ECOLOGICAL UNION

www.ecounion.ru
тел: 8 (812) 571-38-38
mail@ecounion.ru

Analytical Review of the Issue of Incineration: Environmental Considerations +10

The decade that passed since the first Analytical Review was published in May 2008 showed that it not only survived, but on the contrary – the environmental issues identified have become more sensitive.

The following problems are of concern.

- environmental pollution by hazardous compounds has increased not only in regions (countries) where incinerators (waste-to-energy plants) operate, but also in neighboring regions (countries);
- the impact of chemical pollution on food stock grown in these regions has increased;
- there is a continuing increase in the incidence in the environmental morbidity classes and, therefore, increased healthcare expenses.

New findings make it possible to review the situation, keeping pace with modern advances.

What is the problem of the maximum permissible dioxin emission?

The practice of incineration of municipal solid waste (MSW), which is commonly referred to as incineration, which commenced in the early 1980s, by the early 1990s demonstrated warning signs of increasing environmental pollution by persistent organic pollutants, primarily dioxins. In different countries, the challenge was addressed in different ways. In 1995, the United States legislated against the construction of new waste-to-energy plants, and at the same time, tightened regulatory requirements for the existing ones. In 2000, in the European Union, the EU/2000/76 Directive on Incineration was issued, setting the standard maximum allowable dioxin content in emissions from incinerators at the rate 0.1 ng/m3. The authors did not treat this standard as definitively safe, but as a temporary one subject to further toughening.

www.ecounion.ru
тел: 8 (812) 571-38-38
mail@ecounion.ru

This statement is supported by the fact that it is an understatement to say that limited concentration of dioxins in emissions from waste-to-energy plants (0.1 ng/m3) is an unsafe level – **this is a very dangerous level**. The matter is that dioxins, toxicologists referred to as

“Superecotoxicants” are persistent organic pollutants with a decay period of 20 years or more. They are the key subject matter of the Stockholm Convention on Persistent Organic Pollutants adopted almost simultaneously with the EU Directive 2000/76 of 2001.

The de facto standard 0.1 ng/m^3 (0.1x10^{-9} g/m^3) is 5,000 times the sanitary maximum permissible limit established in the EU for dioxins in the atmosphere, which is 0.02 pg/m^3 (0.02x10^{-12} g/m^3). A simple calculation shows that, with such a ratio, each ton of incinerated MSW will significantly degrade the quality of 25 million m^3 of the atmospheric air. Given the long period of resistance of dioxins, this implies inevitably increasing pollution along the “air → soil → plants → animals → food” chain. This effect was confirmed unexpectedly quickly: in 2006, the EU adopted the ***Codex Alimentarius – CAC/RCP 62: «Code of Practice for the Prevention and Reduction of Dioxin and Dioxin-like PCB Contamination in Food and Feeds”*.** The very name of the document became sensational, which directly acknowledged that food products have been contaminated with the said toxicants, and the **goal was set to reduce the contamination**.

The section of the “Rules and Regulations” dealing with sources of contamination, the major sources are specifically indicated:

a) *“incineration of waste, including household, hazardous or medical waste or wastewater sludge”;*

b*) “incineration of hazardous waste in a kiln for [cement] clinker”* (Clause 16)

It has been argued that *“It will take many years to take measures for reduction of pollution sources to lower the level of pollution in fish caught in natural conditions, due to the long half-life of dioxins and dioxin-like PCBs in the environment”* (Clause 27). The wording leaves no doubt as to the meaning of the statement, i.e. pollution with dioxins is an ascertained fact.

However, there is a crucial circumstance: quantitative indicators of the level of contamination are publicly unavailable. The reason for this I understandable: any leak of the relevant data would have the most negative impact on the food exports from the EU countries.

www.ecounion.ru
тел: 8 (812) 571-38-38
mail@ecounion.ru

The EU's answer to the Question "What is To Be Done?"

We have encountered the challenge of finding and making an acceptable solution. The choice was rather narrow:

1. To stop the waste-to-energy plants immediately.

However, this would mean the hundreds of thousands of jobs cuts, as well as breaking the well-established technical and economic chains. In addition, there was hope for improved waste incineration technologies.

2. No actions to be taken.

However, it was quite impossible, because the problem has become transparent.

3. To postpone the decision for several years.

This allowed for more accurate assessment of the hazard levels, possible risks, as well as the results of improved incineration technologies.

In fact, it was the Hobson's choice; the third alternative has been decided on.

It took another decade to admit the truth. During this time, it has become clear that:

- dioxin background has been increasing – to optimists' regret, but predictable for experts in the field of incineration;
- costly improvements of incineration technologies have led to the situation when the physical volume and cost of the waste gas purification systems have reached the values that exceeded half of the total cost of the waste-to-energy plant complex; however, the results turned out to be disappointing, namely, a disproportionately low reduction in hazardous emissions decreased negligibly, while production costs grew significantly, which required an increase in budget subsidies for green tariffs for the energy generated by incinerators.
- it was not possible to stiffen the standard for maximum permissible emissions of dioxins – the incineration technologies have hit the ceiling of physical and chemical capabilities of a fundamental nature.

