Wind Operated Water Purifier

DHRUV R. JOSHI[1], NISHITH JOSHI[2], KAUSHIK NANDANIYA[3], BHAGIRATH SINHAR[4]
[1,2,3,4] *Department of Mechanical Engineering, Dr. Subhash Technical Campus*

Abstract- Desalination has often been perceived as a high cost means of producing water. Reason being that some of the water treatment method use electricity to run a pump as in reverse osmosis system and some uses thermal energy to produce steam as in multi effect distillation. This paper explores the possibility of using wind power for water treatment. In costal countries tremendous wind power is available at the costline which may be used to drive a RO plant. Gujarat state gives a fair idea about potential of energy that can be generated. This energy can be harnessed to run a rotating pump, or a piston-cylinder arrangement coupled with RO module to provide the necessary pressure required to push saline water through the membrane. Along the western coast of India there is an abundance of wind energy to capitulate high amount of energy in terms of electrical power. If the rotor diameter is 4feet and located at a height of 8 feet, each wind turbine may produce power of around 2 KW.

I. INTRODUCTION

As per over general idea of this project, we worked with the development and statics of this system .in which there are different working mechanism are there which are as follows.

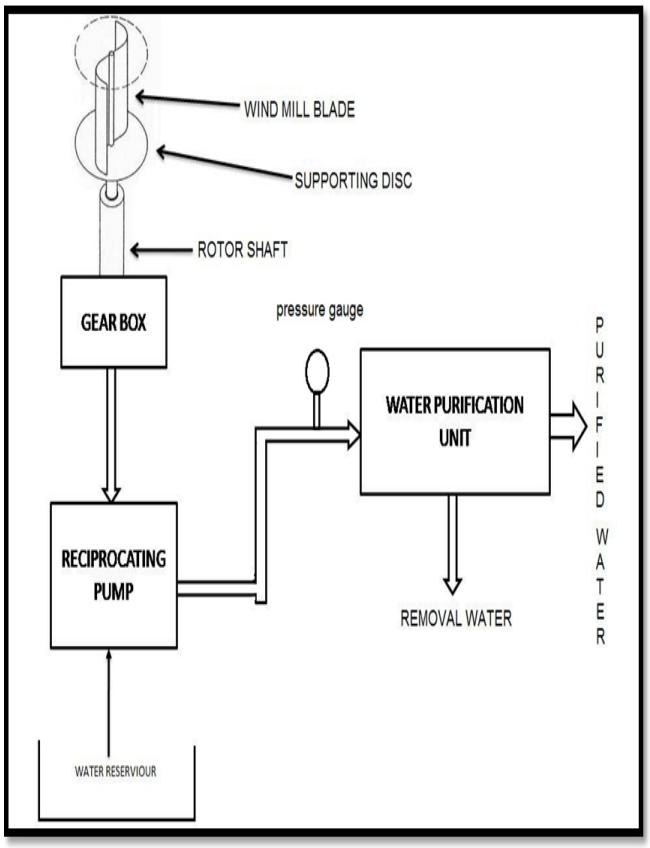
1. Wind mill (vertical axis ,seveneous type)
2. Reciprocating pump
3. Reverse osmosis purifying unit

The working flow diagram of the wind mill water purifying system is as shown in the figure

- General assembly detail of system:

As above shown in the figure, vertical type of wind mill is used named savnious type. Two blades are mounted on the wind turbine shaft with the assembly of bearing. A gear box is connected with the shaft, in gear box the bevel gear assembly is mounted to maintain speed and shaft of rotating elements.

Arther one fly is attached with the gear box and rotating shaft which further connected with the reciprocating pump with linkage mechanism in which reciprocating pump sucks water from the water source which is at some datum level. Now output of the pump is given to the purification unit by means of water tubes. A pressure gauge is placed on water tube to maintain pressure for purification unit. Finally water can be purified.



- Design under consideration:
  - Assumptions made:

    Wind speed=9m/s
    Tip ratio for blades=1
    (The tip-speed ratio (λ) for wind turbines is the ratio between the rotational speed of the tip of a blade and the actual velocity of the wind)

- Measured data

  Height of the blade=94.4cm
  Clearance=5.7cm
  Total rotation diameter=68.5cm
  Blade diameter=38cm
  Thickness=0.5cm(negligible)

(1) Swept Area

A=D*H……(1)

=0.38*.94

=0.3572mm^2

(2) Power

P=.15ρAV^3……(2)

density of air at 30ºc=1.165kg/m^3

= 0.15*1.165*0.3572*(5.2728)^3

at 35º c=1.142 kg/m^3

=9.15w

(3)RPM:

