Automatic textile sizing machine using PLC, VFD, HMI

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***Abstract*— The textile sizing machine is used for size of polyester, viscous and cotton yarns. These are many factors which effect the size of yarn like temperure, chemicals, speed of motor, bobbin winding tension and synchronization of motors. As we know as to control mention above factors we have to develop a fully automatic systems for textile sizing machine. for this purpose we are going to used PLC,HMI and VFD drives ,In our project first we should control optimum temperure with respect to speed to maintain set temperure of yarn, for controlling the speed of motor we will use VFD drives. For speed control of motor, synchronization of motor, set point of winding tension and to control the pressure of size box we used VFD drives based motor system. We also provide auto cut-off of machine when bobbin is full of desired level of yarn using proximity sensor. In our project we will develop automatic textile sizing machine using PLC, HMI and VFD drives.**

***Index Terms*— PLC, VFD, HMI, Textile sizing machine, Automation**

I. INTRODUCTION

Textile sizing machine is basically used to do chemical coating on yarns. Sizing is the most important terms for weaving technology. After winding and warping, sizing of yarn is done during beam preparation. Sizing is done by applying various types of size materials on the yarn. During application of size materials steam is needed

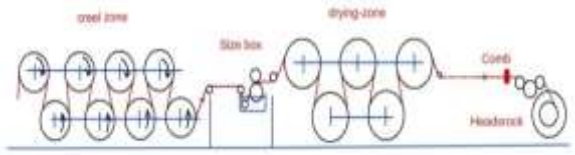

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Fig-1 sizing machine

Sizing is a protective process. The process of applying a protective adhesive coating upon the yarns surface is called sizing. This is the most important operation to attain maximum weaving efficiency especially for blended and filament yarns. Sizing is called the heart of weaving

II. PURPOSE OF SIZING

Sizing is done during beam preparation for getting some advantage of weaving. Sizing has lots of objects which are given below:

- To improve the weave ability of warp yarn by making it more resistance to action of weaving like absorption, friction, tension etc.
- To maintaining good fabric quality by reducing hairiness, weakness and by increasing smoothness and absorbency of yarn.
- Tensile or breaking strength of cellulosic yarn is increased by sizing.
- Elasticity of the yarn is also increased.
- By adding size materials, yarn weight is increased.
- To increase the frictional resistance.
- Projected fibers are removed by this process.
- To reduce electrostatic formation.

III. PROPERTIES OF SIZING YARN

Generally size ingredients are used for warp yarn but sometimes it applies on weft yarn. Anyhow, by applying size ingredients on the yarn, following properties are obtained. Properties of sized yarns are given below:

- Higher elasticity
- Higher yarn strength
- Lower flexibility
- Lower extension or elongation
- Lower frictional resistance
- Increased smoothness
- Less weakness
- Insensible to over drying
- Less hairiness

So, size ingredients change the physical properties of cellulosic fibers which is used for making a weavers beam.

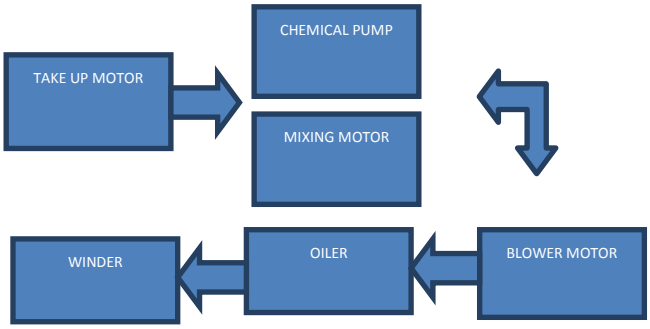
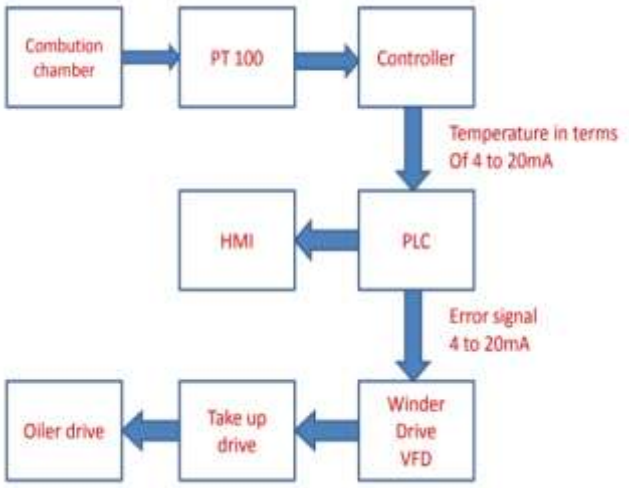


