TRAM'S ELECTRIC DRIVE

I.D. Pryakhin, G.A. Nizkodubov
Tomsk Polytechnic University
The institute of Power Engineering, group №5G53

When railways and tramways had been implemented, many problems associated with the efficient and convenient handling of this vehicle has arisen. How smooth was starting and traveling in a tram, how economically does it consume the electric energy, how long can operate the equipment that converts electrical energy into mechanical energy, how to control all processes as simple as possible and profitable? All these issues are still relevant today, because many of the trams stay in the depot and in need of repair as the equipment and cosmetic one.

What is electric drive?

Electric drive is operated electromechanical system, designed to convert electrical energy into mechanical energy and back, and to control the process. Modern electric drive is a composition of many electric machines, apparats and their control systems. It is a major consumer of electric energy (60 %) and the main source of mechanical energy in industry.

Why is electric drive is so popular?

Almost all of the processes associated with mechanical energy are carried out by the electrical drive. The only exceptions are the autonomous vehicles (cars, planes), using non-electric motors. So wide, almost universal distribution of the electric drive due to the peculiarities of electric energy — the ability to transfer it at any distance, constant readiness for use, ease of transformation into other types of energy.

Advantages of tram's electric drive

Using electric current as an energy source, tram compared to other transport vehicles has a very significant advantage. It does not emit products of combustion polluting the air that for cities has a great ecological impact.

The elements of tram's electric drive

Consider the electric drive as a system consisting of three main parts*: traction motor*, *gear mechanism* and, most importantly, *the motor control system*.

THE ADDITIVE TECHNOLOGY IN NUCLEAR POWER PLANTS

M.A. Vergaskina
Tomsk Polytechnic University
Institute of Power Engineering, Department of Nuclear and Thermal Power Plants,
5032 group

The additive industry development has began with the 3D-printers. Now plants are plan to produce metal details via additive technology.

In RF this technology is at a low level. The main problem, that has appeared after the Russian ruble fall, is the foreign additive technologies high cost. For example, the titanium powders price for the Russian consumer is about 520 euros, but in Europe it is just 230 euros.

Rosatom has offered a program to solve this problem. Now this program is being realized. It consists of the subsections: technology, raw materials, equipment and standardization. There are involved 3 institutions for the development of metal powder production for 3D-printers. Over the past year, Russian scientists have developed several kinds of metal powders and a 3D-printer, for example in the TPU.

Additive technologies advantages:

1. new technologies allow us to reduce the components cost. It is easier to correct fault components in the design process via the additive technologies, but in the production stage of the traditional manufacture this will be more expensive;
2. the reduction of the components weight via the wall thickness decrease while preserving the desired properties;
3. the absence of any faults as for example with casting or molding;
4. create a complex and unique details.
5. The additive technology in the nuclear industry:
6. design of the reactor components;
7. replacement or repair of components during production. For example, steam turbine damaged rotor blades restoration.

In the nuclear industry there is a category of components with internal cavities and tubular structures complex system. For example a surface heater, which is used to preheat feed water. Its main disadvantage is underheating. The main cause of this underheating is the air presence in a heater. With the 3D-printer help, we can create heater shell with the necessary properties: no air in the heater and increase its heating surface.

Let’s come to the heater’s scheme. We have calculated the influence of underheating on its efficiency. On the basis of the heat balance equation we have found that the under heating could be expressed via formula (1).

$$\theta_m = \theta \cdot e^{-\frac{kF}{Wc_p}} \quad (1)$$

Underheating, temperature and pressure of the heating steam have been reduced, thus this improvement has increased heaters efficiency. [1]

Also, we plan to increase heating surface, which has a positive impact on the NPP efficiency. However capital charges for production of the new heater will increase on the heaters price - 125 million rubles (2), but operating costs will be decreased. The efficiency change is approximately equal to the electrical power (3).

$$\begin{cases} The\ cost\ of\ a\ new\ heater = 5000kg \cdot 5000\frac{ruble}{kg} = 25000000\,ruble \\ Total = 25000000 \cdot 5 = 125000000\,rubles \end{cases} \quad (2)$$

$$\eta \uparrow \rightarrow \delta\eta = \Delta N = 0{,}08; N_{new} = N + 0{,}08 \cdot N = 450 + 0{,}08 \cdot 450 = 486\,MW \quad (3)$$

The profit is expressed via formula (4).

$$P = (486 - 450)MW \cdot 10^3 \cdot 24 \cdot 365\frac{hour}{year} \cdot \frac{0{,}4\,kW}{hour} = 126144000\,\frac{ruble}{year} \quad (4)$$

Consequently, the new heaters will be repaid within 1 year (5).

$$\tau = \frac{125000000\,ruble}{126144000\,\frac{ruble}{year}} \cong 1\,year \quad (5)$$

REFERENCES

1. Singh, Murari. Blade Design and Analysis for Steam Turbines / M. P. Singh, G. Lucas. — New York : McGraw-Hill, 2011. — 364 p. 7. Leyzerovich, Alexander. Wet-Steam Turbines for Nuclear Power Plants / A. Leyzerovich. — Tulsa : PennWell, 2005. — 456 p.
2. Алексей Дуб: Технологии на вырост (журнал "В мире науки"). URL: http://www.rosatom.ru/journalist/interview/tekhnologii-na-vyrost-zhurnal-v-mire-nauki-/?sphrase_id=352 (дата обращения 19.09.16)
3. Инновационный прорыв - аддитивные технологии СГАУ становятся реальностью. URL: http://www.ssau.ru/news/11687-Innovacionnyy-proryv---additivnye-tekhnologii-SGAU-stanovyatsya-realnostyu/ (дата обращения 19.09.16)
4. Ассоциация государственных научных центров «наука». URL: http://agnc.ru/ (19.09.16)
5. Атомный эксперт №6. URL: http://atomicexpert.com/sites/default/files/ae-639_web.pdf (дата обращения 19.09.2016)

Scientific advisor: A.V. Balastov, senior lecturer, Institute of Power Engineering, Department of Foreign Languages.

APPLICATION OF NUMERICAL METHODS IN THE STUDY OPERATIONAL CHARACTERISTICS OF THE COMBUSTION CHAMBER (PUMPING UNIT GPA-16U) AT DIFFERENT LOADS

[1]V. Konusarov, [2]L. Sobinova
[1.2]Tomsk Polytechnic University
Faculty Institute of Power Engineering
[1]Department electric power systems
group 5A3A

One of the problems in the operation of the gas turbine is to provide the reliable operation of the combustion chamber. Modern pumping units with the growth of the thermodynamic cycle parameters influences on a variety of aspects, such as: increasing temperature, rising pressure and, at last reliability problems.

Thus, the purpose of paper is to study operational characteristics of the combustion chamber by using numerical simulation. The object of research is the pumping unit (GPA-16U) that is considered to be useful to develop cost-effective and significant recommendations for further design, manufacture and operation of the combustion chamber and the pumping unit.

A detailed study of the combustion chambers is performed in different modes in order to prevent abnormal situations in future.