An Engineering Solution to the CKDu

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- According to WHO report 12% to 15% prevalence of disease in the affected areas

- In Anuradhapura district about 200 deaths per annum

Progress Report 13 Feb 2012
Chronic Kidney Disease of Uncertain Aetiology (CKDu) Sri Lanka

Dr Shanthi Mendis
Senior Adviser and Coordinator, Chronic Disease Prevention and Management
World Health Organization, Geneva, Switzerland

4. Strengthen water purification schemes in the North Central Region: Some studies have shown a weak inverse relationship between water hardness and cardiovascular disease up to a level of 170 mg calcium carbonate per litre of water. The World Health Organization has reviewed the evidence and concluded the data were inadequate to allow for a recommendation for a level of hardness. Recommendations have been made for the maximum and minimum levels of calcium and magnesium in drinking water, and total hardness.

http://dh-web.org/place.names/posts/WHO-on-CKDU.pdf

WATER AVAILABILITY

- SURFACE WATER IS GENERALLY ACCEPTABLE IN THE AFFECTED AREAS

- GROUND WATER IS THE ONLY OPTION IN SOME PLACES (TAREGT WATER QUALITY Hardness < 150 mg/L & Fluoride < 0.3 mg/L)

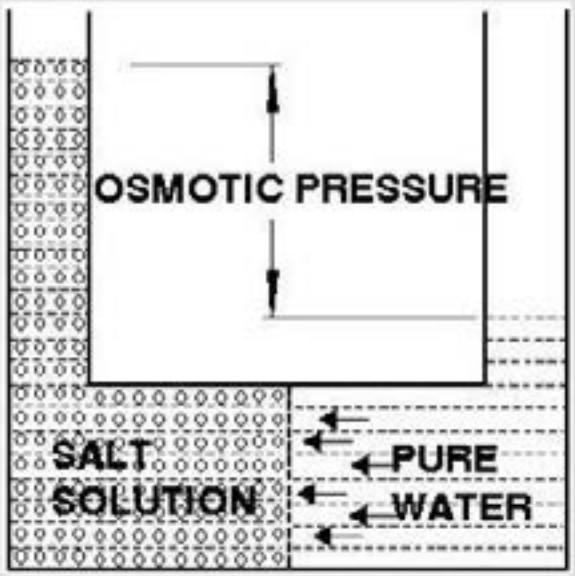
OPTIONS FOR CLEAN WATER FOR DRINKING & COOKING 5 lpcd (20 L PER FAMILY PER DAY)

- Household water treatment – not easy to monitor

- Rainwater harvesting – for roof area of 50 sq.m , 2000 L PE tanks could be used – The capital cost per household will be around Rs 50,000.

- Reverse Osmosis treated ground water – will be a viable option due to cost per household will be a around Rs 20,000 per Household. This will cover Treatment plant, 1000 L PE tank for 3 houses, Tractor bowser service with filling once in two weeks. A 10 cum /day capacity RO plant can cover 500 houses.

