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BEST AVAILABLE TECHNIQUES, GENERAL BINDING RULES AND DECARBONISATION OF THE CONSTRUCTION MATERIALS INDUSTRY

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ABSTRACT

Environmental Industrial Policy (EIP) as an integral part of the industrial policy aimed at the resource efficiency enhancement at two levels – the level of industrial installation and the regional level. The article shows the correlation between Sustainable Development Goals, Environmental Industrial Policy and Circular Economy goals. Authors focus their analysis on the construction materials industry as one of the resource intensive sectors regulated both by the legislation based on Best Available Techniques (BAT) and carbon-related legislation.

In Russia, BAT concept is seen as an instrument for the industrial resource efficiency enhancement. Environmental Performance Indicators are included in BAT Reference Documents (BREFs) laying a basis for the assessment of greenhouse gases (GHG) emissions. To optimise two interrelated regulatory systems (BAT and GHG), BATs providing for the high resource efficiency are seen as the top priority for reducing emissions of ordinary pollutants and GHGs as well as and for forming inter-sector links typical for the circular economy.

In the production of cement clinker and glass, it is possible to increase the use of secondary materials and thereby to reduce energy consumption and GHG emissions. Decreasing clinker content in cement and applying light concrete lead to decreasing GHG emissions during the life cycle of buildings. Modern glass also provides for minimising heat losses of buildings. In the ceramic sector, such solutions are less evident, but using waste wood leading companies produce hollow bricks with excellent heat-insulating properties. Prioritising resource efficiency, industries should maintain also robust environmental management procedures and apply general binding rules for insignificant pollution sources.

Keywords: Best Available Techniques, resource efficiency, greenhouse gases, decarbonisation, general binding rules, circular economy

INTRODUCTION

Increasing resource efficiency and expanding the practice of resource conservation has recently become a priority in the industrial policy of resource-rich countries, including Russia. The already traditional discussion of the necessity of rational use of mineral, land, and forest resources is increasingly accompanied by debates concerning the importance of such resources as clean air, water, and all the bio-sphere "assets" that the society has

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long perceived as unlimited. These approaches are reflected in the Sustainable Development Goals (SDGs) and the National Goals of the Russian Federation that include economic development, innovations, and decent employment for the population along with responsible production and consumption, increasing energy efficiency, and mitigating climate change [1]. The policy of increasing resource efficiency aims at creating a circular economy and contributes to curtailing the consumption of raw materials, materials, energy, and water in production processes as well as reducing emissions and involving secondary resources in the economic turnover [2].

Hence, the movement towards sustainable development is a process of purposeful change, in which resources appear as a powerful limiting factor. Herewith, the concept of "resource efficiency" implies not only the efficiency of the use of materials and energy but is a broader term that covers (or should cover, although to date this opinion is not generally recognised) water, air, land re-sources, that is, all the resources that the society relies on to support its life activity in one way or another [3].

THANATIA OR CIRCULAR ECONOMY?

Over the centuries, economists and sociologists have been considering the problem of limited resources and the issues related to increasing the efficiency of their use and opportunities for saving (including for future generations). Among the most widely known are the R. Solow's theory of economic growth [4], N. D. Kondratiev theory of technological patterns [5]. J. Stiglitz's theory of resource management [6] and, of course, the concept of sustainable development [1].

In the first decades of the XXI century, thermodynamic economics — a new direction of economic theory – was formulated. Antonio, Andres, and Alicia Valero created an anti-utopia named Thanatia – a completely depleted Earth with all mineral resources extracted, used, and dispersed in space or placed as waste and all fossil fuel reserves burned [7]. The authors focus on the depletion of mineral and energy resources yet at the same time emphasise that the exhaustion of the assimilative capacity of the biosphere should also be considered as a limiting factor in human development. According to Valero, the categorical imperative of the society's development in modern conditions is to unite the efforts of politicians, economists, sociologists, technologists, and ecologists for the transition from the Thanatia model to the model of sustainable development and circular economy [7].

Ideally, the sustainable use of resources could be imagined as an endowment fund, the main (natural) capital of which is not spent and where the provision ("financing") of anthropogenic activities is carried out at the expense of income formed as a result of prudent management. Concerning renewable resources, such management can be imagined through the example of alternative energy sources or the functioning of the timber industry. The regeneration of forests takes place over a period comparable to the human lifespan (~80 years), forest resources can be used up almost completely, including in highly efficient pulp and paper production, and the products can be recycled. With regards to non-renewable resources, it is much more difficult to imagine such an endowment fund, but the profound recycling, complete usage, long-term maintenance of resource value, minimisation of waste, and involvement of secondary resources in economic turnover are the approaches that allow a more responsible and sustainable use of natural capital. At the same time, in the construction sector, mineral materials (such as cement, concrete, glass, metal, etc.) can be recycled or used in other sub-sectors: glass cullet that can't be used to produce new float glass, has good potential for being recycled to produce roads.

