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## ECO-CONDITIONS OF CITY ENVIRONMENT

The European project within TEMPUS program  
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Principles & Advanced Technologies without Losing Identity“

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ECO-CONDITIONS OF CITY ENVIRONMENT

TEXTBOOK

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Ecology environment - a vital factor of the health and quality of life. Ecological conditions of the city environment are an indicator of the relationship between a man and created by him artificial urban environment and the natural environment. Due to the rapid development of industry and the widespread of industrial facilities, these relationships led to the global disruption of the structure and functioning of the natural balance elements. To generate optimal solutions to the problems of urban ecology, first of all, significant steps are needed to educate, clarify and spread the knowledge and to consolidate joint efforts of all population sectors of all countries of our common home - the Earth. The ability to see related environmental problems and understand their causes gives to man keys to a reasonable harmonious unity and interaction with the world around him. The vast majority of the world's population now lives in cities, and the trend of urban growth has been a steady long-term perspective. Objectives of normalization of ecological conditions of the urban environment requires an interdisciplinary professional studies involving architects and town planners, professionals in the field of urban planning, sociology, urban economics and law.

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## ***Introduction***

Ecology of the urban environment, urbo-ecology (from the Greek. Οἶκος - dwelling house, and λόγος - word, concept, doctrine) - applied science that studies the problems generated by the influence of the urban environment on man and the environment, leading to disruption of the structure and natural equilibrium elements functioning, and forming optimal ways to solve them.

In all clarity of problems and their immediate solution, it is needed measures aimed to education, awareness raising, promotion of knowledge and consolidation of joint efforts of all sectors of the population of all countries of our common home - the Earth. The ability to see related environmental problems and understand their causes gives a person the keys to a reasonable harmonious unity and interaction with a world around him. This course is designed to fill the apparent lack of systematic information in this area and provide clues to understanding current problems and ways to solve them.

The course structure is built on a common scheme. Table of Contents, Introduction and learning objectives of the course give a general orientation in the subject. Hyperlinks, list of figures and tables, glossary help you easily to guide in studying topic and serve as semantic markers for mastering material. Questions, assignments and keys - reliable means while review of material, self-control and exam preparation. List of recommended literature expands professional competence.

The main part of the course consists of three chapters. The first chapter deals with current environmental problems of urban environment. It is given introductory basic concepts and definitions, the main factors of city interaction with the environment and environmental problems in the cities historical perspective are examined, the current state of cities ecology and key environmental problems of the urban environment are discussed.

The second chapter presents ecology of urban environment in the context of the sustainable development concept. It is considered the concept of "sustainable development", its meaning and content basis, preconditions of its practical realization in life and city functioning. It is considered modern successful experience on solving urban environment ecology problems. Specifics of some problems of urban ecology in Ukraine take a particular place.

The third chapter is devoted to theoretical and technological support of successful solution of urban environment ecological problems. Perspective purpose and urban environment ecology challenges are summarized. Challenges and ways of solving problems of urban environment with use of modern technology.

## ***Objectives of the course***

The main objective of the textbook is to facilitate the advanced study of the training material of the lecture course "Sustainable Urban Development Based on Eco-Humanistic Principles" by master students of specialties: 8.06010201 "Architecture of buildings and structures", 8.06010202 "City planning" and 8.06010203 "Design of architectural environment".

The aim of the course is to provide future professionals with the knowledge and skills in the design and organization of the urban environment

The task of the textbook is to help Master's Degree students to form professional approach to the analysis and solution of environmental problems of urban environment. The textbook studied complex major environmental problems caused by urbanization, but also showed the ways of normalization of environmental conditions in urban areas, the characteristics of the current ecological conditions of large and small-birth and populated areas are shown.

The course consists of logically interrelated sections that fully cover the most urgent environmental problems of the urban environment. The basic concepts and problems of ecology are presented. It is considered environmental problems associated with the growth of urban structures; issues on protection from various types of pollution; measures on utilization of solid household and industrial waste are offered; the features of the formation, ways of preserving and developing the urban flora and fauna are described; a brief analysis of environmental, psychosocial and medical problems some of the townspeople is given.

It is expected that within this course the students will obtain or develop the following competences:

- at the level of generic competences - the formation of knowledge in key areas of ecology of the urban environment, the ability to develop critical and analytical thinking;
- at the level of research competences –the ability to innovate in the field of environmental architecture and urban planning, professionally analyze functional processes of maintenance of buildings and city life, identify problems and propose science-based solutions;
- at the level of professional competences –understanding of the scale and intensity of anthropogenic and technological impact on the environment, forecasting the possible risks and consequences of this action and the corresponding adjustment of environmental measures in the design of architectural objects, planning of urban structures and urban planning.

## ***Glossary***

**Anthropogenic stress** - degree of direct or side effect of people and their economic activities on nature as a whole or on its individual environmental components.

**Anthropogenic pollution** - pollution, resulted from biological existence and economic activity of people, including their direct or indirect effect on the natural pollution intensity.

**Anthropogenic landscape** - landscape, the properties of which are due to human activities.

**Anthropogenic factor** - influence that human and his activities exert on organisms, biogeocoenoses, landscapes, biosphere (as opposed to natural or environmental factors)

**Biogeocoenosis** - system, located in a balanced inter-action and interconnection, that includes a community of living organisms and closely related to it a set of factors of inanimate environment in the borders of particular territory. They are interconnected by the cycle of matter and the energy flow (natural eco-system). It is a stable self-regulating ecological system in which bio-energy components (animals, plants) are inextricably connected with abiotic ones (water, soil).

**Groups of risk** – social population groups, exposed to the greatest risk of adverse environmental factors influence.

**Capacity of biotic environment** - 1) the number of individuals or their communities whose needs can be met with resources of their habitat without traceable damage to its further welfare; 2) the ability of the natural environment to include (absorb) various substances (pollutants), while maintaining steadiness.

**Atmospheric air pollution** – addition of uncharacteristic physical, chemical, and biological Substances to the air or changing their natural concentration.

**Soil pollution** - kind of anthropogenic degradation of soils in which the content of chemicals in soils, exposed to the human impact exceeds natural regional background level of their content in the soils.

**Water(s) pollution** - amount of pollutants in ground water, water of springs, rivers, lakes. It occurs by direct or non-direct penetration of pollutants in water in the absence of adequate measures for prevention, treatment and disposal of hazardous substances.

**Ecological criteria** - a sign, on the basis of which an evaluation, definition or classification of ecological-ray systems, processes and phenomena are made. It may be environmental protective (preservation of the ecosystem integrity, species of organism, its habitat, etc.), anthropoecological (effects on humans, on its population) and management, up to the impact on the entire system "nature-society".



**Xenobiotics** - alien compounds for organisms (industrial pollution, pesticides, household chemicals, medicaments etc.) Once penetrated in the environment in significant quantities xenobiotics can affect the organisms genetic apparatus, cause their death, disrupt the balance of natural processes in the biosphere.

**Environment** –habitat and activity of the humanity. Natural and created by human material world that surround him. The environment includes natural environment and artificial (man-made) environment, i.e. the set of environment elements, created from natural substances by the work and conscious will of man and have no analogues in the virgin nature (buildings, structures, etc.). In the broad sense, the concept "environment" can include material and spiritual conditions of existence and development of society. Often, the term "environment" refers only to the natural environment; in this sense it is used in international agreements

**Overpopulation** - type of demographic crisis, characterized by resource population surplus in relation to the resource base of the populated territory. The result is a lack of resources to maintain the hygiene of life and a restriction of livelihood.

**Densification, infill development** - construction of new (often multi-storey) buildings or structures in the historically formed development, residential area, courts, on the sites of green areas, squares and parks. It is often elevated with gross violations of sanitary norms and ecology; accompanied by a significant deterioration in the quality of accommodation for the residents of surrounding houses, and, as a consequence, conflicts with developer.

**Sustainable development** – a concept of a harmonious and balanced development, refers to the process of human development (from the individual to the human society in general). It is based on the four components of sustainability: economic, environmental, political and cultural.

**Sustainable city, eco-city** - the city projected including environment interactions, the population of which seeks to minimize energy consumption and resource use, thereby minimizing environmental pollution, pollution of waste and ground water, release of carbon dioxide, methane, combustion gases and aerosols, thus monitoring microclimate and sanitary conditions of the city.

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26. <http://www.ecolife.org.ua/> Общественный экологический Интернет проект
27. <http://www.eco-mnepu.narod.ru/ctaep/bul.htm/> Экологические новости – информационный бюллетень
28. <http://www.epa.gov/> Сайт американского агентства по окружающей среде (EPA)
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## 1 Problem development background of city environment ecology

*City - artificially formed habitat, macro-dwelling of human being, providing him acceptable living conditions. City consumes resources of various energy sources, food and water; is enriched with new inhabitants, grows up and spreads outwards and thus is an open actively functioning system, the elements of which communicate with each other and with the environment with flows of matter, energy and information.*

*The result of urban system operation is expressed not only in the production of material goods and financial flows and information accumulation, but also in reverse process of separation of city operation wastes - the production of a significant amount of solid, liquid and gaseous wastes that pollute the environment. Increasingly, cities become a source of poisoning the global environment: diffuse spread of increasingly diverse ugly life-melting substances is being more extended form. Actively growing cities texture, absorbing and destroying surrounding natural environment, natural resources and emitting many negative factors instead in the total weight impact on the local climate and ecological communities, the climate and ecological balance of a wider region, and totally affects the ecological balance and climate of continents and the planet as a whole.*

*Current crisis in the relations of human being and nature brought to a critical point is increasingly forcing society immediately come to understand and resolve the accumulated problems. Number of adherents of living in balance with nature and the number of ecological organizations increase, multilateral environmental projects are developed and spread, environmental standards and legislative instruments are passed. Nowadays accumulated knowledge allows efficiently to solve problems of interactions between growing human needs and preservation of the ecological balance.*

### 1.1. City as functioning organism

City as a functioning organism

In accordance with a dominant engineering outlook in the first half of the twentieth century, famous French architect Le Corbusier considered a house as a machine for living, and the city - as a mechanism, which should carry programmed functions. Present day, city is often compared to cyber and information systems. However, it should be understood that any mechanism or cybernetic device would not exist and would not function without human being who created and run them and without developed by human being software. Namely a man is a creator and a user, which set a desired program of action and the very purpose of functioning city-system.

Above all, in contrast to mechanism or cyber machine, the city breathes, drinks water, consumes food, thinks, lives ... People inhabiting the city communicate, coordinate, cooperate in accordance with specific goals and objectives, perform activity, movement, flows circulation. Thus, the modern city is more like a living organism, in which organs and tissues up to each cell perform their functions, and

interact in a general rhythm and direction. No wonder more and more often in urban planning and architecture it is used terminology associated with wildlife: metabolism, vital resources, livelihoods, nervous system, brain, heart, arteries, lungs, etc. Today it is well founded city is regarded as a living functioning organism, which is consistent with the modern approach from the view of ecology, bioclimatics and biomimetics.

From the colonies of simplest to symbiotic structures and, finally, ending with bee families, ant hills, termite mounds - they re-present complexly living structures, which are formed according to certain laws. In nature there are many examples of living structures, connected by common cycles and rhythms, systems of supply, consumption, management, transportation and disposal. As anthropogenic analogous it can be called urban systems of energy, electricity, gas and heat supply, systems of communications, transportation, air purification, water supply, drainage, sewer, sanitation and treatment, collection and recycling wastes.

The larger the city and the more developed its industry, the more complicated organization system of its operation. The more society civilized and technologically supported the more life support for each city resident depends on the society. One of the most important tasks of a functioning urban structure is to maintain the highest standards of living while respecting the favorable environmental conditions.

## 1.2. Factors of interacting city and environment

City is a dense habitated geographic territory with developed infrastructure of buildings, streets, transport network, energy, industry, finance and services. This area is an area of the human community activity. City created by man for man. But we must not forget that man is just one of the links of the nature and the role of other parts of the environment are not less important than the role of a man arrogantly proclaimed himself "the master of nature." One must not forget about natural environment surrounding humang being.

