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THE ENERGY EFFICIENCY INCREASING OF THE SYSTEM «ROCK EXCAVATOR - POWER LINE» IN CONDITIONS OF THE UKRAINIAN MINING AND ORE ENTERPRISES

A large portion of rock excavators working in the quarries of Ukraine are equipped with a five-machine system "generator - motor" [1]. In this system, during the start-up period, the primary synchronous motor is directly connected to the power supply system. This technical solution causes seven-fold starting currents, which create 49-fold electrodynamic forces, which leads to the rapid accumulation of fatigue damage in the windings of the synchronous machine and the power transmission line. Therefore, the existing technology imposes strict restrictions on the number of direct starts of the motor - no more than 3-4 times a day, which makes it possible to maintain the aggregate in a working condition.

This approach contradicts the principles of energy efficiency, because during periods of technological pauses (for example, waiting for technological transport, which can reach a total of up to 4 hours of working time per day), the generator group of the excavator works in idle mode with electricity consumption from the network. During non-productive waiting periods, the power consumed by excavators is: EKG-8 - 110-120 kW, EKG-10 - 130-150 kW, ESH-10/70 - 200 kW. This power is converted into heat and carried out by fans into the atmosphere. At the same time, the windings heat up, the insulation ages, the bearings wear out, the brushes wear out, and the collectors on the generators are wiped. The engine resource of the unit is unproductively consumed and reduced.

In addition, the problem of reactive power generation by a synchronous motor is added both in the working cycle and during periods of technological pauses at idle speed.

The existing problem is effectively solved by a smooth (shockless and therefore harmless, both for the electrical equipment of the excavator and for the power supply line) start of the generator set at the nominal current with the help of a device for operational control of the conversion unit of the rock excavator, which is provided by patents of Ukraine [2, 3]. This device realizes the immediate shutdown of the aggregate operating for more than 0,5-2 min. in idle mode, which saves electricity.

After the end of the technological pause, the device realizes shock-free (smooth and harmless) acceleration of the aggregate to the nominal speed. The acceleration time of the aggregate is: 20-25 seconds for the EKG-8 excavator; 25-30 sec. - EKG-10; 45-50 sec. - ESH-10/70. There are no starting currents and dynamic shock loads in the "generator - motor" system and the power transmission line.

A shock-free start is ensured by the fact that an inductive-capacitive converter with a three-phase rectifier is connected to the armature circuit of the generator in the multi-machine unit of the excavator, which contains an alternating current machine and direct current generators on one shaft, during the start-up period. Such a converter allows to synchronize the voltage levels at the output of the uncontrolled rectifier with the nominal voltage of the armature circuit, and on the other hand, it fully preserves its functionality in case of network voltage dips.

The problem of generating excess reactive energy is solved by applying a suitable device to regulate the excitation current of the synchronous motor both in the working cycle and during periods of technological pauses. This is achieved by monitoring the generated reactive power and automatically maintaining it at a given level, down to zero when the power factor is equal to one.

Currently, the effectiveness of the proposed options is confirmed by the positive experience of implementation on excavators in the conditions of the Southern mining and ore-dressing plant, which significantly increased the technical and economic performance of rock quarry excavators and power supply lines.

The effect of the implementation of the soft start device has been confirmed by the specialists of the technological and electrical equipment operation services of the Southern mining and ore-dressing plant.

They note that the energy efficiency of the excavator and the power supply system has significantly increased. The expected economic effect is more than UAH 1,700,000 per year due to electricity savings and at least UAH 800,000 due to the extension of the aggregate's trouble-free operation. The payback period of the project is expected to be 6-7 months.

Conclusions

Therefore, the application of the proposed method and device for soft start of the generator set of the excavator allows to eliminate shock currents at the time of connecting the alternating current machine to the power supply network, increase their non-accident life, improve energy indicators during the period of acceleration of the generator set, and eliminate the impact on the power supply system of starting loads.

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SUSTAINABLE COPPER MINING: BALANCING RESOURCE EXTRACTION WITH ENVIRONMENTAL AND SOCIAL RESPONSIBILITY. CASE STUDY

The mining industry has been a cornerstone of human progress and economic development for centuries, providing the raw materials necessary for infrastructure, technology, and countless other essentials of modern life. However, the environmental and social costs associated with conventional mining practices have raised serious concerns. In response to these challenges, sustainable mining has emerged as a guiding philosophy that seeks to reconcile the imperative of resource extraction with the pressing need to protect our planet and foster social well-being.

One of the fundamental principles of sustainable mining is environmental responsibility. This involves minimizing the environmental footprint of mining operations. Strategies encompass the reduction of water and energy consumption, the efficient management of waste, and the prevention of pollution. Sustainable mining aims to rehabilitate and restore mined areas to their natural state once extraction is complete, allowing ecosystems to recover and flourish.

Social responsibility is equally integral to sustainable mining. Respecting the rights and well-being of local communities and indigenous peoples is paramount. This includes recognizing their land and cultural rights and promoting community engagement, consultation, and participation in decision-making processes. Sustainable mining operations aim to enrich the communities in which they operate by providing jobs, supporting local businesses, and contributing to regional development. Moreover, they work toward fair and equitable distribution of benefits and revenues.

Economic responsibility within sustainable mining means creating economic opportunities for local communities. This is achieved through job creation, support for local businesses, and contributions to regional development. Economic benefits should be shared equitably among stakeholders, ensuring that wealth generated from mining is not concentrated in the hands of a few, but rather supports the broader community.

Resource efficiency is central to sustainable mining. Companies seek to maximize resource recovery while minimizing waste. Techniques and technologies are employed to optimize processes