The Microwave
Theory And Application

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Abstract-**we are now see the improvement in the technology and we all know that this improvement is developing day by day and I'm here talking about the microwave oven and discuss the theory of the working and simple equation to calculate the power of this oven.**

I_ introduction

We all use the microwave oven everywhere at homes, restaurants, and also here in KFUPM we are always use the microwave. But somebody asking what is the microwave oven, who invent it, and haw it is work. Like many of today's great inventions, the microwave oven was a by-product of another technology. It was during a radar related research project around 1946 that Dr. Percy Spencer was testing a new vacuum tube called a magnetron when he discovered that the candy bar in his pocket had melted. This intrigued Dr. Spencer, so he tried another experiment using some popcorn and notice the popcorn sputtered. The next morning, Scientist Spencer decided to put the magnetron tube near an egg. The rapid temperature rise within the egg was causing tremendous internal pressures. Evidently the egg exploded and splatterehot yolk all over. This lit up with a logical scientific conclusion: the melted candy bar, the popcorn, and now the exploding egg, were all attributable to exposure to low density microwave energy. Thus, if an egg can be cooked that quickly, why not other foods? Experimentation began.

The first commercial microwave oven hit the market where gigantic and enormously expensive, standing 5 1/2 feet tall, weighing over 750 pounds, and costing about $5000 each.

II_ Theory

Microwave ovens are popular because they cook food in an amazingly short amount of time. They are also extremely efficient in their use of electricity because a microwave oven heats only the food and nothing else. Let us see the mystery behind the magic of "meals in a minute" with microwave. A microwaves oven uses microwaves to heat food. Microwaves are radio waves In the case of microwave ovens, the commonly used radio wave frequency is roughly 2,500 megahertz (2.5 gigahertz). Radio waves in this frequency range have an interesting property: They are absorbed by water, fats and sugars. When they are absorbed they are converted directly into atomic motion heat. Microwaves in this frequency range have another interesting property: they are not absorbed by most plastics, glass or ceramics. Metal reflects microwaves, which is why metal pans do not .work well in a microwave oven Food has a high percentage of water, and water is famously H2O. The molecule of water has the O (Oxygen) in the middle, and the two H's (Hydrogen) stuck on it like Mickey Mouse ears at a particular angle (105o). The H's are positive and the O is negative, so the molecule has a + and end. It has "polarity".Polarized molecules try to line themselves up with the electrical field, like compass needles trying to point at North. But because the electrical field is changing 2,450 million times a second the molecules don't quite have time to line up one way before they have to try to line up the other way! So, anything with water in it has all these molecules being moved this way and that by the electrical field, and heated up. The dishes, walls of the oven, etc, don't pick up radio, so don't get heated up.

III_ calculation

The water dipole attempts to continuously reorient in electromagnetic radiation's oscillating electric field. Dependent on the frequency the dipole may move in time to the field, lag behind it or remain apparently unaffected. When the dipole lags behind the field then interactions between the dipole and the field leads to an energy loss by heating, the extent of which is dependent on the phase difference of these fields; heating being maximal twice each cycle. The ease of the movement depends on the viscosity and the mobility of the electron clouds. The applied field potential figure (1) (E, volts) of electromagnetic radiation is given by;

$E = E_{max}.\cos(\omega\tau)$

where Emax is the amplitude of the potential, ω is the angular frequency in radians.second-1 and t is the time (seconds). If the polarization lags behind the field by the phase (δ, radia ns) then the polarization (P, coulombs) varies as

$P = P_{max}.\cos(\omega t - \delta)$

where Pmax is the maximum value of the polarization.

Hence the current (I, amperes) varies as

$I = (dP/dt) = -\omega P_{max}.\sin(\omega\tau - \delta)$

The power (*P*, watts) given out as heat is the average value of (current x potential). This is zero if there is no lag (that is, if δ = 0), otherwise

$P = 0.5\ P_{max}E_{max}\omega.\sin(\delta)$

Conclusion

This powerful is what we use everyday. we have seen how the microwave is working and give us this powerful power in short time.

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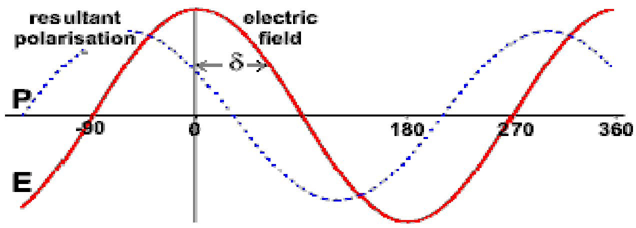

figure (1)

electric field and polarization resultant.