The term "environment" is to use in relation to a subject, which this environment surrounds – i.e.with respect to human or human society. Applied to other organisms the concept of "external environment", "environment" are used.

*City environment* - a material shell of the city, a limited area of urban development and related engineering and transport structures and facilities. Urban environment is divided into biotic and abiotic. By the biotic environment are objects of nature: people, animals, plants - living organisms.

Abiotic environment contains a natural physical (geology, water and air) and artificial (technical, spiritual and cultural and socio-psychological) environment.

Environment

City environment

Biotic and abiotic environment

### **1.3. Problems of cities ecology in historical retrospective**

Genesis of the cities associated with development of civilization, which, in turn, increases knowledge and achievements development and development of technology.

In the early stages of human society development, gathering and hunting were a basis of providing vital resources. The earliest people lived with natural environment had to respect the balance, because their lives depended on the mercy of nature. Population on a given territory obeyed the biological laws and depended on the environment resistance. Nature was regarded as a great mother with reverence, worship and canonization. It was endowed with anthropomorphic features, trying to understand the cause-and-effect relationships of the world.

Replacement of hunter and gatherers communities' culture by crop farmers and pastoralists' culture has made a great turn in human development. Have domesticating animals and cultivation of plants man became to convert natural environment, he needed more extensive areas for livestock grazing and for growing plants. In the relationship between man and nature has been a part of human host, managing user of nature and nature transducer.

#### **1.3.1. Cities foundation**

Early cities

Predictable economy, active goods exchange, extension of geographical scope of settlements, consolidated social-formations and large settlements have been emerged. The first cities appeared more than 5,000 years ago. They were small and compact settlements, located, as a rule, on the area of exchange or food, furs, fabrics, crafts, tools and adornments trade. Such cities existed due to trade and accumulation of wealth so they needed protection and were enclosed with perimeter protection facilities. Cities topography began to get more and more clear planning and hierarchical structure. Cult centers, markets, yards, outbuildings and streets distinguished themselves. Population of the city acquired the social structure and hierarchy. Cities owned the function of power, accumulation of wealth, cult centers and concentration of artisans etc. Villages supplying the city with food began to develop around cities. Respectively, pastures and crops surrounded these settlements. Distances between settlements were limited by walk access.

Cities mainly located on the banks of rivers, lakes, seas, first of all because bodies of water and their banks were natural-governmental highways (especially for large loads, which were easier to transport by water). Water resources surrounded cities also served as a vital factor for life and hygiene, for agriculture and pasture. To drink water population used springs, springs and wells.

### 1.3.2. Cities of the ancient world

Cities were spreading, developing and growing. With the growth of cities, consumption was increasing and, consequently, the amount of waste and sewage were increasing as well. Waste products and municipal wastes have been merging into pits and earthed right next to dwellings in the courts, which inevitably led to contamination of groundwater and wells. Paving of streets and construction of bypass canal-equipment to some extent solved the sanitary conditions of the time. **СЛОЭВ.** The first known structures that served as sewers refer to the ancient Indian civilization (Mohenjo-Daro, 2600 BC). The following ancient ones are sewer systems of Babylon. Small size of early cities could not cause environmental disasters. However, overcrowding, narrowness and location of drinking water sources of drinking water close to sewage has often led to the propagation of toxins and infections through contamination of soil and water-carrier layers. Archaeological excavations confirmed cases of early local environmental problems associated with dense urban settlements, with the depletion of natural resources, intensive land use, soil salinization due to excessive irrigation and pollution of surrounding territories - mass mortality of the population from epidemics and famine.

Cities of the ancient world

Modifications in the structure of society, social and economic differentiation facilitated a transition to the emergence of cities hierarchical network, consolidated centers, large city-states (cities in Mesopotamia, Egypt, cities of Mycenaean culture, Phoenician cities, cities of Asia Minor and the Middle East and Balkans, etc.). These cities founded civilization basis, giving fundamentals of the state system and law, ethics, culture and art. Monopolization of authority and power of individual cities was taking place in parallel with development of major religious centers, first states and general state religions (as ideological foundation of the state). One of the known fixed laws of the ancient world is the Babylonian "Code of Hammurabi" (c. 1750 BC). In addition to interrelations of citizens and their obligations to the state, in this laws norms of human behavior in relation to the environment are mentioned: issues of rent fields (art. 42-46); negligence in the construction of irrigation dams (art. 53-56); inadmissibility of destroying gardens and regulators of their rent and use (art. 59- 66).

Ancient scriptures Vedas, Avesta, Tenah (Pentateuch) include texts that define a place and role of man in the world and prescribe his responsible attitude to society and environment. According to Karl Jaspers an "axial age" originates with the first "pen-religions" in mankind history (800 - 200 BC) - the beginning of a rational worldview and philosophy, the beginning of civilization. Relationship between people and the world around them turned into religion and ethical norms, getting a status of indisputable laws. Societies, in the broad sense of the word, are historically rooted kinds synergy of interaction and forms of people union, and civilization is a certain level of united people interaction. Civilized society requires a high degree of organizing people. This is a new stage in the society development.

Axial age

Civilization





Fig.1.1 Ruins of ancient Egyptian city Shali.

### 1.3.3. Antique cities

Antique cities

At this time, cities centers position is allocated, where wealth and masses of the people are coming (to the beginning of our era, the population of the city of Rome, for example, already accounts for about one million). In central cities vitally important need for urban land improvement and hygiene is manifested. Plumbing, aqueducts, paved streets, public baths, public toilets, sewerage are emerged. In ancient Rome during the reign of the fifth king Lucius Tarquinius Priscus an ambitious project of sewer system is launched. Places for trade and mass entertainment are regulated and developed. Legislative regulation to urban areas, streets width, etc is created. However, the extremely high population density and many slaves (the number of slaves was not officially fixed) repeatedly led to devastating epidemics. Commodity exchange and contacts between cities were also the ways of spreading epidemics. Sewage in the cities were buried or poured into common big dump wells, which often were overflowed. Primitive sewage was just poured into rivers. Roman sewer system, including Cloaca Maxima, was poured into the river Tiber. No wastewater treatment existed and cities located upstream created many problems for settlements downstream. Anyway, with regard to environmental and health antiquity was much more cultured than followed Middle Ages.

### 1.3.4. Cities of Middle Ages

Cities of Middle Ages

Declining antiquity was replaced by socio-economic system - the Middle Ages. Allotments (tenas, feuds or fiefs) are becoming a measure of feudal status and are given to vassals for work. Feudal estates, castles and monasteries, which assigned their land holdings together with farmers and land for hunting were growing. Feudalism features in Western Europe were the simultaneous presence of two authorities - secular and clerical, high degree of political decentralization, a significant social differentiation by estates, guilds, shops.



Fig.1.2. Medieval Siena. Ambrogio Lorenzetti – The Effects of Good Government in the city. Fresco. 1337-39. Palazzo Pubblico, Siena.

Medieval European cities became centers of trade and craft. They grow in limiting rings of outworks and because of the extreme limit of the territories structures inside them closely cling to each other and learn the vertical direction. Narrow curves street mazes are in fact narrow deep corridors devoided of direct sunlight. In medieval Western Europe citizens dumped garbage, food waste and sewage right in to the streets and peppered them with straw. Taken into account more commonly used horses it is easy to imagine abundance of waste in city streets. The streets were not cleaned, trash was not taken out. The streets were narrow and crooked, unreached for the sun. After rains streets turned into fetid swamps, and in the summer heat streets were full of caustic dusty slurry spiraled breath. Cities were filled with hordes of rats, spreaded tularemia, typhus and bobonic plague by lices and fleas. Puddles of sewage were seeping through the soil layers into the ground waters, poisoning drinking water in city wells. In such circumstances, epidemic diseases constantly accompanied life in cities, and during frequent epidemics of cholera, smallpox and plague the highest mortality were in the cities in particular.

Epidemics and  
pandemia

The first huge pandemic of plague occurred in the early Middle Ages during the reign of Empress Justinian. Originating from Egypt and spreading from the eastern borders of the Byzantine Empire to the west, the pandemic of plague was devastating all the cities of the Mediterranean for nearly 60 years. In the period of greatest height of "justinian plague" in 542, thousands of people died only in Constantinopole every day.

Crusades and widespread practice of pilgrimages in the Middle Ages along with the lack of basic hygiene brought to Europe diseases from the southern countries, leprosy. Steadily replenished community of lepers concentrated as outcast groups not far from cities and monasteries.

Medieval science did not know about the true disease causes and epidemics, believing them a pay for sins and result of miasma and hums effect. Incensing was considered the best means. Attention to the purity of life and body were not con-

sidered important because they were identified with physical frailty and sinfulness. For a long time, but until modern age there was stable, at the level of superstition, prejudice against washing and bathing. It was thought that one can wash away the grace of God, received with a laver washing up or bathing.

Life and hygiene standards of medieval Europe differed significantly from Eastern civilizations. Heritage of antiquity - bathing, soap, scented oils and other means of maintaining cleanliness, were in wide use in the East, where there were mandatory religious prescribing of maintaining cleanliness. In cities of the East there were public baths and fonts. In the west of medieval Europe moors and mozarabs of Toledo and Cordoba were distributing a construction of irrigation systems and rational use of land, brought fruit orchards cultivation tradition, including cultivation of citrus planting in future Spain.

Active trade with the East, developing commercial and financial exchanges in Europe in the end of Middle Ages led to the growth of plants and development of manufacturing production, a large influx of productive forces and rapid growth of urban population. Cities - republics of Venice, Florence, Luca, Siena, Pisa, Bologna, Genoa started to develop rapidly. First manufactory and institutions serving trade and business emerged in Italian cities in the XIV century.

But against the old medieval living standards, the rapid growth of urban population, their high density on relatively small limited areas, drowning in their own wastes, inevitably leads to the huge pandemic, bubonic plague come from Asia. It was quickly spreading further about all the cities and empty about 25 million people in a short time from 1346 to 1348 - more than a third of Europe's population. Only in Venice and Florence "Black Death" pandemic claimed more than half of the population. Salvation from the plague was only escape from the city.

### 1.3.5. Cities of Renaissance

Devastation of Western Europe by "Black Death" in the XIV century dramatically changed attitudes and values, the inner world of many Europeans, giving background social and cultural changes, the spirit of humanism and Renaissance. Rejection of medieval norms and practices draws attention and makes Renaissance thinkers to look for ways to overcome them. Italian scientist, humanist, writer and architect Leon Battista Alberti (1404-1472) critically remarked on inadmissible cities pollution and all related features as an example of Siena: "... the whole city emits a stench not only in the first and last custody night, when pottles filled with accumulated filth are poured through the windows, but also in other hours it is disgusting and very dirty." Evaluation and reinterpretation of living standards in Renaissance led to emerging open to the sun areas, urban villas and gardens. Architects of Renaissance were about a new project of "ideal cities" with interest. Alberti in treatise "On Architecture" paints an ideal city, beautiful on a rational layout and building, streets and squares appearance. Alberti's ideal city is characterized by equal improvements of all its parts for the people lives of different social status and availability of all beautiful public buildings - schools,

theaters, term – to them.

Due to the culture of Renaissance the growing interest to the ancient heritage, sciences and human being displaced medieval world. Permanent era of feudal strife has left and state centralization has strengthened. An era of navigation, learning sea-lanes, discovery and reclaiming the New World, conquering new distant territories, meeting new cultures and new food products approached. Boundaries of the world comprehended and the scope of Eorpean world-view are spreaded.

### 1.3.6. Modern age

Western European religious reformation transformed the entire belief system and influenced development of civil society, civil rights, founded legal equality, development of private property liability and active life position. Active free labour has become a norm of protestant community, giving a basis for quickly capitalism development. In the Netherlands, capitalist relations emerged in the field of navigation, shipbuilding, fishing and related crafts. In villages capitalist rent, capitalist farming and free tenure spreaded. Young Dutch bourgeoisie, which received Calvinism ideology, was in conflict with feudal Spain. This contradiction caused the first bourgeois Netherlands revolution in 1566, which quickly led to hegemony of the Netherlands in the field of capitalism development. The Netherlands became a leader in a shipbuilding, fishing, wool weaving, silk and velvet production and so on. Merchant fleet of the Netherlands was almost twice greater than the fleet of Britain and France together. By 1650, the Netherlands (and most of all Amsterdam) has took the first place in the field of foreign trade.

