

With The Help of Power Factor How To Reduce The Load Current.

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ABSTRACT:

In this research, the study involves an overview about with the help of power factor how to reduce the load current. Research relates the power factor, supply voltage, frequency and load in (KVA) load current of small industry. By using the two different power factors with a same load in (KVA) calculating a load current and taking their difference with the help of that difference calculate the how much load current is reduced by using the correct power factor. The research exposed that the load current compact by 11 to 23% when the power factor is corrected from 0.7 to 0.9. This compact the waste in electrical energy, enlarge output power and deposit effectiveness. Improving the power factor by using the KW, KVA and power factor relationship which is useful to reduce the load current. All the calculations and results shown in mat lab.

Key words: Load current, Reduce Current, Power factor.

I. Introduction

Pakistan relates with the third world country and Karachi is the largest city and former capital of Pakistan on the Arabian Sea near the Indus River. Karachi is not just a city. It is a heart of Pakistan. The area of Karachi is about 3,366 sq. km with more than 18 towns and 6 cantonment boards and in this large city distribution of electricity is not an easy task. In this large city the requirement of electrical energy is about 2400 MW. And the produced energy is about 2000 MW. Due to the short fall and losses there is a lot of load shedding in the city or due to the transmission losses, distribution losses, theft of electrical energy and as well as power factor losses in the industries.

In this research the main objective is to reduce the load current by using the correct power factor in small scale industries in Karachi.

Low power factor is a problem which can be resolved by adding power factor correction capacitors to the plant distribution system [2].

1.1. Active & Reactive Power:

The power factor is a relationship between Active (**working power**) and reactive (**non working**) power and (**total energy**) is consumed. The greater the power factor the more successfully power is being used and vice-versa.

A distributed system power is divided in to two parts. The Active (**Working**) and reactive (**Not Working**) power. The function is to develop magnetic fields by inductive devices. And power factor decreased with increased motor load.

Power Factor is the ratio of active and reactive power of the system.

Power Factor = Kilo Watt / Kilo Volt Ampere

An Electrical system with a power factor of unity is using 100% useful current with greater efficiency. More-over a system with a power factor of 0.5 is using (50%) twice as much current as it needs. In reference with this case improvement in power factor is achieved by connecting a power factor correction static capacitor to the electrical supply resulting in electrical power efficiency.

1.2 Correction of Low Power Factor

“Low power factor means poor electrical efficiency”.

The low power factor, the higher the consumed power drawn from the distribution side [3]. The low power factor is not corrected; the utility must provide the reactive power. In addition to the working active power. Use of large motors and generators and other higher distributed system devices which would otherwise be unnecessary. The utility expenses and cost of operating gone higher and higher. Gone to pass these higher expenses down the line to industrial users in the form of power factor penalties.

1.3 Disadvantages of low Power Factor

➤ If the power factor is low the current in the machinery increased which results higher loss, overheating and increased the cost of maintenance.

- A system with a low power factor result is higher expense both for distribution and consumer.
- In 3 phase system the power factor decreases the current rises. The heat dissipation in the system raise proportional equivalent to the square of current size [1].
- Low power factor reduces a distribution system capacity by increasing current flow and causing voltage drops.
- Low power factor shorten the life span of electrical system and also causes power system losses to the supplied company.

II. Current Consumed VS Power Factor

When the power factor is 1.0, giving a constant power load of 100% below figure represents. After dropping the power factor from 1.0 to 0.9 powers is used less effectively. 10% more current is required than when the power factor was 1.0 to handle the same load. A power factor of 0.7 requires 45% more current, On the other hand if power factor is 0.5 requires approximately 100% more (doubled as much) as when the power factor was 1.0 to handle the same load. The graph shows the relationship between total current consumed and power factor.

III. Estimating of Load Current Saving

An industry having a energy ratings are.

- Voltage = 440V
- Frequency = 50 HZ
- Load KVA = 400

a) Comparing power factor (0.8 Vs 0.9 and 0.7 Vs 0.9)

Matlab Coding

```

clc
clear all
close all
syms kva cosa v cosb ir cosc cosd
kva=400
v=440
%Intially Power Factor @ 0.8 and then @ 0.9
cosa=0.8
cosb=0.9
%The power at the total load wrt to its power factor
Pkw=kva*cosa*1000
%The load Current "ia" @ power factor "0.8"
ia=Pkw/(3^0.5*v*cosa)
%The load current "ib" @ power factor "0.9"
ib=Pkw/(3^0.5*v*cosb)
%The Difference of the Currents wrt to changing the
power factor
ir=ia-ib
%The total reduction of current
Irp=ir/ia*100
%Finally Power Factor @ 0.65 and then @ 0.9
cosc=0.7
    
```

```

cosd=0.9
%The power at the total load wrt to its power factor
Pkw=kva*cosc*1000
%The load Current "ia" @ power factor "0.7"
iac=Pkw/(3^0.5*v*cosc)
%The load current "ib" @ power factor "0.9"
ibc=Pkw/(3^0.5*v*cosd)
%The Difference of the Currents wrt to changing the
power factor
irc=iac-ibc
%The total reduction of current
Irpc=irc/iac*100
solve(Irp,ir,ib,ia,Pkw,cosb,cosa,kva,v,Irpc,irc,ibc,iac,
Pkw,cosc,cosd)
    
```

