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THE ENVIRONMENTAL ELECTROMAGNETIC POLLUTION PROBLEMS ANALYSIS IN THE CONTEXT OF THIS TYPE OF ENVIRONMENTAL HAZARD ENVIRONMENTAL MONITORING METHODOLOGY FORMATION

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Purpose. The analysis of the previous scientific researches results of environmental electromagnetic pollution problems in the context of the environmental monitoring methodology formation has been carried out. **Methodology.** The previous scientific researches analysis has been conducted in three directions: electromagnetic pollution as a factor in disease onset and acceleration, the methods of electromagnetic radiation exposure level decrease, urbanized territories electromagnetic monitoring. **Practical value.** The basic ideas have been systematized and the environmental electromagnetic pollution problems have been solved in previous studies, which allowed to determine the underlying issues that call for additional researches in this area at different organizational levels. **Conclusions.** The necessity of developing assessing and predicting methods of pollution impacts on environmental components at the state level has been proved. The tasks that should be solved as a prerequisite for the electromagnetic pollution ecological monitoring systems development have been distinguished, namely: the social strata definition, which is indicative from the point of view of the statistical calculation reliability of the load level that is generated by electromagnetic pollution on their organisms; development of balancing accounting methods of indoor and outdoor electromagnetic fields exposure effects; the environmental and economic appropriateness of electromagnetic pollution environmental monitoring system holding has been grounded. References – 26, table – 1.

Key words: electromagnetic pollution, environmental monitoring, analysis, results, electromagnetic fields.

АНАЛІЗ ПРОБЛЕМ ЕЛЕКТРОМАГНІТНОГО ЗАБРУДНЕННЯ ДОВКІЛЛЯ У РОЗРІЗІ ФОРМУВАННЯ МЕТОДОЛОГІЇ ЕКОЛОГІЧНОГО МОНІТОРИНГУ ДАНОГО ВИДУ ЕКОЛОГІЧНОЇ НЕБЕЗПЕКИ

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Здійснено аналіз результатів попередніх наукових досліджень з проблем електромагнітного забруднення довкілля у розрізі формування методології екологічного моніторингу. Аналіз попередніх досліджень проведено у трьох напрямках: електромагнітне забруднення як фактор виникнення і прискорення захворюваності, методи зниження рівня впливу електромагнітного випромінювання, електромагнітний моніторинг урбанізованих територій. Систематизовано основні ідеї та розв'язані завдання у попередніх дослідженнях електромагнітного забруднення довкілля, що дозволило визначити базові питання, які потребують здійснення додаткових досліджень у цій галузі на різних організаційних рівнях. Обґрунтовано необхідність розробки на державному рівні методики оцінювання та прогнозування впливу даного виду забруднення на компоненти довкілля. Виділено задачі, розв'язання яких має бути передумовою для розробки систем екологічного моніторингу електромагнітного забрудненням, а саме: визначення соціальних верств населення, які є показовими з точки зору достовірності статистичного врахування рівня навантаження, що створюється електромагнітним забрудненням на їх організми; розробка методики збалансованого врахування ефектів впливу електромагнітного поля; обґрунтування еколого-економічної доцільності проведення системних заходів екологічного моніторингу електромагнітного забруднення.

Ключові слова:електромагнітне забруднення, екологічний моніторинг, аналіз, результати, електромагнітні поля.

PROBLEM STATEMENT. Electromagnetic pollution is a factor of the environmental hazards formation at the local level. Due to the continuous growth in demand for devices that are the sources of electromagnetic radiation, not only at home but also in industry, this subject study has been accelerating recently. The researches are appearing, deepening and concretizing to determine the electromagnetic pollution level in areas of radio and telecommunication towers, mobile communications units, industrial enterprises, power transmission lines [1]. Along with this, some studies to determine the household devices of daily use – wireless Wi-Fi routers, microwaves, TVs, computers, smart phones contamination level [2] and predict this equipment type negative impact on living organisms are being conducted. Today in Ukraine there are no permanent sanitary and hygienic standards for the assessment of electromagnetic pollution sources negative impact on living organisms. There is no methodology and concrete methods of this type of air pollution environmental monitoring. State control in the field of electromagnetic radiation sources use was carried out by the sanitary and epidemiological service and the Environmental Inspectorate until 2014. The above – mentioned state services are under the procedure of reforming, their ultimate authority on this matter is still unknown. Thus, there is the reasonable necessity to conduct a series of studies aimed at investigating methodological features of the electromagnetic pollution environmental monitoring system conceptual objectives. Taking into the account the fact that effective management of ecological safety is possible only if a comprehensive, detailed and thorough analysis of ecological danger forming conditions, the presupposition

for the research purpose is the previous studies results analysis in this area. Thus the purpose of this work is the analysis of the previous scientific researches results of problems of the environmental electromagnetic pollution in the context of the environmental monitoring methodology-formation. The previous scientific researches analysis has been conducted in three directions: electromagnetic pollution as a factor in disease onset and acceleration, the methods of electromagnetic radiation exposure level decrease, urbanized territories electromagnetic monitoring.

