

## LABORATORY EXPERIENCES ON MARINE ENERGY CONVERSION DEVICES FOR SUPPLYING ELECTRICITY DEMAND OF REMOTE COASTAL COMMUNITIES

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### INTRODUCTION

Sustainable development of coastal communities must consider, at least, provision of food, water and energy. In the case of energy, it is undeniable that several small coastal populations in developing countries have been left aside of national grids mainly because extending the infrastructure is very expensive. Under the actual paradigm of megageneration of electricity, this situation is not likely to change. The conversion of clean, renewable energy sources offers a great possibility of supplying electricity to remote communities assuming that the energy is generated close to the demand spots. The opportunities for research and development in this scenario are large given that the conversion devices, power plants and micro-grids needed to fulfil this demand present high site-specific characteristics.

Marine energy conversion is envisaged as a suitable source from which electricity can be produced and provided to coastal communities at relatively low costs if the local people is involved in the placement, operation and maintenance of the power plants. This means that simple, small devices located nearshore, should be preferred over large apparatus placed in deep seas. In turn, farms composed of modular, replaceable elements seem to be optimal for these purposes.

Among the variety of energy sources available in the ocean, wave and salinity gradient energy are the best for covering the demand of remote coastal communities as the infrastructure related to these kinds of energy can be placed nearshore and/or onshore. Wave and salinity gradient energy show also the advantage that their main energy flux is naturally directed towards the coast, so the energy can be easily harnessed. In this sense, in the Coastal Laboratory of UNAM, Mexico a group of marine energy conversion devices has been developed and tested that can be used to supply electricity to low demand communities and with which the local people may be involved to reduce overall costs. Some of them are presented herein.

### BLOW-JET WEC

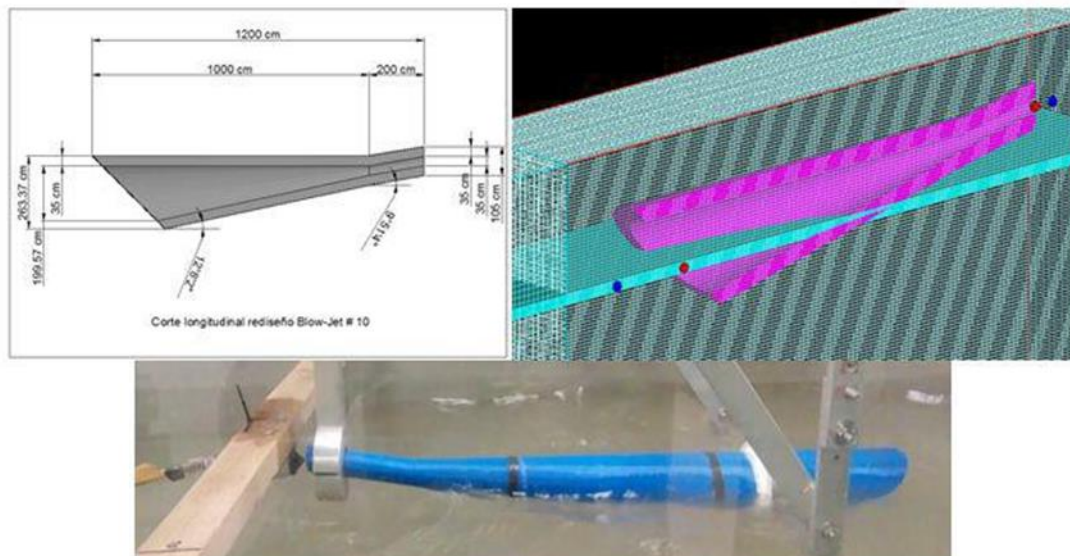


Figure 1. (a) Sketch of the Blow-Jet; (b) numerical grid for 3D modelling and (c) image of the laboratory tests.

The Blow-Jet (Figure 1) is a wave concentrator inspired in the natural coastal features known as blow holes. Its operation is enhanced by the reduction of the diameter (Venturi effect) and the electricity is generated as the expelling water jet hits an impulse turbine. This device may be placed floating nearshore or embedded in existing coastal defense structures.

