ACID RAINS: REASONS AND SOLUTIONS

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Acid rain has many ecological effects, but none is greater than its impact on aquatic environments. The objectives of the present paper is to clarify the notion of acid rain; identify the causes, in particular, those connected with oil and gas industry; and outline the ways to solve this problem.

The term "acid rain" was first introduced in 1872 by English engineer Robert Smith in the book "Air and rain: the beginnings of chemical climatology" [3]. Acid rain, containing solutions of sulphuric and nitric acids, causes significant damage to the environment. .Land, water, vegetation, animals and buildings become their victims. In 1996, more than 4 million tons of sulphur and 1.25 million tons of nitrate nitrogen fell as precipitation on the territory of Russia. The situation became particularly serious in the Central and Central black-soil regions, in the Kemerovo region and Altai Krai, Norilsk. As for Moscow and St. Petersburg, due to the acid rain, up to 1500 kg of sulphur per 1 km^2 fall to the earth annually. Significantly lower the acidity of precipitation in the coastal area of North, West and East Siberian areas [4]. The most favorable region in this regard is recognized the Republic of Sakha (Yakutia).

To give the definition of acid rain, we need to introduce the concept of acidity. The acidity of the aqueous solution is determined by the presence of positive hydrogen ions H+ and is characterized by the concentration of these ions in one liter of solution. In practice, the degree of acidity of a solution is expressed in a more convenient pH value. The scale of acidity goes from 0 to 14, the smaller the pH value, the higher the acidity. The value of pH=7 corresponds to a neutral environment (chemically pure water). However clean rainwater in the absence of pollutants has slightly acidic reaction (pH = 5.6) because it easily dissolves carbon dioxide with the formation of weak carbonic acid.

Acid rain or acid precipitation are called precipitation (rain, snow, hail, fog) with a value of pH less 5.6.Compounds, which decrease the pH of precipitation, are oxides of sulphur, nitrogen, hydrogen chloride and volatile organic compounds (VOC).

The causes of acid rain can be divided into two groups: natural and anthropogenic. The natural causes include microorganisms, volcanic activity, decay of nitrogen-containing compounds and combustion of wood. The anthropogenic causes of acid rain are all the objects that pollute the atmosphere. These include: thermal power plants and metallurgical plants [1], which emit nearly 255 million tons of sulfur dioxide and nitrogen oxides; enterprises producing sulfuric acid and processing oil; cars, exhaust gases which contain up to 40% of nitrogen oxides entering the atmosphere.

From the point of view of chemistry, the mechanism of formation of acid rain is quite simple: oxides entering the atmosphere react with water molecules forming acid. Oxides of sulfur entering the air produce sulfuric acid, nitrogen oxides – nitrogen acid. We should consider this fact that atmosphere above major cities always contains particles of iron and manganese that serve as catalysts for reactions. Due to the water cycle, the water in the form of precipitation eventually hits the ground, and as a result, the acid reaches the ground as well.

The effects of acid rain are global in nature and affect nearly everyone and everything. The effect of acid rain leads to population reduction or even total loss of fish and aquatic plants in lakes and rivers. This question was crucial in the Scandinavian

countries in the late 20th century, when fish almost entirely disappeared in half of all lakes.

Another problem is degradation of forests. Acid rain does not often damage trees directly. Instead, the most likely wilt of trees because of damage to their foliage, soil acidification and destruction of nutrients in it, contact of the roots with toxic compounds that very slowly washed out from it.

Acid precipitation illustrates the threshold effect. Most of the soils, lakes and rivers contain alkaline chemical substances, which can interact with a number of acids, neutralizing them. However, regular long-term exposure to acids depletes most of these deterrent acidification substances. This leads to the death of trees and fish in lakes and rivers. If it happens, it is too late to take any measures.

Acid rains destroy buildings, pipelines, lead to breakdown cars, reduce soil fertility and may contribute to the infiltration of toxic metals in water-bearing soil layers.

As to the effects of acid rain on humans, it can significantly affect human health. For example, acid rain can cause respiratory diseases. Regardless of how harmful substances carried by acid rain gets into the body (through food, drink or air), the consequence can be not only serious illness but also death, and this applies to both adults and children.

Since the problem of acid rain is global, then it can only be solved globally. The most effective solution is to reduce emissions into the atmosphere and water. Since all power plants burning coal emit into the atmosphere sulfur dioxide, the solution to the problem is the use of coal containing less sulfur, setting filters and sewage treatment plants, the transition to other more environmentally friendly fuel. It is also necessary to reduce exhaust emissions from vehicles, which can be done by the use of alternative sources of power of vehicles, such as natural gas, electricity and combinations of alternative and gasoline-powered vehicles. It is also vitally important to reduce fossil fuels production and to turn to the alternative sources of energy, such as nuclear power, hydropower, wind energy, geothermal energy, and solar energy.

References

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