Journal of Engineering and Applied Sciences 12 (Special Issue 4): 6787-6789, 2017
ISSN: 1816-949X

Research of Vacuum Pumping of the Luminescent Lamp

O.Y. Kovalenko and Y.A. Pilshchikova
Mordovian State University of N.P. Ogaryov (National Research), Saransk, Russia

Abstract: In this study, technological operation-vacuum pumping of a luminescent lamp is described, criteria of the evacuating means choice-vacuum pumps or evacuating units, key parameters of vacuum pumps are described, results of pilot production studies of vacuum pumping of a luminescent lamp are stated, the schedules of interdependence of vacuum pumps parameters influencing productivity of vacuum system in general are provided.

Key words: Vacuum pumping, vacuum pump, luminescent lamp, production, pilot, parameters

INTRODUCTION

Pumping and filling of gas-filled lamps is the operation exerting decisive impact on lamp quality. The main objective of pumping and filling consists in creating the dense gaseous environment containing the minimum number of impurities and the polluting impurity in a lamp.

Gaseous impurity is understood as molecular gases, vapors of water and mercury as well as vapors of low-molecular organic substances. First of all oxygen of couple of water and carbon dioxide which can remain in lamps from the atmospheric air which was contained in them as well as hydrogen, carbon monoxide and hydrocarbons (oil vapors) which can get into a lamp during technological process belong to the polluting impurity in gas-filled lamps. Impurity of the specified type, possessing a big volatility, desorbing rather easily from a surface and are removed by the vacuum pump. In category plasma these impurities are exposed to polymerization that leads to poisoning of luminiferous layer and the activated surface of electrodes (Churkina *et al*., 2003; Novels, 2017).

MATERIALS AND METHODS

Main part: Vacuum pumping is a creation of the rarefied environment in the closed system for realization of technological process in the conditions excluding or minimizing impact of the gas environment on its course or creation of the rarefied environment for conducting pilot studies on studying of the rarefied environment impact on the mechanisms and devices intended for work in vacuum. Only the gas-filled lamp, free from such impurity can have the required durability (Van Atta and Hablanian, 1991; Demihov *et al*., 2009). Vacuum pumps of various types are used to receiving vacuum of the necessary degree. The technical progress made in the vacuum equipment allows to make the choice of vacuum pumps, units and systems for receiving working depression in the wide range of values from several to 10^{-10} Pa and less.

However, the right choice of the pumping means for any specific application is a hard task in the course of which solution, it is necessary to have the following basic data:

- The required size of working depression in the pumped-out volume
- the conditions shown to structure of the residual gas environment
- size of a total gas stream
- capacity of vacuum system
- Time of the set depression achievement in working volume

On the basis of the requirements formulated the type of the pump or unit is chosen and the schematic vacuum diagram is formed on the known formulas of the vacuum equipment calculation of vacuum system is made and the required productivity of the chosen type pump is defined.

However, at the choice of various type of the pump except the size of the limit depression created it is necessary to be guided also by some other factors for example, to know characteristics of their speed of pumping in the wide range of pressure, efficiency of the pumping-out action in relation to various components of gas mix, a possibility of warming up, it is also necessary to have data on reliability of work and service life of the pump, especially in working conditions at long cycles of process and short-term breaks in work and to consider

Corresponding Author: O.Y. Kovalenko, Mordovian State University of N.P. Ogaryov (National Research), Saransk, Russia

Fig. 1: Racks with evacuating lamps

Fig. 2: Evacuating post for pumping of luminescent lamps air

some economic characteristics. Carry limit vacuum, the greatest outlet pressure and speed of operation of the pump to key parameters of vacuum pumps (Uyueston, 1988).

Vacuum pumping was investigated on the example of a luminescent lamp in NIIIS of N.A. Lodygin. Works on pumping of air from lamps and tubes and to filling with their mercury are followed by allocation in air vapors of mercury and at semi-automatic pumping and mercury pouring.

Pumping of lamps was carried out according to specifications of their production (Fig. 1 and 2). The diffusive vacuum mechanical pump NVDM-250 with a nitric trap was used. Characteristics of the vacuum pump are presented in Table 1.

On the existing manufacturing techniques of luminescent lamps during pumping of a lamp outgas glass flasks and luminiferous covering warming up in the furnace at a temperature about 420°C then, carry out

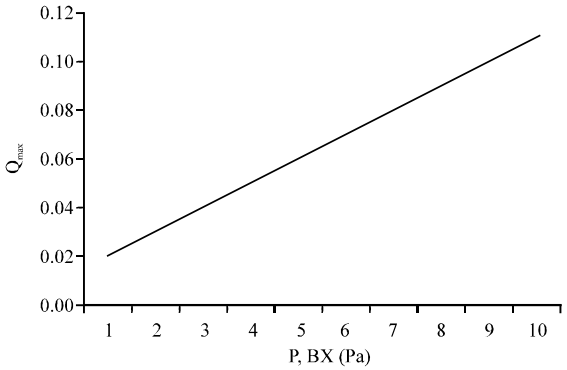

Fig. 3: Dependence of the maximum size of values on the pumped-out gas from pressure on an entrance to the ejector

