



DISCHARGE PROCESS IN DIELECTRICS

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Abstract: In the process of ionization, positive ions appear between the electrodes and move towards the cathode. Due to the difference in mobility of electrons and ions, during the movement of the electron beam to the anode, the positive ions remain in the place where they appeared. It is known that due to many ionizers in nature (space particles, radioactive radiation, ultraviolet radiation of the sun), free electrons continuously appear between the electrodes. A continuous avalanche of electrons occurs under the influence of the voltage placed between the electrodes

Keywords: electrodes, discharge, ionization, charge, voltage, dielektr, gas, amper, transformation, energy

I. Troduction The movement of charged particles between the electrodes creates a discharge current. An external ionizer should be added to ensure the flow of electric current through the gas between the electrodes at a voltage value lower than U_0 . After the effect of the external ionizer ends, the current flow between the electrodes also stops, and the discharge process is not independent. The highest electrical conductivity of gases. it is observed in its plasma state, because the conductivity of the plasma depends on the number of ionized ions.

II.Methodology & empirical analysis Electrical conductivity is also observed in gas, solid and liquid dielectrics. In dielectrics, conditions are created for the start of the discharge process only in strong fields. Relatively large conduction current appears in gases i.

Conduction current appears in real dielectrics under the influence of electric fields. But the electrical conductivity of the dielectric is much lower than that of the metal. The electrical conductivity of the dielectric has some negative consequences. Firstly, if the conductivity current of the dielectric is the cause of the energy loss (dielectric loss) that occurs when an electric field affects them, and secondly, this loss causes it to break from heat at a certain value of the electric field strength as a result of additional heating of the dielectric. can come

When the density of the gas is high, the effect of increasing the voltage is used in the devices where the compressed gas is used (for example, cables and capacitors). When the gas density is low, the effect of voltage increase is used in vacuum insulated devices (for example, high-voltage electron beam tubes, fluorescent lamps, vacuum switches).

II.Results. As the distance between the electrodes, that is, the thickness of the insulation, decreases, the discharge electric field intensity E_p increases. The physical meaning of such a connection is that the number of collisions increases with the decrease of the distance S , i.e., the length of the moving path of the avalanche. Therefore, to increase the number of collisions and the probability of ionization in the insulation gap, it is necessary to increase the strength of the electric field. A graph of this relationship is presented in Figure 1.

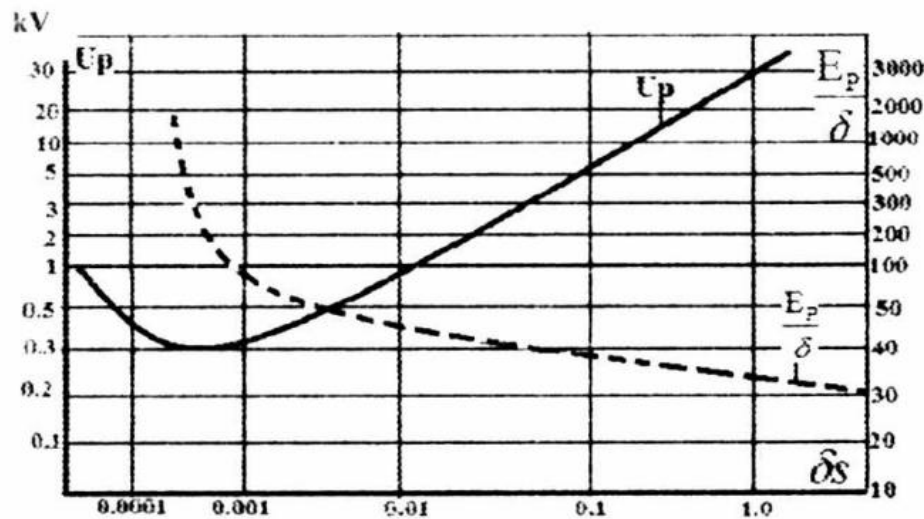


Figure 1. For air, $U_p=f(\delta)$ and $E_p=f(s)$ (dotted lines) for $\delta=1$.

Discharge processes in gases take the following forms:

- burst discharge;
- spark discharge;
- arc discharge;
- coronation discharge.

