

ENVIRONMENTAL

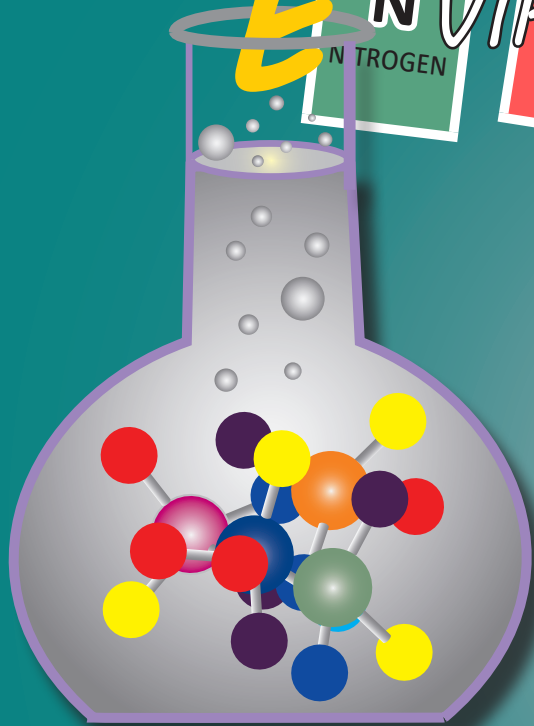
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PROTECTION



NO_x EMISSIONS

SO_x EMISSIONS

ACID RAINS

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Global environmental issues

Nitrogen and sulfur oxides emissions

Acid rains

KEY TOPICS

1. What are the major environmental issues of the contemporary civilization?
2. Why are sulfur oxides and nitrogen oxides in air harmful for man and environment?
3. What are acid rains?
4. Is it possible to control and reduce harmful emissions?

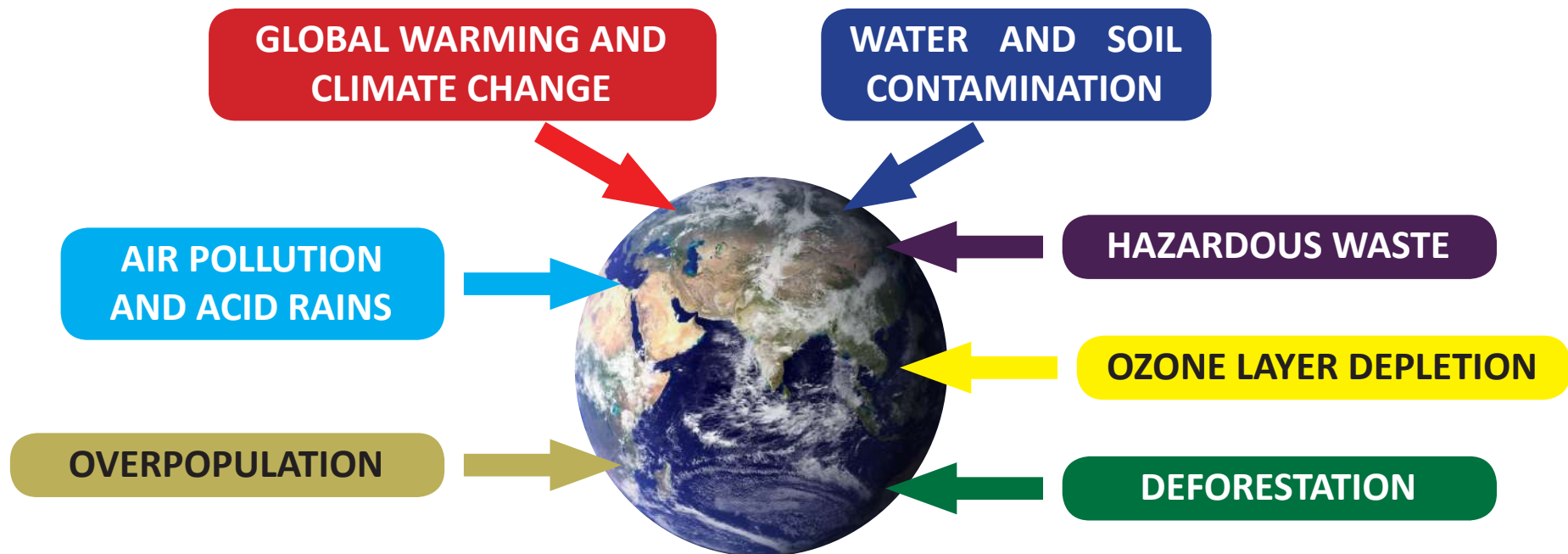
KEY WORDS

- NO_x emissions
- SO_x emissions
- Acid rains



CHEMISTRY IS PART OF OUR EVERYDAY LIFE. It is impossible to live even one day without using products of the modern chemical industry – clothes, cars, homes, packages, highways, vehicles, pharmaceuticals, books, computers, phones, airplanes, trains, space-rockets, shoes, cosmetics Modern chemistry makes our life more comfortable and gives us stunning opportunities. We enjoy that comfort but we often miss its enormous harmful impact on the environment – air contamination, water and soil pollution, global warming and climate change, ozone layer depletion, etc.