Fig-2 Electrical block diagram of the sizing machine

The Electrical block diagram of the sizing machine is mainly divided in to 5 zones. First zone consist the take up motor which is used to take number of yarns approx 10000 to 14000 from the creel. The second zone consist two number of motors. One is to used to run the chemical pump and another is mixing motor. Chemical pump is used to take the chemical from downwards to upwards. The chemical which is used for the coating is polyvinyl alcohol, modified starch. which has property like glue. so we have to continuous mixed it for this task we require mixing motor. The third zone consist heating process, for which have to run the blower for this we require the blower motor. After the heating process the yarn becomes dry and brittle. so to avoid or to decrease the breaking of yarns

we have to do fixed amount of oil coating on yarns, so the next zone consist oiler motor. The last Zone consist winder motor which one is used to wound the sized yarns on the bobbin.

IV. RELATION BETWEEN SPEED AND TEMPERATURE



The main problem in the sizing machine is that the temperature of combustion chamber will not maintain constant, due to this the quality of the yarn will very according to the variation in the temperature

To overcome this we used controlling panel which contain mainly three drives to control take up motor, oiler motor, winder motor. PT100 which is RTD used to measure the instantaneous temperature of combustion chamber. we also include the PLC & HMI which both are interconnected for bilateral communication. PLC received the electrical output of controller which gives the instantaneous value of temperature of combustion chamber. PLC detect the error between the actual temperature and the reference temperature. This error signal it gives to the winder drive. According to the error winder drive very the speed of the winder motor. All three VFD are interconnected so take up and oiler drive also very the speed according to the variation in the speed of winder drive.

HMI used to display the what is actual temperature of the combustion chamber and we can also very the reference temperature.

Due to variation in the temperature the parameter which are changed by VFD is given below.

Table -1: VFD PARAMETER

TEMPERATURE	FREQUENCY	VOLTAGE	SPEED
110/220	50	440	1375-1500
90/110	39.5	343.2	1186-1375
70/90	29	259.6	886-1186
50/70	20	183.04	625-886

V. OBJECTIVE

1. We will control following parameter using PLC and VFD drives

- To control desired level of temperature with respect to speed of machine
- To control the bobbin winding tension
- Zone wise constant stretch control
- Synchronization of motor for improving system efficiency
- Control the pressure of chemical size box machine
- To develop auto cut off system when bobbin is full of desired level

VI. PLC

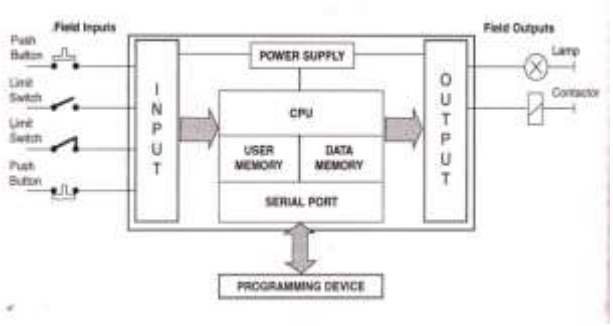


Fig-3 PLC block diagram

What Is PLC?(Programmable Logic Controller)

A PLC is an industrial control system that continuously monitors the state of input devices and makes decisions based upon a program to control the state of output devices.

