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Monitoring of the Electromagnetic Fluctuations from Industrial Sources (Range Geomagnetic Pulsations 0.01-10 Hz)

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1. Introduction

Nowadays it becomes obvious that the magnetic storms and also geophysical disturbances accompanying these storms influence the biological life on the Earth. Fundamental rules of geophysical disturbances development and their influence on the biological objects were researched by many scientists.

The use of the electromagnetic energy in various spheres of human activity had led to the thing that to the existing natural electric and magnetic field of the Earth, to the atmosphere electricity, etc. had been added the electromagnetic field of artificial origin. Sometimes its level significantly increases the level of the natural electromagnetic field of the Earth.

Being the biologically active factor the electromagnetic field of artificial origin can make the unfavorable impact on the environment and on the human beings. That's why the monitoring of the nature environment becomes urgent, because of the electromagnetic pollution of man-caused origin. It is a serious theoretic, technical and economical task for the most of the large cities.

In relation with that we faced the problem – to research the level of electromagnetic radiation of man-caused origin in the region of Irkutsk – Akademgorodok (at a range of the Earth magnetic field variations).

2. Experiment

We used for the monitoring the induction nanoteslometer used for the registration of geomagnetic pulsations in observatories of ISTP SB RAS.

As the preliminary analysis had shown, the expected amplitudes of the signals of man-caused origin could exceed in many times the amplitudes of natural oscillations. In relation with it we have modernized the standard instrument complex according to our task changing the parameters of the used instruments.

The instruments tuning and control of their meteorological parameters was made in the basic observatory of the Institute located in the settlement Patrony. Then this instruments complex was located on the ISTP territory. In order to exclude the influence of the background electromagnetic radiation from the multiple plants and instruments of the Institute we have chosen for the experiments only week-ends and holidays.

The days with the increased level of magnetic activity ($\Sigma Kp \leq 16$) were not taken into consideration in order to exclude the impact on the experiment of intensive electromagnetic signals of natural origin during the significant magnetosphere disturbances.

The experimental material analysis.

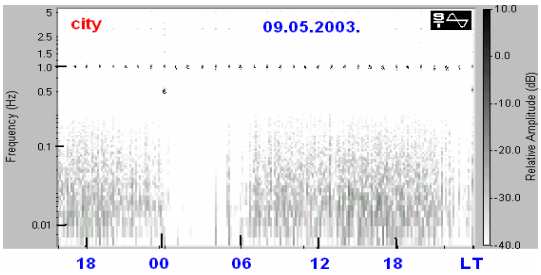
The registration of the useful signals was made by the three band-pass filters P2;P3;P4 to the slow analogous magnetograph with FM-modulation and to the standard self-recording unit. The frequencies ranges of band-pass filters was as follows:

P2: 0.01-0.25 Hz;

P3: 0.25-2.5 Hz;

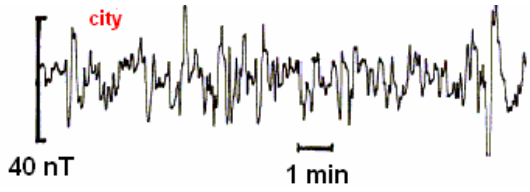
P4: 2.5-10 Hz.

The spectral content of the registered signals was analyzed on a personal computer according to the special program and the signals amplitudes were estimated according to recordings in self-recording units in nanotesls. The analysis results of the experimental data are presented in the figures 1, 2.



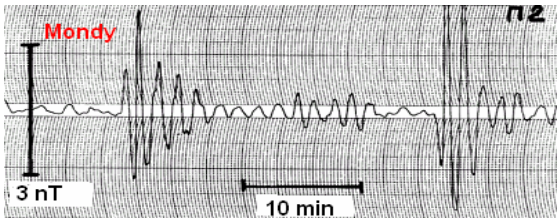
(a)

(a)The dynamic spectrum of the signal registered in Irkutsk.Vertical scale on the right – oscillations frequency, Hz. Horizontal scale – local time. Points – hour sign. Here is shown the scale of the spectrum power in relative units.



(b)

(b)There is a part of analogous record of a noise signal in Irkutsk. Vertical line on the left – the scale for the amplitude determination. Here the segment quantity corresponds to 40 nT.



(c)

(c)Geomagnetic pulsations in the observatory in Mondy. This is Pi2 pulsations. Vertical line on the left – the scale for the amplitude determination. Here the segment quantity corresponds to 3 nT.

Figure 1. P2 frequency band $\Delta f =$ 0.01 - 0.25 Hz.

In this Figure 1 are presented the results of electromagnetic radiation registration by the band-pass filter P2. In the upper part of the figure is presented the dynamic spectrum of the signal registered in Irkutsk.

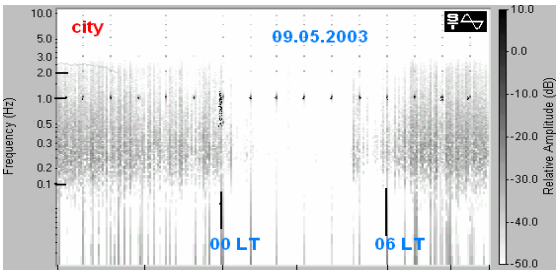
Points – hour sign, vertical scale on the right – oscillations frequency, Hz, horizontal scale – local time. Here is shown the scale of the spectrum power in relative units.