EXPERIMENTAL PART AND RESULTS OBTAINED. The most important direction of research has been and it still remains the question of the electromagnetic waves impact on living organisms. In academia and it still does not stop the discussion about the effect of the «invisible electromagnetic smog» [3]. The author of the scientific experiment [4] has proved by developing a modulator with frequency change that with the help of electromagnetic radiation malignant cancers can be reduced by up to 50 %. On the contrary to this discovery, there is a large number of works in which the cases are described where in the course of field and laboratory experiments the opposite opinion – the effect of waves can not only lead to the development of existing diseases, but also causes chronic diseases [5] – has been proved. Thus, the connection between electromagnetic pollution and the occurrence of cardiovascular diseases caused by change of speed of blood clotting has been substantiated [6].

The authors of the researchers [7, 8, 9] have identified and explained the low frequency electromagnetic radiation effect on:

– brain cells that causes insomnia and sleep disturbances, anxiety and nervousness;

– size and growth rate of malignant cancers, while the study participants [9] managed to prove that cancer cells that are daily present in a human body can be captured into tumor under the electromagnetic waves influence;

– the development of breast cancer among women.

The effect of radiation is not limited only by the manifestation of negative consequences in the health and life of humans and mammals, it also deals with lower organisms [10]. It has been empirically determined that prolonged electromagnetic radiation exposure reduces the cells division rate, their growth and development, and in some cases offspring may have genetic abnormalities.

Plants exposed to constant electromagnetic effects begin to change at the cellular level, causing disorders of biochemical processes, changes in the active enzymes work [11].

Therefore, it can be proved that prolonged electromagnetic pollution sources exposure can cause systemic disorders in the activities of living organisms that do not have natural protection from the effects of electromagnetic radiation formed by man-made sources over a natural background. While the previous studies have not found out which social groups are relevant from the point of view of statistical accuracy of the load level calculation that is generated by electromagnetic pollution on their organisms.

The rapid development of the information society has brought great popularity in the electronic equipment, which led to more and more severe high-frequency electromagnetic radiation pollution. Electromagnetic radiation not only interferes into the normal functioning of electronic devices, but also it is harmful to human health, therefore, electromagnetic radiation protection has become a hot issue in the research of the international level [12].

Scientists from around the world explore the ways and methods of protection from electromagnetic waves exposure by using materials with high absorption characteristics. The best electromagnetic waves absorber, which has a negative impact on humans (in the range of 2-4 GHz) today is foam cement. It is a new type of thermal isolation building materials, which is widely used in domestic construction and decoration. Foam cement group is used as dielectric structure and S-band absorber, which was developed by the dielectric matching method [12].

The main advantages of this method of protection from electromagnetic radiation are the following: the used of traditional acoustic insulation which is widely used in construction, its accessibility, effective protection. low material cost, lightness and high insulation, simple preparation process, availability for industrialization.

The authors of [13] consider the use of green barriers in the form of trees as one of the methods which is not less effective method of protection against the effects of electromagnetic waves. The study was based on the selection of suitable trees to create a protective screen, by choosing the types with big thick crown and height enough to reduce the angle between the transmitter and the receiver of electromagnetic waves. The result was a list of trees varieties that are the most suitable for protection from radio waves, namely Pittosporum tenuifolium (commonly known as karo), Cryptomeria japonica (Japanese cedar), Chaenomelesjaponica (Camellia) and Malus pumila (Apple). In the experiment, it was concluded that the plate leaf-area significantly affects the electromagnetic waves flow retension. Plant varieties for the creation of green barriers should meet the greater number of the following criteria: presence of leaf cover throughout the year; a sufficient height to reduce the angle between the target and base stations; high density sheet plate.

