WASTES AS RESOURCES FOR SUSTAINABLE DEVELOPMENT

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Contents

Summary

Society faces the problem of utilization of wastes for sustainable development in two aspects. One involves wastes as an additional or alternative source of supply of non-renewable resources. The other treats waste as a source of environmental pollution.

Because of their different origin, scale of accumulation and material composition, wastes play a different role in the economy of individual states and regions. Specific conditions determine the priority of each aspect of the problem.

This article analyzes the problems of utilization and storage of wastes of the mining and power industry, and of solid household and construction wastes in the Russian Federation.

Most wastes from the mining and power industry, by their forms of accumulation and chemical composition, are similar to natural deposits of mineral resources. This is why approaches to their utilization are identical to technological chains of employment of natural mineral resources. Another group of wastes from these industries differs from traditional mineral resources in their physical and chemical characteristics and requires special treatment. Utilization of different wastes, both by their origin and by areas of practical use, is described in the article.

In the past the primary method of disposal of solid household wastes was dumping at

landfill sites, which needed large expenditure without providing any guarantee of safe storage. Rapid growth of the volume of these wastes makes it necessary to look for other methods of management, associated with their utilization, recycling, secondary use and composting of their organic component. Russian and foreign experience of solid household wastes management is examined, and the reasons for inadequate solution of these problems in Russia are analyzed.

At present many cities and towns in Russia face the problem of managing wastes generated as a result of demolition of obsolete five-story buildings, built during the 1950s to the 1970s. Appropriate experience and the results of activity of a Moscow-based finance and industrial corporation "Satory" are considered.

Finally, general approaches to solution of the waste management problem, the particular situation in Russia and the reasons for low volumes of utilization of wastes by industrial enterprises, are analyzed.

1. The origins and the essence of the problem.

In recent decades public opinion has begun to considers exhaustion of mineral resources as one of the grave dangers facing humankind in its future development. The arguments of those who share these views seem very convincing. Mineral resources are local concentrations of certain chemical elements in the Earth's crust. The volume of the Earth's crust is finite, whereas the probability of occurrence in it of natural concentrations of mineral deposits is as low as hundredth fractions of a%. Consequently, rare concentrations of minerals, which are available in limited volume, are exhaustible and finite in the process of their extraction from the limited volume.

Concern about the scarcity of mineral resources grows as their rates of extraction outstrip population growth. For example, between 1900 and 1970 the output of mineral resources grew 12.5 times whereas the population increased 2.5 times. Since the 1970s the volume of extraction of many minerals has exceeded the total volume of their extraction from 1900 to 1970.

This situation gave rise to a number of "alarmist" statements, which predict grave problems connected with supply of mineral resources as early as the first years of the twenty-first century. Though such estimates made in the 1960s and 1970s have already proved far from adequate, the concern is nevertheless still there. This concern is reflected not only in analytical papers and forecasts, but also in legislative documents. The Law of Subsurface of the Russian Federation proclaims (in Article 35) that the primary task of regulation by the State of relations connected with the use of mineral resources is to ensure reproduction of the potential of mineral resources and raw materials, their rational use and protection of mineral deposits in the interests of current and future generations of the peoples of the Russian Federation.

Globally, here has been a steady decline in the growth rates for production of minerals. One may claim that production of raw material resources has entered a stable phase, which correlates with demand in conditions of lack of physical shortages of raw materials. As to the stability, this is ensured by both new developments in science and

technology, which make it possible to explore new, sometimes complex, sources of raw materials. Consumption is stabilizing, and actually reducing in some countries. Reduction of consumption of raw materials by the developed economies is caused primarily by structural and technological factors, decrease of the share of industry and growth of the share of services and information technologies. For countries with transitional economies, such as Russia, reduction of consumption of raw materials is caused by radical structural changes in the economic system, and considerable decline of output in some branches of the economy—the traditional consumers of raw materials. At the same time both in Russia and in other countries, consumption of primary mineral resources is declining as a result of several factors, including use of wastes as their substitutes. In some instances the decline in the use of raw materials is caused not so much by their shortage but by environmental problems, connected with accumulation, storage and disposal of wastes.

In the process of support of everyday activities of society, different kinds of wastes are generated—solid, household, industrial (including hazardous wastes), agricultural, construction and demolition, medical, biological, radioactive, biochemical; deposits of drainage waters, military wastes, garden wastes, wastes of commercial and trade sectors, mining wastes, wastes of excavating and bottom recession operations.

A peculiar feature of contemporary economic development of practically all the nations of the world, including Russia, is rapid growth of the overall mass of technogenic and household wastes, which have recently assumed gigantic proportions and is characterized by values of magnitude fraught with catastrophic consequences.

The importance of wastes utilization appears to be more distinct in the framework of material flows, generated as a result of human activity.

Human activity on extraction and utilization of mineral resources causes redistribution of chemical elements in all the components of biosphere, the lithosphere, the hydrosphere and the atmosphere. As to concentration of the elements in the lithosphere, this is balanced by the expense of destruction of local high density sectors—mineral deposits. These elements are concentrated again on the surface of the lithosphere, this time in the form of artifacts (stationary and mobile) and their concentration in this new form is much higher than in natural deposits Anthropogenic activity is accompanied by exhaustion of some elements into the atmosphere and hydrosphere, where in certain conditions their concentrations considerably exceed appropriate average values.

