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Design and Local Manufacturing of Energy Efficient High Pressure Pumps for Small SWRO Units

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Market Value of Small Modular Reverse Osmosis Desalination Plants

- The growing demand for smaller desalination systems has led to a number of companies developing small RO systems.
- Research from the International Desalination Association (IDA) has forecast the market value for containerized desalination plants in 2016 to be US$ 1.25 Billion, with an annual growth rate of 15%.
- The benefits of small systems are clear compared to large scale, fixed infrastructure: they are designed to produce low cost drinking water, quickly and efficiently.

Operation of Small Reverse Osmosis Desalination Plants

- Conventional small RO systems are mostly operated under constant feed pressure.
- The recovery ratio varies according to salinity and temperature of the feed stream.
- The limited availability of cost effective energy recovery devices for these small systems causes brine energy to be lost.
- Maximizing permeate production dictates maximizing the recovery ratios and the associated feed pressures.
- At high recovery ratios, solubility limits of some salts are exceeded and scale foulants are formed on the surface of the membrane.

Operation of Small Reverse Osmosis Desalination Plants

- Selecting a proper recovery ratio will maximize production and simultaneously will ensure that salts solubility limits are not exceeded and the possibility of membranes scale fouling is dramatically reduced.

Deepening Local Manufacturing Initiative

Academy of Scientific Research and Technology

An initiative launched by ASRT aimed at pumping many of the outstanding products to the Egyptian market based on the technical and technological knowledge generated by the applied research projects.

Deepening Local Manufacturing Initiative

Academy of Scientific Research and Technology

- This will deepen local and national industries and will reduce reliance on imports and increase exports.
- Attract local as well as foreign investments.
- Creating job opportunities for youth to face the problem of unemployment.
- Creating value added to the national product.
- Localization of advanced technologies.

Design and Local Manufacturing of Energy Efficient High Pressure Pumps for Small SWRO Units

Objectives:

- Design, local manufacturing and testing of solar powered energy efficient high pressure pump prototype integrated with built-in energy recovery and a seawater RO desalination module for small plants.

- Development of a complete technical package for technology transfer that allows the local mass production of the system.

Design and Local Manufacturing of Energy Efficient High Pressure Pumps for Small SWRO Units

Methodology

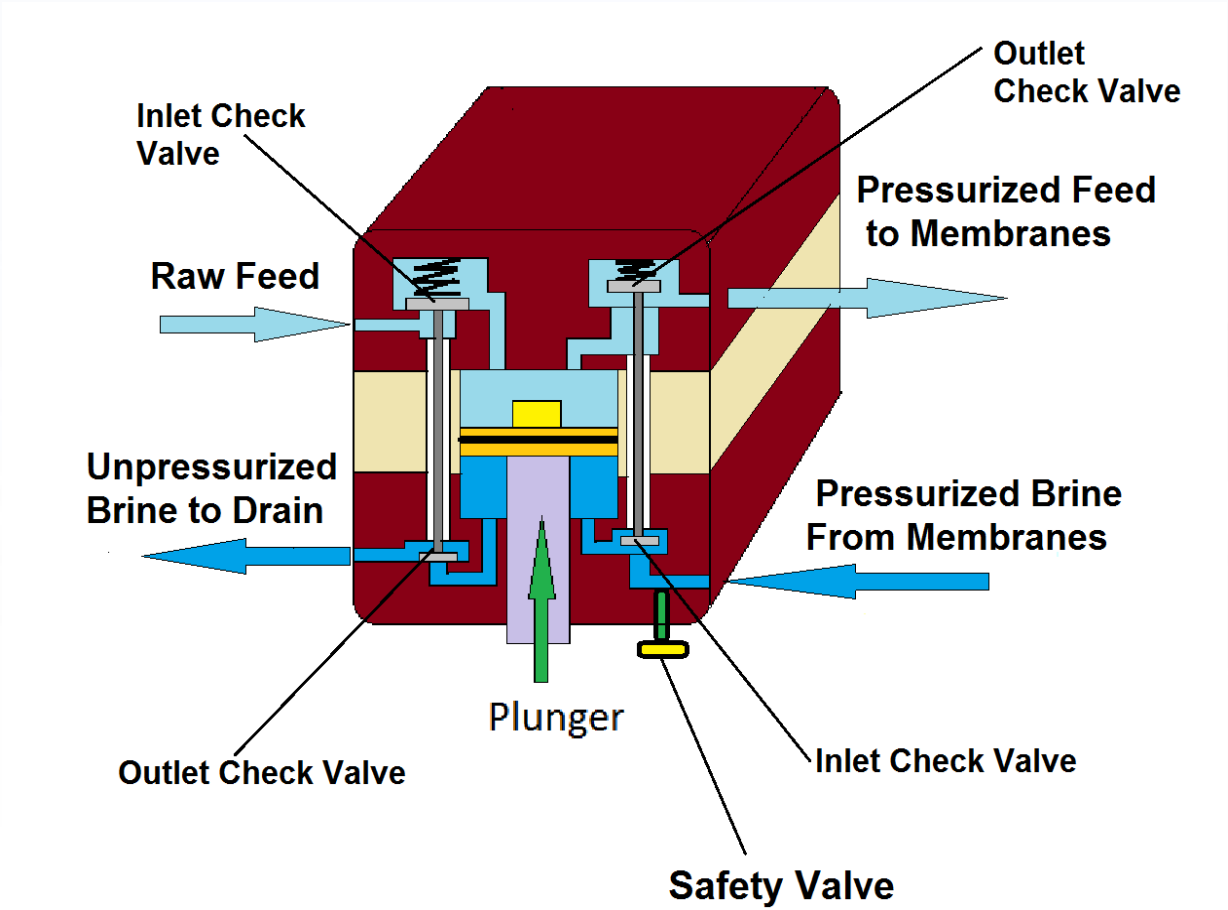
- **Design Phase.**
  - ✓Modeling.
  - ✓Materials Selection.
  - ✓Stress Analysis.
  - ✓Detailed Design.
- **Manufacturing Phase.**
  - ✓ CNC Machining.
  - ✓ Wire Cut Machining.
  - ✓ Assembly of Prototype.
- **Testing Phase.**

