Study of the possible causes of climate change on the planet and ways to solve the problem

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Abstract. A possible cause of climate change on the planet is the "greenhouse" effect. The opinions of scientists and experts on the issue of the "greenhouse" effect on the planet and its consequences were divided into diametrically opposed ones: 1) there is a "greenhouse" effect, 2) there is no "greenhouse" effect. Despite the contradictory views on the "greenhouse" effect, it can be stated that the consequences of an increase in the average annual temperature of the air basin and the marine oceanic environment are very negative and predictably catastrophic. We have carried out an analysis and computational studies over the past 60 years, characterized by the most intensive consumption of hydrocarbon raw materials of a non-renewable nature, by the accumulation of carbon dioxide, a marker of the "greenhouse" effect. From the results of the studies carried out, a conclusion suggests itself about the congruence of the growth of anthropogenic carbon dioxide emissions in the air basin and the increase in the average annual temperature of the air basin. There are ways, it is more difficult to make a decision on a planetary scale. The examples of the implementation of research work to reduce the emission of components of "greenhouse" gases in marine transport, which will solve the two-vector task - to increase the economic efficiency of sea freight and ensure the environmental safety of sea freight.

Key words: "greenhouse" effect, man-made systems, marine transport, carbon dioxide, temperature, marine, oceanic environment.

Introduction.

The technogenic systems, in particular marine transport, are the basic «suppliers» of components of «greenhouse» gases, such substances and connections as dioxide of carbon, hydrocarbons, nitrous oxide, organic mineral dust, soot, pairs of water behave to that.

Opinions of scientists and experts through question of planetary «greenhouse» effect are diametrically opposite. And it, in our view, under itself has basis. Really, to answer a simple question, whether there is a «greenhouse» effect on a planet or he is not present, necessary to have the reliable materials got as a result of research works. To conduct experiments in the global scale of planet and space in the direction of study of «greenhouse» effect on the modern

stage is not possible. Therefore this work is conducted on the offered hypothetical models. The methods of mathematical design, on the basis of that preferentially drawn conclusion about of presence or nonpresence of «greenhouse» effect on Earth, are used in calculation researches. A lack of any offered models of «greenhouse» effect is the absence and/or impossibility of verification of them on adequacy in the real terms of experiment on a planet and in space.

Analysis of publications of the examined question in fact.

The idea of the mechanism of the "greenhouse" effect was first outlined in 1827 by Joseph Fourier in the article "Note on the temperatures of the globe and other planets", in which he considered various mechanisms of the formation of the Earth's climate, while he considered them as factors affecting the overall heat balance Earth, (heating by solar radiation, cooling due to radiation, internal heat of the Earth), and factors affecting heat transfer and temperatures of climatic zones (thermal conductivity, atmospheric and oceanic circulation).

In works [1,2] the detailed analysis over of possible reasons of origin and consequences of «greenhouse» effect is brought.

Scientists from the Californian University in Irwine (USA) reported about the threat of flood for 400 million persons from a rise in temperature, «greenhouse» effect [3].

The content of carbon dioxide in the Earth's atmosphere in August 2019 increased by three points relative to the same indicator in 2018, which means that humanity cannot reduce CO_2 emissions into the atmosphere and slow down global warming, said the National Aeronautics and Space Administration (NASA, USA) [4].

In works [5-7] scientists propose to spray aerosols into the atmosphere of the air basin so as to reduce warming by 50%.

As a comment of authors of this article to work [5-7]:

1) from where to take in the enormous amounts of planetary scale dioxide of sulphur as a protective aerosol?

2) dioxide of sulphur in the stratospheric layer of atmosphere will be exposed to oxidization by an active oxidant by ozone to the sulphuric anhydride, and sulphuric anhydride at co-operating with the pairs of water, contained in atmospheric air, will result in formation of sulphuric acid.

The transport sector accounted for 22% of global carbon dioxide emissions in 2010 [8,9] , including the shipping sector in 2013 accounting for 2.2% of global CO_2 emissions compared to 2.7% of CO_2 emissions in 2008 (IMO, 2014).