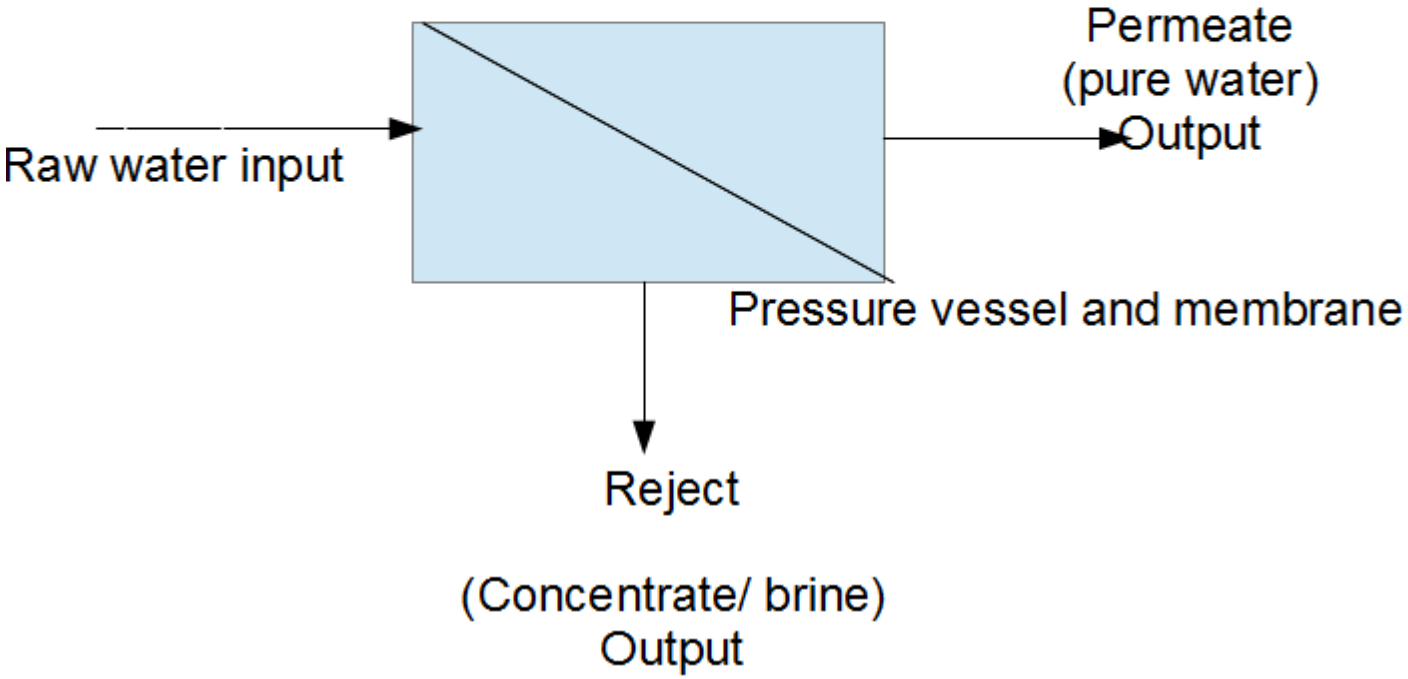
OSMOSIS

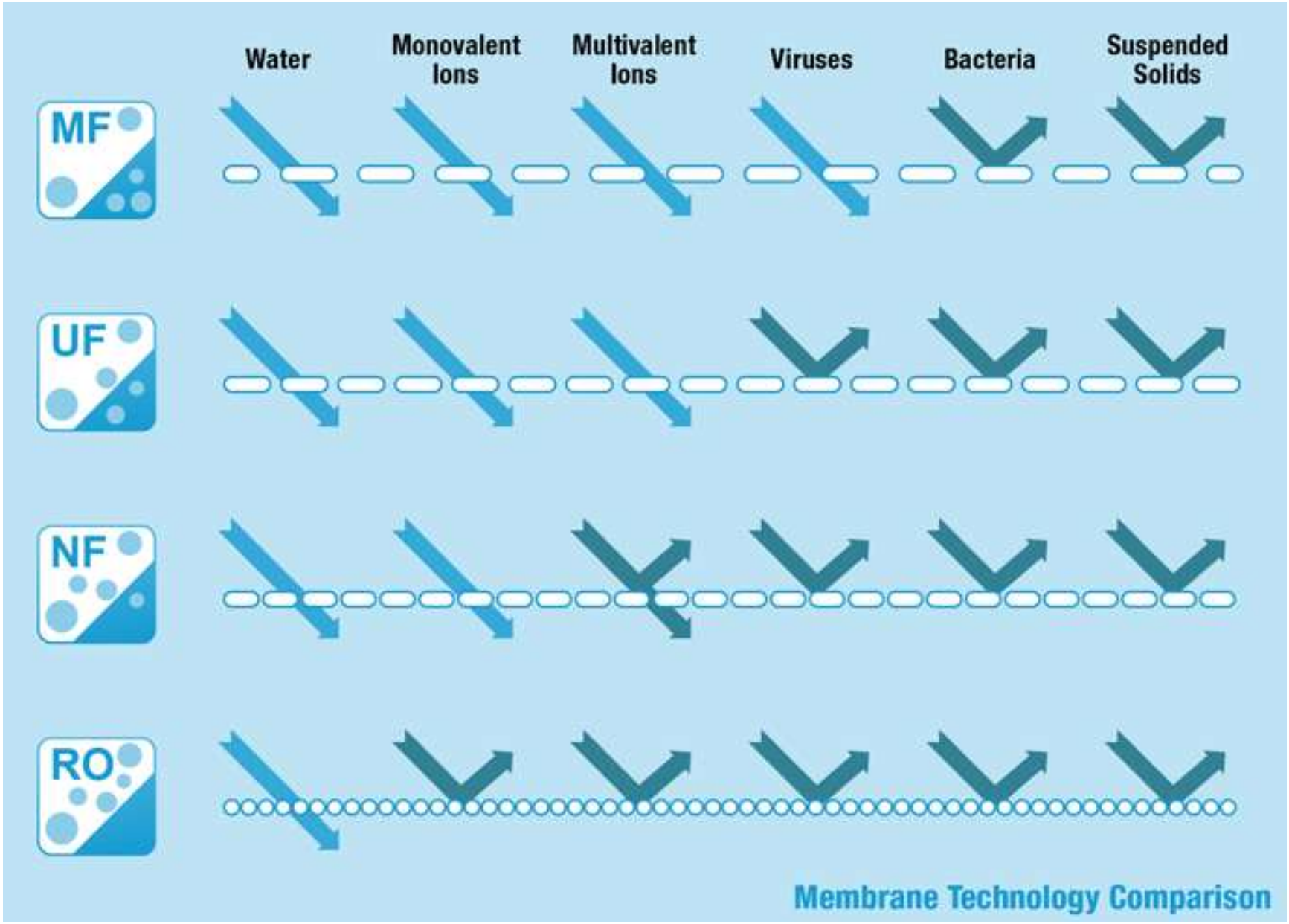


Two chambers are separated by an osmotic membrane. Right-hand compartment has pure water in it. Left-hand compartment has salt solution in it. If left alone, pure water flows in the direction of the arrows from the pure water compartment, into the salt solution compartment. Pressure-head in the salt solution compartment continues to rise, until it reaches a value represented by the osmotic pressure of the solution. Then the flow of water stops.