Bursting discharge. In rarefied gases, each avalanche leads to an increase in the number of initial electrons that drive the next avalanche. This type of discharge occurs at low pressures between the electrodes

(10-20 mm above the wire) appears, it completely covers the space between the electrodes, that is, plasma appears. In the plasma, most of the gas molecules are ionized and it is quasi-neutral ($N^+=N^-$) for the entire volume of the gas. Since the electrical conductivity of the plasma is very low, the absolute value and density of the current flowing through it will not be very large. (20-50 mA/cm²). Devices using this type of discharge include, for example, fluorescent lamps, gas light bulbs.

Spark discharge. In electrical networks, spark discharge occurs as a result of air insulation puncture under the influence of switching or atmospheric transfer impulse. As the current at the front of the pulse increases, the plasma channel heats up and expands. The expansion of the plasma channel increases to the anial in the form of a cylindrical shock wave. In the initial phase, the expansion of the channel sounds like an explosion. If wooden supports break under the influence of a spark discharge, reinforced concrete supports can crack. Experiments show that the electric field spark discharge does not develop in gases at the value satisfying the condition $E_{worker} < E_{kr}$. The transformation of a spark discharge into an arc discharge is probable.

The spark discharge plays a leading role in the controlled thermonuclear reaction. The first thoughts on this issue were expressed in academician Kurchatov's document. Excess energy as a result of such a reaction A4 is scattered into the environment by radiation with a wavelength of l. In this

$$\lambda = \frac{K}{\Delta A} = \frac{2 \cdot 10^{-8}}{\Delta A}$$

K- calculation coefficient; ΔA - radiation energy, (eV).

A spark discharge occurs at extremely large values of the distance between the electrodes and the gas pressure, and the developing discharge does not completely occupy the space between the electrodes, but occupies a certain narrow channel. The concentration of ionization in the plasma filling this channel is high enough. the value of the current flowing through it can be large enough. The value of the flowing current is determined by the power of the source.

Arc discharge is a further form of spark discharge, which occurs only when the power of the source is large enough. Arc discharge appears after a spark discharge at a value satisfying the operating condition of the electric field strength under operating voltage between the electrodes of high-voltage electrical equipment. An arcing discharge occurs when a burning conductor falls on the electrodes. In arc discharge, when the current density is 250-500 kA/cm², it is called a free arc, and when it is 6-18 kA/cm², it is called a spray arc. In this case, a large current flows through the channel between the electrodes, it heats up the channel and further increases its conductivity, resulting in a further increase in current. As the current in the arc channel increases, the voltage in the arc decreases, because the increase in current leads to an increase in the cross section of the arc channel and thermoionization of the gas, tennoelectron emission on the heated surface of the cathode.

Under normal conditions, the voltage that ensures the ignition of the arc when the distance between the electrodes is 1-100 cm is found from the following relationship:

$$U_{\text{voy}} = 62 + l(11,4 + \frac{32,6}{i})$$

where i is the current passing through the arc channel, l is the length of the arc. The arc formed in alternating current voltage can extinguish and re-ignite when the current passes from zero. The electrical stability of this electrode gap depends on the recovery rate of E_1 and the increase of the electric field strength E that creates the recovering voltage. If $E_1 > E$, the arc is extinguished.

A rapid increase in the electric strength of the arc gap is observed in the grooves or in the mixing of heated plasma with cold air. This principle is used in tube dischargers, oil circuit breakers and high voltage circuit breakers using air spray.

Corona discharge is a type of independent discharge that occurs in highly inhomogeneous electric fields. The process of ionization takes place in a small area near the electrodes and does not form a conductive discharge channel regardless of the pressure of the gas. Coronation does not mean the complete loss of the insulating properties of gases.

The discharge that develops on the surface of power line conductors or any electrode with a small radius of curvature during coronation under the influence of operating voltage is called coronation discharge. Corrosion near the surface of the conductor (on the wire) is characterized by the appearance of flame, the spread of crackling sound, the appearance of noise and the effect of high-frequency interference.

The appearance of corona indicates that the electric field is not very homogeneous and that there is an electric field strength sufficient for the development of volume and surface ionization on the surface of the electrode where corona is developing. This value of the electric field strength is called the critical value of the electric field strength.

