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Generation of Electricity by Utilizing Mine Exhaust Air

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ABSTRACT

The energy demand of the world has become unbridled. With increase in energy demand, the conventional sources of energy (fossil fuels, nuclear) are encumbered with monumental pressure and hence, if use of this continual then it leads to deficiency of fossil fuels. This has provoked extensive research into the area of non-conventional energy sources like hydro, wind, thermal energy, etc. In recent years the scientific and public awareness on environmental and energy issues has brought in major interests to the research of advanced technologies. This paper deals with the production of energy by using mine exhaust air. The exhaust air from the mine is using as motive force to rotate the wind turbine. The wind turbine is placed accurately Infront of the exhaust air. The exhaust air from mine which was captured by exhaust fan expels on the wind turbine. The kinetic energy of air converts into the electrical energy.

KEYWORDS: ***Mine exhaust fan, wind turbine, ventilation.***

I. INTRODUCTION

Energy plays a crucial role in modern societies. It has a vital input to all sectors (e.g., residential, transportation, and manufacture) and is essential to generate electricity. In other words, all societies require energy services to meet basic human needs such as lighting, heating, and mobility. Thus, energy is not just a regular commodity, rather it is a strategic one and is the lifeblood of today's civilization. In the last several decades the world was heavily dependent on coal, oil, and natural gas to meet its energy needs. To be sure, these fossil fuels still dominate the energy mix in most countries today and are projected to continue this domination in the foreseeable future.

Renewable energy comes from sources or processes that are constantly replenished. These sources of energy include solar energy, wind energy, geothermal energy, and hydroelectric power. If use of this continual then it leads to rapid depletion of natural resources and fossil

fuels. The rapid depletion of natural resources and fossil fuels has led to the development of alternative sources of energy. This paper mainly focused on production of energy by utilizing mine exhaust air.

II. METHODOLOGY

MINE VENTILATION FANS

Mine ventilation fans provides a flow of air to the underground workings of a mine of sufficient volume to dilute and remove dust and noxious gases (typically No_2, so_2, methane, co_2 and co) and to regulate temperature. The source of these gases is equipment that runs on diesel engines, blasting with explosive, and the orebody itself. Sufficient volume of air is required for proper ventilation. A bulk of electric power is required for driving fans. By installing variable speed control air quantity can be optimized hence the power. The main mine ventilation fan is installed at surface. Centrifugal fans deliver low quantity of air at higher headswhereas assail flow fans deliver large quantity of air at lower heads. The exhaust air energy from mine ventilation fans installed at surface can be used to drive wind turbines to generate electricity.

WIND TURBINE

A wind turbine turns wind energy into electricity using the aerodynamic force from the rotor blades, which work like an airplane wing or helicopter rotor blade. When wind flows across the blade, the air pressure on one side of the blade decreases. The difference in air pressure across the two sides of the blade creates both lift and drag. The force of the lift is stronger than the drag and this causes the rotor to spin. The rotor connects to the generator, either directly (if it's a direct drive turbine) or through a shaft and a series of gears (a gearbox) that speed up the rotation and allow for a physically smaller generator. This translation of aerodynamic force to rotation of a generator creates electricity.

EXPERIMENTAL SET UP

An integrated experimental set-up is developed consisting of a 3-bladed fan. It acts as an exhaust fan, which is the source of air stream. A 3-bladed fan which act as a wind turbine. The turbine across the exhaust air is installed to harness the discharged air for electric power generation. Exhaust air is used as a motive force to rotate the wind turbine. The LED light will glow when the wind turbine rotates, by this energy is produced. Hence the kinetic energy of the exhaust fan is converted into electric energy.

The regulatoris used to control the speed of the exhaust fan in (rpm). The speed of the exhaust fan and wind turbine was measured with the tachometer and the velocity of the exhaust fan is measured with the anemometer anda multi-meter is used to measure the voltage and current in in wind turbine. Electric power is calculated by multiplying the voltage and current. The wind power is calculated from the relationship $P = \frac{1}{2}(Cp * \varrho * A * v^3)$, Where ϱ is the density of air, A is the swept area of rotor blades, V is the velocity of wind m/sec, Cp is the capacity factor lies between 0.35 and 0.45. In this paper The air density is assumed as1.0 kg/m3 and Cp is assumed as 0.40.