Design and Local Manufacturing of Energy Efficient High Pressure Pumps for Small SWRO Units

Technical Package &Technology Transfer

- **Manufacturing Documents.**
  - ✓Detailed Drawings.
  - ✓Assembly Drawings.
  - ✓Specifications of Standard Items.
  - ✓Process Sheets.
- **Quality Documents.**
  - ✓ Mechanical Inspection.
  - ✓ Testing.
- **Operation & Maintenance Documents.**
  - ✓ Spare Parts.

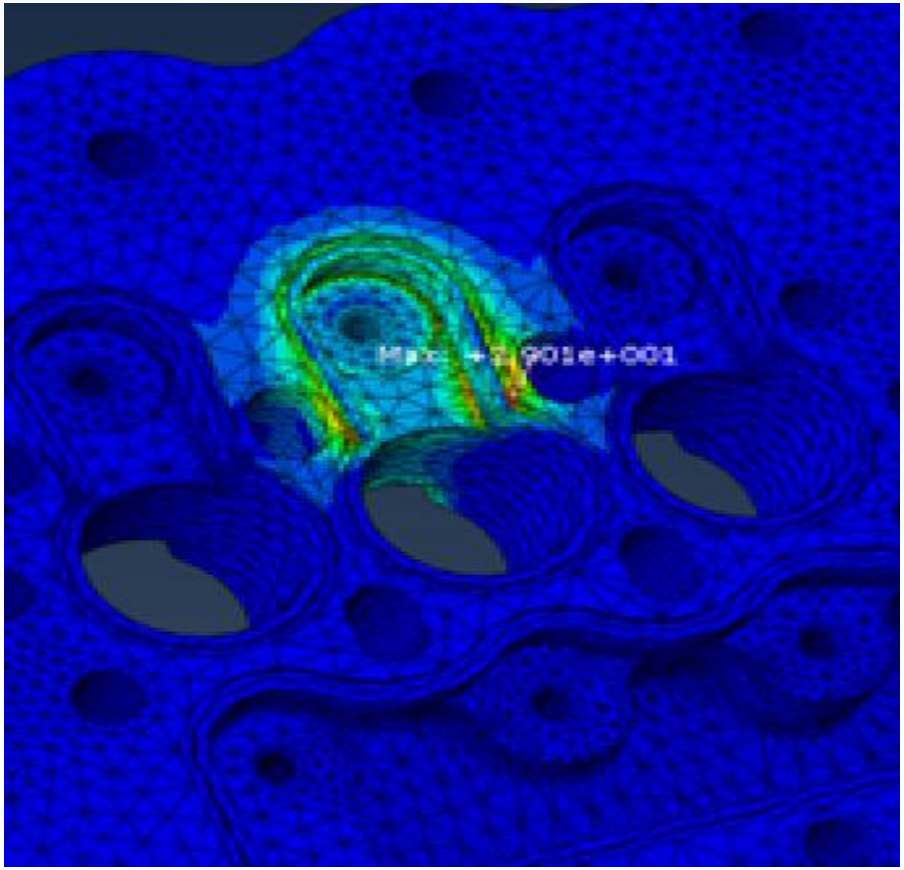
Main Design Features of the High Pressure Pump



