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DESIGN OF VERTICAL AXIS WIND TURBINE DRIVEN BELT CONVEYOR SYSTEM

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Abstract – *Conveyor system is a part of material handling system .which is used for transportation of material. the main application of conveyor system is for transportation. There are many types of conveyor system are there and we have various needs by them like mining, power generation port systems, grain handling etc. Though these conveyors have numerous advantages they also require huge amount of power to drive belts. As the result of increased fuel prices in global markets and scarce of fuels electricity tariff is increasing tremendously. By using vertical axis wind turbine to drive these belts we can save huge amounts of electrical energy / money as well as reduce greenhouse gas emission.*

Key Words: conveyor, Shaft, gears, bearings, vertical axis wind turbine

1. INTRODUCTION

The device which converts wind's kinetic energy in to electric energy is known as wind turbine [1]. These wind turbines are mostly used for generation of electricity [2]. The generated electricity stored in the form of batteries. There are two types of wind turbine namely vertical axis wind turbine and horizontal axis wind turbine [3].in vertical axis there are two types namely VAWT savonius and VAWT darrieus. With the help of wind turbine we can draw water from underground levels. With the help of wind turbine we can run conveyor system. Conveyor system it is a part of material handling. It is used for the transportation of materials from one place another place. Though conveyor require electric energy to run, we can make conveyor run by using wind turbine, this can be done using gear mechanism between conveyor and wind turbine. By this we can say that direct energy transformation takes place i.e. from mechanical energy to mechanical energy

2. Methodology:

2.1 Fabrication of "vertical axis wind turbine"(VAWT) driven belt conveyor System:

First we have to fabricate the vertical axis wind turbine and next conveyor system.

2.2 Preparation of angles:

- To prepare the wind turbine we take the angles.
- Angles are used to support the wind turbine
- The material used is mild steel
- The angles are fabricated using cutting machine
- The length of angles 4*1000mm
- The length of angles 4*1200mm
- The grinding work is done on particular bases.

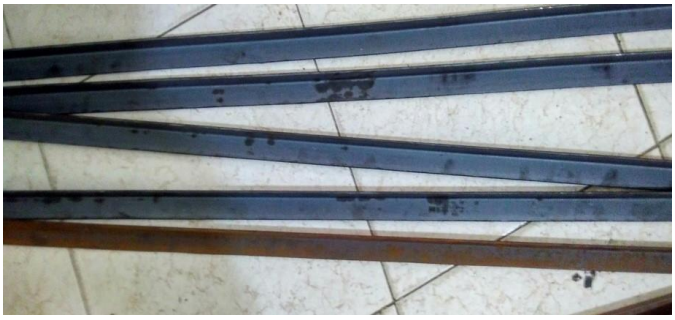

Fig -1: Angles

2.3 Preparation of flats:

- The material used in preparation of arm is mild steel
- The arms are in flat shape
- The length of arms are 375mm*12nos, width 17mm, thickness 3mm
- This whole operation is done using cutting machine
- Grinding work is done on particular bases.

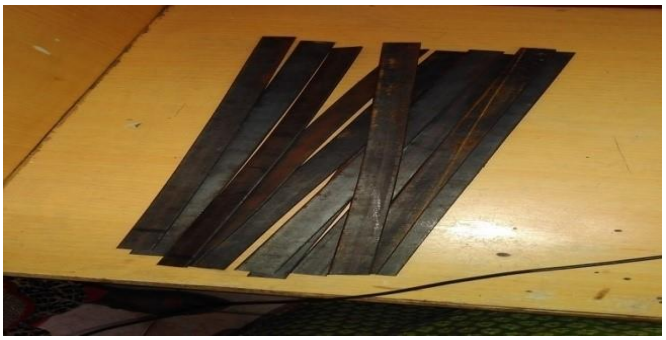

Fig -2: Flats

2.4 Preparation of fan blades:
Turbine Blade:

A wind turbine is a rotary engine that extracts energy from the flow of wind. The simplest turbines have one moving part , a rotor assembly, Which is a shaft with blades attached. Wind energy acts on the blades, or the blades react to wind, so that theyrotate and impart energy to the rotor.

- Blades are made of fibre material
- Blades are taken according to the dimensions length(6*700mm), width (6*30.25mm)
- cutting process and grinding process is done
- Movable blades are made in VAWT.

Fig -3: blade

2.5 Preparation of bevel gear, Bearings:

BEVEL GEAR: These gears have teeth cut on a cone instead of a cylindrical blank[4] . They are used in pairs to transmit rotary motion and torque where the bevel gear shafts are at right angles to each other.

Pedestal Bearing: An independent support for a bearing, usually incorporating a bearing housing.

Sleeve Bearing: A machine bearing in which the axle or shaft turns in a sleeve that is often grooved to facilitate distribution of lubricant to the bearing[5].

- The type of gear used is Bevel gear.
- The gear ratio is 1: 1.6
- The life span of bearing is 20 years.

The type bearing used in VAWT is sleeve and pedestal bearng.

Fig -4: Bevel gear

2.6 Fabrication of belt conveyor system :
Idlers:

Idlers are an important component in any conveyor system as they are used to support the onveyor belt and the load carried on the belt.Idlers are the low friction sliding surface over which an endless conveyor belt is dragged by the dive pulley enabling a conveyor to operate for many thousands of hours without wearing out the belting.

- Return idlers and carrying idlers are used to carry the bulk material in conveyors.
- Wooden idlers are used in this project.
- Rexine belt is used in belt conveyorto to carry the bulk material.
- The conveyor can carry up to 12kgs of bulk material.