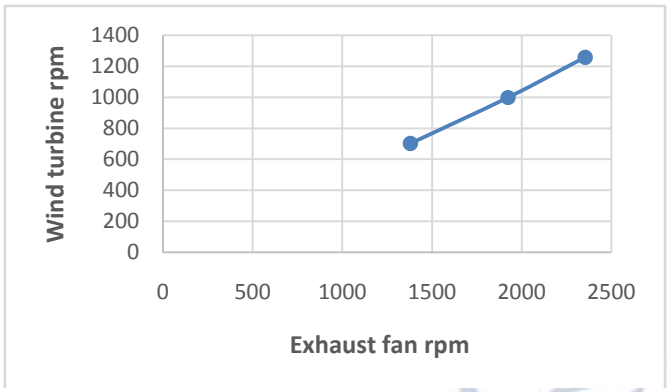
III. RESULT AND DISCUSSION

Table 1. calculation

S. NO	fan rpm	turbine rpm	Voltage in wind turbine generator (measured)	Current in wind turbine generator (measured)	Wind velocity (m/sec)	% of slip b/w fan and turbine	Wind power	Electric power
1	1380	701	3	3.98	6	49.20	0.570	0.011
2	1925	998	3.4	15.5	8.7	48.15	1.738	0.052
3	2355	1258	4.1	28.1	9.7	46.58	2.409	0.115

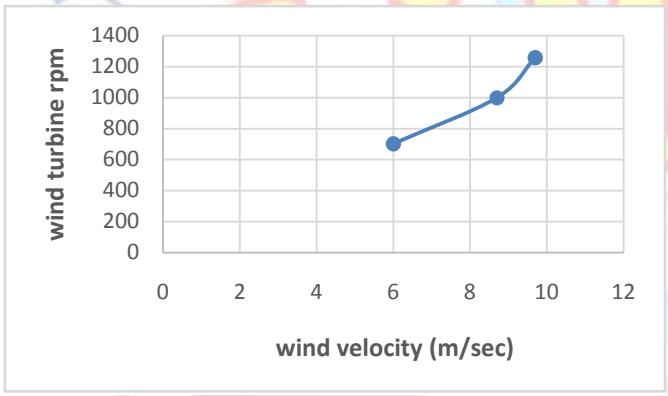
By calculating considering the turbine rotor area is 0.0132 and considering air density is 1.0 and capacity factor is 0.40. These values are used in calculation of wind power which was represented in Table 1.

The analysed results are represented graphically:



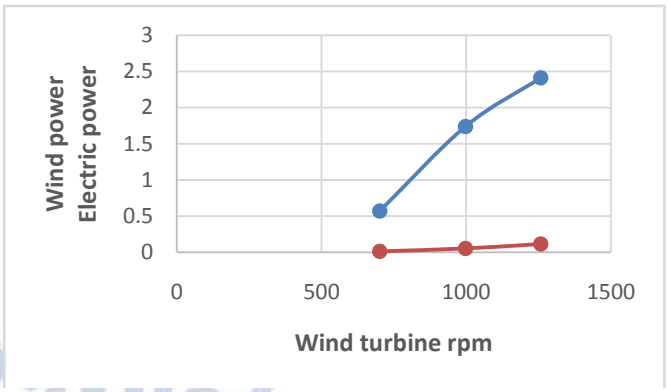
Graph.1 comparing exhaust fan rpm and wind turbine rpm

From above Graph.1 it is observed that when the exhaust fan rpm increases then the wind turbine rpm also increases. When the exhaust fan speed is 1380rpm, then the wind turbine rotates at 701 rpm. As the exhaust fan speed increases to 1925rpm then the wind turbine speed increases to 998rpm. Similarly, when exhaust fan speed increases to 2355rpm then the wind turbine speed increases to 1258rpm.



Graph. 2: comparing wind turbine rpm and wind velocity

From above Graph.2 it is observed that as the wind velocity increases then the wind turbine rpm also increases. When the velocity of wind is 6m/sec, then the wind turbine rotates at 701 rpm. As the wind velocity increases to 8.7m/sec then the wind turbine rotates at 998rpm. Similarly, when wind velocity increases to 9.7m/sec then the wind turbine speed increases to 1258rpm.



Graph.3: comparing the wind power and electric power with the wind turbine rpm

From above graph observed that as the wind turbine rpm increases then the wind power and electric power also increases. When the wind turbine speed is 701rpm then the wind power and electric power generated is 0.570w and 0.011w respectively. As the wind turbine speed increases to 998rpm then the generation of wind power and electric power increases to 1.738w and 0.052w respectively. Similarly, sas wind turbine speed increases to 1258rpm then the wind power and electric power generation increases to 2.409w and 0.115w respectively.

IV CONCLUSION

Energy plays a key role in modern societies.All societies require energy services to meet basic human needs such as lighting, heating, and mobility. It has a basic input to all the sectors and is essential to generate electricity. In this paper energy is produced by using the mine exhaust air. In this experimental set-up is done and readings are measured from it. Based on measured readings the wind power and the electric power are calculated. As the rpm of the exhaust fan increases then the wind turbine rpm increases, simultaneously power generated in wind turbine increases. By this kinetic energy of the wind is converted into the electric energy.

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