The authors [13] propose to apply these green barriers not only in urban residential areas, but in close proximity to healthcare, preschool and school institutions. Camellia (Pittosporum tenuifolium) refers to a number of extended criteria. In addition, these plantings will prevent the electromagnetic fields propagation, they will be able to reduce significantly the pollutants dispersion in the atmospheric air, noise and vibration load levels.

One of the most common sources of electromagnetic radiation today is a mobile phone. They are being used not only by adults but also by children who can't give it up, and parents, despite the claims of scientists about the danger of this means of communication, can not deny the child using this gadget in daily life [14].

Therefore, to protect from the harmful influence of electromagnetic radiation in [14] it has been proposed the set of the following rules:

– parents should forbid their children to use the phone without any need;

– during a telephone conversation you should hold the device at a distance of 2-5 cm from your ear;

– if it is possible, use a Bluetooth headset;

– do not use a mobile phone in public places (like bus) to prevent passive exposure to other people;

– at night do not leave the phone near you, and in the day time wear it so that it has not any direct contact with the body;

– do not use a mobile phone for long conversations;

– do not use the device when going at high speed (train, car), because the level of electromagnetic radiation increases;

Thus, it has been clearly established that technical methods of protection from electromagnetic radiation effect are fundamentally different from those used to reduce the negative impact of other air pollutants on human health, such as noise. At the same time, it is clear that the main methods of protection are organizational, as scientifically based limits under the action of electromagnetic fields (EMF). It should be noted that basic researches in the field of organization and conducting of electromagnetic pollution ecological monitoring are aimed to the effects of outdoor effect exposure, and organizational recommendations are to reduce the impact of indoor sources. The methodology of these different influences balanced consideration is missing today.

It is known that for some of electromagnetic energy generating technical means is a specific feature that is related to their functional purpose, while for others it is a byproduct [15]. However, in both cases, the radiated field is the active factor of environmental pollution. These questions refer to a specific field of study – electromagnetic ecology, traditionally, the problems associated with them, are solved by using electromagnetic monitoring that includes [15]:

– calculative prediction of electromagnetic field, which is very important for stages of development, design and placement of urban technical means that are the sources of EMFs;

– instrumental monitoring of the electromagnetic environment on the operational stage of facilities and their complexes;

– the development of measures and recommendations for the protection from EMF and the urban situation electromagnetic normalization.

In the general case electromagnetic monitoring should include impacts monitoring, environmental conditions evaluation at the relevant criteria, forecasting the situation on this factor and creation of an information system shaving special purposes. Depending on the electromagnetic monitoring goal in its composition we can identify several types [15]:

– electromagnetic environment monitoring: for the purposes of hygienic assessment it is carried out during the design, construction and operation of the emitting technical means. The basis of this type of monitoring is the electromagnetic situation prediction by means of calculation methods. The result is presented in the form of sanitary and hygienic conclusions on the radiating object;

– electromagnetic geoecological monitoring: a large number of diverse technical equipment, spatial separation of radiating objects, the effect of terrain and buildings on the electromagnetic situation;

– socially oriented electromagnetic monitoring: it enables the timely and efficient informing of the population about electromagnetic pollution levels.

Detection of electromagnetic radiation sources is, of course, a matter of urgency, but at the same time, it entails high costs (expensive equipment), requires constant presence of the operator with professional skills (directly near the source of pollution). Therefore, at the initial stage of development of this kind of environmental monitoring it is important to develop methodological and practical basis for its automation.

Thus, the authors [16] have proposed and implemented a structure of hardware-software electromagnetic field level monitoring complex among several developed autonomous mobile measuring terminals and the central terminal. Along with this the methodology of EMF measurement on the territory of the network coverage of the cellular GSM standard communication, making it possible to increase the number of measurements for 1 minute and to bind the obtained data to specific geographic coordinates.

An essential element of monitoring automation is mobile labs that can measure tension and density of electromagnetic flux in motion, save the measured values in the database along with the geographical coordinates. Therefore, the authors [17] have justified the large-scale use of the «ARGUMENT-U» mobile station which is equipped with a panoramic measuring receiver, a remote control, a converter and devices for measuring the radioactive contamination and noise levels.

The disadvantage of the existing electromagnetic monitoring equipment is that they provide measurement of the pollution level only at separate specific frequencies (communication system of the GSM standard) in the operating range of EMF levels, ignoring values that exceed this range [18].

According to the authors [18], to obtain a reliable picture of electromagnetic pollution a measuring device must provide:

– opportunity for integrated measurements of the radiation power along with some operators simultaneously operating antennas in different frequency ranges.

