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Power Developed from a Cluster of Savonius (VAWT) Wind Turbines

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Abstract—*In front of a blower generating a velocity of 10 m/s, three Savonius wind rotors are kept in front of the blower , and their rotational speed (and hence power) is calculated. Orientation has been changed twelve times .The model of Savonius wind rotors are kept in area of 80cm*50cm and their combined rotation speed (900rpm, 585 rpm, 600 rpm for model 1 , model 2 and model 3) has been obtained. And this is compared with the result, when one Savonius rotor is kept in that particular area .It has been observed that total rotation speed in case of 3 rotors (2085 rpm) is much more than the case when one Savonius rotor (1400rpm) model is kept in that area . Similarly other readings are measured with other orientation and compared when one Savonius rotor is kept in that particular area.*

1. INTRODUCTION

Savonius turbine is a type of VAWT used for converting the force of wind in to torque on a rotating shaft. the turbine consist of a number of aero-foils - but not always – vertically mounted on a rotating shaft or framework, either ground stationed or tethered in air-bone systems. T is the one of the simplest turbine. Aerodynamically it is a drag type device consists of two or three scoops or blades. Looking down the rotor from above, a two scoop machine would look like an 'S' shape in cross section. Because of curvature, the scoop experience less drag when moving against the wind than when moving with the wind. Different blade causes the savonius turbine to rotate. Because they are drag type devices, savonius turbine extract much less of the wind's power then other similar –sized lift type turbines.

2. OBJECTIVES OF THE PROJECT

Objective of the project is :

(1) To design and fabricat two bladed Savonius wind turbine models.

(2)To construct a cluster of three wind turbines models so a get a conception of wind farm.

(3) To study variation in power developed by all three rotors for diiferent positions in front of blower.

3. FABRICATION OF THE EXPERIMENTAL SET-UP

3.1 Base plates

Base plate and bearings are the supporting mechanism for the rotor. Base plate with dimension central hole of around 35 mm up on which the entire assembly is mounted has been fabricated with a bearing for smooth rotation of rotor. The bearing used is a small ball bearing with 10 mm inner diameter and 35 mm outer diameter as shown in **Fig. 1.**. This bearing has been inserted in a central hole of around 35 mm round circular metallic block. Two other holes are also made in the base plate besides the central hole for the nut so that it supports the shaft and absorb the vibrations when the test is conducted.

This base plates are kept on a cubical block made up of cement. Base with bearing is shows in Fig. above.

3.2 Cubic block

The cubic block has been constructed for two purposes. The first purpose is to make the distance between the rotor and the blower to enhance the performance and the other function is to support the rotor when it rotates in front of the centrifugal blower.

Fig. 1: Cubic block with base at top

This technique also prevents the drilling of flower to install the support mechanism. The dimension of the cubical block with side is 48 cm as shown in **Fig. 1.** given below. The cement cube having the strip of bolts attached to the inside of the cement block and base bearing at the top.

3.3. Design and Fabrication of Savonius rotors

The blades of the Savonius turbine has made up of aluminum sheet due to its versatile properties. It has low weight, high strength, good workability and anti-corrosion properties. The density of the aluminum material is 2700 kg/m^3. The rotors have been given a semi cylindrical shape with height 15cm and chord length 10 cm. After the bending of rotor, holes of approximately 8 mm have been drilled at a distance of 2 cm from the vertical edge and 1 cm from horizontal edge in order to facilitate the bolting of blades to the shaft.

The length of the shaft is 48 cm and diameter of shaft is 1.5 cm. one end of the shaft is turned to a diameter of 1 cm for a length of 1.5 cm to facilitate its assembly with the bearing. Appropriate number of holes has been drilled in the shaft for bolting of blades with shaft. The turning process of shaft is done on the lathe machine.

In order to observe the effect of overlap ratio (ratio between the distance of the two adjacent blades and rotor diameter) and types of array used in the testing, Reynolds number on the aerodynamic characteristics of the Savonius VAWT rotor, three different rotor models with and without overlap ratio were designed in the department workshop and physically fabricated Washer and nuts having knurled surface have used to produce the overlap between the blades of the Savonius rotor. By changing the number of nuts and washer the overlap increased or decreased. With increase in overlap the overall diameter of the rotor has decreased. These five models were tested in front of the centrifugal blower for various flow conditions.

3.4. Savonius rotor models

The two bladed Savonius rotor model with no overlap between adjacent blades was designed and fabricated in the departmental workshop. The designed and the fabricated model of the Savonius wind turbine are shown in **Fig. 2**. The model is made of two semi-cylindrical blades of height, H = 15 cm, and diameter, d = 8 cm. At first the aluminum plate has been cut in to the required dimensions. The curved part making has been taken for bending in circular manner. The turbine model was made of aluminum sheet. The central shaft was not removed from the turbine model. The blades were 180° apart from each other and the overall rotor diameter was D = 16 cm for the Model. A fabricated single 2-bladed Savonius rotor and comined three 2-bladed Savonius rotors are shown in Fig. 1, Fig. 2 and Fig. 3 respectively.

Fig. 2: Fabricated Two-bladed Savonius Rotor.

Fig. 3: Cluster of three 2-bladed Savonius wind rotors.(3-D view)

Fig. 4: Cluster of three 2-bladed Savonius wind rotors.(Front View)

4. CONCLUSIONS :

It is concluded that when one turbine is kept in an area of 80cm*50cm , then rotational speed obtained is 1400 rpm. But when three models are kept in that area the total rotational speed obtained is 2085 rpm and hence more power is obttained.

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