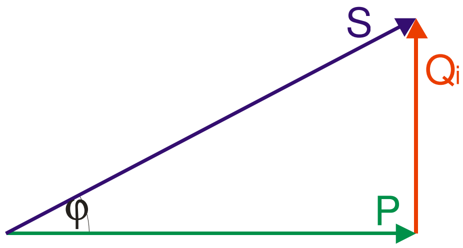
1. GENERAL INFORMATION

Every industrial inductive load (motor, transformer), consumes power from the network:

- active power P (kW), which is transformed by loads to other forms of power (mechanical, thermal),

- reactive power Q (kVar), which is consumed from the network (it is used for generation of electromagnetic field, required for operation of induction motors and transformers), **but cannot be transformed to other form, and it only flows between sources and receivers of alternating current.**

Effective power, consumed by a load, is described as apparent power S (kVA). Dependence between this values is following:



$$S = \sqrt{P^2 + Q^2} = \sqrt{3} \times U \times I$$

Apparent power level determines value of current, consumed by a load from supply network, and thus capacity of transformers and distribution and transmission lines, and its value depends on the reactive power consumption.

φ angle on the diagram above is described as phase shift angle, and its cosine or tangent – as a power factor.

Example of power factor values is shown in the table below:

Description		cosφ
Lighting	traditional light bulb	1,00
	fluorescent light bulb	0,50-0,60
	sodium light bulb	0,50-0,60
Motors	induction motor	0,60-0,90
	thyristor drive	0,70
Welding	arc welding	0,50
	resistive welding	0,60
Electric furnaces	induction furnace	0,60-0,80
	arc furnace	0,60-0,80
	resistive furnace	1,00

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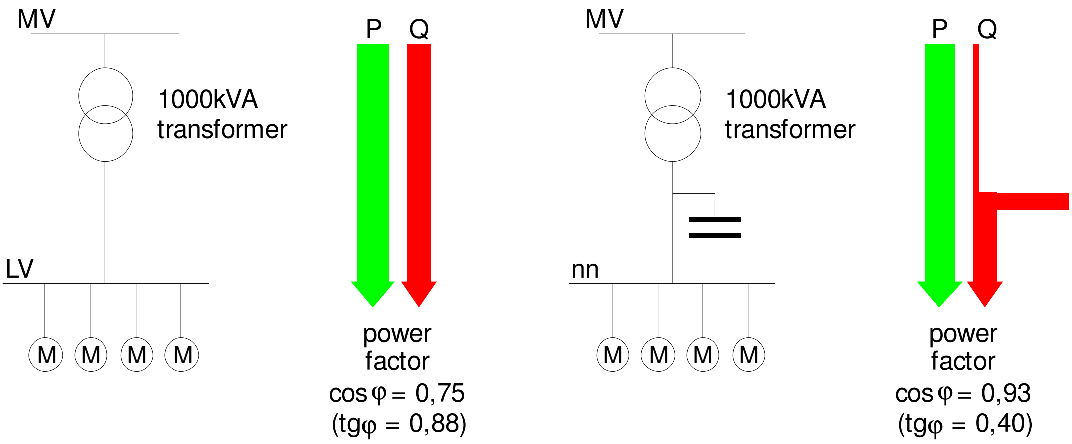
Reactive power, instead of being transmitted on big distances through a transmission lines, can be generated on site, in industrial plant or in distribution point of the network. Such action is called the power factor correction and it is being accomplished by means of capacitors and capacitor banks.

In industrial plant shown on the scheme below, equipped with loads of power 750kW and natural power factor cosφ=0,75 (tgφ=0,88), apparent power consumed from network is 1000kVA, and current – 1444A (on secondary side of the MV/LV transformer). Installation of a capacitor bank of power 360kVar, and thus correction of the power factor to value cosφ=0,93 (tgφ=0,40) will reduce the apparent power consumption to 808kVA, and current consumption - to 1166A level, meaning 19%.



For the plant, it means:

- no fees for reactive power consumption (in most of the European countries, energy distributors issue additional fees in order to cover transmission losses caused by reactive power flow, in case the power factor tgφ is higher than 0,4 or cosφ lower than 0,93);
- possibility of additional loads installation without necessity of supply transformer replacement.

For a energy distributor it means, that power requirement of the plant, which should me manufactured and transmitted is reduced by 19%.

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Utilisation of capacitors permits reduction of many negative aspects of dispensable power transmission, such as:

- reduction of system burden, and thus increase of its capacity;
- reduction of active power losses in transformers and supply cables resulting from reactive current flow:

$$\Delta P = 3I^2R,$$

where: I – current value
R – resistance of conductor

For an example above, reduction of current by 19% means reduction of transmission losses by almost 35%.

- reduction of voltage drops in distant points in the network; voltage on loads' terminals depend on voltage drops on energy transmission way, and they – on effective current value, so on power factor. It means, that the voltage value in points distant from energy distribution point could be too low for a correct operation of the equipment.

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