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EXPERIMENTED EXAMINATION OF DUAL-ROTOR WIND TURBINE WITH VARIABLE ROTOR SEPARATION

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Abstract

In a dual rotor wind turbine, the variable distance of separation has a great influence on the performance parameters including rotor speed, braking load, braking torque, power produced, and coefficient of power. In the present work, the focus has been made to study the effect of variable distance of separation to improve the performance of a dual rotor wind turbine in the controlled condition of variable wind velocity. The distance of separation ranges from 500 mm to 320 mm. The result figures out that the power produced by dual rotor wind turbine decreases for constant wind velocity with decreasing the distance of separation between two rotors. At 500 mm rotor separation, the power produced is 31.2 % more than that to the minimum separation of 320 mm. at minimum wind velocity of 2.5 m/s and at maximum wind velocity of 8 m/s, 500 mm rotor separation the power produced is 5.01 % more than the power at a minimum separation of 320 mm.

Keywords- BL-Braking Load, DRWT-Dual Rotor Wind Turbine.

I. Introduction

Conventional energy resources are in limited quantity which can destroy one day like petrol and diesel will abolish one day apart from this conventional energy resources may also affect the nature and human life negatively.[15] The environment is affected badly by the use of conventional energy resources. [1]As we see that day by day the number of automobiles increasing day by day[23], a large number of vehicle runs daily over the world which uses petrol and diesel the exhaust of which affect the nature badly. [2]

Apart from conventional energy resources, we have nonconventional energy resources as discussed above.[8] The main advantage of conventional energy resources is that they are not harming full for nature and human beings.[18],[19] But the main disadvantage of nonconventional energy resources is that utilization efficiency is low,[3] most of the research has been carried out in increasing utilization efficiency,[16],[17] still, much research is going on to increases utilization factor. [4],[9]

Wind energy utilization is also the major

process to convert energy from wind.[10] As we know that if the body moves with some velocity

(v) It consist of energy in the form of kinetic energy from the equation [11],[22]

$E=1/2(m*v^2)$

Where E=Kinetic Energy m=mass of object

v=velocity of moving object [12]

Thus the equation shows that wind has a certain amount of energy with itself if it is having a certain mass with some velocity. [4]In the present equation,[21] energy varies with the second power of velocity which means energy varies with a higher degree with the small variations of wind velocity. [20], [5]

In the experimental process fabrication of wind turbine with dual rotor assembly is made and then Torque,[13] Rotation of the rotor, and Power are calculated.[14] Listed parameters have been analyzed with different rotor separations for dual rotor wind turbines with variable separation of distance.[6],[7]

a) Rotation (RPM).
b) Breaking Load (BL).
c) Braking Torque(BT).
d) Power.
e) Coefficient of Power.

Set up for experimental analysis

Blade model on CATIA

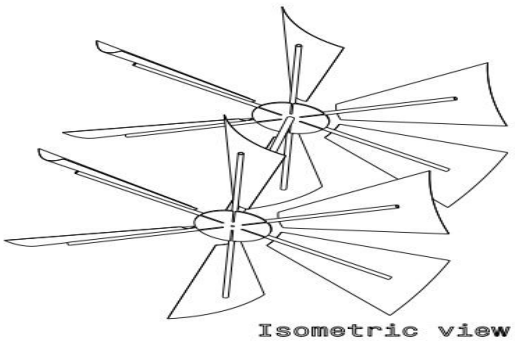


Figure 1 Isometric view of dual-rotor 6 blade assembly

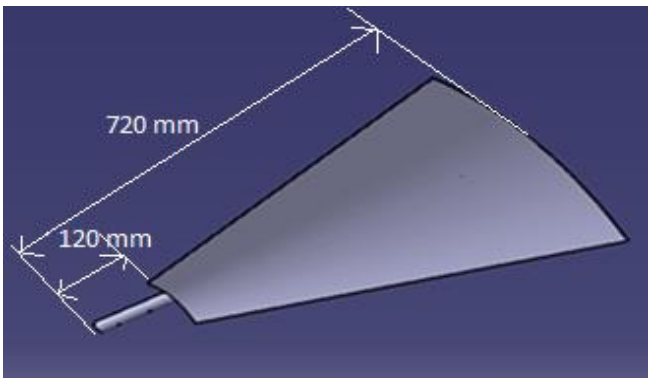
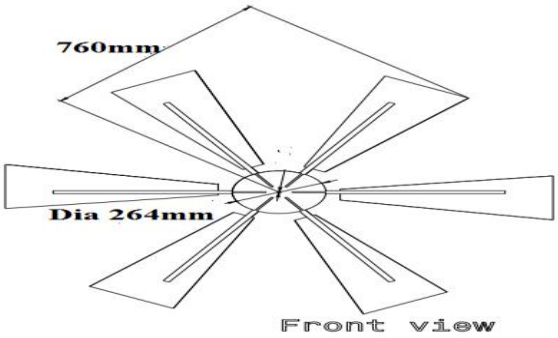


