National Conference On Recent Trends And Developments In Sustainable Green Technologies
Journal of Chemical and Pharmaceutical Sciences www.jchps.com ISSN: 0974-2115

DESIGN AND ANALYSIS OF DRAG AND LIFT VERTICAL AXIS WIND TURBINE

Thanigaivel G*
Institute for Energy Studies, CEG campus, Anna University, Chennai, India.
***Corresponding author: Email:velslocker@gmail.com**

ABSTRACT

Growing energy demand and the depletion of convention energy resources pull the focus of world towards sustainable and renewable sources of energy. Wind energy represents an important resource of energy for many countries nowadays, and it provides an effective solution to reduce fossil fuel consumption and pollutant emissions. The vertical axis wind turbine is simple in construction, inexpensive and can accept wind from any direction and suitable for urban environment. Darrie vertical axis wind turbine (VAWT) appears to be particularly promising for the conditions of low wind speed, but has low efficient than horizontal axis wind turbine. Moreover VAWTs are not always self-starting, which is a major drawback. The present project gives solution to improve this drawback by designing a VAWT that possess both self-starting and high power coefficient. Savonius rotor is less efficient than Darrieus but has good starting torque than it. To make Darrieus completely self-starting it is incorporated in a hybrid system with Savonius rotor as its starter. A 50 W hybrid turbine is designed theoretically. The diameter and height of the hybrid turbine are 0.75m and 0.7365m respectively for the cut in speed and rated speed of 3m/s and 7m/s. It is found that the hybrid design fully exhibits self-starting capability at all azimuthal positions, signified by the positive static torque coefficient values**.**

INTRODUCTION

Wind Energy Conversion System: The wind is a free, clean, and inexhaustible energy source. It has served mankind well for many centuries by propelling ships and driving wind turbines to grind grain and pump water. . Interest in wind power lagged, however, when cheap and plentiful petroleum products became available after World War II. The high capital costs and the uncertainty of the wind placed wind power at an economic disadvantage. The days of cheap and plentiful petroleum were drawing to an end. People began to realize that the world's oil supplies would not last forever and that remaining supplies should be conserved for the petrochemical industry.

Vertical-axis wind turbines (or VAWTs) have the main rotor shaft arranged vertically. One advantage of this arrangement is that the turbine does not need to be pointed into the wind to be effective, which is an advantage on a site where the wind direction is highly variable. Also, the generator and gearbox can be placed near the ground, using a direct drive from the rotor assembly to the ground-based gearbox, improving accessibility for maintenance.

The key disadvantages include the relatively low rotational speed with the consequential higher torque and hence higher cost of the drive train, the inherently lower power co efficient , the 360 degree rotation of the aero foil within the wind flow during each cycle and hence the highly dynamic loading on the blade, the pulsating torque generated by some rotor designs on the drive train, and the difficulty of modeling the wind flow accurately and hence the challenges of analyzing and designing the rotor prior to fabricating a prototype.

Types of VAWT

Drag Devices: The wind literally pushes the blade. Drag devices are slow rotating and high torque machine with two or more scoops are used. They are high reliability low-efficiency power turbines.
Example: Savonius Turbine, Panemone turbine
Lift type VAWT: Uses lift generated by aerofoil-shaped blades to drive a rotor, high speed, and suitable for generating alternating current (AC) electricity. Require some external power source to start turning as the starting torque is very low.
Example: Darrieus H Rotor, Egg beater type

OUTCOME OF LITERATURE ANALYSIS

It is inferred that VAWTs are suitable for low speed and urban environment. The Darrieus Rotor is easy to design and fabricate and less cost. But its self-starting capability is less. Though Darrieus-rotors exhibit good power coefficient than conventional Savonius turbine, but the former rotor is characteristically limited due to its non-self-starting nature as opposed to the latter rotor which is always self-starting at any wind speed. This main drawback of

all Darrieus rotors has been addressed in the recent past and many authors have attempted to improve this property of Darrieus rotors through both experimentations and numerical simulations. In the recent years many hybrid VAWT designs have been proposed for making the oval shaped Darrieus rotor self-starting and Variable Pitch method was used. Present work is to increase starting capability by coupling the low cost Savonius turbine is in the axis of Darrieus rotor.