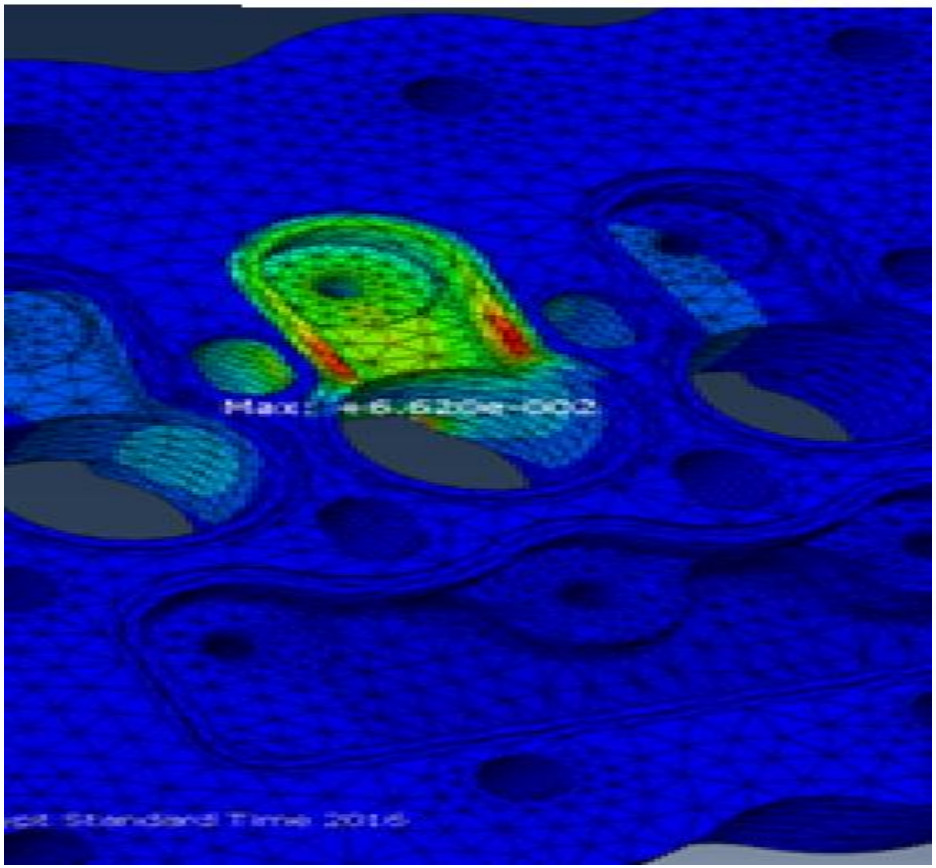
Main Design Features of the High Pressure Pump

Parameter	Value
Feed flow rate	1.5 m^3/h
Maximum discharge head	600 m
Maximum speed	720 r.p.m
Maximum recovery ratio	35%
Minimum recovery ratio	30%
Frame load	90 bar
Motor	3 Phase
Motor rated power	2 HP
Motor Speed	1440 r.p.m

