

A Study for Improving the Performance of Savonius WindBlades

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Summary

Wind energy is clean, cheap and inexhaustible source of energy. It is used to meet the energy needs of developing various types of wind turbines. This study is intended to improve the aerodynamic performance of the Savonius wind rotor. Here, a review of existing Savonius wind rotors. They can raise the aerodynamic performance of a design is made by performing experimental applications. In this embodiment, negative torque acting on the convex side opposite to the wind direction, were reduced to a minimum. To improve the performance of conventional Savonius wind rotors, it is used a plurality of swinging blades and a rocking motion. Normal and aerodynamic performance increased two and three-bladed design is compared experimentally. Performance increased aerodynamic wind rotors, it is seen that the higher moments of the classic Savonius wind rotors. Savonius according to this study in order to improve the performance of wind rotor, it was concluded to be a good practice in order to take better advantage of wind energy. Thus, the applications offered here as promising, will contribute to the economy and it is understood that it will increase in the use of space.

Keywords: Wind energy, savonius wind rotor, rotor performance, swinging blades.

1. INTRODUCTION

World energy needs for many years has been met by fossil fuels. This fuels more expensive day by day has decreased and increased negative effects on human health. Therefore clean, cheap and increased interest in renewable energy sources. Renewable energy sources, be clean, available in every geography and noteworthy for reasons to be sustainable.

One of the renewable energy resources is wind energy. This energy is clean, cheap and inexhaustible energy source. At the same time environmentally friendly source of energy. Wind turbines, each day is a little more developed, to increase power and are cheaper. These reasons are designed for various wind turbines are produced and applied.

According to others, the Savonius wind rotor there are too many advantages. These comprise: a-Construction is simple, b-It is cheap, c-It can operate at lower wind speeds, d-Direction changing mechanism is not needed. This study was conducted Savonius who excels in many ways in order to increase the performance of the wind rotor. Aerodynamic performance of Savonius wind rotor has tried to be

upgraded. In this study, the two differently designed Savonius wind rotors, made studies to improve the rotor performance is disclosed. The system has been experimentally investigated and the results are given.

2. PERFORMANCE OF WIND TURBINES

The development of wind energy systems and studies to achieve higher efficiency of the wind motor is continued. Therefore designs are developed and used in various wind rotor.

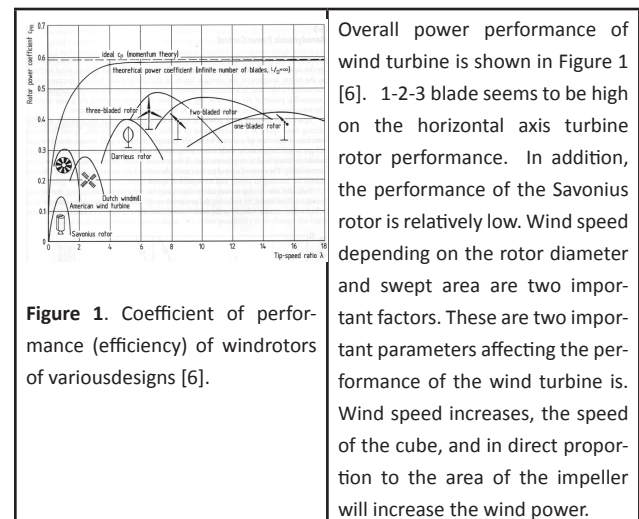


Figure 1. Coefficient of performance (efficiency) of wind rotors of various designs [6].

Expression is defined as follows to ensure maximum wind energy [4, 5].	This energy benefit from a particular portion of the rotor.	(1 and 2) expression of, $\frac{P_{max}}{T} = \frac{16}{27} = 0.5926$ (3) Betz Limit is obtained.
$P_{max} = \frac{8}{27} \rho S V_0^3 (1)$	$T = \frac{1}{2} \rho S V_0^3 (2)$	
Performance of wind turbine is determined by the torque and power coefficients.	Power coefficient, $C_p = \frac{P}{\frac{1}{2} \rho S V_0^3} = \frac{2P}{\rho \pi R^2 V_0^3} (4)$	Moment coefficient, $C_m = \frac{M}{\frac{1}{2} \rho S V_0^2 R} = \frac{2M}{\rho \pi R^3 V_0^2} (5)$
The coefficient of performance of the wind wheel varies as a function of the peripheral rotational speed of the rotor. The blade tip speed ratio is given by the following equation.		$\lambda_0 = \frac{u}{V_0} = \frac{2 \pi R n}{60 V_0} (6)$
Rotor (blade) tip speed ratio (λ) = Wind speed / Rotor blade (peripheral rotation) tip speed.		
Swept area, (S) = (2 d - e)h It is expressed as.		
The optimum power value after using this value is obtained as follows [5]. $P_{opt} = \frac{2}{27} \rho C_1 (2 d - e) H V^3 (7)$		

