ENERGY CONSERVATION USING VFD IN AGRICULTURAL AREA

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Abstract : variable frequency drive (VFD) in agricultural area and comparison between energy conservation by using variable frequency drive and without using variable frequency drive. Variable frequency drive is electronics device used for controlling speed of induction motor by changing voltage and frequency in a fixed ratio. If we only varied voltage then air gap flux between stator and rotor increases and motor core gets saturated hence we have to vary both voltage and frequency in a ratio. In agricultural area no one is using VFD, all farmers are using conventional direct online starter (DOL) or star delta starter. aim is to use VFD for maintaining the speed of pump which is coupled to 3Φ induction motor, by changing speed of motor, speed of pump get changed and hence pressure of water flowing through pump. In drip irrigation system water pressure is main factor which affects whole drip system this paper is intended to make study by comparing energy consumption without VFD and with VFD

Index term- VFD,3 phase induction motor ,pump

I. INTRODUCTION

Now a day's water resources are reducing very fast hence farmers are moving towards drip irrigation system in place of conventional irrigation system. In drip irrigation pressure of water is very important term we have to maintain pressure level equal at all points in farm. Farms near river and hilly area are plotted at different height. Suppose one plot is at 10Ft from base level then second plot may at 20Ft from base level. Generally farmers uses only one motor and one pipe line for all plots and that motor rotates at only one fixed speed , so pressure level of water vary from plot to plot due to difference in height . For maintaining the pressure at required level farmers use one surplus valve from which surplus water again feed back to water source , but in this process lot of energy get wasted and they also don't get required pressure level accurately so here we conversed energy by using VFD. Variable Frequency Drives (VFD) change the speed of motor by changing voltage and frequency of the power supplied to the motor. In order to maintain proper power factor and reduce excessive heating of the motor, the name plate volts/hertz ratio must be maintained. This is the main task of Variable Frequency drive

II. LITERATURE REVIEW

Our main aim behind this project is solving problem in agriculture area. As we know day by day water resources are reducing hence all farmers using drip type irrigation system .In drip irrigation water pressure is very important factor, if water pressure not maintain at balanced state one of the following failure can happen.

1) Main water pipe or drip lateral may break due to high pressure than predicated.

2) Water may not reach at end of the drip pipes. These two failure can happen due to rise and fall of the water pressure To keep water pressure of desired level we have to control speed of the pump which coupled to motor pump speed can be controlled by controlling the speed of motor with driving the pump .Generally 3Φ supply is available all over and hence farmer used 3Φ induction motor with pump for irrigation V/F method is best suitable method of controlling the speed of motor and for that purpose we are going to install variable frequency drive (VFD) in place of DOL starter in cut-out of the farmer. Below figure shows diagram view of farm, here plot 1 and plot 2 are having some difference in height. There is one underground pipeline is provided for irrigation. If drip irrigation is installed in this type of farm then there May variation in water pressure. This problem we are solving in our project.

III. OBJECTIVE

- To study the VFD and 3 phase induction motor
- Find reading with VFD and without VFD
- Calculate the energy saving by using VFD
- Implementation in agriculture area

IV. CIRCUIT DIAGRAM WITH VFD AND WITHOUT VFD

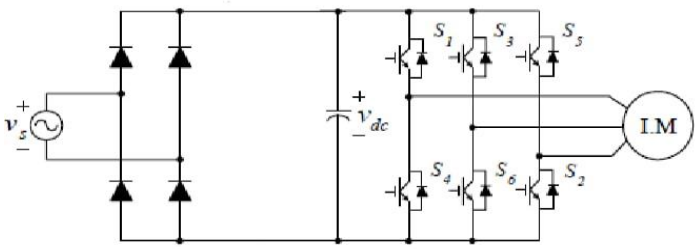

Fig 1: Three phase induction motor with VFD

Fig 2: Prototype model three phase induction motor with VFD

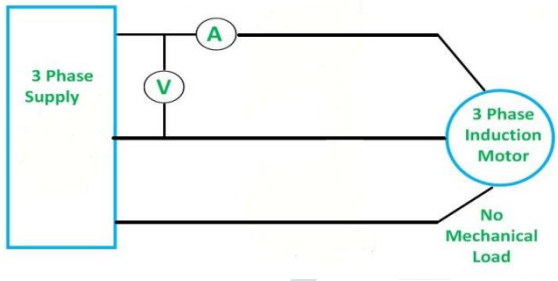

Fig 3: Three Φ Induction motor without VFD

Fig.4: Prototype model three phase induction motor without VFD

COMPONENTS USED

VFD (variable frequency drive)

Fig 5: VFD (Variable frequency drive)

Basically VFD is an energy source efficient device used to change the speed of 3Φ induction motor with keeping V/F ratio constant. VFD is divided into 3 parts 1) Conversion (AC to DC) 2) Inversion (DC to AC) 3) Gate triggering Inside the VFD we convert AC supply into DC supply and again DC supply into AC supply .We do this because we need variable frequency with variable voltage at output of the VFD and this is possible only if we change the speed of alternator ,but we can't do that .
VFD is device which converts fixed frequency AC Supply into variable voltage and variable frequency supply.

VFD Specifications

Sr. No	**Input**		**Output**	
1.	Voltage	200-400V	Voltage	0-240V
2.	Current	3.3A	Current	1.2A
3.	Frequency	50/60Hz	Frequency	0-50Hz
4.	Power rating 180-750Watt			

3 phase induction motor

Induction motor is electrical device which convert electrical energy into mechanical energy and it works on principle of electromagnetic induction In case of three phase AC operation, most widely used motor is 3Φ **induction motor** as this type of motor does not require any starting device or we can say they are self-starting induction motors.

