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REACTIVE POWER COMPENSATION AND ENERGY WASTE REDUCTION DURING START-UP OF THE ELECTRIC MOTOR OF UXK COTTON CLEANING DEVICE

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Abstract: Increasing production capacity in the cotton primary processing industry by energy-efficient methods and the rapid introduction of automation methods in the cotton industry have increased the demand for better process control. This has led to many new applications for the variable speed drive inverter to control the speed and torque of driven machinery. Variable speed inverter drives are also used to meet specific starting and stopping requirements.

Keywords: Cotton device, microcircuit, electric motor, inverter, frequency converter, automatic control, efficiency, reactive power, capacitor device, compensation. soft start, bypass, phases, contactor, Supply voltage, analog.

Introduction. In the cleaning of seed cotton from large impurities, the seed cotton is glued to the surface of the drum with a saw, and it is removed by beating it on colosniks and removing it with the help of drums with brushes. The effect of the working bodies of cleaning machines on seeded cotton, in turn, is due to a number of reasons:

to the performance of the cleaning machine,

to the rotation speed of the working parts,

to technological gaps between working parts,

to their construction,

depends on the number of times the seed cotton is cleaned, etc.

The cotton ginning unit has four ginning sections, in the beginning. Saw drum with two spacers. leveling brush and at the end. Colossians are included, the range of which is combined with them, respectively, four. Sections are installed. The cleaning sections each have a pile block, a brush section with two brush separator drums, and a saw section. Cotton gins can have as many as 70 or fewer sections. It is recommended to combine one 1 XK cotton ginning machines in the initial and final sections for cleaning difficult-to-clean cotton selections. Also, cotton ginning unit is used instead of PLPX technological stream in row-assembled complexes or ginning units, as well as in the main sections of reconstructed cotton ginning mills.

2. Methods. The issue of reactive power compensation is of great importance for the national economy, and is one of the main factors in increasing the efficiency of the power supply system and improving its economic and quality indicators. Currently, the growth of reactive power consumption is much higher than the growth of active power consumption, and in some enterprises, the reactive load is 130% compared to the active load. Long-distance transmission of reactive power along power transmission lines leads to deterioration of technical and economic indicators of the power supply system.

In industrial enterprises, the main part of reactive power is asynchronous drives (60-65% of the total reactive power consumed), transformers (20-25%), overhead power lines, reactors, transformers (about 10%) and other electrical appliances. consumers consume.

Active power is generated by power plant generators, while reactive power is generated by plant synchronous generators, synchronous compensators, synchronous drives, capacitor banks, transmission lines, and thyristor reactive power sources.

In the process of designing the power supply system, it is appropriate to work with the indicator of the reactive power coefficient. The power system decides what the reactive power factor of the enterprise will be, because when the issue of reactive power compensation is correctly solved, the efficiency of the system operation, which includes consumers, power transmission lines, power distribution devices, transformers, converters and generators is provided.

The intended problem is the issue of saving material resources in enterprises at the present time. In order to solve this problem, it is necessary to solve the following tasks:

1. Assessment of current state of use of energy resources.
2. Determining the demand for electricity in cotton ginning enterprises.
3. Development of directions that bring electricity consumption to an optimal state.
4. To study the situations that cause energy consumption and to determine ways to prevent them.
5. Creating a device that allows to reduce the consumption of electricity.
6. Creation of technical and economic mechanism of efficient use of electricity.

The solution to the intended problem is unique. Until now, scientific research has not paid enough attention to this issue, and no solution has been found. As a result, the electricity capacity has increased. Currently, the creation of a device that allows to reduce energy consumption has a huge socio-economic effect. The saving of electric energy allows to start up modern enterprises and organizations in our country and to use them to their full economic potential.

The process of transmitting reactive power through transmission lines and transformers leads to additional power losses, increased voltage losses and increased costs of the power supply system.

