

# Brackish Water Desalination Through Eolic Reverse Osmosis for Rural Communities

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## Introduction

Mexico has 23.46 % of its population living in rural areas. According to the 2007 national water statistics, 10.8 % of the total population lack access to potable water. Many of these communities are located in arid or semi arid regions where ground water represents the only source of water. Unfortunately, many of these sources present high levels of toxic and non-toxic elements like sodium chloride, sodium sulfate, arsenic and fluoride, making ground water non potable, according to Mexican water standards.

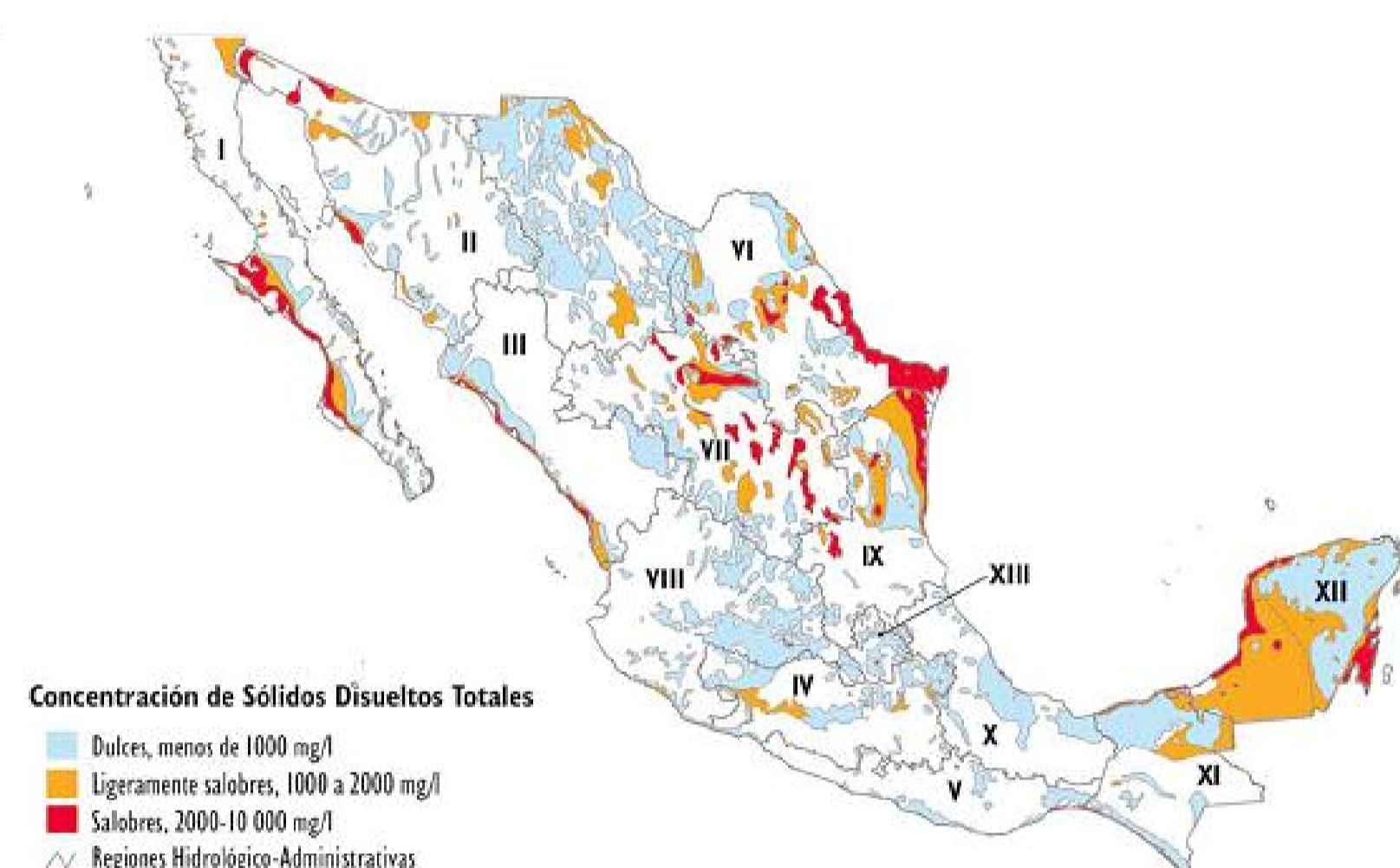


Figure No. 1 Total dissolved solids in Mexican ground water.

Mexican water authorities have had water policy to provide rural areas with the RO systems. These units provide enough water (12 – 20 liter / person-day) for essentials needs. Although the community do not pay for the RO investment cost, they are responsible for the operating cost. Many rural areas have a very low income (\$ 9.0 USD/ household-day) turning operating RO cost into unachievable responsibility.

