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New ways in using long-waved infrared and their influence over environment and human habitats

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Abstract The applicability of the long-waved infrared technology has been studied from two different perspectives: environment and human habitats. The environmental approach focused merely on a case-study in Baia Mare city. Here, the potential for the implementation has been investigated by taking into account the multiplicity of factors: electric energy-consume climatic and micro-climatic conditions, microbial loading of air and effects over animals, effects on plants and soil, prolusions over general health and comfort status of human being. Nowadays, life is to be better if innovative alternative technologies are given a chance to prove their applicability and use. By studying new types of heating systems, new and simple ways in adopting a "green" life style is proposed.

Keywords: long-waved infrared technology, human habitats innovative technologies

1. Introduction

Infrared is a zone in the electromagnetic spectrum which populates the whole Universe. It is known that the infrared natural radiation zone has been studied for a long time and scientists have determined three infrared segments: A, B, and C [1]. Each letter corresponds to a specific wavelength and each has specific applications in industry, agriculture and human health.

Nowadays, the majority of the usual infrared sources emit short frequency waves that work at thousands Celsius grades and the dark red colored radiation belonging to the visible specter becomes visible near the emission sources (the lamps).

Recent research published in the specialty literature [2, 4, 7] informed that emission sources working at the other side of the specter are being made. Infrared that works with long wavelength (about 10 000 nm). These sources allow radiation to merge in the nearby of air molecules, by doing this, the distance affected by the waves becomes 3,5-4,5 m, the temperatures of the emitting surfaces have thermal values between 80-150 °C, the effective light being undetectable in the visible specter. These radiations have effects over the solid corps and over living organisms.

When traditional heating systems are being used, the hot air migrates in the nearby of the ceiling where it releases the heat. After cooling, the air lowers and begins a new heating circuit. When long-wave infrared is used, air has no currents. In this case, all solid corps gets heated by the radiation emitted by the panels (walls, ceiling, floor and the solid corps inside – furniture etc.). These corps emit the heat absorbed from the panels. Therefore, the room is heated not by lamps, but by the solid corps inside, that create a great ambient atmosphere.

Using in practice demonstrated that the advantages brought in environmental protection need research for making the lamps accessible when it comes to mass using (price and energy consumption) and safe from the human health point of view.

Because of the intense research done for the developing this technology, the future picture gives us hope for using infrared technology in heating human ambient space (houses, commercial spaces, industrial production spaces, farms, saunas, etc.) and for applications in domains that require controlled thermal energy [3]. Actual research is focused both on heating, drying, backing, frying and on cooling, freezing, and transporting products in controlled climate.

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2. Experimental

The measurements took place in a room placed on the top floor of an edifice of the North University of Baia Mare, built in 1976. This room is placed in the corner; it has two walls to exterior, which are not isolated, and the ceiling, which is relatively well isolated. The dimensions of the room are: 6, 20 m long* 2, 95 width * 2, 85 height, and is equipped with a new, well-isolating window, which has a North exposition and an entrance door from hall with a South exposition.

The measurements were done in cold period of the winter 2007-2008, November-February period.

The measurements were done in the following domains:

2.1. Electric expenditure the hourly/daily electric-consumes. The measurements were done using specialized control equipment.

2.2 Climate

a. Interior – 3 times a day (7:26; 13:26 and 19:26 hour), in 4 different points (1st point was placed in corner, at 2 meters high, near the sealing; 2nd point was placed in the center of the room on a work table; 3rd point was placed near a wall at a chair level; 4th point was placed the opposite corner of point no. 1, on the floor).

b. Exterior – near the building – 3 times a day, at the same hours, following the urban microclimate.

c. Baia Mare Weather Station – 3 times a day, at same hours too, using DigiWeather software and Romanian Metheorological National site, following the regional climate [9].

The meteorological observations were done using a type WMR100 Meteorological station and with common measurement instruments, such as different mercury based thermometers and hygrometers. The data monitoring and evaluation was done using the weather station's PC integrated software.

