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PROBLEM OF ELERCTRIC ENERGY EFFICIENCY POTENTIAL EVALUATION OF UNDERGROUND IRON-ORE PRODUCTION

The paper contains the analysis of energy consumption volumes at iron-ore production enterprises with underground method of mining. The research shows that electric energy presents about 90% of all energy expenditures. Ways of enhancement of electric energy efficiency at these mining enterprises are considered. The structure of energy saving potential for iron-ore production is suggested. Recommendations, aimed at the improvement of energy efficiency of underground iron-ore productions are given.

***Key words*:** *energy supply, iron-ore production, energy efficiency.*

Introduction. Characteristic feature of iron-ore production, distinguishing it from other methods of mineral resources mining is constant lowering of levels where the mining is performed, as a result cost of ore mining increases. At the enterprises of Kryvyi Rih iron-ore basin the cost of 1 ton of iron ore increased two times in recent 5 years [1]. As the analysis of the elements of the total cost shows power costs represent considerable share of the total cost.

Materials and the results of research. Main type of energy, consumed by iron-ore mines is electric energy, the share of this energy is about 90% of the total energy consumption (Fig. 1).

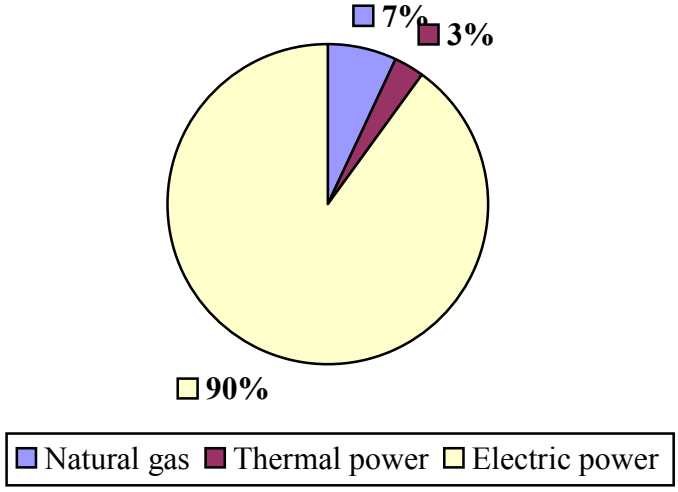

Fig. 1. Diagram of power costs components at iron-ore enterprises with underground method of ore mining

The most power-intensive consumers of electric energy at iron-ore mines (IOM) are stationary installations – water pumping, ventilation, hoisting, compressor station – taken together they consume more than 80% of all electric energy, consumed by the mine. Expenditures for compressed air production by central compressor station are particularly great, they represent more than 30% of the electric energy consumed by the plant [1].

The most promising method of energy expenses reduction at iron-ore mines is the reduction of energy consumption and energy expenditures at stationary units and, especially, in central compressor units (CCU).

Compressed air from central compressor stations, located on the surface of the mines, is transported via pipe lines to the places of usage (to the faces of the mines) at the distance of several kilometers. It is natural that greater part of energy is lost during transportation. As a result (taking into account all the losses) pneumatic drive efficiency in iron-ore mines is only 8 – 10% [2].

Proceeding from this, replacement of pneumatic drive by electric drive, having the efficiency by an order greater for loading and drilling machines, impact tools. This enables to reduce or eliminate the

usage of compressed air, central compressor stations and long pneumatic pipe lines. At the same time, if it is necessary, mobile compressor stations of small capacity can be used directly in the places where compressed air is used in underground openings of the mines and on the surface.

Energy efficiency can be substantially increased by means of application of regulated electric drive for such loads as conveyers, fans, etc. Fans of main ventilation consume up to 20% of electric energy that shows low energy efficiency of ventilation systems. Usage of regulated electric drive will allow to regulate air supply in accordance with the demand of ventilation. Additionally at the expense of air supply decrease the mine depression also decreases and, correspondingly, internal and external air leakages decrease.

Expenses for the consumed electric energy can considerably be reduced by means of regulation of energy consumption according to tariff zones of the day. Taking into account that in night hours electric energy price is 4.8 times less, than in maximum hours, energy systems elaborate plans – schedules of regulating measures, introduction of which will allow to reduce the load in the hours of morning and evening maximums of energy system load. In conditions of mines water pumping installations can be most efficiently used as loads-regulators, these installations must operate mainly in the hours of minimal price for electric energy - in night hours. Water tanks usually have sufficient reserve, if necessary, these tanks can be enlarged.

The problem of compensation of reactive power for the increase of the efficiency of energy supply systems remains actual. Peculiarities of reactive power compensation in conditions of iron-ore production enterprises, using synchronous machines, taking into account their operation modes and additional losses of energy, stipulated by generation of reactive power, are considered.

Power transformers, installed at main substations of iron-ore production enterprises have low loading factor (30 – 40 %), that is why they operate in uneconomic modes. Evaluation of losses reduction while withdrawal of one of the transformers into cold reserve depending on the resulting loading factor of the operating transformer load has been performed. It is determined, that the withdrawal into cold reserve is economically expedient if the resulting loading factor is less than 0.6.

Among underground users the most complex and energy consuming electric engineering complex is electric locomotive transport, having low efficiency of energy usage. Application of rheostat control systems results in useless loss of 30 – 40% of electric energy in regulating rheostats of traction electric engineering complexes of electric locomotives. Present-day development of industrial electronics allows to improve substantially technical characteristics of electric locomotives and reduce 1.5 times electric energy consumptione [3].

