ISSN 2518-170X (Online),
ISSN 2224-5278 (Print)

ҚАЗАҚСТАН РЕСПУБЛИКАСЫ
ҰЛТТЫҚ ҒЫЛЫМ АКАДЕМИЯСЫНЫҢ
Қ. И. Сәтпаев атындағы Қазақ ұлттық техникалық зерттеу университеті

Х А Б А Р Л А Р Ы

ИЗВЕСТИЯ

НАЦИОНАЛЬНОЙ АКАДЕМИИ НАУК
РЕСПУБЛИКИ КАЗАХСТАН
Казахский национальный исследовательский
технический университет им. К. И. Сатпаева

N E W S

OF THE ACADEMY OF SCIENCES
OF THE REPUBLIC OF KAZAKHSTAN
Kazakh national research technical university
named after K. I. Satpayev

SERIES
OF GEOLOGY AND TECHNICAL SCIENCES

2 (434)

MARCH – APRIL 2019

THE JOURNAL WAS FOUNDED IN 1940

PUBLISHED 6 TIMES A YEAR

ALMATY, NAS RK

NAS RK is pleased to announce that News of NAS RK. Series of geology and technical sciences scientific journal has been accepted for indexing in the Emerging Sources Citation Index, a new edition of Web of Science. Content in this index is under consideration by Clarivate Analytics to be accepted in the Science Citation Index Expanded, the Social Sciences Citation Index, and the Arts & Humanities Citation Index. The quality and depth of content Web of Science offers to researchers, authors, publishers, and institutions sets it apart from other research databases. The inclusion of News of NAS RK. Series of geology and technical sciences in the Emerging Sources Citation Index demonstrates our dedication to providing the most relevant and influential content of geology and engineering sciences to our community.

Қазақстан Республикасы Ұлттық ғылым академиясы "ҚР ҰҒА Хабарлары. Геология және техникалық ғылымдар сериясы" ғылыми журналының Web of Science-тің жаңаланған нұсқасы Emerging Sources Citation Index-те индекстелуге қабылданғанын хабарлайды. Бұл индекстелу барысында Clarivate Analytics компаниясы журналды одан әрі the Science Citation Index Expanded, the Social Sciences Citation Index және the Arts & Humanities Citation Index-ке қабылдау мәселесін қарастыруда. Webof Science зерттеушілер, авторлар, баспашылар мен мекемелерге контент тереңдігі мен сапасын ұсынады. ҚР ҰҒА Хабарлары. Геология және техникалық ғылымдар сериясы Emerging Sources Citation Index-ке енуі біздің қоғамдастық үшін ең өзекті және беделді геология және техникалық ғылымдар бойынша контентке адалдығымызды білдіреді.

НАН РК сообщает, что научный журнал «Известия НАН РК. Серия геологии и технических наук» был принят для индексирования в Emerging Sources Citation Index, обновленной версии Web of Science. Содержание в этом индексировании находится в стадии рассмотрения компанией Clarivate Analytics для дальнейшего принятия журнала в the Science Citation Index Expanded, the Social Sciences Citation Index и the Arts & Humanities Citation Index. Web of Science предлагает качество и глубину контента для исследователей, авторов, издателей и учреждений. Включение Известия НАН РК. Серия геологии и технических наук в Emerging Sources Citation Index демонстрирует нашу приверженность к наиболее актуальному и влиятельному контенту по геологии и техническим наукам для нашего сообщества.

Б а с р е д а к т о р ы

э. ғ. д., профессор, ҚР ҰҒА академигі

И.К. Бейсембетов

Бас редакторының орынбасары

Жолтаев Г.Ж. проф., геол.-мин. ғ. докторы

Р е д а к ц и я а л қ а с ы:

Абаканов Т.Д. проф. (Қазақстан)
Абишева З.С. проф., академик (Қазақстан)
Агабеков В.Е. академик (Беларусь)
Алиев Т. проф., академик (Әзірбайжан)
Бакиров А.Б. проф., (Қырғыстан)
Беспаев Х.А. проф. (Қазақстан)
Бишимбаев В.К. проф., академик (Қазақстан)
Буктуков Н.С. проф., академик (Қазақстан)
Булат А.Ф. проф., академик (Украина)
Ганиев И.Н. проф., академик (Тәжікстан)
Грэвис Р.М. проф. (АҚШ)
Ерғалиев Г.К. проф., академик (Қазақстан)
Жуков Н.М. проф. (Қазақстан)
Қожахметов С.М. проф., академик (Казахстан)
Конторович А.Э. проф., академик (Ресей)
Курскеев А.К. проф., академик (Қазақстан)
Курчавов А.М. проф., (Ресей)
Медеу А.Р. проф., академик (Қазақстан)
Мұхамеджанов М.А. проф., корр.-мүшесі (Қазақстан)
Нигматова С.А. проф. (Қазақстан)
Оздоев С.М. проф., академик (Қазақстан)
Постолатий В. проф., академик (Молдова)
Ракишев Б.Р. проф., академик (Қазақстан)
Сейтов Н.С. проф., корр.-мүшесі (Қазақстан)
Сейтмуратова Э.Ю. проф., корр.-мүшесі (Қазақстан)
Степанец В.Г. проф., (Германия)
Хамфери Дж.Д. проф. (АҚШ)
Штейнер М. проф. (Германия)

«ҚР ҰҒА Хабарлары. Геология мен техникалық ғылымдар сериясы».
ISSN 2518-170X (Online),
ISSN 2224-5278 (Print)
Меншіктенуші: «Қазақстан Республикасының Ұлттық ғылым академиясы» РҚБ (Алматы қ.).
Қазақстан республикасының Мәдениет пен ақпарат министрлігінің Ақпарат және мұрағат комитетінде 30.04.2010 ж. берілген **№10892-Ж** мерзімдік басылым тіркеуіне қойылу туралы куәлік.

Мерзімділігі: жылына 6 рет.
Тиражы: 300 дана.

Редакцияның мекенжайы: 050010, Алматы қ., Шевченко көш., 28, 219 бөл., 220, тел.: 272-13-19, 272-13-18,
http://www.geolog-technical.kz/index.php/en/

© Қазақстан Республикасының Ұлттық ғылым академиясы, 2019

Редакцияның мекенжайы: Қазақстан, 050010, Алматы қ., Қабанбай батыра көш., 69а.
Қ. И. Сәтбаев атындағы геология ғылымдар институты, 334 бөлме. Тел.: 291-59-38.

Типографияның мекенжайы: «Аруна» ЖК, Алматы қ., Муратбаева көш., 75.