❖ Types of PLC.

- Compact - i/p & o/p both are on one device
- Modular - i/p & o/p both are on different device
- Hybrid - combination of compact and modulator

❖ Limitation of PLC

- There is to much work required in connecting wires
- There is difficulty with changes or replacement
- When a problem occur hold up time is indefinite, usually long

VII. VFD

- A Variable Frequency Drive (VFD) is a type of AC motor controller that drives an electric motor by varying the frequency and voltage supplied ratio to the electric motor. Other names for a VFD are variable speed drive, adjustable speed drive, adjustable frequency drive, AC drive, and inverter.
- Frequency is directly related to the motor's speed (RPMs). In other words, the more the frequency, the faster the RPMs go. If an application does not require an electric motor to run at full speed, the VFD can be used to change the frequency and voltage ratio to meet the requirements of the electric motor's load. As the application's motor speed requirements change, the VFD can simply turn up or down the motor speed to meet the speed requirement.

1. Modes of VFD drives

[A] Open Loop Vector

It changes the frequency with respect to feedback of running speed

To change the frequency it consider mainly three parameters (A) No load speed (B) measured speed (C) torque characteristic

[B] V/F Ratio Constant
It change the ratio of V/F to keep the torque constant

VIII. HMI

Human machine interface (HMI) – also known as User Interface (UI), or Man Machine Interface (MMI) – consists hardware and software solutions for information exchange and communication between machines and a human operator. HMIs enable control, management and/or visualization of device processes and can range from simple inputs on a touch display to control panels for highly complex industrial automation systems. HMIs can be found in multiple locations such as portable handheld devices, on machines, centralized control rooms, as well as factory floor machine and process control. Applications include industrial and building automation, digital signage, vending machine, medical, automotive, and appliances.

IX. CASE STUDY

Trishul,pvt,ltd,Surat

INTRODUCTION

Trishul, pvt, ltd ,is basically a part of textile industry. this factory provide the sizing process of yarns and its consist traditional sizing machine

EXISTING SYSTEM

This sizing machine mainly devided in five zone is explained above .and each zone consist one motor of require rating which are maintained below
MOTOR RATING
Take up motor - 3 HP/4.7 Amp
Oiler Motor - 1 HP/1.2 Amp
Winder Motor - 5 HP/7.5 Amp (With Encoder)
Blower Motor - 5 HP/7.5 Amp
Size Pump motor - 2 HP/3.1 Amp
Winder cooling fan - 0.5 Amp 3-Phase fan

Each motor start with the MCB of the require rating and there is no other protaction than MCB,so they have to face numbers of problem due to faultes in motor and at the starting of the machine due to any reason if any motor stops working there will be huge loss of yarns . and it economical affectes the honor of the factor or there will be failer in synchronism of these moteres

PRAPOSED SYSTEM

To overcome this problem these problems and achieve the above maintain objectives we are proposing the electric panel which consist of PLC,VFD,HMI and number of basic component like CHOKE, MCB, SMPS, DBR .which are helpful to achieve our objectives . following components with its rating we are going to proposed to atomize the machine

Drives rating

[1] Take up drive 09 Amp YASKAWA V1000, Choke 5 Hp, MCB 16 A
[2] Oiler drive 04 Amp YASKAWA J1000, Choke 1 Hp, MCB 6 A
[3] Winder drive 11 Amp YASKAWA A1000, Choke 5 Hp, MCB 16 A
contactor and OLR rating
[1] Blower 16 A 3 phase, OLR 4 to 7 Amp
[2] Size pump 6 A 3 phase, OLR 2.5 to 4 Amp
[3] winder cooling fan 6 A 3 phase, OLR 0.7 to 1 Amp
Main MCB 63 Amp, DBR 100 E/ 1000W