2.3. Microbial loading of the air – the analysis and probation had been done in collaboration with an accredited microbiology laboratory. The drawings were taken before long-waved infrared panel start function, during its running and after its stopping. The working method for analyses was standard „KOCH sedimentation method" [5, 6].

2.4. General health and comfort status of human being

There were 14 selves for this research work. They were volunteers, and their age and available were amongst their selection criteria. The age intervals of the research's member team are presented in the **table 1.** As sex criteria, there were 6 female and 8 male. The group was very diversity like characters and daily activity.

Table 1. The age distribution of the selves

Age (years)	< 18	20-50	> 50
Number of selves	2	10	2

Each team's member managed a „Personal Observation Form" during the project time. It was marked personal observations regarding the comfort status, general and particular organic health and sanity [8].

3. Results and Discussions

3.1. Electric expenditure-the hourly/daily electric-consumes

The expenditure of electric current variations is presented in the **table 2**.

It has noticed that the electric energy consumption takes values between 0.33kw/h and 1.68kw/h. The minimum values of electric energy consumption is registered when the temperature at night has oscillated round 0 ºC and at midday, in hours of maximum isolation, between 7ºC and 11ºC. The maximum values of electric energy consumption had been registered when outside temperature maintained under 0ºC even at noon and inside the temperature was to be maintained at a comfortable temperature of over 20ºC.

Due to the concrete conditions in which the experiment has been made, the oral medium consume of electrical power has values between 0,88kw/h and 1.08kw/h. These high values are the effect of bad thermal isolation of the building which has not benefit of thermal isolation when build, on 1976 year. Also, the work-room has three walls with exterior contact, so the heat loss is maxim.

The energetic consume is an important economical indicator. It is influenced by both environment and building thermal isolation factors, but there also must be taken to consideration the

consumers' options like as the temperature from each room and the usual day-night alternation.

Table 2. Hourly expenditure of electric current, medium, maximal and minimal (kW/h)

Month	Week	Medium exp.	Max. Exp.	Min. Exp.
November	**1**	0.88	0.89	0.86
(13.11-02.12.07)	**2**	0.88	0.89	0.86
	3	0.88	0.91	0.85
		0.88		
December	**4**	0.87	0.89	0.84
(03.12-30.12.07)	**5**	0.87	0.9	0.86
	6	0.89	1.11	0.73
	7	0.93	1.6	0.48
		0.89		
January	**8**	0.9	0.97	0.85
(31.12-03.02.08)	**9**	1.06	1.65	0.43
	10	1.21	1.64	0.8
	11	1.1	1.43	0.73
	12	1.12	1.41	0.62
		1.08		
February	**13**	0.73	1.6	0.33
(04.02.-02.03.08)	**14**	1.25	1.63	0.86
	15	1.02	1.68	0.04
	16	0.73	0.93	0.49
		0.93		

3.2. Climate

The specialized literature mentions that for the Baia Mare Depression, like for the Romania geographical area, January is the coldest recorded month of winter [9, 10]. Sometimes, the minimum temperature reached on February, the long time cloudy on December, but the strongest frost were registered always on January. Although usually it is snowing a lot in Baia Mare Depression (medium 109 snow-days/year), on 2007-2008 winter, it was registered few snowing-days [8] and no gust of wind during the measurement period.

The maximum minimum and medium temperature values for air, registered in the winter season when the experiment unrolled are presented in the **table 3**.

It is noticed that the urban air temperature is about 2 ºC higher than the temperature registered by the regional weather station. The thermal amplitude is normal for this year period. The minimum temperatures from the urban environment have to be used in programming the equipment function.

Obtaining a temperature in the 19-21 ºC intervals inside a room is the main objective in the cold periods of the year. Considering the preferences, the comfortable temperature can vary with a couple of grades in a 24 hour cycle.

In Fig.1 it is shown the daily temperature variation inside the room and in the urban environment (outside), the temperature being measured through the experiment.