It was a deadlock, with a difficult, but the only way to lead out: the reality could not be denied anymore.

Thus, on January 26, 2017, a **Communication from the European Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions «The**

www.ecounion.ru
тел: 8 (812) 571-38-38
mail@ecounion.ru

role of waste-to-energy in the circular economy» COM (2017) 34 final was published, containing the following guidelines: *"The member states are encouraged to switch gradually state funding to the generation of energy from mixed waste."* With regard to waste-to-energy conversion plants, *"Introducing a moratorium on new objects and decommissioning of more obsolete and less effective facilities."*

The conclusion focuses on the following, *"It is the prevention of waste generation and recycling that make the greatest contribution to energy savings and reducing greenhouse gas emissions."*

The basic point was formulated as follows: *"The processes of conversion of waste into energy can play a role in the transition to circular economy, provided that the waste hierarchy adopted in the European Union is used as a guideline, and the choice made does not discourage the higher-level waste prevention, reuse and recycling. This is extremely important to achieve the full potential of circular economy, both from an economic and environmental point of view... More attention should be paid to particular processes such as anaerobic decomposition of biodegradable waste, when recycling materials is combined with energy generation."*

The final conclusion of the document is as follows: *"The EU funding and other state financial support should be focused on the options of waste treatment in accordance with the hierarchy, where the priority is given to preventing waste generation, as well as to repeated use, separate collection and recycling."*

It is clear that with such a new course, manufacturers of equipment for incinerator have to look for new markets, one of which is Russia, with renewed vigor.

It is notable that, as the European Commission recognizes, *"**1.5%** of the total final energy consumption in the EU was achieved by obtaining energy from waste through incineration, accompanied by incineration in cement kilns, and anaerobic decomposition, i.e. about 676 PJ per year.*" This is a very small value. If we evaluate and summarize the economic losses resulted from subsidizing this relatively small amount of energy, and environmental damage caused by environmental pollution, it becomes clear that the EU's waste treatment methods in the early 1980s have brought to a deadlock. However, to realize this, it took 35 years. Another 10–15 years may be necessary due to the inertia of the process, to implement the decisions taken and to find the way of environmentally sustainable waste management.

Global situation

The ecological consequences of incineration can be lucidly and quite correctly illustrated by the well-known oriental tale of the genie: when compacted, the

www.ecounion.ru
тел: 8 (812) 571-38-38
mail@ecounion.ru

carrier of evil existed safely in a jug, but when released outside in gaseous form, increased manifold, it turned out to be uncontrollable and extremely dangerous.

Dioxin background has grown all over the globe and continues to grow. This is confirmed by analyzes of control samples taken in a number of remote locations of the planet, including ice core in Antarctic.

In days past, millions of children in the world were treated with fish oil for rickets. Today, doctors forbid giving children natural cod-liver oil – it poses a serious danger due to the high content of dioxins. Being the top of the food chain "air → water → plankton → sea animals", blubber rather quickly accumulates dangerous doses of persistent organic toxicants.

Atmospheric air is the first of all environments of the terrestrial biosphere, to become contaminated by ecotoxicants. Air is the most important living environment for human beings and the entire aerobic terrestrial biota. Man breathes uninterruptedly and rhythmically with a cycle of 4 seconds, the lung and blood transmitting an average of 20 kg of air per day. During this time, about 2 liters of water and 1 kg of food are consumed. That is, in mass exchange between our body and the environment, the air is 85%, it entering us without a pause, like clockwork.

This fundamental biological mechanism explains why the state of atmospheric air is the key factor affecting human health. Of all things, this fact was disputed and discussed with displaced energy on many world scientific environmental and medical sites for more than two decades. Finally, in 2013, the WHO officially recognized fume-laden air an oncogenic factor causing lung cancer in urban dwellers.

March 25, 2014, Geneva: the WHO published new data stating that in 2012, about 7 million people died – every eighth of the total number of deaths in the world – due to air pollution. *"This indicator is more than twice as high as the preceding estimates and it confirms that currently, air pollution is the largest environmental risk to health in the world. Reducing air pollution can save millions of lives."*

A statement made by the Ministers of the Environment representing different countries of the world was an important outcome of the UN Environment Assembly **«*Towards a Pollution-Free Planet*"**, Nairobi, December 4-6, 2017, which voiced the following: ***"It is extremely important that people around the world know that daily, 9 out of 10 people breathe air which indicators exceeding the maximum permissible limits... and more than 17,000 people will die prematurely for this reason."***

Today, the main challenged to be addressed is how to stop increasing pollution of the earth's atmosphere and enable it to start the process of self-purification.

www.ecounion.ru
тел: 8 (812) 571-38-38
mail@ecounion.ru

Meanwhile, it is known that technogenic products such as dibenzodioxins and dibenzofurans enter the atmosphere in quantities measured for different countries by tens to thousands of grams per year.