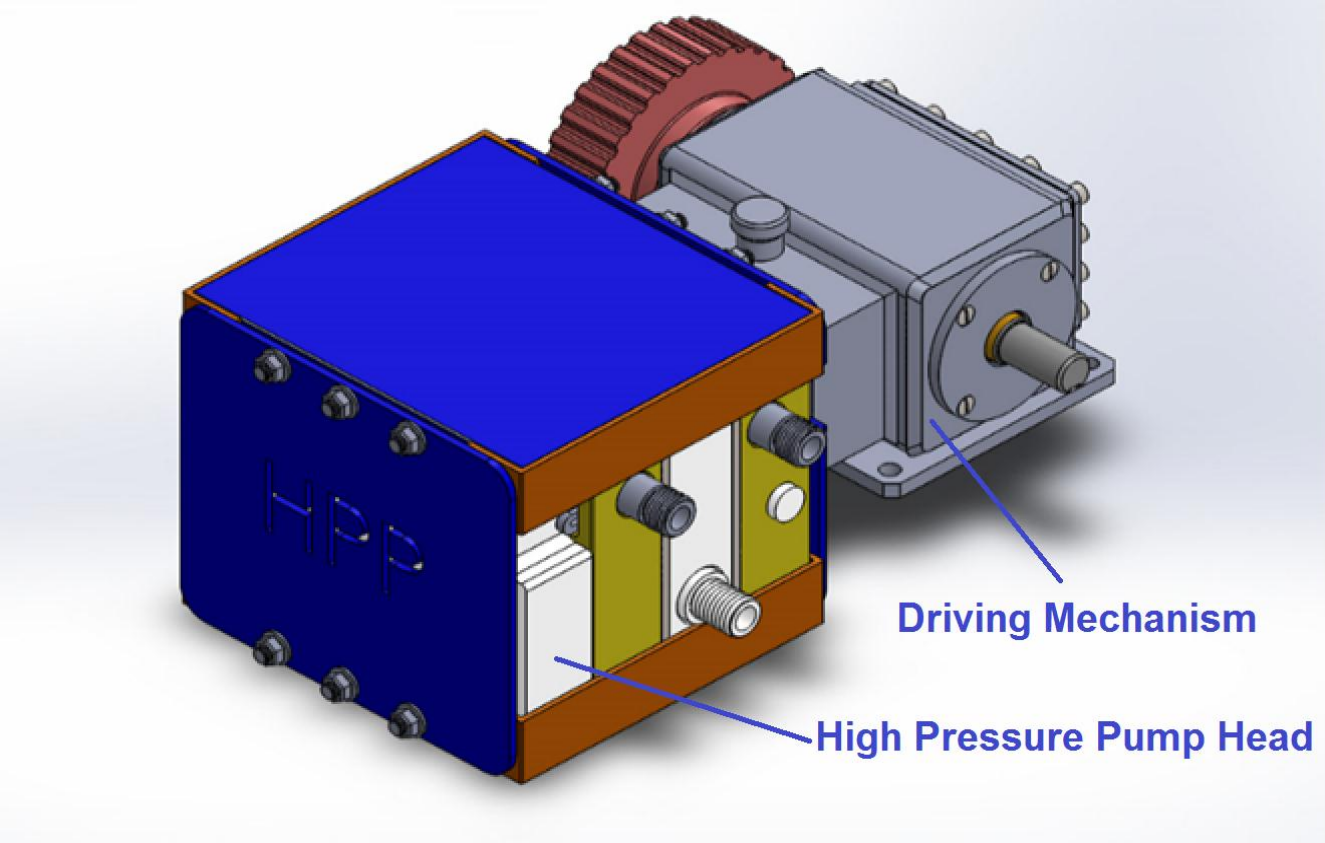
Stress Analysis of Pump Components Under Maximum Loading



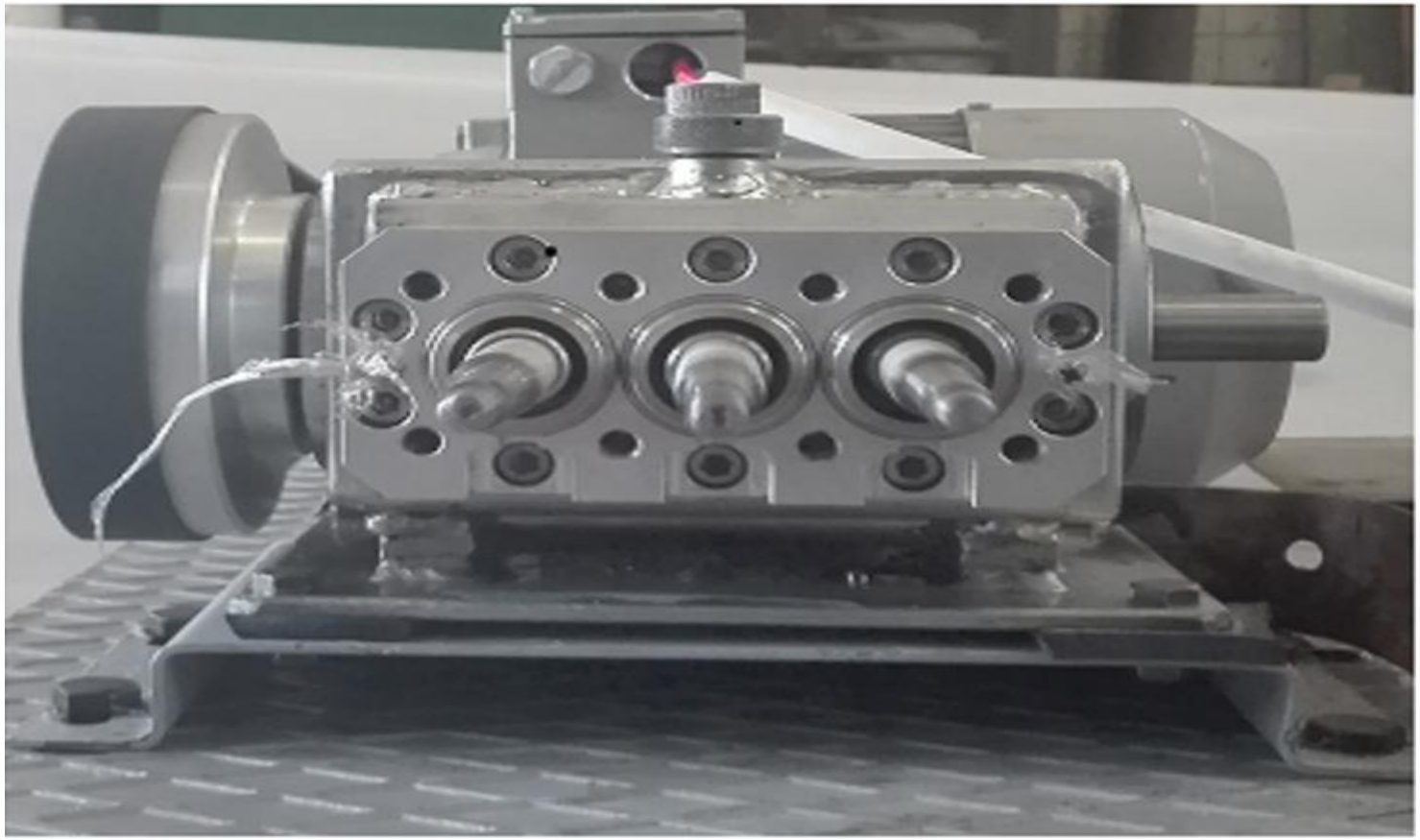
Deformation of Pump components Under Maximum Loading