Clear parameters of the sustainable development model are not established yet – there exist only certain benchmarks including those systematised in the SDGs adopted by the United Nations. Numerous research teams are seeking universal indicators. A compromise (and a largely politicised one) is the indicator of carbon intensity as sustainable development is increasingly identified with the reduction of greenhouse gas (GHG) emissions [8, 9]. At the present stage, such a solution may be considered acceptable – the emissions of the "major" GHG, carbon dioxide, characterise primarily the processes of fuel combustion and, thus, the energy efficiency of production and consumption. Methane and carbon dioxide are also produced as the result of the decomposition of carbon-containing compounds.

A report issued by the International Resource Group [3] highlights that a low-carbon, resource-efficient, and resource-saving economy must include optimised production and consumption systems as they pertain to the use of natural resources. In a circular economy, the value of products, materials, and resources is maintained and renewed for the longest period possible, and the formation of emissions (waste, losses, emissions, discharges, etc.) is minimised. Hence, to create a circular economy it is necessary to develop and implement the policy of "dematerialisation" [3] aimed at reducing the consumption of materials and energy and the policy of continuing "materialisation" that focuses on the reuse and recycling of products and the usage of secondary resources in production processes. Russian-language literature usually deals with the reduction of material and energy intensity of production and consumption and the return of secondary resources in the economic turnover [2].

ENVIRONMENTAL INDUSTRIAL POLICY, BEST AVAILABLE TECHNIQUES AND GENERAL BINDING RULES

"Dematerialisation" and "re-materialisation" (circular economy) along with increasing the energy efficiency of production and consumption are the main directions of the "Green Deal" [10] – the modern strategy for sustainable development and greener economy adopted by the European Commission in 2019. Similarly, the environmental industrial policy (or Environmentally Efficient Industrial Policy) along with the Strategy of Socio-Economic Development with Low Level of Greenhouse Gas Emissions should be regarded as integral parts of the sustainable development strategy of the Russian Federation.

At the level of industrial installations and sectors, the environmental industrial policy (EPP) is a policy of modernisation, development, and implementation of fundamentally new (innovative) technologies and technological processes. The minimum, threshold requirements for resource efficiency of technological processes are established in Reference Documents on the Best Available Techniques (BAT). These Reference Documents (BREFs) are worked out and reviewed by technical working groups (TWGs) within the framework of the Technical Committee on Standardisation TC 113. As BREFs are revised, the indicators of resource efficiency are specified and their spectrum is extended. The TWGs consist of representatives of industry associations, federal executive authorities, and, significantly, the expert community. Independent experts – employees of project teams and consulting organisations, research institutes, and higher school

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establishments – are also involved in developing new technologies and evaluating resource efficiency and environmental performance of the existing installations.

Increasing the efficiency of the use of raw materials, water, and energy; reducing the losses; and introducing environmental and energy management systems – these are the BATs described practically in every BREF (accounting for industry specifics). In addition, some processes, such as the production of lightweight glass containers, hollow bricks, or cement with low clinker content, already contribute towards the "dematerialisation" of high-temperature inorganic materials [11].

In the single-medium permitting system, which has been functioning in Russia since the 1980s, major pollution sources and insignificant ("secondary") sources are addressed identically; environmental engineers spend time and effort modelling emissions from welding points and small paining shops and woodworks, etc. Such pollution sources contribute 0.1-0.5% towards the overall emissions of industrial sites where glass, brick or cement installations are located. It is possible to manage such sources by standard procedures similar to General Binding Rules (GBRs). GBRs should include both statutory emission limit values and requirements for certain operational matters. In Russia, BREFs are documents of the national standardisation system, and it would be logical to develop GBRs as national standards. To make their development cost-effective, such standards should cover a sufficient number of similar pollution sources. Application of GBRs can help to optimise the system of technological regulation based on Best Available Techniques [12].

At the regional and sectoral levels, EPP is focused on recycling of industrial waste (secondary resources). Industrial symbiosis is a combination of installations and processes by which wastes or by-products of one industry or industrial process become the raw materials for another one. Industrial symbioses provide for using materials to in a more sustainable way. Thus, the environmental industrial policy supports the formation of a circular economy by setting requirements for reducing material and energy intensity of production processes.