In works [3,10] materials on carbon dioxide emissions from public transport are given: in Sydney (Australia), the level of carbon dioxide emissions per passenger-kilometer was, g: 188 for an average car, 120 for a bus, 105 for a train ride, 171-by light rail. CO_2 emissions from each chain were approximated by the sum of emissions from all stages of the trip.

Results - one cannot do without reducing technogenic (manmade systems) emissions of

components of "greenhouse" gases, one cannot solve the global problem of climate warming on planet Earth[11-13].

Formulation of the problem. By us, in order of discussion, for the last 60 years an analysis , calculation researches, is conducted on the accumulation of carbon dioxide - basic component of «greenhouse» gases on a planet[14]. This period of time was accepted coming from that exactly he is characterized by the most intensive consumption of hydrocarbon raw material of unrenewable character (oil, natural gas, coal, slates) and, accordingly, most emission of dioxide of carbon in an atmosphere and environment. The results of researches are shown on a figure 1.

The dynamics of an intensive increase in the total concentration of carbon dioxide in the environment (Curve 1, Fig. 1) is fully consistent with the intensive consumption of hydrocarbons over the same period of time. Curve 2 (Fig. 1) characterizes the growth dynamics of the concentration of carbon dioxide in the atmospheric air, which includes two sources of carbon dioxide formation - anthropogenic (predominant) and natural (Curve 4, Fig. 1). We had found that curve 2 (increasing of CO2 concentration in the atmospheric air) and curve 3 (average annual increasing of atmospheric temperature over the same period of time) are practically parallel (congruent), which indicates that the accumulation of CO_2 in atmospheric air is related to the average annual increasing of atmospheric air temperature. And this, in turn, determines the role of carbon dioxide as the main component of "greenhouse" gases that stimulate the "greenhouse" effect, leading to a warming of the climate on Planet.

Interesting, in our opinion, is the nature of the change in the natural concentration of CO_2 in the atmospheric air, why there is a monotonic increase in the concentration of CO_2 over the analyzed period of time.. Excess natural carbon dioxide accumulates in the atmospheric air, which is consistent with the course of curve 4 (Fig. 1).

It should be noted that the results of computational and analytical calculations carried out by us [14] correspond to the data on the accumulation of carbon dioxide obtained by Japanese researchers (Main Meteorological Administration of Japan, NHK TV channel). The concentration of carbon dioxide in the atmosphere around Japan has become the highest during the observation period (2020-2021), which is carried out at three points in the northeast of the island of Honshu and on two remote islands in the southwest and east of Japan. The average indicators for 2020 were, respectively, 416.3 ppm, 417.2 ppm, 414 ppm. This is the highest CO_2 level ever recorded since 1987. Meteorologists record a tendency towards an increase in the concentration of CO_2 in the atmosphere. This is despite the decrease in CO_2 emissions amid a decrease in production in Japan due to the coronavirus. Scientists note that the concentration of CO_2 in the Earth's atmosphere is constantly increasing, and this leads to an increase in temperature and climate change. It should be noted that the practical data obtained recently by Japanese researchers sufficiently and fully correspond to the data obtained by us by calculation and analytical methods,

as in terms of the CO_2 accumulation figures - 414-417.2 ppm. and according to the general conclusion about the interrelation of the average temperature of atmospheric air and the accumulation of CO_2 in the atmosphere (Fig. 1) [15].

Based on the foregoing about the technogenic prerequisites for the emergence and intensification of the "greenhouse" effect, it is possible to propose a "scenario" of the impact of planetary climate change on the environment, ecosystems, biota, biome, biosphere, and humans.

