

Application and development of microwave sterilization technology



Under the action of microwave electromagnetic field, the polar molecules in the dielectric materials consisting of polar and non-polar molecules change from thermal motion state to alignment orientation following the alternation of electromagnetic field of [microwave drying machinery and equipment](#), resulting in intense friction between molecules. In this microscopic process, microwave energy is transformed into heat in the medium, which makes the temperature of the medium increase macroscopically. This is the microwave thermal effect.

In recent years, [microwave sterilization equipment](#) has been applied in clinical work. Microwave can sterilize metal instruments needed for operation. Microwave irradiation is used to sterilize surgical knives, surgical scissors, steel plates, screws and steel needles contaminated by bacteria. The irradiation time is 3 to 5 minutes, which can completely kill *Escherichia coli*, *Staphylococcus aureus* and hepatitis B virus. In addition, due to the potential shortage of allogenic bone required for allogenic bone transplantation due to bacterial contamination, foreign scholars can effectively sterilize contaminated femoral head allogenic bone after microwave irradiation in a domestic microwave oven for 2 minutes.

However, the interaction between microwave and organism is a complex process, in addition to the thermal

effect, there are non-thermal effects. The non-thermal effect is that microwave electric field changes the distribution of electrons in the cell membrane section, affects the concentration of electrons and ions around the cell membrane, changes the permeability of the cell membrane, and makes the cell unable to metabolize normally, thus causing cell dysfunction. Another explanation of non-thermal effect is that polar molecules such as protein, nucleic acid and water cause the rotation or vibration of protein molecular groups in the microwave field of high frequency and strong electric field, which results in the denaturation of protein molecules.

Microwave sterilization is the synergistic effect of microwave thermal effect and non thermal effect. Microwave heating effect can increase the temperature of substances, modify or inactivate the molecular structure of proteins and nucleic acids in microorganisms, and kill microorganisms. Microwave non-thermal effect makes organisms produce strong biological response without obvious internal temperature rise, and causes various physiological, biochemical and functional changes in organisms, leading to bacterial death and sterilization.

1.2 the characteristics of microwave sterilization (1) microwave sterilization belongs to physical sterilization, which is safe and harmless. Without adding chemical preservatives, bacteria, molds, eggs, viruses and other harmful microorganisms can be killed. When food is sterilized, it will not pollute the food again with toxic or radioactive substances, nor will it change the color, fragrance and nutrition of the food. (2) Without preheating, under the same conditions, the lethal temperature of microwave sterilization is lower than that of traditional heating sterilization, and the sterilization effect is more remarkable. (3) The sterilization cycle is short, the speed is fast and the consistency is high, and the whole sterilization can be carried out on the surface of the sterilized material at the same time.

Two

Three

4. Microwave heating is caused by the loss of electric field energy of the dielectric material itself, so the sterilization time of microwave heating is greatly shortened. Under a certain power density, it usually takes tens of seconds and minutes to achieve satisfactory results. Microwave has penetrability, and it acts on both the surface and the interior of the medium. It can ensure that both the interior and exterior temperatures meet the required values, so the sterilization is uniform and thorough. (4) effectively avoid the effect of prolonged heating on food quality. Microwave sterilization can achieve the best results for materials that need sterilization as well as quality requirements such as color, fragrance and taste unchang