A significant portion of this waste falls on waste-to-energy plants and incineration of medical waste, in particular, about a half in the United States. And this is despite the fact that in 1995, a law was passed in the United States banning the construction of new incinerators, and about a half of the states prohibited the construction of waste-to-energy plants on their territory from the very beginning.

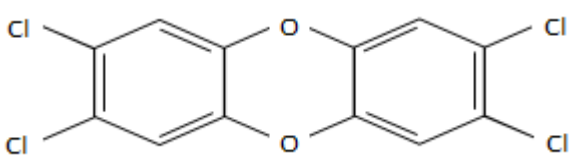
The situation in Europe is much worse.

In Japan, where the technological process of waste incineration has been made pure poetry, the main consequence of operation of incinerators is, in addition to air pollution, increasing pollution of marine biota.

The topic of the UN Assembly in Nairobi ***"For the Pollution-Free Planet"*** was chosen not by accident: it was preceded by a year of heated discussions in academic and environmental communities in many countries of the world. The topic of pollution of the biosphere was convincingly recognized as the key one. Incineration of waste is the most traumatic moment of the problem.

Dioxins are internationally treated as an absolute poison, which has a stronger effect than cyanides, strychnine, curare, soman and sarin gases, tabun, etc. Dioxins are not a specific substance, but several dozen families, including tricyclic oxygen-containing xenobiotics (substances unacceptable for living organisms), as well as a family of biphenyls that do not contain oxygen atoms. These are all 75 polychlorinated dibenzodioxins, 135 polychlorinated dibenzofurans, 210 substances from organic bromine families, and several thousand mixed chlorine-bromine-containing ones.

A dioxin molecule is a rectangle 3 x 10 angstroms. Thus, it can precisely fit into the receptors of living organisms. The strangers' physiological activity suppresses the vital functions of the hosts, making them work differently. In small doses, dioxins are not so much poison as they alter the living organism.



The most toxic dioxin – structural formula 2,3,7,8, - tetrachloroedibenzodioxin (TCDD $C_{12}H_4Cl_4O_2$)

Dioxin can accumulate in the body for years, without any interactions, and then makes itself felt in the form of a wide variety of diseases. A freak child might be born, a malignant tumor or a mental illness developing... Toxicologists even claim that th concept of maximum permissible concentration cannot apply to dioxins at all: just one molecule can change human life. This explains the phenomenally low MPC standard for dioxins – picograms, pg/m^3, l, kg, (10^{-12} g/m^3, l, kg). The vast majority of all other pollutants are MPC in milligrams, i.e. mg/m^3, l, kg (10^{-3} g/m^3, l, kg).

This means the following: **it is necessary to avoid any technological processes capable of producing, at least theoretically, even the seemingly smallest amount of dioxins.**

In the USA and Western Europe, the dioxin hazard has been realized, and the most necessary measures have been taken.

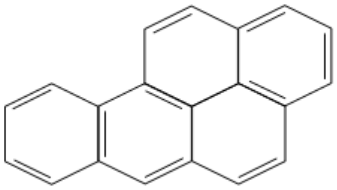
The scale of the dioxin hazard somewhat covered up another acute and no less dangerous, problem of PAHs or polycyclic aromatic hydrocarbons. These are also persistent organic pollutants (SOS) – man-made products of almost all processes, including the combustion of natural hydrocarbons and their derivatives, in particular, waste, which are the dominant part of municipal solid waste. All PAHs – 115 species – are biologically active. Many of them are carcinogenic.

The indicative PAH is **benzo(a)pyrene (BP):** it is always present where there are other PAHs, and it is more common in the environment than other carcinogenic polyaromatic hydrocarbons. It is characterized by the most pronounced carcinogenic activity. It has begun to accumulate in the environment since mankind had learned to make wide use of fossil hydrocarbons, i.e. from the late 19^{th} century. BP enters soil and water mainly with precipitation.

With the increased consumption of fossil hydrocarbons and waste incineration, dissemination and concentration (background) of BP in the environment are at the high, especially in industrialized countries. For example, bottom sludge of the Great Lakes, USA, contains BP in concentrations from 10 to 1000 ng/g. In the lake deposits of European countries, BP content is 100 to 700 ng/g. (Switzerland) and 200 to 300 ng/g (Germany).