For example, for a polished wire of radius r placed along the axis of a cylinder with radius R , the critical intensity of the electric field is determined by the following empirical formula:

$$E_{kr} = 31\delta(1 + \frac{0,308}{\sqrt{r\delta}}), U_{kr} = E_{kr}r \ln \frac{R}{r}$$

Two conductors of radius r located at a distance $S \gg r$ from each other for or for a conductor passing through a plane at a height of $h=S/2$, the following formulas are appropriate:

$$E_{kr} = 31\delta \left(1 + \frac{0.301}{\sqrt{r\delta}}\right), U_{kr} = E_{kr} r \ln \frac{S}{r}.$$

The above formulas are very similar in structure, but the results obtained by them are also very close.

The development of corona discharge in the conductors of the electric transmission line leads to the deterioration of technical and economic indicators by the flow of slip current between the conductors and the occurrence of energy waste. To determine the dissipation in the corona at constant current voltage, it is necessary to determine the volt-ampere characteristic of the corona ($I = f(U)$). Then the power loss per unit length of the line is determined using the following formula

$$P = Uf(U)$$

Coronation dissipation at constant current voltage is found as:

$$P = AU^2(U - UK)$$

Here is the coefficient that depends on the geometric shape of the A-electrode gap.

In alternating current power lines, the polarity of the conductor is constantly changing. When the polarization of each conductor changes, the volume charge moves away in the first half-cycle, and moves closer in the second half-cycle.

If $r_{max}^2 \gg r^2$ We can estimate the displacement of the volume charge from the axis of the conductor with radius r , where the corona discharge is developing, using the following formula:

$$r_{max} \approx \sqrt{kT} E_{kr} r$$

Determining the dissipation of corona in alternating current voltage is brought to the calculation of its volt-coulomb characteristic. The coronal dissipation in alternating current voltage is found by the empirical formula recommended by the American engineer Pick.

$$P = \frac{241}{\delta} (f + 25) \sqrt{\frac{r}{D}} (U_f - U_0)^2 10^{-5}$$

where d is the relative density of air; D is the average geometric distance between conductors; r is the radius of the conductor; f - frequency; U_f - the effective value of the phase voltage; U_0 is the calculated voltage close to the critical voltage, which is determined by the following expression:

$$U_0 = 21.2 r \ln \frac{S}{r} m_1 m_2,$$

Where $m_1 m_2$ is the support of the conductor and the weather coefficient. The coefficient m_1 characterizes the condition of the surface of the conductor, and for real conductors this coefficient is in the range of $0.85 \div 0.9$. Irregularities on the surface of the conductor further reduce the detection coefficient. The coefficient m_2 takes the installation depending on the wet and foggy weather conditions of the crowning waste. One of the main ways to waste crowning is to increase the diameter of the conductor.

$m_1 m_2 = 0.8$, taking the relative air density $\delta = 1.0$ as the average $\ln \frac{S}{r} = 6.5$ for high-voltage overhead power lines, the phase voltage for open weather conditions can be expressed as:

$$U_f = \frac{U_I}{\sqrt{3}} = 21.2 \cdot 0.86 \cdot 6.5 r \approx 110 r$$

In operating conditions, the voltage in the power transmission line can be up to 10% higher than its nominal value. Then we make the following condition for the minimum diameter ($d_{mm} = 2r$):

$$d_{min} = 1.15 \cdot 10^{-2} U_n$$

where d_{mm} is expressed in centimeters, and U_n is expressed in kV. The value of their equivalent diameter is determined based on this relationship when phase conductors are used in high and ultra-high power transmission lines:

$$r_E = \sqrt[n]{ra^{n-1}} \text{ or } r_E = \sqrt[n]{rD_1 \dots \dots D_{n-1}}$$

where a is the step of splitting the phase $D_1, \dots, D_{n-1}$ is the distance from the arbitrary conductor to the remaining conductors in the phase

Knowing the capacitance of the phased line, it is possible to determine the charge located on each conductor. If the charge were evenly distributed on the surface of the conductors, the strength of the electric field it creates on the surface of the conductor would be determined as follows:

$$E_{or} = \frac{U_f}{nr \ln \frac{S}{r}}$$

III. Conclusions. In practice, due to the influence of other conductors in the phase, the distribution of the field along the surface of the conductor will not be flat. Because the strength of the field created by the cylindrical conductors changes proportionally to the distance between the conductors, and in real lines $S \gg D$.