CONSTRUCTION MATERIALS INDUSTRY: CIRCULARITY ASPECTS

The construction materials industry is a part of the construction complex, which is being actively developed in Russia within the frame-work of the "Housing and Urban Environment" national project. Resource efficiency of enterprises that produce sheet glass and building ceramics is relatively high as most plants were either fundamentally renovated or built anew in the last 10-15 years. The situation in the cement industry is more complicated – along with the most modern plants, there are enterprises that were put into operation several decades ago. All of them are now being modernised in accordance with the Environmental Performance Enhancement Programmes [11].

Large brick factories produce a wide range of products, and the costs of raw materials and energy vary quite widely as they depend on the type of manufactured bricks and ceramic blocks. Leading enterprises have reduced unit energy consumption to 1.5-1.7 GJ per tonne of product. The advantage of hollow bricks in the construction of walls is their lightness and good heat insulation properties. Hollow bricks are produced with the use of fusible clay; hence, the unit consumption of raw materials and energy in the process is lower than in the production of solid bricks [13].

Cement in Russia is produced using dry, combined, and wet techniques. The best energy efficiency is achieved in the dry method of production (3.5-4.2 GJ per tonne of clinker). Additionally, the replacement of natural raw materials (first of all, limestone) with industrial raw materials, such as blast-furnace slag, allows for a greater reduction of energy consumption. This solution aims at increasing the resource efficiency of production and recycling large-tonnage industrial waste as well as reducing the carbon footprint. This is a manifestation of the internationally accepted strategy for the development of cement and concrete production [13].

The float-process of polished glass production enables to obtain high-quality products with minimum losses. More than 80% of energy is used up in the glass furnace. At the beginning of a glass-making campaign for especially large furnaces (800 tonnes of glass per day and more), specific energy consumption can be less than 5 GJ per tonne of glass. Reduction of energy consumption and greenhouse gas emissions can be achieved by increasing the proportion of glass cullet in the charge, yet there are limitations related to product quality. Russian experts believe that the maximum proportion of glass cullet in the charge must not exceed 35%-37%. Opportunities to further reduce greenhouse gas emissions exist in the field of building construction and renovation. Glass can be made more transparent and covered with a special heat-saving coating, which allows reduced energy consumption for lighting and heating (Fig. 1).