http://www.bluspr.com/reverse_osmosis_introduction.html

Reverse Osmosis Process

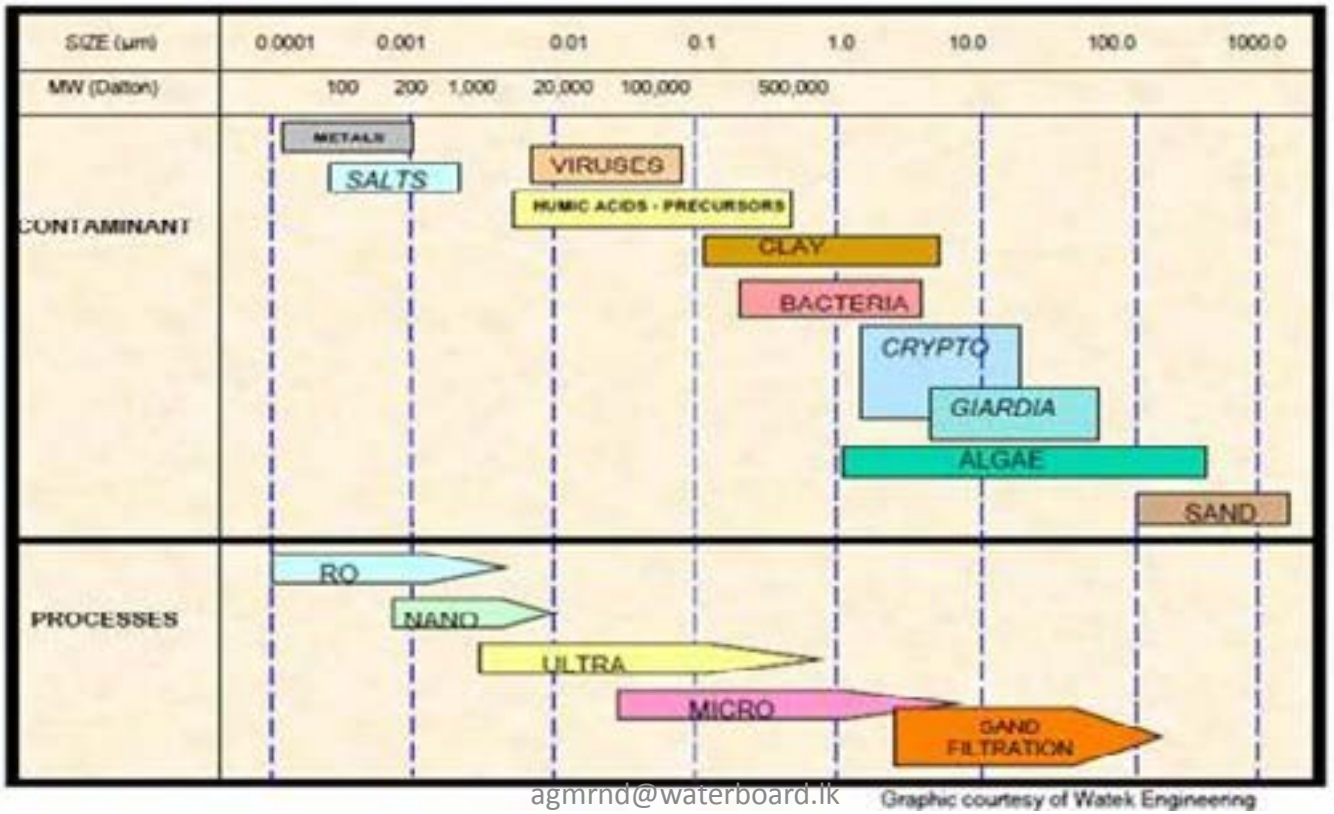




http://www.kochmembrane.com/learning-center/Technologies.aspx

Comparison of Membrane Filtration Levels				
Filtration Level	**Microfiltration**	**Ultrafiltration**	**Nanofiltration**	**Reverse Osmosis**
Pore Size Range	0.05 – 1.0 µm	0.005 – 0.5 µm	0.0005 – 0.01 µm	0.0001 – 0.001 µm
Target Contaminants	Particulate material like algae, *Giardia*, *Crypto*, bacteria, and clays	All substances removed by microfilters plus humic acids and some viruses	All substances removed by microfilters and ultrafilters plus dissolved metals and salts	All substances removed by microfilters, ultrafilters, nanofilters plus smaller dissolved metals and salts

µm is a micron, which is one millionth of a meter, and is also known as a micrometer.