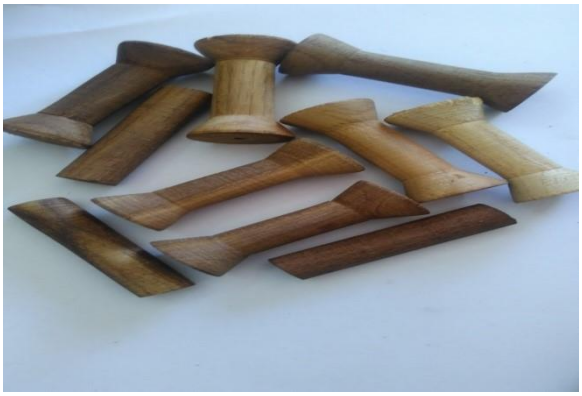

Fig -5: Return and carrying idlers

2.7 OVERALL FABRICATION OF VAWT DRIVEN BELT CONVEYOR SYSTEM:

Vertical axis wind turbine, where the main rotor shaft is set transverse to the wind while the main component is located at the base of the turbine. This arrangement allows the gear box to be located close to the gorund, facilitating service and repair.When the wind turbine starts rotating, the gear box also rotates which inturn moves the belt conveyor which is directly connected to it.

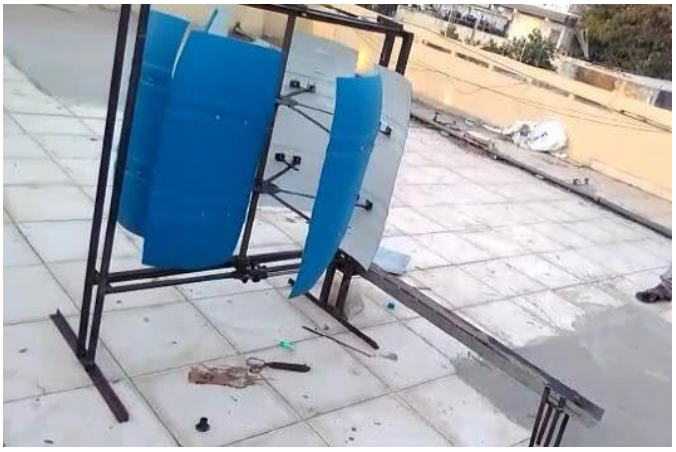

Fig -6: assembly design

3. Calculations of vertical axis wind turbine driven belt conveyor system:

3.1 Theoretical Calculation

3.1.1 Conveyor basic data:

- Operator and capacity of the conveyor = 10kgs.
- Design margin = 20%.
- Total capacity of the conveyor=12kgs.
- Type of material being to handle= Rice and coal.
- Speed of the belt is 1.25meter/ min.
- Drive pulley radius = 20mm.

3.2 Belt conveyor calculation:

Area of the conveyor:

Flow rate (q) = Area *velocity

Flow rate (q) = volume/ time

= (mass/ density)/ time

= 12/ 800*60

(q) = 0.00025

Flow rate (q) = area *velocity

0.00025 = area* 1.25

Area = 0.0002 m^3

Area = 200mm^2

Therefore the area of the conveyor is 200mm^2

The power is used by the conveyor is 30 watts

3.3 calculation for drive pulley

The diameter of the drive pulley is 40mm

Area of the drive pulley = πD

= 3.14*40mm

= 125.6mm

Velocity of the conveyor = design margin *area

= 20*125.6

= 2.512meter/ minutes

Velocity of the wind turbine = 1.4 meter/ min

3.4 calculation for the idlers

Total area for the idler A= 714mm^2

3.5 conveyor calculations:

Mass of carrying idlers = 9*40(gm) = 0.36kg

Mass of return idlers = 9*30(gm) = 0.27kg

Mass of pulleys = 100gm+50gm=150gm

= 0.15kg

Mass of belt = 100gms =0.1kg

Mass of material on belt = 2.22kg

Coefficient of friction (e) = 3

Gravity (g) = 9.81m/sec^2

Force (f) = c*Rotating mass +mass of belt + mass of material*9.81

= 3*(0.78+0.1+2.2291)*9.81

= 91 N-M

3.6 Wind turbine power calculations:

Nominal power required (P_{nom}) = 10 watts

(To drive conveyor)

Efficiency = 90%

Power coefficient (c_p) = 0.35

Nominal wind speed (V_{nom}) = 3.3m/s

Power in air = P_{nom}/efficiency

= 10/90%

= 11.11

Air density at sea level = 1.25kg/m^3

Turbine radius (R)

= $(2*P_{air}/3.14*density*c_p*V_{nom}^3)^{1/2}$

= 0.67mts

Radius considered = 0.78mts which is higher than Required

Hence windmill fabricated is capable of force.

Force = C*Rotating mass + mass of belt + mass of material*9 = 91

Speed of belt =2*3.14*(20/1000)*20*1.5/60

= 0.0628m/s

Power = force *velocity

= 91*0.0028

= 5.73Watts

Considering 50% of design margin

Power = 5.73*1.5 = 8.6 watts

4. CONCLUSIONS

When Tested the VAWT is able to drive the conveyor and the conveyor is able to transfer the material rock, sand and coal at 25 Kgs/hr.

As the need for conveying systems is rapidly increasing and power generation using fossil fuels has several negative shades. We suggest usage of VAWT driven conveyors for bulk material transfer

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