

The Hazards and Protection Measures Against Electromagnetic Radiation Generated by Household Appliances

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Abstract: Household appliances generate electromagnetic radiation in the process of use, and prolonged exposure to excessive electromagnetic radiation can do harm to the human body. A correct understanding of electromagnetic radiation generated by household appliances and its prevention can effectively mitigate the impact of electromagnetic radiation on the human body. In this paper, we analyze electromagnetic radiation generated by common household appliances and presents opinions on how to protect against electromagnetic radiation.

Keywords: Household appliances, Electromagnetic radiation, Prevention.

1. Introduction

Recently, France has required Apple Inc. to temporarily suspend the sale of iPhone 12 smartphones in their country, due to excessive levels of electromagnetic radiation. This event once again brings the issue of electromagnetic radiation generated by communication devices and household appliances into people's attention. Electromagnetic radiation, just like air, is ubiquitous. Regarding electromagnetic radiation, we need to have an intuitive and correct grasp of it, neither exaggerating its harm nor neglecting its harm. And it is important to scientifically understand its hazards and protect ourselves consciously.

2. Principle of Radiation Generation by Household Appliances

Radiation refers to the propagation of energy in space. Radiation can be classified into particle radiation and electromagnetic radiation based on type, and into ionizing radiation and non-ionizing radiation based on mode of action. The electromagnetic radiation generated by household appliances generally belongs to non-ionizing radiation, and has far less effect on human health compared with ionizing radiation that directly damages molecules and chemical bonds in the human tissues, but it is also to be reckoned with.

Non-ionizing radiation includes visible light, ultraviolet rays, infrared rays, radio waves, ultrasound waves and microwaves, etc. Although the energy carried by them is too little to change the chemical properties of substances, they still transfer energy, accelerate the thermal movement of molecules, and raise the temperature of objects. Prolonged exposure to the range of action of non-ionizing radiation can exert an effect on the human body. Common household appliances generally contain one or more non-ionizing radiation sources. Household appliances, whether big or small, have components that give rise to electromagnetic radiation, they all generate electromagnetic radiation to a greater or lesser extent, although the principles and intensities of radiation generation differ. The wavelengths of non-ionizing radiation sources, if arranged in descending order, are as follows: radio waves, microwaves, infrared rays, visible light,

and ultraviolet rays, with shorter wavelengths indicating stronger radiation capability.

3. Analysis of Electromagnetic Radiation from Common Household Appliances

All household appliances can generate electromagnetic waves and electromagnetic radiation, but when the human body is in an environment with excessive electromagnetic radiation for a long time, major physiological systems can be injured to varying degrees, resulting in symptoms such as insomnia, memory decline, irregular heart rate, decrease in white or red blood cell counts, increased chance of cancer cell proliferation and impaired vision. On this account, we should develop an accurate perception of the electromagnetic radiation characteristics of household appliances, use them properly, and mitigate the impact of radiation on the human body.

In terms of safety limits for electromagnetic radiation, it is important to note that when the frequency of electromagnetic waves is within the range of 30M~3000MHZ, the standard limit for electromagnetic radiation is 400MW/cm²; when the frequency is below 30MHz, it belongs to low-frequency radiation, and the standard limit for radiation is 0.12μT[3].

3.1. Television

The television itself is a source of electromagnetic radiation, which generates electromagnetic waves during its operation, thus releasing electromagnetic radiation. Apart from electromagnetic waves, televisions also emit static electricity, and produce static electricity radiation. In the picture tube of a television set, rays need to be produced to promote the electrons to form images, so there is also a small amount of ray leakage during television operation. The backlight sources of televisions are typically fluorescent lamps or LED lamps, which contain ultraviolet rays and generate radiation, as well. Outdated television sets used to emit more rays and static electricity when they were is use, so the radiation levels were high. However, after the popularization of LCD television, the electromagnetic radiation generated by televisions is much smaller compared with previous models.

A domestically produced 32-inch television has a radiation level of about $19.2\mu\text{T}$ near its LCD screen, which falls sharply to $0.12\mu\text{T}$ at a distance of 18cm from the screen[2], through measurement with a professional device. Although the radiation of LCD of televisions is high, it decreases rapidly with the increase of distance. Therefore, keeping a certain distance from the TV screen can effectively control the electromagnetic radiation received, and the larger TV screen, the longer distance should be kept.