Modern age

The city became a major center of population growth and people migration from rural areas has become commonplace. As population movement from countryside to the city there was a need to increase the quantity of food consumed by urban dwellers. This led to reduction in number of peasant communities that produced goods for their own consumption. In England, from the XV century a peasant landless process drove out a lot of rural people to urban areas, increasing the mass poverty there and offer of cheap wage labor. Similar processes have also occurred in other Western European countries. XVI century was marked with increasing the number of cities and their population. By the XVIII century numerous manufactures has become a widespread phenomenon in Western Europe. Manufactories owners and bankers have formed new ruling elite, pushed aside old land-owning aristocracy. Colonialism became a particular feature of developing capitalism.

### 1.3.7. Industrial society

The emergence of industrial capitalism refers to the turn of the XVII and XIX centuries, when effective and productive steam machines and mechanisms emerged. They were using the energy of fuel burned, which was gradually led to the emergence of a new stage of civilization - industrial society. The use of steam engines led to the large factories appearance. The Industrial Revolution was ac-

Industrial revolution



accompanied by rapid increasing labor productivity, urbanization and economic growth. Implementation of machines allowed to use low-skilled workers who did not possess great physical strength. In industry it is started to use female and child labor massively. The more it became a potential labor force the cheaper hired labor was paid. The cheaper labor was paid the lower a working and living conditions level was. Rapid urbanization and the growth in the number of hired workers aggravated social problem. During the XIX - early XX century dwelling-conditions of large number of urban population did not meet elementary igienic and sanitary requirements. Workers settled not far from places of work in barracks or in rented apartments. Such settlements formed "workers' blocks" with high level of poverty and crime rate. Concerns for working conditions, life and health of hired workers did not take place - some workers died, their place once occupied by others – there was not scarcity of potential workers and a source of hands was inexhaustible.

The result of industrial revolution was a replacement of water and wind turbines by steam engines; horse-drawn carriages and sailing ships by locomotives and steamships burning coal. If in pre-industrial fuel was used mainly for domestic heating and food cooking, in new society it is mainly used for machines, for metals melting. It is needed a lot of fuel, fossil fuels – coal and oil - have the greater heat-storage capacity. This is accompanied by a significant increase in size of extraction and production of coal first and oil later. With growing need for metals to create machines and goods mineral resources extraction scale increases. The metall ores sources were of particular importance. Industry urgent need for fuel and ore led to a massive deforestation, quarries and mines spread, developing transport and roads. The number of cities and industrial settlements was actively growing along with the growth of smoking factories.



Fig.1.3. Industrial landscape of the late XIX century.

Industrial period marked a radical turn in human being relationship with environment. Until that time, city has used almost exclusively renewable resources primarily of biosphere origin - wood, agricultural raw materials, peat, hydroresources and only in small amounts metal-containing ores. With proper waste recycling consumables and energy were almost completely back either again to production or to biosphere. City was incorporated in the processes of biosphere matter and energy cycle as a new element, not disrupting an overall balance of these cycles. At this stage, the level of city industrial element impact on the environment generally did not exceed the limits of its ability to self-purification.

Background of environmental crisis

But the industry has strongly invaded the Earth's interior, removing from them ever-growing volumes of energy commodities, which soon fell into biotic environment in the form of waste production and consumption. Those substances that have accumulated in the depths for tens and hundreds millions years, were sucked into the biosphere in decades. Thus, the city began to make no compensated imbalance in natural biogeochemical processes. In addition, biotic systems and human body began to receive an incredible amount of toxic chemical elements and compounds from the environment having far-reaching consequences. Industrial has brought air, water and soil pollution of such type and scale that had not existed before. Prior to the industrial period, most waste products were biological in nature. Industrial wastes are often have an origin, which is different from the origin of natural biological waste. That is why their influence on the environment is more significant.

Environmental crisis of industrial society

To come to a threshold of the global environmental crisis, industrial society needed a little more than two hundred years. The result of the industrial phase was a worsening ecological planetary scale:

- air pollution caused acid rain;
- depletion and pollution of surface waters, continental water bodies and water courses and groundwater;
- ocean pollution, dumping poisonous and radioactive substances in it, penetrating man-made oil products, heavy metals and chemicals;
- occurrence of secondary chemical reactions in all biosphere environments caused toxic substances forming;
- declining forest area, oxygen imbalance and reduction of animal and plant species;
- formation of ecological niches and filling them undesirable organisms - pests, parasites, pathogens of new diseases;
- desertisation of the planet in new regions, expansion of existing deserts;
- global climate change background through emissions of combustion products and greenhouse gases, aggravating factors of the greenhouse effect.

With a huge load of environmental problems humanity began transiting to a new stage of post-industrial society development.

### 1.3.8. Post-industrial society

Posti-ndustrial society

The term "post-industrial society" appeared in the second half of the twentieth century, when after two World Wars there was values transvaluation, and it became apparent a contrast of modern society from the previous pre-war period. The rate of mechanization and labor automation have changed, due to that working hours have reduced and free time has increased accordingly. The economic growth rate has accelerated. Welfare has upgraded. A "middle class" has formed - the basis of post-industrial society. Prestige of education increased, a layer of qualified professionals emerged. Services, education and science gradually begin to dominate over industry and agriculture, in which, in turn, scientific knowledge and achievements are more and more widely used. Developed communication equipment is ministerial to free access to information and knowledge. Knowledge capacity becomes so large that provides a quantum leap forward. But the most important distinctive feature of post-industrial society was a qualitative change in the mindset that allows us to speak of a qualitatively new type of society.

However, not all the Earth's population can be attributed to the post-industrial society. Different countries and nations are at different levels of development. Predominantly Western civilization is called "post-industrial". In the post-Soviet society an adequate level of social welfare was not achieved, "middle class" was not formed, there were no significant postmodernism changes in mind. In essence, there were all the realities of industrial society, which growth rates have been significantly curtailed.

Modern post-industrial society is characterized by the processes of economy globalization, growth of the transnational corporations role. Management of the global economy in the modern world is concentrated in a few hundred transnational corporations that control up to half the world's industrial production.

Metropolitan areas, where headquarters of many transnational banks and companies are concentrated, play very important political, cultural and economic role. Many large cities on the scale of their economic activities exceed the national average states and become an independent force in the economic and political spheres.

Cities of post-industrial society

Service industry and marketing are a significant part of the economy of postindustrial society. It is important to note high level of agriculture mechanization and automation in developed countries, where the minimum of population employed in the agricultural sector provides food whole society. Mainly agricultural and industrial sectors of economy in developed countries are often placed outside the territories of these countries. Thus, the load of environmental problems of some countries is solved for account of others. However, if such displacement solves problems at local levels, it exacerbates them globally. This situation gives rise to the number of problems that determine a demographic situation, quality of life and health status.

Modern post-industrial city - it is expanded and compacted city on the basis of industrial city, with a higher number of population and high energy consumption

per capita. Post-industrial city is characterized by extensive transportation network, advanced media and communication means. Currently a post-industrial society is identified as the concept of information society. Libraries, documentation, management, trade and money are digitalized.

Multiethnic composition of large cities creates a new international subculture. Modern art, music and cinema have an international orientation. Residents of large cities watch the same movies and programmes, listen to the same music hits, brought on common standards of aesthetics, education and behavior, live in the same rhythm.

Consumer nature of modern society contributes to filling environment with ever-newer types of pollution in ever-growing amounts. With general availability of knowledge, with sufficient awareness ecological crisis continues to aggravate, have passed into a planetary scale long time ago. Destructive influence on the environment today and then continues, but already more consciously - with understanding and foresight of far-reaching consequences. Financial interests of state-oligarchic structures and multinational corporations stubbornly stand up sensible rational requirements of the thinking part of population and numerous projects and actions of environmental associations. Oil mining and oil refining, chemical and motor car industries continue to play particular destructive role. Recently active environmental protests also aim against innovative technologies in the field of biotechnology and genetic engineering, multinational company Monsanto (Monsanto Company).

### Questions, tasks and keys

1. What are the prerequisites for the early cities emergence?
2. What were the measures for the urban land improvement and hygienic in the major cities of antiquity?
3. What are the main causes of pandemics in the Middle Ages?
4. What is the basis of rethinking living standards in Renaissance era?
5. What caused the rapid urban population growth in the urban industrial era?
6. What are the causes of the ecological crisis of industrial society?
7. What is the difference between the characteristics of post-industrial society urban environment?



## 2. Current ecological problems of city environment

Ecological problems of the city environment, associated with negative impact of industry concentrated in the cities, traffic congestion and the accumulation of toxic wastes are so vast and numerous that for today these problems have evolved from numerous local and regional to the overall problem of global ecological crisis. This problem brings mutational changes in the gene pool of human and death of flora and fauna biological diversity on land and in oceans. All this witnesses of the global ecological system degradation and global environmental crisis increase. The social consequences are obvious. This is a lack of food and lack of nutrition, morbidity and new infections diversity growth, the expansion of ecological migrations.

Asphalt surfacing

City poisons itself consciously and systematically. Everybody knows carcinogenic properties of many oil products. Against the background of common fear of cancer and sufficiently wide informing people regarding the carcinogenic properties of asphalt, a significant part of the urban area is covered with asphalt concrete pavement. While densifying urban development and growth of traffic load from ramming with asphalt often becomes total. Erosion and evaporation of asphalt, bitumen and tar in the hot summer weather are harmful by carcinogenic polycyclic hydrocarbons. Asphalt laying process itself is exceedingly harmful by evaporation. Finally, a very harmful production of asphalt bituminous mixtures occurs directly in urban areas.

Buildings and constructions roofing

If asphalt covers one large part of urban areas, the other part of it is forever sealed up by different sorts of buildings and constructions those dysfunctional roofs are exposed to the sun and rain. Most modern flat roofs have carcinogenic covering on the basis of bitumen. More modern PVC membranes are not ideal for chemical indicators. Pitched asbestos-cement coverings are dangerous by eroded microscopic asbestos filaments causing lung cancer (in European countries asbestos use in building materials is prohibited by law)

Overheating urban air

Together, all cobbled and paved streets and territories, trampled and empty plots of ground, roofs buildings and structures of various coating create a huge area in cities that excessively absorb solar heat during hot summer days and warm up city atmosphere. Saturation of urban air with car exhausts, dust and aerosols abundance in it, high concentrations of greenhouse gases create some kind of gas and dust domes over cities, aggravating overheating urban air.

Green orderlies of the city

Due to redistribution of the city real estate and densifying urban areas massive trees felling in the streets, in parks and squares - to clean sites for construction - has become common in the former USSR. As a result, the city deprived of its lungs - organs of oxygen supply, humidification and air cleaning from dust and dirt. Green orderlies - trees and shrubs are particularly important for the urban microclimate, because evaporating moisture, they create forced circulating convective airflows contributing to the natural conditioning urban spaces. Evolving

volatile, our green friends neutralize pathogenic microflora and contribute to the protection of citizens from pathogenic viruses and bacteria. Preservation and enhancement of greenery is a very actual in the eastern Ukraine, forest-steppe zone, steppe and woodlands, where the natural environment surrounding the city does not have enough green resources.

The problem of urban cemeteries is very important. Urban population is constantly born, and dies. Cyclical alternation of generations goes on. The more ancient the city, the more remains are buried in its land. Taking into account the intense concentration of population in the local area sites, this problem is very important in terms of modernity. Often urban residential or recreational areas are located on the former burial places where the soil is oversaturated with pathogenic organic and pathogenic microorganisms. The search for solutions to this problem is actively taking place. However, here the essential complexity of innovations acceptance or rejection is in the religious and ethical norms, which have centuries-old established traditions. Social and technological modifications rates are far ahead of the cultural and ethical transformation.