Главный редактор

д. э. н., профессор, академик НАН РК

И. К. Бейсембетов

Заместитель главного редактора

Жолтаев Г.Ж. проф., доктор геол.-мин. наук

Редакционная коллегия:

Абаканов Т.Д. проф. (Казахстан)
Абишева З.С. проф., академик (Казахстан)
Агабеков В.Е. академик (Беларусь)
Алиев Т. проф., академик (Азербайджан)
Бакиров А.Б. проф., (Кыргызстан)
Беспаев Х.А. проф. (Казахстан)
Бишимбаев В.К. проф., академик (Казахстан)
Буктуков Н.С. проф., академик (Казахстан)
Булат А.Ф. проф., академик (Украина)
Ганиев И.Н. проф., академик (Таджикистан)
Грэвис Р.М. проф. (США)
Ергалиев Г.К. проф., академик (Казахстан)
Жуков Н.М. проф. (Казахстан)
Кожахметов С.М. проф., академик (Казахстан)
Конторович А.Э. проф., академик (Россия)
Курскеев А.К. проф., академик (Казахстан)
Курчавов А.М. проф., (Россия)
Медеу А.Р. проф., академик (Казахстан)
Мухамеджанов М.А. проф., чл.-корр. (Казахстан)
Нигматова С.А. проф. (Казахстан)
Оздоев С.М. проф., академик (Казахстан)
Постолатий В. проф., академик (Молдова)
Ракишев Б.Р. проф., академик (Казахстан)
Сеитов Н.С. проф., чл.-корр. (Казахстан)
Сейтмуратова Э.Ю. проф., чл.-корр. (Казахстан)
Степанец В.Г. проф., (Германия)
Хамфери Дж.Д. проф. (США)
Штейнер М. проф. (Германия)

«Известия НАН РК. Серия геологии и технических наук».
ISSN 2518-170X (Online),
ISSN 2224-5278 (Print)
Собственник: Республиканское общественное объединение «Национальная академия наук Республики Казахстан (г. Алматы)
Свидетельство о постановке на учет периодического печатного издания в Комитете информации и архивов Министерства культуры и информации Республики Казахстан **№10892-Ж,** выданное 30.04.2010 г.

Периодичность: 6 раз в год
Тираж: 300 экземпляров

Адрес редакции: 050010, г. Алматы, ул. Шевченко, 28, ком. 219, 220, тел.: 272-13-19, 272-13-18,
http://nauka-nanrk.kz /geology-technical.kz

© Национальная академия наук Республики Казахстан, 2019

Адрес редакции: Казахстан, 050010, г. Алматы, ул. Кабанбай батыра, 69а.
Институт геологических наук им. К. И. Сатпаева, комната 334. Тел.: 291-59-38.

Адрес типографии: ИП «Аруна», г. Алматы, ул. Муратбаева, 75

E d i t o r i n c h i e f

doctor of Economics, professor, academician of NAS RK

I. K. Beisembetov

Deputy editor in chief

Zholtayev G.Zh. prof., dr. geol-min. sc.

E d i t o r i a l b o a r d:

Abakanov T.D. prof. (Kazakhstan)
Abisheva Z.S. prof., academician (Kazakhstan)
Agabekov V.Ye. academician (Belarus)
Aliyev T. prof., academician (Azerbaijan)
Bakirov A.B. prof., (Kyrgyzstan)
Bespayev Kh.A. prof. (Kazakhstan)
Bishimbayev V.K. prof., academician (Kazakhstan)
Buktukov N.S. prof., academician (Kazakhstan)
Bulat A.F. prof., academician (Ukraine)
Ganiyev I.N. prof., academician (Tadjikistan)
Gravis R.M. prof. (USA)
Yergaliev G.K. prof., academician (Kazakhstan)
Zhukov N.M. prof. (Kazakhstan)
Kozhakhmetov S.M. prof., academician (Kazakhstan)
Kontorovich A.Ye. prof., academician (Russia)
Kurskeyev A.K. prof., academician (Kazakhstan)
Kurchavov A.M. prof., (Russia)
Medeu A.R. prof., academician (Kazakhstan)
Muhamedzhanov M.A. prof., corr. member. (Kazakhstan)
Nigmatova S.A. prof. (Kazakhstan)
Ozdoyev S.M. prof., academician (Kazakhstan)
Postolatii V. prof., academician (Moldova)
Rakishev B.R. prof., academician (Kazakhstan)
Seitov N.S. prof., corr. member. (Kazakhstan)
Seitmuratova Ye.U. prof., corr. member. (Kazakhstan)
Stepanets V.G. prof., (Germany)
Humphery G.D. prof. (USA)
Steiner M. prof. (Germany)

News of the National Academy of Sciences of the Republic of Kazakhstan. Series of geology and technology sciences.
ISSN 2518-170X (Online),
ISSN 2224-5278 (Print)
Owner: RPA "National Academy of Sciences of the Republic of Kazakhstan" (Almaty)
The certificate of registration of a periodic printed publication in the Committee of information and archives of the Ministry of culture and information of the Republic of Kazakhstan N 10892-Ж, issued 30.04.2010

Periodicity: 6 times a year
Circulation: 300 copies

Editorial address: 28, Shevchenko str., of. 219, 220, Almaty, 050010, tel. 272-13-19, 272-13-18,
http://nauka-nanrk.kz/geology-technical.kz

© National Academy of Sciences of the Republic of Kazakhstan, 2019

Editorial address: Institute of Geological Sciences named after K.I. Satpayev
69a, Kabanbai batyr str., of. 334, Almaty, 050010, Kazakhstan, tel.: 291-59-38.

Address of printing house: ST "Aruna", 75, Muratbayev str, Almaty

N E W S
OF THE NATIONAL ACADEMY OF SCIENCES OF THE REPUBLIC OF KAZAKHSTAN
SERIES OF GEOLOGY AND TECHNICAL SCIENCES
ISSN 2224-5278
Volume 2, Number 434 (2019), 181 – 190 **https://doi.org/10.32014/2019.2518-170X.53**

UDC 541.128, 547.261, 665.612.3, 662.767, 66.023:088.8, 66.093.673

L. R. Sassykova[1*], S. Sendilvelan[2], K. Bhaskar[3], A. S. Zhumakanova[4], Y. A. Aubakirov[1], T. S. Abildin[1], Sh. N. Kubekova[5], Z. T. Mataeva[6], A. A. Zhakupova[1]

[1]Al-Farabi Kazakh national university, Almaty, Kazakhstan,
[2]Department of Mechanical Engineering, Dr.M.G.R. Educational and Research Institute, University, Chennai, Tamilnadu, India,
[3]Department Automobile Engineering, Rajalakshmi Engineering College, Chennai, India,
[4]JSC "D. V. Sokolsky Institute of Fuels, Catalysis & Electrochemistry", Almaty, Kazakhstan,
[5]Kazakh national research technical university after K. I. Satpayev, Almaty, Kazakhstan,
[6]Kazakhstan engineering tehnological university, Almaty, Kazakhstan,
Satbayev university, Almaty, Kazakhstan.
E-mail: larissa.rav@mail.ru

NORMS OF EMISSIONS OF HARMFUL SUBSTANCES GENERATED FROM VEHICLES IN THE DIFFERENT COUNTRIES OF THE WORLD

Abstract. According data of the World Health Organization (WHO), almost 92% of the population on Earth lives in places with polluted air. The problem of environmental friendliness of cars arose in the middle of the twentieth century, when cars became a mass product. European countries before the others began to apply various environmental standards. Ecological standards existed in separate countries and included various requirements for the content of harmful substances in the exhaust gases of cars. On emissions of harmful substances from stationary sources into the atmosphere Kazakhstan is among the three leaders after Russia and Ukraine (amongst CIS countries). The level of air pollution due to the development of industry and vehicles has increased dozens of times from year to year. The authors of this article have collected and systematized the data published in modern literature sources about ecological norms of emissions generated from cars in different countries (European countries, USA, Japan, India, CIS countries). Obviously that it is necessary to tighten regulatory emissions in a legislative way. It is very important to reduce emissions of NO_2 and particulate matter (soot), to carry out qualitative tests of catalysts in real conditions of the cars exploitation.

Key words: catalyst, exhaust gases, vehicles, ecological norms, emissions.

