Fabricated of Vertical Axis wind turbine (VAWT) and study the parameter

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ABSTRACT

Due to the lack of electric power in areas away from power transmission lines and high prices of conventional fuel due to high pollution. A vertical system is used which depends on wind energy used to rotate a vertical turbine. The system is manufactured from local materials and tested. and study the number of blades with the other characterization of system we found, increasing the torque with increasing the blade of turbine, and increasing the power coefficient with increasing the tip speed ratio and low bitz limit.

1. Introduction

Communities begun to show great interest in fossil fuels, so many researchers go on solving this crisis using green renewable energy projects, Environmental protection is required To achieve sustainable development, renewable energy is one of the means of protecting the environment. Where a number of researchers worked to improve renewable energy projects to improve life and develop energy, [1-3]. Paul studied and analyzed the complex aerodynamics of the designs of the Savona's, Darius and Giromel turbines using a multi-flow multiplier to illustrate VAWT performance details in terms of turbine blade loads and power output[4], Furat studied the use of a PID system for turbines where the speed of the rotor is controlled when the wind speed is changed from 4.7m/s to 8.1m/s. By controlling the rotor blades and changing the angle between 5° and 15°. In order to maintain the speed at reference value 47.1 rad/s [5]. Gupta in 2010. Analysis of two-dimensional computational fluid dynamics using (FLUENT 6.2) program and analysis of the performance of the three codes of the rotary H-Darrieus. The flow was simulated on the rotor using a technique to solve the equations of maintaining the momentum and mass and the adoption of an estimate of the wind [6]. Ronak D Gandhi and others, designed the wind mill wind turbine , And worked to improve the rotor and its components to maximize the coefficient and energy efficiency. The theory of momentum is derived from the length of the tendon

based on the maintenance of angular momentum and the theory of aerodynamics on the blade. The momentum theory is first derived from the Blade Element Momentum (BEM) theory, then the theory was used to conduct a study that would determine whether the improved code values and the length of the tendon effectiveness[7]. Prasad studies the design of the windmill to improve rotor and components to produce maximum efficiency in energy use, Where he studied the vector, load matching, state deviation and so on. In addition, it also includes the study of wind and an estimate of the load capacity of the work to improve the shape of the feathers width of the tendon[8], Mubeen designed a hybrid wind turbine that combines the Savonius wind turbines to handle the individual defects of both models and to correct them and obtain a more efficient turbine that was connected to a pump and used to raise water from the wells to the areas where it was used[9] Ilamathi studied and designed a system that linked solar and wind energy. The wind turbine is designed with Savonius Wind Turbine. A photo-voltaic solar cell was also used and a power output controller was used for the hybrid system, which was approximately 22% efficient[10].ZHUJian studied VAWT's self-operating aerodynamic characteristics under variable wind. Turbine rotation is determined by the dynamic interaction between changing winds and turbines. A weak coupling method has been developed to simulate the dynamic interaction between variable

winds and negative gyro turbines. The results show that if the oscillating wind is of sufficient capacity and frequency, VAWT's own aerodynamic characteristics will be enhanced. It is found that compared to the oscillation capacity, the oscillation frequency in the variation in wind speed has a slight effect on the performance of the turbine [11]. Karthickeyen investigate the design and experimental analysis of the model of a water pump working on wind energy that transfers water from the wells used for irrigation, as well as calculate the energy that can be provided by the wind and then energy analysis to see what speed of wind required for the system to work [12].Yan presented a study in which a new method was proposed to connect the blade to a rotary column called the offset blade method for straight concrete. In order to exploit the efficiency of this method and the effects of the main parameters including the length of the offset and the blade to improve the performance of the output power [13].

2. Theoretical part

The streamlined effectiveness is the prompt proficiency of change of wind vitality into mechanical vitality at the pole [14], In request to contribute the vitality, need let the draft go through the sharp edges to. section This makes the perfect wind turbine hinder the breeze (2/3) of its greatest speed of 59% called the Bitz [15]. The power coefficient is given by equation (1,2)and the power actual equation (3,4),also the Area of turbine

equation(5) , is subject to sharp edge pitch point and TSR equation (6,7,8) [15].