Figure 2 Single blade CATIA model



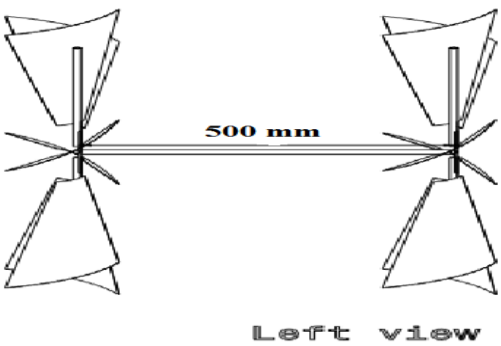


Figure 3(a), (b). Front view of the blade assembly.Side view coaxial shaft dual rotor.

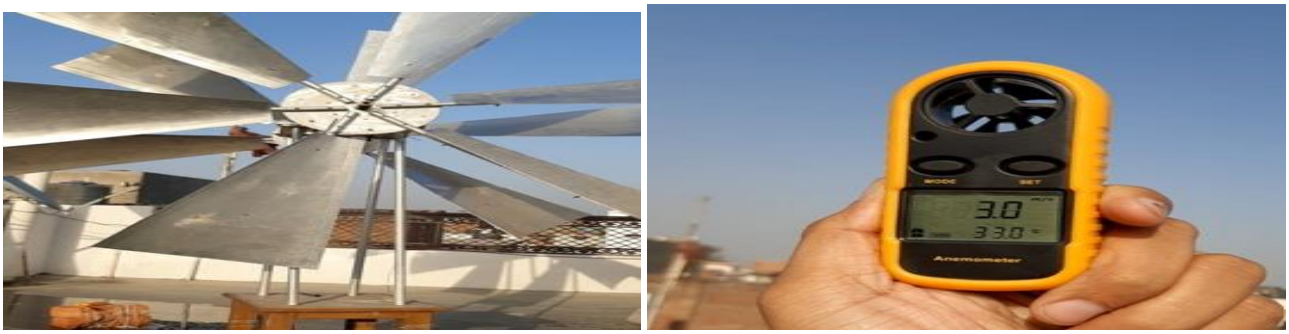


Figure.4(a) Side view of the real dual rotor assembly, (b) Anemometer wind speed and temperature measuring instrument.

Our main objective is to find out various parameter on DRWT with variable rotor separation distance. Blade tiltation is taken 45 degrees from vertical. Wind turbine radius 76 cm. The frontal area of the wind turbine 1.813 m^2.

Here from one side air at different velocities entered the single and then dual rotor due to which dual rotor rotates and with the conversion of wind energy into rotational energy of wind thus enhanced power extraction from wind energy takes place.

Figure 5. Real Dual rotor Wind Turbine.