Introduction. Burning 1 kg of gasoline absorbs from the air 3.5 kg of oxygen, the reaction of oxidation of products of world oil production during the year absorbs about 12 billion tons of oxygen from the atmosphere. Combustion of natural gas produced per year absorbs from the atmosphere more than 11 billion tons of oxygen. It is no accident that in the air of megacities only 17% of oxygen is contained in place of natural 21% [1-4]. Therefore, air pollution causes much more concern than any other type of environmental destruction.

International, intergovernmental and in-country scientific conferences and symposia, meetings and seminars on scientific principles of rational use and conservation of nature are held all over the world. Countries unite their efforts and begin to cooperate in the field of the environment. The enormous scale of the economic activities of the countries of the world, the colossal amount of extraction and processing of natural resources require significant environmental costs in modern conditions [5-9].

The concept of sustainable development proclaimed by the international community is a conceptual base for development the international and national politician in the field of the environmental management and environmental protection considering close interrelation of nature protection activity with

economy and the social sphere. The most important documents of the concept of sustainable development were adopted at the United Nations Conference on Environment and Development, held in 1992 in Rio de Janeiro (CED-92) and at the World Summit on Sustainable Development, held in 2002 in Johannesburg (WSSD- 2002) [10-14].

92% of the population on Earth lives in places with polluted air - these are the data of the World Health Organization [15, 16]. It is associated with about 3 million deaths per year. 90% of them occur in low- and middle-income countries. 2 out of 3 cases occur in South-East Asia and the West-Pacific region. 94% of the diseases that lead to death are non-contagious: mainly cardiovascular and lung diseases. Contaminated air can also become a breeding ground for acute respiratory infections. Vulnerable more often than others are children, women and the elderly [17].

The problem of environmental friendliness of cars arose in the middle of the twentieth century, when cars became a mass product [18-22]. The greatest danger is represented by nitrogen oxides, about 10 times more dangerous than carbon monoxide, the share of toxicity of aldehydes is relatively small and amounts to 4-5% of the total toxicity of exhaust gases. The toxicity of various hydrocarbons is very different. Unsaturated hydrocarbons in the presence of nitrogen dioxide are photochemically oxidized, forming toxic oxygen-containing compounds - components of smog.

The quality of afterburning on modern catalysts is such that the fraction of CO after the catalyst is usually less than 0.1%. Polycyclic aromatic hydrocarbons discovered in gases are strong carcinogens. Among them, bensz(a)pyrene is the most studied, besides it, anthracene derivatives.

European countries, being in a relatively small area, before the others began to apply various environmental standards. They existed in separate countries and included various requirements for the content of harmful substances in the exhaust gases of cars.

Ecological norms of exhaust gases from vehicles. Legislative norms for the emission of harmful gases are constantly being improved, norms are becoming more stringent. The test program varies among the three main legislators: in the US, in Japan and in Europe. In 1988, the UN Economic Commission for Europe introduced a single regulation (the so-called Euro-0) with requirements to reduce emissions of carbon monoxide, nitric oxide and other substances in cars. Once in several years, the requirements became tougher, other states also began to introduce similar standards. In table1 different levels of pollution are shown.

Table 1 – Classification of Pollution by Level

Production level	Annual Mean Concentration Range ($\mu g/m^3$)					
	Industrial, residential, rural and other areas			Ecological Sensitive Area		
	SO_2	NO_2	PM_{10}	SO_2	NO_2	PM_{10}
Low (L)	0-25	0-20	0-30	0-10	0-15	0-30
Moderate (M)	26-50	21-40	31-60	11-20	16-30	31-60
High (H)	51-75	41-60	61-90	21-30	31-45	61-90
Critical (C)	>75	>60	>90	>30	>45	>90

European countries, being in a relatively small area, before the others began to apply various environmental standards. They existed in separate countries and included various requirements for the content of harmful substances in the exhaust gases of cars [23].

Emission standards in the USA. The mechanisms generating photochemical smog were elucidated in the United States at the beginning of the 1950s, at which point the need to control automobile exhaust was recognized. The American Clean Air Act (also called the Muskie Act) was passed in 1970, and even stricter emissions control legislation has followed.

Since 1990, the regulations of various countries and their sub-regions have become increasingly strict, especially such as in California.

The Federal Standard for Car Emissions in the US for passenger cars is divided into three categories: low-emission vehicles (LEV), ultra-low-emission vehicles (ULEV-hybrids) and vehicles with super-low emissions (SULEV-electric vehicles). There are separate requirements for each of the classes.

In the US, there are two regulatory centers: the EPA Environment Agency and the California Air Resources Board. In California the norms are the toughest.

EPA (The United States Environmental Protection Agency) is an agency of the US federal government established to protect the environment and human health, for which it develops and monitors compliance with regulations based on laws, adopted by Congress. The agency was proposed by Richard Nixon and began operating on December 2, 1970. The Agency is managed by an administrator appointed by the president and approved by the Congress. Since February 2017, this position is taken by Scott Pruitt. The administrator of the agency is a member of the US Cabinet. The EPA is headquartered in Washington, with regional offices in each of the 10 regions and 27 laboratories. The Agency conducts an environmental assessment, executes research and engages in educational work. Its job is to monitor the implementation of the adopted standards and norms, some of these responsibilities are delegated to the states. The agency has about 15,000 full-time employees, and also works with many people on a contract basis. In March 2017, the Trump administration proposed to reduce by one-quarter the budget of the Environmental Protection Agency. By 2018, environmental spending will be reduced by 25% - to $ 6.1 billion. Each fifth employee will fall under the reduction. At the same time, Trump guarantees that the project will not endanger the safety of air and water. The cost of the program in 2018 will be $ 29 million. Priority will be the sewage treatment programs, including industrial wastewater, and the modernization of the water supply system [24].

So, regulations in US for diesel engines (figure 1):

Clean Air Act of 1963 - Ist government look into stationary emissions.

Clean Air Act 1970 - Regulation of 6 criteria pollutants such as CO, SO_x, NO_x, Hydrocarbons, ozone and Particulate Matter (PM).

Clean Air Act of 1990-Acid rain control plus 189 secondary pollutants.

Since then, there are numerous periodic reductions.

Ultra-Low Sulfur Diesel (ULSD) mandatory 2007.

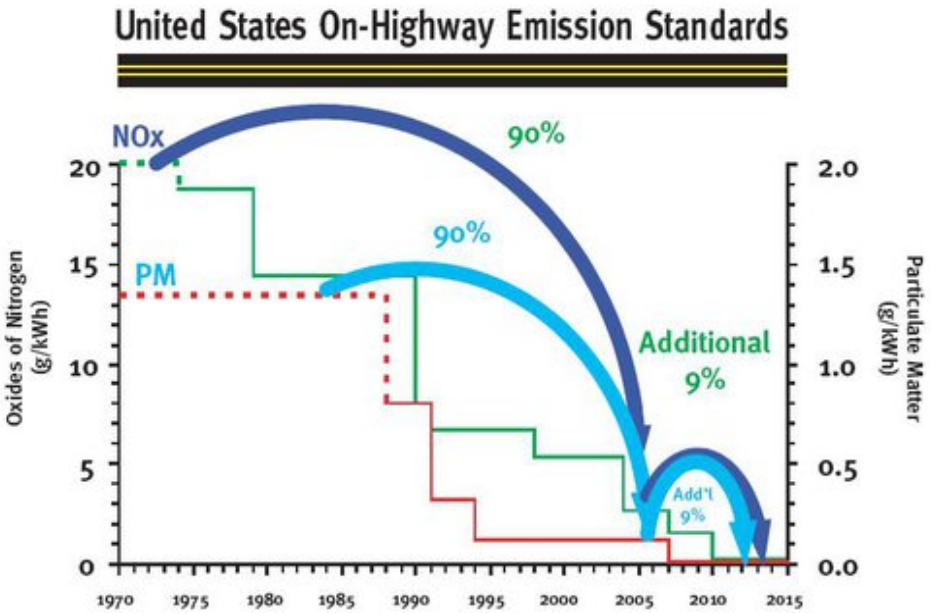

Figure 1 – Regulations in US on diesel engines [25]

Other countries have adopted either European or Japanese norms. For example, Korea and Brazil adopted American standards, and China and India are European.