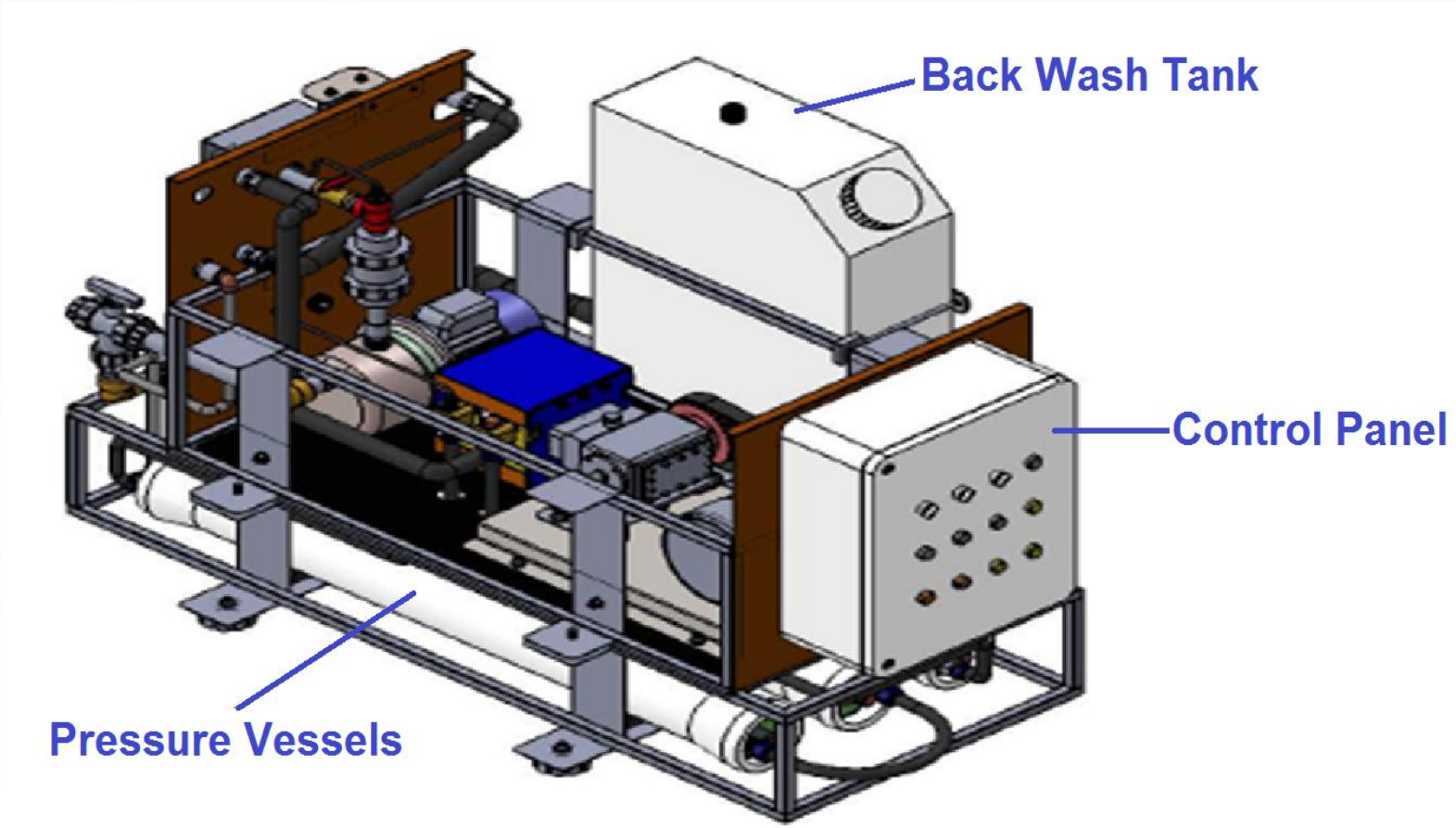
Design and Manufacturing of the Prototype