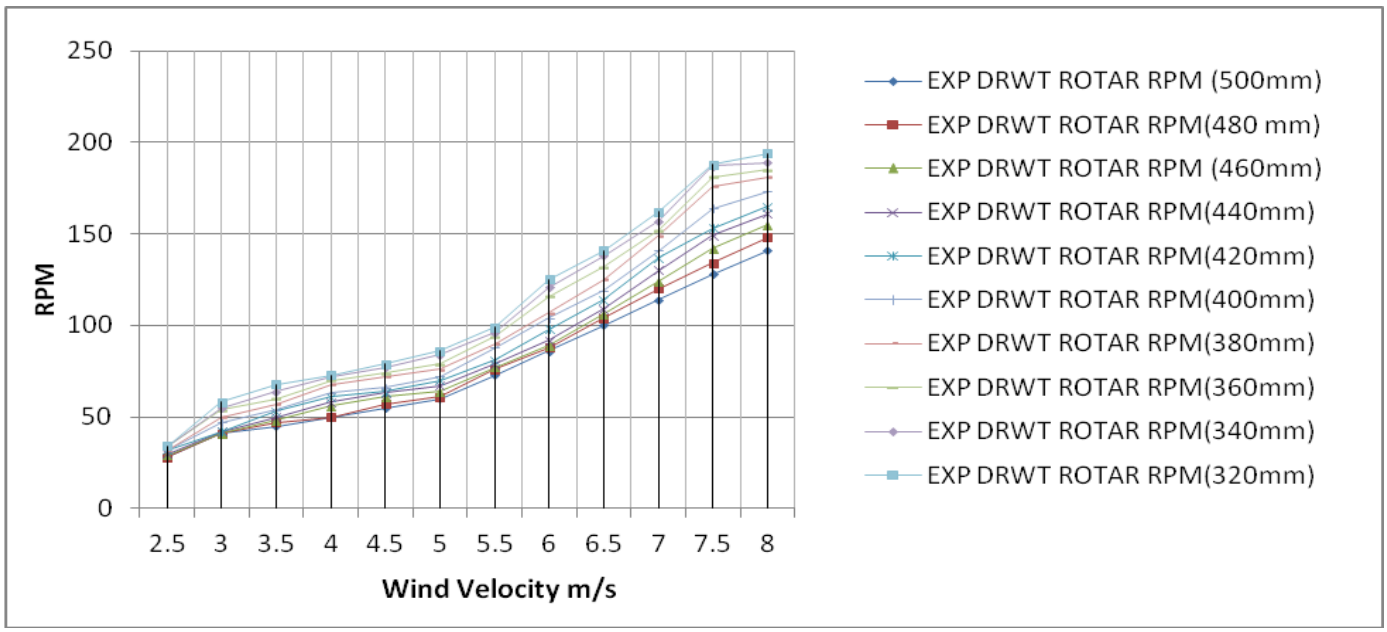
II. Result and discussion-

Dual rotor wind turbines have been analyzed experimentally in the controlled condition of wind turbines in which velocity varies from 2.5 m/s to 8 m/s.

Analysis of DRWT at variable rotor separation-

1. Experimented analysis for Rotor RPM

Graph 1

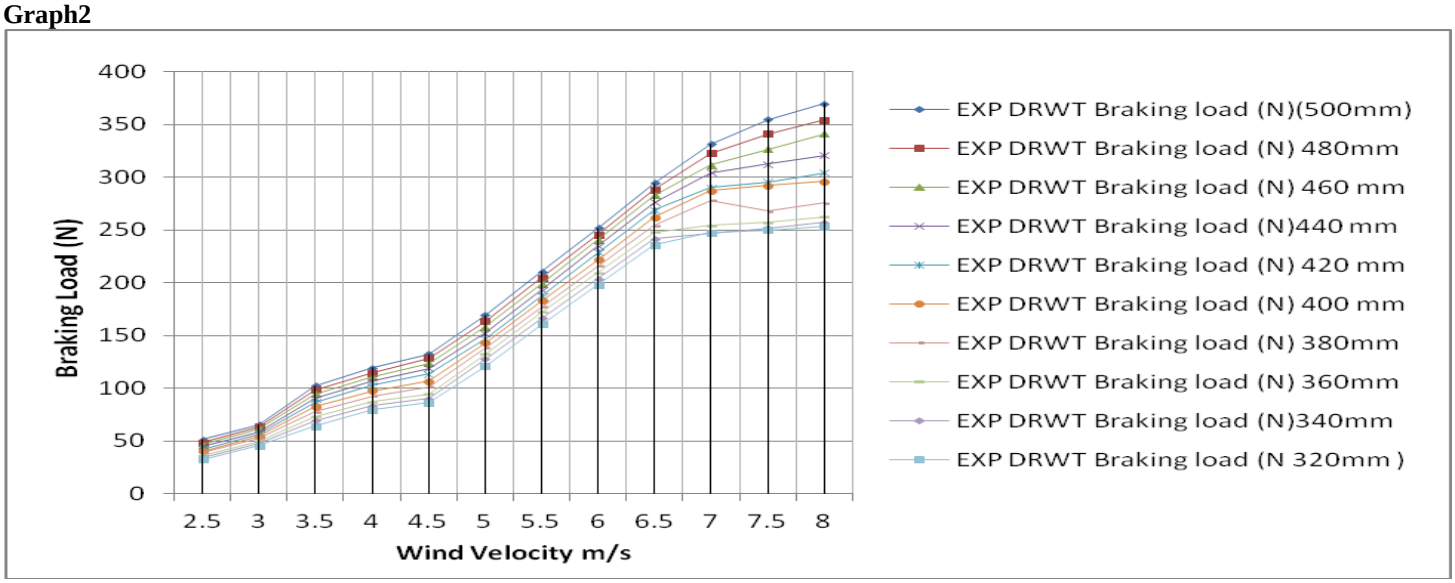


Explanation of Graph 1-The graph is plotted for the given table which was obtained after experimental analysis of DRWT with varying rotor separation by the segment of 20mm i.e. from 500 mm separation to 320 mm separation total 10 readings for DRWT have been considered for single wind speed. From the graph, it is observed that on decreasing the distance between rotor for