N=(60*λ*V)/π*D……(3)

= (60*1*5.2728)/3.14*.38

=265 rpm

Considering 70% efficiency, therefore

265*0.70=186 rpm

As from above calculation, from references we got gear ratio 1:4 therefore theoretical r.p.m we got as below.

$$\frac{1}{4} = \frac{N}{180}$$

N= 45 r.p.m

- Initial data measurement:

V=1.3 m/sec (standard)

Bore diameter (d) = 3 inch

Thickness of cylinder (t) = 8mm

S=3.5 inch

(1) Bore diameter=$\sqrt{\frac{gal}{min}}{20}$

3=$\sqrt{\frac{gal}{min}}{20}$

9=$\sqrt{\frac{gal}{min}}{20}$

$$\frac{gal}{min} = 180$$

(2) D=(2A-a)S_{nm}/231……(4)

= (2✕$\frac{\pi}{4}$✕8^2-.785) ✕3.5✕100✕$\frac{1}{100}$

= 151.13$\frac{gal}{min}$

(3) V=$\frac{GPM}{2.45D}$……..(5)

= $\frac{180}{2.45\times151.13}$

=.4861m/sec

(4) Piston speed

V=ns/6……..(6)

=100✕3.5/6

=58.33 inch/mm

= .97 inch/sec

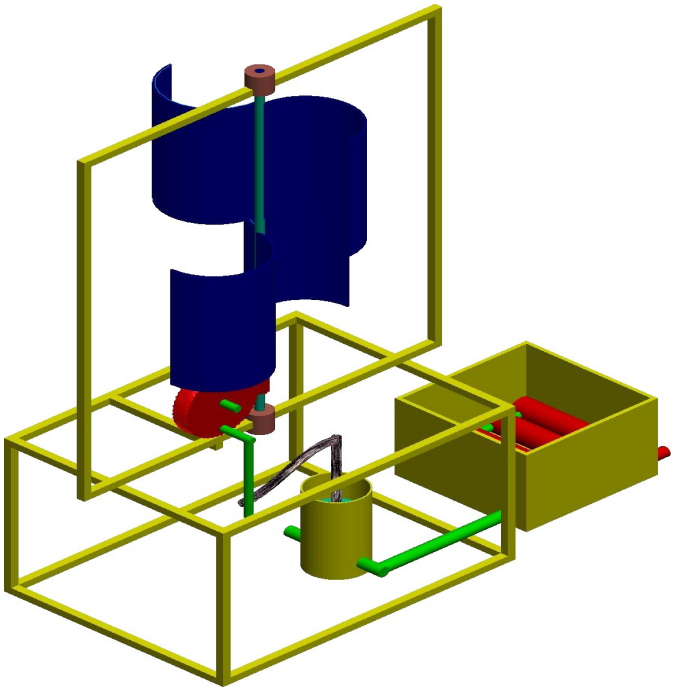
(5) Acceleration head:

H_a= $\frac{LVNC}{k\times g}$……(7)

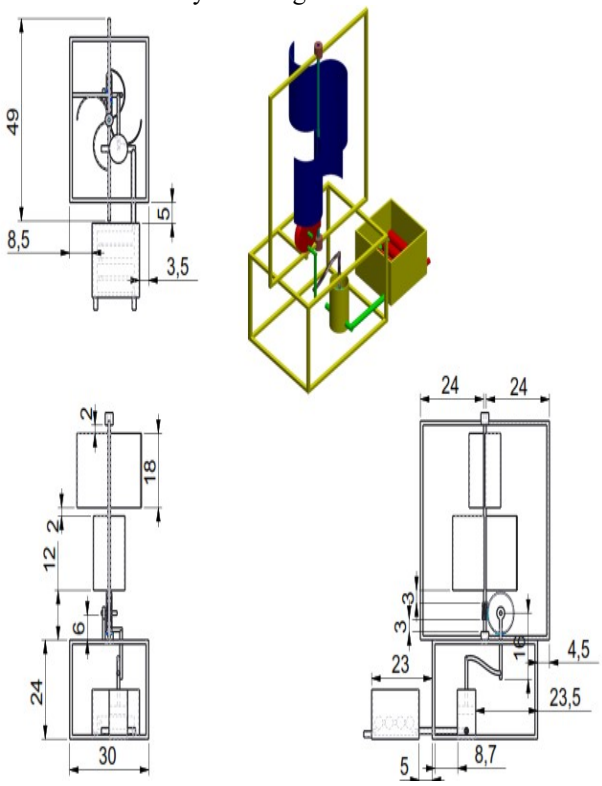
=(3✕.32✕100✕.200)/(1.5✕32.2)