The maximum permissible concentrations (MPC) of benz(a)pyrene are very strict: 0.1 µg/100 m^3 or 1 ng/m^3 for atmospheric air, 0.02 mg/kg for soil, 10 ng/kg for water and food products. At the same time, BP, like dioxins, are characterized by hazardous prolonged exposure even at doses lower than the MPC, and if low concentration is accompanied by long-term exposure, a stronger negative effect is often observed than for high concentration and short-term exposure.

www.ecounion.ru
тел: 8 (812) 571-38-38
mail@ecounion.ru



Benz(a)pyrene – structural formula.

Priority polycyclic aromatic hydrocarbons (PAH) to be controlled in food stock in the EC

No.	PAH	Carcinogenic effect	No.	PAH	Carcinogenic effect
1	Acenaphthene	+	9	Dibenzo[a,h] anthracene	+ + +
2	Acenaphthilene	+	10	Indeno[1,2,3 - c,d]pyrene	+
3	Anthracene	+	11	Naphthalene	TP
4	Benzo[a]pyrene	+ + +	12	Pyrene	CC
5	Benzo[b]fluoranthene	+ +	13	Phenanthrene	+ + +
6	Benzo [k] fluoranthene	+ +	14	Fluoranthene	CC
7	Benzo [a]anthracene	+	15	Fluorene	+
8	Benzo [g,h,i]perylene	CC	16	Chrusene/triphenylene	+

Conventional designations:

+, ++,+++ - activity rate

CC – co-carcinogen with benzo[a]pyrene

TP – ability to cause tumors of various nature

Priority dioxins to be controlled in food stock in the EC

No.	Dioxin	TEF	No.	Dioxin	TEF
1	2378-tetrachlorodibenzofuran	0.1	10	123478-hexachlorodibenzodioxin	0.1
2	2378-tetrachlorodibenzo-p-dioxin	1	11	123678-hexachlorodibenzodioxin	0.1

www.ecounion.ru
тел: 8 (812) 571-38-38
mail@ecounion.ru

3	12378-pentachlorodibenzofuran	0.05	12	123789-hexachlorodibenzodioxin	0.1
4	23478- pentachlorodibenzofuran	0.5	13	1234678-heptachlorodibenzofuran	0.01
5	12378-pentachlorodibenzo-p-dioxin	1	14	1234789-heptachlorodibenzofuran	0.01
6	123478-hexachlorodibenzofuran	0.1	15	1234678-heptachlorodibenzo-p-dioxin	0.01
7	123678- hexachlorodibenzofuran	0.1	16	Oktachlorodibenzofuran	0.0001
8	234678- hexachlorodibenzofuran	0.1	17	Oktachlorodibenzo-p-dioxin	0.0001
9	123789- hexachlorodibenzofuran	0.1			

TEF – toxic equivalent

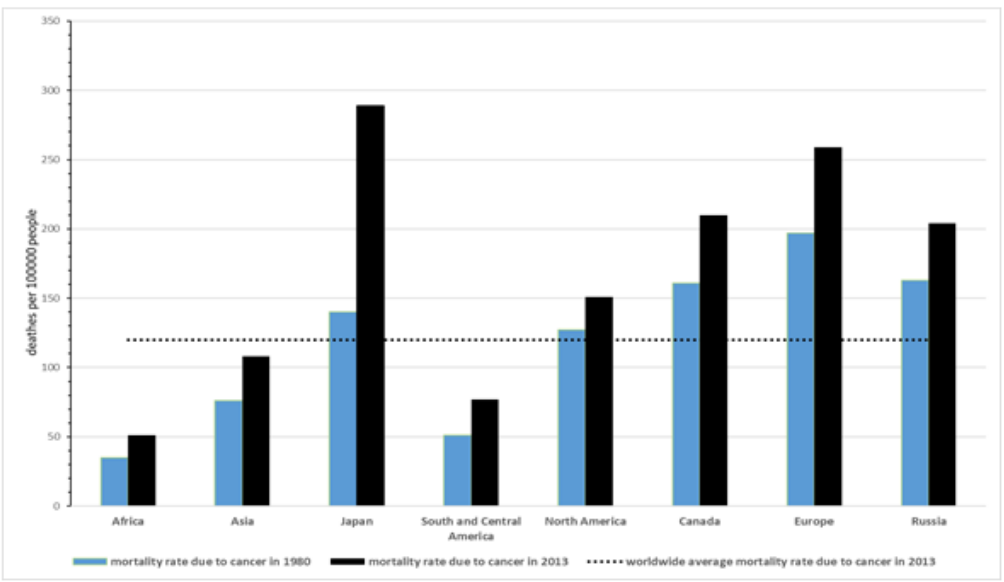
Global nature of mass exchange processes in the biosphere requires that the danger of pollution by persistent organic pollutants is realized on a global scale, and adequate response measures in individual countries are taken.

Contamination of Living Environment and Public Health

As noted above, the fact that human health immediately depends on the state of the environment is not only acknowledged by leading international organizations, but this is also confirmed by all new statistics and observations.

