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# DESIGN AND APPLICATIONS OF VARIABLE FREQUENCY DRIVE FOR COLD ROLLING MILL

**Monil shah[1], Sharan kad[2], Prof. Madhusudan Barot[3]**

*[3]Assistant Professor, Department of Mechanical Engineering, Indus University, Ahmedabad, India*

*[1,2]Final year student, Department of Mechanical Engineering, Indus University, Ahmedabad, India*

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**Abstract:***As in this modern world every sector is being modernized especially the industrial sector. It's necessary to minimize the usage of power consumption too. In this paper we are going to deal with the power, stress, and strain factor. To sustain rolling force on the ballet it requires high rigidity, sufficient strength. We try to simplify the concept of VFD in rolling mill. By using VFD we try to optimize the structural parameter and time –invariant while including different loads on the mills. It also deals with the smooth start, maximum utilize increases the life of the rollers. We also found the improved power factor up to 0.98. In this paper we justify our points by the comparison tables with VFD and without VFD.*

**KEYWORDS**: power consumption, stain and strain analysis.

## 1. INTRODUCTION :

A VFD is an electronic controller that adjusts the speed of electric motor by regulating power being delivered. Major electricity is consumed by electrical motors in the industries. Energy conservation is the key factor due to increasing demand of electricity in day to day life .By installation of VFD in the mills we try to save the extra power used during the start of the mill. As rolling mills works for 24/7 it's hard to save the power but by using VFD we can save power consumption when worker is out for refreshment. This small savage of electricity can lead to higher energy conservation is our main aim in this project. It's found that in variable torque type load, 20%reduction in speed of induction motor reduces about 45%energy consumption [1]. It's also leads to lower demand on distribution line too .For constant torque type of load applications twenty percent reduction in speed reduces about 20% energy consumption.

Rolling is one of the application to reach the high productivity, variety .It also deals with many dimensions and shape of the metal work piece .If the temperature range is above the recrystallisation temperature material then this process is hot rolling and if below recrystallisation temperature then process is known as cold rolling[2].It has been said from the energy consumed by the ac motors 10%goes idle and 12%-15% is lost when motor does not run at full load [3].

## 2. Speciation of rolling mill

- 4HI 23156 bearing size
- Rolling thickness:600 mm
- Input thickness: 0.8-1.0 mm
- Output thickness: 0.30-0.70 mm
- Pressure holder : 50HP940rpm
- Large roll: barrel length -650mm dia -600mm hardness-50-55
- Small roll barrel length 600mm dia -160-185mm hardness -65

2.1 controlling the number of poles

$$Ns = \frac{120F}{P}$$

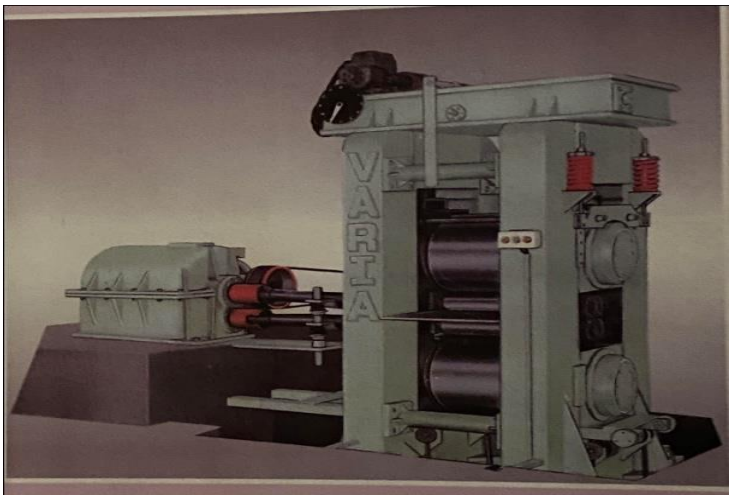
i.e.
Ns = synchronous speed of induction motor
F = stator supply frequency
P = number of poles

2.2 Objective of the study :

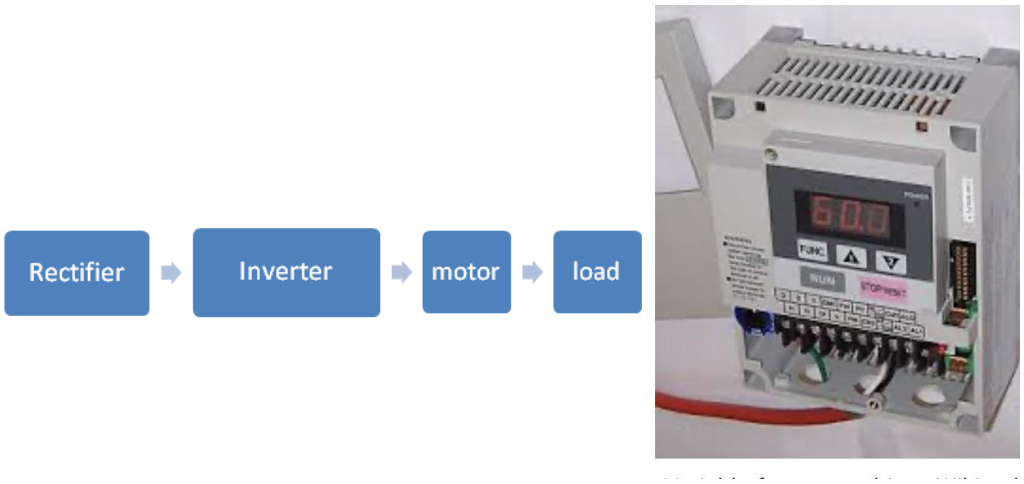
- To reduce the electric consumption and save electricity
- To reduce the dropdown voltage
- To control and varied speed according to the load applied
- To reduce the thermal stress
- Analysis on the thermal strain
- Lower the maintaince cost of the machine
- Lower chances of system disruptions