=12.19 cm

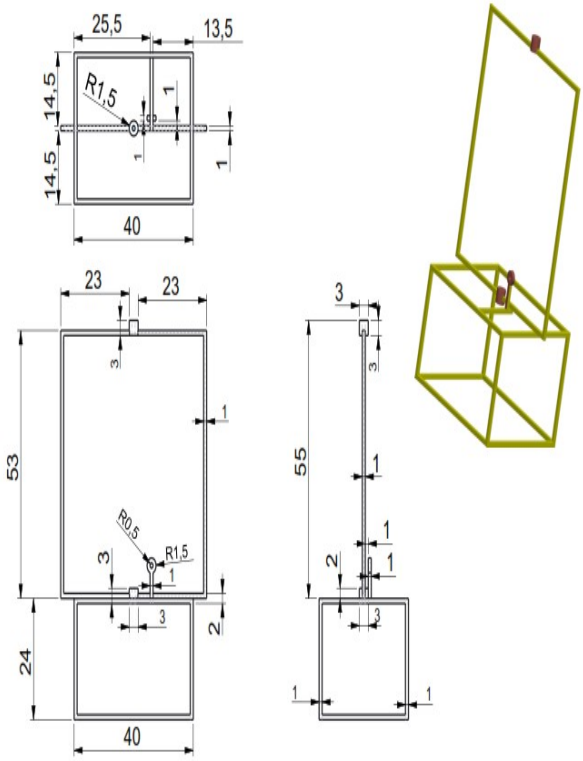
- Full Assembly Design View



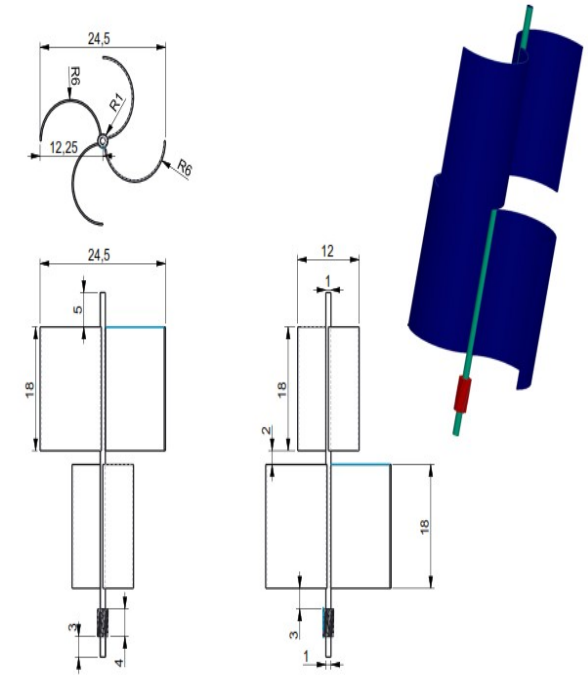
- Full Assembly Drawing



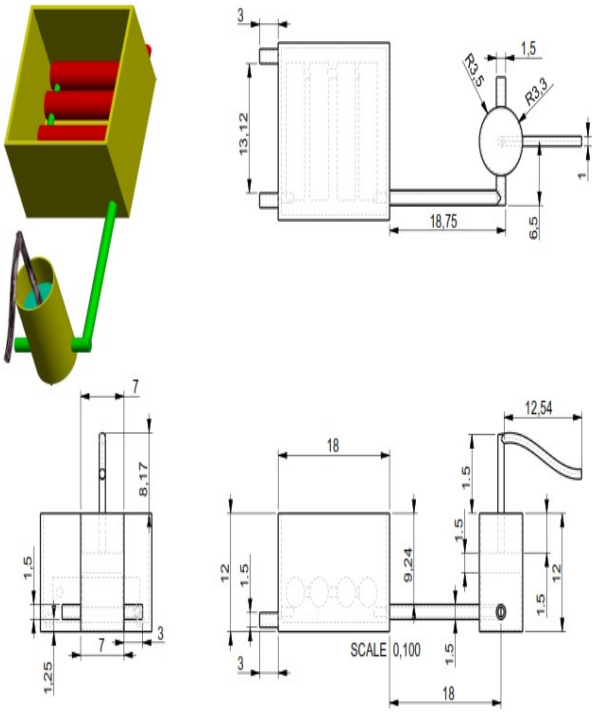
- Frame Structure of Box pipe



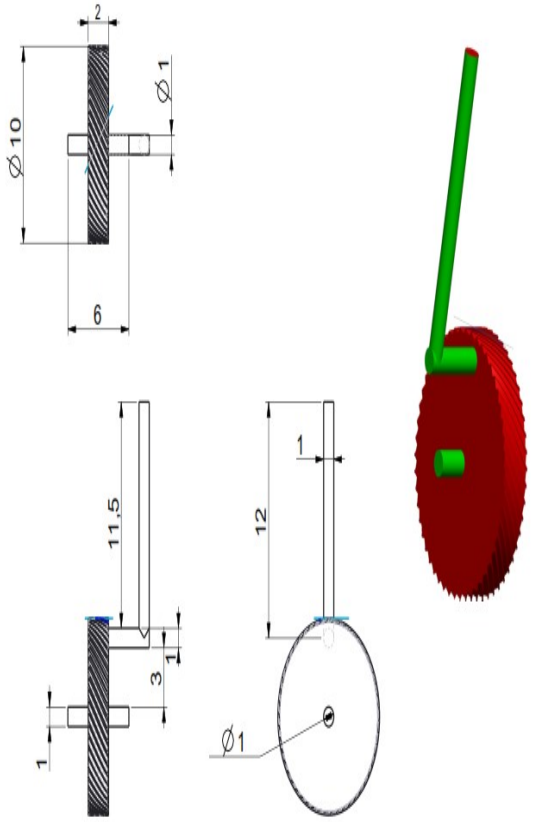
- Wind wing with vertical shaft



- Pump with Water Filter



- Gear Pair with Shaft



- List of Components

Sr.No	Components	Designation/size	Quantity
1	Worm & worm gear with key way(nylon)	Standard gear size	1
2	Bearings	6206 , 6204	2 + 2
4	Wind mill blades	Plastic barrels	2
5	Nut-bolts, fasteners	2 inch. Bolt ,2.5 inch bolt	10
6	Shaft	1 inch dia. 5'' length	1
7	Coupling(bright bar)	1.800 kg piece	1
8	Framing, welding	20ft. material	-
9	R.O system equipment	Membrane ,Coupling , Flow Nozzle	3 ,6 ,1
10	Reciprocating pump	Hand pump	1
11	Knuckle pins	cast iron	4
12	Water pipe	1.25",4 ft	1

Table No. 1 component of wind operated water filter

- Cost Estimation

Sr.No	Components	Quantity	Cost
1	Worm & worm gear with key key way(nylon)	1	4500
2	Bearings	2 + 2	590
4	Wind mill blades	2	800
5	Nut-bolts, fasteners	10	390
6	Shaft(plastic pipe)	1	400
7	Coupling(bright bar)	1	320
8	Framing, welding	-	4200
9	R.O system equipment	3 ,6 ,1	5200
10	Reciprocating pump	1	1400
11	Knuckle pins	4	20
12	Water pipe	1	60
	TOTAL		17880

Table No. 2 Cost estimation of wind operated filter

- Advantages
  - It is operated by the non-conventional energy (wind).
  - It doesn't produce pollution.