References:

1. Abdixoshimov, M., & Tojimurodov, D. (2023). KRANLAR TO 'G 'RISIDA UMUMIY TUSHUNCHALAR. Science and innovation in the education system, 2(6), 5-7.
2. Абдихошимов, М. (2024). ДОСТИЖЕНИЕ ЭНЕРГОСБЕРЕЖЕНИЯ В КРАНОВЫХ ЭЛЕКТРОПРИВОДАХ. ОБРАЗОВАНИЕ НАУКА И ИННОВАЦИОННЫЕ ИДЕИ В МИРЕ, 36(5), 138-140.
3. Абдихошимов М. ДОСТИЖЕНИЕ ЭНЕРГОСБЕРЕЖЕНИЯ В КРАНОВЫХ ЭЛЕКТРОПРИВОДАХ //ОБРАЗОВАНИЕ НАУКА И ИННОВАЦИОННЫЕ ИДЕИ В МИРЕ. – 2024. – Т. 36. – №. 5. – С. 138-140.
4. Абдихошимов М. ВЫБОР СИЛОВОЙ СХЕМЫ КРАНОВОГО ТПН //Лучшие интеллектуальные исследования. – 2023. – Т. 11. – №. 5. – С. 99-102.
5. Абдихошимов, М. (2023). ВЫБОР СИЛОВОЙ СХЕМЫ КРАНОВОГО ТПН. Лучшие интеллектуальные исследования, 11(5), 99-102.
6. Abdulboqi o'g'li A. M. et al. ПРИМЕНЕНИЕ ПРЕОБРАЗОВАТЕЛЕЙ ЧАСТОТЫ ОБЩЕПРОМЫШЛЕННОГО ИСПОЛНЕНИЯ В КРАНОВОМ ЭЛЕКТРОПРИВОДЕ //International journal of scientific researchers (IJSR) INDEXING. – 2024. – Т. 4. – №. 2. – С. 149-152.
7. Abdulboqi o'g'li, A. M., Ibrohimjon o'g'li, T. R., & Zaynabidin o'g, X. M. B. (2024). ПРИМЕНЕНИЕ ПРЕОБРАЗОВАТЕЛЕЙ ЧАСТОТЫ ОБЩЕПРОМЫШЛЕННОГО ИСПОЛНЕНИЯ В КРАНОВОМ ЭЛЕКТРОПРИВОДЕ. International journal of scientific researchers (IJSR) INDEXING, 4(2), 149-152.

8. Turatbekova A. et al. Research into biologically active plant terpenoids and the mechanisms underlying on biological activity // E3S Web of Conferences. – EDP Sciences, 2024. – Т. 563. – С. 03076.
9. Turatbekova, A., Masharipova, M., Umarova, F., Khalmuradova, E., Rustamova, R., Abdixoshimov, M., & Teshaboyev, R. (2024). Research into biologically active plant terpenoids and the mechanisms underlying on biological activity. In E3S Web of Conferences (Vol. 563, p. 03076). EDP Sciences.
10. Ходжиматов, М. Б. (2023). ВЫБОР ПОВЕРХНОСТИ СЕЧЕНИЯ СЕТЕВОГО ПРОВОДНИКА ПО ДОПУСТИМОМУ РАССЕЯНИЮ НАПРЯЖЕНИЯ. ОБРАЗОВАНИЕ НАУКА И ИННОВАЦИОННЫЕ ИДЕИ В МИРЕ, 35(5), 52-56.
11. Zaynabidin o'g'li, M. B. (2023). THE RELEVANCE OF THE APPLICATION OF MICROPROCESSOR RELAY PROTECTION. Educational Research in Universal Sciences, 2(13), 155-157.
12. Ходжиматов М. Б. ВЫБОР Поверхности сечения сетевого проводника по допустимому рассеянию напряжения // Образование наука и инновационные идеи в мире. – 2023. – Т. 35. – №. 5. – С. 52-56.
13. Turatbekova, A., Parmanova, N., Abdukadirova, M., Khadzhiev, A., Arzikulov, X., & Xodjimatov, M. B. (2024). Study on the effect of organic fertilizers for enhancing the yield and quality of the white cabbage (*Brassica oleracea* var. *Capitata* f. *alba*). In E3S Web of Conferences (Vol. 563, p. 03075). EDP Sciences.
14. Khodjimatov, M. B. (2023). The principle of operation of automated lathes. International journal of scientific researchers (IJSR) INDEXING, 3(2).