Euro-fuel standards on fuels. There are standards from Euro-0 to Euro-6.

Euro-0 is an environmental standard that regulates the content of harmful substances in the exhaust gases. It was introduced in the territory of most countries of Europe in 1988. Replaced by the Euro-1 standard in 1992 [26].

It provides emission by petrol engines:
- carbon monoxide (CO) - no more than 11.2 g/(kW·h) (grams per kilowatt-hour);
- hydrocarbons (C_xH_y) - no more than 2.4 g/(kW·h);
- nitrogen oxides (NO_x) - not more than 14.4 g/(kW·h);
- solid particles (particulate matter) - not regulated;
- smoke - not regulated.

Euro-4 introduced in the European Union in 2005 as a replacement for the previous standard, Euro 3. In 2009 it was replaced by a new standard - Euro-5.

Conversion to Euro-4: the procedure for the completion of wheeled vehicles, self-propelled vehicles or small vessels under the ecological standard Euro-4. It is carried out by installing special catalytic converters or filters of technological purification (magnetic, ultrasonic, etc.), which allows to reduce fuel consumption and significantly (more than 50%) to reduce harmful emissions. Such effects are achieved due to changes in fuel quality and a number of its physical parameters.

Euro-5 - the standard is mandatory for all new trucks sold in the EU since October 2008. For passenger cars - from September 1, 2009 [27].

Euro-6 - it was originally assumed that this standard of environmental regulations will come into force in Europe on December 31, 2013. But later its introduction was postponed for 2015. According to its requirements, Euro-6 is close to the current environmental standard EPA10 in the US and the Japanese Post NLT. A new European standard will facilitate the coordinated development of future uniform standards [28].

Table 2 shows the environmental standards for passenger cars (in units of g/km) [23, 25-29].

Table 2 – Environmental standards for passenger cars according to Euro standards (in units of g/ km)

Ecological standard	Carbon monoxide (CO)	Hydrocarbons C_xH_y	Volatile organic compounds	Nitrogen oxide (NO_x)	HC+NO_x	Suspended particles, particulate matter (PM)
For diesel engine						
Euro-1	2.72 (3.16)	–	–	–	0.97 (1.13)	0.14 (0.18)
Euro-2	1.0	–	–	–	0.7	0.08
Euro-3	0.64	–	–	0.50	0.56	0.05
Euro-4	0.50	–	–	0.25	0.30	0.025
Euro-5	0.500	–	–	0.180	0.230	0.005
Euro-6	0.500	–	–	0.080	0.170	0.005
For gasoline engine						
Euro-1	2.72 (3.16)	–	–	–	0.97 (1.13)	–
Euro-2	2.2	–	–	–	0.5	–
Euro-3	2.3	0.20	–	0.15	–	–
Euro-4	1.0	0.10	–	0.08	–	–
Euro-5	1.000	0.100	0.068	0.060	–	0.005
Euro-6	1.000	0.100	0.068	0.060	–	0.005

Regulations in Japan. In Japan, emissions regulations regarding carbon monoxide in car exhaust were first passed in 1966, and regulations similar to the Muskie Act were put in place in 1973 [30]. It's clear that at the time, the Japan regulations were said to be the most severe in the world.

Statistics from the Ministry of the Environment of Japan show that in 2011 transport accounted for 19.6% of CO_2 emissions, and this NO_x (g/km) continues to grow annually [31].

Figure 2 shows the tendencies in regulations of NO_x norms (sum of the NO+NO_2 amounts) during the period of years 1995-2020.

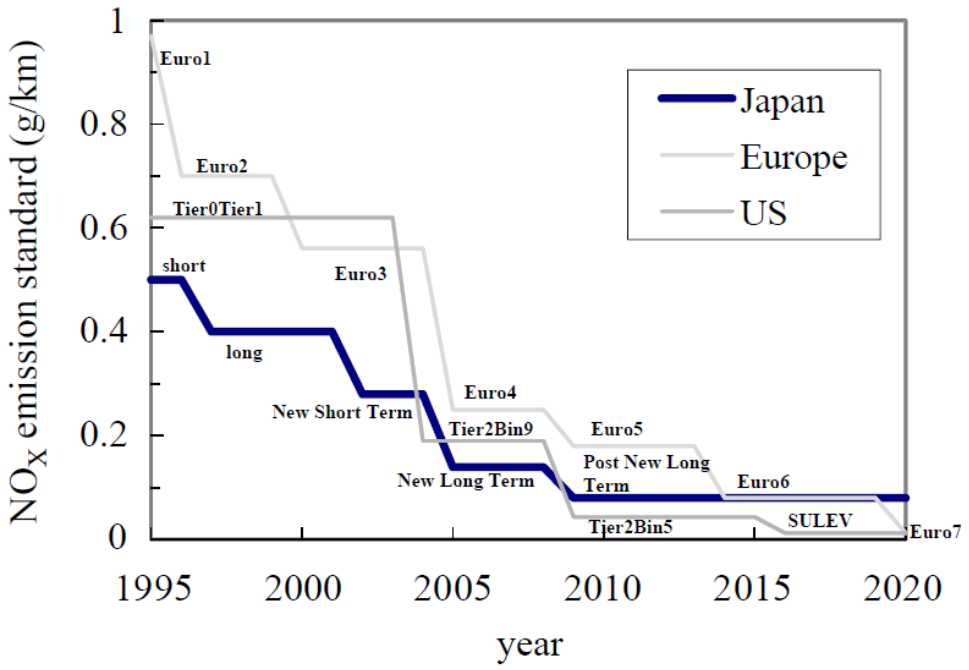

Figure 2 – Comparison of NO_x norms in US, Europe and Japan during 1995-2020 y.y.

Emission standards in India. In order to properly monitor the concentrations of pollutants, the Central Council for Pollution Control in 1984-1985 launched a national air quality monitoring network, which was subsequently renamed the National Air Monitoring Program (N.A.M.P.). The Central Pollution Control Board has identified and revised the National Ambient Air Quality Standards on April 11, 1994 which was notified in Gazette of India, Extra-ordinary Part-II Section 3, sub section (ii), dated May 20, 1994 [32-38].

The vehicle emissions standards were established for the first time in the 1990s when the government, in accordance with the Supreme Court order, introduced European standards in 1999. Later, this was replaced by the Bharat Stage Emission standards. In 1990, the union government adopted a revised law on motor vehicles, according to which emission standards are regulated by the federal government. India has set limits on carbon monoxide emissions (idle) for cars, motorcycles and three-wheeled vehicles with a gasoline engine; emissions of diesel smoke are limited to 75 Hartridge units at full load.

Central pollution control initiated the National Atmospheric Air Quality Monitoring Program (NAAQM) in 1984 with 7 stations in Agra and Anpara. Subsequently, the program was renamed the National Air Quality Monitoring Program (NAMP). Gradually, the air quality monitoring network was strengthened by increasing the number of monitoring stations from 28 to 365 during 1985-2009. The quality of air in the different cities was compared to the corresponding NAAQS (table 3). Exceedence Factor is the ratio of annual mean concentration of a pollutant with that of a respective standard.