http://water.me.vccs.edu/exam_prep/mfiltration.html

Reverse Osmosis Contaminant removal Chart

Contaminant	Removal %	Contaminant	Removal %
Giardia cysts	100%	*DDT*	>99.9%
E.coli bacteria	>99.9%	*Lindane*	>99.9%
Vibrio choleriae	>99.9%	*Serratia marcescenes*	>99.9%
Sodium Fluoride	99%	*Sodium Chloride NaCl*	99%
Magnesium Chloride	99%	*Copper Sulfate CuSO4*	>99%
Glucose	98%	*Chlorinated Pesticides*	99.9%
Sodium	95-99%	*Chloride*	99.9%
Potassium	92-99%	*Bicarbonate*	99%
Calcium	95-99%	*Nitrate 3*	90-99%
Magnesium	95-99%	*Fluoride*	90-95%
Iron	95-99%	*Silicate*	95-99%
Aluminum	95-99%	*Phosphate*	95-99%
Ammonium	95-99%	*Chromate*	95-99%
Cryptosporidium cysts	*100%*	PCB	>99.9%
Fecal bacteria	*>99.9%*	Salmonella typhi	>99.9%
Shigella dysenteriae	*>99.9%*	Toluene	>99.9%
Calcium Chloride	*99%*	Sucrose	99%
Nickel Sulfate NiSO4	*>99%*	Lactic Acid pH5	99%
Sodium Nitrate NaNO3	*97-99%*	Silica SiO2	98%
Nickel	*95-99%*	Radioactivity	95-99%
Zinc	*95-99%*	Sulfate	95-99%
Strontium	*95-99%*	Ferro cyanide	96-99%
Cadmium	*95-99%*	Arsenic +3	95-99%
Silver	*95-99%*	Arsenic +5	95-99%
Mercury	*95-99%*	Lead	95-99%
Barium	*95-99%*	Copper	95-99%

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10,000 Liters per day Reverse Osmosis Water Treatment Plant At Thambalagollewa in Rambewa


