# INFLUENCE OF ELECTROSTATIC FIELD ON LOW–TEMPERATURE PLASMA

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***Abstract.*** *The article is devoted to analyzing of the theoretical and practical study of the nature of the influence of electrostatic field in low-temperature plasma as a source of electrostatic field acts converter, followed by the application of this phenomenon in everyday life, using a more powerful device Tesla generator. Conducted theoretical calculations, which give an answer to the question: Is it possible to put out the fire using the electrostatic field? The description of technology of application of this phenomenon in the real world.*

***Keywords:*** *Electrostatic field, low-temperature plasma, Tesla generator, converter, candle.*

Everybody knows what a great harm fires can do to people, buildings and nature through burning. They threaten human life, animal life, health and property of people. Firefighting is the practice of attempting to extinguish a fire, protect life and property, and minimize damage and injury. Fire (or conflagration) can be accidentally begun, naturally caused in forests or specially created by a man.

Fire is the rapid oxidation of a material in the exothermic chemical process of combustion, releasing heat, light and various reaction products. Fires can be extinguished traditionally by water, fuel removal or chemical flame inhibition [1].

Military agency DARPA engineer's invented an unusual method of extinguishing fire. This is a method with using electric field. It was affecting the flame, so powerful particle flow occurred, which were blowing flames away.

The second method assumed, that fire can be extinguished by sound waves. They put fire between two speakers in experimental machine. Fire have been extinguished in few seconds [2]. That means, that acoustic waves affects on flames by decreasing its temperature.

In some respects, firefighting technology has come a long way over the several past decades. Now we have flame suppressing foams and powders for instance, as well as new ways of delivering them to the fire [3]. But in general, we're still fighting fires in the old- fashioned way: we use a point hose, a bucket and a pressurized container.

Extinguishing fire with the help of electrostatic field may be more effective.

The effects of electric fields on burning flames have been studied by using several types of experimental techniques as well as few numerical methods. The flame is influenced by the electric field mainly due to electric charges present in it as a result of chemical reactions that take place in the flame. In earlier experiments it was shown that the electrical power needed to influence the flame is much less compared to the combustion energy generated by the burning flame.

A group of researchers from Harvard University in the USA predicts a day when firefighters will snuff out flames not with a physical suppressant but with a blast of electric current.

The scientists described means of extinguishing flames without flooding buildings with a large amount of water. American researches developed an electrical wave «blaster» that could be the basis of a new method of firefighting.

A blaster could allow firefighters to open a path in a wall of flame in order to get inside a burning building, or open a passage of escape for people trapped inside the building. The device could even be mounted into the ceiling and save entire buildings from getting burnt when a fire breaks out in one small corner.

Now we want to describe you an experiment that will show you the interaction of the electromagnetic field and a flame.

H-v converter «Разряд-1» (pic. 1.) consists of two electrodes and a source of voltage. There is a candle between two electrodes. First we supplied a negative charge to the flame (pic. 2. *а)*. As a result, no extinguishing of the flame happened because positive and negative ions were attracted to each other.

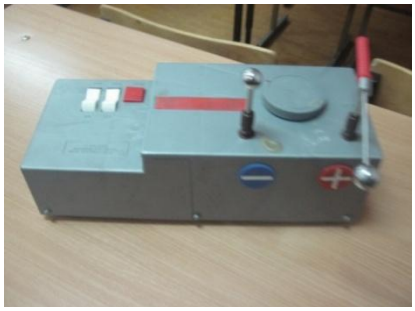
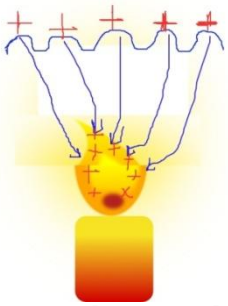
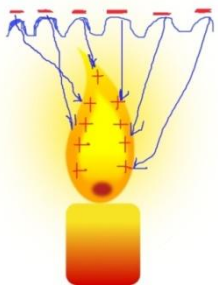


Figure 1. H-v converter «Разряд-1»

But when we supplied a positive charge (pic. 2. *б)*, positive charges of the flame and positive charges of the field repelled, so we were able to see a little interaction of the flame and electromagnetic field. The flame was reduced and held back, because the power of the converter wasn't big enough to extinguish the flame completely. The capacity of the converter is about 5W with 12V voltage.



a – a negative charge to the flame



*б – a positive charge to the flame;*

Figure 2. The interaction the electromagnetic field and a flame of the candle:

As we said we could use this technique of extinguishing fire in real life (in barns, for example). For this purpose we can use Tesla generator as a converter.

Figure 3. Tesla coil

Tesla coils produce positive electric charges powerful enough to interact with fire. Tesla coil with a metal grid as an electrode can produce a positive electric charge which will interact with positive charges contained in the fire. If fire occurs, smoke sensors (which are mounted in the Tesla coil) will send a signal to a smart phone and the Tesla coil will acti-

vate immediately. As a result these similar positive charges repel and expansion of the fire stops. You can activate the coil yourself without sensors, using Faraday's cage which will compensate electric charge.

To extinguish fire with electric field during one discharge, we need the coil power to be bigger, than heat quantity, which is emitted when the flame is burning.

The power of our MIDI-coil is 600W and it works under 220V.

**Calculations**

To extinguish fire with electric field during one discharge, we need the coil power to be bigger, than heat quantity, which is emitted when the flame is burning.

Our MIDI-coil's power is 600Vt and 220V voltage.

In the 1st picture you can see a plan of the barn, which is built from wooden planks (Birch). Planks thickness is-20mm.

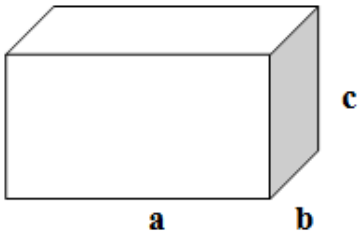



Figure 1.The plan of the barn: a=2,5; b=6,5; c=3,5

$$Q = qm; \quad (1)$$

$q$-wood specific combustion =10MJ/kg

$$m = \rho v; \quad (2)$$

$\rho =$ wood density (Birch)=650kg/$m^3$wood density (Birch)=650;

We'll presume barn floor is burning. Let's find the floor's volume:

$$V=(2a+2b+4c)h=0,64m^3 ; \quad (3)$$

$$m=0.64м^3*650\ kg/m^3=416\ kg, \text{ than} \quad (4)$$

$$Q=10MJ*416kg=4160MJ; \quad (5)$$

H – wooden plank thickness is 2cm.

**Results**

Our calculations show that the capacity of Tesla coils is not big enough to extinguish the fire in the barn. In conclusion we can say, that this idea is very perspective. Of course, you can't extinguish fire completely, but you can stop expansion of fire, thanks to the laws of physics.

**References**

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# ВЛИЯНИЕ ЭЛЕКТРОСТАТИЧЕСКОГО ПОЛЯ НА НИЗКОТЕМПЕРАТУРНУЮ ПЛАЗМУ СВЕЧИ

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***Аннотация.*** *Данная статья посвящена проведению теоретического и практического изучения природы воздействия электростатического поля на низкотемпературную плазму, в качестве источника электростатического поля выступает преобразователь, с последующим применением данного явления в повседневной жизни, используя в качестве более мощного устройства генератора Тесла. Проводятся теоретические расчёты, которые дают ответ на вопрос: Возможно, ли потушить пламя при помощи электростатического поля? Приводится описание технологии применение данного явления в реальных условиях.*

***Ключевые слова:*** *электростатическое поле, низкотемпературная плазма, генератор Тесла, преобразователь, свеча.*