Systems of energy supply of iron-ore production enterprises used nowadays are characterized by considerable overestimation of the capacity of power transformers, installed both on the surface and at underground substations. Accordingly, the parameters of the equipment and cross-section of cables are also overestimated, capital costs grow. . All this takes place at the stage of design as a result of overestimation of calculated electric loads. The reason of such situation is imperfection of the methods of computation and incorrectness of calculation coefficients used. While carrying out calculations of electric loadings the loads are conventionally divided into groups with similar operation mode, although in reality there exist technological groups of loads with various operation modes: loads of technological units, shops, enterprises as a whole. In other words, logic of the construction of calculation techniques, applied, does not correspond to the structure of energy supply systems [4].

Fig. 2 shows the cartogram of the potentials of the increase of energy efficiency components of iron-ore mines systems of energy supply and energy consumption. Energy efficiency is understood to be the potential (in per cent) of possible reduction of consumption or electric energy losses by definite loads or the component of energy supply systems.

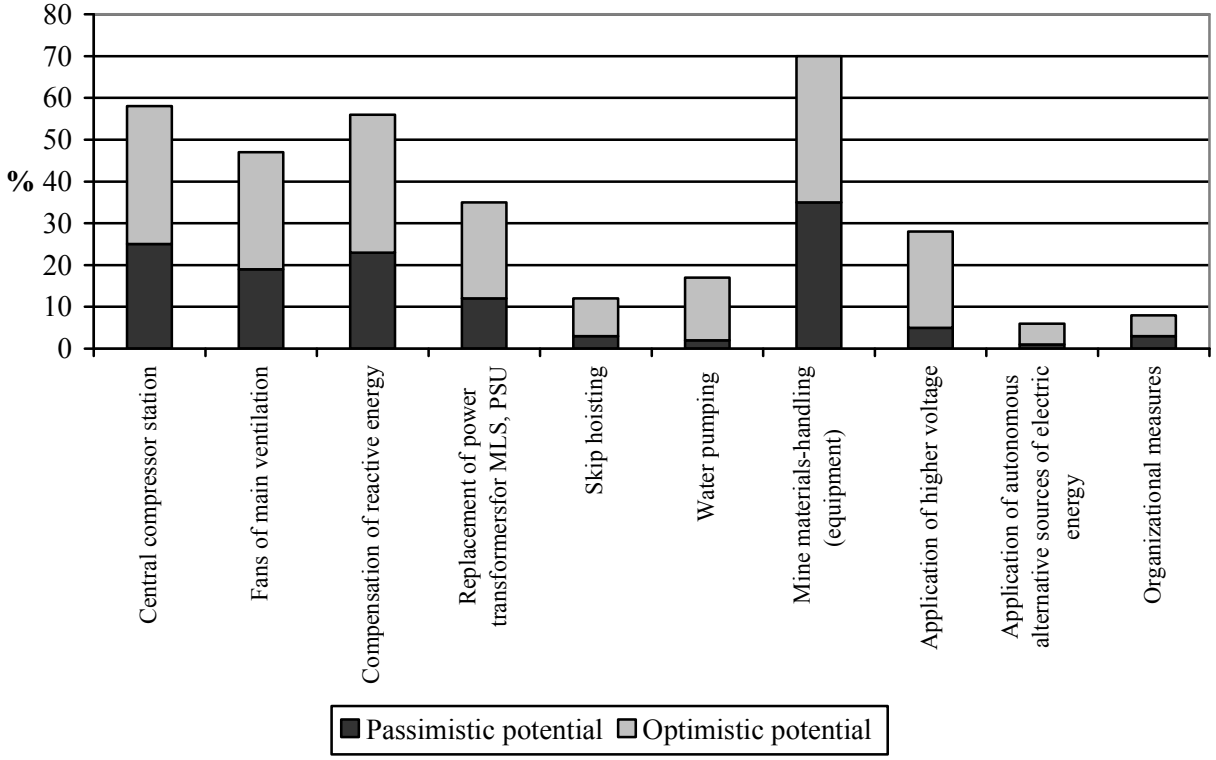

Fig. 2. Comparison of optimistic and pessimistic potentials of energy efficiency increase of the elements of the systems of energy supply and electric equipment of iron-ore mines

Realization of the recommended methods will allow to reduce the consumption of electric energy at iron-ore mine (integrated works) by 35 – 40% in case of optimistic variant, and by 15 – 20% in case of pessimistic variant.

In addition, we would like to note, that the increase of energy efficiency it is a complex problem, it could be realized not only by means of engineering measures but first of all, by development and introduction of the efficient structure of energy management.

Conclusions. 1. The most power intensive users at iron-ore production enterprises are stationary installations – water pumping, ventilation, hoisting, compressor units – consuming more than 80% of the total consumed electric energy.

2. The replacement of the pneumatic drive by the electric drive, the efficiency of which is by an order higher for loading, drilling machines, pneumatic hammers is expedient.

3. Application of regulated electric drive for fans of main ventilation for air supply regulation in accordance with the requirements of ventilation is efficient.

4. Expenses for energy supply can be considerably reduced by means of energy consumption regulation by tariff zones of the day. Water-pumping units are most efficient for usage as loads-regulators.

5. Application of modern frequency-regulated asynchronous traction drives for mine electric locomotives will allow to improve considerably technical characteristics of electric locomotives and reduce 1.5 times electric energy consumption at electric transport.

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