3.2. Laptop

Laptops are the preferred choice for people's daily work. In the process of use, a variety of components of laptops, such as the chassis, monitor and keyboard, can generate electromagnetic fields, and produce in electromagnetic radiation. In addition, some components in computers probably contain heavy metals, which emit rays that also contribute to radiation. As manifested by experimental results, the radiation level is the highest near the monitor, but also decreases the most quickly with the increase of distance. On the other hand, the radiation level at the keyboard decreases the most slowly and doesn't fall below the safety limit, until at a distance of about 24cm above the keyboard. The experimental results reveal that the back of the monitor also emits strong radiation, and at a distance of 10cm from the back, the radiation level drops below the safety limit. Therefore, during the use of laptop, it is advisable to avoid having the back facing directly towards other people, minimize the time spent on the keyboard, and keep away from the computer screen as far as possible.

3.3. Desktop

Compared with laptops, desktops offer a wider range of component choices and have higher cost-effectiveness. The principle of their generation of electromagnetic radiation is similar to that of laptops. Through a test with testing devices, it is found that the CPU of a desktop emits the strongest radiation and has the weakest attenuation ability. The radiation level doesn't drop below the safety limit until at a distance of about 20cm from the CPU. The radiation at the computer fan and hard disk is also strong, but decreases quickly, and basically drops below the safety limit at a distance of 10cm. In contrast, the radiation from the monitor drops below the safety limit at a distance of 7cm from the back and 6cm from the front. Therefore, the safe distance of a desktop is about 20cm [2].

3.4. Microwave Oven

In daily life, the microwave oven is an indispensable household appliance in the kitchen. The working principle of a microwave oven is to convert electrical energy into microwaves using a magnetron in it, which has a frequency of 2.45GHz and can generate high-frequency electromagnetic radiation. On the other hand, the internal current can also emit low-frequency radiation. Through measurement with devices, it is found that the maximum high-frequency radiation is detected at the slit of the front door of microwave oven, which attenuates slowly. The maximum radiation level measured at the slit is about $6453.1\text{mw}/\text{cm}^2$, far exceeding the safety limit of $400\text{mw}/\text{cm}^2$. The high-frequency radiation around the slit of the door of microwave oven is always strong, while the radiation on the sides of the oven is weak, always below the safety limit [2].

Through a test of low-frequency radiation of microwave

oven, it is found that the low-frequency radiation on all sides of the microwave oven is always strong, and the right side has the strongest radiation. The radiation doesn't decrease to $0.12\mu\text{T}$ until at a distance of 124cm from the right side. Combined with the results of high-frequency analysis, during the use of microwave oven, it is recommended to keep a distance of at least 124cm, and not to stay around the microwave oven for long.

3.5. Hair Dryer

When a hair dryer is in use, the internal motor generates an electromagnetic field through currents, converting electrical energy into mechanical energy, and during this process, electromagnetic radiation is generated. A hair dryer is tested during its operation. When it is in the low cool mode, the maximum electromagnetic radiation value at the handle is $19.52\mu\text{T}$. When it is in the high hot mode, the radiation at the handle exceeds the maximum measured value of $19.99\mu\text{T}$. And it is only at a distance of 17cm from the handle that a reading of $19.89\mu\text{T}$ is obtained [2]. The radiation value at the air outlet declines with the increase of distance, but rate of decline gradually slowed down. At a distance of 8cm from the air outlet, the radiation level is about $18.8\mu\text{T}$, and at a distance of 32cm, the level is about $0.1\mu\text{T}$. Hair dryers belong to household appliances with relatively high radiation, so we should minimize the use of hair dryers and keep away from the air outlet as far as possible when using it.

3.6. Electric Rice Cooker

The electric rice cooker directly heats the pot inside it by using an electromagnetic coil connected with alternating current and raises the temperature quickly. Electromagnetic waves are generated in this process, and further electromagnetic radiation is produced. During the operation of a rice cooker, its electromagnetic radiation is tested, and it is found that the radiation around the rice cooker decreases with the increase of distance, but the rate of decrease varies. At a distance of 11cm from the front of rice cooker, the radiation decreases to $0.12\mu\text{T}$. At a distance of 22cm from the back, it drops to $0.12\mu\text{T}$. On the left and right sides, the radiation also drops to $0.12\mu\text{T}$ at distances of 12cm and 14cm, respectively. To sum up, when using an electric rice cooker for heating, it is recommended to keep a distance of at least 22cm.