Table 3 – Emission standards in India [39-41]

Emission Standard	Implementation (where and when)	RSPM*
India 2000 Based on Euro 1	Nationwide	0.14
Bharat Stage II Based on Euro 2	NCR*, Mumbai, Kolkata, Chennai	0.08
Bharat Stage III Based on Euro 3	NCR+11 cities (Nationwide implementation by 2010)	0.05
Bharat Stage IV Based on Euro IV	NCR+ 13 Cities (Plan for all India implementation by 2017)	0.025
Bharat Stage V	2022 (All India)**	0.005
Bharat Stage VI	2024 and onwards (All India)**	0.0025
* RSPM - Respirable suspended particulate matter. ** As per Saumitra committee recommendation.		

The four air quality categories are:

- Critical pollution (C): if EF is > 1.5;
- High pollution (H): if EF is between 1.0 - <1.5;
- Moderate pollution (M): if EF between 0.5 - <1.0;
- Low pollution (L): when the EF is < 0.5.

In the end of 2012, the Government of India appointed a committee under Saumitra Chaudhri to draft the Auto Fuel Vision Policy road map up to the year 2025.

Environmental standards in countries of CIS. Until the late 1980s in the Soviet Union, problems with exhaust were not as acute as in the US, Japan and Europe. And the reason, paradoxically, was in the low technical level of domestic cars and their small number: with a huge territory in the country produced about a million cars a year, and most engines had a relatively low compression ratio and a correspondingly low NO_x emission of nitrogen oxides that are formed at high temperatures and pressures. In addition, unlike abroad, where tetraethyl lead was added to the gasoline for the sake of increasing the octane number, we did not have an urgent need for this, and the lead content in fuel and, correspondingly, in the exhaust gas was much lower [23, 42, 43].

Nevertheless, work to reduce the toxicity of exhaust gases was carried out quite actively. For example, when the engine brakes, that is, when the CO and CH emissions are particularly large, to reduce the concentration of these components, the fuel supply to the engine must be reduced. For this purpose, NAMI developed the "Cascade" system for carburetors of VAZ, UAZ and ZAZ cars. With the help of the electropneumatic valve, when braking the engine, it blocked fuel access to the cylinder.

Russia follows EU standards for exhaust emissions, although their implementation lags behind for 6-10 years. The first standard, which was officially approved in Russia, was Euro-2. The Euro-2 standard was adopted by the Russian government in the fall of 2005. Sales of gasoline AI-95 Euro-2 in Russia are prohibited from January 1, 2011. In Kazakhstan this standard was adopted on July 15, 2009.

All vehicles manufactured in Russia or imported into Russia, starting from January 1, 2008, must meet the requirements of the Euro-3 standard. In Kazakhstan, the standard was adopted on January 1, 2013, in Azerbaijan - on July 1, 2012.

Since 2014 in Russia for imported cars is the Euro-5 standard. Since 2016, it has been applied to all cars produced. In Russia, the Euro-5 standard applies to all imported cars from January 1, 2016. The standards of Euro-5 and Euro-6 have the same norms for maximum emissions of harmful substances for cars with a gasoline engine. But for cars that run on diesel fuel, the Euro-5 standard has less stringent requirements: nitrogen oxide (NO_x) should not exceed 0.18 g/km, and hydrocarbons and oxides of nitrogen ($HC + NO_x$) - 0.23 g/km.

In Kazakhstan, the Euro-4 ecological standard was introduced by the Decree of the Government of the Republic of Kazakhstan No. 97 of February 6, 2013 for imported cars from July 1, 2013 and for manufactured cars - from January 1, 2014.

Standard Euro-4 began operating in Kazakhstan in May 2015.

The state priorities in the "Strategy-2030" of the Republic of Kazakhstan include: environmental safety, rational use of natural resources, environmental well-being of citizens and some problems of social ecology. The response to the first environmental crises and catastrophes was expressed in the "Environmental Law" of 1997 [44].

The territory of Kazakhstan due to its geographical position and climatic conditions is subject to many natural disasters - environmental risks affecting the economy of the republic. The problem of air pollution, especially in large industrial centers of Kazakhstan is a very serious challenge.

According to the World Meteorological Organization, the destruction of the ozone layer over the past 25 years has been 10%. Over Kazakhstan, where observations of the total ozone content have been carried out since 1973 at five stations, the thickness of the ozone layer has been reduced by 5-7 %. On some days, lower values of ozone in the atmosphere may be observed, which causes an increase in the doses of ultraviolet radiation, which are extremely dangerous for humans. Kazakhstan ratified the Vienna Convention for the Protection of the Ozone Layer, and the Montreal Protocol to the Vienna Convention. According to the "Strategy 2030", the Government of the Republic of Kazakhstan, the Concept for Environmental

Safety takes possible measures to protect the ozone layer and limit consumption of ozone-depleting substances. An integrated approach is needed to develop a state system of measures to adapt to changing natural and climatic conditions, based on the achievements of advanced science and technology, on the experience of other states aimed at reducing the vulnerability of natural and human systems to existing and expected climate changes [45-49].

Modern environmental problems of the Republic of Kazakhstan are complex, diverse and territorially differentiated. On emissions of harmful substances from stationary sources into the atmosphere Kazakhstan is among the three leaders after Russia and Ukraine (amongst CIS countries). In the industry of Kazakhstan, the level of use of toxic substances is at a low level. Pollution of the air basin by toxic emissions of enterprises leads to high incidence of the population, low life expectancy and degradation of the surrounding nature. The level of air pollution due to the development of industry and vehicles has increased dozens of times from year to year [50-52].

Among all the ways to reduce the toxicity of man-made emissions into the atmosphere, catalytic oxidation of harmful components is one of the promising methods of improving the atmosphere.

It is necessary to emphasize the fact that despite the large number of studies on the catalytic purification of diesel exhaust gases from NO_x impurities and individual advances, for example, achieved using Cu, Fe and Co-containing zeolites, the problem of NO_x purification is still not solved. A sufficiently efficient and selective catalyst was not found to ensure the decomposition or reduction of NO_x. In recent years, the attention of researchers has been directed toward the creation of cyclic systems in which, in the first stage, NO_x is absorbed by the main adsorbent, for example BaO, and in the second stage decomposition or reduction of the absorbed NO_x occurs. Usually, noble metals are used in combination with alkaline earth oxide deposited on Al_2O_3 or CeO_2. Under the process conditions, unwanted reactions can occur: sulfur poisoning, thermal sintering to form metal crystals, and reaction of BaO with the carrier to form $BaAl_2O_4$ and $BaCeO_3$.

There is the problem of “cold start” of ICE (Internal Combustion Engines), in which catalysts not heated up to 300ºC do not reach the set operating mode and the composition of the exhaust gas engine is 60% more toxic than when operating under the load [53-56].

Conclusions. In general, developed countries rely on similar standards for the content of harmful substances in the exhaust gases. The European Union in this regard is a kind of authority: it most often updates these indicators and implements strict legal regulation. Other countries follow this trend and also update emission standards. For example, the Chinese program is completely equivalent to the Euro: the current China-5 corresponds to the Euro-5.

CIS countries are also trying to keep up with the EU, but at the moment a standard is being implemented that operated in European countries until 2015.

