The Power Factor Correction of Three Phase Induction Motor

Sanket Pawar[1], Chetan Medhane[2], Yogesh Patade[3], Tushar Pandhi[4], Dr. Deepak Kadam[5]
[1,2,3,4,5]*Department of Electrical Engineering, MET Institute of Engineering, Adagaon, Nashik*

Abstract-This paper demonstrates how a capacitor bank can improve the power factor of an induction motor. Power factor increases will instantly result in energy savings. Any provider of electrical services strives for a power factor of one because, if it is less, they must provide the consumer with more current for a given amount of power use. They incur more line losses. The most widely used electrical motors are induction motors because of their dependability, affordability, and durability. Three-phase AC induction motors are the primary power source for the vast majority of equipment used in industrial and mining applications. It is estimated that between 70% and 80% of the electricity used worldwide is used by these motors. Under zero load, induction motors have a relatively low power factor. It gets more adept at transitioning from no load to heavy load. Power factor correction is achieved by connecting capacitors in parallel with the relevant motor circuits at the starter, switchboard, or distribution panel.

INTRODUCTION

The power factor is the ratio of the actual load power (KW) to the apparent load power (KVA) that is drawn by an electrical load. In particular, it is an excellent indicator of the impact of the load current on the effectiveness of the supply system. It measures how well the current is transformed into usable work output. Because the majority of industrial loads are inductive in nature, there is energy loss and waste, which leads to high power bills and harsh penalties from electricity boards. It is particularly challenging to maintain unity power factor when the load is unequal. Power Factor Correction, which keeps the power factor at unity, is employed to get around this problem. Thus, industries need a technology for automatic power factor correction. The basic purpose of power factor correction is to increase power factor. Power Factor, which is a crucial component in calculating electricity consumption, can be defined as the ratio of active power to perceived power. Everyone is aware of how expensive electricity has become recently. Hence, it becomes crucial to reduce power consumption in order to decrease costs. Power factor correction is extremely helpful in achieving this goal. In those businesses where electrical facilities are intended to serve a substantial electrical load, the use of these controllers becomes essential. An increase in Power Factor might result in operational losses and a fine from the electrical board, which is in charge of providing electricity.

LITERATUR SURVEY

This project's goal is to improve the power factor of a three-phase induction motor because both industrial and home applications require better power factors.
The following information was gathered to get a general understanding and knowledge of the project title.
One of the shunt-connected FACTS devices, STATCOM is used to adjust network voltage and absorb or inject reactive power. STATCOM has the following advantages over SSSC (Static Synchronous Series Compensator), such as quick reaction and small size. IGBT (Insulated-Gate Bipolar Transistor) or GCT (Gate-Commutated Thyristor) are typically utilized for switching in STATCOM voltage source converters. Anytime a STATCOM is attached to a bus, depending on the situation, it either absorbs or injects reactive power, regulating the bus voltage. STATCOM can be implemented in various ways. Multi pulse converters have a number of drawbacks, such as the inability to control the generated voltage, the requirement for an additional transformer, and the difficulty in controlling due to the magnetics. Hence, a multilayer converter can be utilized as a substitute for multi pulse inverters to get around their drawbacks. The output of multilevel inverters, which combine semiconductor switches, capacitors, and diodes, is stepped voltage. Low harmonic distortion is produced as a result of an

increase in output steps and levels. The inverter's control becomes complicated as a result, though. However, a STATCOM's main drawback (with no energy storage) is that it only has two steady-state operating modes, namely inductive (lagging) and capacitive (leading). [1]