The WHO statistics show that the highest mortality rates due to neoplasms are recorded in the EU, Japan, the USA and Canada.

Mortality rate due to cancer in the world
According to the WHO



www.ecounion.ru
тел: 8 (812) 571-38-38
mail@ecounion.ru

The diagram shows that the highest mortality rate due to cancer in the densely populated regions of the globe is observed in Europe, North America (Canada and the USA) and Japan. Russia is also distinguished by a mortality rate comparable to these countries.

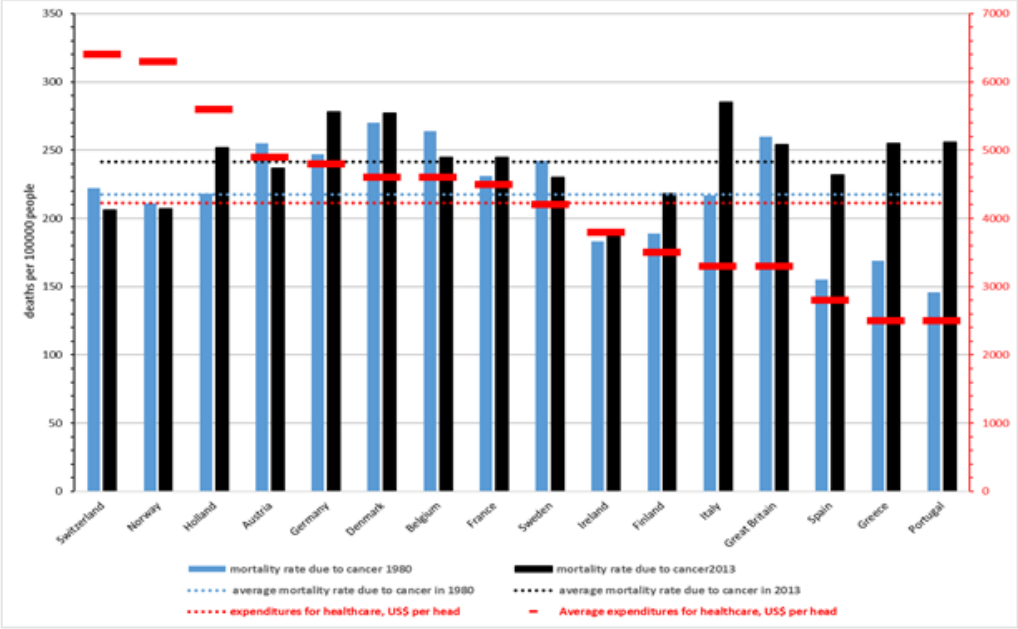
Waste-to-energy plants are intensively used in the countries of Western Europe, Japan, the USA, and Canada.

In Asia, Japan is the leader, while the mortality rate in Japan (289) almost triples the weighted average value in Asia (108), and grew from 1980 to 2013 more than 2 times.

In Europe, the situation is different. Since the early 1980s, the countries of Western Europe have been actively using incineration, including countries that incinerate more than 20% of MSW (descending): Denmark, Switzerland, Sweden, Holland, Belgium, Germany, France, Austria, Portugal, and Finland.

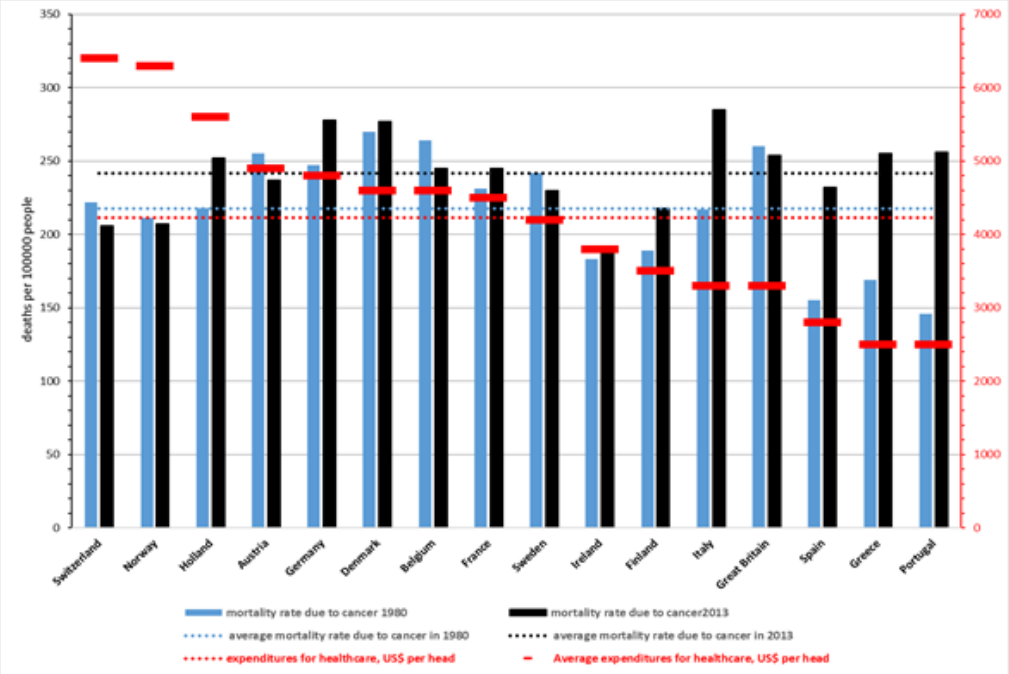
However, a high mortality rate is also recorded in the countries of Eastern Europe, which are also characterized by a sharper increase in the mortality rate since the early 1980s. So, if the average mortality rate in Western Europe increased during 1980–2013 by 12%, then in Eastern Europe - by 49%, or 1.5 times.