Table 1: Characteristics of the vacuum NVDM pump

Name of parameters	Values
Extreme residual pressure at ambient temperature	
From 10-25°C, Pa (mmHg)	6.6×10^{-5} (5×10^{-7})
Over 25-45°C, Pa (mmHg)	6.6×10^{-4} (5×10^{-6})
The greatest outlet pressure, Pa (mmHg), not less	33.3(0.25)
Power consumption with a rated voltage of 380 V (W)	2000
The volume of the filled-in worker of liquid (L)	0.55
Consumption of the cooling water (L/h)	100
Return stream of vapors of working liquid (mg/min.cm^2)	8×10^{-4}
Weight (kg) under (without caps and details of their fastening)	31.5

decomposition of a carbonate covering of cathodes by calcinating the cathodes by electric current and further activation of cathodes, washing of lamps with inert gas, a training with the category, filling tap of ready lamps (Uyueston, 1988).

RESULTS AND DISCUSSION

It is considered that for normal work of a lamp, it is necessary that pressure of residual gases in it did not exceed 10^{-1} Pa. However, in practice this concept is mistakenly identified with extreme value of residual pressure in vacuum system of a post which is measured by the vacuum gage.

Modernization of vacuum system can be reached by updating of physically worn-out equipment, increase in productivity of evacuating systems and vacuum units, reduction of energy consumption of the equipment (Rozanov, 1990).

For the purpose of increase in productivity of evacuating systems and vacuum units dependence of the maximum size of a gas stream on pressure on an entrance was defined. On the basis of data the generalized schedule of dependence of the maximum size of values on the pumped-out gas from pressure on an entrance to the ejector (Fig. 3) is

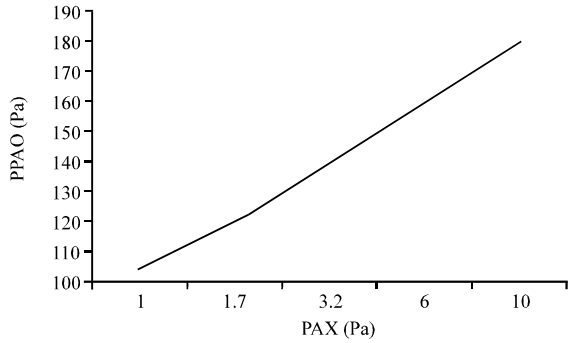

Fig. 4: Dependence of pressure on an entrance and working pressure

constructed. For the purpose of increase in productivity of evacuating systems and vacuum units dependence of pressure on an entrance and working pressure on the basis of data was defined, the generalized schedule of pressure dependence of working steam on a nozzle entrance to pressure on an entrance to the ejector (Fig. 4) is constructed.

Summary: The analysis of data and brought researches allows concluding that the most sensitive step to change the range of work in the diffusive pump is the ejector. Restriction of diffusive pumps operation on the maximum streams of the pumped-out gas is process of working liquid oxidation. Increase in pressure in a steam line of the diffusive pump leads to improvement of work characteristics on all steps of the pump and therefore, to increase in productivity of vacuum system in general improvement of vacuum pumping of a lamp.

CONCLUSION

It is possible to draw a conclusion that increase in pressure in a steam line of the diffusive pump leads to improvement of characteristics of work on all steps of the pump, it directly affects improvement of vacuum pumping productivity of a lamp.

REFERENCES

Churkina, N.I., V.V. Lityushkin and A.P. Sivko, 2003. Bases of Technology of Electric Light Sources. Mordov Publishing House, Saransk, Russian, Pages: 344.

Demihov, K.E., Y.U.V. Panfilov and N.K. Nikulin, 2009. [Vacuum Technique: Directory]. Mashinostroenie Publishers, Moscow, Russia, Pages: 590 (In Russia).

Novels, O.V., 2017. Research of Characteristics of the Vacuum Pumps used in Production of Light Sources. In: The XLV Ogaryovsky Readings: Materials of a Scientific Conference, Romanov, O.V., I.A. Kavyrkin and Y.A. Pilshchikova (Eds.). Mordov Publishing House, Saransk, Russian, pp: 386-389.

Rozanov, L.N., 1990. [Vacuum Technique]. Izdatel'stvo "Vysshaya Shkola", Moscow, Russia, (In Russia).

Uyueston, D., 1988. [Ultrahigh Vacuum Technology: For S'ang]. Mir Publishers, Moscow, Russian, Pages: 366 (In Russia).

Van Atta, C.M. and M. Hablanian, 1991. Vacuum and Vacuum Technology. In: Encyclopedia of Physics, Lerner, R.G. and L.T. George (Eds.). Wiley-VCH Publishers, Weinheim, Germany, pp: 1330-1333.