PRE-FILTER
PRESSURE


POST FILTER
PRESSURE

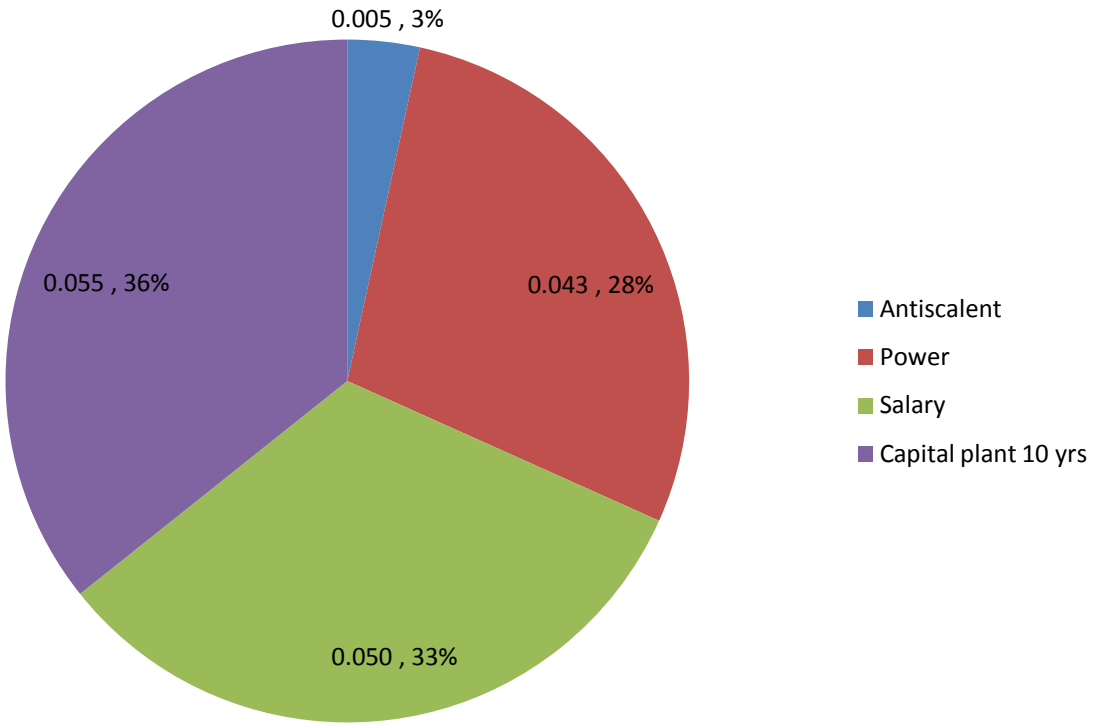

Pure Aqua, Inc. USA
FLOWMETER


RECIRCULATION
VALVE
SYSTEM
PRESSURE

Clean water sold at cost Rs 1.50 per liter

PARAMETERS	Limits on SLS 614:1983 part 1 & 2			2013.10.15					
	Units	Desirable	Permissible	Well	Sand filter	AC filter	Permeate	Reject	2603
PHYSICAL & CHEMICAL QUALITIES									
Colour	Pt - Co	5	30	00	00	00	00	00	00
Turbidity	FTU	2	8	0.26	0.22	0.18	0.42	0.19	0.21
Electrical Conductivity at 25°C	uS/cm	750	3500	1010	1010	1020	30	2020	30
pH		7.0-8.5	6.5-9.0	7.42	7.44	7.44	5.80	7.64	7.10
Chloride(as cl)	mg/L	200	1200	28			8		
Total Alkalinity (as $CaCO_3$)	mg/L	200	400	440			12		