$$C_P = \frac{Actual\ power\ extracted\ by\ rotor}{Total\ power\ available\ in\ the\ wind}\ ----(1)$$

$$C_p = \frac{P_{actual}}{P_{total}}-----(2)$$

$$P_{total} = 0.5\ \rho A v^3 ---(3)$$

$$P_{actual} = C_P\ 0.5\ \rho A v^3 ---(4)$$

$$A = \frac{\pi D^2}{4}------(5)$$

Where : C_p = power coefficient , ρ =Air density in (Kg/m^3), A=Swept area in (m^2), v =*wind speed in(m/s)* ,D=*diameter of turbine (m)*

Tip speed ratio $\lambda = \frac{blade\ tip\ speed}{Undisturbed\ wind\ speed}---(6)$

$$\lambda = \frac{\omega\ R}{v_o}---(7)$$

$$v_o = \frac{\omega R}{\lambda} = \frac{2\pi N R}{\lambda}----(8)$$

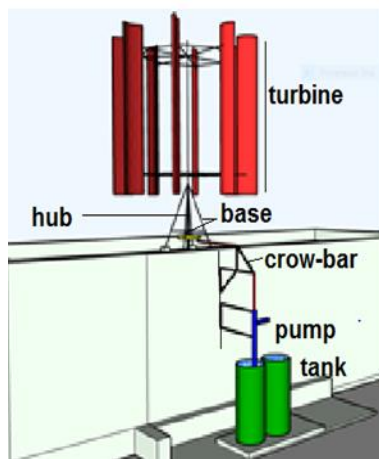The torque of turbine is(T) given by equation (9)

T= $\omega \times$R -------(9)

$\omega = 2\pi N$ = rotational speed of the turbine [rpm]; ,R= Rotor radius in meter ,v_o undisturbed wind speed . N=number of blade

3. Experimental work

The practical part can be dividing the system into two parts

1-Turbine:

2- Base :

This can be illustrated by the figure(1) the parts of the system Turbine consists of several parts :-

Fig. 1: Assembly water pump system.

3.1-**turbine** : it Consists of a vertical axis of rotation diameter of 10 cm and the length of (2.2m) are installed eight axes of the top and the bottom of the length of each axis (0.9m) figure (1). The function of the axes install the blades. The hub also moves easily because of Ball Bearing fixation with the base.

3.1.1 Blade: The blade is made of (2 mm thickness), steel strips width 30 cm and length of 180 cm, which the shape of parabola figure (2) the blade shape.

Fig. : 2Shows the blade dimension

3.1.2 structure:

It consists of an upper and lower part in the shape of an octagon mounted on a spindle of a diameter. 2.5 Cm set on the base. is useful for carrying the blades.

3.2 **Base** : It is made of iron in the form of pyramid figure (3) .with 60 cm ,height of 100cm which proves the axis of rotation above the base ,which holds the turbine.
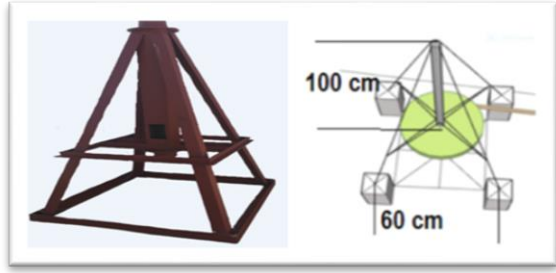

Fig. 3: The base of system.

4- Results and discussion

The system has been installed at 8meter high
Design of system :
When the output power of turbine
p= 200 watt at wind speed = 5 m/s
From equation (3)
$200 = 0.5 \times 1.225 \times A \times (5)^3$
A=2.6 m^2
From equation (5)
$2.6 = \frac{\pi \times D^2}{4}$
D=1.8 m
Torque 0f the turbine is the most essential element from equation (9).
W= Sum of weights of the eight blade
W at $_{8\ blades}$ = 8 (4.25kg) = 34kg. (the mass of one blade is 4.25 kg)
W at $_{4\ blades}$ = 4 (4.25kg) = 17kg
W at $_{8\ blades}$ = 3 (4.25kg) = 12.75kg
Radius is found to be 0.9 m ,so as the torque
T at $_{8\ blades}$ =34×9.81 ×0.9 = 300 N.m
T at $_{4\ blades}$ = 17×9.81×0.9 = 150 N.m
T at $_{3\ blades}$ = 12.75 ×9.81×0.9 =112.5 N.m
The study tries to explain The relationship between wind velocity and the power of turbine with changing the number of blades we see increasing the power with increasing the wind velocity also when using the three blades ,the suggest that the power of wind turbine is greater than when using four blades of eight blades, but the torque in three blades low than when used four or eight blades figure (4) This is agreement with [16] .
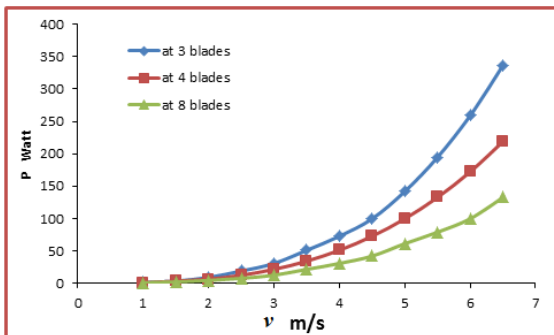