3. UPGRADING THE PERFORMANCE OF WIND ROTOR SAVONIUS

Vertical axis wind wheel Savonius wind rotors which was discovered in 1925 by S. Savonius (Figure 2a, b).

These rotors, arranged between the two horizontal disc is composed of two semi-cylindrical geometric and shifted.

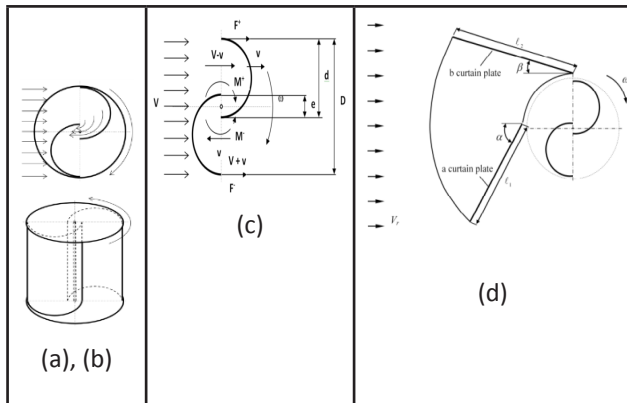


Figure 2. Savonius wind rotors model and parameters [5, 9].

According to the working principle of this engine; positive and negative torques occur in the outer portion of the inside of the half cylinder forming the wheel under the influence of wind energy. Positive moment of the inner core is formed on the outside of large skin negative moments. Thus, rotational movement of the positive torque direction is provided. Savonius rotor in order to improve the performance of many studies have been made. Slip amount (e) was determined to be about 10% of optimum values [2]. Savonius moment that occurs in the opposite direction to the direction of rotation of the wind motor is tried to be eliminated. Savonius design attracts attention both to improve the aerodynamic performance of wind rotor. One of them is the Savonius wind rotor and the other swinging hinged vane rotors are Savonius wind.

3.1. CURTAIN WIND ROTOR OF THE SAVONIUS

In this embodiment, the rotor around, changing direction depending on the wind direction and preventing the negative torque in the negative direction of the wind screen on (Figure 2d). This design also improves the efficiency of the rotor and power as the wind speed increases. With this curtain, the wind swept area will be less than the input. So that the rotor speed will increase and it will increase as power is connected to a proportional manner. A design is provided for reducing the moment that a convex surface in Figure 2d. Thus, low aerodynamic efficiency of the Savonius wind motor is increased.

3.2. SWINGING BLADES WIND SAVONIUS ROTORS.

Savonius wind has made significant efforts to improve the aerodynamic performance of the rotor. significant improvements in increasing their power and torque performance is obtained. Savonius experimental studies using hinged and swinging in the wind rotor vane wheel is made. The performance of Savonius wind rotor in this study, developed with movable blades [7, 10] (Figure 3a). Savonius wind rotor on tiny blades next to the swinging blades are made using an experimental study in. In this study, the free motion of the rocking side result has been tried to elimi-

nate the negative resistance when a convex side [1] (Figure 3b). To improve the work efficiency of the Savonius wind rotor as shown in Figure 3c is disposed a plurality of fins instead of arcuate portions of the wind rotor [3, 11]. The small blades are working to reduce the negative pressure by opening the convex surface. Small blades, concave surface that will automatically shut down again fulfill its normal function. The very low-end velocity ratio, the conventional Savonius wind vane rotor of the piece according to records obtained higher torques are given below [3]. Swinging the piece bladed wind rotor shown in biogas production can be used for mixing [12].