X. DESCRIPTION OF FLOWCHART

we used controlling panel which contain mainly three drives to control take up motor, oiler motor, winder motor. PT100 which is RTD used to measure the instantaneous temperature of combustion chamber. we also include the PLC & HMI which both are interconnected for bilateral communication. PLC received the electrical output of controller which gives the instantaneous value of temperature of combustion chamber. PLC detect the error between the actual temperature and the reference temperature. This error signal it gives to the winder drive. According to the error winder drive very the speed of the winder motor. All three VFD are interconnected so take up and oiler drive also very the speed according to the variation in the speed of winder drive.
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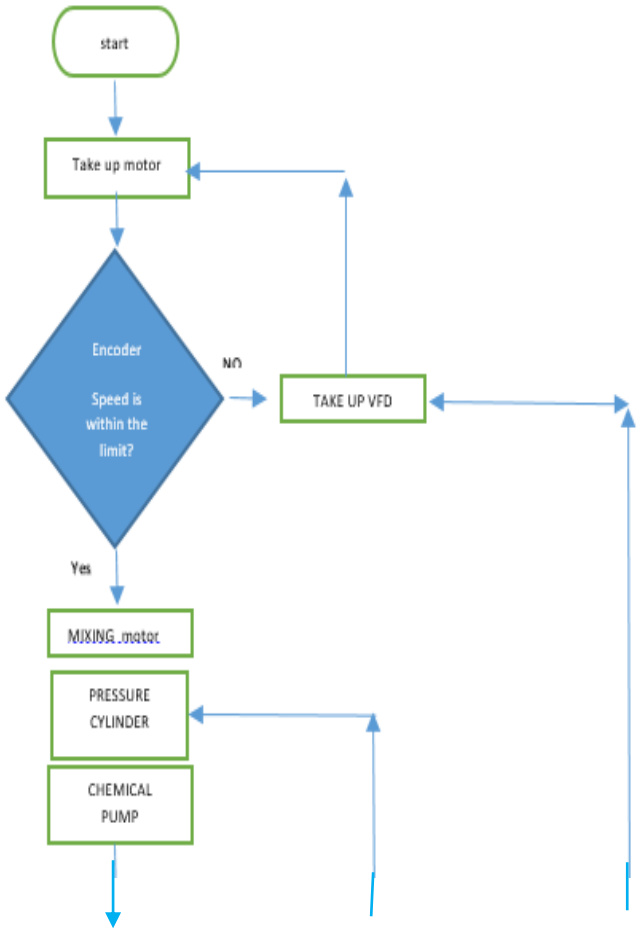