Fig. 4: Relation between wind speed and power of turbine.

The relationship between wind velocity and number of turbine cycle(Rpm)figure(5),we see the increasing cycles of turbine with increasing wind speed. also notice the increase in cycles by increasing the number of blades. This because ,When the number of blades is three, the air passage through the turbine and movement is rapid. When the blade increases, the air passes through the turbine in difficult .This happens in four blades so as the turbine is more slowly than the three blades .otherwise By increasing the blades to eight blades. In addition to the difficulty of passing air currents to turbine the air current that works toward the original wind current this cause too slow and agreement with [17] .
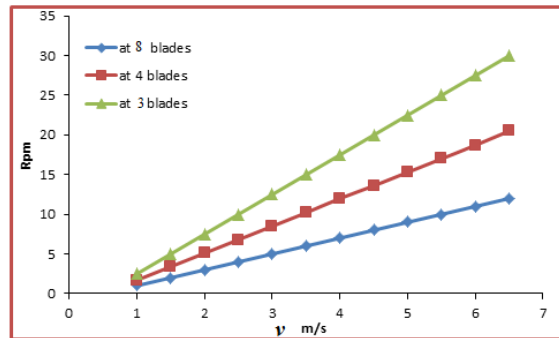

Fig. 5: Variation between wind speed and Rpm of turbine.

The relationship between the tip speed ratio (λ) and the power coefficient (C_p),on the blades was also studied in figure(6), because the tip speed is a function with number of blades ,the study shows great interest in see when turbine exceed bitz limit the system operated therefor the power coefficient increasing continues and when increasing tip speed the C_p is fixed saturated because for any turbine limit of C_p the this coincident with[20].
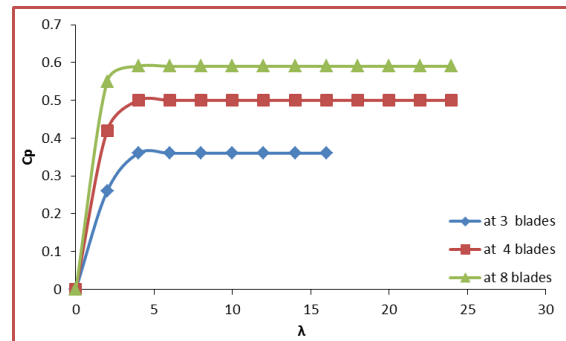

Fig. 6: Relation between tip speed ratio and power coefficient of turbine.

5- Conclusion

From the design, it can be concluded that
1- The total torque of the turbine is 300 N.m ,at eight blade , 150 Nm at four blades ,122N.m at three blades , with a maximum instated at 8 m,
2- from system we found increasing the power coefficient with increasing the tip speed ratio and found the best power coefficient,(0.35,0.51,0.58) at three, four, eight blades .

3-The system economically ,because the materials used are locally available and at a low cost making

3-The system suitable for water pump at low speed wind when we used eight blades.

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تصنيع منظومة رياح عمودية ودراسة معلماتها

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الملخص

بسبب نقص الطاقة الكهربائية في المناطق البعيدة عن خطوط نقل الطاقة وارتفاع أسعار الوقود التقليدي, وبسبب التلوث العالي . تم استخدام نظام رأسي يستخدم طاقة الرياح لتدوير التوربينات العمودية. تم تصنيع النظام من المواد المحلية واختباره. ودراسة عدد شفرات المنظومة مع الخصائص الاخرى للنظام ووجدنا ،بزيادة عزم الدوران مع زيادة عدد شفرات التوربينات ، وزيادة معامل القدرة مع زيادة نسبة سرعة طرف وانخفاض حد يتز .