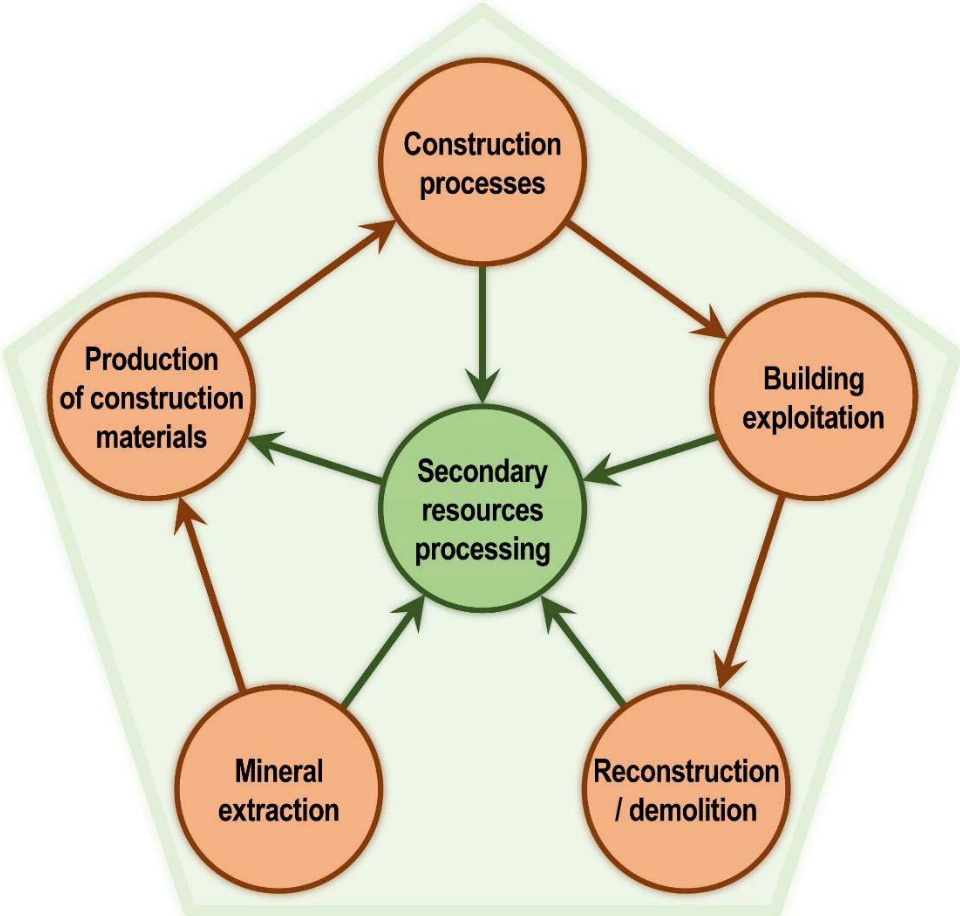

Fig. 1. Opportunities for “closing the loop” in the construction sector

Note that according to the UN data in 2019, buildings were responsible for 38% of greenhouse gas emissions in the world [14]; hence, improving resource (including energy) efficiency of buildings is one of the priorities of the low-carbon development national strategies in all countries. Therefore, the projects initiated, for example, by the Union of Glass Producers, whose member companies offer not only glass production but resource-efficient solutions for construction, should be considered as climate friendly. The projects of the Association of Ceramic Wall Materials Manufacturers that played an important role in the development of the BAT concept could be considered similarly.

The question of whether the reduction of greenhouse gas emissions achieved, for example, during the implementation of the renovation program by the companies producing low-emission glass will be "credited" to these enterprises remains open – in Russia, the requirements for climate projects have not been established yet.

Undoubtedly, the choice of architectural and planning solutions and building materials and structures (the range of which is very wide and by no means limited to products made of high-temperature inorganic materials) is per-formed at the stage of designing buildings and structures. But the approaches of sustain-able, "green" construction systematised in Russian and international standards and methodological documents provide opportunities for the formation of stronger links be-tween the building materials industry and the construction sector as a whole. For example, the minimum requirement for selecting bricks, cement, or glass for "green" buildings should be the compliance of industrial enterprises with the BAT. In this case, the assessment of suppliers can be carried out, for example, in accordance with the principles of the BES 6001 standard – "Responsible Sourcing of Construction Products". At the same time, the expansion of responsibility of construction materials producers can stimulate the increase of resource efficiency at all stages of the cycle including the extraction of natural resources, production of goods (together with the use of secondary resources, both industrial and those related to the construction sector), buildings construction and repair, renovation programs, and processing and preparation of secondary resources (in this case — cullet, construction waste, demolition, etc.). In international practice, such approaches are called "forming the loop" or "closing the loop."

Requirements for "green" construction include the selection of sites and locations including in relation to water bodies and landscaped or protected natural areas (here we recall the ecosystem services); infrastructure; transport accessibility; water supply and sanitation; electricity and heat supply; maintenance; conditioning; waste management and the like. This article considers opportunities for improving resource efficiency on the example of production and consumption of only three types of building materials. However, despite the intentional simplification, the cycle, schematically depicted in Fig. 1, contains the key elements, the interrelated development of which creates the basis for improving resource efficiency at the level of enterprises, industries, and the construction sector as a whole.

CONCLUSION

Three fundamental concepts – the sustainable development, the circular economy and the low-carbon growth – attract attention of not only scientists but practitioners working in various countries around the world. Region by region, sector by sector, new case studies prove that environmentally sound industrial policies play a very important role in making economy more resource efficient, provide for the reduction of environmental impacts and open opportunities for “closing the loop” – forming cycles of material and energy in economic and industrial systems.

Construction materials industry is one of the resource intensive sectors regulated both by the legislation based on Best Available Techniques and carbon-related legislation. Producers of cement, glass and ceramics produce a rich variety of construction materials trying at the same time to reduce the energy and material intensity of the technological processes and products. In the European Union and in Russia, requirements of Best Available Techniques are set to stimulate large installations to enhance their environmental performance and to recycle secondary resources (when possible) replacing thereby and conserving natural resources. Regulating insignificant pollution sources by the simplified approaches (such as General Binding Rules) helps practitioners to focus their attention on priority resource efficiency and environmental aspects.

BAT-based regulation and carbon regulation are inter-related: enhancing environmental performance, larger installations reduce GHG emissions. In the production of cement clinker and glass, the use of secondary materials leads to forming inter-sectoral links, reducing energy consumption and in some cases – decreasing negative environmental impacts. On the other hand, modern energy efficient glass, bricks and ceramic blocks allow designers to come up with resource and energy efficient solutions in the construction and renovation of buildings. International by the origin, leading companies producing construction materials collaborate with research teams to develop modern approaches complying with the sustainable development, circular economy and low-carbon development principles.

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