## MICO

This is a WEC which takes advantage of the potential energy travelling with waves. A floating body transmits movement to a gearbox where a clutch and a flywheel give power to the rotor of an electric generator as can be seen in Figure 2.

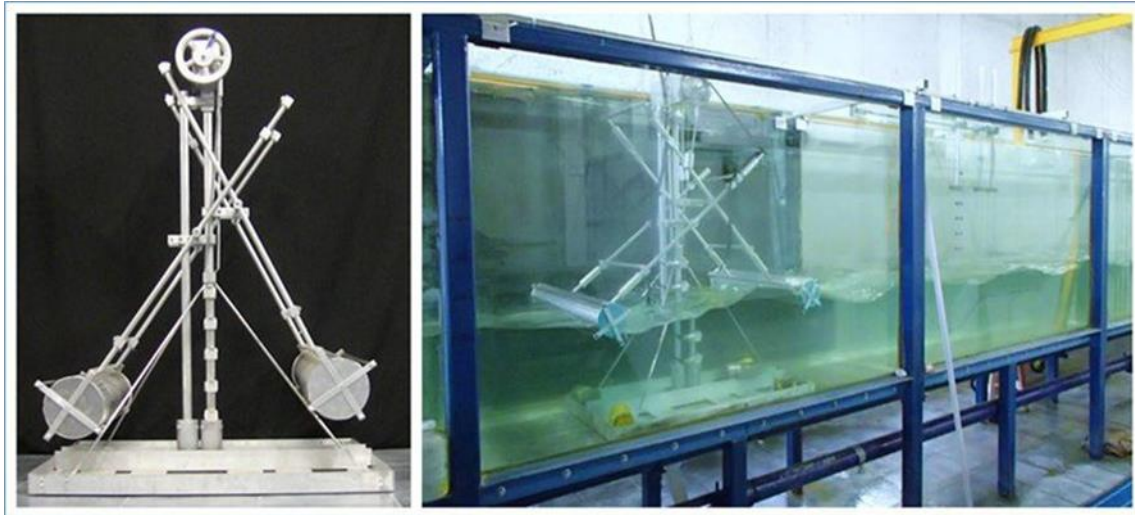


Figure 2. Small scale model of the MICO WEC.

The MICO device can be placed in depths lower than 20 m and although it has several moving parts, its maintenance can be performed by not specialized personnel.

## SALINE GRADIENT CELL

This device is a chemical electricity generator based on the principle of reverse electrodialysis. The principle of operation of this cell is producing a controlled mix of two solutions of water with different salt concentration using ion exchange membranes. Cations and anions separated by the membranes travel towards adequate electrodes and an electric potential is obtained (Figure 3).



Figure 3. Small scale model of the saline gradient cell.