Major global threats for our planet resulting of the negative impacts that humans have had on the nature are:



*„The world is a fine place
and worth fighting for.“*

Ernest Hemingway

Nature is a very complex system. Every negative change reflects at the whole planet – like a domino’s effect. A simple example – **deforestation**. Imagine it is the first domino’s piece that falls and all other follow it. Everything changes – no tree roots, water from the rainfalls is not absorbed and carries away organic and mineral substances. The consequence – soil erosion and floods. And furthermore:

NO FOREST → **LESS OXYGEN AND MORE CO₂ IN THE AIR** →
→ **THE GREENHOUSE EFFECT IS ENHANCED** → **THE CLIMATE CHANGES** →
→ **THE NATURE CHANGES** → **OUR LIFE CHANGES!**

An old Indian prophecy says:

ONLY AFTER THE LAST TREE HAS BEEN CUT DOWN,
ONLY AFTER THE LAST RIVER HAS BEEN POISONED,
ONLY AFTER THE LAST FISH HAS BEEN CAUGHT,
ONLY THEN WILL YOU FIND THAT MONEY CANNOT BE EATEN!

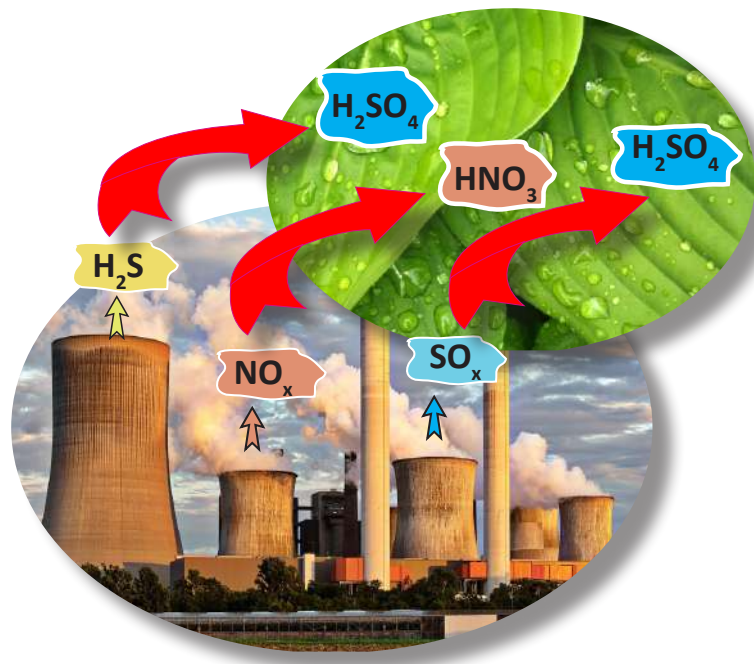
Problems of environment have become global because they concern all of us. Green technologies offer a great promise for a sustainable environment without upsetting the balance in nature. Over the last decades many solutions to environmental problems have been proposed, diversified activities are going on and numerous new projects are under way to properly manage, develop, protect, restore, enhance and conserve the environment for our children and for the future generations.

Sometimes the best way to do this is to start with something very simple – saving water and electricity at home, planting trees and flowers, separately collecting the wastes. So you become participants in the green movement to save the Earth:

THINK GREEN AND ACT GREEN!

NITROGEN AND SULFUR OXIDES EMISSIONS

Sulfur, nitrogen and carbon oxides and some volatile organic compounds released in air by industries, power plants, motor vehicles and combustion of fossil fuels are major air pollutants. The smog (smoke + fog) in the cities is caused by many factors and consists of over 100 chemicals that may have various harmful health effects and can cause diseases.



Nitrogen forms several oxides (N_2O , NO , NO_2 , N_2O_3 , N_2O_5) but the most important air pollutants are nitrogen dioxide NO_2 and also nitrogen oxide NO . They are often designed as NO_x . Sulfur dioxide SO_2 is considered as the major sulfur-containing air pollutant but most often processes generating SO_2 generate SO_3 too. Both oxides are designated as SO_x .

The main source of NO_x and SO_x in the air is the burning of fossil fuels. Some industrial processes, volcanoes activity also contribute to the accumulation of these gases in the atmosphere. Sulfur oxides and nitrogen oxides at high concentrations are harmful for the vegetation but they can negatively affect also an entire ecosystem returning back to the ground as acid rains – precipitations (snow, rain, fog, hail, dust) with acidic components such as sulfuric or nitric acid.

