



Research Article

TEMPERATURE CHANGE IN BLOOD TISSUES DUE TO MOBILE PHONE HANDSET RADIATIONS AT 4G (2300MHz) FREQUENCY

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ABSTRACT

This is theoretical study of change in temperature of blood due to 4G mobile phone frequencies. We have done mathematical calculation of temperature change in blood of human body at different depths and different exposure time. Temperature change in blood tissues due to mobile phone radiation at different time exposure 10, 20, 30 40 50, and 60 minutes. The power of mobile phone handset is taken as 1.5 W. The distance inside the blood of 0.1mm to 0.5mm is taken for this study.

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INTRODUCTION

The interaction of electromagnetic wave with the body falls in the field of Bio-electromagnets. During speaking, human being absorbs some electromagnetic energy when it is exposed to it. Electromagnetic fields are all around us as cellular telephones, television signals and radio fields from electrical appliances, power lines and more. The interaction of electromagnetic energy with the body may be thermal or non-thermal. [1]. Depending on the frequency of electromagnetic radiation, the human body interacts with field and thermal effects. Heat generated in the medium is proportional to the absorbed power. The thermal interaction may cause tissue heating by deposition of power from the mobile phone [2]. If the organism cannot dissolve heat energy the internal temperature of the body will rise. The Biological effects of radiofrequency energy depend on the rate at which power is absorbed [3]. Tissue damage will occur during exposed to high RF levels generated from mobile phone handset. Exposure to high mobile phone radiations, the power densities increases the human body temperature. At power density levels of 1 to 10 mW/cm2, the radiofrequency energy can result in heating of body skin, blood and eyes are to mainly known to heating by radio frequency energy. Mobile phone radiation penetrates in tissues is proportional to their power density. Most of the experimental investigations rabbits and mice have been employed for biological effects of radio frequency exposure [4].

That is why it is dangerous to live close to high power mobile phone tower for a long time. Mice and rabbits have been employed for most of the experimental investigations on biological effects of RF exposure [5]. The effect of mobile phone wave is dielectric heating in which the living tissues of human being are heated by the rotations of polar molecules.

METHOD AND CALCULATION

The change in temperature can be calculated by this formula given below

Delta T = SAR (Delta t)/ C

Where C is specific heat of bio- material and Delta t is time in seconds

The Specific Absorption Rate (SAR) can be defined as

SAR = (sigma * E_i^2) / rho

Where rho is the density of bio material, sigma is the conductivity of the biological material and E_i is the field inside that material,

Standard values [6,7]

At 4G (2300 MHz), sigma = 1.5919 W K^-1 m^-1, Mass density for blood tissues= 418600

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Table 1 Temperature change (degree C/10 minutes) in blood tissues at different depth and 1 cm to 15 cm apart from the mobile phone at frequency of 4G (2300 MHz)

Distance from phone in cm	Temperature change in blood 10 minutes exposure at 4G (2300MHz) frequency				
	0.1 mm	0.2 mm	0.3 mm	0.4 mm	0.5 mm
1	3.067322981	3.029505495	2.99215528	2.955266603	2.918830865
2	0.76683053	0.757376445	0.748039035	0.738816579	0.729707931
3	0.340670139	0.336470139	0.332321739	0.328224654	0.324178022
4	0.19173999	0.189375968	0.187041185	0.184735213	0.182457764
5	0.122692891	0.121180248	0.11968624	0.11821065	0.116753263
6	0.085199814	0.084149398	0.08311194	0.082087281	0.081075237
7	0.062594462	0.061822747	0.061060549	0.060307754	0.059564233
8	0.047926914	0.04733603	0.046752441	0.046176034	0.045606737
9	0.037864185	0.037397372	0.036936307	0.036480932	0.036031161
10	0.03067323	0.030295055	0.029921553	0.029552666	0.029188309
11	0.025347635	0.025035136	0.024726479	0.024421634	0.024120545
12	0.021297262	0.021034687	0.020775366	0.020519226	0.020266254
13	0.018146402	0.017922671	0.017701706	0.017483464	0.017267917
14	0.015646312	0.015453411	0.015262891	0.01507472	0.014888858
15	0.013631108	0.013463054	0.013297071	0.013133134	0.012971219

Table 2 Temperature change (degree C/20 minutes) at different depth and 1 cm to 15 cm apart from the mobile phone at frequency of 4G (2300 MHz)