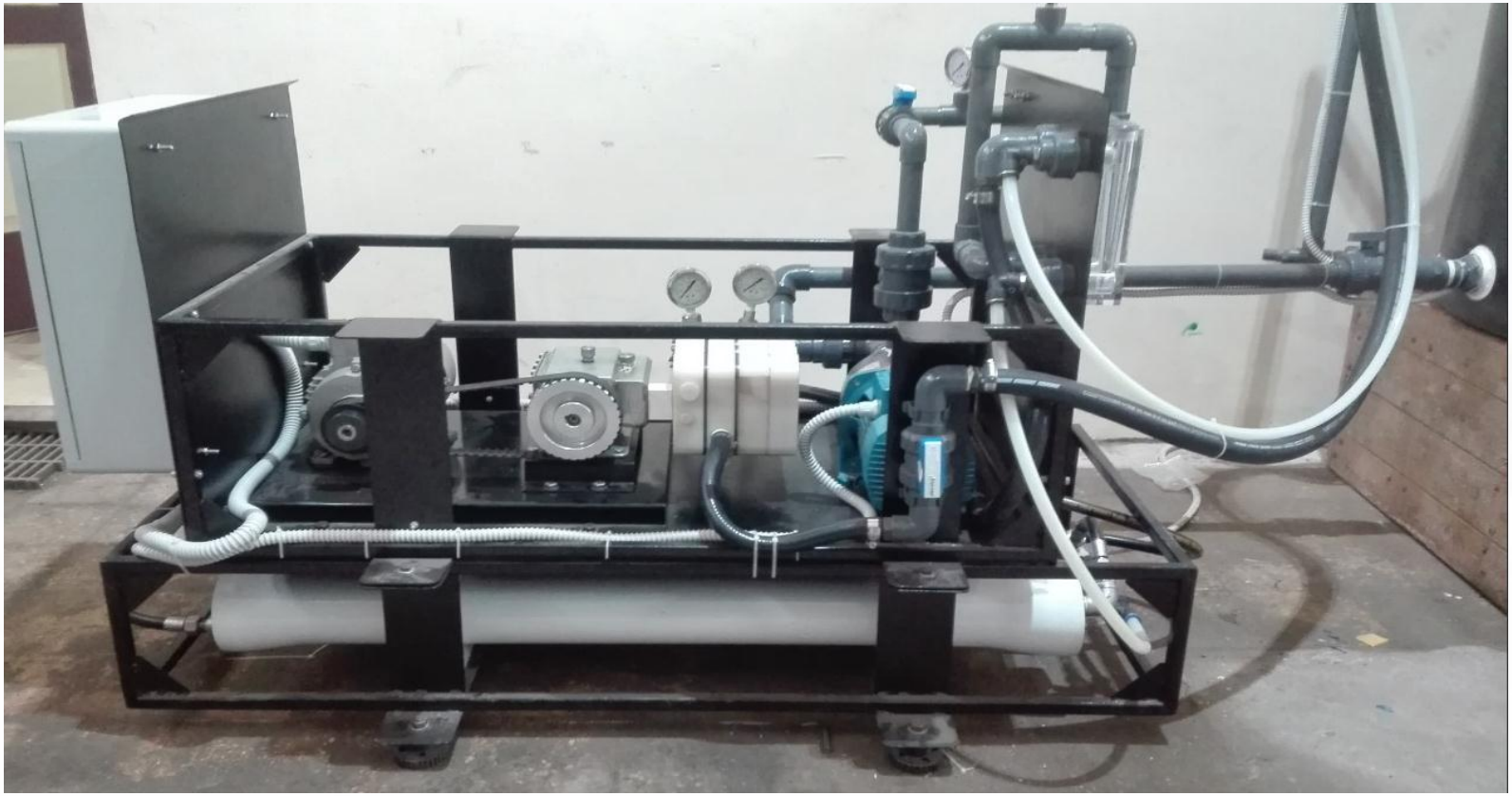
Driving Mechanism Assembly



Testing The Prototype



Small SWRO Unit
10 m^3/day



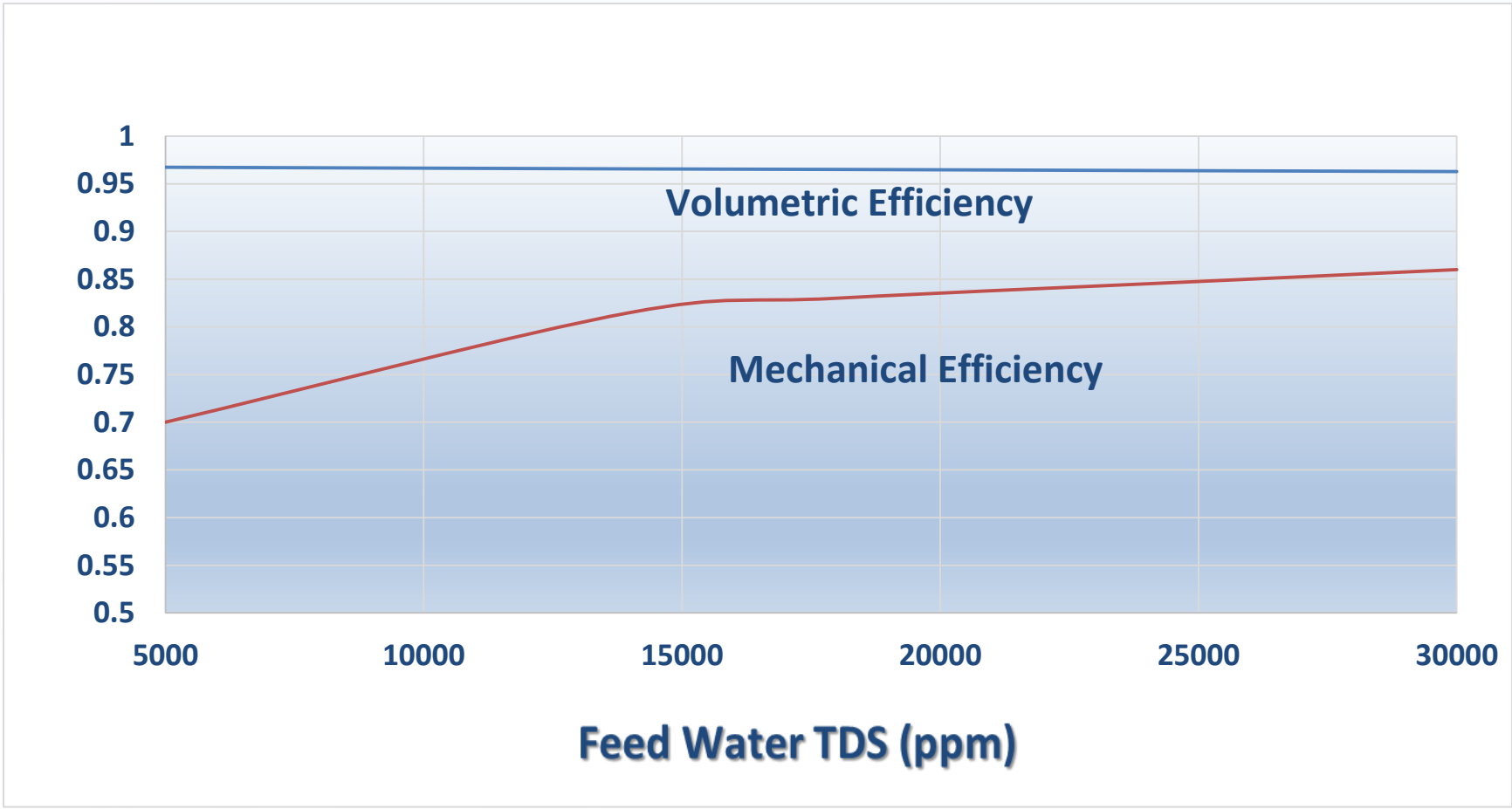
Testing The Prototype

Item	Specification
Recovery Ratio	30
Number of Pressure Vessels	3
Number of RO Elements	3
Type of Element	Sw30-4040