The cleaning of gas polluted by exhaust gases from motor vehicles and chemical industries is a scientific, technical and social problem. The problem of NO_x purification is still not solved. A sufficiently efficient and selective catalyst was not found to ensure the decomposition or reduction of NO_x.

The applicability of the latest catalytic systems requires the presence of sophisticated electronic control systems for the combustion process in the engine, which is interrelated with a constant rapid analysis of the quality of the neutralizer and the composition of the exhaust gases.

The enormous scale of the economic activities of the countries of the world, the colossal amount of extraction and processing of natural resources require significant environmental costs in modern conditions.

Indeed, it is necessary to tighten regulatory emissions in a legislative way. Very important is the need to reduce emissions of NO_2 and particulate matter (soot), conducting qualitative tests of catalysts in real conditions for obtaining more complete information on the operation of catalytic converters.

Л. Р. Сасыкова[1*], С. Сендилвелан[2], К. Бхаскар[3], А. С. Жұмақанова[4], Е. А. Әубәкіров[1], Т. С. Абильдин[1], Ш. Н. Кубекова[5], З. Р. Матаева[6], А. А. Жакупова[1]

[1]Әл-Фараби атындағы Қазақ ұлттық университеті, Алматы, Қазақстан,
[2]Department of Mechanical Engineering, Dr. M.G.R Educational and Research Institute, University, Chennai, India,
[3]Department Automobile Engineering, Rajalakshmi Engineering College, Chennai, India,
[4]Д. В. Сокольский атындағы жанармай, катализ және электрохимия институты АҚ, Алматы, Қазақстан,
[5]Қ. И. Сәтбаев атындағы Қазақ ұлттық техникалық зерттеу университеті, Алматы, Қазақстан,
[6] Институт химических и биологических технологий КазНИТУ им. К. И. Сатпаева, Алматы, Казахстан

ӘРТҮРЛІ ӘЛЕМ ЕЛДЕРІНДЕ АВТОМОМОБИЛДЕН ШЫҒАРЫЛАТЫН ЗИЯНДЫ ЗАТТАРДЫҢ МӨЛШЕРІ

Аннотация. Бүкіләлемдік денсаулық сақтау ұйымының мәліметі бойынша жер бетіндегі тұрғындардың 92% ауасы ластанған жерлерде тұрады. Көліктен туындайтын экологиялық ахуал жиырмасыншы ғасырдың ортасында әртүрлі маркалы машиналардың көптеп шығарылуымен туындады. Басқа елдерге қарағанда Еуропадағы мемлекеттер әртүрлі экологиялық стандартты қолдана бастады. Экологиялық талаптар жекелеген елдерде ғана болды және автомобилден шығарылатын улы заттардың құрамы мен мөлшеріне байланысты әртүрлі талаптар қойылды. Атмосфераға тұрақты көздерден шығарылатын улы заттар мөлшері бойынша Қазақстан ТМД көлемінде Ресей мен Украинадан кейін үштікке кіреді. Ауаның ластану деңгейі жыл сайын өндірістің және көлік құралдарының дамуы есебінен ондаған есе артуда. Бұл мақала авторлары әртүрлі елдерде (Еуропа мемлекеттері, АҚШ, Жапония, Индия, ТМД елдері) автомобилден шығарылатын зиянды заттардың мөлшері туралы қазіргі әдебиеттерде жарияланған мәліметтерді жинақтап, талдап топтастырған. Яғни шығарылатын зиянды заттардың мөлшеріне қойылатын талапты заңды құқықтық нормамен реттеу керек. Азот оксидтерінің және қатты бөлшектердің (күйе) мөлшерін төмендету, автомобилді пайдалану кезінде катализаторды нақты жағдайда сынауды сапалы жүргізу маңызды.

Түйін сөздер: катализатор, шығарылатын газдар, көлік құралдары, экологиялық талаптар, улы шығарылымдар.

Л. Р. Сасыкова[1*], С. Сендилвелан[2], К. Бхаскар[3], А. С. Жумаканова[4], Е. А. Аубакиров[1], Т. С. Абильдин[1], Ш. Н. Кубекова[5], З. Р. Матаева[6], А. А. Жакупова[1]

[1]Казахский национальный университет им. аль-Фараби, Алматы, Казахстан,
[2]Department of Mechanical Engineering, Dr. M.G.R Educational and Research Institute, University, Chennai, India,
[3]Department Automobile Engineering, Rajalakshmi Engineering College, Chennai, India,
[4]АО «Институт топлив, катализа и электрохимии им. Д. В. Сокольского», Алматы, Казахстан,
[5] Казахский национальный исследовательский технический университет им. К. И. Сатпаева, Алматы, Казахстан,
[6] Институт химических и биологических технологий КазНИТУ им. К. И. Сатпаева, Алматы, Казахстан

НОРМЫ ВЫБРОСОВ ВРЕДНЫХ ВЕЩЕСТВ, ВЫРАБАТЫВАЕМЫХ АВТОМОБИЛЯМИ, В РАЗНЫХ СТРАНАХ МИРА

Аннотация. По данным Всемирной организации здравоохранения (ВОЗ), почти 92% населения Земли живет в местах с загрязненным воздухом. Проблема экологичности автомобилей возникла в середине двадцатого века, когда машины стали массовым продуктом. Европейские страны раньше других стран начали применять различные экологические стандарты. Экологические нормы существуют в отдельно взятых странах и включают различные требования к содержанию вредных веществ в выхлопных газах автомобилей. По выбросам вредных веществ из стационарных источников в атмосферу Казахстан входит в тройку лидеров после России и Украины (среди стран СНГ). Уровень загрязнения воздуха за счет развития промышленности и транспортных средств увеличивается из года в год в десятки раз. Авторами этой статьи были собраны и систематизированы данные, опубликованные в современной литературе об экологических нормах выбросов, вырабатываемых автомобилями, в разных странах (Европейские страны, США, Япония, Индия, страны СНГ). Очевидно, что необходимо ужесточить нормативные выбросы законодательным путем. Очень важно снизить выбросы оксидов азота и твердых частиц (сажи), провести качественные испытания катализаторов в реальных условиях эксплуатации автомобилей.

Ключевые слова: катализатор, выхлопные газы, транспортные средства, экологические нормы, выбросы.

Information about authors:

Larissa R. Sassykova, Ph.D., Ass. Prof. of the Department of Physical Chemistry, Catalysis and Petrochemistry, Faculty of Chemistry and Chemical Technology, al-Farabi KazNU; larissa.rav@mail.ru; https://orcid.org/0000-0003-4721-9758

Subramanian Sendilvelan, Prof., Dean, Department of Mechanical Engineering, Dr.Sc. M.G.R Educational and Research Institute, University, Chennai, India (Hirsch index 12); sendilvelan.mech@drmgrdu.ac.in; http://orcid.org/0000-0003-1743-4246

Bhaskar Kathirvelu, Prof., Head of Department Automobile Engineering, Rajalakshmi Engineering College, Chennai - 602 105, India (Hirsch index 9); https://orcid.org/0000-0002-3681-4474

Ardak S. Zhumakanova, Ph.D., Scientific secretary of JSC "D. V. Sokolsky Institute of Fuels, Catalysis and Electrochemistry"; zhumakanova62@mail.ru; https://orcid.org/0000-0003-4983-4199

Yermek A. Aubakirov, Prof., Head of the Department of Physical Chemistry, Catalysis and Petrochemistry, Faculty of Chemistry and Chemical Technology, al-Farabi KazNU; miral.64@mail.ru; https://orcid.org/0000-0001-5405-4125