## Objective

To develop an eolic RO unit with a lower operating cost, compared to the standard electrical RO unit.

## Methodology

A typical 500 people rural community was selected for pilot purposes. The community (Figure No.2) is located central Mexico, Guanajuato well known arsenic and fluoride affected area. The community was initially evaluated in terms of drinking and cooking habits as well as external arsenic and fluoride exposed symptoms. No attempt was made to evaluate initial health status of the selected community. A proprietary conceptual system was developed and installed to joint a commercial wind mill with a commercial RO unit. A commercial 16ft wind mill with a 3" piston from Aeromotor along with three 4" x 40" spiral wound membrane model SE4040CZH from Osmonics were selected and installed at an arsenic and fluoride ground water source with 897 ppm of total dissolved solids (TDS). Wind speed, pressure, conductivity and flow rate sensors were installed to send data every 15 minutes using Advantage Pro 5, ADCON Telemetry.

## References

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Figure No. 2 Eolic reverse osmosis system at a rural Mexican community

## Results

The eolic energy buffer controlled operating pressure at wind speeds from 0 to 40 km/hr as seen in Figure No. 3 and 4. The buffer system was able to operate water pressure between 3.75 and 4.5 bar. The minimum wind speed that obtained the lowest operating pressure (3.75bar) was 10 km/hr with a water production of 45 l/day. The maximum useful wind speed was 18 km/hr with a maximum operating pressure of 4.5 bar and a maximum water production of 105 l/day.