Urban cemeteries  
problem

Among the key problems of the city environment problems of air pollution, water pollution (not just cities, but even the planet as a whole), the problem of domestic and industrial wastes, sanitary and epidemiological problems, electromagnetic and radioactive contamination, flora and fauna degradation due to the onset of the city environment nature are the most acute.

## 2.1. Air pollution

If a person can abstain from food for some time, can abstain from water for several hours, to intake a breath-hold even for a few minutes is impossible. A vital need of humans and animals is air, namely oxygen contained in it. Therefore, the purity of inhaled air is a most important problem for the human population and natural biotic environment. The average consumption rate per person is about 1 m<sup>3</sup> per hour (at a temperature of +10 - + 20 ° C). With increasing temperature, the density of air decreases and necessary volume need for normal breathing increases. In addition to the human other animals and organisms need oxygen. Many chemical and biological processes occur with the consumption of oxygen. Plants and phytoplanktons supply the atmosphere with oxygen. The main suppliers of oxygen to the atmosphere are the world's ocean and forests.

Air resources

Even while urban area intensive greening and having own water bodies the city possibilities for oxygen reproduction are significantly lower the need, which may be covered only by vegetation and water surface of adjacent natural spaces. Their total area should at least 20-30 times exceed the urban area.

Currently, the main factor of negative impact on the air basin state is motor vehicles. The gravity of transport in air pollution of large cities reaches more than 70%. Operation of motor vehicle equipped with petrol-motion explosion motors and diesel engines, results emission of combustion gases that contain extremely hazardous

Factors of air  
pollution

Vehicle affects

substances: carbon monoxide, nitrogen oxide, tetraethyl lead, sulfur compounds, polycyclic hydrocarbons and several other toxic and carcinogenic components.

Change-over to hydrogen fuel seems harmless only to a naive layman. Hydrogen fuel production requires expensive power costs, on which in turn large amount of oil burned is used - a vicious circle. In addition, each changing one form of energy into another sustains heavy losses. For the same reason change-over to electric motors powered by battery is not ideal. Charging batteries takes a lot of electricity to transform electric energy into chemical processes and vice versa. The battery of electric car is charged from electric grid where electric current circulates. It is produced by nuclear and thermal power stations. If we compare electric energy amount on the initial and final stages of electric car use, we will see that electric car works thanks to oil products burned at thermal power stations, etc. The problem can be partially solved by active development of bicycle movement in the cities and limiting vehicles access to central cities districts, creating numerous landscaped pedestrian zones, developing electric transport and metro that occurs in many cities of civilized world. As well the problem of automobile pollution can be substantially reduced due to use of nominal environmental fuels - ethyl (or methyl) hydroxide, propane, etc.

#### Impact of industry

The next significant factor of urban air pollution is a concentration of industrial enterprises, boiler-house, TPP in the cities. Avoiding use of coal and fuel oil at cities boiler-houses, thermal power plants and transferring them to natural gas are of great importance for improving ecological condition of air basin. Innovative solution for industrial air pollution with combustion gases is might be using plasma furnaces for their final afterburning.

#### Growth of allergic diseases and cancer

Effects of pollution in the air are expressed in not only smells, fumes and smog. Over the past decade the number of allergic diseases has dramatically increased mainly among the urban population. The most important consequence of the air pollution is a growing number of cancers, especially lungs, larynx and bronchi. There is a direct connection between a city size and incidence of lung cancer. The trend of rejuvenation incidence age among the urban population is especially alarming.

#### Mutagenesis

In addition to the steady growth of the number of such terrible diseases, another invisible danger is destroying man's future – an inevitable effect of mutagens on the genes structure, structure and number of chromosomes. Correlation of congenital malformations number growth with the intensity of environmental pollution, with living near adverse industrial facilities, landfills, etc.

#### Green lungs of the city

Green areas play an exceptional role in the formation of environmentally friendly urban environment. Landscaping streets, presence of parks and squares within the city, sanitary green belts creation, green belts around cities have a huge ecological and recreational importance. It should be understood that in addition to the oxygen production, green areas also have important air filtering function against aerosols and dust. Plants also produce beneficial phytoncides for human health, normalize moisture conditions of urban air.

## 2.2. Water resources pollution

Urban settlements have historically appeared on the rivers and lakes banks, which served as a source of water, and often as the most convenient transportation route. At the same time rivers were used for removal of liquid and solid people and livestock wastes, leading to their pollution, limiting possibilities of downstream settlements possible to use them for drinking water supply. Rivers became carriers of infectious diseases pathogens such as cholera, dysentery, typhoid and other. It took more than one millenia until people learnt how to prevent water pollution, clean and disinfect wastewaters.

Water resources

With increasing improvement of cities ponds and streams located within the city are becoming increasingly important architectural planning, recreational and aesthetic value. Thanks to comfortable microclimate and attractive aesthetics, city quays are the most prestigious settlement area, a favorite place to stroll. Waterbodies purity, architectural arrangement, landscaping shores and coastal area should be of particular citizens concern.

Needs of millions city for water is estimated at 400-500 million m<sup>3</sup> per year. That amount of surface runoff can not be formed in the city and groundwater resources are generally insufficient. Naturally, city receives water from river. Their reservoirs and lakes catchment area is several times greater than city's own territory.

Extremely important problem is water pollution - both groundwater and wastewater that fall into the rivers and sea. Sewerage systems in the post-Soviet cities were built decades ago, and since then were not improved and were not overhaul, they have dilapidated. Densifying urban development leads to excess load on the sewage system. Mainly in the central part of the city many high-rise residential buildings, high-rise office buildings and hotels, which are connected to pre-existing dilapidated sewage networks, are built. Because of unforeseen load sewer networks collapse, provide numerous leaks and sewage seeps into water-bearing underground layers, spreading in water-bearing stratum unpredictable far. The result is above-norm content of various organic compounds with a high content of nitrates and phosphates in the city sources and streams. Infiltration of oil products into groundwater from numerous oil gas stations, car parks, transport depots and terminals, warehouses and industrial plants diversifies a chemical cocktail.

Water pollution

City residents use springs widely as a source of drinking water. They can also be an alternative source of drinking water supply during emergencies. However, due to the progressive negative impact of the urban environment on groundwater quality, only a few sources after careful hydrogeochemical, microbiological and radiological studies may be recommended for use by the public.

Precipitation washes off everything that does not have time to seep into the soil in storm drains, and more directly into ditches and rivers. Since modern system of central water supply carry water withdrawals from rivers, each city located down-

Superficially active substances

stream consume water from the cities located upstream of the water basin. In this regard, contamination of river water with phosphate and superficially active substances (SAS) is especially immediate. Some of them does not substantially degrade and is concentrated in the aqueous environment respectively downstream. Consuming such water organisms accumulate SASs in unacceptable concentrations. Having positive adsorption, many SASs contribute to the releasing heavy metals from the soil particles into the water. SASs affect the permeability of the cell membranes and have an inhibitory effect on organisms enzymatic systems. The result is allergy and cancer, organism cell senescence.

Nowadays, about 100 thousand different chemical compounds are involved in the poisoning of the environment. The main dose of pollution accounts for about 1.5 thousand of them. These are various chemicals, pesticides, feed additives, cosmetic, medical and other preparations. For more than 90% of the world sewage water discharge accounts for Asia, North America and Europe.

### 2.3. Municipal and industrial waste problem

An important reason for the global ecological system degradation - its pollution by industrial and non-industrial human activity waste. Modern society is called a consumer society. Consumerisation strategy is a thingism and mindless accumulation and continuous acquisition of more and more new items. If before clothing, furniture, household furnishings inherited from generation to generation, and now the use term of such things is only a few years. Vehicles, objects of electronics and technique become obsolete especially quickly. Many popular gadgets become obsolete in one year.

Waste problem

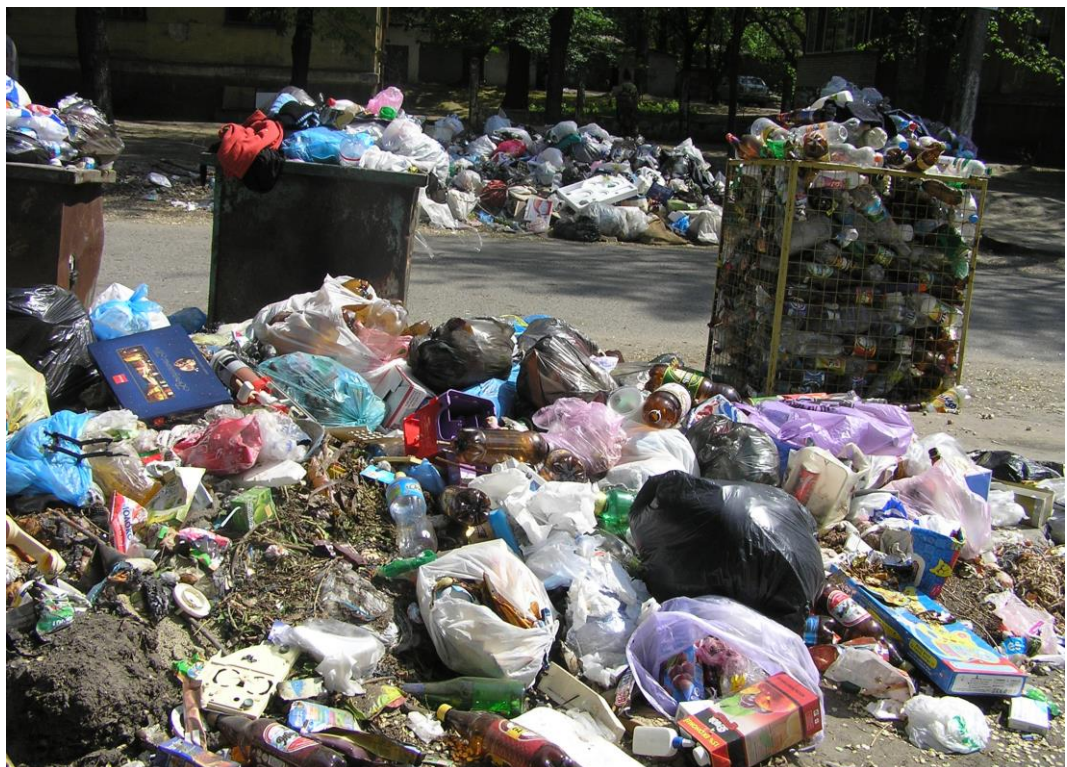


Fig.2.1. The usual garbage dump in the yard of a residential area near the playground.



One of the most pressing environmental problems of the modern city is the accumulation of solid waste. Conventional solid waste of large modern city contains more than a hundred toxic molecular entities, the sources of which are household chemicals, formaldehydes, pesticides, solvents, elements of home appliances and electronics, galvanic cells and batteries containing lithium, arsenic compounds, lead and its salts.

A special problem is "environmental" energy-saving fluorescent lamps containing mercury. In large metropolitan areas more than 10 million units of them are annually thrown away. Each lamp contains from 80 to 120 mg of mercury, and as a result - tons of mercury come to landfills. Mercury vapors and its soluble compounds are extremely dangerous.

Modern marketing uses bright plastic packaging, many colorful promotional products in a large number. Plastic containers, plastic bottles, plastic bags are used in a vast number. Plastics and synthetic materials take a special place among solid waste, as they are not exposed to the biological destruction processes and can be contained for hundreds of years in the soil, in the environment, and when their combustion toxic numerous carcinogens release.



Fig.2.2. Mountains of rubbish pile up in landfills near cities.

Storage of solid domestic waste is one of the most complex environmental problems, especially in large cities. Landfills for disposal of solid waste are located in a suburban area often close to residential settlements and occupy vast areas. Typically, landscape unsuitable for agricultural use, mostly lowlands, ravines and gullies, is used for landfills. Just there suitable aquifers terrain closest to the surface. Thus, the landfills decompose, are washed by precipitation, seep into aquifers and serve as sources of groundwater contamination. It is often difficult to determine the direction of groundwater movement and to assess real pollution impact, especially, that of underground waters form a complex multi-layered intercommunicative system. Rotting and burning landfill surfaces create a persistent

air pollution that annoys residents of nearby settlements to landfills and is a permanent hotbed of social unrest.