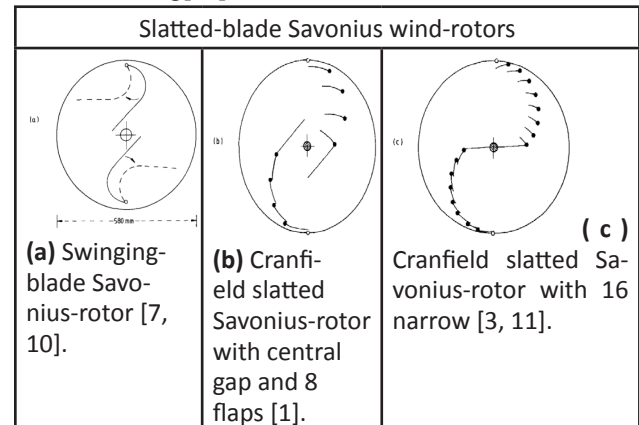


Figure 3. Plan view of the modified Savonius-rotors, each of diameter 580 mm and vertical axis height dimension 450 mm [1, 3, 7, 10, 11]

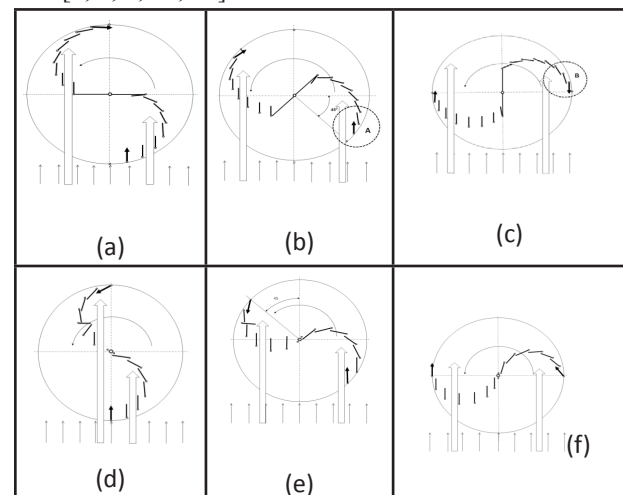
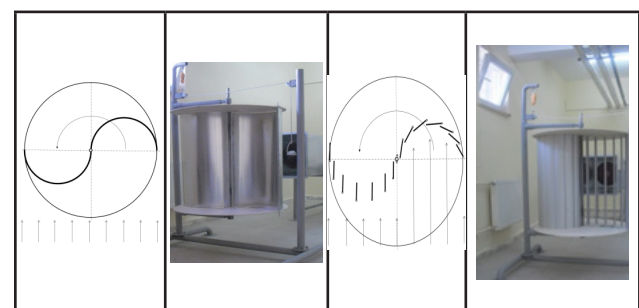


Figure 4. Hinged and swinging blade Savonius wind blade rotors.



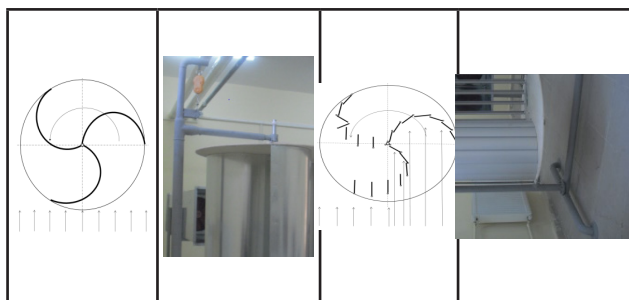


Figure 5. Two and three winged classical and moving slatted Savonius wind rotor.[12].

Figures 3b and c, was determined by us to be a negative impact on the design of the slatted blade Savonius rotor. This problem is met with a negative change in the position of the strips during forming the rotor slatted-blade. This error is shown in Figure 4. Slatted-blade automatically open and free state, with wind speeds are entered into the normal position. Slatted-blade in the position in Figure 4b, then B cannot receive the sash position seen in Figure 4c. Hence, by changing the swinging hinge position and the position of the vertical slats, a new design has been developed by us. (Figure 4d, e, f) [12]. This design has been shown how to integrate into a biogas reactor system stirring. This design is given in Figure 5. In this study, some experimental results are discussed with the development of this design.

4. EXPERIMENTAL STUDIES

In this study, the performance of two and three-bladed wind classic and moving slatted Savonius rotor has been investigated experimentally. A wind tunnel laboratory for experiments in our faculty has created. Wind experiments were performed on the test device placed at the outlet of the tunnel. The experimental setup is given in Figure 6.