Once pumped in the atmosphere sulfur and nitrogen oxides can move away blown by winds and harm forests, natural waters, man-made materials (metals, marble statues) and of course the human health (can cause respiratory problems) far from their sources. So acid rains are a global environmental problem concerning all countries in the world.

ACID RAINS

Most of the problems of air pollution arise from combustion of fossil fuels. If a fuel contains sulfur or its compounds (for example impurities of FeS_2) one of the products of its combustion is sulfur dioxide SO_2 :

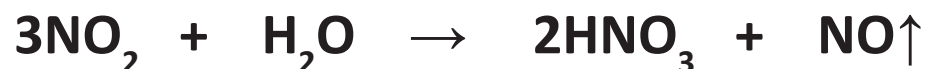


Sulfur dioxide SO_2 released in the air either reacts with water vapours to form sulfurous acid H_2SO_3 (which is readily oxidized by oxygen to sulfuric acid H_2SO_4) or is oxidized to SO_3 which combines with water to form sulfuric acid. These acids are among the main substances responsible for acid rains.

Nitrogen oxides are produced in combustion processes. Nitrogen and the oxygen in the air can react at high temperatures:



The reaction of NO_2 with water is also considered to be partially responsible for the increased acidity of rains in many parts of the world:



In the presence of excess oxygen, only nitric acid is formed:



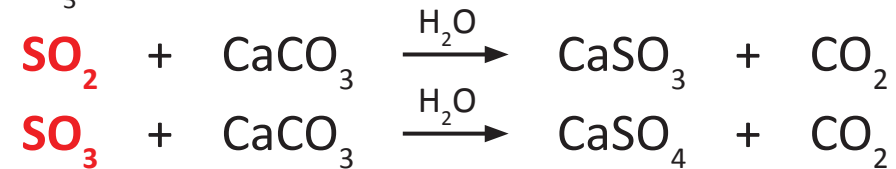
The acid rains acidify the soil and remove valuable minerals and nutrients from it and so retard the growth of plants and trees, acidic droplets cause browning or death to leaves and plants are less able to absorb sunlight, the coniferous forests are damaged. These rains increase water acidity in lakes and that causes the death of numerous fish species. The acid rain causes weathering, destroying of limestone and marble, monuments, statues, buildings, corrosion of metals, peeling of paints on surface, fading of textiles and aging of plastic materials.

REDUCING OF NITROGEN AND SULFUR OXIDES EMISSIONS

Reducing nitrogen and sulfur emission is a key factor for safeguarding the environment.

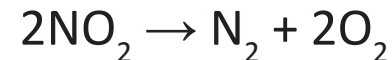
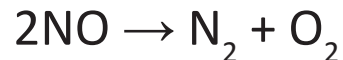
REDUCING SO_x EMISSIONS:

- Use of low-sulfur coal, natural gas or fuel oil instead of high sulfur-coal;
- Desulfurizing of fuel oil in the process of refining;
- Use of wet limestone process in electric power plants. The reactions „capturing“ the evolved SO₂ and SO₃ are as follows:



REDUCING NO_x EMISSIONS:

The emissions of these gases also result mainly from combustion. Some reduction of these emissions can be achieved by modifying the combustion process, by finer control of burning, better maintenance and tuning of auto engines and the use of catalytic converters. They lower the content of nitrogen oxides, CO and other pollutants in automobile exhaust gases – NO_x decompose into N₂ and O₂:



Also, if possible, electric engine with rechargeable batteries should be used instead of internal combustion engines.

Reducing air pollution and using environmentally friendly renewable energy sources can help to prevent the global warming and repair some ecological problems that mankind has caused the Earth.

CAN YOU ANSWER THESE QUESTIONS ?

1. What are the major environmental issues affecting our planet today?
2. Why is it important to monitor NO_x and SO_x emissions?
3. Why are NO_x and SO_x emissions harmful for the environment and for man?
4. Why can NO_x and SO_x evolved in the air cause acid rains?
5. Why do acid rains destroy marble monuments? Try to express the chemical reactions that take place.
6. How to reduce the NO_x and SO_x emissions?
7. Can you imagine what will happen if NO_x and SO_x are pumped in the air without any precautions and control?

18 METAL RECYCLING

KEY TOPICS

1. Why are metals recycled?
2. How are metals recycled?
3. Which metals are the most recycled?
4. Is it worth recycling metals?