There is a part of analogous record of a signal in Irkutsk shown below. Vertical line on the left – the point for the amplitude determination. Here the segment quantity corresponds to 40 nT for this channel.

And, at least, lower – the fragment of natural geomagnetic pulsations registration in the observatory in Mondy. Vertical line on the left – the point for the amplitude determination. Here the segment quantity corresponds to 3 nT for this channel.

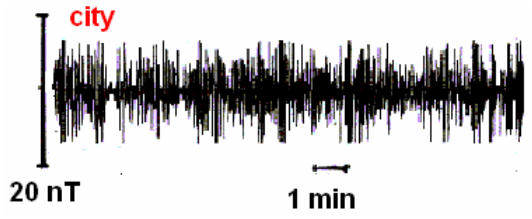
It is clearly seen that during the days in city is observed the constant electromagnetic noise at the frequencies band of 0.01-0.3 Hz, except the night hours from 0 up to 6 of local time. The signal

intensity in the city exceeds the pulsations amplitude in observatory Mondy more than in 10 times. Electromagnetic noise is absent from 0 up to 6 hours of local time.



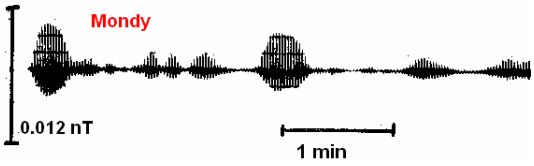
(a)

(a)The dynamic spectrum of the signal registered in Irkutsk. Vertical scale on the right – oscillations frequency, Hz. Horizontal scale – local time. Points – hour sign. Here is shown the scale of the spectrum power in relative units.



(b)

(b)There is a part of analogous record of a noise signal in Irkutsk. Vertical line on the left – the scale for the amplitude determination. Here the segment quantity corresponds to 20 nT.



(c)

(c)Geomagnetic pulsations in the observatory in Mondy. This is Pc1 pulsations. Vertical line on the left – the scale for the amplitude determination. Here the segment quantity corresponds to 0.012 nT.

Figure 2. P3 frequency band Δf = 0.25 - 2,5 Hz.

The picture is similar to the previous one, but here are shown the data at the other range of frequencies for the band filter P3, are presented in the next Figure 2. In the upper part of the figure is presented the dynamic spectrum of the signal registered in Irkutsk.

Points – hour sign, vertical scale on the right – oscillations frequency, Hz, horizontal scale – local time. Here is shown the scale of the spectrum power in relative units.

There is a part of analogous record of a signal in Irkutsk shown below. Vertical line on the left – the point for the amplitude determination. Here the segment quantity corresponds to 20 nT for this channel.

And, at least, lower – the fragment of natural geomagnetic pulsations registration in the observatory in Mondy. Vertical line on the left – the point for the amplitude determination. Here the segment quantity corresponds to 0.012 нТл for this channel.

The comparing of these two diagrams shows that the intensity of the signal in the city exceeds the pulsations amplitude in the observatory of Mondy in 100 and more times.

It is seen that during the days there is observed a constant electromagnetic noise in a frequency band of 0.1-2 Hz, except the night hours. Electromagnetic noise is absent from 0 till 6 o'clock of local time, as also in the previous case.

Observations results processing had singled out the following rules.

In all the three frequency ranges (P2, P3, P4) the electromagnetic noise were observed almost during the whole days except a small break from the midnight till morning hours (0 – 6 hour).The analysis of the intensity of electromagnetic noise in each of the frequencies band it was found that the amplitude of the registered noises oscillations exceeds the natural signals of the Earth electromagnetic field oscillations in 10-100 times. The results of such analysis are presented in the table.

Filter	Frequencies (Hz)	Pulsations amplitude in observatory (nT)	(i) Oscillations amplitude in the city (nT)	Max. quantity of the ratio *i.A city*__ ii.A observ.
P2	0.01 – 0.25	0.1 – 3	3 – 20	~ 7
P3	0.25 – 2	0.01 – 0.5	5 – 10	~ 20
P4	2 - 5	0.001 – 0.1	5 – 10	~ 100

The first column – filter number.

The second column – corresponding frequencies.

The third one – amplitude range of geomagnetic pulsations for the non-disturbed period according to the data from the observatory in Mondy.

The forth one – the range of the registered amplitudes of the electromagnetic radiation in the city.

In the last column of the table are shown the estimates about how the city electromagnetic noise level increases the value of the natural signal according to the observatory data.

It is clearly seen that this quantity increases with the frequency signals rise.

3. Conclusion

Analysis of the amplitude-spectral features of the electromagnetic signals registered in Irkutsk and the appearance of these signals during the days allow making the following conclusions:

- in our experiment the signals of man-caused origin were registered;
- the sources of these signals can be presented by the companies and the city traffic.

We should emphasize that the man-caused signal amplitude ratio to the amplitude of the background natural radiation of the Earth was increasing with the frequency rise (from 7 times in P2 up to 100 times in P4). Consequently, the further experiments in this direction should be made in the higher latitude region.

Referrences