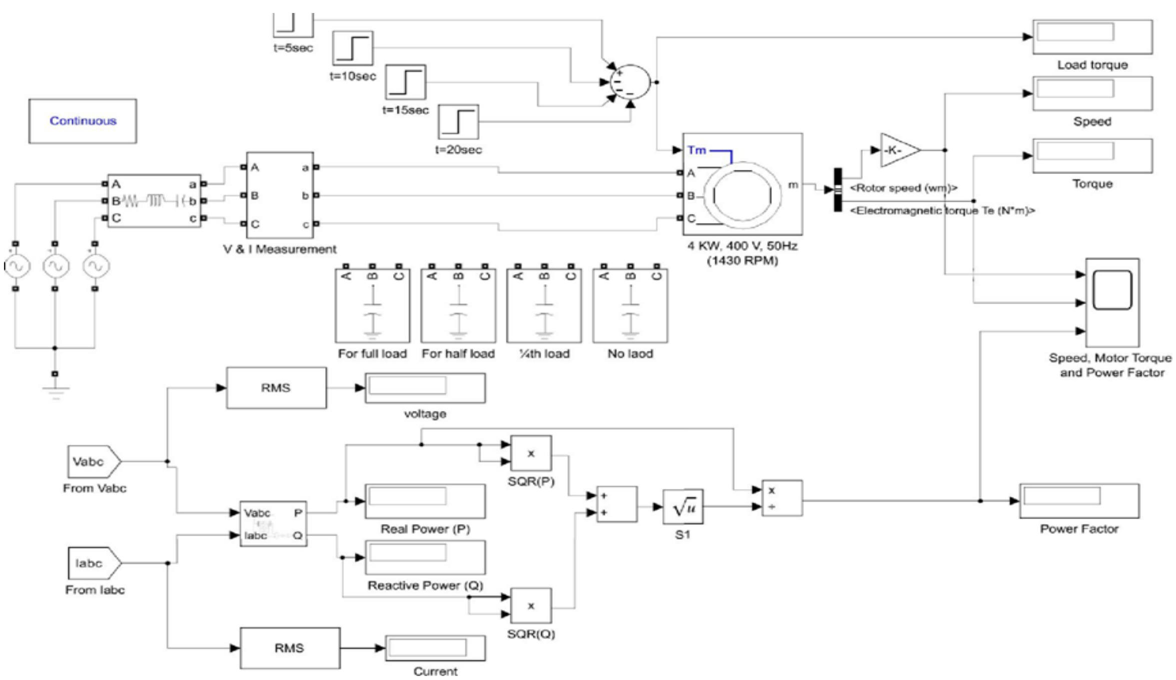
RESULT

In the market, synchronous motors come in a variety of ratings. Based on ratings of 210kW, 480kW, 600kW, 800kW, 1400kW, and 2400kW, the study was conducted. The overall power factor of the plant changes depending on the synchronous motor's rating. The whole plant's power factor is constrained to a range between 0.95 and unity. For loads that fluctuate by 50%, 75%, 100%, and 125%, different synchronous motor ratings are taken into account for power factors of 0.75 leading, 0.8 leading, 0.85 leading, 0.9 leading, 0.95 leading, and unity. But there are more disadvantages, upfront capital expenses and lengthy lead times, high operational costs (electricity to stimulate).[2]

This study examines an induction machine that uses a new converter-fed rotor idea. The rotor windings are open ended and fed by a back-to-back converter with a floating capacitor, while the stator is Y connected and directly connected to the grid. Improvements to the induction motor's power factor and efficiency are investigated using various phase-shift angle settings between the two converters. Also, a 1.8-kW induction machine in the lab is used to study and verify experimentally the induction machine's dynamic performance using MATLAB/Simulink. The results reveal that simulation and experiment are in good accord. [3]

The induction motor (IM) drive system fed by a three phase pulse width modulation (PWM) ac chopper is proposed a new control approach in this study. Input power factor correction (PFC) of the IM drive system is the primary goal of the suggested control strategy under various operating situations. PFC is accomplished by employing the hysteresis band current control (HBCC) technology to continuously force the actual three-phase supply currents with the matching reference currents, which are created in phase with the supply voltages. [4]

