existing technologies, and an antiquated mindset focused almost exclusively on developing new supplies
- major rehabilitation and replacement of aging water distribution and waste-water collection infrastructure
- Funding and Communication Challenges

Technical Approaches & Implementation strategies

- There are two basic scientific solutions

1. Innovation
2. Water Treatment Options

- Promising innovations for localized water treatment systems include new filtration and disinfection technologies, systems for water quality monitoring and control, business models and management systems responsive to community needs and capacity.
- Small-scale local treatment systems that provide a means to meet both changing demands and differing water quality requirements quickly and effectively
- Use of "micro-membranes" and "ultra-filtration" in localized settings that can filter water up to several microns—enough to exclude most pathogens.
- Nanoparticles and nanomembranes offer promise for the directed treatment of specific conditions or contaminants, although the long-term impacts of nanoparticles are still under examination.
- New disinfection systems, including those using the visible light spectrum and ultrasound are also being developed; these might be particularly efficient and cost-effective for localized treatment nodes.

Technical Approaches & Implementation strategies

- Integration of new technological solutions with new business models and the creation of new markets.

- Another area of rapid innovation development is water-resource monitoring and control systems, which focus on real-time information about water quality, quantity, and flow rates among supply and use points.

- New water-distribution market by creating "water stores." Combining new technologies, business models, and market development strategies can allow potential company to establish operations in several regions with severe potable water needs. Some of this are currently in use in places like India, the Philippines, Mexico, and Sri Lanka.

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Conclusions and Recommendations

- Sustainable water treatment solution reduces costs and conserves water
- Proper exposure of researchers to sustainable technologies are needed for the development of water related innovations
- Multi-disciplinary research efforts must be encouraged among scientific experts to promote integrative solutions to world's emerging water challenges

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Acknowledgements

We are grateful to TWAS for the opportunity to be a part of the solution to the world's emerging challenges

Thank You!