Motor specification

Sr. no	Parameters	Ratings
1.	Type of motor	3Φ induction motor
2.	Voltage	415V
3.	Current	0.61A
4.	Power	0.18KW
5.	H.P	0.25
6.	Frequency	50Hz
7.	Speed	1370RPM
8.	Ambient Temperature	50°C
9.	Insulation class	F
10.	Type of connection	Star\Delta

Centrifugal Pump

Centrifugal pumps are a sub-class of dynamic ax symmetric work-absorbing turbo machinery Centrifugal pumps is used to transport fluids by the conversion of rotational kinetic energy to the hydrodynamic energy of the fluid flow. The rotational energy typically comes from an engine or electric motor. The fluid enters the pump impeller along or near to the rotating axis and is accelerated by the impeller, flowing radically outward into a diffuser or volute chamber (casing), from which it exits.

V. OBSERVATION

Sr. no	Voltage (V)	Frequency (HZ)	Current (A)	V/f	Power (W)	Speed (RPM)	Energy for 2hr(WH)	Power factor
1	74	10	0.35	7.4	20	300	40	0.5
2	107	20	0.23	5.35	15	607	30	0.35
3	142	30	0.21	4.74	16	889	32	0.30
4	180	40	0.20	4.5	18	1189	36	0.78
5	239	50	0.19	4.38	20	1488	40	0.77

Table 3. No load test on 3Φ Induction motor without VFD

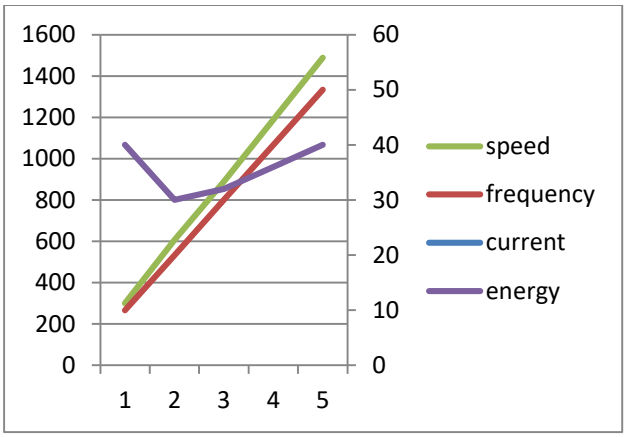

fig7: Plot for no load test on motor with VFD

Table 4. No load test on 3Φ Induction motor without VFD

sSr. No	Voltage (V)	Frequency (HZ)	Current (A)	Power (W)	Speed (RPM)	Energy for 2hr(WH)	Power factor
1	74	50	0.25	16	1318	32	0.5
2	107	50	0.27	18	1429	36	0.35
3	142	50	0.27	199	1463	39.8	0.30
4	180	50	0.33	28	1428	56	0.78
5	239	50	0.4	40	1485	80	0.77

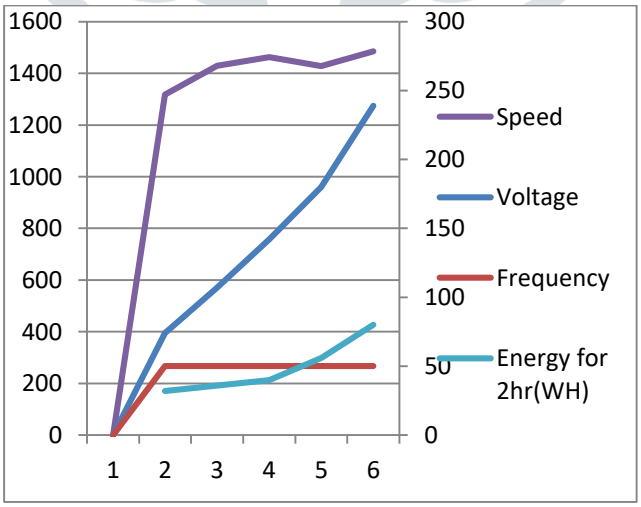

fig8: Plot for no load test on motor without VFD

From these two tests we can see that very much energy is conserved due to use of VFD. In regular starters like DOL we can't get variable speed, but in VFD we can do that. Due to variable supply voltage we can rotate our motor at desired speed, so our motor will consume only that much of energy which is required to drive the load. The main objective of this project is to control speed of three phase induction motor used in agricultural area. Variable frequency drive is used for controlling speed of three phase induction motor. Variable frequency drive maintains speed of three phase induction motor as per requirement. Due to use of variable frequency drive lot of energy can be conserved in agricultural sector.

CONCLUSION

From No load test on 3Φ induction motor, in one case we have connected VFD and in other we have not connected VFD .Hence through both the cases we have observed that energy conservation in case of VFD is much higher as compare to that of without VFD. In India large part of generated energy is used in agricultural areas for irrigation purpose and accordingly lot of energy is wasted also by implementation of VFD in agricultural areas we can conserve lot of energy. VFD also serves as Soft Starter, during starting motor draws 6 times more current than rated current. While starting with VFD, motor draws very less current and also provide a smooth stopping of motor. So the losses occur in motor can be eliminated. VFD also improve the Power Factor, Form the table it can be clearly seen that while controlling the flow with Throttling, Power Factor remains very low compared to VFD which maintain the Power Factor near to unity

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