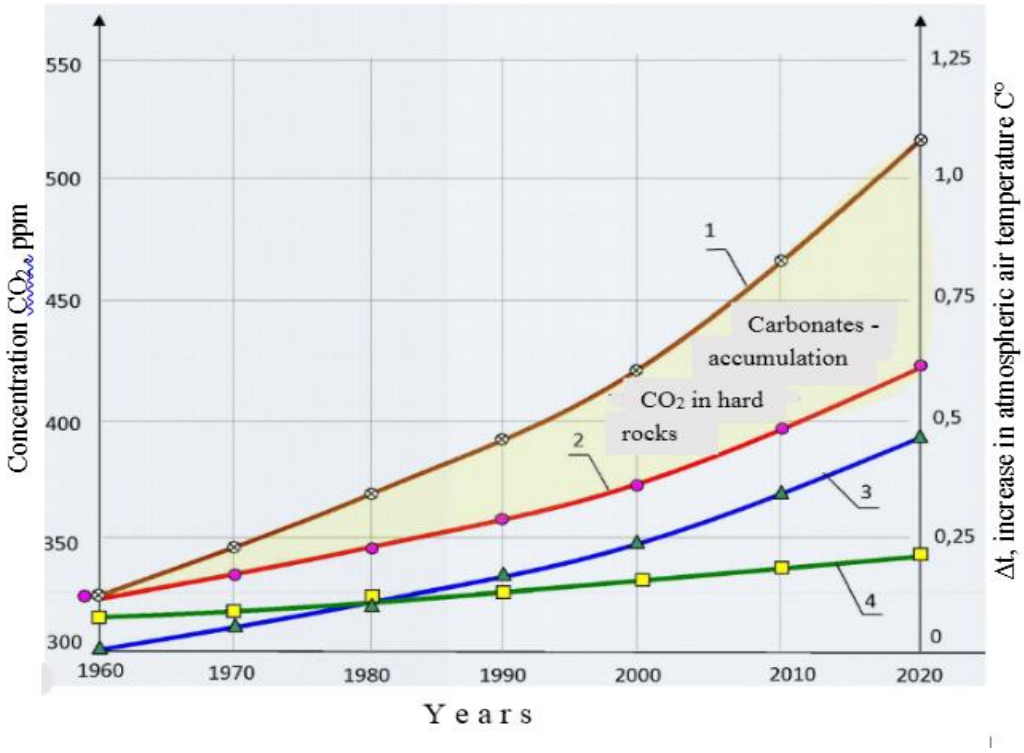

Figure 1 - Change in the concentration of carbon dioxide and the average annualincrease in atmospheric air temperature depending on time (years):

curve 1 - total anthropogenic CO_2 accumulation; curve 2 - anthropogenic accumulation of CO_2 in the atmospheric air; curve 3 - average annual increase in atmospheric air temperature; curve 4 - natural accumulation of CO_2 in the atmospheric air.

Legend: ppm-parts per million , Δ t - the average annual increase in atmospheric air temperature, °C.

.**Ways to solve the global problem of the "greenhouse" effect.**

From a figure 2 follows that emission of carbon dioxide, both general and only as a result of incineration, goes down in a row «coal → fuel oil → natural gas → hydrogen». As an oxidant when incineration of hydrocarbon raw materials was used the air.

Technical suggestions, that will allow to bring down emission of dioxide carbon and, accordingly, bring down the action of «greenhouse» effect, are below given:

1. Development and realization of low-waste, resource-saving technologies, allowing to bring down formation of material wastes and, as a result, bring down the emission of dioxide of carbon.

2. Extraction, concentration, collection, translation in the liquid aggregate state, storage and transporting of the liquefied dioxide of carbon.

3. Chemical conversion of dioxide carbon by the method of the catalytic hydrogenization in methanol [16] and on the basis of methanol production of the plastic masses, urea-formaldehyde resins, hydrocarboxylic acids, fertilizers, pharmaceutical products and etc.