DRWT rotor RPM increases which is minimum at 500 mm separation and maximum at 320 mm rotor separation for single wind speed.

2. **Experimented analysis for BL**

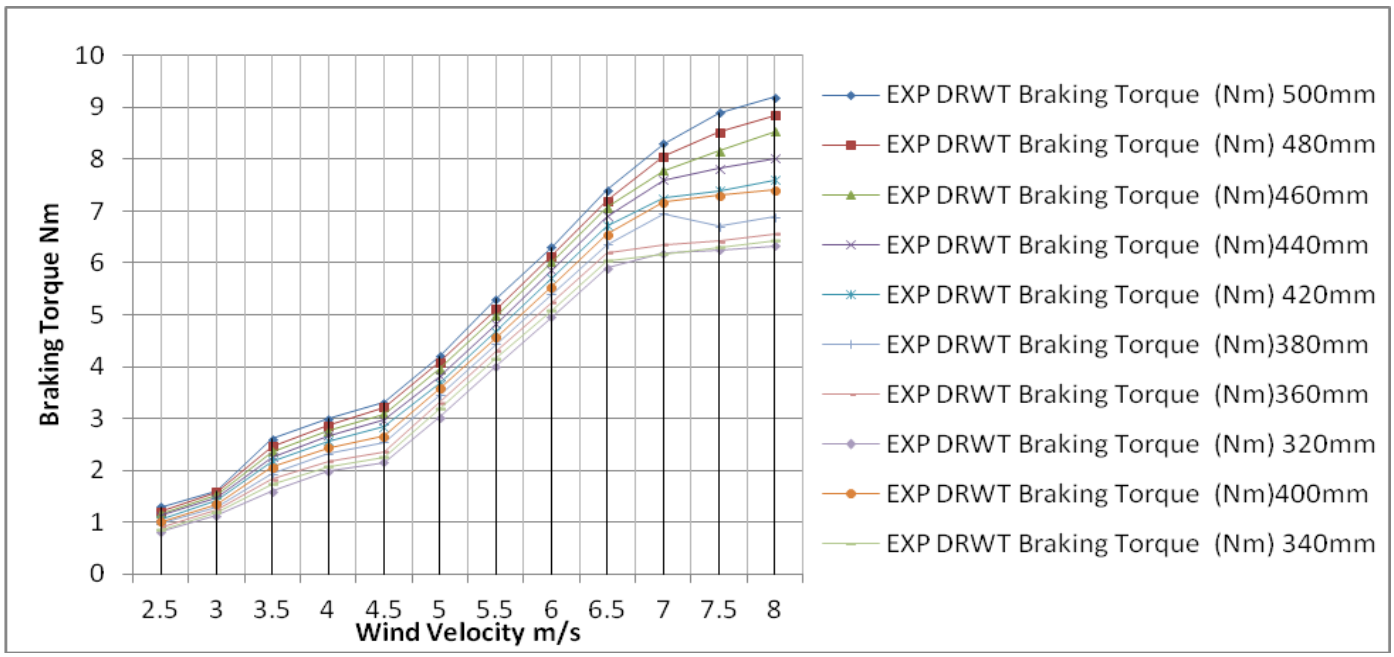
Graph2



Explanation of Graph 2-The graph is plotted for the given table which was obtained after experimental analysis of DRWT with varying rotor separation by the segment of 20mm i.e. from 500 mm separation to 320 mm separation total 10 readings for DRWT have been considered for single wind speed. From the graph, it is observed that on decreasing the distance between rotor for DRWT rotor BL decreases which is minimum at 320 mm separation and maximum at 500 mm rotor separation for single wind speed.