In some large cities there are specialized plants for SDW incineration. Operation of waste incineration plants is typically associated with large amounts of combustion products release into the atmosphere, especially carcinogenic dioxins. Garbage mass energy consumption is high and, consequently, the cost of incineration is high as well. Sites for the slag storage are constantly growing due to the unresolved problems of its use and recycling. The surfaces of the slag dumps are not almost fixed and are a powerful source of toxic dust.

In some countries, the problem of solid waste disposal is based on their sorting by waste types: ferrous and non-ferrous metals, glass, paper, textiles, etc. - and their subsequent disposal. In most Western countries the separate collection of solid waste is produced by the population on several types of waste at the time of their production. Citizens put up waste in different containers, installed in residential areas. Thus, we achieve 92% recycling of solid waste, the remaining 8% are burned, and slag is used to build land area. According to this technological scheme, recycling plants work.



Fig.2.3. Complex of incinerator plant-hydroelectric station Shpittelau in Vienna. Redesigned by artist-architect F. Hundertwasser.

#### Solid waste utilization

Disposal of solid waste, recycling, use of waste as circulating raw materials gives a way to solve serious environmental problems that have reached today a global scale. To obtain ferrous or non-ferrous metals it is necessary to obtain, transport and process ore and successively extract the product from it and make necessary alloys, which takes the mass labor, raw materials, energy and time. Production of metals from waste provides great savings of labor, time, transport and energy. Costs for involving metal waste to secondary use are much smaller than melting primary metal from ores. Recycling of 1 ton of prepared ferrous metal scrap saves more than 1.8 tons of ore, sinter and pellets, 0.5 tons of coke, 45 kg of flux, about

100 m<sup>3</sup> of gas. This saves more than half energy required for melting metals from ore. Recycling of aluminum saves 95% of power, copper - 83% steel - 74%, lead - 64%, zinc - 60%. Rates of savings in recycling rare earth metals are much higher, since they are concentrated in modern technique and electronics. When using scrap for melting metals the load on the environment significantly reduces.

The same can be said about producing and recycling glass, paper, and various types of plastic. Recycled plastic can be used for various purposes: it is used for the manufacture of synthetic yarns, garments, carpets, films, and other articles. Approximately two-thirds of European secondary plastic is used for the production of polyester and fleece, which are used as sportswear, sleeping bags insulation and filler for soft toys.

In addition, packing and building materials can be manufactured from recycled plastic. Of plastic waste mixed with mineral fillers (ash, sand) produced Polymer concrete, which is very strong and durable material and has a variety of applications in the construction industry is produced of plastic waste mixed with mineral fillers (ash, sand). In short, there are incredibly many fields where recycled plastic can be used.

With the help of modern technology, waste which is not amenable to reuse can be subjected to:

- pyrolysis - thermal decomposition at high temperatures in the absence of oxygen;
- hydrolysis - decomposition at extreme temperatures and pressures;
- glycolysis - failure at high pressure and temperature in the presence of a catalyst, with ethylene glycol to production of environmentally sound product;
- methanolysis - splitting some waste with methanol.

Such non-recyclable waste is an additional source of raw materials and modified heat. Residues clean combustion of solid waste is carried out using a finite combustion in plasma furnace at a temperature of from about 3500° to about 10,000° K.

Finally, it must be said about the commercial benefit of solid waste processing. Modern systems for processing combine separating and recycling raw materials, bagging or granular, construction materials and fillers, waste incineration, concurrent electricity and heat production. Sale of recycled scrap metal, plastic, glass, etc. to businesses-consumer produces more profits and gives additional jobs.

#### **2.4. Sanitation and epidemiological problems of modern cities**

A man's life in the artificial urban environment has its own characteristics: accelerated pace of life, combined with clear-cut stickiness; isolation from environment; saturation of habitat with pollutants and toxins. All these factors form negative trends in lifestyle and citizens' health and cause so-called "diseases of civilization". This primarily refers to diseases of the cardiovascular system. In well-developed countries they lead to more than 50% mortality, and has a strong ten-



dency to rejuvenation. Increase in the incidence of heart and vessels is Particularly great at the age of 30-50.

Pollution of water and atmosphere with chemicals significantly affects inhibition of the immune system, increases allergic diseases growth including asthma. High level of carcinogens in the urban environment stimulates the growth of cancer and rejuvenation.

Extremely high population density in modern cities, along with a high degree of contamination is a favorable environment for the emergence and very rapid spread of infections. Modern metropolises become a kind of biological reactors of new pathogenic viruses and bacteria. In recent years, the sudden emergence and rapid spread of a number of exotic diseases: Ebola, West Nile fever, avian and swine flu, Legionnaires' disease, etc. is not a surprise for anybody. The list is constantly updated.

International transport network, modern aircraft are able to deliver infection from one metropolis to another, from one part of the world to another, and to give to any new disease to turn instantly into a global pandemic

## **2.5. Climate of modern city**

Urban climate - the local climate of a large city, created by his own and formed because of changes in the environment industry, transport, and urban development. Compared with a countryside increased average temperature in downtown areas, reduced evaporation, disturbances in atmospheric circulation, air pollution and formation of so-called heat dome, the weakening of solar radiation, increasing cloudiness and precipitation in summer and increasing frequency and intensity of fog in the cold season are the local climate particularities. The precipitation is 10-15% higher than in rural areas, fogs - 30-100% in large cities of moderate temperature zone. With strong smokiness and gaseousness ineracting with fogs, prerequisites of persistent smog formation emerge. Famous London smogs of the industrial age. In many large industrial cities in China today frequent smogs become commonplace. Smoky fogs (smogs) inevitably lead to increasing morbidity and mortality, particularly from respiratory diseases and cardiovascular diseases.

Features of the urban climate are influenced by the great urban air pollution and conditions of absorption or reflecting the infrared part of solar light by buildings, streets cover and so on. Roofs and walls of buildings and artificial streets cover are heated more than a natural surface and increase the air temperature in the city. Industrial plants, heating systems and vehicles heat air over the city and pollute it with smoke and combustion gases, and thus enrich the condensation nuclei. Elevated levels of condensation nuclei in urban air and the weakening of the wind speed in the city (an average of 25%) lead to an increase in the frequency of fog occurrence and an increase in their intensity. The average temperature of the air of a big city is 1-6° C higher than a surrounding terrain, and the maximum temperature difference between them reaches 5-8°C or more. In this regard, sometimes there is airflow

from outskirts to the city center (city breeze), as well as strengthening the rising air movements over the city with the corresponding clouds formation.



Fig. 2.4. Smog in industrial city.

Typically, in a large city snowy winter days are less, plants growing season and frost-free period are longer. Because of the high-rise buildings, daylight hours are shorter in comparison with an open countryside. Relative humidity in the city is decreased by an average of 6%, cloudiness and annual precipitation are increased by 10-15%. Temperature distribution, air pollution, wind direction and speed are depend on the location of streets, squares and green areas.

Climate changes in large cities are local in nature, and should not be confused with global warming. These climate changes can be significantly reduced with help of a competent planning of streets and neighborhoods, taking into account prevailing winds direction (using the compass rose); development of green areas and the use of green facades and green roofs modern technologies. Effective operation of transport, the development of urban public electric networks and underground, the development of vast areas of cycling and walking; good thermal insulation of buildings and structures; saving energy consumption and the development of energy-saving technologies provide large positive effect on urban climate.

## 2.6. Electromagnetic pollution

It is difficult to imagine the life of modern civilization without any kind of electrical appliances and gadgets. They have become so commonplace things that we do not think about their invisible side - effects on human health, on surrounding wildlife.

Life on Earth has originated, developed and spent for a long time in conditions of relatively weak electromagnetic fields generated by natural sources. As a permanent environmental factor, these fields have an importance in all organisms' life, including humans. One should understand that without electromagnetic fields nether life nor the existence of any physical objects and the universe as a whole

are possible. As x-ray and gamma rays, ultraviolet rays, visible light, thermal infrared, microwave and radio waves are belonged to electromagnetic radiation as well. The problem of anthropogenic electromagnetic pollution - electromagnetic smog – corresponds to the spectral range of microwave microwaves and radio waves, i.e. the range in which current-carrying lines, technical equipment and means of communication work and radiate

Electromagnetic fields (EMF)

Over the past few decades, new significant environmental factor - electromagnetic fields (EMF) of anthropogenic origin emerged and developed. As a result, the total intensity of EMF in different points of the earth surface has increased millions of times in comparison with natural background. On the scale of evolutionary progress, this huge increase in tension of EMF can be regarded as an extremely sharp jump with poorly predictable biological consequences.

Electromagnetic smog

Electromagnetic pollution and electromagnetic smog - a set of electromagnetic fields of various frequencies, is called as one of the most powerful negative factors affect both humans and other living organisms on. This is due to around the clock its influence, rapid growth and spread. It is created by two main groups of artificial sources:

- products that are specifically designed to radiate electromagnetic energy: radio and television broadcast stations, radar installations, physiotherapy apparatus, various radio-communication system, technological installations in industry, mobile phones, wireless communication devices;
- devices designed not to radiate electromagnetic energy in space, but to perform any other task. But when they work there is electric current which generates spurious radiation EMF. Basically, these are the electricity transmission and distribution systems (high voltage power lines, electric cables, transformer substations, home wiring) and appliances which consume it (cookers, electric heaters, refrigerators, television sets, lighting, etc.).

Electromagnetic pollution depends largely on the power and frequency of the emitted signal. Some electromagnetic fields at chronic exposure are unsafe for human health. The World Health Organization considers the increased level of EMF in the workplace as a stress factor. Existing standards for Electromagnetic Safety, developed by both national and international organizations, for some frequency bands of electromagnetic field are different in the tens or hundreds of times. This indicates a lack of research in the field of magnetic and electromagnetic biology. Currently, most standards take into account only biological effects of heat and electrochemical reactions due to induced currents.

Types of EMF exposure on living organisms, including humans, are varied: continuous and intermittent, general and local, combined from multiple sources and combined with other adverse environmental factors, etc. The following parameters of EMF affect biological reaction: intensity, radiation frequency, duration of exposure, signal modulation, combination of EMF frequency, frequency of action.

The combination of the above parameters can produce significantly different effects for the reaction of irradiated biological object.

High voltage transmission lines; wireless communication devices - Wi-Fi, Bluetooth, mobile phones, high-frequency communications; computers, monitors, TV-screens; microwaves, fluorescent lamps, electric motors have biological activity. Microwave ovens, aero-grills, refrigerators with "frost free" system, cooker hoods, electric stoves, TV sets must be recognized the most powerful.

Research in the field of EMF biological effect allows us to determine the most sensitive system of human body: the nervous, immune, endocrine and reproductive. EMF under long years of exposure is accumulated and cause development of possible long-term consequences, including degenerative processes of the central nervous system, blood cancer (leukemia), brain tumors and hormonal diseases.

EMF biological effect

EMFs are particularly dangerous for children, pregnant women, people with diseases of the central nervous, hormonal, cardiovascular system, allergies, people with weakened immune systems. In 2011, the World Health Organization and the International Agency for Research on Cancer classified the radio emission of cell phones as a potential carcinogen by defining a group 2B «possibly carcinogenic to humans" factors, together with chloroform and DDT. The decision was announced after a special commission of experts of the Agency assessed the research on this topic over the past 10 years.

Finally, rapid decrease of some insects species populations in recent (eg, bees) scientists connect with extremely high levels of EMF, especially with active proliferation of mobile communication, working in a range of microwaves (MW).

## 2.7. Depletion of flora and fauna

Urban environment influence on surrounding countryside creates problems, leading to disruption of the natural balance elements structure and functioning. Modern often confronts with nature, trying to curb it, enslave, to be its master. The well-known slogan of the industrial era "we can not wait for favors from nature, our challenge is to take them from it" clearly demonstrates the consumer-parameter relation of man to his natural environment. A man who imagines himself the master of nature, the crown of creation, godlike and omnipotent is like a self-assured ignorant, unable to comprehend complexity and grandeur of the universe.