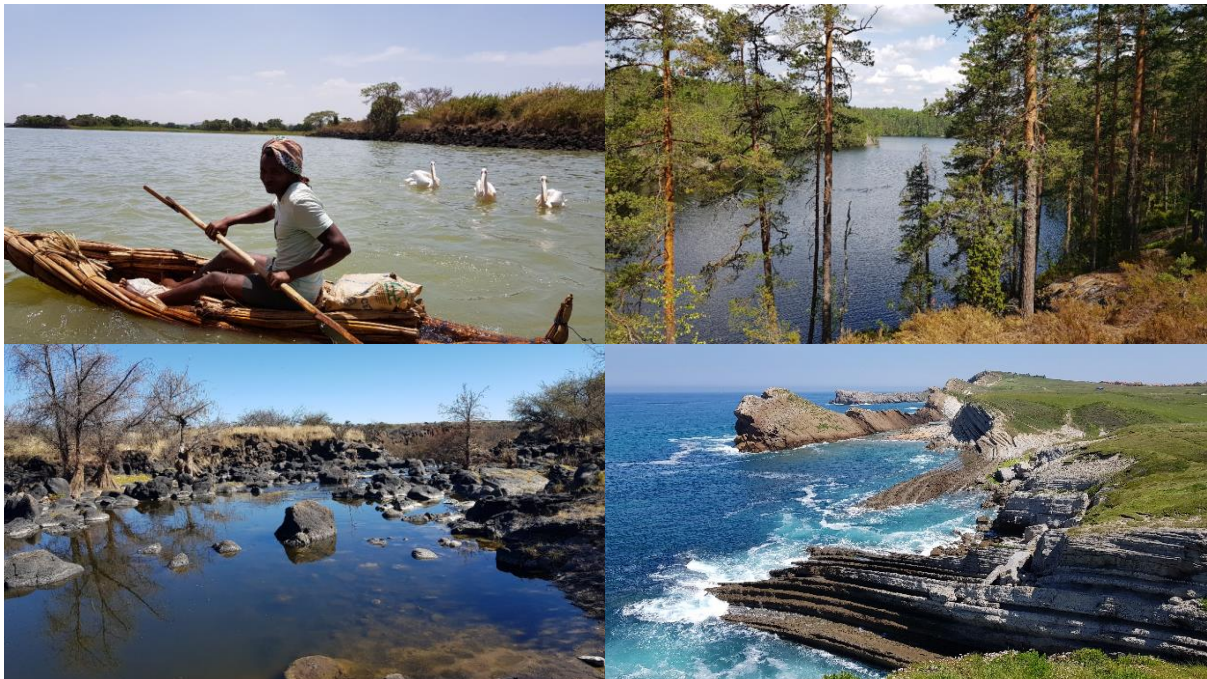
The saline gradient energy plants are constructed onshore and, although its technology is complicated and security measures must be taken, the local people may be involved in its operation and maintenance



# EXCEED - SWINDON Conference 2019

## THE FUTURE OF WATER RESOURCES

October 13<sup>th</sup> - 16<sup>th</sup>, Mérida, Mexico



# Programme and Book of Abstracts

# PROGRAMME

Sunday, 13 <sup>th</sup>		Arrival	
19:00	-	21:00	Welcome cocktail

Monday, 14 <sup>th</sup>		Conference Day 1	
08:30	-	09:00	Registration
09:00	-	09:30	Opening Ceremony <ul style="list-style-type: none"> <li>• Norbert Dichtl</li> <li>• Andreas Haarstrick</li> <li>• Rodolfo Silva</li> <li>• Local authority</li> </ul>
09:30	-	10:00	Keynote speech <ul style="list-style-type: none"> <li>• Norbert Dichtl</li> </ul>
10:00	-	10:10	Break
<b>Session 1: The impact/performance/role of SDGs</b> Chairman: Valeria Chávez			
10:10	-	10:30	Exploring some ocean energy possibilities in Latin America (Jassiel Hernández)
10:30	-	10:50	Water energy nexus in the MENA region (Abbas Al-Omari)
10:50	-	11:10	Ocean energy and marine biodiversity affectations: a life cycle assessment review (Dora Ruiz-Méndez)
11:10	-	11:40	Coffee Break
<b>Session 2: Water-Energy-Nexus (I)</b> Chairman: Dwi Andreas Santosa			
11:40	-	12:00	Wastewater/waste to energy in MENA region: A review for opportunities (Zeinab Abou Elnaga)
12:00	-	12:20	Water-energy nexus in a wastewater treatment plant: Energy efficiency and recovery (Wang Hongtao)
12:20	-	12:40	From wastewater treatment plants to a resources recovery facility (Marcelo Nolasco)
12:40	-	13:00	Seasonal assessment of the energetic potential associated with salinity gradient: Champoton River, Mexico (Gregorio Posada Vanegas)
13:00	-	14:30	Lunch
<b>Session 3: Water, ecosystem and socio-economic integrating aspects (I)</b> Chairman: Germán Rivillas			
14:30	-	14:50	Decolourization and mineralization of acid green 25 dye through single and catalytic ozonation (Liliana Amaral Féris)