**3. STRUCUTRE OF PROCESS:**

The installation of VFD is between the incoming power supply and the motor where VFD works as a speed control

3.1 Design of VFD




## 4. CALCULATIONS

Thermal stresses and strain:

Here,
L= length of a bar of uniform cross section
T1=intial temperature of the bar
T2 =final temperature of the bar
α = co-efficient of the linear expansion
Temperature strain =$\propto (t2 - t1)$
Temperature stress =$\propto (t2 - t1)E$
Where for SS202 series α=17.5×10^-6 per Ċ
E =modulus of elasticity =207GPa

## 5. Analysis

In table 5.1 power reading and total units consumed before VFD

| Sr no | Energy meter reading | Difference in reading *40 | Total units (Kwh) |
|---|---|---|---|
| 1. | 51.4 | | |
| 2. | 55.3 | 3.9 | 156 |
| 3. | 60.1 | 4.8 | 192 |
| 4. | 64.2 | 4.1 | 164 |
| 5. | 68.4 | 4.2 | 168 |

Avg units used in 24 hours = 169.24

- Table 5.2 gives us information about the thickness , length of the ballet , temperature, strain , stress without using the VFD

| Sr no | Before length (mm) | Before thickness(mm) | After length (mm) | After thickness(mm) | Before temperature (Ċ) | After temperature (Ċ) | Thermal stress | Strain |
|---|---|---|---|---|---|---|---|---|
| 1. | 2120.9 | 0.4 | 2159 | 0.38 | 31 | 41 | 171.9 | 35583 |
| 2. | 2242.82 | 0.39 | 2268.22 | 0.38 | 32 | 39.5 | 129.7 | 26847 |
| 3. | 2235.2 | 0.6 | 2260.6 | 0.58 | 32.9 | 40.2 | 126.31 | 26146 |
| 4. | 2164.08 | 0.58 | 2204.72 | 0.57 | 33.4 | 42.7 | 159.75 | 33068 |

- Table 5.3 energy consumption with VFD

| Sr no | Energy meter reading | Difference *40 | Total units |
|---|---|---|---|
| 1. | 146.6 | | |
| 2. | 149.8 | 3.2 | 128 |
| 3. | 152.9 | 3.1 | 124 |
| 4. | 156.2 | 3.3 | 132 |
| 5. | 159.4 | 3.2 | 128 |

Average power consumption = 126.9

- Table 5.4 deals with thickness, temperature, strain, stress using VFD

| Sr no | Before length (mm) | Before thickness (mm) | Before temp (Ċ) | After length (mm) | After thickness (mm) | After temp (Ċ) | Thermal strain | Thermal stress |
|---|---|---|---|---|---|---|---|---|
| 1. | 2120.9 | 0.5 | 31 | 2164 | 0.42 | 38 | 169.9 | 35400.3 |
| 2. | 2242.8 | 0.39 | 32 | 2300 | 0.36 | 39.5 | 129.7 | 26447.5 |
| 3. | 2235.2 | 0.6 | 32.9 | 2260.2 | 0.53 | 39.2 | 124.31 | 26058.1 |
| 4. | 2164.0 | 0.58 | 33.4 | 2224.69 | 0.56 | 40.9 | 155.5 | 33044.2 |

**6. RESULT:**

From the above tables we can reduce thermal stress and thermal stain by using VFD. By using VFD we can save the power to better benefit. Comparing the above table of VFD and without VFD we clearly can state that we comparatively able to reduce the temperature. We are also able to save the power. It states we are reducing the thermal strain and thermal strain as well. The efficiency of the power used is decreased by 3% overall.

**7. CONCLUSION:**

VFD helps to save energy in many applications from the study. It is a power conversion device. It converts a basic fixed frequency to a variable frequency. A VFD is used for control of process temperature, pressure or flow without use of separate controller. Suitable sensors and electronics are used to interface driven equipments with it. Also maintained costs can be lowered, since lower operating speeds result in longer life for bearings and motors. Using VFD helps the motor to start softly. VFD reduces the switching losses and increases the operating speed making it motor operation more reliable.

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