Distance from phone in cm	Temperature change in blood 20 minutes exposure at 4G (2300 MHz) frequency				
	0.1 mm	0.2 mm	0.3 mm	0.4 mm	0.5 mm
1	6.13464596	6.05901099	5.98431056	5.91053321	5.83766173
2	1.53366106	1.51475289	1.49607807	1.47763316	1.45941586
3	0.68134028	0.67294028	0.66464348	0.65644931	0.64835604
4	0.38347998	0.37875194	0.37408237	0.36947043	0.36491553
5	0.24538578	0.2423605	0.23937248	0.2364213	0.23350653
6	0.17039963	0.1682988	0.16622388	0.16417456	0.16215047
7	0.12518892	0.12364549	0.1221211	0.12061551	0.11912847
8	0.09585383	0.09467206	0.09350488	0.09235207	0.09121347
9	0.07572837	0.07479474	0.07387261	0.07296186	0.07206232
10	0.06134646	0.06059011	0.05984311	0.05910533	0.05837662
11	0.05069527	0.05007027	0.04945296	0.04884327	0.04824109
12	0.04259452	0.04206937	0.04155073	0.04103845	0.04053251
13	0.0362928	0.03584534	0.03540341	0.03496693	0.03453583
14	0.03129262	0.03090682	0.03052578	0.03014944	0.02977772
15	0.02726222	0.02692611	0.02659414	0.02626627	0.02594244

Table 3 Temperature change (degree C/30 minutes) at different depth and 1 cm to 15 cm apart from the mobile phone at frequency of 4G (2300 MHz)

Distance from phone in cm	Temperature change in blood 30 minutes exposure at 4G (2300MHz) frequency				
	0.1 mm	0.2 mm	0.3 mm	0.4 mm	0.5 mm
1	9.201968944	9.088516484	8.976465839	8.865799809	8.756492594
2	2.300491591	2.272129336	2.244117105	2.216449737	2.189123794
3	1.022010416	1.009410416	0.996965217	0.984673961	0.972534066
4	0.575219971	0.568127903	0.561123555	0.554205638	0.547373292
5	0.368078672	0.363540745	0.35905872	0.354631949	0.35025979
6	0.255599441	0.252448194	0.249335819	0.246261844	0.24322571
7	0.187783387	0.185468242	0.183181648	0.180923263	0.178692699
8	0.143780741	0.142008089	0.140257324	0.138528103	0.13682021
9	0.113592556	0.112192117	0.11080892	0.109442795	0.108093483
10	0.092019689	0.090885165	0.089764658	0.088657998	0.087564926
11	0.076042905	0.075105409	0.074179436	0.073264902	0.072361634
12	0.063891787	0.063104061	0.062326097	0.061557678	0.060798763
13	0.054439207	0.053768012	0.053105117	0.052450392	0.051803751
14	0.046938935	0.046360234	0.045788672	0.045224161	0.044666574
15	0.040893325	0.040389162	0.039891212	0.039399403	0.038913656

Table 4 Temperature change (degree C/40 minutes) at different depth and 1 cm to 15 cm apart from the mobile phone at frequency of 4G (2300 MHz)

Distance from phone in cm	Temperature change in blood 40 minutes exposure at 4G (2300MHz) frequency				
	0.1 mm	0.2 mm	0.3 mm	0.4 mm	0.5 mm
1	12.26929193	12.11802198	11.96862112	11.82106641	11.67532346
2	3.067322121	3.029505781	2.99215614	2.955266316	2.918831725
3	1.362680554	1.345880554	1.329286957	1.312898614	1.296712088
4	0.766959962	0.75750387	0.74816474	0.73894085	0.729831056
5	0.490771562	0.484720994	0.478744959	0.472842599	0.467013053
6	0.340799255	0.336597592	0.332447759	0.328349126	0.324300946
7	0.25037785	0.247290989	0.244242198	0.241231018	0.238256933
8	0.191707654	0.189344118	0.187009766	0.184704138	0.182426947
9	0.151456742	0.149589489	0.147745227	0.145923727	0.144124644

10	0.122692919	0.12118022	0.119686211	0.118210664	0.116753235
11	0.10139054	0.100140545	0.098905915	0.097686536	0.096482179
12	0.085189049	0.084138748	0.083101462	0.082076904	0.081065017
13	0.072585609	0.071690683	0.070806823	0.069933856	0.069071667
14	0.062585246	0.061813645	0.061051562	0.060298882	0.059555432
15	0.054524434	0.053852216	0.053188283	0.052532537	0.051884875

Table 5 Temperature change (degree C/50 minutes) at different depth and 1 cm to 15 cm apart from the mobile phone at frequency of 4G (2300 MHz)