“Masters of nature”

Greedy consumer activity of modern leads generated by him built environment in conflict with feeding him nature. Active cities growth and development around the world, as a rule, is due to displacement of the corresponding natural environment. Most valuable wildlife areas on the banks of rivers and lakes, near the arable land and forests are mainly selected under the urban development arrangements. Urban areas capture and tightly cover with concrete and asphalt habitat of numerous species of flora and fauna, depriving them of living space and possibility of existence. In addition to the permanent tendency to capturing and sequestering areas, the

functioning urban total body releases a myriad of sewage, landfills and toxic substances, poisoning themselves properly, endangering the lives of many successive generations in the long term. The amount of these wastes recently passed dimensions that threatened the very existence of civilization as no one living organism is able to live in an environment formed by the dregs of his own life.

Effects of human activities

Once infiltrating into the prosperous living landscape, modern mercilessly exploits, tortures and shreds territory chosen by him, often leading it to ecological collapse. To date, mankind activities are so extensive and active, that the extinction rate of many flora and fauna populations exceeds all acceptable norms. Due to population growth, nutritional needs are increased, so mankind has to expand agricultural land due to deforestation. As a result, soils deplete, climate change and different kinds of animals are forced to disappear. Mankind contaminates waterways, drains them artificially, what leads to overall balance disruption of the earth, and degradation of natural resources.

Plant is a base of the food pyramid

All vegetation that grows on our planet, is the basis of the biosphere functioning. Therefore, the overall balance of the planet depends on the flora quality, quantity and condition. One should understand that plants are the basis, the foundation of a food pyramid. The degradation of the food structure clearly threatens with destroying balance of the living world whole system.

Plants areas create special climate conditions in the lower atmosphere layers and stabilize all natural processes. Green cover regulates temperature, humidity and reduces the amplitude of their changes. In addition, thanks to the plants on Earth climate, topography, soil and other natural weather conditions are formed. Forests are of the great importance among the plant resources of the planet. They have a vital impact on animals and humans, on health indicators of the environment.

Deforestation

Today, deforestation continues at an appalling rate. Every year more than 20 million hectares of forest are destroyed. Woodlands disappear as to expansion of cropland and pasture and growth of wood procurement. Very threatening situation exists in tropical forests. Tropical forests are cut at a rate that is 15 times exceeds the natural recovery. Yet these particular forests are usually called "lungs of the planet", as oxygen delivery into the atmosphere is connected with them. There are more than half of all species of flora and fauna represented in the world there. So here is really possible to talk about the degradation of the global ecological system. It should be remembered that with the disappearance of some species of flora and fauna, as well as their depletion the entire ecosystem of the planet changes. It threatens that soon the climate, terrain, water and air quality will change significantly. And with changing chemical composition of the water representatives of waters - fishes, algae and other animals - disappear. Saving the vast expanses of wilderness in its original form is extremely important for the mechanisms of the planet biocenosis.

A steady trend of soil degradation and desertification due to the human economic activities has especially disastrous effects. Water and wind erosion, chemical

(clogged with heavy metals and chemicals) and physical (destruction of soil cover while mining, construction and other works) degradation have the most negative impact on soil. Impoverishment and extinction of forest and agricultural activities, such as salinity in irrigated agriculture, play an important role.

In general, soil degradation takes place particularly intense in the drylands, which together hold 6.1 billion hectares and by the greatest extent are indicative in Asia and Africa. Within drylands there are the main areas of desertification and where overgrazing, deforestation and unsustainable irrigated agriculture have reached the highest level. The analysis shows that in all major regions of the world rangelands are the most affected by desertification. In Africa, Asia, North and South America, Australia and Europe desertification affected 70-80% of pastures in arid areas. On the second place there are irrigated farmland (especially in Asia, Africa and Europe), on the third - irrigated land (particularly in Asia).

The constantly growing soil and water pollution with oil products is extremely detrimental to wildlife. Road transport, aviation, rail, river and sea transport on diesel engines, oil industry, oil terminals, pipelines and tankers and oil industry itself constantly in large quantities pollute the environment with oil spills. Every year there are major crash of oil tankers and accidents at oil-producing enterprises. According to conservative estimates about 3.5 million tons of crude oil and petroleum products get into the oceans annually. Rivers and seas pollution destroys delicate biological balance and leads to the death of huge populations of corals, plankton, fish, birds and marine mammals.

One of the main effects of the environmental crisis on the planet is expressed in impoverishment of its gene pool, decreasing biodiversity. Biological diversity of the Earth by the most conservative estimates is 10-20 million of species. Now 236 species of mammals, 287 species of birds, 119 species of reptiles, 36 species of amphibians recognized endangered are included in the IUCN Red List. Damage in this area is already notable. According to US sources, over the past 200 years 900 thousand species of plants and animals has lost. In addition, during the second half of the XX century the process of reducing the planet gene pool has accelerated sharply. As a result, Western biologists have concluded, that if current trends continue in the near future disappearance of about 20% of all species currently inhabiting our planet is likely.

Effects of the world  
environmental crisis

## **2.8. Psychological climate of modern city**

Man forms an environment and an environment forms a man - an undeniable dilemma, logical paradox. At the turn of the XIX-XX centuries in connection with the rapid growth of industrial cities scientists have become interested in obviousness of the problems associated with the influence of certain physical characteristics and spatial organization of the environment on the psycho-emotional state and citizens behavior.

- Max Weber
- One of the first sociological analysis of the city was offered by Max Weber (1864 - 1920). He defines the city as a whole consisting of village with closely related houses, which is so great that personal acquaintance, which is specific for neighbors' society is absent.
- Chicago City  
Sociology School
- Numerous studies in such areas of the environmental sciences as psychology, behaviorism, proxemics, ethology, ecological psychology and city sociology are devoted to psychological aspects of the city as a socio-spatial community. In the initial period the main developers of the urban problems application areas were representatives of the Chicago Sociology School (Robert Park, Ernest Burgess and Louis Wirth). This school just emerged in connection with the explosive growth of the American cities population in the second half of XIX - early XX century. So, Chicago from a small settlement with a population of 4470 people in 1840, just in forty years by 1880 became the largest city with a population of about 500 thousand people, and in another ten years, its population had grown to one million, and by 1930 - up to 3.5 million people. The School researchers considered the city as a laboratory for the study of social interactions. School sociologists have been researching the impact of migration processes on the social structure of the city and the formation of ethnic ghettos. The Chicago School was one of the first that drew attention to the phenomenon of urban spatial segregation.
- Since 1958, in the New York City University the research group of William Ittelson and Harold Proshansky has been conducted researches of how the elements of the physical, spatial and architectural environment affect people's behavior. Research experiments in the field of ethology, simulating typical life situations of city society on social mammals are the most indicative .
- Konrad Lorenz
- Famous Austrian scientist, one of the founders of ethology Konrad Lorenz (1903-1989) criticizes modern city in his book "The eight deadly sins of civilized mankind". Among the major trends he calls the devastation of living space, overcrowding, intense pace of life, break with tradition and suggestibility of the society. Lorenz indicates that people adapted by the evolution to survive in a small group (which is obvious from the fact that for the average person it is psychologically difficult to remember more than two or three dozen people and maintain a close relationship with them) cannot restrain his natural aggressiveness in a metropolis without additional mental load. As examples of the two extremes it was provided the hospitality of people living far away from cities and explosive nervousness of urban ghettos, where careless glance might lead to a fight. The concentration of people in cities usually involves the nature destruction, which leads to degradation of the aesthetic and ethical people. Aerial view of the city looks like a histology of cancer cell, indicating the destructive nature of the built environment and the lack of natural diversity.
- Paradox of vicious circle
- From the above it becomes apparent dilemma that lies in the fact that: 1) a civilized man cannot exist without the cities that are a shell of its existence, but 2) cities modify the man's consciousness and way of life and endanger its existence, oppressing and poisoning vitally needed natural environment of its habitat

as a species. This paradox seems kind of vicious circle, cyclical wheel of civilization. The logical consequence of this series in the future one of two things may be: either, reaching the limit of resistance to existing civilization consumerism and accumulation will come to collapse; or humanity itself will evolve into a different kind of socially depended post-humanoid creatures such as morlocks - descendants of urban lumpen - described by Herbert Wells in 'The Time Machine'. Recently, these topics increasingly occupy the thoughts of futurists, many dystopian in literature and cinema devoted to them; they increasingly occupy the minds thinking of society.

Whatever architects compete in utopian "ideal city" of the future project-fantasies, no matter how tempting their cyclopean towers of the city with a capacity of one million, none of the authors of such fantasies would not wish to be faceless resident in their own utopia. Whatever fancies paint sky-high megacities of the future with their glittering cities-skyscrapers and ideas of vertical settlements it is too obvious the only one: powerful people and wealthy elites prefer to settle in the lap of nature away from the cities and the urban population becomes an underclass mass of cheap human resources. In this regard, it is worth considering over the futuristic dystopia and cyber-punk warnings.

A man is just one of the links in nature. Like in any natural system, resistance limit to destructive fracture also resides in human society. If nature did not create a man bee or ant with a tiny brain and with six legs, then all sorts of utopian projects of metropolis with a population of millions of faceless individuals of a new type living in mega-huge anthills are doomed to be ineffective.

Any living organisms in nature occupy a certain space - it is primitive necessary living space, and complex personal space. Primitive organisms in excess of the population density biological limits just die, more complex - degrade and degenerate.

Living space

Impressive ethology experiments with modeling characteristic for the urbanized environment situations of overcrowding, compaction, presence of many irritants in the form of constant noise, insecurity, visual bareness clearly demonstrate cause-and-effect mechanisms of violence on the psyche.

Famous American ethologist and researcher of psychology in connection with the problems of population density and its influence on the behavior John B. Calhoun (1917-1995), exploring the social effects of surplus population on rats, as a model of the future for human civilization, introduces the concept of "Behavioral sink". It indicates the distorted behavior in conditions of excessive population overcrowding. Calhoun organized "ideal" conditions for rats' habitat, mimicking living conditions in urban multifamily apartment buildings-boxes. There was not the lack of constant feeding and drinking. Calhoun investigated changes in the rats' behavior as a natural population change. Gradually, Calhoun brought the number of rats up to amount, which was disproportionable for the residential structure space. The result was the destruction of the social structure and individuals' behavior: expulsion and even murder of offspring, sexual disorientation and degra-

Social experiments  
of John B. Calhoun



dation, refusal of defending areas, increasing aggressiveness of females. Cannibalism was observed even in the abundance of food. Gradually subjects entirely abandoned the social activity, focusing exclusively food intake. Soon the population died out completely.

#### Personal space

Famous experiment was subsequently used as a basis for the development of the proxemics concept of Edward Hall. The concept of behavioral sink also had an impact on the development of urban sociology. In 1950s anthropologist Edward Hall (Edward T. Hall), exploring the personal space of everyday behavior, came to the new understanding of the relationship between people. Everyone has a certain area, which they considered to be personal. Distance while communicating depends on many factors (origin, culture, personal preferences). With too small or long distance people can feel awkward and uncomfortable. The dimensions of personal space, invasion of other people in which we allow, as studies of Hall have shown, culturally are determined (for people of different cultures (nationals) differ). Eastern cultures allow a shorter distance while communication, rather than Western. Hall identifies four intersubjective zones: intimate (0-0.5m), personal (personal) (0.5m-1.2m), social (1,2m-3,65m), public (3,65m and more).

#### Social situation and roles

According to the theory of Roger Barker the social situation and the roles performed by people in the relationship have an impact on the behavior. In certain circumstances, people are taking role positions inherent in social behavioral norms. Human roles in the modern society are limited by his social status and environment of his communication. However, social roles may undergo substantial metamorphosis in accordance with characteristics of the environment.