KEY WORDS

- Metal recycling
- Metal scrap

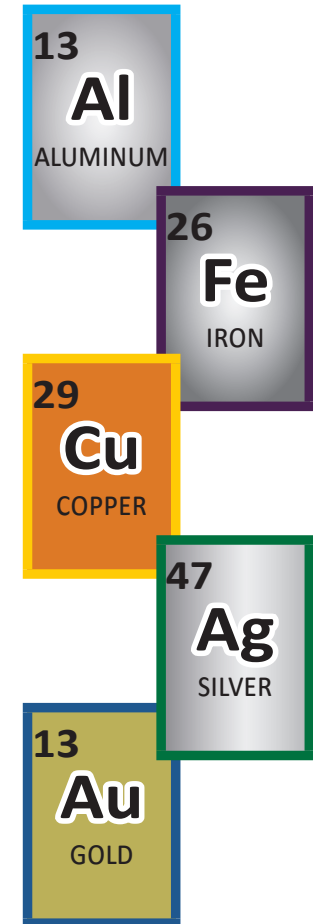


METALS AND ENVIRONMENT

Metals are one of the most important and valuable materials for the development of industry and in our everyday life. They are included in a lot of products that surround us and that we use every day. Metals are also applied in the manufacture of many other articles and materials that people use.

Since ancient times man has acquired the skills of mining ores and producing metals and their alloys of various applications. However, the resources of ores containing these valuable raw materials decrease and the production of metals which includes extracting, transporting, refining and purifying becomes more expensive. Furthermore, metals extraction has a negative impacts to the environment. Metal mining can affect the quality of air in the surrounding areas with higher levels of dust and gases, destroys the landscape which causes flooding and soil erosion, loss of biodiversity, air, soil and water pollution. etc. The habitants of these areas suffer from noise.

In order to minimize all these negative impacts people are urged to collect and recycle metals. Recycling is considered as one of the best solutions to the problem. Most metals are easily recycled and reused many times without altering their properties.



RECYCLED
REUSED

METAL RECYCLING IS A COST-EFFICIENT SOURCE OF RAW MATERIAL:

- **Reduces** the demand for mineral ores;
- **Transforms** waste into a useful resource;
- **Saves** energy and **decreases** extraction activity and its resulting negative environmental impacts;
- **Produces** fewer emissions of greenhouse (CO₂) and other harmful gases and requires less energy than producing new metals;
- **Reduces** the consummation of natural resources and limits the amount of metals that must be produced;
- **Reduces** the amount of wastes which go to the landfills and helps people to protect the natural environment.

The recycling of metals has become an important industry. The major sources of used metals are some metalworking enterprises, the motor vehicles, large steel constructions, railroad tracks, ships, farm equipment and domestic materials.

The most recycled metals are iron Fe and aluminium Al. Aluminium is one of the most used metals (light, corrosion resistant, conductor of electricity, etc.). Its recycling is very important and saves energy and money. The cost of re-using scrap aluminium is about 20 times lower than that of the pure metal produced from its ores. The energy savings when recycling aluminium and copper are 90 - 95% and for steel they are more than 50%.



HOW ARE METALS RECYCLED?

Metals can be recycled many times. This process includes the following main stages:

- **COLLECTING**
- **SORTING** - the collected scrap metals are first divided into ferrous and non-ferrous materials using electromagnets to separate iron-containing products due to their magnetic properties;
- **SHREDDING** - assures a large surface area which promotes the melting process by using less energy;
- **MELTING** - In large furnaces and under conditions specific to each type of metal;
- **PURIFICATION** and **REFINING** – removes the nonmetal impurities and ensures the high quality and the required characteristics of the final products;
- **SOLIDIFYING** – the melted metals are cooled and solidified and formed into different shapes (bars, plates, etc.) convenient for further processing;
- **TRANSPORTATION** – the recycled metals are ready to use. They are transported to various factories as raw material for the manufacturing of new products.

Metals are essential reusable resources and their recycling contributes to the sustainability of their use. Today about 30 % of metals are recycled – about 400 000 million tonnes of metals every year worldwide.

Recycling is something that everyone can do to help the environment.

CAN YOU ANSWER THESE QUESTIONS ?

1. Are metals a renewable resource?
2. Why is it worth recycling metals?
3. Do metals change their properties and qualities if recycled?
4. What are the main steps of the process of metal recycling?
5. What aluminum-containing objects do you most often use? Do you know which of them are produced of recycled aluminum?
6. Why are gold, silver and aluminum among the most recycled metals worldwide?



PROJECTS

1. HOW TO LOWER SO_x AND NO_x EMISSIONS?

Find out the major sources of SO_x and NO_x emission in Bulgaria. Draw down a map of the most polluted regions. Discuss several possibilities to improve the quality of life by reducing the amount of pollutant in the air.

2. ACID RAINS AND MARBLE MONUMENTS

Read more about the effect of acid rains on marble monuments. What should be done to protect them?

3. ALUMINUM – WHY TO RECYCLE IT?

Search and share more information about the recycling of aluminum. Why is aluminum one of the most recycled metals?

4. THE AIR WE BREATHE

What is the air composition? What are the main pollutants in air? How do they affect man health and nature? How to preserve air from harmful emissions?