– reference measured parameters to the time, date, geographical coordinates, height;

– saving of measurement results in volatile memory;

– possibility of autonomous operation (no operator intervention);

– the ability to work in confined spaces (apartments, houses).

Based on the above mentioned requirements [18] it has been proposed a model of a measuring device for measuring the density of electromagnetic flux from 0,01 to 20 mW/cm2 in the range of 0,1–2,7 GHz. To reduce the error of the simultaneous use of two instruments, it is calculated estimate, and then data is transmitted to the memory card.

With the aim of electromagnetic monitoring development in urbanized areas [19] it was theoretically proved and developed a computational method for the electromagnetic pollution determination, and on the spline-interpolation basis of the experimental data it was invented the «Calculation of power lines electromagnetic fields» model, algorithm and computer program. The software allows to calculate the electromagnetic stress at different distances from the power lines in the linear arrangement of the track and its turns.

Due to the fact that a large number of industrial equipment can be a source of electromagnetic pollution there is a need to develop a computer programs that will be able to give a reliable result on the negative impact effects on workers. In [20] it was proposed to use the software that displays an EMF graph in a workplace and contains a description of its placement appropriateness after mathematical calculation. When using the program it is possible to calculate the level of electromagnetic pollution negative influence on a worker, to minimize or to avoid it and to reduce material costs to conduct working conditions regular monitoring.

A separate research direction of the chosen direction is the creation of electromagnetic cards. Of course, information about the electromagnetic environment at the scale of the modern city is a large amount of data. Therefore, an integral part of electromagnetic monitoring is the technology of the visualization and graphical obtained data processing [21].

In recent years, the practice of using geoinformational technologies and electronic maps has been widespread, in consequence of which the concept of «geoecological mapping» has appeared. Fundamentals of the environmental monitoring results visual presentation with using GIS technologies include [15]:

– database creation that records all the radiating objects parameters necessary for the further operations;

–database objects placement of on the electronic map.

The electronic map is a multi-layered image and it can be created by combining raster maps and photographic material, vector area objects, matrices, location properties and user data [22, 23].

To create vector maps, in contrast to the raster it is more practical and easier to use, [16] the «MapInfo Professional» product is used, the process of a map creating includes the following steps:

– scanning raster maps of the studied territorial unit;

– geographic referencing to the obtained raster image;

– vectorization (highlighting main layers: streets, rivers, lakes, etc.);

– saving data in Shape format files (*.shp), so the maps become available for use.

Due to the electromagnetic vector maps scope specificity the «Borland Delphi» special software has been developed, which has a high speed of visual information displaying, easy integration of new data and opportunity to predict future status of the territory (district, city, region) in the future [16].

In [17] the authors identify three components that are necessary in the geoinformation systems composition. They are as follows:

– a block of natural and ecological maps – topography, forest stands, and water systems maps;

– a block technical and ecological maps – engineering and technical facilities of the territory, urban features, pollution sources;

– a block of social and ecological maps – demographic, social, medical and geographical maps.

The electromagnetic maps creation is important not only for use in the research community. Every person has the right for access to information about the environmental state, so it is important to reproduce information not only in full size, but so that it was clear to every citizen [24, 25]. In addition, the electromagnetic maps creation should be preceded by reliable measuring method identification of the high-frequency radiation negative impact, so as to make the map reliable [25].

Special attention should be paid to issues of assessment and prediction of noise exposure and electromagnetic pollution on the natural reserve and recreational area. So the authors [26] have considered the aspects of creating a basis for assessing and predicting noise and electromagnetic radiation negative impacts on a natural preserve and recreational areas. It has been stated out the absence of procedures for determining the impact of these harmful physical factors on the biota, and shown that in Ukraine there is no system of regulating noise and electromagnetic radiation exposure levels in conservation areas.

In any case, researches in this area should be carried on and deepened because in order to develop optimal means of protecting people, at first, it is needed to understand the mechanism of the «electromagnetic smog» effect on the body, but also to explain clearly environmental and economic feasibility of environmental monitoring systematic events.

CONCLUSIONS. The analysis of previous scientific research concerning electromagnetic pollution of the environment and the electromagnetic radiation impact on living organisms has shown that nowadays a solid theoretical basis for further research in this area have been laid. The main results of the analyzed studies are presented in the table 1.