Mortality rate due to cancer in the countries of Western Europe
According to the WHO



www.ecounion.ru
тел: 8 (812) 571-38-38
mail@ecounion.ru

Mortality rate due to cancer in the countries of Eastern Europe
According to the WHO



The below circumstances are striking:

1. The average mortality rate due to cancer in Eastern Europe has exceeded the rate in Western Europe;

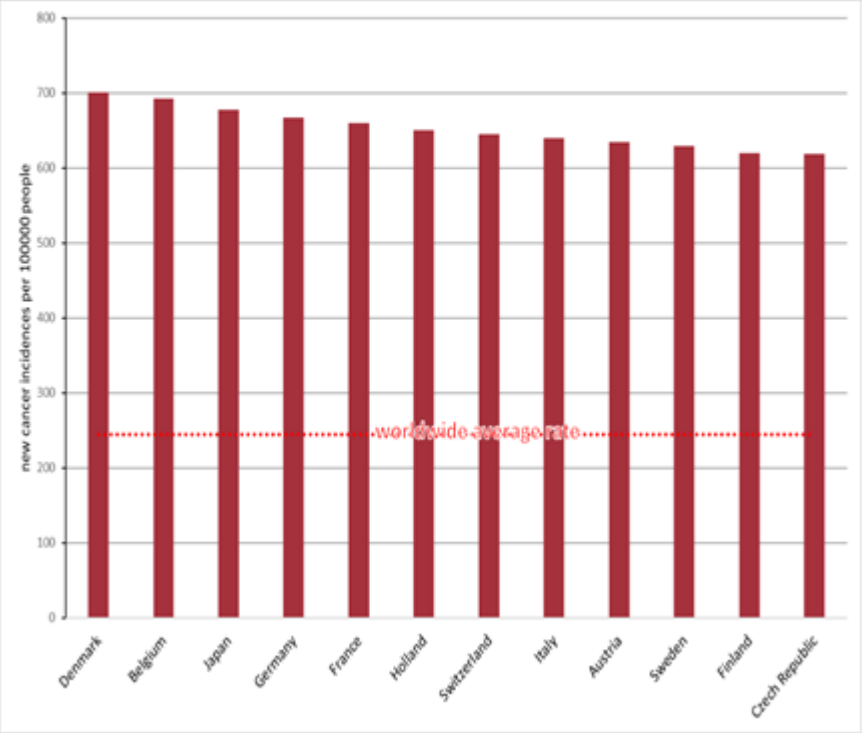
2. In some countries of Western Europe (Switzerland, Norway, Austria, Belgium, Sweden, United Kingdom), the mortality rate has slightly decreased relative to the level of 1980.

If we take into account and consider the cost factor for health care, then everything will click into place. The average level of health care expenditures (for 2013) in Western Europe was $4,200 per capita, while in Eastern Europe $1,600, i.e. 2.6 times more. The correlation between the mortality rate and the quality (funding) of health care is clearly visible: the higher the health care expenditures, the greater the reduction in mortality compared to the previously available indicators.

We can get a complete picture of the situation in West and East Europe if consider the cancer **incidence rates** in different countries.

www.ecounion.ru
тел: 8 (812) 571-38-38
mail@ecounion.ru

Countries with the highest cancer incidence rates
According to the WHO for 2013
in patients of all ages with a de novo disease



This diagram illustrates the world highest incidence in the countries of Western Europe, with the only non-European country, Japan, included. The list correlates with the countries intensively using incinerators.

It is quite obvious that the increase in environmental pollution generates an increase in the incidence, in the first place, in the most dangerous classes: neoplasms, congenital anomalies, and in the second place, an increase in the overall morbidity, but also increases disability, i.e. increased number of people with limited or without working ability.