Results of The Tests at 15 Deg. C

TDS ppm	Feed Pressure bar	Brine Pressure bar	Current Amp	Power K.W	SEC K.W/ m3
5000	18.10	17.70	3.80	0.8664	1.9900
14000	30.50	29.80	4.65	1.0509	2.4185
18000	35.30	34.70	5.10	1.1628	2.6777
26000	45.40	44.80	5.90	1.3490	3.1113
30000	50.10	49.80	6.25	1.4312	3.3033

Results of The Tests at 15 Deg. C



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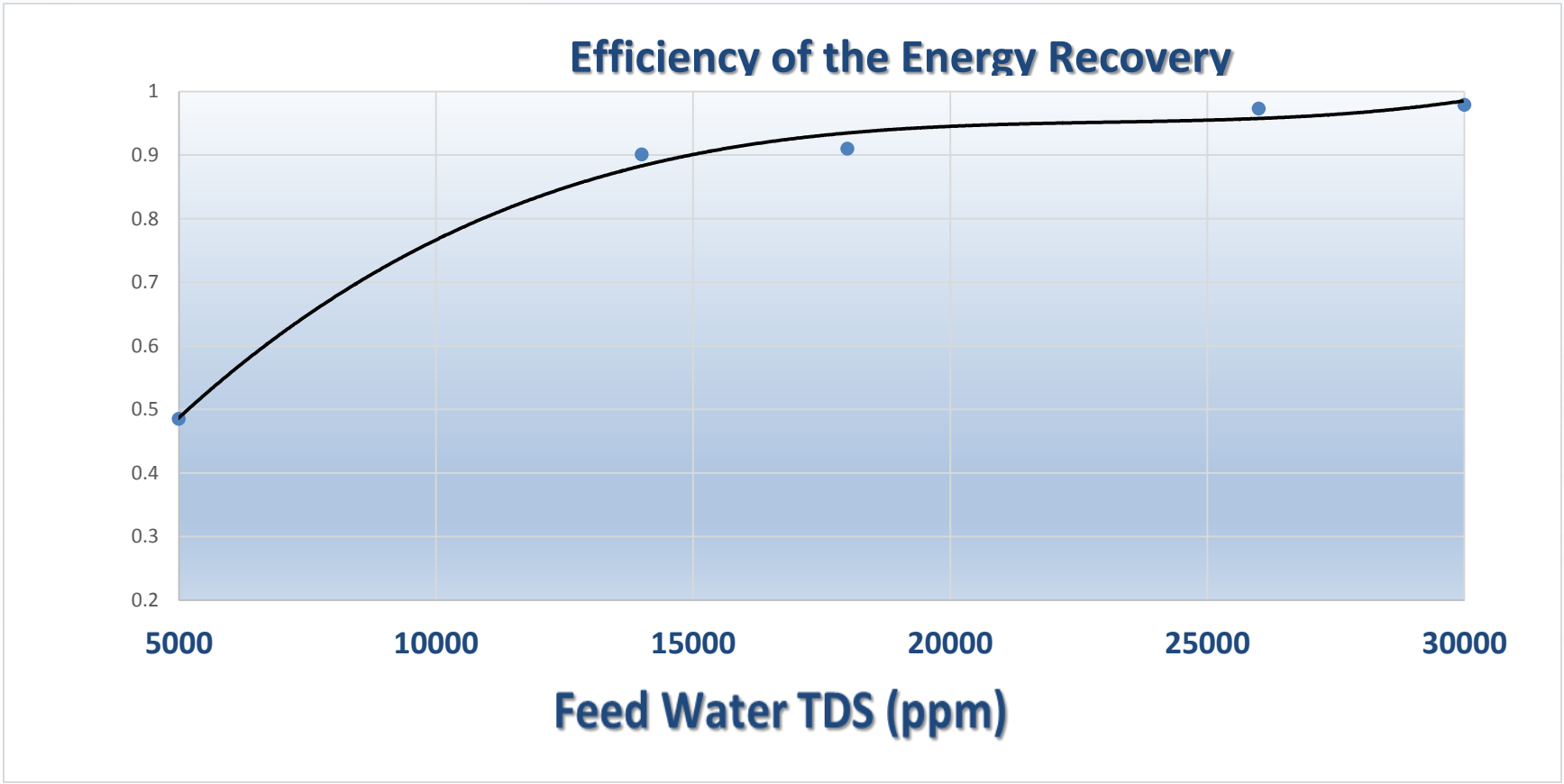

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