

6. Summary

State of the art of the reverse osmosis plants' mechanisation is diesel or electricity, both methods having some disadvantages. They are expensive and their gas and salt emissions are a severe impact on the environment.

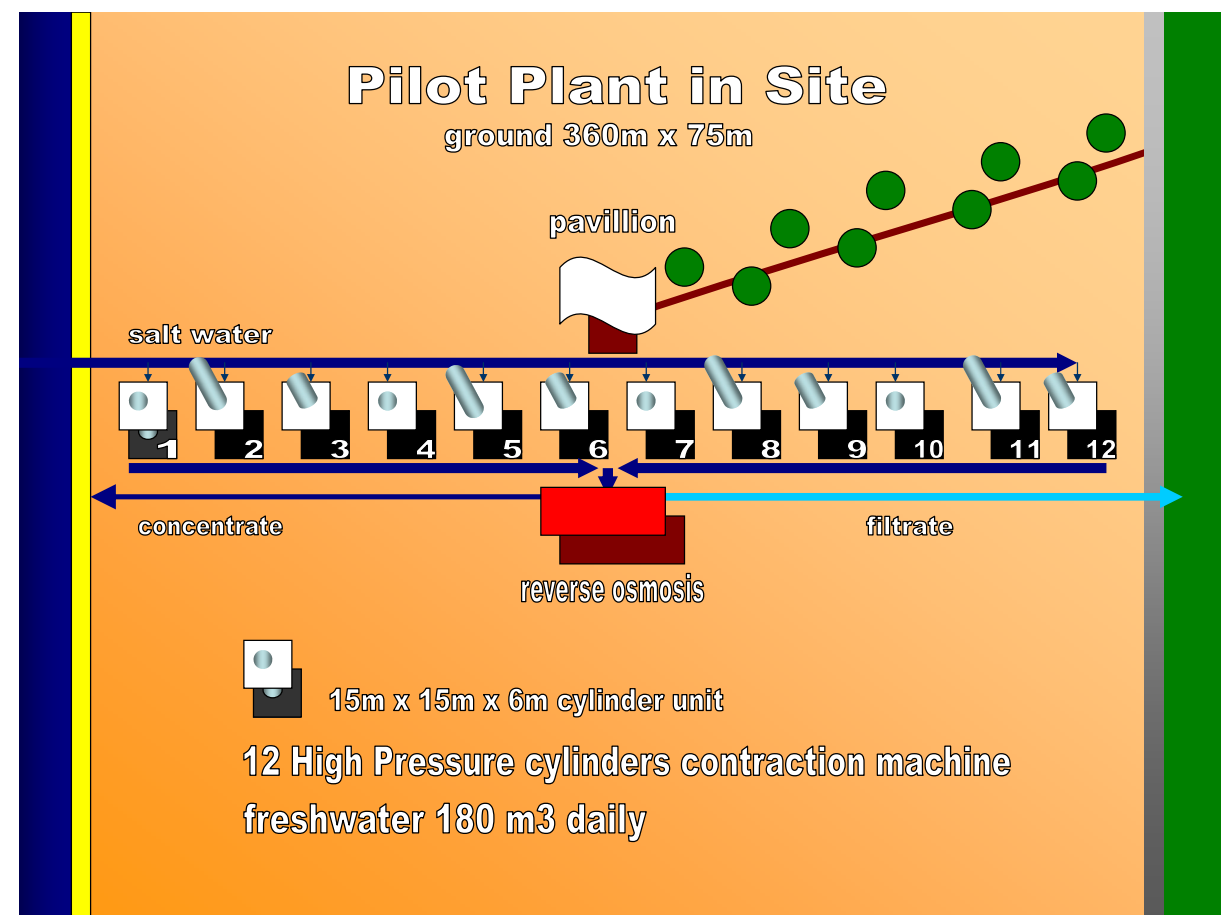
The main negative impact on the environment is the concentrated salt emission, being deposited directly from the RO plant into the sea.

The aim is to lower the water production costs. The Contraction Motor does solve the economical and environmental problem.

The integrated solar driven pump of HIGH PRESSURE ENGINEERING GmbH & Co. KG i.G. offers the desalination of non-drinking water by the established RO technology at reasonable costs.

Clients and target groups:

- Agriculture (drip irrigation, fish farming)
- Industry
- Communities
- Hotels
- Public institutions



The Contraction Motor as a Reverse Osmosis Drive

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1. The Idea

The founder of the company High Pressure Engineering discovered a unique solution for the solar driven desalination of seawater.

At the fair "IENA", the 'International Exhibition of Inventions and New Solutions' in Nuremberg his patent received the Silver Medal.

The German inventor has developed the Contraction Motor especially for use in countries with a high rate of solar radiation and a lack of pumping energy or fresh water. It is best used in countries in the sunshine belt as the high rate of evaporation makes it work effectively as a pump or for the production of fresh water by reverse osmosis.

The new technology relates to a machine gaining mechanical energy from hot air and a construction of ropes having the ability to extend and contract when liquid is added and evaporates respectively.