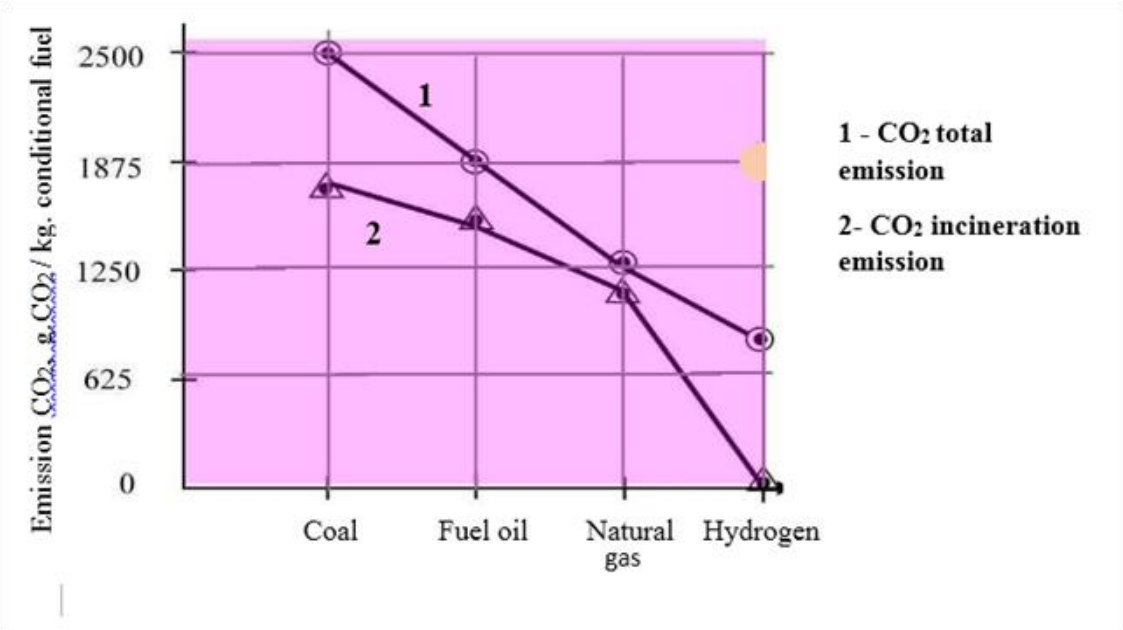

Figure 2 - Emissions of carbon dioxide depending on the type of fuel burned

A pool of the Black sea is the powerful source of unconventional energy resources, namely: the sulphuretted hydrogen and ground crystallo-hydrates.

The scientific and technical problems of deployment of the hydrogen sulfide for the production of motor fuels and compounds include the next stages [2,13]:

- deep-water extraction of the sulphuretted hydrogen;
- effective processing of the sulphuretted hydrogen in a motor fuel and chemical compounds.

We have been worked out an original technical decision on the deep-water marine of the sulphuretted hydrogen (≈10000 м). A decision is protected by the patent of Ukraine [17].

At a complex extraction and processing of the sulphuretted hydrogen of the Black Sea the basic problems of ecological safety, financial viability, resource-saving, defence of marine environment are deciding:

1) the potential danger of «breach» through the seawater of toxic, explosive and fire-hazardous hydrogen sulfide is reduced;

2) the dependence of countries on imports of hydrocarbon energy is reduced;

3) the socio-economic and environmental damage to the environment of the Black Sea countries is sharply reduced.

On April 23, 2021, at the initiative of the US President, large-scale negotiations on the "climate" crisis were held, and the leaders of 40 leading countries of the world were invited.

According to the Global Carbon Atlas, China, the USA, India, Russia, Japan, Iran, Germany, Indonesia, and South Korea are the “leaders” in emissions of carbon dioxide, the main component of “greenhouse” gases. In the speeches of the leaders of the leading countries of the world, it was reported that by 2050 carbon dioxide emissions will decrease by 3-5 times.

Figure 3 shows the dependence of the change in carbon dioxide emissions in general around the world and for individual countries for the period from 1990 to 2050 [18]. Figure 3 shows that the maximum emission of carbon dioxide, both in individual countries and around the world, falls on our time, 2015-2020, and by 2050, carbon dioxide emissions should decrease by more than seven times. This begs the question of how, on a global scale, carbon dioxide emissions can be reduced sevenfold. As we have shown (Fig. 2), it is practically impossible to achieve this within the framework of hydrocarbon energy, hydrocarbon raw materials (HCRM) of a non-renewable nature. It remains to assume the change HCRM of the era to non-hydrocarbon feedstock (NHCFS). Depending on the adopted strategy, specific technical decisions will be made.