  - It gives purified water in remote area.
  - Very simple construction
  - Easy to maintain.
  - Less costly parts.

- Disadvantages
  - Very frequent, It can't give regular water.
  - Too much bulky.
  - Initial cost is high.

REFERENCES

[1] "Stand-alone river water purification system powered by solar photovoltaic panels in Haiti", Rami sleiman, ziyad salameh , international journal of engineering research & technology , this work is licensed under a creative commons attribution 4.0 international license. volume/issue: vol. 3 - issue 9 (September - 2014)

[2] "Systems Development for Environmental Impact Assessment of Concentrate Disposal – Development of Density Current Simulation Models", Rule Base, and Graphic User Interface Water Resources Research Center University of Hawaii at Manoa2540 Dole Street, Holmes Hall 283 Honolulu HI 96822

[3] "The Study of Water Supply and Traditional Water Purification Knowledge in Selected Rural Villages in Tanzania" Nancy Jotham Marobhe, Gunno Renman and Gunnar Jacks

[4] "Hardware Design of Vertical Axis Highway Windmill Department of Electrical and Electronics Engineering", Christ the King Engineering College, Tamilnadu, India

[5] "Water Purification System For Remote Areas Using Photovoltaic" S.S.Phuse , R.S.Shelke Student, IV Semester M.Tech (Heat Power Engineering) Assistant Professor, Mechanical Engineering Department, G. H. Raisoni College of Engineering, Nagpur-440016, India