Design and Construction of Windmill for Pumping Water

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Abstract:

The horizontal axis wind pump is designed to drive rope pump. The blades of wind pump are designed by using the NACA 64-215 series. The rotor diameter is 2.4 m and rotor swept area is 3.56 m2. The rotor speed is 62 rpm. We applied Analytic Hierarchy Process methodology to choose the Suitable Material for the blades.

The torque output of the windmill is 106.4572 Nm and this is sufficient to sustain the desired flow rate of (0.1157 X 10^{-3}) m^3 per second with a maximum head of 20 m, and also overcome other barriers to motion such as friction. The other components such as hub, shaft, bearing, gears and pulleys were designed and selected to meet the required specification of proposed windmill. Finally, we built the prototype and experimental results for prototype are also presented.

Objective:

- Design and construction a windmill to generate renewable energy for pumping water system.

Proposed Design Requirement:

Proposed head of well = 20 m

Proposed Volume Flow rate= 10 m^3/day =0.1157 × 10^{-3} m^3 per second= 2641.72 gallon per day.

Given the average wind speeds, the average wind speed was selected is 3.9 m/s. The average atmospheric temperature for Al-Kharj is 26.7°C.

Swept Area and Chord Length

$$A = \frac{Pump\ Power}{0.5 \times \rho \times V_{wind}^3} = \frac{124.5}{0.5 \times 1.178 \times 3.9^3} = 3.56\ m^2$$

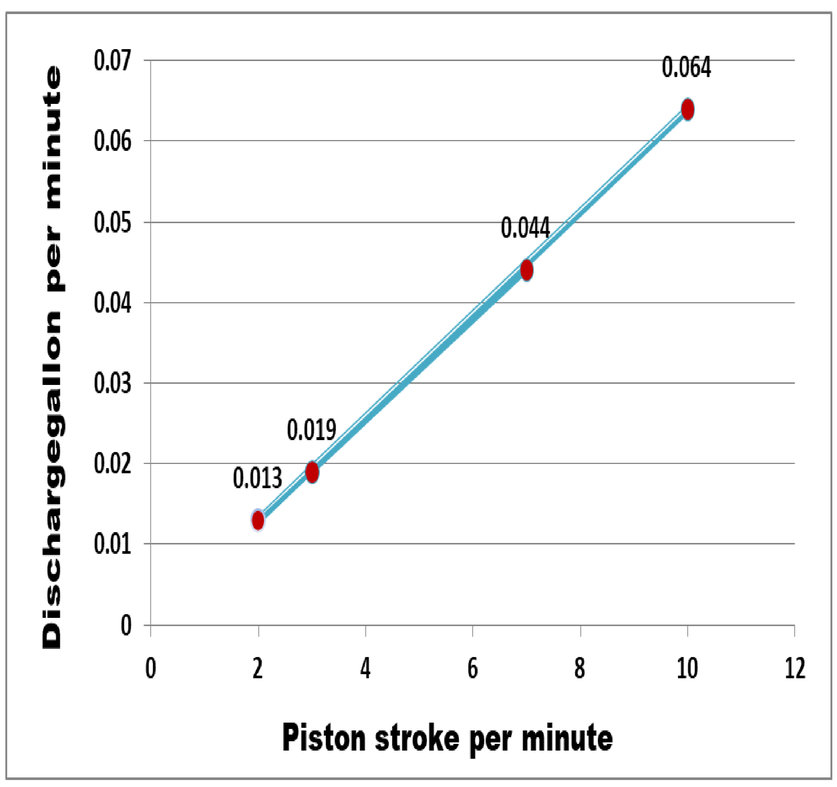
$$C = \frac{0.15 \times \pi \times 2.4}{12} = 0.1\ m$$

Windmill for Pumping Water Prototype

Fixed and testing prototype

Build and Test the Prototype:

In this section also we tested our turbine tip speed in the field, we used a tachometer to measure the rotational speed



Discharge Versus Piston Stroke Per Minute

Constraints:

Our design take in consideration the following constraints:

- Safety
- Environment
- Economic

Conclusion:

We used modern rope pump is based on the principle of the ancient chain pump. By making use of new materials, it has been redesigned to provide a low-cost pump for water supply. Its straightforward working principle and easy construction flip it into a very effective pumping device. It can handle a range of pumping heights and volumes. Finally, all materials used are locally available and at a low cost making the model economically viable.