Countering these processes requires a significant increase in expenses for health care, which is affordable for the richest countries, and unaffordable for the poorest ones. **This pursuit can be stopped only by changing the trend of pollution of the biosphere**: first slowing down, then stopping, followed by reduction of the pollution level, ideally, to a natural state.

The only effective tool for such a transformation is immediate abandoning hazardous technologies, in particular, waste incineration, and a transition to environmentally friendly technologies.

These efforts will naturally result in a decrease in morbidity, mortality, economic growth, and finally, improvement of the quality of life.

But **efforts must always be first**.

Situation in Russia

The situation in Russia is characterized by low public awareness of the dangers caused by air pollution by waste incineration, in particular, and of the quality of the environment, in general.

Lobbyists of construction of incinerators cite the data on dioxin emissions in other countries, trying to convince of their being insignificant and, therefore, harmless. For example, the data were published in the journal “Waste Management” (USA) in December 2015, in the article “Inventory of U.S.2012 Dioxin Emissions to Atmosphere”, from which it follows that dioxin emissions produced by all waste-to-energy plants in the United States in 2012 was 3.4 grams, they stating this to be negligible. Is this estimate correct? Leaving behind the question of accuracy of the information provided by the American magazine, promoting interests of the “garbage” business, let us make a simple calculation. Based on current US safety regulation, i.e. MPC for dioxins in the air, which is 0.02 pg/m^3 (0.02x10-12 g/m^3), we can determine the amount of air that is rendered unfit (dangerous) for humans by dioxins in the amount of 3.4 g. It is:

$$3.4\ g/0.02 \times 10^{-12}\ g/m^3 = 1.7 \times 10^{14}\ m^3, \text{ i.e. } 170 \text{ trillion } m^3$$

Given that for vital activity, an individual needs at least 20 m^3 of air per day, we can determine that for 1 year (365 days), 3.4 g of dioxins make the air dangerous for breathing, which is necessary

$$1.7x10^{14}/20\ m^3/day \times 365\ days = 2.3x10^{10}$$

for 23 billion people, which is 3 times the total population of the Earth (!)

We can see no immediate consequences only because the population is scattered over a large area. The resulting figure is theoretical, which means that if the global population lived in a limited area around an incinerator, then each person would be exposed to 3 MPC of dioxins, i.e. guaranteed lethal dose. But due to the atmospheric transfer and accumulative (cumulative) effect, the pollution of the habitat (air, water, soil) on the planet gradually, but rather quickly, grows, causing **growth of negative demographic consequences**.

- global cancer incidence, first of all, in the countries using incineration, and in the neighboring countries; these are record breakers in cancer mortality, despite the enormous costs of health care;

- dioxin background (see above), the accumulation in the environment of persistent organic pollutants (dioxins, PAHs, etc.) means: their input exceeds the adaptive capabilities of the biosphere.

Given these phenomena, our country should consider the choice of technologies for waste treatment with great care. However, recent decisions on the construction of incinerators in the Moscow region and Kazan and expert evaluations of these projects leave the matter unsettled.

Examination of the project materials for the construction of four waste-to-energy plants scheduled in the Moscow region shows that their environmental impact was estimated without calculation of mass and energy balances or assessment of environmental damage, therefore it is incomplete, and unreliable. According to the project, each of these plants (project name “Plant for Thermal Disposal of MSW”) with a capacity of 700,000 tons of MSW per year will produce:

240 thousand tons of sludge;

20.5 thousand tons of ash;

2.4 thousand tons of pollutants

and some energy

In fact, material balance of a waste-to-energy plant looks as follows:

Material balance of a waste-to-energy plant (annual)

Resource consumption		Products	
Resource	**Amount**	**Resource**	**Amount**
ϒ raw materials: MSW From the environment: ϒ clean water ϒ atmospheric air	700,000 thousand 350,000 m^3 > 9 billion m^3 (not considered in the project)	ϒ sludge ϒ ash ϒ pollutants (emissions to the atmosphere) ϒ greenhouse gases (not specified in the project) ϒ spent gas purification reagents	240,000 tons 20,500 tons > 2 mln. tons Considered in the project) not

Note: the cost of electricity produced will significantly exceed the tariffs in the energy market and will require significant budgetary subsidies for the “green tariff” (envisaged in the program).

The material balance convincingly demonstrates that the correctly calculated environmental damage caused by the implementation of the project will be huge. But it is not defined in the project. At the same time, the cost of greenhouse gas emissions of CO_2 at an average European price of 20-25 euros/ton commensurate with the cost of electricity produced. Assessment of other types of environmental damage may reveal the value of a higher order. Background pollution of the environment is growing followed by increased demographic damage.

State report *"On the State of Sanitary And Epidemiological Welfare of the Population in the Russian Federation in 2013":*

"Among the environmental factors that affect public health, air pollution remains a priority... Economic losses due to priority air pollutants were estimated in 2013 at 69.1 billion rubles."

