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ANALYSIS OF WAYS TO REDUCE ENVIRONMENTAL POLLUTION FROM COKE PRODUCTION IN CHINA

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Abstract

The work considers environmental pollution by coke production using traditional technology in China. The features of emissions and discharges treatment, which are introduced into the practice of treatment systems in industrial production, are determined. The directions of reducing pollutant emissions into the air and natural waters, which provide for an integrated approach that combines regulatory and legal regulation, technical innovations in methods of cleaning polluted streams, introduction of technological methods of coke production, etc. are analyzed and systematized.

Key words: *coke production, pollutants, treatment methods, regulation, innovations, technological methods.*

China is a leading producer, consumer and exporter of coke in the world. At the same time, there is an urgent need to address the high emissions of pollutants and carbon dioxide associated with traditional coke production in the country [1]. Pollution from volatile organic compounds generated in the coke industry alone accounts for about 7.8-20% of total historical industrial emissions of these substances in China. It is proposed to take stricter and more effective measures for the coke industry regarding coking and gas treatment processes [2]. Considering this situation, an analysis of publications on current trends in reducing environmental pollution may be appropriate when implementing activities to prevent the negative environmental impact of coke production.

Emissions from coke production contain a range of pollutants: particulate matter (PM10 and PM2.5), sulphur dioxide, soot, benzene-soluble substances, benzopyrene, NO_X, H_2S, CO_2, CO and NH_3. The coking process releases volatile organic compounds such as alkanes and alkenes, aromatic compounds, and benzene, which is a Group 1 carcinogen.

To solve the air pollution problems related to the coke industry in China, the Chinese government has issued a number of policy documents [3]. These include regulations on issuing permits for pollutant emissions for the coke industry, monitoring coke ovens, etc.

A special attention is paid to the formation of coke oven gas that needs to be treated. Currently, the following methods are widely used to treat coke oven exhaust gas: absorption, adsorption, condensation, combustion, negative pressure recovery, rotary molecular sieve adsorption concentration technology, RCO, RTO, nitrogen cycle desorption adsorption recovery technology, and biological treatment [4]. To solve the problem of carbon neutrality, China is implementing new ways to utilize coke oven gas, which involves the production of hydrogen, methanol and other "green" alternatives to coke oven gas utilization [1]. Considering that the hydrogen content of coke oven gas

positions it as a promising source on the way to a hydrogen economy [5], it is important for the country to develop this area.

The volume of wastewater generated in the production of coke in China is quite significant and reaches 60 % of the world's volume and contains a large number of various pollutants, including only 300 organic compounds [6]. Coke wastewater contains insoluble (suspended and colloidal) particles, but the main pollutants are phenolic substances and a number of other organic compounds, such as benzene and its derivatives, monocyclic, polycyclic and heterocyclic compounds, petroleum products, fatty acids, etc. [7]. An integrated approach is usually used for wastewater treatment: pretreatment, physical and chemical treatment, and biological treatment [8]. The traditional technology of physical and chemical treatment of coking wastewater mainly includes such methods as adsorption, coagulation precipitation, extraction, etc. After the primary physical and chemical treatment, biological treatment stages are usually applied in bioreactors with activated sludge.

Due to the low biodegradability of coke oven wastewater, the required degree of treatment can be achieved by combining new technologies and bioreactors [7]. There are six different variants of biological treatment processes, classified according to the high (A/A/O, O/A/O, oxic/hydrolytic/oxic (O/H/O)) or low organic load of coking wastewater (A/O, A/O/O, A/A/O, A/A/O/O), and which are applied in real systems in China [7–9]. The integration of anaerobic, anoxic and oxidative processes is promising and can replace traditional biological treatment [10]. It is also advisable to use the SBR process, which is a sequential batch aerobic biological treatment process similar to the oxygenation method, to treat coke oven wastewater [11].

Thus, in order to minimize the negative environmental impact of coke production and comply with the principles of sustainable development, it is necessary to introduce new and improve existing environmentally friendly and energy-saving production technologies and to consider activities in the circular economy.

The analysis of information sources has revealed that the reduction of environmental pollution from coke production in China can be achieved through a comprehensive approach that includes:

- regulatory policy to regulate environmental pollution in the technological sphere of product manufacturing and environmental limitation;
- implementing the most modern methods of treatment of polluted emissions and discharges, as well as conducting research to improve the efficiency of emissions and discharge treatment systems;
- development of scientific research on the development of new and improvement of existing coke production technologies (coal pretreatment and mixing, pyrolysis process, coke quenching processes, fluidized bed coking, impact of environmental standards on coke production, etc.);
- investing in technological innovations to reduce pollutant emissions, save energy and implement the latest emission and discharge treatment technologies.

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АНАЛІЗ ШЛЯХІВ ЗМЕНШЕННЯ ЗАБРУДНЕННЯ НАВКОЛИШНЬОГО СЕРЕДОВИЩА ВІД КОКСОХІМІЧНОГО ВИРОБНИЦТВА В КИТАЇ

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Ключові слова*: коксохімічне виробництво, забруднювачі, методи очищення, регулювання, інновації, технологічні методи.*

Анотація

У роботі розглянуто забруднення навколишнього середовища при виробництві коксу в Китаї за традиційною технологією. Визначено особливості очищення викидів і скидів, які впроваджуються у практику очисних систем промислового виробництва. Проаналізовано та систематизовано напрями зменшення викидів забруднюючих речовин в атмосферне повітря та природні води, які передбачають комплексний підхід, що поєднує нормативно-правове регулювання, технічні інновації в методах очищення забруднених потоків, впровадження технологічних методів виробництва коксу тощо.