Proposed Model(Combined): Two Stage overlapping Savonius rotor is the most Efficient ,it allows the turbine to be started with wind from any directionbecause off setting the stages will ensure that one "one Bucket" is always in the direction of wind

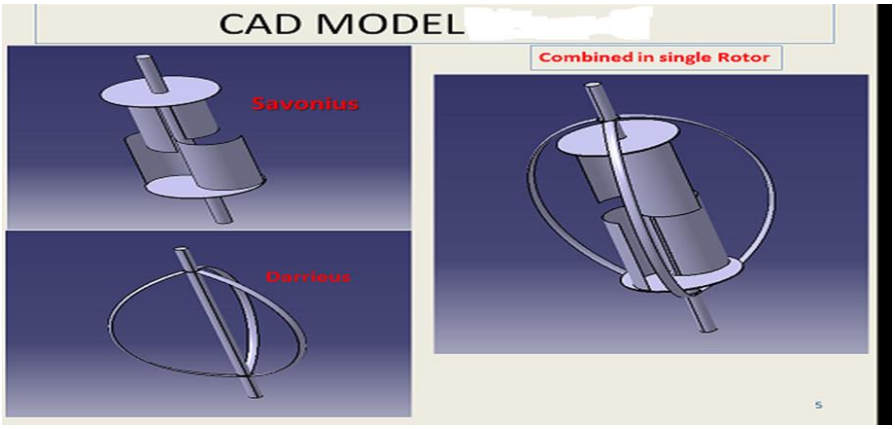
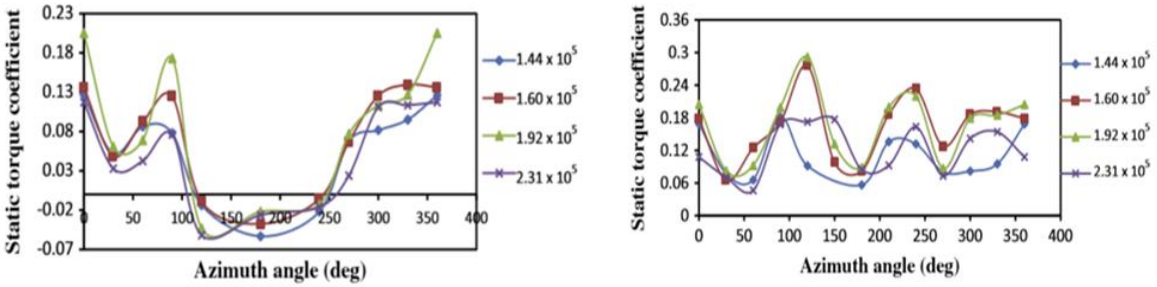


Fig 1 CAD Model of Savonius, Darrieus, Combined Turbine.

RESULTS AND DISCUSSIONS



Hybrid Darrieus Turbine **Simple Darrieus Turbine**

Fig 2 Static torque Co efficient vs. azimuth angle of Simple H Rotor at Reynolds no. 1.44x10^5(7.5m/s), 1.60x105(8.33m/s), 1.92x105(10m/s), 2.31x105(12m/s)

It is observed that for Some Degrees of Azimuth angle Darrieus Rotor Produces **negative Torque efficient**. So by Incorporating Savonius turbine in the same shaft this negative Torque will be eliminated.

It is found that the **hybrid design** fully exhibits self-starting capability at all azimuthal positions, signified by the positive static torque coefficient values.

CFD Analysis has to be done for further refinement of Result.

CONCLUSIONS

Since VAWTs show many specific advantages (compact design, easier connection to gears/generator, easier blade control if needed, lower fatigue.), it is important to check quantitatively and qualitatively of such turbines. The major objective of the present work is to improve the self-starting capability of H-rotor Darrieus turbine for wind energy conversion. The purpose of the present work was to design a VAWT rotor that possessed both self-starting and high power coefficient simultaneously. For improving its self-starting, the design was built into a hybrid mode with Savonius rotor. The performances of both the classes of rotors were compared at different Re.

ACKNOWLEDGMENT

The authors wish to express their gratitude to for their support to DrM. VenkataRamanan, Dr.R.Velraj Anna University, Chennai,

REFERENCES

Al-Hadhramil M. Performance evaluation of small wind turbines for off grid applications in Saudi Arabia. Energy Convers Manage, 81, 2014, 19–29.

Baker JR. Features to aid or enable self-starting of fixed pitch low solidity vertical axis wind turbines. Journal of Wind Engineering and Industrial Aerodynamics, 15, 2003, 369–80.
Biswas S, Sreedbardt BN, Singh YP, Dynamic analysis of a vertical axis wind turbine using a new wind load estimation technique. Computers and Structures, 65, 1997, 903–16.
Fang Feng,Dan Xu, Torque Characteristics Simulation on Small Scale Combined type VAWT.International Conference on Applied physics, 2012, 781-786.
Francesco, Feasibility analysis of a Darrieus vertical axis Wind Turbine installation in the Roof Top of a Building.Elsevier/Applied Energy, 2011, 921-929.
Gupta R, Sharma KK. Flow physics of a combined Darrieus–Savonius rotor using computational fluid dynamics (CFD). Int Res J EngSci, Technol Innovation, 2012, 1–13.