SIMULINK DIAGRAM



Waveforms observed in scope after successfully running the model

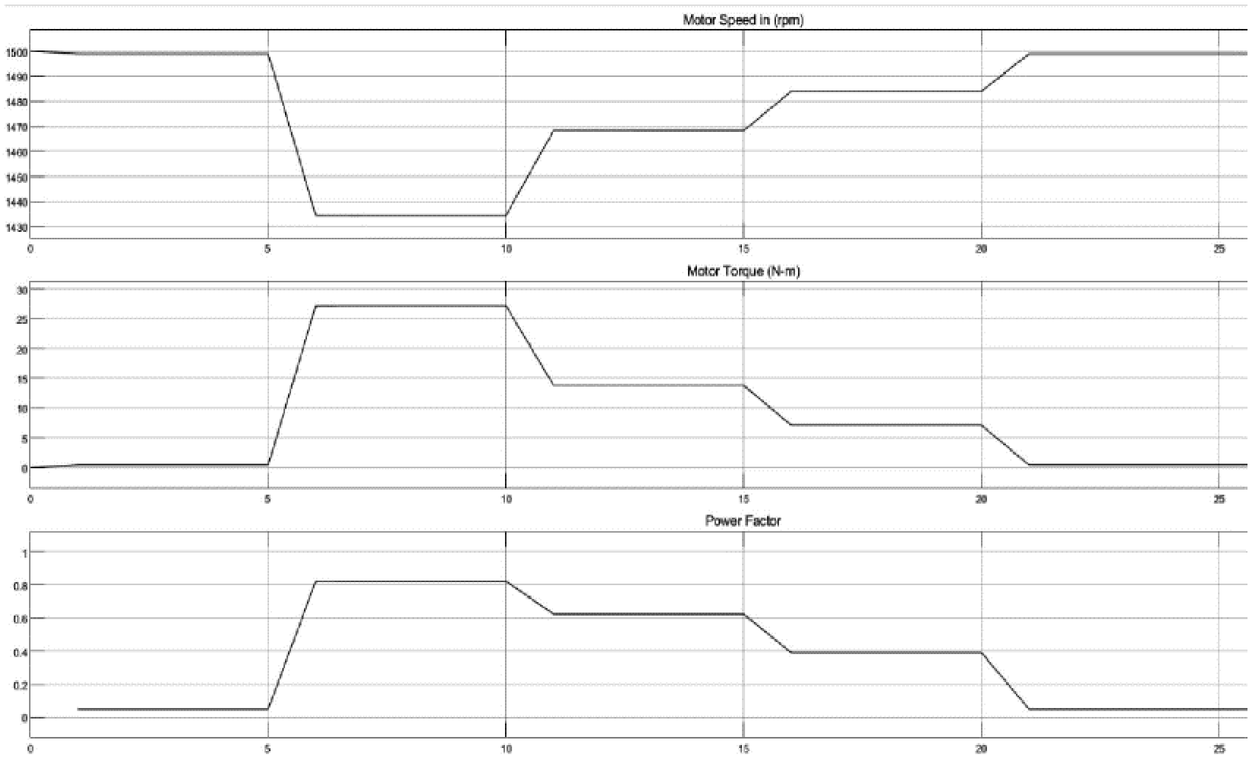


Fig.1 Waveforms-without connecting capacitor

Without a connected capacitor: - The power factor fluctuates in accordance with how the motor is loaded. Here, the power factor drops to zero for the first five seconds when the motor is operating at maximum load, then it rises to 0.8 when the load is steady. Power factor is decreasing towards 0 as load increases