1. Additional active power and energy loss occur as a result of reactive power passing through power lines and transformers. If power R and Q are transmitted through a transmission line with resistance R, the active power dissipation is defined as:

$$\Delta P = I^2 R = \left(\frac{S}{U}\right)^2 R = \frac{P^2 + R^2}{U^2} R = \frac{P^2}{U^2} R + \frac{Q^2}{U^2} R = \Delta P_a + P_p$$

Therefore, as a result of transmission of reactive power from the power transmission line, additional active power loss $(\Delta P_p = \frac{Q^2}{U^2} \cdot R)$ occurs and its value is directly proportional to the square of Q. Therefore, it is not appropriate to transfer reactive power from power plant generators to consumers

2. When R and Q energies are transmitted from the energy system element, whose active R and reactive X resistances are calculated, the voltage loss is found as follows:

$$\Delta U = IRcos\varphi + IXsin\varphi = \frac{UIcos\varphi}{U}R + \frac{UIsin\varphi}{U}X = \frac{P}{U}R + \frac{Q}{U}R = \Delta U_a + \Delta U_p$$

here, ΔU_a; ΔU_r is the voltage loss associated with the transmission of active and reactive power.

Therefore, as a result of reactive power transmission, an additional voltage loss

(ΔU_a =QX/U) occurs in the element of the power supply system, the amount of which is directly proportional to Q and X.

The loading of the enterprise power supply system with a large amount of reactive power causes the cross-sectional area of overhead and cable power lines to increase and the power of transformers to increase.

There are two ways for industrial enterprises to receive less reactive power from the power system:

- natural method;
- method of using special compensating devices.

First of all, it is necessary to consider reducing the consumption of reactive power based on natural methods, because it does not require large costs.

Reactive power compensation techniques include the following devices: capacitor banks, synchronous drivers or compensators, and valved static reactive power sources.

Reactive power is produced when the excitation current of synchronous drives (SDr) is increased from the nominal value.

Synchronous compensator (SC) is a SDr working in pure operation mode, there is no mechanical load on the axis and it is designed only for reactive power generation.

Condenser batteries are widely used in industrial enterprises. They are 0.22; 0.38; 0.66; Designed for voltages of 6 and 10 kV, it can be placed inside or outside the building. Capacitors are produced as single or three-phase. The main reasons for the widespread use of capacitor banks in reactive power compensation are as follows:

- the relative loss of active power can be as small as 0.005 (kW/kVAr);
- operation and repair (assembly) works are easily performed;
- the price is relatively cheap;
- light weight;
- works without noise;
- can be installed in the area where the group of electric consumers is located.

As a shortcoming in the device's operation, it can be said that depending on the product's arrival at the supplier, the electromotive device can work for different durations at different times. This increases the number of disconnections of the electric motor, and requires 5-6 times the power consumption of the start-up mode when connected. The large number of disconnections means the consumption of electricity and the effects on the device during start-up, i.e. it reduces the durability period of the shaft and saw teeth.

When the electric motor is started directly, the voltage in the mains drops sharply, the starting currents in the stator windings reach critical values (6-8 times higher than the nominal value) and increase significantly. moment. A soft starter is used to control these parameters. During the acceleration of the electric motor, the soft starter increases the supply voltage to an initial level (40-60% less than the nominal), then gradually increases it to the nominal value. As the voltage increases, the starting current and its rate of increase decrease, and as a result, the starting time of the electric motor increases. To limit the voltage, power switches - thyristors are used.