Table 1 – Basic ideas and solved problems in the research of electromagnetic pollution of the environment

Research title	Authors, country, year	The main ideas, tasks solution related
1	2	3
«Analysis of the electromagnetic pollution for a pilot region in Turkey»	Bayrak M., Genç Ö., Yaldiz E. Turkey, 2010	The level of electromagnetic pollution influence from the mobile operators antennas, citizens are faced with has been investigated.
«The incidence of electromagnetic pollution on wild mammals: A new "poison" with a slow effect on nature?»	Balmori A. Spain, 2010	The negative impact on wild mammals has been investigated.
«Killing Fields»	Firstenberg A., 2004	The effect of electromagnetic radiation sources on the incidence has been investigated.
«Effects of electromagnetic fields on biological processes are spatial and temporal-dependent»	Buckner C., Canada, 2011	The EMF frequency change modulator slows down the growth of tumors and helps to reduce them.
«Clean» pollution: the hidden legacy of the electromagnetic wave»	Ghosh R., Sunkavalli S., 2010	EMF changes the enzyme activity, resulting in changes of the whole organism.
«Mechanism of the biological impact of weak electromagnetic fields and the in vitro effects of blood degassing»	Shatalov V.M., Ukraine, 2012	Blood degassing leads to cardiovascular diseases.
«Effects of low frequence electromagnetic fields on status oncogene expression level in peripheral blood mononuclear cells»	Maha E.D., Salah A.R., Sanaa R., Sarah E.M., Yehia M., Egypt, 2014	EMF is a factor that increases the risk of oncological disease.
«Orientation studies of a cell-phone mast to access electromagnetic radiation exposure level»	Dhami A.K., Jagbir K., India, 2012	EMF affects brain tissue, causing diseases.
«Impact of environmental contaminants on breast cancer»	Jampílec J. and Kráľová K., Slovakia, Czech Republic, 2015	EMP is a catalyst for cancerous tumors growth.
«The influence of electromagnetic pollution on living organisms: historical trends and forecasting changes»	Ambroziak D., Gradolewski D., and other, Poland, 2015	EMF is a sources of negative impact on all types of living organisms.
«Cell phone electromagnetic fields radiations affect rhizogenesis through impairment of biochemical processes»	Batish D.R., Kohli R.K. Sharma V.P., Singh H.P., India, 2011	EMF significantly affects biological materials.
«The double-layer matching design of broad-band foam cement absorbing panel for electromagnetic pollution control»	Chen D., Dong Y., Hao W., Wang M., Wu F., Yi Y., Yu X. Zhao H., and Zhang Y., China, 2013	Use of foam cement as an insulation material reduces the level of electromagnetic pollution.
«Vegetal barriers for minimizing electromagnetic pollution at cellular phone bands»	Alejos A.V., Cuinas I. and Sanchez M.G., 2005	The use of tree rows is a way to reduce EMF effect and to improve environment.
«Growing concern about electromagnetic pollution and cell phones»	Herberman R., USA, 2008	The use of the means that there are EMF sources, should be kept to minimum
«Electromagnetic monitoring of the megapolis»	Maslov M. Y., Spodobaev M.Y., Spodobaev Y.M. Russia, 2013	Systematic environmental monitoring. The algorithm of geoecological monitoring technology, principles of data visualization.