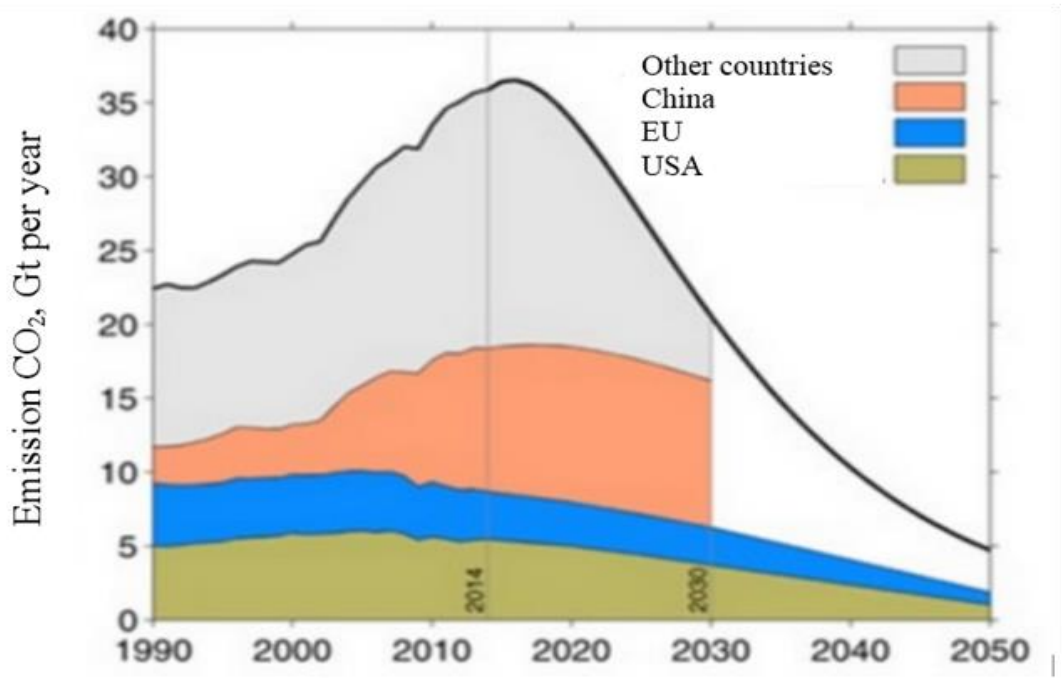

Figure 3-Dependence of the emission of carbon dioxide into the air basin depending on the time [18].

For the decline of emission of hydrocarbons in atmosphere in the process of exploitation of tankers, gas carriers, chemical tankers, LPG carriers, innovative technical decisions are worked out to practical realization on a marine transport [1,2,13].

When hydrocarbons are emitted into the atmospheric basin, economic damage is caused during the transportation of oil products and environmental damage to the air basin. Below is a logistic scheme for the transportation of oil, its processing into "light" oil products and refueling of vehicle engines, from which it follows that in the case of absorption of hydrocarbons after the capacitive equipment, the emission of hydrocarbons into the air basin decreases 30 times

compared with the option without absorption of hydrocarbons.

To reduce the emission of hydrocarbons into the atmosphere during the operation of tankers, gas carriers, chemical gas carriers, methane carriers, innovative technical solutions have been developed for practical implementation in sea transport [2,13].

To select the most effective technology, we carried out research using the following methods of absorption of hydrocarbons from steam-air mixtures:

1) absorption;

2) adsorption;

3) catalytic;

4) low temperature condensation;

5) homogeneous oxidation of hydrocarbons at elevated temperatures.

Based on the performed feasibility studies of the above methods of absorption of hydrocarbons in comparable conditions, it was determined that the most effective method in this case is adsorption (point 2).