3. Experimented analysis for BT

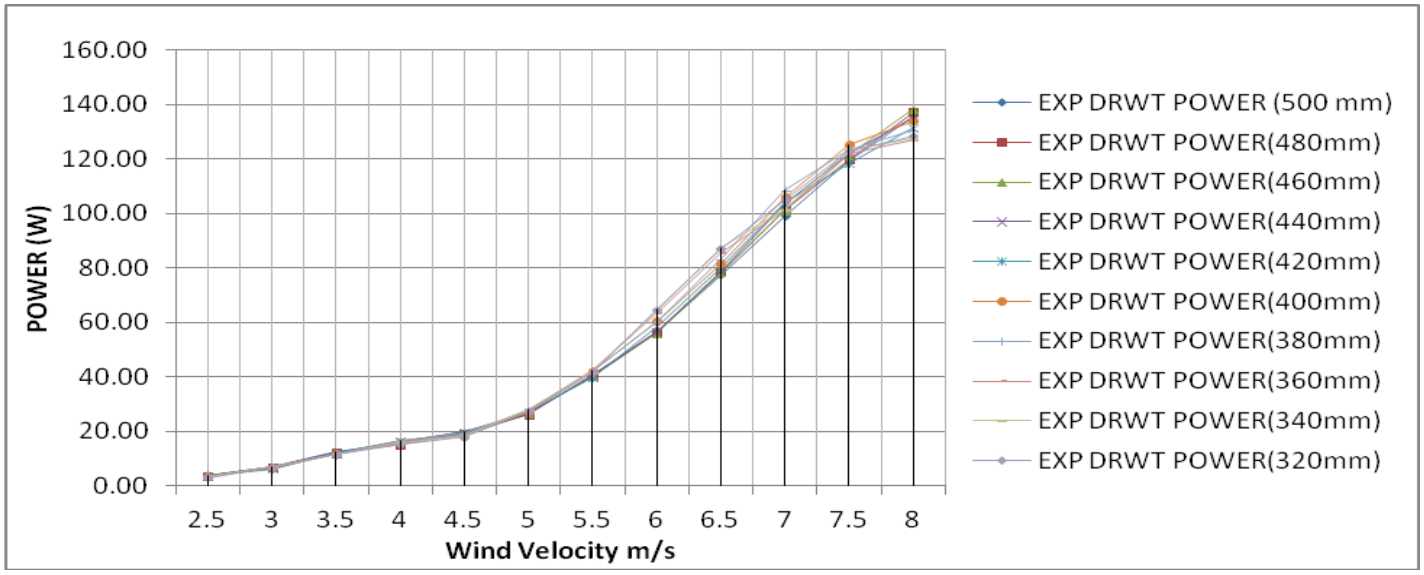
Graph 3



Explanation of Graph 3-The graph is plotted for the given table which was obtained after experimental analysis of DRWT with varying rotor separation by the segment of 20mm i.e. from 500 mm separation to 320 mm separation total 10 readings for DRWT have been considered for one single wind speed. From the graph, it is observed that on decreasing the distance between rotor for DRWT rotor BT decreases which is minimum at 320 mm separation and maximum at 500 mm rotor separation for single wind speed.