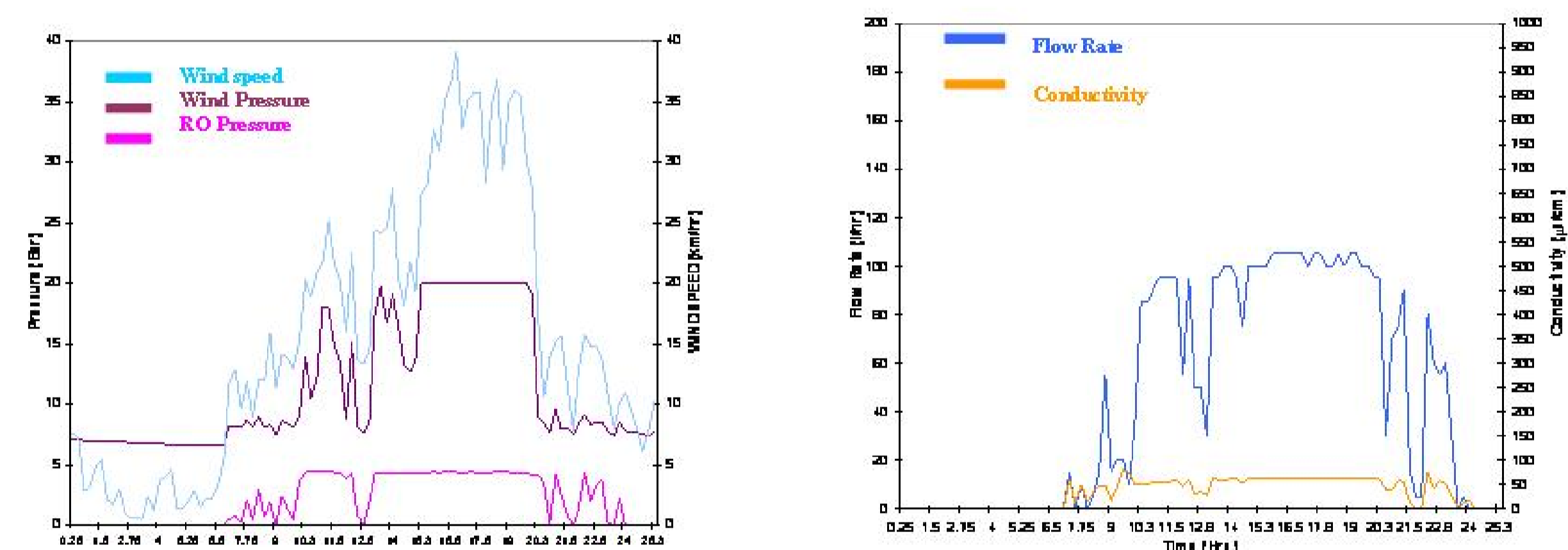
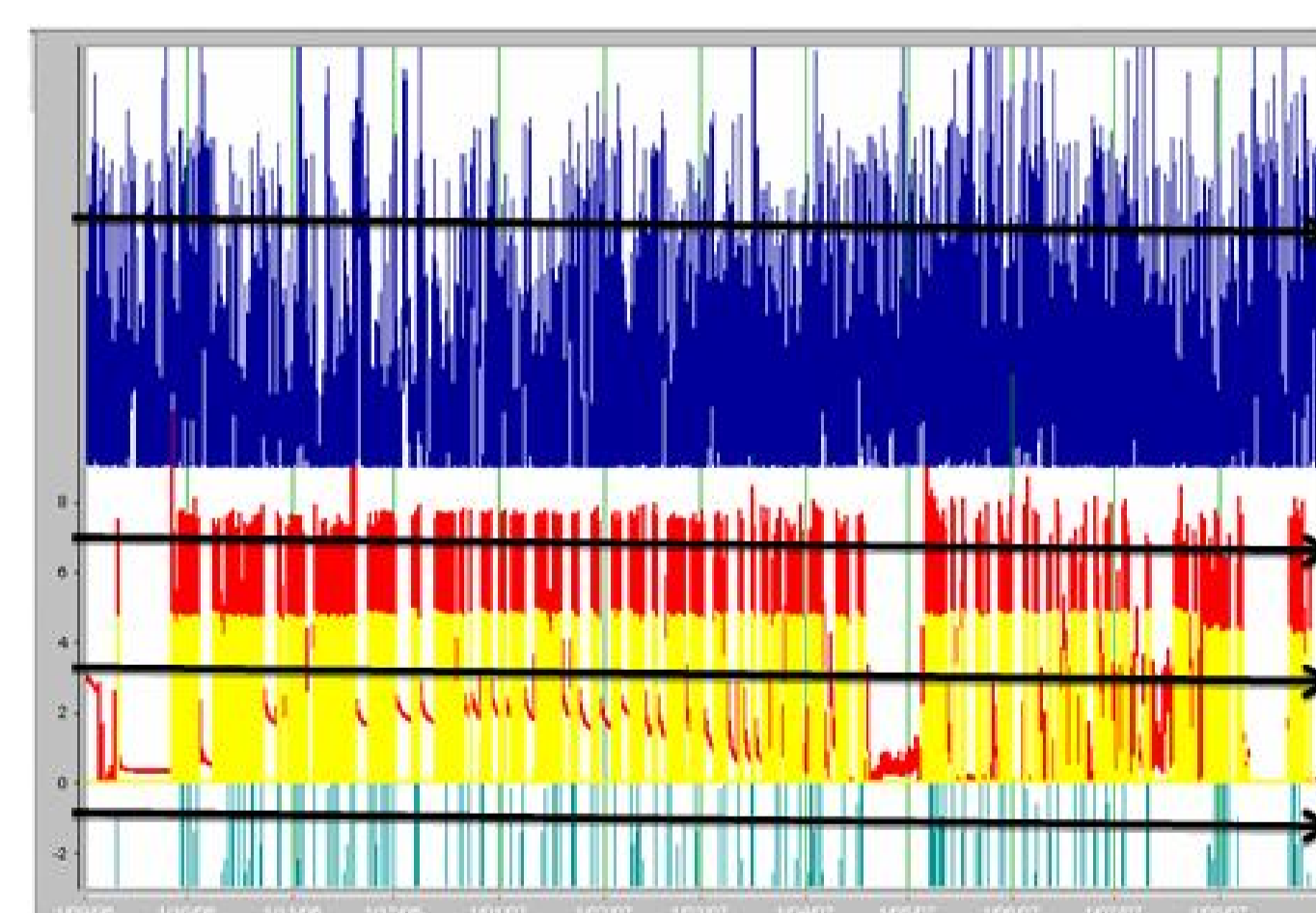


Figure No. 3 Wind speed, wind pressure, RO pressure, flow rate and permeate conductivity during a 24 hr eolic reverse osmosis period.

The pilot eolic RO averaged in a 12 month period a wind speed of 6.55 km/hr, and the average regulated RO pressure was 4.4 bar with an average water production of 30.8 l/hr and 49 ppm of TDS, as seen in Figure No. 5. No external energy was needed in the desalination process but eolic energy.



Avg. Wind Speed 6.55 Km/hr

Avg. Wind Pressure 8.92 bar

Avg. RO Pressure 4.4 bar

Avg. Flow Rate 30.8 l/hr

Figure No. 4 Telemetry values of wind speed, wind pressure, RO pressure and flow rate during a 12 month eolic RO operating period

## Conclusions

The Eolic Energy Buffer System regulates inlet pressure at set point allowing commercial wind mills and reverse osmosis membranes to be connected and operate with regular maintenance. The Eolic Reverse Osmosis system represents a feasible, reliable and sustainable small scale desalination option for rural areas. Savings from the use of eolic energy in small reverse osmosis units can range from \$ 0.36 to 2.0 / m<sup>3</sup> depending on TDS concentration.