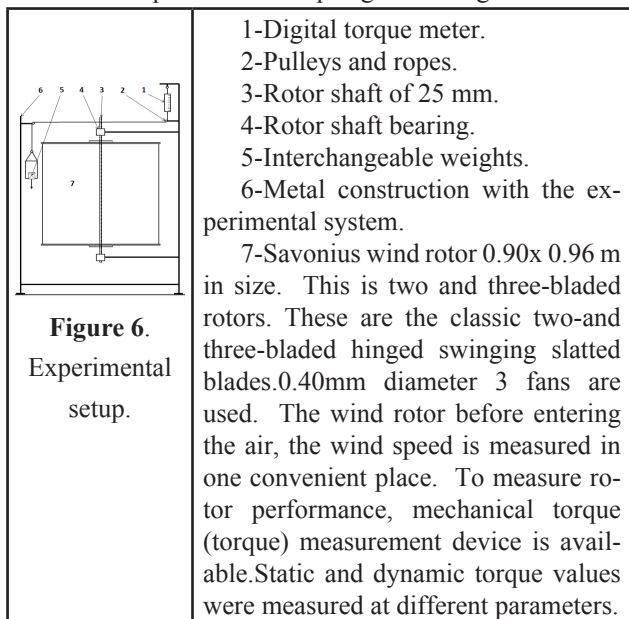


Figure 6.
Experimental setup.

Table 1. Dynamic torque test results.

Two-bladed classic Savonius wind rotor. Moment (Nm)	Two-bladed aerodynamic Savonius wind rotor. Moment (Nm)	Three-bladed classic Savonius wind rotor. Moment (Nm)	Three-bladed aerodynamics Savonius-wind rotor. Moment (Nm)
6.04	7.44	6.72	8.02
8.36	10.32	8.94	11.10
11.24	14.02	11.82	14.06
13.14	16.34	13.79	17.11
16.15	19.02	17.46	21.42
20.14	26.17	22.03	26.94
24.23	30.18	25.78	32.22
29.21	36.42	31.08	37.91
32.98	41.55	33.64	41.63
37.64	46.29	39.06	48.02

5. RESULTS AND DISCUSSION

Wind turbines; increasing power has an important place because of business potential and low environmental impact. The development of wind energy systems and research for higher efficiency in operation of the wind rotor is continued. Therefore, it is used a lot by developing different types of wind wheel designs. Although many benefits over other wind rotor, the performance of Savonius wind rotor is very low. Because of the positive and the exterior of a half cylinder that forms the inside of the impeller due to the wind blowing at a certain speed occurs when a negative torque. Therefore, this poor performance is due, stems from the lack of streamlining.

Savonius wind is not preferred due to their low power and duty blade provided rotor. Savonius work we have done to improve the performance of wind rotor is described here. In this study performed in Savonius design it was applied to intact original geometric shape of the wind rotor. The major difference here is to try to eliminate the moment of the negative direction.

Compared to the results obtained in this study, the aerodynamic Savonius wind rotor according to the conventional Savonius wind rotor were found to be more efficient. This yield is approximately 25%. Air leak is present in the aerodynamic rotor blades. When this leak taken into consideration, it is understood that a higher yield aerodynamic rotor. These air leaks can be minimized with proper design. Also moving blades in the aerodynamic design constitutes noise. This noise can be reduced at least by appropriate structures. Perform the opening and closing events of the flaps forming the aerodynamic rotor at high air speed is difficult.

In this study, Savonius wind rotor aerodynamic blades is applied. This practice, although common, if not two, and applying a multi-bladed Savonius streamlined and movable flaps hinged to the wind rotor results should be examined.

Work should be done on different rotor sizes. The effect on the rotor performance, the performance of different geometric changes should be investigated. In addition, effects on performance by changing rotor materials can be examined. The work on this subject is very small. This work should be tested in a real environment.

Here, because of the constant opening and closing of the blades will occur wear on moving parts. This problem can be solved with a good draft. Which does not pose an additional burden on the system, which is cheap and easy to use performance-enhancing work that has been shown to be available so comfortable. Savonius wind, especially in the aerodynamic performance of the rotor so that the increase with lower wind speeds can be achieved good success. Every success will be achieved in this regard, it will provide a positive and significant contribution to the economy.

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