14:50	-	15:10	Adsorption of naphtholate-as dye in wastewater of batik industry using green synthesized zn layered hydroxyl salts (Sri Juari Santosa)
15:10	-	15:30	Adsorption of hexavalent chromium in coal beneficiation tailing in fixed bed column (Liliana Amaral Féris)
15:30	-	15:50	Kinetics of the adsorption of anionic and cationic dyes in aqueous solution by low-cost activated carbons prepared from sea cake and cotton cake (Ibrahim Tchakala)
15:50	-	16:10	Distribution of microplastics in water and sediment in a Biosphere Reserve (Cecilia Enriquez)
16:10	-	16:30	Evaluation of microplastics contamination in the margins of the Patos Lagoon in south of Brazil (Eduardo Saldanha Vogelmann)
16:30	-	17:00	Coffee Break
<b>Session 4: Water, ecosystem and socio-economic integrating aspects (II)</b> Chairman: Rodolfo Silva			
17:00	-	17:20	Hydrodynamic modelling of the Huave Lagoon System, Oaxaca (María Fernanda González Amador)
17:20	-	17:40	Impact effects of hard infrastructure in Salamanca Natural Park (Juan Carlos Caez-Perez)
17:40	-	18:00	The decision-making in face to coastal squeeze, analysis between social and economic impacts: Case study of Campeche, Mexico (Debora L. Ramírez-Vargas)
18:00	-	18:30	Keynote speech • Elvis Carissimi
20:00			Dinner

<b>Tuesday, 15<sup>th</sup></b>		<b>Conference Day 2</b>	
<b>Session 5: Water, ecosystem and socio-economic integrating aspects (III)</b> Chairman: Arwa Naser Damen Hamaideh			
09:00	-	09:20	Dispersion of submarine groundwater discharges in reef lagoons and associated environmental effects (Arlett Rosado Torres)
09:20	-	09:40	Salt intrusions into a freshwater spring in a tropical coastal lagoon, Yucatán, Mexico (Xaní Malagón)
09:40	-	10:00	Variability of the saline gradient in a hypersaline coastal lagoon (Brenda Natalia Fitch Geymonat)
10:00	-	10:20	Sedimentation and water quality status of lake Tana, the headwaters of the Blue Nile, Ethiopia (Seifu A Tilahun)
10:20	-	10:40	An innovative approach to mitigate risks on the existing iron tailings dams in Brazil (Jose Araruna)

10:40	-	11:00	Urban sustainable water management and water efficiency improvement for buildings – a case study for Istanbul (Ahmet Baban)
11:00	-	11:30	Coffee Break
<b>Session 6: Water-Energy-Nexus (II)</b> Chairman: Eduardo Saldanha Vogelmann			
11:30	-	11:50	Reverse electrodialysis for energy and water: coupled systems based in salinity gradients (Mateo Roldan-Carvajal)
11:50	-	12:10	Development of graphene oxide membranes for its use in reverse electrodialysis systems (Eddie López Honorato)
12:10	-	12:30	Development of graphene oxide based materials for water treatment (Ana Cecilia Reynosa Martinez)
12:30	-	12:50	Laboratory experiences on marine energy conversion devices for supplying electricity demand of remote coastal communities (Jassiel Hernández)
12:50	-	13:10	Plate type obstacles used for coastal protection and power generation (Luis Eduardo Pérez Paez)
13:10	-	14:40	Lunch
<b>Session 7: Water, ecosystem and socio-economic integrating aspects (IV)</b> Chairman: Thi Thanh Van Ngo			
14:40	-	15:00	Evaluating combinatorial water treatment by locally available materials (Chrispin Kowenje)
15:00	-	15:20	Desalination by capacitive deionization as a tool to provide drinkable water to small communities in the Brazilian semiarid (Luis Augusto Martins Ruotolo)
15:20	-	15:40	Fluoride ions removal from groundwater by alumina adsorption (Elvis Carissimi)
15:40	-	16:00	Bio-refineries: A new concept towards green energy production from agroindustrial wastewater (Víctor Alcaraz)
16:00	-	16:20	The importance of water and nutrients management in paddy fields as an effort to increase crop yields and producing an electrical energy through microbial fuel cells (Dwi Andreas Santosa)
16:20	-	16:50	Coffee Break
16:50	-	17:20	Keynote speech • Klaus Fricke
16:50	-	18:00	Panel discussion Moderators: Edmilson Santos de Lima and Norbert Dichtl
20:00			Gala dinner