3.7. Induction Cooker

The working principle of an induction cooker is similar to that of an electric rice cooker. It first converts a 50Hz low-frequency alternating current into a 30-40KHz high-frequency alternating current, and then applies it to the coil panel of the induction cooker, to generate a high-power electromagnetic field. After that, it makes use of the electromagnetic field to produce eddy currents and converts electromagnetic energy into heat energy for heating. This process produces electromagnetic radiation.

Through a test of induction cookers with different power levels, the higher the power level, the higher the electromagnetic radiation emitted, and the farther away from the induction cooker, the smaller the electromagnetic radiation. Taking a 2100W power induction cooker for example, the strongest electromagnetic radiation is detected above the induction cooker. It is at a distance of 160cm that the radiation above drops to the safety limit of $0.12\mu\text{T}$, whereas the second strongest electromagnetic radiation is

detected on both sides, which falls to 0.12 μ T at a distance of 107cm. When an induction cooker is in use, it is recommended to keep a distance of at least about 1m^[2].

3.8. Refrigerator

The refrigerator is a household appliance with a relatively low working frequency and relatively low electromagnetic radiation. When a refrigerator is working, the electromagnetic radiation generated mainly comes from two parts: one is the compressor and the other is the heat dissipating pipes at the rear or bottom. Among them, the electromagnetic radiation generated by the compressor dominates.

A refrigerator is tested during its operation. The electromagnetic radiation right in front of the refrigerator door is small, basically the same as the surrounding environment. For both sides, the electromagnetic radiation in the upper parts is also relatively small, similar to the ambient level, while the electromagnetic radiation in the lower part near the compressor is high. The maximum radiation is detected at the rear of refrigerator near the wall, but it attenuates quickly. The radiation is similar to the ambient level at a distance of 25cm from the rear of the refrigerator.

4. Methods to Protect Against Electromagnetic Radiation from Household Appliances

Household appliances are necessities in daily life, and their use is unavoidable. Based on an analysis of electromagnetic radiation from household appliances above, we can learn that each household appliance produces electromagnetic radiation, and prolonged exposure to excessive electromagnetic radiation can have varying degrees of impact on the human body. To effectively prevent and mitigate the impact of electromagnetic radiation generated by household appliances on the human body, some measures and methods can be adopted and implemented. These measures and methods can be divided into those for appliances themselves and those for individuals.

Regarding measures and methods for appliances themselves, firstly, when choosing home appliances, we should give priority to high-quality products. When buying household appliances, we should first choose products by regular manufacturers. Products without conformity certificates and without explicit indication of codes and names of executive standards should not be considered [4]. Secondly, having learned the propagation characteristics of electromagnetic radiation generated by household appliances, we should first try to stay away from sources of radiation. Being aware of the cumulative effect of radiation hazard, it is advisable to avoid using high-radiation household appliances for extended periods whenever possible. With respect to the placement of household appliances, we should avoid concentrated placement, especially avoid placing large-power appliances such as televisions, computers, and refrigerators in the bedroom. If household appliances are temporarily not in use, don't leave them the standby mode, for even in the standby mode, household appliances can generate weak

electromagnetic fields. At the same time, proper ventilation should be ensured when using household appliances.

The protection measures for individuals include: to mitigate the impact of electromagnetic radiation on the human body, one may choose to drink two to three cups of green tea or chrysanthemum tea daily, for they contain rich provitamin A, which can be converted into vitamin A in the body and effectively mitigate the impact of electromagnetic radiation on the human body. Secondly, it is advisable to eat more foods that are high in calcium, able to enhance the body's resistance to disease and improve eyesight, etc. Also due importance should be given to the intake of trace elements.

Apart from the above protection methods, we can also protect ourselves during the propagation of electromagnetic radiation. For example, the impact of household appliances on the body during operation can be effectively mitigated by using electromagnetic radiation protection suits. Alternatively, electromagnetic radiation protection cards can be used, which are made of a variety of high-energy materials that utilize the principle of energy conversion, to convert electromagnetic energy into thermal energy, thereby forming an electromagnetic wave attenuation range centered on the card, effectively absorbing and reducing electromagnetic radiation. Besides, we can also use electromagnetic protection glass, screens, and films. The screens are shielding mesh screens made of glass or resin under high temperature and pressure through special processes, which can effectively shield electromagnetic radiation and be attached to the surface of the screens of computers, televisions and communication devices, to minimize the propagation of electromagnetic waves.

Household appliances can generate electromagnetic waves during use, which is unavoidable. We do not need to demonize them. As long as we have a correct grasp of it, and choose appropriate methods, we can minimize the impact of electromagnetic radiation generated by household appliances on the body.

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