Total Hardness (as $CaCO_3$)	mg/L	250	600	364			8		
Nitrates as N	mg/L		10	0.80			0.40		
Nitrites as N	mg/L		0.01	0.002			0.001		
Sulphate(as SO_4^{2-})	mg/L	200	400	28			00		
Fluorides (as F^-)	mg/L	0.6	1.5	0.83			0.00		
Total phosphate (as PO_4)	mg/L		2	1.03			0.03		
Total Iron	mg/L	0.3	1	0.00			0.01		
Total Dissolved Solid	mg/L			682	680	688	14.57	1396	16.97
BACTERIOLOGICAL QUALITY									
RCI			0.2 mg/L						
Coliform bacteria	Per 100ml	Nil	10	148	88	86	Nil	72	Nil
E-Coli Bacteria	Per 100ml	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil

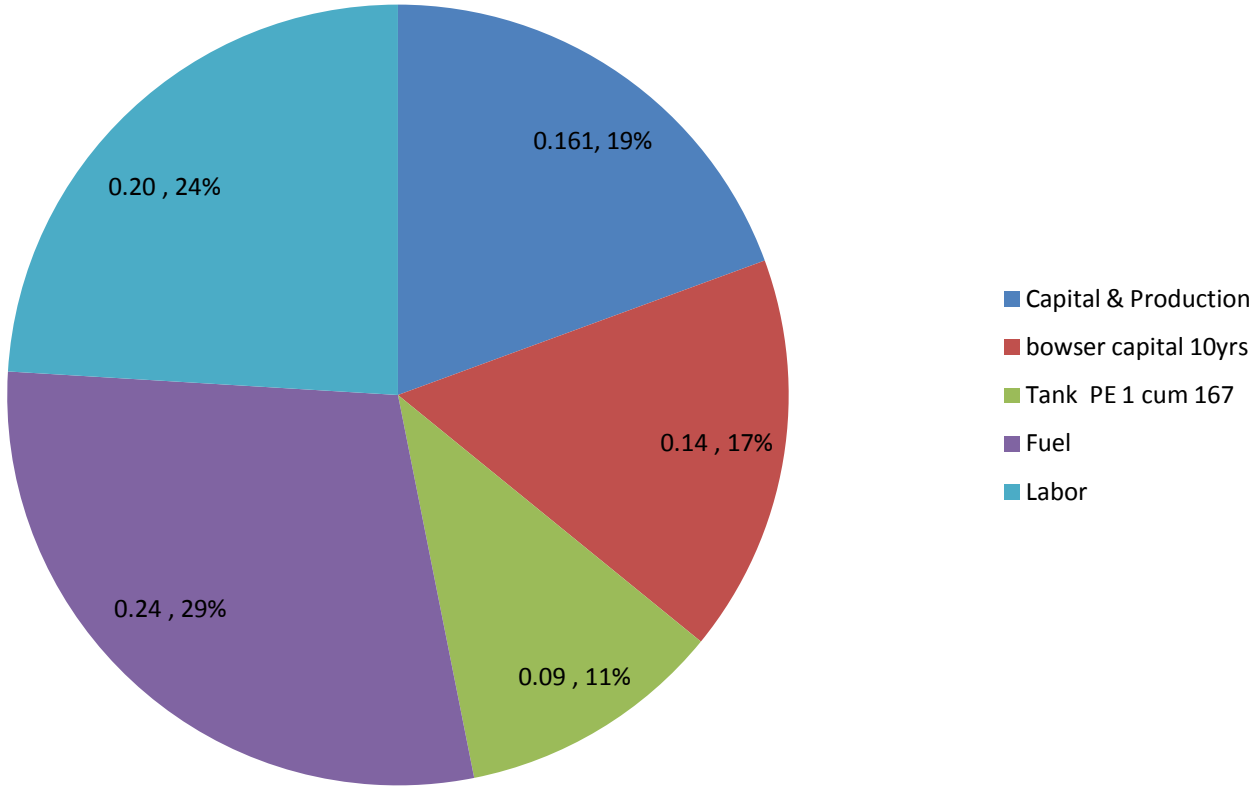
10 cum/day RO plant – Cost of Production in Rs including Capital recovery