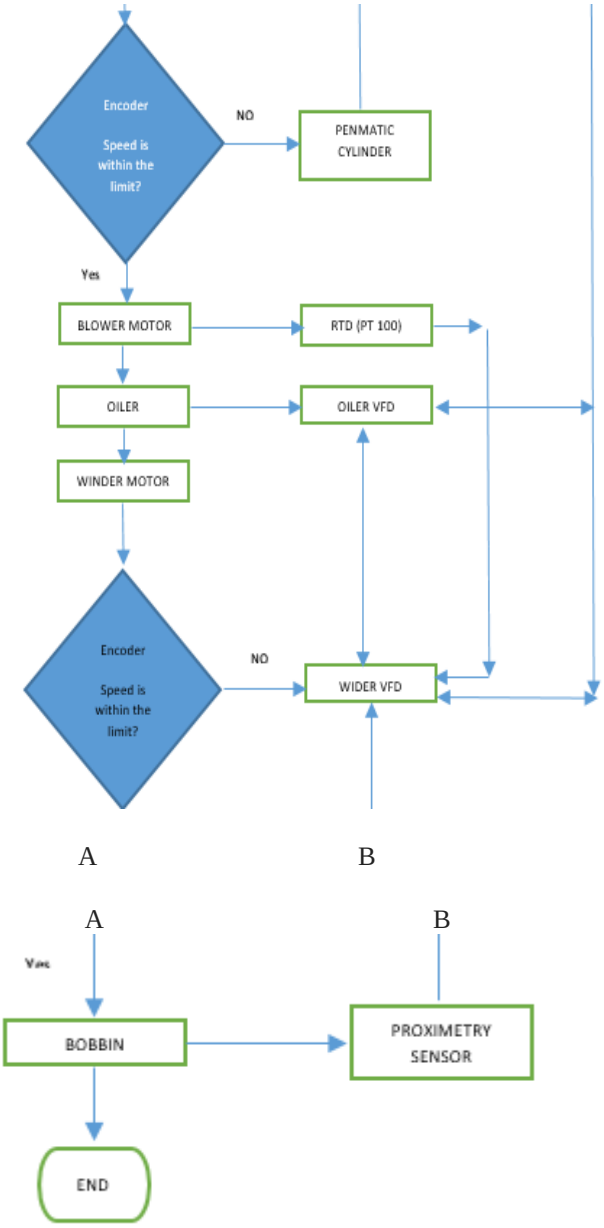


Fig-4 FLOW CHART

XI. COMPARISON BETWEEN EXISTING AND PRAPOSED SYSTYEM

name of induction motor	Motor Rating	Energy Consumption per year of existing machine	Energy Consumption per year of proposed system	starting current of existing system	starting current of proposed system
Take Up Motor	3 HP	22937.7	19152.98	21.3 Amp	4.7 Amp
Oiler Motor	1 HP	7645.9	6393.33	5.64 Amp	1.2 Amp
Winder Motor	5 HP	38229.5	31921.64	36.2 Amp	7.5 Amp

XII. HOW THIS SYSTEM IS ENERGY SAVING AND COST SAVING

Actual Power= $(\sqrt{3}*V*I*\text{Cos }\Phi)/1000$

Energy Consumption/ Day = Actual Power * Working Hr/day

Energy Consumption/ Year= Actual Power * Working Hr/day * 365

Total energy consumption by 3 motors using VFDs/ year = =19152.98+6393.33+31921.64

=57457KWH

TOTAL ENERGY SAVED & PAYBACK CALCULATIONS

Total energy saved = Energy consumption/year by motor - Energy consumption/year by motors using drive.

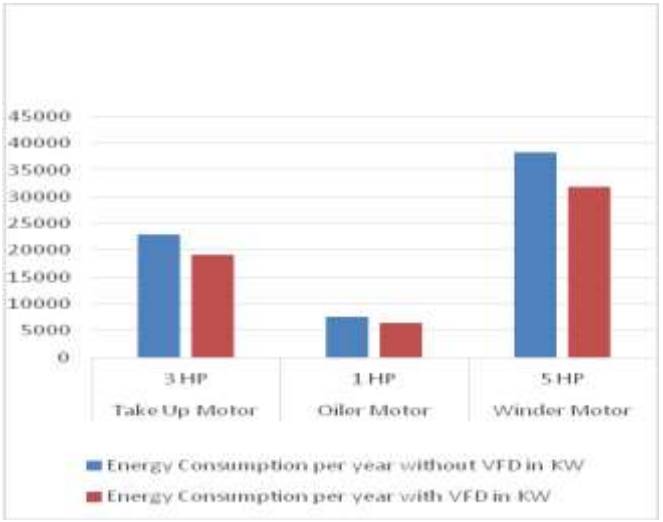
= 68813.1-57467.95 KWH

= 11345.15 KWH

Energy cost at Rs. 5.74/unit = total energy saved x 5.74 = 11345.15 x5.74 = 65121.16 /-

Cost of drive panels and auxiliary material = 350000/-

Thus this capital is recovers within 4 year approximately.



XIII. CONCLUSION

By designing this textile automation panel for sizing machine of yarns we can control the number of parameters like manufacturing speed, temperature of heating chamber, winder motor torque , tension of yarn between two section. After the automation it's easy to supervise the process and decrease the human hazard and risk and we can get large Varity in the quality of the yarns. we also provide the auto cut off facility when the bobbin is full of desire level.

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