continued Table 1

1	2	3
«Control of electromagnetic pollution of the territory in the frequency bands of GSM and UMTS»	Dementiev V.E., Elyagin S.V. Russia, 2010	The hardware and software complex for electromagnetic monitoring automation, software for creating, modifying, reading and changing electromagnetic cards have been created.
«Automated monitoring of electromagnetic field intensity»	Begishev M. R., Dvoeglazova S.V., Kozmin V. A., Kochkin D.E., Saveliev S.A., Russia, 2012	Electromagnetic monitoring automation via the «ARGUMENT-U» mobile laboratory.
«Mobile environmental monitoring device-level electromagnetic field»	Armer A. I. and Elyagin S. V. Russia, 2008	A mobile device for electromagnetic monitoring with a wide range of flux density has been developed
«Environmental monitoring and improvement of electromagnetic safety of the urbanized territories in the vicinity of power lines»	Sviridova E. Y. Russia, 2012	The «Calculation of transmission lines electromag-netic fields» software package was developed for a computer.
«Method of evaluation and monitoring of electromagnetic radiation at aviation enterprises of civil aviation»	Merzlikin I. N. Russia, 2013	The software that allows you to predict the impact level on the employee has been created
«Investigation about urban electromagnetic pollution sources from perimeter of city of Oradea»	Cret. P., Lolea M. and Sorin G. Romania, 2014	High influence from telecommunication antennas EMF on the city population has been grounded.
«The spatial statistics formalism applied to mapping electromagnetic radiation in urban areas»	Antolin A., Jimenez A., Paniagua J. M., Rufo M., Spain, 2012	Spatial statistics is a tool of EMF distribution analysis.
«Programming an artificial neural network tool for spatial interpolation in GIS – a case study for indoor radio wave propagation of WLAN»	Bulucu U., Gümüşay Ü., Kavas A. and Şen A. Turkey, 2008	Spatial interpolation of EMF measurements with using the neural network feedback advanced submission.
«Software engineering for mapping radio frequency pollution»	Aboura H., Agbinya J. and Chaczko Z. Australia, 2010	A database of electromagnetic pollution has been created to inform the public with the environmental state.
«How to use traditional spectrum analyzers for correct evaluation of the human exposure to electromagnetic fields generated by WiMAX devices»	Betta G., Capriglione D. and Miele G. Italy, 2010	The method of the electromagnetic pollution level assessing that is being created has been proposed
«Assessment and forecasting influence of electromagnetic noise and pollution on protected territory and leisure»	V. Nykyforov, O. Sakun, V. Bakharev. Ukraine, 2015	The reactions of biological systems to the effect of noise and magnetic field were registered. The levels of critical magnetic induction, which cause an exhaustion and loss of organisms, were grounded

Despite the above mentioned achievements the issue under analyses still remains relevant for Ukraine. It is already known that electromagnetic radiation causes disturbances of the nervous system, cardiovascular system, leads to sleep disorders and migraine and, therefore, requires more detailed consideration from the point of view of the influence mechanism on the human body. Our particular concern is the degree of electromagnetic radiation influence on kids under the age from 1 to 3 years old who are staying round the clock under the adverse effect of indoor and outdoor electromagnetic radiation sources. Hence the factor of electromagnetic pollution is important to be taken into account when building urban systems, especially concerning the EMF impact on the settlement recreational areas. In the national aspect this issue

requires conceptually valid methods of assessing and predicting pollution impacts on environmental components. From the point of view of the municipal systems unresolved local problems for environmental monitoring the following can be marked out:

– determination of the social strata that is indicative from the point of view of load level statistical calculation reliability that is generated by electromagnetic pollution on organisms.

– EMF exposure indoor and outdoor effects balancing accounting methodology development;

– ecological and economic performance substantiation of the electromagnetic pollution environmental monitoring systematic events.

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АНАЛИЗ ПРОБЛЕМ ЭЛЕКТРОМАГНИТНОГО ЗАГРЯЗНЕНИЯ ОКРУЖАЮЩЕЙ СРЕДЫ В РАЗРЕЗЕ ФОРМИРОВАНИЯ МЕТОДОЛОГИИ ЭКОЛОГИЧЕСКОГО МОНИТОРИНГА ДАННОГО ВИДА ОПАСНОСТИ

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Проведен анализ результатов предыдущих исследований по проблемам электромагнитного загрязнения окружающей среды в разрезе формирования методологии экологического мониторинга. Анализ предыдущих исследований проведено в трех направлениях: электромагнитное загрязнение как фактор возникновения и ускорения заболеваемости, методы снижения уровня воздействия электромагнитного излучения, электромагнитный мониторинг урбанизированных территорий. Систематизированы основные идеи и решены задачи в предыдущих исследованиях электромагнитного загрязнения окружающей среды, что позволило определить базовые вопросы, которые требуют проведения дополнительных исследований в этой области на различных организационных уровнях. Обоснована необходимость разработки на государственном уровне методики оценки и прогнозирования влияния данного вида загрязнения на компоненты окружающей среды. Выделены задачи, решение которых должно быть предпосылкой для разработки систем экологического мониторинга электромагнитного загрязнения, а именно: определение социальных слоев населения, которые являются показательными с точки зрения достоверности статистического учета уровня нагрузки, создаваемой электромагнитным загрязнением на их организмы; разработка методики сбалансированного учета in door and out door эффектов воздействия электромагнитного поля; обоснование эколого-экономической целесообразности проведения системных мероприятий экологического мониторинга электромагнитного загрязнения.

Ключевые слова: электромагнитное загрязнение, экологический мониторинг, анализ, результаты, электромагнитные поля.

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