Very simply, a plurality of ropes building the motor at one end are attached to a stationary rigid network and at the other end to a movable rigid network. This movable network is connected to a piston. After being moistened the ropes extend, then they are dried by warm air and contract. By this the piston is actuated by the movements of the ropes creating mechanical energy in a cylinder.

The machine's output depends on the climate, it is most productive in hot and dry climatic conditions. In connection with some area this technology is a gratis pre-stage for saltern. The Contraction Motor works only by the sun's energy as it heats the air.

Of course, you also can produce with the Contraction Motor mechanical energy or electricity: Actuating hundreds of tons of pressure, utilizing the slow rhythm of the machine it is possible to drive mechanical processes requiring considerable power like presses used in several applications, as oil production or cooling processes.

Each element of the plant is mounted within a tent of appr. 20 m diameter x 6 m height. The amount of daily 7 m³ fresh water is produced by the enormous power of 500 tons by the contraction of millions of ropes out of sea water (3.5 % salt).

A group of 12 elements is capable to supply the drinking water demand of 500 people by 84 m³/d. Depending on the client's special demand, you even can gain the marine salt (3 tons/d). The area of such a plant is 5 ha.

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2. State of the Art

This principle of expansion-contraction of fibres is well known. E.g. hygrometers use this method.

The Contraction Motor's patents (by PCT-No. WO 98/21475) are granted in the listed below states:

Australia	No. 725224
India	No. 3235
Israel	No. 129917
South Africa	No. 97/10235
USA	No. 6196811
Germany (Southern Europe)	Nr. 196 46 887

For the last few months a prototype of the machine driving a pump is being tested in the inventor's workshop. The tests show the fibre's properties as well as the optimisation of the power. By this, the result of the tests so far proves the suitability for the above mentioned applications.

There is an expert opinion of Prof. Erdmann (Institute of Energy Systems, Technical University Berlin) confirming highly efficient thermodynamics of the system.

3. Competitiveness, Profitability

3.1 Competitiveness

Only low friction losses are caused by the slow movement of the Contraction Motor causes only. By this the machine represents a most effective pump producing drinking water at unequalled low costs. In addition, the water price is nearly independent of raw material's market conditions. The machine's high pressure output is not based on the fluctuating oil prices.

In comparison to other solar energy systems this technology uses the natural process of evaporation, has a compacter design and is more efficient. It represents a lean solution.

3.2 Profitability

The different ways of motorising the RO lead to different prices for 1 m³ potable water.

fossile variant:		Contraction Motor:	
price of raw oil	60 US\$/b (90 US\$/b)	o & m	0.16 US\$/m ³
		Investment	1.00 US\$/m ³
part of energy	1.77 US\$/m ³ (2.34 US\$/m ³)	ropes' replacement	0.45 US\$/m ³
		./. CO ₂ -Bonus*	0.18 US\$/m ³
<u>water price</u>	<u>2.18 US\$/m³ (2.75 US\$/m³)</u>	<u>water price</u>	<u>1.43 US\$/m³</u>

o & m = operation & maintenance

raw oil in barrel (b) translating US\$/b oil price into US\$/m³ potable water

*the special CO₂ dividend in accordance with EEX-Börse, Leipzig is 25 €/t, summer 2005)

An extensive service guarantee is included. The plant comprises only a few movable parts. As the fibres represent the power source, the service agreement gives the fibres' replacement priority.

4. Costs of R & D, total Costs

During the first 24 months, the costs of 1,536 Thousand € comprise the R&D phases 1 - 3, defined as milestones. The total of 3,460 Thousand € results of phases 1 - 4, founding the company.

The first phase of R&D comprises of the assembling, optimising of a prototype of the Contraction Motor under artificial laboratory conditions.

	phase	time	costs	accumulated
	1) lab phase	(month 1 - 3)	-217 T€	-217 T€
R & D	2) test of prototype	(month 4 - 11)	-344 T€	-561 T€
	3) pilot plant	(month 12 - 24)	-975 T€	-1,536 T€
market	4) production start	(month 25 - 30)	-1,924 T€	-3,460 T€

The phases 1 to 4, including the production expenditure:

	Sum	R&D phases only
Personnel costs	-698 T€	-493 T€
Production expenditure	-2,089 T€	-919 T€
Marketing	-173 T€	-124 T€
Income ./. material's expenditure	<u>-500 T€</u>	<u>-0 T€</u>
Total:	-3,460 T€	-1,536 T€

The above mentioned time limits of the actual development status are based on the experience of German firms who offer comparable plants in the mechanical engineering sector.



5. Turn over, Profitability

Within 2 years after sales start the company will meet the break even point in accordance to the following turn over.

Turn over	2008	2009	2010	2011	2012	2013
year						
turn over in million US\$	25	38	55	76	100	126

The world wide RO-market is a billion dollar market and its increasing by 8 % per year. In accordance with the increasing demand of fresh water (drinking water), also taking into account the ever rising oil price the estimated return on investment (ROI) will be

15 % - 18 % within the next few years.