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Acquisition of electrical power using synchronous generators at the Universidad Politécnica De Victoria

Obtención de potencia eléctrica a través de generadores síncronos en la Universidad Politécnica De Victoria

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Abstract

The lack of use of renewable resources, in terms of wind energy, at the Polytechnic University of Victoria has been unnoticed. Specifically, the implementation of wind power systems leads to the formulation of a hypothesis that proposes the use of wind currents at levels lower than 5 meters above ground level between the buildings of the university to provide electrical power through 400 Watts wind generators. The methodology includes the acquisition of official plans of the university, delimitation of the study areas, collection of wind speed data, the analysis of the information obtained and installation of the wind generator that allows carrying out its operation in practice. The main result will be the use of available renewable resources to generate clean energy, reduce dependence on hydrocarbons, thus contributing to energy sustainability.

Sustainability, Wind Generator, Renewable Energy

Resumen

El poco aprovechamiento de los recursos renovables, en materia de energía eólica en la Universidad Politécnica de Victoria ha pasado desapercibido. Específicamente la implementación de sistemas eólicos, ha dado paso a la formulación de una hipótesis que plantea el aprovechamiento de las corrientes eólicas a niveles inferiores a 5 metros de altura sobre el nivel del suelo entre las edificaciones de la universidad para proporcionar potencia eléctrica mediante generadores eólicos de 400 Watts. La metodología comprende la adquisición de planos oficiales de la universidad, delimitación de las áreas de estudio, recopilación de datos de velocidad de viento, el análisis de la información obtenida e instalación del generador eólico que permita llevar a la práctica su funcionamiento. El principal resultado será el aprovechamiento de los recursos renovables disponibles para generar energía limpia, reduciendo la dependencia de los hidrocarburos contribuyendo así a la sostenibilidad energética.

Sostenibilidad, Generador Eólico, Energía Renovable

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Introduction

Population growth and the increase in the consumption of inputs per individual has driven an accelerated increase in the demand for natural resources, both renewable and non-renewable, attributable to technological development, causing global climatic changes such as the unusual warming generated in the last 150 years due to greenhouse gases, and this process will certainly accelerate in the coming decades. In the current scenario, it is necessary to initiate actions to adapt to the new climatic conditions, given the high vulnerability of various sectors such as forests, agriculture and mainly water, which will be the most affected by temperature increases of between 2°C and 4°C at the end of the century, with a predominance in the northern part of the country (Mexico). The best way to prevent a climate disaster is to resort to preventive, adaptive and mainly participatory strategies (Magaña, 2007).

Currently, the accelerated rate of consumption of fossil fuels and depletion of natural resources for energy production have generated negative consequences not only for a nation but for the whole world, where the signs of deterioration are already visible due to the high levels of environmental pollution resulting from the high concentration of 〖CO〗 _2〗 _2 (Santaló, 2009). It follows that the use of smaller-scale generators can be considered ideal for supplying electricity to low-demand systems. Generation can be increased by including more devices in the collection network. Therefore, the use of wind currents at levels below 5 meters between the buildings of the Polytechnic University of Victoria that have sufficient speed to provide power according to the prevailing wind currents by means of a 400 Watts wind generator is analysed in the present work.

Based on these considerations, wind energy is prioritised because of its abundance at the Victoria Polytechnic University. The university can take advantage of its large surface area and use one of the least environmentally degrading technologies by employing a synchronous generator. Although these generators do not compete with those used by large industries, they may well represent a contribution for those places where it is easy to install and adapt to local needs due to their tiny dimensions.

Methodology to be developed

The study area is located within the Tecnotam Park in Ciudad Victoria Tamaulipas in the area corresponding to the Polytechnic University of Victoria, which has seven irregular hectares of land within which there are already existing buildings and future construction projections. However, there are still available spaces and/or the roofs of the built structures for the implementation of small wind farms. On the other hand, a 400W 12/24V permanent magnet synchronous generator was used, of which there is a prototype for installation and wind speed sensors.

In the elaboration of the research project, quantitative methods are used, derived from the quality that the methodology demands in terms of reliability and veracity of the data, especially those that were recorded at the site where the experiment was carried out. Tests were carried out in the different areas of a structure consisting of a tripeé reinforced with a 2" tubular base with the capacity to house in its interior 2 extensions of smaller diameters respectively one of the other in order to have a structural element that allows easy transfer and installation in different areas without affecting the infrastructure of the university as shown in image 2.

Figure 1 Selection of possible data collection and experimentation areas in yellow circles

Figure 2 Design in Solidworks and prototype developed

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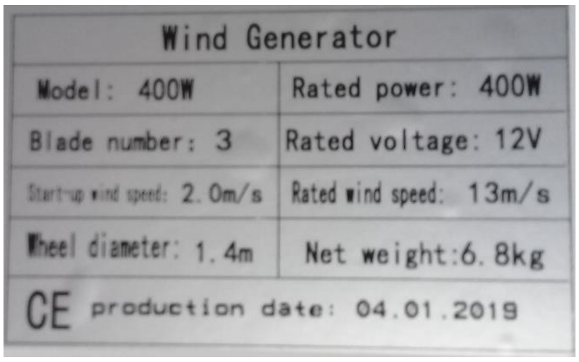