4. Experimented analysis for Power

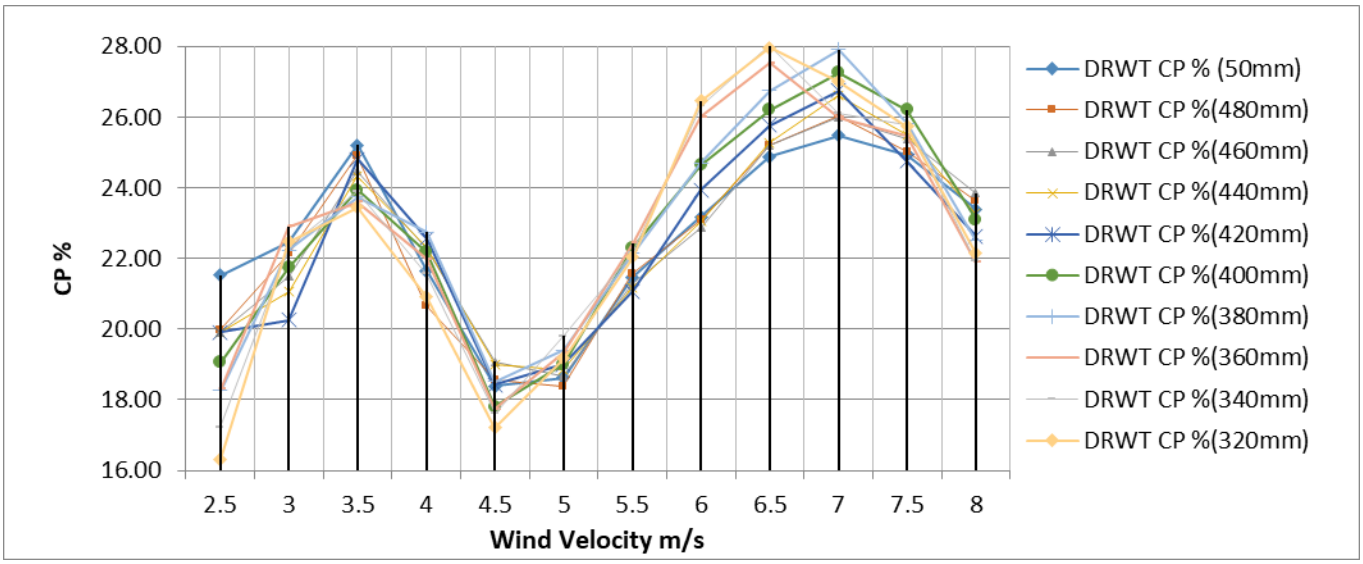
Graph 4



Explanation of Graph 4-The graph is plotted for the given table which was obtained after experimental analysis of DRWT with varying rotor separation by the segment of 20mm i.e. from 500 mm separation to 320 mm separation total of 10 readings for DRWT have been considered. From the graph, it is observed that on decreasing the distance between rotor for DRWT rotor Power decreases which is minimum at 320 mm separation and maximum at 500 mm rotor separation for single overall wind speed.

5. Experimented analysis for Cp

Graph 5



Explanation of Graph 5 - The graph is plotted for the given table which was obtained after experimental analysis of DRWT with varying rotor separation by the segment of 20mm i.e. from 500 mm separation to 320 mm separation total 10 readings for DRWT have been considered. From the graph, it is observed that on decreasing the distance between rotor for DRWT rotor coefficient of power decreases overall which is maximum at 500 mm and minimum at 320mm rotor separation for a minimum wind speed of 2.5 m/s and for a maximum wind speed of 8 m/s it is observed that value of power coefficient in a maximum of 23.8 % at 460 mm rotor separation and a minimum of 21.89 % for 360 mm of rotor separation.

III. Conclusion

1. The graph is plotted for the given table which was obtained after experimental analysis of DRWT with varying rotor separation by the segment of 20mm i.e. from 500 mm separation to 320 mm separation total of 10 readings for DRWT have been considered for single wind speed. From the graph, it is observed that on decreasing the distance between rotor for DRWT rotor RPM increases which is minimum at 500 mm separation and maximum at 320 mm rotor separation for single wind speed.

2. The graph is plotted for the given table which was obtained after experimental analysis of DRWT with varying rotor separation by the segment of 20mm i.e. from 500 mm separation to 320 mm separation total of 10 readings for DRWT have been considered

for single wind speed. From the graph, it is observed that on decreasing the distance between rotor for DRWT rotor BL decreases which is minimum at 320 mm separation and maximum at 500 mm rotor separation for single wind speed.

3. The graph is plotted for the given table which was obtained after experimental analysis of DRWT with varying rotor separation by the segment of 20mm i.e. from 500 mm separation to 320 mm separation total of 10 readings for DRWT have been considered for one single wind speed. From the graph, it is observed that on decreasing the distance between rotor for DRWT rotor BT decreases which is minimum at 320 mm separation and maximum at 500 mm rotor separation for single wind speed.

4. The graph is plotted for the given table which was obtained after experimental analysis of DRWT with varying rotor separation by the segment of 20mm i.e. from 500 mm separation to 320 mm separation total of 10 readings for DRWT have been considered. From the graph, it is observed that on decreasing the distance between rotor for DRWT rotor Power decreases which is minimum at 320 mm separation and maximum at 500 mm rotor separation for single overall wind speed.

5. The graph is plotted for the given table which was obtained after experimental analysis of DRWT with varying rotor separation by the segment of 20mm i.e. from 500 mm separation to 320 mm separation total of 10 readings for DRWT have been considered. From the graph, it is observed that on decreasing the distance between rotor for DRWT rotor coefficient of power decreases overall which is maximum at 500 mm and minimum at 320mm rotor separation for a minimum wind speed of 2.5 m/s and for a maximum wind speed of 8 m/s it is observed that value of power coefficient in a maximum of 23.8 % at 460 mm rotor separation and a minimum of 21.89 % for 360 mm of rotor separation.

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