Tleutai S. Abildin, Prof. of the Department of Physical Chemistry, Catalysis and Petrochemistry, Faculty of Chemistry and Chemical Technology, al-Farabi KazNU; abildin54@mail.ru; https://orcid.org/0000-0002-2710-7233

Sholpan N. Kubekova, Associated professor, Candidate (Ph.D.) of Technical sciences, Department of Chemical Technology of Inorganic Substances, Institute of Chemical and Biological Technologies, KazNTRU after K. I. Satpayev, Almaty, Kazakhstan; kubekova_10@mail.ru; https://orcid.org/0000-0001-8665-9970

Zayra T. Mataeva, Ph.D., Dean of the Engineering and Technology Faculty, Kazakhstan Engineering Technological University; zaira.mataeva@mail.ru; https://orcid.org/0000-0002-5025-4995

Aiman A. Zhakupova, Ph.D., Ass. Prof. of the Department of Recreational Geography and Tourism of the Faculty of Geography and Nature Management, al-Farabi KazNU; aiman.zhakupova15@gmail.com; https://orcid.org/0000-0001-7223-1172

REFERENCES

[1] Bahadori A. (2014). Pollution Control in Oil, Gas and Chemical Plants. Springer, New York. ISBN 9783319012346. (In Eng.).

[2] Sassykova L.R. (2018). Technogenic emissions into the atmosphere: impact on the environment and neutralization by catalytic methods. Almaty: Qazaq university. ISBN 978-601-04-3440-0. (In Eng.).

[3] Verheggen B. (2012). Global Warming Debate. in: Encyclopedia of Global Warming & Climate Change. Edit. S. George Philander. DOI 10.4135/9781452218564.n314. (In Eng.).

[4] Meinshausen M., Meinshausen N., Hare W., Raper S.C.B., Frieler K., Knutti R., Frame D.J., Allen M.R. (2009). Greenhouse-gas emission targets for limiting global warming to 2^{o}C // Nature. 458: 1158-1163. (In Eng.)

[5] The Global Air Pollution Crisis. http://greencleanguide.com/the-global-air-pollution-crisis/ (In Eng.).

[6] Lefeber R. (2006–2007). Non-compliance procedures and mechanisms and the effectiveness of international environmental agreements, 303. DOI 10.1007/978-90-6704-557-5_18. (In Eng.).

[7] Krylov O.V., Tretyakov V.F. (2007). Catalytic purification of automobile exhaust [Kataliz v promyshlennosti]. 4: 44-54. (In Rus.).

[8] Core Writing Team, Pachauri R.K., Meyer L.A. (2014). IPCC 2014 Climate Change: Synthesis Report // IPCC. Geneva, Switzerland, 151. (In Eng.).

[9] Technical bulletin. (1999). Nitrogen oxides (NO_x): Why and how they are controlled, U.S. Environmental protection agency. Research triangle park, North Carolina: Office of air quality planning and standards. 21-43. (In Eng.).

[10] https://ru.wikipedia.org/wiki/ (In Eng.).

[11] https://cop23.unfccc.int/ (In Eng.).

[12] http://bellona.ru/2007/05/08/kiotskij-protokol-k-ramochnoj-konvents/ (In Eng.).

[13] Kyoto Protocol. http://unfccc.int/kyoto_protocol/items/2830.php (In Eng.).

[14] The UNFCCC website www.unfccc.int. (In Eng.).

[15] http://www.cleanairpower.com/emissions.html (In Eng.).

[16] http://www.who.int/mediacentre/news/releases/2016/air-pollution-estimates/en/ (In Eng.).

[17] http://unfccc.int/resource/docs/convkp/kpeng.pdf (In Eng.).

[18] Bhaskar K., Sassykova L.R., Prabhahar M., Sendilvelan S. (2018). Effect of dimethoxy-methane ($C_3H_8O_2$) additive on emission characteristics of a diesel engine fueled with biodiesel // International Journal of Mechanical and Production Engineering Research and Development. 8: 399-406. (In Eng.).

[19] Sendilvelan S., Bhaskar K. (2017). Aluminium phosphate supported copper phosphate catalytic converter to reduce nitrous oxides and particulate matter from engine emission // Oriental J Chem. 33: 2111-2117. (In Eng.).

[20] Sendilvelan S., Bhaskar K. (2017). Chemical and experimental analysis of fumigation process to reduce emission without affecting the performance of an engine // Rasayan Journal of Chemistry. 10: 111-116. (In Eng.).

[21] Sassykova L.R., Nalibayeva A., Gil'mundinov Sh.A. (2017). Development of technology of synthesis of catalysts for neutralization of emissions of the industry and motor transport // Bulg. Chem. Comm. 49: 583-588. (In Eng.).

[22] Sassykova L., Nalibayeva A. (2018). Development and testing of catalysts on metal block carriers for exhaust gases neutralization // Journal of Chemical Technology & Metallurgy. 53: 289-295. (In Eng.).

[23] Norms of emissions of harmful substances by cars in the world (2017). Spravka, Arguments and Facts, http://www.aif.ru/dontknows/file (In Rus.).