Total Cost of Production is Rs 0.16 per Liter-

The chart above provides the cost breakup in Rs/L with percentages

10 cum per day RO plant with 167 PE tanks fed by 5 cum Bowser with Twice a month Filling



Total Cost of Production and distribution Rs 0.83 per Liter-

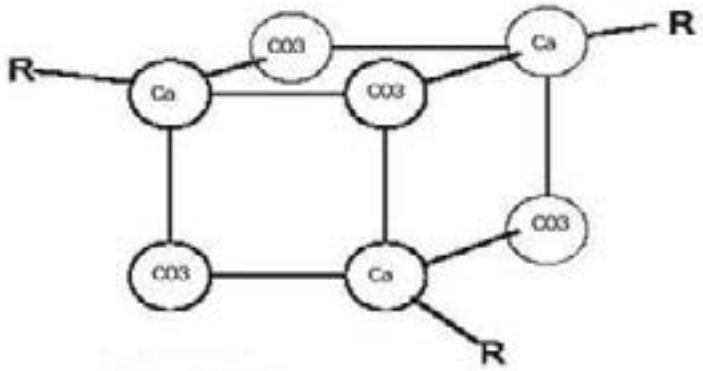
The chart above provides the cost breakup in Rs/L with percentages

FEATURES OF THE RO SYSTEM

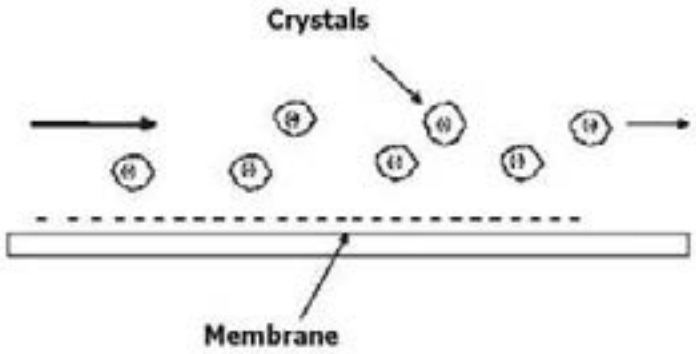
- Semi Auto Backflush prefilters
- System shut off at power failure
- NSF approved Antiscalant
- Single phase power supply

REJECT MANAGEMENT

Reject water consists of ions in raw water and the Antiscalent added.



Threshold Mechanism



Dispersancy

It is proposed to treat the RO reject by evaporation and constructed wetland

http://www.lenntech.com/antiscalants.htm


THANK YOU