Distance from phone in cm	Temperature change in blood 50 minutes exposure at 4G (2300MHz) frequency				
	0.1 mm	0.2 mm	0.3 mm	0.4 mm	0.5 mm
1	15.33661491	15.14752747	14.9607764	14.77633301	14.59415432
2	3.834152652	3.786882226	3.740195174	3.694082895	3.648539656
3	1.703350693	1.682350693	1.661608696	1.641123268	1.62089011
4	0.958699952	0.946879838	0.935205925	0.923676063	0.91228882
5	0.613464453	0.605901242	0.598431199	0.591053249	0.583766316
6	0.425999068	0.42074699	0.415559699	0.410436407	0.405376183
7	0.312972312	0.309113736	0.305302747	0.301538772	0.297821166
8	0.239634568	0.236680148	0.233762207	0.230880172	0.228033684
9	0.189320927	0.186986861	0.184681534	0.182404658	0.180155805
10	0.153366149	0.151475275	0.149607764	0.14776333	0.145941543
11	0.126738175	0.125175681	0.123632394	0.12210817	0.120602723
12	0.106486312	0.105173435	0.103876828	0.10259613	0.101331271
13	0.090732011	0.089613354	0.088508528	0.08741732	0.086339584
14	0.078231558	0.077267057	0.076314453	0.075373602	0.07444429
15	0.068155542	0.06731527	0.066485354	0.065665671	0.064856094

Table 6 Temperature change (degree C/1hour) at different depth and 1 cm to 15 cm apart from the mobile phone at frequency of 4G (2300 MHz)

Distance from phone in cm	Temperature change in blood 1 hour exposure at 4G (2300MHz) frequency				
	0.1 mm	0.2 mm	0.3 mm	0.4 mm	0.5 mm
1	18.40393789	18.17703297	17.95293168	17.73159962	17.5129852
2	4.600983182	4.544258672	4.488234209	4.432899474	4.37824759
3	2.044020831	2.018820831	1.993930435	1.969347922	1.94506813
4	1.150439943	1.136255805	1.122247109	1.108411276	1.09474658
5	0.736157344	0.727081491	0.718117439	0.709263899	0.70051958
6	0.511198882	0.504896388	0.498671639	0.492523688	0.48645142
7	0.375566775	0.370936484	0.366363297	0.361846527	0.3573854
8	0.287561481	0.284016178	0.280514649	0.277056206	0.27364042
9	0.227185112	0.224384233	0.22161784	0.21888559	0.21618697
10	0.184039379	0.18177033	0.179529317	0.177315996	0.17512985
11	0.15208581	0.150210817	0.148358872	0.146529804	0.14472327
12	0.127783574	0.126208122	0.124652193	0.123115356	0.12159753
13	0.108878414	0.107536025	0.106210234	0.104900784	0.1036075
14	0.093877869	0.092720468	0.091577344	0.090448323	0.08933315
15	0.081786651	0.080778324	0.079782424	0.078798806	0.07782731

RESULTS AND DISCUSSION

In this paper, we discuss about only one frequency namely 4G of mobile phone waves. Calculation of change in temperature for blood, at different distances and different depth are made. In table 1 when we bring mobile phone from 15 cm towards our body at 10 minutes exposure then temperature of blood increases. When a mobile phone handset move from 15 cm to 1 cm distance towards person, then the temperature of blood tissue increases up to 99.55%. Table 2 represents variation of temperature in blood tissues for exposure time at 20 minutes. The temperature of blood increases from 15 cm to 1cm. The table 3, 4, 5 and 6 represents change in temperature in blood tissues at different time exposure i.e. at 30 minutes, 40 minutes, 50 minutes and 1 hour.

CONCLUSIONS

From above calculation it occludes that at 4G frequency of mobile phone waves namely 2300 MHz change in temperature for blood, different distances and at different depth are made. For different exposure time temperature is different. It varies for different distances at 10 minutes exposure the highest temperature is 3.06 C⁰ at depth of 0.1 mm and lowest at 0.5 mm is 0.01 C⁰.

In table 2 the temperature increases from 0.02 C⁰ to 6.13 C⁰ at distance varies from 1cm to 15 cm at depths from 0.5 mm to 0.1 mm. In table 3, it varies from 0.03 C⁰ to 9.20 C⁰. In table 4, it varies from 0.05 C⁰ to 12.26 C⁰. In table 5, it varies from 0.06 C⁰ to 15.33 C⁰. This highest increase in temperature at 60 minutes talking time at a distance of 1cm apart and depth of 0.1mm inside the blood. It means that when a person using mobile phone about 1 hour at distance of 1cm and 0.1 mm depth the temperature reaches 18.40 C⁰. Such type of increase in temperature is harmful for human being. This highest increase in temperature can cause blood cancer, brain tumor, skin diseases and various other diseases in human beings. So always use mobile phone at some certain distance and less talk time.

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