



Effect of dust on the performance of wind turbines

by Aboelyazied M. Koliub and Mohammed G. Khalfallah
Desalination 209 (2007) 209-220

Abstract

An experimental investigation on the effect of blade surface roughness, due to dust accumulation, on the performance of wind turbines was performed. The development of the energy generating costs of wind turbines directly depends on the wind turbine output, which depends upon the characteristics of the turbine blades and their surface roughness. An important operating requirement that relates to a wind turbines airfoils are its ability to perform when the smoothness of its surface has been degraded by the dust. The effect of surface roughness of rotor blades due to accumulated dust on the blade surface of stall-regulated, horizontal axis 300 kW wind turbine was investigated. The mechanism of dust built up and accumulation on the blade surface of wind turbine was investigated, and the effect of operation period of wind turbine on the blade surface roughness intensity was investigated experimentally. Also, the quantity of dust accumulated on the blade leading edge; and the effect of changing dust area on blade surface were studied. Standard roughness in Hurghada site was chosen and put in various leading edge areas. The roughness area on blades was changed from 5 to 20% from the chord line towards the leading edge. The effect of dust on the performance of pitch-regulated 100 kW horizontal axis wind turbine was investigated. These results from pitch-regulated wind turbine were compared with 100 kW stall-regulated wind turbine.

Authors

Mohammed G. Khalfallah (3), Aboelyazied M. Koliub (3)

Tags

Pitch regulated (2)

The roughness area on blades was changed from 5 to 20% from the chord line towards the leading edge. The effect of dust on the performance of pitch-regulated 100 kW horizontal axis wind turbine was investigated. These results from pitch-regulated wind turbine were compared with 100 kW stal ...

Stall regulated (0)

... of its surface has been degraded by the dust. The effect of surface roughness of rotor blades due to accumulated dust on the blade surface of stall-regulated, horizontal axis 300 kW wind turbine was investigated. The mechanism of dust built up and accumulation on the blade surface of win ...

Wind turbine (3)

An experimental investigation on the effect of blade surface roughness, due to dust accumulation, on the performance of wind turbines was performed. The development of the energy generating costs of wind turbines directly depends on the wind turbine output, which depend ...

Performance (16)

An experimental investigation on the effect of blade surface roughness, due to dust accumulation, on the performance of wind turbines was performed. The development of the energy generating costs of wind turbines directly depends on the wind turbine output ...

Effect of dust (1)

An experimental investigation on the effect of blade surface roughness, due to dust accumulation, on the performance of wind turbines was performed. The development of the energy generatin ...

Conclusion

It is concluded that, the effect of dust accumulated on blade surface on the performance of horizontal axis wind turbines depends on the specifications of the rotor turbine, speed of rotor, the altitude of nacelle from the ground and the type of power-regulation (pitch or stall). Also, the specifications of wind farm site play an important role on the accumulation and built-up of dust on the blade surface of wind turbines. Whereas, the height of nacelle and rotor RPM in pitch regulated turbine were higher than stall-regulated one, the effect of dust on the performance of pitch-regulated wind turbine is low. With growing dust on the surface of wind turbine blades, the drag force of the airfoil increases, but the lift force decreases diminish- ing the power output of the turbine. Also, the dusting on the rotor's blades of horizontal axis stall-regulated wind turbines may lead among others to long time stops without no production due to heavy accumulated dust and safety demands, decreased power production and maintenance costs. The drag power loss in airfoils of wind turbines sections depends on the surface roughness of blade types of airflow, attack angle and geometry of blade airfoils. The blade surface roughness due to site dust depends upon the climate parameters as wind speed, number of sandy storms in each month, wind direction, relative humidity, and blade specifications. There are some factors that can not be controlled like climate factors, but other factors may be controlled as the blade surface roughness during manufacturing process and site surface roughness index. Also, some manufactured and petroleum vapors in near wind farm site especially in Zafarana may be affect the mechanism of accumulation of dust particles on wind turbines blades surface. Generally, it is concluded that the blade surface roughness of wind turbines is increasing in desert sand roughness index sites due to accumulation of the dust. The blade surface roughness reduces the effectiveness of the airfoil to extract the useful power from wind and also leads to decreasing the power output of turbines. The extent to which roughness affects airfoil performance is dependent on the nature of the roughness, its size relative to the boundary layer thickness, the Reynolds number and the airfoil type.

Source: <http://www.desline.com/articoli/7527.pdf>

Find this paper on ScienceDirect

Key issues in Seawater Desalination

Seawater Intake

Desalination Pretreatment

- Chlorination
- Dechlorination
- Chlorinator system

Desalination Post-treatment

- Boron Removal