[24] https://www.epa.gov/history (In Eng.).
[25] Diesel Engine Exhaust Aftertreatment Systems. Nick Molzahn. CBE 555. Presentation. (In Eng.).
[26] Johann Dueck J., Tatayeva R., Baymanova A., Bakeshova Z., Kapsalyamov B. (2018). Biological treatment of waste water: theoretical background and experimental research // News of the National Academy of Sciences of the Republic of Kazakhstan. Series of Chemistry AND Technology. 432: 16-22. (In Eng.). https://doi.org/10.32014/2018.2518-1491.21.
[27] https://ru.wikipedia.org/wiki/Евро-5. (In Rus.).
[28] https://ru.wikipedia.org/wiki/Евро-6. (In Rus.).
[29] Ekologicheskiye standarty Yevrosoyuza dlya avtomobiley. Spravka. https://ria.ru/eco/20090901/183291397.html. (In Rus.).
[30] Toshiyuki T. (2013). Studies on NO_x purification catalysts under excess oxygen conditions. Dissertation, Kyoto University. DOI: 10.14989/doctor.r12770. (In Eng.).
[31] National Greenhouse Gas Inventory Report of JAPAN. (2012). Ministry of the Environment, Japan. (In Eng.).
[32] http://www.indiaenvironmentportal.org.in/files/StudyofExhaustGases.pdf (In Eng.).
[33] Vehicular Pollution and Emission Standards in India. http://greencleanguide.com/vehicular-pollution-and-emissions-standards-in-india/ (In Eng.).
[34] Indian Vehicle Emission Standards. http://greencleanguide.com/tag/air-pollution/ (In Eng.).
[35] National ambient air quality. Status & trends in India-2010 (2012) National ambient air quality monitoring. NAAQMS/ 35 /2011-2012. Central pollution control board. Ministry of Environment & Forests. (In Eng.).
[36] Sharpe B., Delgado O. (2016). Engine technology pathways for heavy-duty vehicles in India. Working paper 2016-6. International Council on clean transportation. (In Eng.).
[37] Sendilvelan S., Jeyachandran K., Bhaskar K. (2001). Experimental investigation of emission control from spark-ignition engine using electrically heated catalyst // SAE Technical Paper. 2001-01-2000. DOI 10.4271/2001-01-2000. (In Eng.).
[38] Ganesan M., Sendilvelan S. (2017). Experimental investigation of cold start emission using dynamic catalytic converter with pre-catalyst and hot air injector on a multi cylinder spark ignition engine // SAE Technical Paper. 2017-01-2367. DOI 10.4271/2017-01-2367. (In Eng.).
[39] http://cpcb.nic.in/Vehicular_Exhaust.php (In Eng.).
[40] Tungatarova S.A., Xanthopoulou G., Kaumenova G.N., Zhumabek M., Baizhumanova T.S., Grigorieva V.P., Komashko L.V., Begimova G.U. (2018). Development of composite materials by combustion synthesis method for catalytic reforming of methane to synthesis gas // News of the National Academy of Sciences of the Republic of Kazakhstan. Series of Chemistry and Technology. 432: 6-15. (In Eng.). https://doi.org/10.32014/2018.2518-1491.20.
[41] Auto Fuel Vision and Policy 2025. (2014). Report of The Expert Committee. Govt. of India May 2014. (In Eng.).
[42] Faiz A., Weaver Ch.S., Walsh M.P. (1996). Air pollution from motor vehicles. Standards and technologies for controlling emissions, Washington, The World Bank, D.C. (In Eng.).
[43] https://www.nkj.ru/archive/articles/14312/ (In Eng.).
[44] Nazarbayev N.A. (2012). Socio-economic modernization is the main vector of Kazakhstan's development // Message of the President of the Republic of Kazakhstan to the people of Kazakhstan. Vecherniy Almaty. 28.01.2012. (In Rus.).
[45] Sassykova L.R. (2017). Development of catalysts for the hydrogenation of the aromatic ring in gasolines // Chemical and biochemical engineering quarterly. 31: 447-453. (In Eng.).
[46] Lee C.S., Lee K.H., Kim D.S. (2003). Experimental and numerical study on the combustion characteristics of partially premixed charge compression ignition engine with dual fuel // Fuel. 82: 553-60. DOI 10.1016/S0016-2361(02)00319-8. (In Eng.).
[47] Prabhahar M., Sendilvelan S., Sassykova L.R. (2018). Studies on pongamia oil methyl ester fueled direct injection diesel engine to reduce harmful emissions // Indian J. Environmental Protection. 38: 269-277. (In Eng.).
[48] Baiseitov D.A., Tulepov M.I., Sassykova L.R., Gabdrashova Sh.E., Magazova A.N., Dalelkhanuly O., Kudyarova Zh.B., Mansurov Z.A. (2017). Catalytic hydrogenation of coal of the kazakhstan fields in presence of polymers // Bulg. Chem. Comm. 49: 600-607. (In Eng.).
[49] Sassykova L., Bunin V., Nalibayeva A., Nurakhmetova M. (2018). Synthesis of catalysts on the metal block carriers and testing their effectiveness in the real conditions of operation // J. Chem. Technol. Metall. 53: 537-542. (In Eng.).
[50] Baiseitov D.A., Tulepov M.I., Tursynbek S., Sassykova L.R., Nazhipkyzy M., Gabdrashova Sh.E., Kazakov Y.V., Pustovalov I.O., Abdrakova F.Y., Mansurov Z.A., Dalton A.B. (2017). Processing of the bottomhole zones of oil wells with use of the carbon nanomaterials // Rasayan J. Chem. 10: 344-348. (In Eng.).
[51] Baiseitov D., Tulepov M., Sassykova L., Gabdrashova Sh., Kudaibergenov K., Mansurov Z. (2017). Physicomechanical properties of petrosorbents of the phytogenesis // Rev. Roum. Chim. 62: 249-253. (In Eng.).
[52] Akhmedzhanov T.K., Abd Elmaksoud A.S, Baiseit D.K, Igembaev I.B (2012). Chemical properties of reservoirs, oil and gas of Kashagan field, southern part of pre-Caspian depression // Kazakhstan, Int. J. Chem. Sci. 10: 568-578. (In Eng.).
[53] Yao M., Zheng Z., Liu H. (2009). Progress and recent trends in homogeneous charge compression ignition (HCCI) engines // Prog. Energy Combust. Sci. 35: 398-437. DOI 10.1016/j.pecs.2009.05.001. (In Eng.).
[54] McGrath M. (2017). Four major cities move to ban diesel vehicles by 2025. http://www.bbc.com/news/science-environment-38170794. (In Eng.).
[55] Bhaskar K., Sendilvelan S., Sassykova L.R. (2018). Effect of premix and exhaust gas recirculation on the emission characteristics of biodiesel fueled engine // News of the National Academy of Sciences of the Republic of Kazakhstan. Series of Geology and Technical Sciences. 428: 6-17. https://doi.org/10.32014/2018.2518-170X. (In Eng.).
[56] Kumar B.R., Saravanan S. (2015). Effect of exhaust gas recirculation (EGR) on performance and emissions of a constant speed DI diesel engine fueled with pentanol/diesel blends // Fuel. 160:217-26. DOI 10.1016/j.fuel.2015.07.089. (In Eng.).

Publication Ethics and Publication Malpractice
in the journals of the National Academy of Sciences of the Republic of Kazakhstan

For information on Ethics in publishing and Ethical guidelines for journal publication see http://www.elsevier.com/publishingethics and http://www.elsevier.com/journal-authors/ethics.

Submission of an article to the National Academy of Sciences of the Republic of Kazakhstan implies that the described work has not been published previously (except in the form of an abstract or as part of a published lecture or academic thesis or as an electronic preprint, see http://www.elsevier.com/postingpolicy), that it is not under consideration for publication elsewhere, that its publication is approved by all authors and tacitly or explicitly by the responsible authorities where the work was carried out, and that, if accepted, it will not be published elsewhere in the same form, in English or in any other language, including electronically without the written consent of the copyright-holder. In particular, translations into English of papers already published in another language are not accepted.

No other forms of scientific misconduct are allowed, such as plagiarism, falsification, fraudulent data, incorrect interpretation of other works, incorrect citations, etc. The National Academy of Sciences of the Republic of Kazakhstan follows the Code of Conduct of the Committee on Publication Ethics (COPE), and follows the COPE Flowcharts for Resolving Cases of Suspected Misconduct (http://publicationethics.org/files/u2/New_Code.pdf). To verify originality, your article may be checked by the Cross Check originality detection service http://www.elsevier.com/editors/plagdetect.

The authors are obliged to participate in peer review process and be ready to provide corrections, clarifications, retractions and apologies when needed. All authors of a paper should have significantly contributed to the research.

The reviewers should provide objective judgments and should point out relevant published works which are not yet cited. Reviewed articles should be treated confidentially. The reviewers will be chosen in such a way that there is no conflict of interests with respect to the research, the authors and/or the research funders.

The editors have complete responsibility and authority to reject or accept a paper, and they will only accept a paper when reasonably certain. They will preserve anonymity of reviewers and promote publication of corrections, clarifications, retractions and apologies when needed. The acceptance of a paper automatically implies the copyright transfer to the National Academy of Sciences of the Republic of Kazakhstan.

The Editorial Board of the National Academy of Sciences of the Republic of Kazakhstan will monitor and safeguard publishing ethics.

Правила оформления статьи для публикации в журнале смотреть на сайте:

www:nauka-nanrk.kz

ISSN 2518-170X (Online), ISSN 2224-5278 (Print)

http://www.geolog-technical.kz/index.php/en/

Верстка *Д. Н. Калкабековой*

Подписано в печать 12.04.2019.
Формат 70x881/8. Бумага офсетная. Печать – ризограф.
15,2 п.л. Тираж 300. Заказ 2.

Национальная академия наук РК
050010, Алматы, ул. Шевченко 28, т. 272-13-19, 272-13-18