The technology of hydrocarbon absorption by the adsorption method has been developed (Fig. 4)

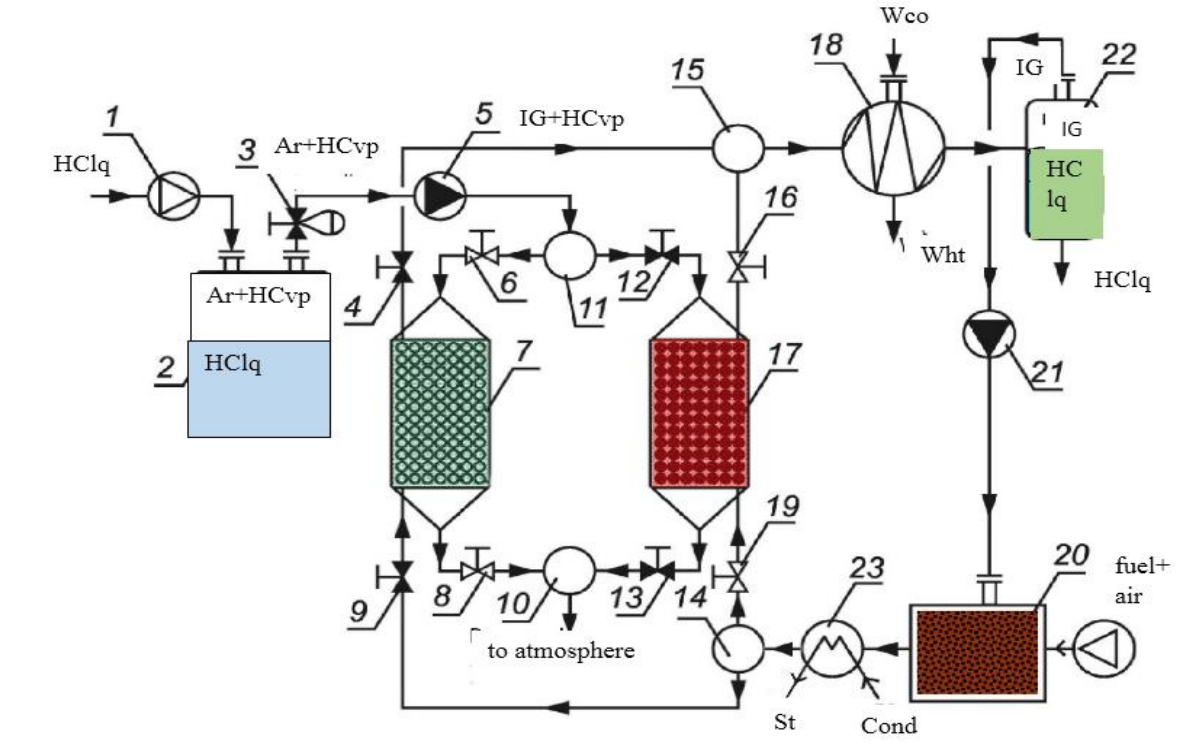

Figure 4 - Schematic diagram of vapor recovery hydrocarbons [2, 14].

The technology includes the following main stages:

1. Collection and compression of the air-hydrocarbon mixture outgoing from the storage pos. 2

2. Adsorption of hydrocarbons vapors in the adsorber pos. 7.

3. Regeneration of the saturated adsorbent in the adsorber pos. 17 in an inert gas stream at increased temperature.

4. Cooling of hydrocarbons vapors in the refrigerator-condenser pos. 18

5. Separation of inert gas and liquid hydrocarbons in the separator pos. 22.

6. Return of inert gas after separator pos. 22 in the regeneration cycle.

7. Return of gasoline (liquid hydrocarbons) to the storage pos. 2.

The developed hydrocarbon absorption scheme is resource-saving and environmentally safety. This is especially becoming relevant at the present time, since the world's reserves of non-renewable hydrocarbon raw materials are intensively depleted and limited, dangerous for the environment, biosphere and humans.

The technology for capturing hydrocarbon vapors complies with the Kyoto Protocol on 1997 (Japan), Paris Agreement COP-21 (2015) on the reduction of emissions of “greenhouse” gas components.

Conclusions.

Thus, as a result of the work performed, the following conclusions can be drawn:

1. Losses of hydrocarbons during transportation and storage of petroleum products have two negative vectors - economic and environmental.

2. Research on the absorption of hydrocarbon vapors under static and dynamic conditions has been carried out.

3. Resource-saving technologies for absorption of hydrocarbons from vapor-air environ have been developed.

4. Experimental-industrial tests of the hydrocarbon absorption process were carried out.

5. The technical and economic considerations of the expediency of introducing the technology for the utilization of hydrocarbon vapors have been developed.

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