It is clear to notice that there were no difficulties in reaching and then maintaining the comfortable temperature. The vast variety is the result of "preference game". Long-waved infrared heating offers flexibility with no effort in what makes a great surrounding climate, according for the time being demands, but it marks the influence of the weather evolution, especially when dealing with long severe cold.

In Fig.2 it is shown the daily relative humidity variation inside the room and in the urban environment (outside), the humidity being measured through the experiment.

The relative humidity of the air registered very small variation in the work-room while the relative humidity of the atmospheric air registered normally large variations. This permanently homogeneous environment, created by the relative air humidity makes a microclimate that is well tolerated by the sensitive organisms.

A correlation between the air temperature and the relative humidity in the room shows that for these experimenting conditions, maintaining the temperature over 20 ºC, the relative humidity of air registers values round 40%. This modification has not been reported as discomfort by the subjects, but it has been registered by the researchers as the object of ulterior studies in which there will also be studied other parameters of the immobile.

Table 3. Monthly maximal, minimal and medium recordings temperature (°C) in comparison to the Weather Station at the University (kW/h)

Month	Baia Mare Metheorological Weather Station				University –Urban Climate	
	MIN	AVERAGE	MULTI.	MAX	MIN	AVERAGE
NOV.	-6.0	1.2	4.9	12.0	-4	3.3
DEC.	-7.0	-1.5	-0,2	9.0	-3.5	0.8
JAN.	-7.0	-0.07	-2.4	10.6	-4.0	3.2
FEB.	-10.0	2.07	-0.1	14.7	-5.4	5.9