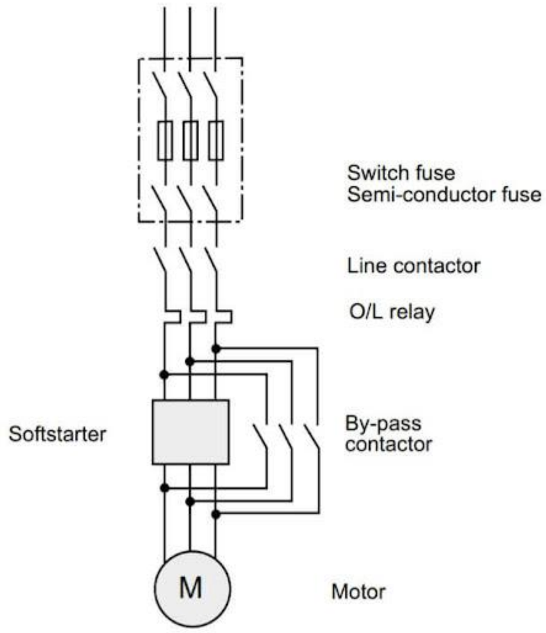

Photo 1. Soft starter circuit with external bypass contactor

After the motor voltage reaches the nominal value and the acceleration process is completed, the soft starter bypass contactor is removed from the circuit. Through the soft starter, the current stops and the device cools down. Some soft launchers have a built-in bypass. This allows to reduce the size and weight of the starter, because there is no need for a large cooling radiator.

When the motor is braked, the soft starter supplies direct current to the stator windings. This function is necessary when controlling an electric drive with an active load (elevators, elevators, food conveyors).

Smooth regulation of the input voltage and starting torque of the electric motor allows to reduce the initial load on the drive, reduce the load on its mechanical parts and protect the equipment from overloading and overheating.

Depending on the number of adjustable phases, soft starters can be two-phase or three-phase. In the first case, the launch control occurs in two stages, the third stage is connected directly to the electric motor. Two-phase soft starters are smaller and less expensive. It is recommended to use such soft starters only for low starting frequencies.

Photo 2. Digital

When choosing a soft starter, first of all, you should pay attention to the nature of the load. There are 3 types of cargo: normal, heavy and very heavy.

During normal operation, the input current can be 3 times higher than the nominal value. Typical examples of easy starting are: centrifugal pumps, centrifugal compressors and fans, elevators, presses, escalators, sawmills and circular saws. In such cases, the soft starter should have the same capacity as the electric motor.

With a heavy load, the current can exceed 4.5 times the nominal value, with a very heavy load - 6 times. Examples of heavy and very heavy actuation: reciprocating compressors, winches, mill grinders, vertical conveyors, centrifuges, band saws. Such equipment requires the installation of a soft starter of one size (with power reserve) from the electric motor.

In addition, when choosing a soft starter, you should pay attention to the following parameters:

• Starting frequency. The soft starter limits the maximum number of starts per hour.

• Number of control phases (two-phase and three-phase soft starts).

• Magnitude of supply voltage.

• Functionality The starter can perform a number of additional functions: motor overload protection, soft starter self-protection, dynamic braking capability, bypass. When connecting several electric motors in parallel with synchronous starting, it is necessary to have a bypass contactor to bypass the thyristors.

• Operating conditions of the soft starter (ambient temperature, relative humidity, altitude, etc).

Results and Discussions. Capacitor batteries are connected to a three-phase network in the form of a triangle. When connected in this way, the voltage value of each element is √3 times greater than when connected according to the star scheme, and the amount of reactive power produced is 3 times more. When the capacitors are disconnected from the network, the residual charge must be automatically discharged to the active resistance. Two single-phase voltage transformers at voltages of 6-10 kV, incandescent lamps at voltage of 0.38 kV are used as discharge resistors.

When determining the required power of compensating devices, it is necessary to take into account the amount of reactive power of the energy system transmitted to the enterprise. In general, the following condition is required:

$$Q_k \geq Q_h - Q_t; \text{ (kVAr)}$$

here, Q_h is the calculated (consumed) reactive power of the enterprise, (kVAr);

Q_e- reactive power transmitted by the power system, (kVAr);

Q_k- reactive power that needs to be compensated in the enterprise (kVAr).