New concentrations of compounds of anthropogenic origin, combinations of which are not available in natural conditions, undergo further changes, thus supplementing and enlarging the circulation of matter in the biosphere. The major feature of this element of circulation is its speed, which exceeds the rate of natural evolution by several orders of magnitude. As the same time transformations of technogenic concentrations may as a first approximation be compared with natural destruction of ore bodies with the cardinal difference that in the latter case they are caused by the physical and chemical laws and in the former technical, economic and social causes of dispersion are more influential.

Due to these factors the secondary kinds of accumulation of mineral substance assume

different forms and require other methods of measurement, exploration and development. Though the theory of secondary resources is still in the stage of elaboration, we have already at our disposal individual methods of their economic measurement as well as the results of the first efforts of their classification. Let us try to outline the main body of the problems associated with the use of this kind of resource and the of the problems of protection of the environment from pollution with different industrial and household wastes.

The major part of the primary raw materials, which are used in industrial production, continues its existence in the form of ready-made products, and in the course of their physical wear they are transformed into wastes. Affected by chemical and physical processes, a part of these materials are dispersed in the environment; they are involved into natural cycling of matter and are lost irreversibly. As to the major amount of production raw materials and those resources, which were used in different products, they are accumulated in a dispersed state on the surface of the Earth and form a new resource base. This resource base has its own technological chain, which starts from collection and sorting of wastes and ends in their metallurgical or chemical reprocessing, from which they are involved once again into the area of production and consumption of ready-made products together with materials of mineral origin.

Materials for secondary treatment are formed on all stages, starting from metallurgical conversion (for example, non-penetrated metal or under-conditioned alloys). While the metals are processed by cutting, large amounts of chippings and remainders of blanks, as well as rejected parts, are sent into wastes. These two types of wastes are referred to in the literature by definition as “new scrap”, and this is different from old or “depreciated scrap”, which constitutes obsolete or out-of-operation industrial equipment or consumer articles.

In the context of environmental protection and resource saving the efficiency of secondary treatment or recycling of mineral resources is not limited only to reduction of output of solid wastes and to gaining additional amounts of raw material. Large scale secondary treatment makes it possible to reduce output in the mining industry and, accordingly, to improve the protection of the environment. There is a possibility of reducing extraction of both the raw material and energy resources. The total saving (less the costs related to collection of materials for consequent treatment) may amount, in theory, to 98% of energy costs for treatment of primary raw materials. In practice, however, the saving is around 60 to 80%. Some estimates show, that in production of steel out of wastes, energy consumption, compared to its production from primary raw materials, is reduced by 74%, water consumption by 40%, and atmospheric pollution by 87%. Finally, the amount of mining wastes is reduced by 97%. At the same time industrial wastes are reduced by 105%, since in the course of recycling no wastes are produced and the amount of existing wastes decreases.

Secondary use of non-ferrous metals has proved itself to be very efficient. For example, in production of aluminum and its alloys out of secondary raw material, consumption of electrical energy is reduced 20-25 times, and the total mass of nominal fuel consumption is reduced more than 7 times, whereas appropriate capital investments are reduced 6 to 8 times and more.

The most promising in present conditions is use of consumer scrap of solid household wastes, since the degree of its utilization, compared to industrial scrap is low due to the lack of sufficient interest of local authorities (owners of municipal dumps, where this scrap is accumulated) in sorting and productive use of different components of the dumps. Other factors are the relatively underdeveloped technologies for collection and separation of solid household wastes and extraction of non-metallic components, among which fuel is very important. The available estimates of average content of different metals on municipal dumps in Europe and USA rank them as natural deposits with concentration below profitable development limits. Such estimates, however, ignore the expenses related to collection, transportation and disposal of wastes on municipal dumps, as well as the cost of land, diverted for dumps. In some cases such expenses are so high, that make recycling of consumer scrap economically profitable even without account of costs related to extraction and processing of equivalent amount of metal from ores. Growth of the relative fraction of recycling will be more urgent as the quantity of accumulated wastes grows and the quality of natural deposits deteriorates.

It is not only wastes with metal content, produced from materials of mineral origin, that undergo secondary treatment. It is generally assumed that fuel and energy resources are consumed irrevocably and cannot be reused. However in this area there are alternatives for repeated use, which involve utilization of gas fuels (coke, blast furnace, converter and oil refinery gases) as well as the physical heat of high temperature exhaust gases, back-pressure gas and hot water. Secondary energy resources of Russian industry amount approximately 70 million tons of comparable fuel per year.

The variety of sources of wastes, spheres of their utilization and the different purposes of their use (e.g. substitution of natural mineral raw material and traditional kinds of fuel, improvement of ecological situation, diversion of land for other purposes and other uses, including their combinations) make it very difficult to develop a unified approach to their analysis. To demonstrate the problems of utilization of wastes in Russia, therefore, several case studies, involving different types of wastes and reasons for their use, are analyzed.

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Biographical Sketch

Professor Alexander Arbatov was born in 1938 in Moscow. He graduated from Moscow Oil and Gas Institute as a geologist. He is the chairman of the Committee for Productive Forces and Natural Resources of the Russsian Academy of Sciences. Formerly, he was the head of the Department of Natural Resource Supply in the Institute for System Studies, RAN, and senior researcher in the Institute for Oil and Gas Exploration of the Ministry of Geology of the Former USSR. Alexander Arbatov has Ph.D. in geology and a doctoral degree in economics.