جامعة حمد بن خليفة
HAMAD BIN KHALIFA UNIVERSITY
عضو في مؤسسة قطر
Member of Qatar Foundation

HBKU Thematic Research Grant 3rd Cycle– Project Highlight

Project Title: Energy-Smart Solar-Assisted Plasma Technology for Sustainable Water Desalination and Brine Valorization

Dr. Ahmed Abotaleb

Executive Summary (limit to 200 words)

The project pioneers a novel, energy-smart desalination concept that integrates non-thermal plasma activation with solar-assisted multi-effect distillation (MED) to enhance evaporation efficiency and sustainability. By modifying key thermophysical properties of water, such as surface tension and latent heat, plasma activation reduces the evaporation onset temperature, enabling up to 20% energy savings compared to conventional MED systems. Moreover, plasma-generated reactive species provide chemical-free disinfection and micropollutant degradation, minimizing reliance on chemical pretreatment and reducing environmental impact.

Through experimental studies, machine learning modeling, and pilot-scale deployment at a local desalination plant, the project aims to establish a scalable plasma-assisted desalination framework powered by solar energy. This initiative aligns with Qatar's sustainability and energy transition goals and has achieved international recognition by advancing to the Qualified Team Testing phase of the XPRIZE Water Scarcity competition. The project will deliver validated plasma–water interaction datasets, predictive models, pilot performance results, and a comprehensive life cycle assessment, establishing a transformative pathway to address water scarcity through next-generation desalination and brine valorization.

Expected Outcome (limit to 100 words)

The project will deliver several tangible outcomes that advance plasma-assisted desalination toward real-world application. These include an invention disclosure for the plasma-integrated thermal desalination process, a machine learning model for predicting and optimizing plasma-induced changes in water properties, and a feasibility study demonstrating plasma-based seawater disinfection. A lab-scale prototype and pilot-scale evaluation of the plasma-MED desalination system will validate its performance under operational conditions. Furthermore, a comprehensive life cycle and techno-economic assessment will benchmark plasma-based desalination against conventional technologies in terms of sustainability and cost-effectiveness.

Collaborating HBKU entities:

- Qatar Environment and Energy Research Institute (QEERI)
- College of Science and Engineering (CSE)
- Qatar Computing Research Institute (QCRI)

Photos –

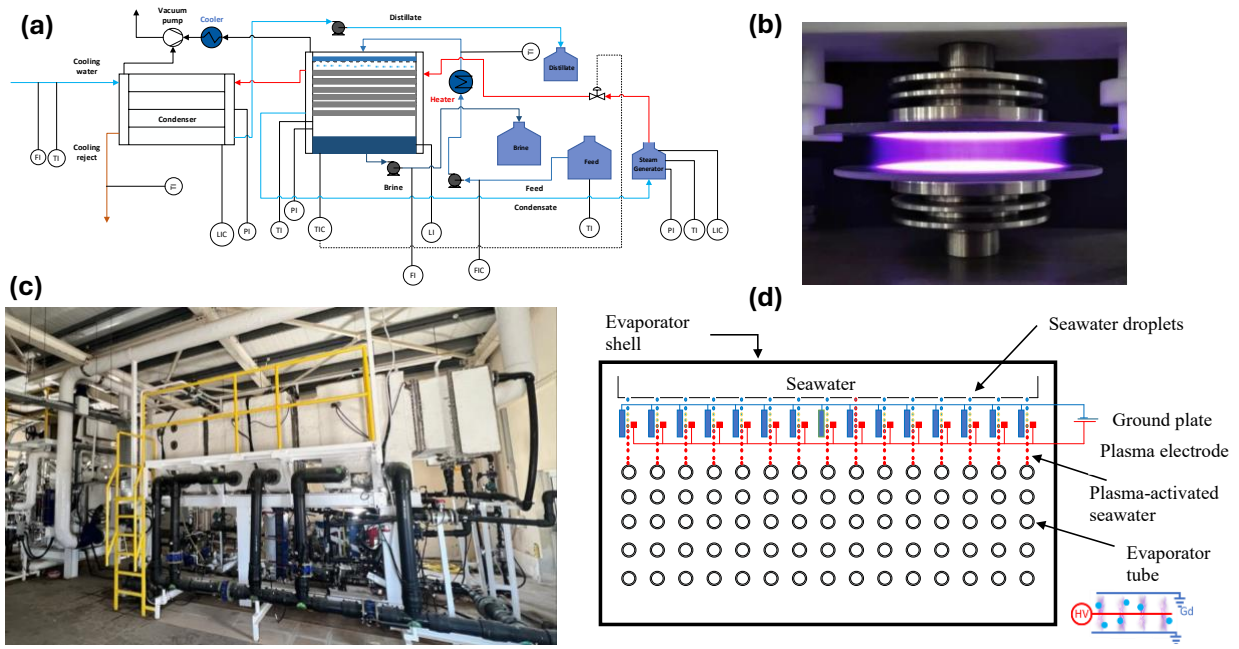

Figure 1. Plasma Desalination Concept: (a) custom-built lab-scale plasma desalination system, (b) DBD plasma discharge, (c) MED pilot plant (25 m^3/day capacity), and (d) plasma-integrated MED system with a one-wire plasma unit schematic.