b) Matlab results

Load In Factory

Kva = 400

Voltages Required

v = 440

Using Power Factor

cosa = 0.8000

Correct Power Factor

cosb = 0.9000

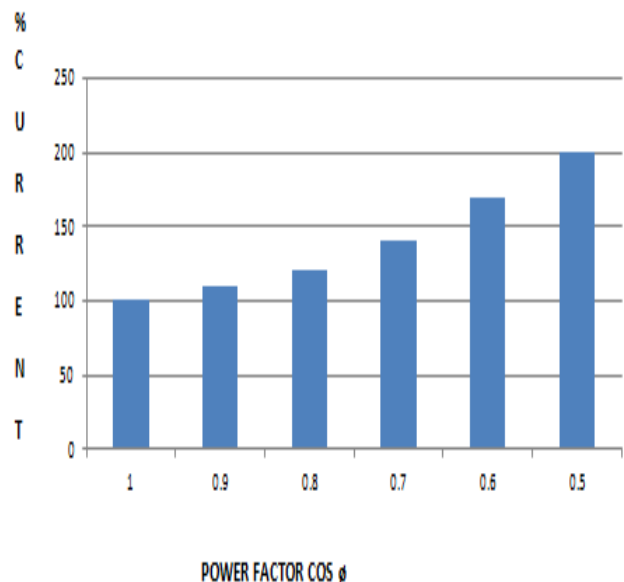
The total power

Pkw = 320000

First Load Current at "0.8"

Ia = 524.8639

Current Vs Power Factor



Second load current "0.9"

ib = 466.5457

The Difference of Ia and Ib

ir = 58.3182

The Reduced Current in %

Irp = 11.1111%

Cosc = 0.7000

cosd = 0.9000

The total power

$P_{kwc} = 280000$

First Load Current at "0.7"

$i_{ac} = 524.8639$

Second load current "0.9"

$i_{bc} = 408.2275$

The Difference of i_{ac} and i_{bc} .

$i_{rc} = 116.6364$

The Reduced Current in %

$i_{rpc} = 23\%$

IV. Discussion of results obtained in both comparisons.

The results obtained showed in the results that initially taking power factor is 0.8 and 0.7. And after correction with 0.9 and by using the total load in both these power factors and calculating the load currents. The total load current reducing starts from 11.22 to 23 % load current is reduced.

V. Improving the power factor by using different schemes.

- Static Capacitors is used and a capacitor bank is used in an industry.
- Phase advancer is also used to improve the power factor of induction motors.
- Flexible AC transmission system.
- Synchronous motor takes leading current when over excited and therefore behave as a capacitor.

VI. Conclusion

Based on mathematical calculation analysis shows that when we are using the correct power factor there is a lot of saving of electrical energy in our country as well as the improvement in the performance of electrical system and its efficiency as well. To improve the Power Factor in the small scale industries and load current is reduced.

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$$P_{kw} = K_{va} * \cos a$$

$$= 400 * 0.8$$

$$\underline{P_{kw} = 320 \text{ KW}}$$

Then!

Power becomes

$$P = (3^{1/2}) * V * I * \cos a$$

The Load Current is

$$I_a = P_{kw} / (3^{1/2}) * V * \cos a$$

$$= 320 \text{ KW} / (3^{1/2}) * 440 * 0.8$$

$$\underline{I_a = 524.86 \text{ Amp}}$$

The Expected Load Current I_a after correction at 0.9 ideal power factor.

$$I_b = 320 \text{ KW} / (3^{1/2}) * 440 * 0.9$$

$$\underline{I_b = 466.54 \text{ Amp}}$$

Now the load current drops from 525 Amp at 0.8 to 467 Amps at 0.9 power factor creating a reversed current.

$$I_r = I_a - I_b$$

$$= 525 - 467$$

$$\underline{I_r = 58 \text{ Amp}}$$

% The Total Reduction In Current

$$\% \text{ Reduced "I"} = (I_r / I_a) * 100$$

$$= (58 / 525) * 100$$

$$\underline{\% \text{ Reduced "I"} = 11\%}$$

c) Comparing powerfactor(0.7Vs 0.9)

$$P_{kw} = K_{va} * \cos a$$

$$= 400 * 0.7$$

$$\underline{P_{kw} = 280 \text{ KW}}$$

Then!

Power becomes

$$P = (3^{1/2}) * V * I * \cos a$$

The Load Current is

$$I_a' = P_{kw} / (3^{1/2}) * V * \cos a$$

$$= 260KW/(3^{1/2})*440*0.7$$
$$\underline{Ia' = 525 \text{ Amp}}$$

The Expected Load Current Ia after correction at 0.9 ideal power factor.

$$Ib' = 280KW/(3^{1/2})*440*0.9$$
$$\underline{Ib' = 408 \text{ Amp}}$$

Now the load current drops from 525 Amp at 0.8 to 408 Amps at 0.7 power factor creating a reversed current.

$$Ir' = Ia' - Ib'$$
$$= 525 - 408$$
$$\underline{Ir' = 117 \text{ Amp}}$$

% The Total Reduction In Current

$$\% \text{ Reduced "I"} = (Ir'/Ia')*100$$
$$= (117/525)*100$$

$$\underline{\% \text{ Reduced "I"} = 23\%}$$