"In general, in 2013, economic losses associated with underproduction of gross domestic product, due to mortality and morbidity of the population, determined by the harmful effects of chemical, physical and biological environmental factors of the living environment amounted about 192.8 billion rubles."

"The contribution of chemical factors (pollution of the air, drinking water, soil) to the mortality of the population is 21%, to morbidity is 48%, and to economic losses are 28%."

State Report "On the State and Protection of the Environment in the Russian Federation in 2015":

"In 20 constituent entities of Russia, 17% or more of the urban population are exposed to high and extremely high air pollution, in three regions (Saint Petersburg, Sverdlovsk region and Taimyr Autonomous District) – more than 75% of the urban population."

"Mortality rate of the population due to neoplasms is consistently associated with the pollution of atmospheric air with benzo(a)pyrene and formaldehyde in 12 regions of the Russian Federation. The priority areas include... Moscow, Saint Petersburg..."

It should be recognized that, in terms of physical and chemical processes, waste incineration is a transfer of a matter to a gaseous state, accompanied by formation of new hazardous compounds, including especially hazardous persistent organic pollutants and release them into the atmosphere. Moreover, any gas purification technology provides the trail of new waste (spent reagents, filters, and screenings).

The law of conservation of matter cannot be abolished. It is this law that determines inevitability of negative environmental consequences of any attempts to "dispose" of waste.

Waste management is conceivably an integral part of the life cycle “production-to-consumption”. It is congruent with the imperative of the circular economy and consists in a return to the production cycle to the maximum (ideally 100%). The modern legislatively adopted hierarchy of waste management gives priority to the prevention of generation, reuse and recovery (recycling). This requires massive implementation of separate collection of municipal solid waste, public education on environmental issues, introduction of environmentally friendly recycling technologies and technologies for the temporary storage of MSW fractions that do not have environmentally friendly recycling technologies available.

S.M. Gordyshevskiy

Non-commercial Partnership Ecological Union, Saint-Petersburg, Russia

July 12, 2018

References:

1. Communication of the European Commission *“The Role of Waste-to-Energy Conversion in the Circular Economy”* COM (2017) 34 final

2. Materials of the Third Session of the United Nations Environment Assembly, the United Nations Environment Program (UNEA3), Nairobi (Kenya), December 4-6, 2017

3. Directive 2000/76/EC of the European Parliament and of the Council “On Waste Incineration”

4. Codex Alimentarius – CAC/RCP 62: «Code of Practice for the Prevention and Reduction of Dioxin and Dioxin-like PCB Contamination in Food and Feeds”

5. State report *“On the State of Sanitary And Epidemiological Welfare of the Population in the Russian Federation in 2015”:*

6. State report *“On the State and Protection of the Environment in the Russian Federation in 2015”*

7. Report of the State Council of the Russian Federation *“On the Environmental Development of the Russian Federation in the Interests of Future Generations”,* Moscow, Kremlin, 2016

8. https://medialeaks.ru/gorodskoj-vozdux-vyzyvaet-rak-legkix/

9. https://www.oncotrust.ru/zagryaznenie-vozdukha-negativno-vliyayet-na-prodolzhitelnost-zhizni-patsientov/

10. https://www.who.int/mediacentre/factsheets/fs313/ru/

11. https://www.who.int/mediacentre/news/releases/2014/air-pollution/ru/

12. https://www.ecolearn.ru/chapter/143.html

13. Atlas of Population Health in European Union Regions. Authors Pola Santana and others, 2017

14. GLOBAL CANCER OBSERVATORY;
NORDCAN: www.gco.iarc.fr/databases.php

15. https://www. who.int/gho/data/node.country.country-RUS?lang=en

16. www:dep.iarc.fr/WHOdb/WHOdb.htm

17. Europian Journal of Cancer, volume 49, Issue6, April 2013 «*Cancer incidence and mortality patterns in Europe: Estimates for 40 countries in 2012*»,
J.Ferlay www.sciencedirect.com/science/article/pii/S0959804913000075#t0020

18. https://www.cancer.org/content/dam/cancer-org/research/cancer-facts-and-statistics/annual-cancer-facts-and-figures/2017/cancer-facts-and-figures-2017.pdf

19. https://www.bbc.com/russian/science/2016/02/160204_gch_cancer_infographics

20. Public Health Statement for Polycyclie Aromatic Hydrocarbons (PAHs) www.atsdr.cdc.gov

21. https://eur-lex.europa.eu:COMISSION REGULATION(EU) №589/2014

22. Dioxins-EU LEGISLATION, Commission Recomendation 2006/794/EC www.fsai.ie

23. https://icss.ru/economicheskaya-politika/ekologiya/plata-za-vyibrosyi-parnikovyix- gazov-po-stranam-mira

and others.