#### Social experiments of Didier Dezor

In 1994 French researcher Didier Dezor from the University of Nancy had an interesting job with the study of the rats social hierarchy. Initially several individuals participated in the experiment. The experiment was based on the procedure of obtaining food in an uncomfortable tight space and stressful obstacles. Very quickly a clear hierarchy among the six participants in this experiment has been formed: two individuals were "exploiters" - they did not hunt food, but robbed it from the exploited hunters.

The most surprising was the fact that, no matter how much the scientist repeats the experiment with different rats eventually roles distributed in the same way. When only exploiters, only slaves or only independent united in the group, all the time their community consistently repeated the same result of the division into classes. When the group was increased to several hundred individuals, the result was even more impressive - in the rat community a complex system of subordination has been formed: "servants" who collected it from workers brought food to "authority". In this case, also the "beggars" class has been formed as well - they did not work and did not fight, and fed with the crumbs from the floor. The analysis of these social experiments clearly shows a significant interconnectedness of adverse overly compacted living conditions and appropriate social behavior.



Fig. 2.5. Faceless monotony of urban "sleeping areas" of Hong Kong.

Numerous studies have shown the spread latent aggression, rudeness, callousness and indifference of typical city dweller in contrast with the openness, kindness and sympathy of a typical suburban dweller. Stone wombs of the cities become hostile to man created them, destroying his health and psyche and marginalizing his mind. The urban population is much more likely to suffer from depressive disorders, suicide rate, and more criminal cases based on affective disorders, higher incidence of heart attacks and strokes due to unhealthy lifestyles and frequent stress, etc. Urban chaos simultaneously generates and attracts urban and crazy freaks, marginalized subcultures.

By the end of XX century a clear understanding of the interconnectedness of human behavior with features of the environment organization was finally confirmed. A realization that the vast majority of mental and physical health degradation of the urban population is directly related to the habitat conditions in a simulated hypertrophied environment is formed. The average resident of compacted central urban areas and peripheral "sleeping areas" lives in a small apartment-tiny room with thin walls with no insulation in numerous multi-storey buildings, faceless houses-boxes resembling hives or laboratory cage-racks. This created by a sick human imagination artificial environment contradicts the natural standards of life, which are incorporated in man by nature. This conflict of natural origin and modified human consciousness spills in the form of aggression, criminality and social instability.

It is interesting that today, when these facts are widely known, city degradation continues in an even more accelerated pace. The reason is a certain inertia of ur-

ban managers and planners' consciousness, brought up in the aesthetic and conceptual stereotypes of the industrial age. On the other hand, the commercial component of the urban economy gives an advantage to ignorant building houses-boxes due to the cheapness and deployment mass. In addition, it should be noted that social depersonalization, unification and lumpenization are a fertile ground of authoritarian regimes and the path to totalitarianism – it is easier to manage a faceless uniform mass.

Way out of the urban hypertrophy crisis can be deurbanization of urban structures, elimination of urban ghettos, creation of autonomous communities-satellites instead of "sleeping areas", introducing recreational green areas and water bodies, creating comfortable view spaces. Good examples in this regard are the modern space-planning and social decisions of a number of cities in Denmark and Northland - Copenhagen, Oslo, Stockholm, Malmo; Canada - Vancouver, Calgary; Australia - Adelaide, Perth.

### Question and tasks

1. What are the local and global ecological effects of industrial society on the environment?
2. What are the main current problems of the modern city ecology?
3. What are the factors of the urban pollution?
4. What is the way of groundwater contamination?
5. What are the benefits of recycling household and industrial waste?
6. What factors affect the urban climate?
7. What is electromagnetic smog? What is its origin?

### **3 Practical providing successful solution of urban environment ecological problems in sustainable development strategy**

XX century was an era of rapid civilization leap in the development of art and technology, in the untouched areas invasion and mastery of air and water spaces. Starting with a few self-propelled carts-cars and timid homemade fly airplanes, very soon, in a few years, civilization flooded the world with suffocating vehicles and high-speed aircraft. By the 1960s, humanity came into space, in July, 1969 mankind made the first steps on the Moon, and to the beginning of the XXI century all the planets of the solar system and their satellites were studied in detail with space probes. Postindustrial era was marked by the unprecedented surge in the development of science, has become the era of many important discoveries and inventions from the theory of relativity and nuclear research before the invention of semiconductor devices and computers.

But we must not forget that this century was the most violent in people's relations in the history of mankind, bringing millions of victims during two World Wars, in the course of innumerable local conflicts and civil wars, in the resulting of the Holocaust and genocide, numerous dictatorships and totalitarian regimes. Wars, famine, poverty, slavery, inequality, social injustice and corruption are still relevant.

Humanity appeared ignorant and ungrateful in respect of the shelter and food which natural environment gave to it. It devastated and turned into a giant landfill innumerable amount of vitally important areas taken from nature. In the shortest period civilization has put nature on its knees, turning it from a nursing mother into a hostage of its mercantile interests and insatiable greed. For several decades of irrepressible activity the mankind has led nature to the global environmental disaster. By the end of the second millennium, it became clear that the path of modern civilization and mercantilism inevitably led to a dead end. And for a very banal reason: appetites of civilized mankind are growing rapidly, and the whole world is not enough for those who wish and hungry for. Stocks of resources on the planet are limited and rapidly shrinking, the biosphere cannot manage with the rapid pollution increase; degradation of natural ecosystems causes adverse changes in the environment on a global scale.

Despite the pessimistic outlook, nobody is going to give up the ideology of consumerism: rich countries batten next to abundant feeders, and the poor dream of becoming rich. Paradoxical contradictory combination of human mind grandeur and terrifying primitive greed and vanity is a prerequisite for rapid development that engulfed the entire planet of systemic crisis.

Historically life on Earth has repeatedly been exposed to disasters of apocalyptic scale - from sizzling comets and asteroids falling to the long-term glaciations. However, nature has always come out of the incredible deadlocks, sacrificing useless species of organisms. With continuing growth of the destructive impact on

the environment and critical explosive growth of human populations, mankind may become the sacrificial species for the sake of the rest of nature tormented by its activities. Sadly, it is a natural law - nature does not endure a long devastating violence on itself. Ephemeral necessity of accelerating race of continued economic growth and continuous gaining weight of the things around us has threatened our very existence and the existence of future generations.

Changes necessity

The necessity to break the destruction deadlock of the environment of our own existence, a self-destruction deadlock came to a head long time ago. The only possible way - a change of mentality, a change of values and goals of modern civilization. To curb rampant race of excessive consumerism and increase of garbage and waste accumulation, to revise the barbaric treatment to resources, to provide a reasonable approach to design and construction based on ecological methods and technologies - that's the most urgent tasks of the implementation of which depends on the possibility of the existence of the future for the next generations.

A concept of "sustainable development» is a strategy as opposed to "stable growth of the economy". It reflects a real need to rectify a treatment of humanity to the surrounding natural environment. The only chance to save from extinction is to learn the rules of harmonious coexistence in the natural environment and build our life not in spite of, and in accordance with the laws of the universe.

### 3.1. Concept of sustainable development

Sustainable growth

The value of this concept in the Russian translation is often understood incorrectly as "sustainable growth", indicating that the steady increase in the level of growth (e.g. economic indicators) and completely close to the post-Soviet bureaucrat lexicon. Probably as a tracing from Russian Ukrainian translation of "stalyi rozvytok" gets a shade of inviolability and stagnation at all. At first acquaintance with these terms there is any opposition to stagnation and confusion of short-sighted plans for the "steady growth of economic indicators of living standards and welfare of society" from the arsenal of slogans of "stagnation" Soviet-era in the 1970s. Both cases - typical examples of uncomprehended mechanical translation and are seriously in need of more elegant presentation. The term contains the contradiction that on the one hand, emphasizes the need for continuous development (including material), and on the other hand, supposes a limit of this development. From the perspective of evolutionary theory the combination of terms "stability" and "development" is controversial itself.

Sustainable development

In fact, in the nuances of the English language "sustainable development" more accurately means the system's ability to maintain its integrity and its viability.

Formulation of principle of "sustainable development"

The term was introduced by the International Commission of the United Nations on environment and development (ICED) in 1987 to refer to such life support, in which **"the needs of the present do not compromise the ability of future generations to meet their own needs"** - according to the wording of the report "Our Common Future", 1987.

To be fair to say that the idea of living within our means and not to steal (including not steal from the next generations) is not new. Almost all traditional religions proclaim the commandment "do not steal" and "do not take what is not given". Most of all these rules, along with an understanding of human equality and prohibition of verbiage and false is emphasized by ethical standards of Protestantism, which results in a special leadership role of the Scandinavian countries, Denmark, Germany and the Netherlands in the movements for human rights, environmental movements, movements for the purity and naturalness.

One must also pay tribute to the individual intellectuals and various informal sub-cultures (hippies, pacifists), ecological (Greenpeace), religious and public (New Age) and protest currents of 1960-70s, prepared a ground for conversion from consumer mercantilism and materialism cult to the harmonious development. Of all the 1960s, there has been a significant turn for the practical implementation of the new world of architecture and energy-efficient technologies.

Since April 1968, the founder of the Rome Club industrialist Aurelio Peccei has organized works that began the formation of the sustainable development concept as opposed to the notorious "sustainable growth" of economic indicators developed in industrial society. Rome Club is an international public organization, uniting representatives of the world's political, financial, cultural and scientific elite. The organization has made a significant contribution to the study of the biosphere development prospects and the promotion of the idea of harmonizing relationship between man and nature.

Rome Club

In 1983, because of growing concern "about the rapid deterioration of the environment, human and natural resources, and the effects of worsening economic and social development" Commission on Environment and Development (WCED), chaired by Gro Harlem Brundtland, was convened in the United Nations Organization. When creating a commission UN General Assembly recognized that the global nature of environmental problems meets the common interests of all countries on developing policies for sustainable development. The concept of sustainable development adopted in "Agenda for the XXI century" at the United Nations Conference on Environment and Development in Rio de Janeiro in 1992 by the representatives of 179 countries has gained the status of the most important principle of the modern civilization existence.

"Agenda for the XXI century"

Finally, in March 2000 as a result of six years of international dialogue in order to develop human goals and common values the document "Earth Charter" emerged. It was prepared at the initiative of civil society and was formally adopted at a meeting of the Earth Charter Commission at the UNESCO main office in Paris. The mission of the Earth Charter is to promote a conversion to a sustainable lifestyle and build a global community based on common ethical principles, including respect and care for the whole community of life, ecological integrity principles, universal human rights, respect for cultural diversity, economic justice, democracy and peace culture.

"Earth Charter"

Sustainable development nondepletable development is a model of resource use, a model of interaction between humans and nature and a civilization development model based on innovation. With this model a satisfaction of vital needs of the present generation together with the environment preservation, the strengthening of personal and public health, and without deprivation future generations of this ability are achieved. This process of changes in which the exploitation of natural resources, investments pattern, orientation of technological development, personal development and institutional changes are adjusted with each other and strengthen the current and future potential to meet human needs and aspirations, to improve the quality of life. A set of guiding principles for sustainable development, aimed at modernizing the public institutions resulted from these general provisions and should be aware at all levels of the international community and apply in practice. The modernization strategy is not limited to the economic system, but also includes the regulation and control in social sphere, science, culture and education, innovation and technology development in the field of defense and security, and so on.

The concept of sustainable development is considered as a prerequisite for long-term progress of humanity, followed by capital increase and improvement of environmental conditions. For humanity as a whole, this concept implies a partial, focused, supporting the movement of financial resources from rich to poor regions with a broad exchange of environmental knowledge and information.

In recent years, a large number of countries have made real steps to conversion to sustainable development. They established government bodies responsible for sustainable development (councils, commissions, committees under the Government or Head of State), documents have been developed or are being developed at the national level that guide the development on the path of sustainability (sustainable development strategies and concepts, laws, regulations and other guidance documents). Models of sustainable production and consumption are gaining increasingly greater ground. The participation of the public, scientists, business in sustainable development problems solving is spreading. A large majority of UN agencies involved in its activities significant environmental component that focuses on the transition to sustainable development.