Figure 3 Generator data sheet

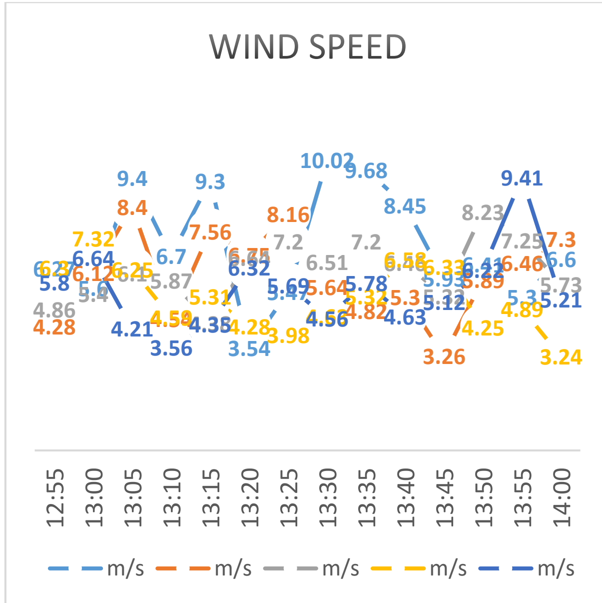
Results

The generator manufacturer states a nominal working wind speed of 13m/s (Figure 3) equivalent to 46.8km/h, and the excess effort was characterised by a speed of 60km/h or 16.6m/s, giving a difference of 3.6m/s.

Wind speed data was collected taking into consideration the maximum value captured by the instrument during a sample period of one minute reading for every five minutes of sampling. Table 1 shows the data collected from various samples taken on different days within an approximate time span of one hour during daylight hours. Graph 1 shows a trend in the fluctuations of the velocities oscillating between values between 3m/s and 10m/s, so that the intermediate gusts have the necessary values to maintain the operation of the device in optimal conditions.

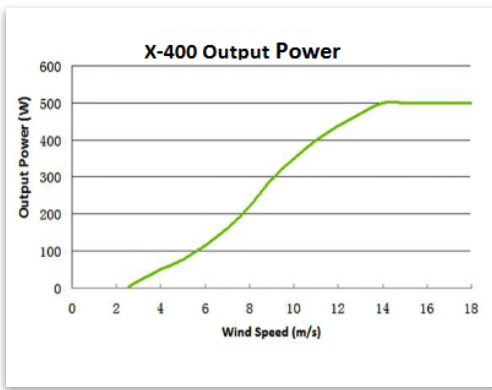
Time	m/s	m/s	m/s	m/s	m/s
12:55	6.27	4.28	4.86	6.3	5.8
13:00	5.6	6.12	5.4	7.32	6.64
13:05	9.4	8.4	6.1	6.25	4.21
13:10	6.7	4.54	5.87	4.59	3.56
13:15	9.3	7.56	4.38	5.31	4.35
13:20	3.54	6.75	6.64	4.28	6.32
13:25	5.47	8.16	7.2	3.98	5.69
13:30	10.02	5.64	6.51	4.63	4.56
13:35	9.68	4.82	7.2	5.32	5.78
13:40	8.45	5.3	6.46	6.58	4.63
13:45	5.93	3.26	5.32	6.33	5.12
13:50	6.41	5.89	8.23	4.25	6.22
13:55	5.3	6.46	7.25	4.89	9.41
14:00	6.6	7.3	5.73	3.24	5.21
Promedio	7.05	6.03	6.23	5.23	5.54

Table 1 Random sampling of velocities at one-hour intervals



Graphic 1 Cumulative values of maximum speed ranges from 3m/s to 10m/s.

It is estimated that a 400W generator will be able to operate and supply an electrical load, as its technical data sheet has a start-up speed of 2m/s. Comparing the risk speeds of the device and the maximum speeds in optimal climate conditions, it is determined that the generator is within the acceptable operating ranges.



Graphic 2 Power output by speed range

Figure 5 Location of wind direction mostly predominantly northeasterly

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The average speed is around a maximum of 7m/s and the maximum bursts up to 10m/s, so the available power is between 150W to 350W as shown in Graphic 2. From the tests carried out we can see that from 13m/s onwards the operation is risky, as the maximum power (400W) is at 11m/s, which is a higher value than the readings captured in the area under study.

Acknowledgement

Thanks are due to the Polytechnic University of Victoria for the support provided to carry out the measurements, installation and testing of the generator in the different work areas.

Conclusions

In situ tests were carried out taking into consideration wind speed parameters, which made it possible to determine the speeds of the currents that predominate mainly in a north-easterly direction during different periods of the year. From the tests, a constant wind speed of over 60km/s was determined, which means that both the structure and the generator itself are at risk of fracturing the rotor blades. However, these must be sustained gusts, which is unlikely to occur for a prolonged period of time, except in the case of larger natural phenomena.

The wind generator by itself and with the existing average wind values has the capacity to start its operation without inconvenience, which makes it feasible to feed a battery bank and to be isolated or interconnected to the electrical grid. This type of alternative energy adaptations are of utmost importance both for the region and globally, so it should be considered appropriate to take advantage of local conditions, and thus make contributions to mitigate climate change, which has been an important factor to consider in the near future.

References

Méndez, M. (2007). Valoración de un parque eólico con opciones reales. (P. U. S.A.España, Ed.) España

Santaló, J. M. (2009). La generación eléctrica a partir de combustibles fósiles. México, México.