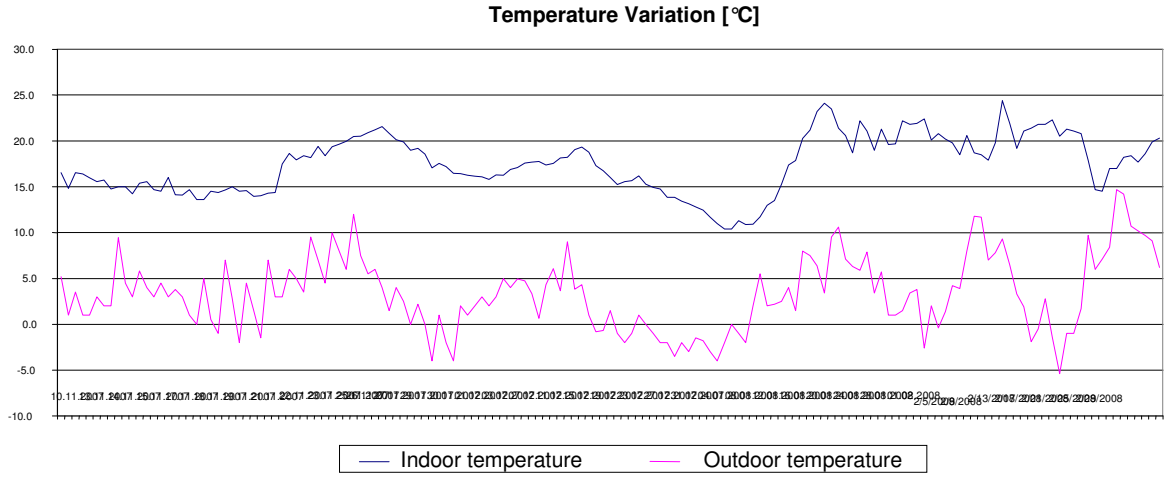

Fig. 1. The temperature variation inside and outside

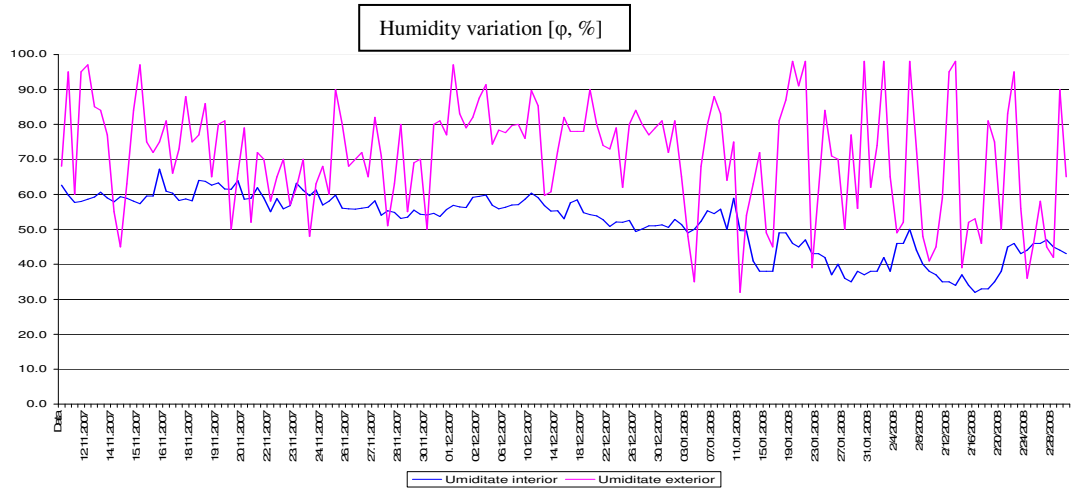

Fig. 2. The relative humidity variation inside and outside

3.3. Microbial loading of air

The results of microbial loading of air analyses are presented in the **table 4.**

Table 4. Recorded values on the air micro flora

Indicator		Total number of germs (TNG)	Pathogenic Staphylococcus *(Staphylococus sp.)*	Haemolytic Streptococcus *(Streptococus sp.)*
Sample /Recorded value/ m^3	1st	1731	78.7	absent
	2nd	1416	absent	absent
	3rd	314.8	absent	absent
	4th	314.8	absent	absent
Norm values		1500-2000	0	0

It noticed that there was registered both quantitative and quality changes in the air loading in the same using conditions for the space. The quantitative changes are major. After 6 weeks the microbial loading air has stabilized on the low level. The last sample was collected after 10 days the panel stops. It noticed that the hygiene of the room was been maintained at the same level.

The scientific literature [5, 6] shows that there is no Romanian standard for domestic hygiene. So, like a hygiene level, it was used the collectivity norm values.

3.4. General health and comfort status of human being

From the analysis of the individual „Personal Observation Form" records it presented the following:

Children opinion was „Sense of wellbeing. It's O.K.". Their parents, members of the research team, didn't observe any dysfunction or health problems during the experimental time. It wasn't noticed skin or eyes problems. The flu, particular illness for children during winter time, was registered only ones, respectively twice but in an easy form.

Grown-ups opinion was that atmosphere is balance, pleasant and comfortable, sense of wellbeing relief, back pain/ spinal column pains amelioration. This group was very heterogeneity. There were hard-worker students, lovely computers, and lovely - sport students. There were 4 female and 6 male. The lovely computers students usually have back pain. They realized that can use long-waved infrared panel for their therapy. The lovely-sport students usually have muscle bound from hard sport exercises. They considered that pleasant atmosphere help to get back. They also required a sauna panel. There were selves who remarked only the easy atmosphere and no health problems.

Elders' opinion was that they felled calming effect, positive effects against flu, rheumatic pain amelioration and, for one person, diabetes analysis improvements. They were very carefully with their glasses and eyes. They noticed that there was no problem on this point. They also required having a same panel to their home.

As a general observation, is that persons who stayed continuously for several hours in that room felt the instinctive need to align their backs to long-waved infrared panels.

4. Conclusions

In actual conditions considering the European strategy in the domain of energy and gas emissions, the research results show that long-waved infrared technology:

- It is innovative and promising for the future, from ecologic and biogenetic point of view;
- It is clean, efficient, non polluting emission technology;
- It can be used in a very large scale of domains;
- The agro-industrial applications are at the beginning;
- The benefic effects of this technology regarding the organisms can be fragmentary quantify for the time being;
- It can be successfully implemented in Romania.

Research in this domain is to be continued because of the multitude of the less known

phenomenon and the limits in the use of this new technology.

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