An important issue in the implementation of the concept of sustainable development, especially because it is often considered as the evolving one, was an identification of its practical and measurable indicators. Research institutions as well as international organizations are now working in this direction. Based on the above triad, such indicators can bind these three components and reflect the environmental, economic and social (including psychological, such as the perception of sustainable development) aspects.





Fig.3.1. Triune concept of sustainable development.

### 3.1.1. Economic component

Economic approach to the concept of sustainable development is based on the theory of maximum flow of aggregate income, which can be produced while maintaining the total capital, with the help of which this income (Jax - Lindahl theory) is produced. This concept implies the optimal use of limited resources and the use of nature, energy, and material-saving technologies, including extraction and processing raw materials; creation of environmentally friendly products and minimization, recycling and waste disposal. However, when deciding how much capital should be maintained (e.g. physical or natural, or human capital) and how the different types of capital are interchangeable for, as well as while valuation of these assets, especially environmental resources, problems of correct interpretation and count emerge. Two types of stability have emerged - weak when it is referred to the undiminished during the time natural and produced capital, and strong - when natural capital should not diminish (and part of the profits from the sale of non-renewable resources should be directed towards increasing the value of renewable natural capital).

Jax-Lindahl theory

Natural capital is the resources that humanity derives from the earth; water used in industry and everyday life; soil we till to get agricultural products for food and feed cattle; the atmosphere, air we breathe, gases needed for chemical reactions in the industry; flora and fauna, live environment.

Natural capital



Termination of unsustainable growth of resources use	<p>In fact, we can refer not to an immediate cessation of economic growth in general, but on the first stage to the termination of unsustainable growth of environmental resources use. The former is difficult to be realized in a world of increasing competition, growth of such current indicators of successful economic activity as productivity and profit. At the same time, a conversion to an "information society" - the economy of intangible flows of finance, information, images, messages and intellectual property - leads to the so-called "dematerialization" of economic activity: now the volume of financial transactions is many times greater than the volume of material goods trade. Not only shortage of material and natural resources move new economy, but increasingly abundant resources of information and knowledge. Energy intensity of economic activity continues to decline, although the overall power consumption is still increasing.</p>
Conversion to "information society"	
Fair Green Economy	<p>Meeting the challenges of a sustainable economy can satisfy human needs, eliminating resource extraction or production of waste to the extent that exceeds the ability of the environment to heal itself. Principles and objectives of the Fair Green Economy include the implementation of long-term economic programs aimed at prosperity and overall civilization development; realization of mechanisms of implementation and control of environmental and resource strategies enforcement in industry; implementation of green products and green technologies market stimulation mechanisms of in the form of tax and credit incentives; provision of social support and pursuit to balanced well-being of all society members of society or their majority; supporting educational and training programs, funding information resources and activities. Without solving identified problems widespread innovations are impossible. Without their solving it is impossible to stop pollution and devastation of the environment, without stopping which it is impossible to achieve ecological balance. Without ecological balance a healthy society and life itself on the planet Earth are impossible. Therefore, the economy, as a science that manages all the vital processes of civilization, has no other alternative but to become Green and Fair.</p>
Ecological debt	<p>In order to understand the gist of ecological balance it is useful to consider the global interests of nature and society, their "credit relations", which can be expressed in the concept of "ecological debt" - the debt of society to nature. Nature is an integrated system in which everything is interconnected by flows of matter and energy, and everything is fed with primary energy of the sun. This system is capable to self-healing, self-regulation and adaptation. This ability is also its capital. Humanity consumes minerals, coal, oil and timber, harvests, transforming natural capital into economic one (industrial production, construction, transport, goods and services). Herewith, natural systems are destroyed and polluted, and if this caused damage exceeds their ability to recover, we begin to take a loan from nature in the expense of future generations, which will also need this natural capital. Increased intensity and scale of human activity leads to disruption of the ecological balance, increasing ecological debt. The concept "interest on ecological debt" is, first of all, a lost national income due to pollution and environmental destruction spent on the damage elimination. This is a financial cover for ecological debt to future generations. Rather conditional philosophical category of eco-</p>

logical debt can be converted by applied ecology into actual economic macro-indicators. Perspective tool for predicting inter-action of ecological and economic systems is a computer simulation. Described dynamic growth process of ecological debt reflects the principle of "pays the polluter."

### 3.1.2. Social component

Social component of sustainable development is focused on human rights and aimed at preserving social and cultural systems stability, including reduction of destructive conflicts between people. An important aspect of this approach is an equitable distribution of benefits. It is also desirable to preserve cultural capital and diversity on a global scale, as well as a better use of sustainable development practices in traditional cultures. To achieve sustainable development modern society will have to create a more efficient decision-making system that takes into account historical experience and encourages pluralism. It is important to achieve justice, not only within but also between generations. Within a concept of human development, man is not an object, and the subject of development. Based on the expansion human choices variants as the main value, the concept of sustainable development implies that people should be involved in the processes that shape the scope of its activities, to promote the adoption and implementation of decisions, monitor their execution

Distributive justice

Principles of responsible healthy society imply territorial self-government and citizens involvement; openness and transparency; freedom and democracy; friendliness, tolerance, diligence, honesty; actively work together for the common good; every citizen awareness of their place in society and public awareness of its place in the chain of consumption and life cycle of the planet Earth.

Principles of responsible healthy society

A sign of a healthy society is the development of self-organization and local government according to the type of territorial communities or communities where members are primarily friends and allies to each other, united by common tasks, ideas and solutions. Each member of such community, being a free person, contributes, according with their own choice, worldview and call of conscience. Important tasks of building a healthy society are: self-identification and preservation of cultural and historical traditions; family strengthening and raising healthy offspring; a high level of general education; availability and quality of health care; sustainable consumption and functioning on the basis of healthy standards.

An important quality indicator of a healthy society is a high standard of living with a rational balanced consumption. Healthy society cannot be organized without ecological balance of the artificial urban human habitat and natural environment, from which we derive resources for life, but where instead dispose wastes.

### 3.1.3. Environmental component

The principles of life-sustaining activities of natural systems - atmosphere, soil, forests, rivers and the biosphere as a whole define ecology as the science of physical and biological relationships in nature. From an environmental perspective, sustainable

## Health of ecosystems

development must ensure the integrity of the biological and physical natural systems. Degradation of natural resources, pollution and loss of biodiversity reduce the ability of ecosystems to heal itself. Therefore, the focus should be on maintaining the ability of such systems to heal itself and dynamically adapt to change, without bringing them to a total collapse. The health of ecosystems that affects global stability of the entire biosphere is of particular importance. Applying the principles of ecology in urban planning aims reasonable, rational and balanced arrangement of artificial human environment in interaction with the natural environment.

Applied Ecology is to decide specific issues of environmental management, to determine the allowable load on the environment, to develop methods of natural systems management and ecological modernization of various human activities. Now the most urgent tasks of Applied Ecology are reducing all types of emissions; the recycling and reuse of materials and resources; control of cities and buildings air quality; comprehensive measures to reduce energy consumption; improving the efficiency of water consumption; complex development of territories; sustainable consumption; restoring the natural balance of flora and fauna. Health indicators of the ecological balance are the following: clean air, clean water, clean city, the natural state of the climate, the natural state of soil and forests, the prevalence of organic matter in the mass-consumption of food, goods and services.

#### **3.1.4. Concepts unity**

Coordination of economic, social and environmental concepts is a means to achieve sustainable development - the task of essential complexity, since all three pillars of sustainable development should be considered in a balanced way and simultaneously. Methods of interaction between these three concepts are also important. Economic and social elements interacting with each other, give rise to new challenges such as achieving equity within a generation (for example, measures in respect of the income distribution) and providing targeted assistance to the poor. Method of interaction between economic and environmental elements has generated new ideas on valuation and internalizing (accounting reporting at the economic enterprises) external influences on the environment. Finally, the link of social and environmental elements caused interest in issues such as equality, both within a single generation, and between generations, including the rights of future generations, and public participation in decision-making.

#### **3.2. Effective innovation**

Innovation is a novelty seriously increases the effectiveness of existing systems and being introduced in all areas of human activity. The main objective of innovation in the framework of sustainable development is a balancing of human needs with spending resources of the biosphere in a way that does not destroy the stocks and undermine the foundations of the future life of future generations. Effective green innovations relate to design, construction, operation, business and activity standards; automation and computerization; development of information technol-

ogies; the use of renewable energy and sustainability processes and materials; energy efficiency; education; economy, etc. Widespread innovation requires specific economic conditions that encourage, or at least not hinder the modernization of production and social spheres of society. Innovations are designed to reduce the cost of resources, time, energy and efforts on the production, easing the burden from the growing needs of humanity.

For two decades of developing concept of sustainable development, very little progress taking into account further aggravation of poverty and environmental degradation has been made. The world community does not need new philosophical and economic disputes and debates on policies and sharing, but assuming practical measures widely by the heads of corporations and states, as well as any other leaders at the highest level and succeeding in the four areas described above.

Necessity of practical measures

### **3.3. Principles of territories sustainable development**

Currently, the unprecedented growth of cities has revealed the urgent need for the development and implementation of sustainable development principles in the field of urban planning and land use planning. The corresponding concept of "sustainable development of territories" means security and favorable conditions of human life, limiting the negative impact of economic and other activities on the environment and ensuring the protection and rational use of natural resources for the benefit of present and future generations. In order to achieve the high standards required by the sustainable development concept in the design of new urban areas and settlements is necessary to observe the following series of measures and recommendations:

The architectural appearance of the buildings is recommended to coordinate with regional characteristics, with the features of the local landscape, with existing national architectural traditions.

The humane number of storeys in residential buildings (no more than 5 floors) in projected localities or city blocks is recommended. It is recommended a construction on the quarters-cells principle, i.e. green courtyards and playgrounds are created. Business districts with high-rise buildings must be separated from residential green areas. Much attention should be paid to landscaping, parks, alleys, creation of artificial reservoirs, arrangement of embankments, etc. While designing it should be calculated a functionality of each quarter, taking into account climatic factors, taking into account the wind rose, etc., demographic prospects, regional economic specifics up to the realities of macroeconomics.

While creating a transport infrastructure the priority should be given to the most appropriate transport (trolley buses, trams, cable cars, electric trains) from an environmental point of view. The most serious attention must be given to the public transport network as well as the development, promotion and support of cycling.

It is needed a reliable calculation of parking spaces close to residential areas and administrative and business centers linked to the demographic and economic development of the region; planning decisions should take into account creating a

convenient transportation infrastructure, easy access to administrative, business and shopping centers, social institutions.

An important element is a creation of social infrastructure that is necessary for the educational and cultural and spiritual development of a healthy, creatively active community, and taking into account differences of age groups and stimulation of society to actively cooperate.

While creating an engineering infrastructure it is necessary to consider the possibility of using local sources of renewable energy in each quarter. In the design of residential buildings, it is necessary to include the possibility of using the intra-house energy-saving technologies (devices to provide natural ventilation and lighting) in relation to the possibilities of regional energy and climate peculiarities of the region.

It is necessary to equip an efficient system of water supply and sanitation in conjunction with local systems for wastewater recycling, treatment of so-called "gray" waters, i.e. used for commercial purposes.

It is necessary to establish the system of solid waste separate collection, a maximum recycling of recycled materials, study schemes of non-solid waste composting that are convenient for the population; integrated solution of the problem concerned with the rationalization of sorting, recycling and disposal of waste.

Finally, the socio-economic sphere needs stimulation of dynamic positive social interactions; the development of local democratic self-government; joint decision to develop a common strategy and decisions on the current life; joint management within the community, holding festivals, fairs and events. It is necessary to develop local economies in small communities and small businesses, providing diversity, self-support and self-sufficiency.

### Questions, tasks and keys

1. When and how did the concept of sustainable development accept?
2. What is the basic meaning of sustainable development concept?
3. What is the more precise translation on semantic content of the term "Sustainable development"?
4. What is the triune concept of sustainable development?
5. What is meant by the term "ecological debt"?
6. What fields of knowledge and activity touch upon the effective green innovations?



## ***Questions, tasks and keys***

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