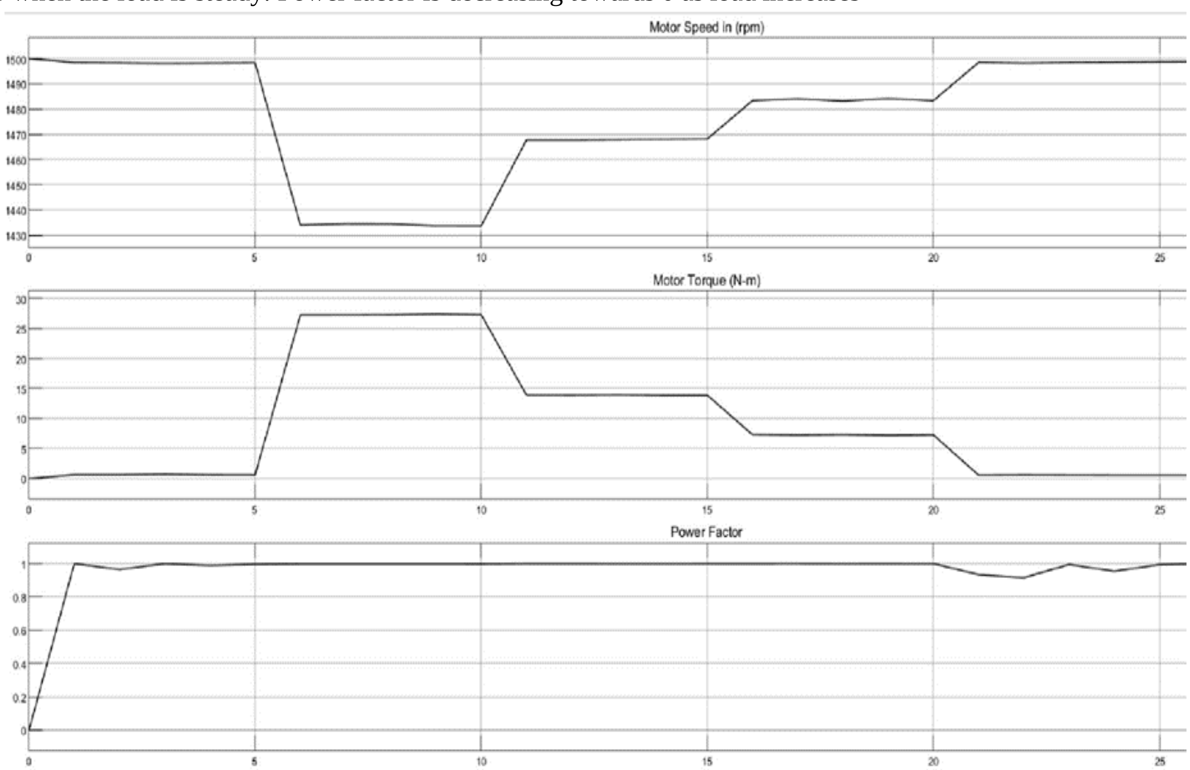
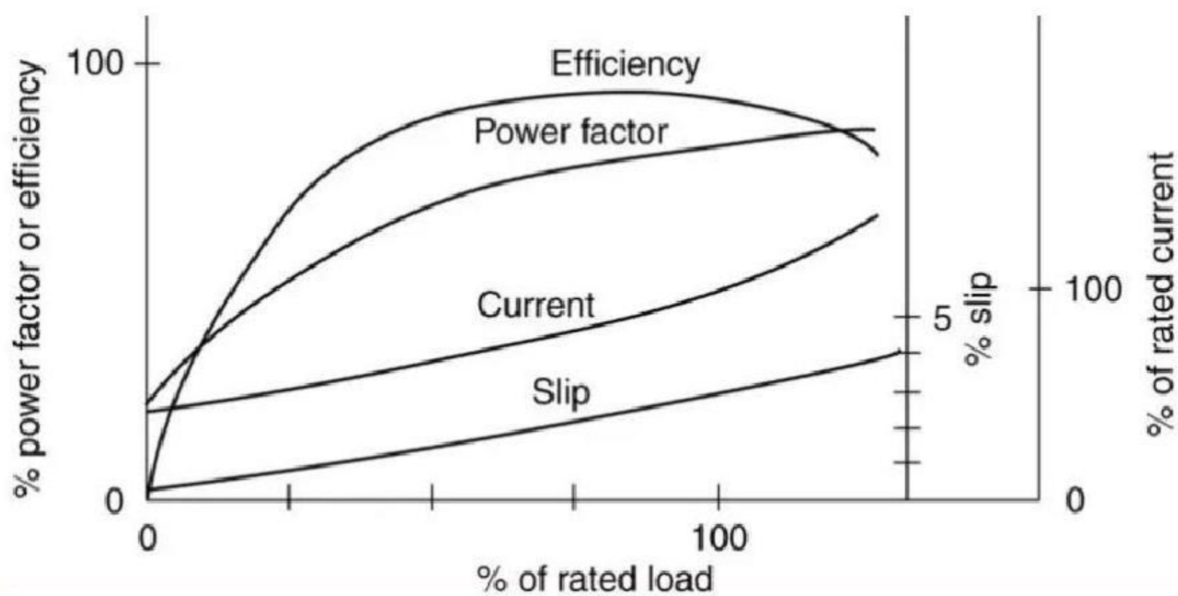


Fig.2 Waveforms-with connecting capacitor

The following is the system's primary target:
▪ Enhanced System Efficiency The system and device's efficiency can be increased with the installation of PFI equipment.
▪ Greater Power Available The power available at the secondary of an MV/LV transformer is increased by the installation of PFI equipment on the low voltage side. An electrical installation is optimized by a high-power factor since it allows for better component use.
▪ Reduced Voltage Drops By lowering voltage dips upstream of the PFC device's connection point, capacitor installation prevents network overload and lowers harmonics.
▪ Somewhat Smaller Installation Size Since less current is absorbed by the compensated installation for a given active power when PFI equipment is installed, the section of the wires can be reduced.
▪ Reduced Electricity Bills Reactive energy penalties are eliminated via power factor improvements, which also lower kVA demand and lessen power losses produced in plant transformers and conductors.
▪ Reduced Electricity Bills Following fig shows the relations of above points.



CONCLUSION

From this simulation, it is concluded that the power factor of the induction motor is Achieved successfully at unity by connecting the capacitor bank in parallel. Also, the voltage profile is improved, the load carrying capability is increased, power system losses are decreased, harmonic disruptions are reduced, and the demand charges and penalties can be avoided. So, the issue of low power factor can be solved by adopting the concept of automatic power factor improvement, which can be very beneficial for companies using inductive load. The power factor should be as unity as feasible because it is directly related to the amount of electricity consumed.

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