Part of the reactive power deficit of the enterprise is covered by the energy system, and the other part is filled by compensators installed in the enterprise.

The capacity of compensating devices can be determined as follows.

$$Q_k = P_{um} \cdot (tg\varphi_h - tg\varphi_e); \text{ (kVAr)}$$

here, P_{um}- is the active power of the enterprise when the power system load is maximum, (kW);

$tg\varphi_h$- reactive power coefficient corresponding to P_{um};

$tg\varphi_e$ is the reactive power coefficient required by the energy system (for calculations, in the case of cosφ=0.95, tgφ_e=0.328 is assumed)

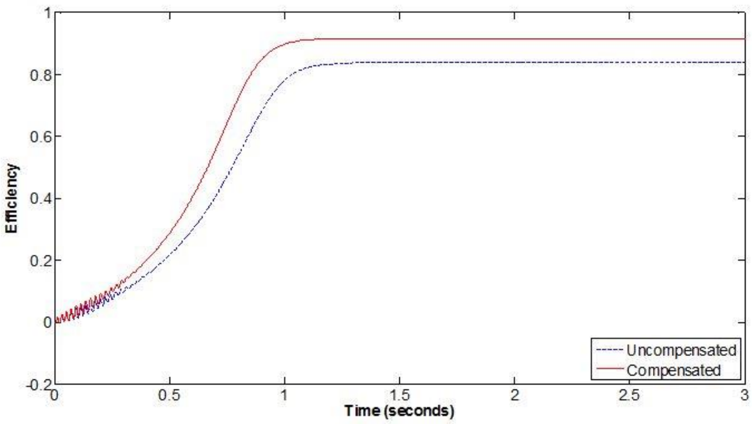

Photo 3.

The change of reactive resistance and reactive power components of an asynchronous motor depending on the voltage: dependence of a - Q_μ = f(U); b - dependence of magnetizing current and resistance on voltage; v - dependence of reactive power dissipation on voltage; g is the dependence of the reactive power consumed by the asynchronous motor on the voltage.

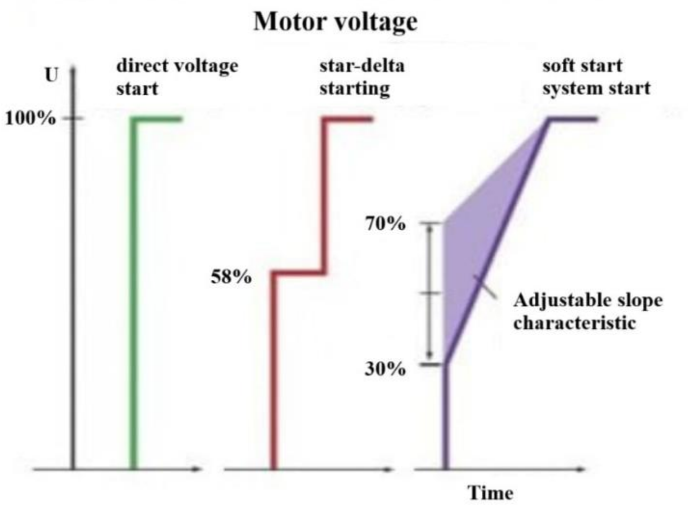

Photo 4. Electric motor load graph with digital soft start

Conclusion. One of the ways to improve the energy efficiency of the primary cotton processing plant, especially the linter, is the power that can be saved through reactive power compensation, which prevents the imbalance of the active and reactive power balance even if it is not noticeable in the current full power structure. In the balance of active and reactive power, a larger part of the received power is used for useful work without changing the value of the received full power. At this point, the costs of the received power for reactive power are reduced. The increase of the useful power and the reduction of the consumption cost will lead to the increase of the electricity saving and efficiency of the cotton industry, especially of the linter device. By applying this method to other facilities in the primary cotton processing plant, the benefits can be seen to be significant.

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