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Chemical Treatment Methods for Types of Chemical and Environmental Pollution: Review

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Abstract

Developed countries have witnessed the industrial revolution and technological advancements, as a result, environmental pollution is steadily increasing, negatively impacting living organisms and life sources. The causes are well known, as are the solutions, but major industrialized nations are procrastinating and postponing implementation of solutions because it reduces their profits. To address chemical pollution: reducing the use of nuclear energy, disposing of chemical waste in proper ways, and focusing on green chemistry and environmentally friendly materials, are the solutions. Environmental pollution is no longer a local problem, or one limited to major industrialized countries. It has become a global problem due to its accumulating effects and the delay in implementing solutions. There are many other forms of pollution, such as light, electromagnetic, visual, acoustic, and even space pollution. Although these new forms of pollution, created by some major industrialized countries, are relatively recent on the human level and less prevalent than other traditional pollutants. At the commencement of the 20th century, social relations shifted from protecting themselves from environmental hazards to protecting the environment from its dangers. Before World War II, the production of harmful substances from sources increased. Various industries such as the manufacture of chlorine, pesticides, plastics, paints, etc., and large sums of money are spent to clean places of pollutants and harmful chemicals, in order to avoid their transmission to living organisms, especially humans, through the accumulation of pollutants of one of the components of the situation in which they are present (air, water, soil), even in small amounts and over period.

Keywords: Corruption, fumes, heavy metallic element, situation, echnological advancements

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INTRODUCTION

The use of nitrogen in fertilizers allows farmers to grow more food. With chemical pollutants ubiquitous in so many aspects of our daily lives, we have reached a point where the limits of our planet's tolerance are being tested, with the overuse of some chemicals causing far more harm than good. When mismanaged, toxic chemicals cause an alarming number of premature deaths and cause significant damage to human and planetary health alike [1–3]. Exposure to toxic chemicals reduces life expectancy, as chemical pollution takes various forms and has various repercussions. Therefore, water and air pollution by chemical pollutants and heavy metals are among the most dangerous types of environmental pollution, especially for the oxygen that humans need for life [4, 5].

Causes of Soil Pollution by Chemicals

Nitrogen fertilizers, often used to enrich agricultural soil with nutrients, are another example of chemicals that have harmful effects on people and the planet alike. Only 40% of the nitrogen is actually absorbed by crops [6, 7]; the remaining 60% is either released into the air or dissolved and seeped into water. This, in turn, can create large dead zones in water bodies, thereby eliminating wildlife. Chemical pollution is linked to the climate crisis, as climate change can increase the amount of unsafe chemicals in the environment. Other chemicals in our everyday lives are equally concerning. Cadmium, a chemical found in batteries, electronics, and paint, as well as some foods, affects cardiovascular health and can cause kidney failure and cancer. Asbestos, known to cause lung cancer and banned in most high-income countries, is still commonly used as an insulation material in some countries. Soil is considered polluted when it contains an abnormal concentration of chemical compounds that are potentially hazardous to human, animal, or plant health [8–12]. Contamination occurs either through the digestive system (through consumption) or through the respiratory system (dust from contaminated soil entering the atmosphere) [13, 14]. Most often, human activities are the source of soil pollution. For example:

- Industrial facilities can contaminate the site in the event of a leak, accident, or even an abandoned factory.
- The spread of pesticides, plant health products, and waste from livestock buildings and farms are sources of soil pollution, particularly nitrogen and phosphate, which in turn contaminates surface water runoff and, subsequently, waterways.

Types of Pollution

There is chemical pollution, radioactive pollution, nuclear pollution, heavy element pollution, and natural pollution from hospital waste, among other things. There are many other forms of pollution, such as light, electromagnetic, visual, acoustic, and even space pollution. Although these new forms of pollution, created by some major industrialized countries, are relatively recent on the human level and less prevalent than other traditional pollutants, they remain dangerous and can be just as harmful as traditional types of pollution [15, 16]. Air pollution leads to environmental degradation and exacerbates environmental problems. Water pollution occurs due to the presence of certain chemicals or hazardous foreign substances in the aquatic environment, such as lead, mercury, and sewage effluent, in addition to the chemical compounds found in pesticides and agricultural fertilizers. The United Nations warns that approximately 785 million people worldwide lack access to clean drinking water due to this type of pollution. Under the influence of these rays, some molecules decompose into active atoms, some of which combine again with oxygen molecules to form ozone. This process absorbs a large amount of ultraviolet radiation from the sun. Only a moderate amount reaches the Earth's surface, which does not affect the life of living organisms. Thus, the ozone layer, which forms in the upper layers of the atmosphere, acts as a protective shield that protects living organisms on the Earth's surface from these destructive rays [17–20]. The causes of the ozone hole in the atmosphere in general, and above the North and South Poles, are a variety of civil and military activities, the lion's share of which is concentrated in developed countries, to a large extent excluding developing countries. These causes include the following: harmful aerosols, jet aviation, and launching rockets into space. Pollution has clearly emerged as an environmental problem and a dilemma in human life since the beginning of the 19th century, coinciding with the expansion of human activity, particularly around urban areas, and as a result of the industrial Renaissance. The Industrial Revolution, which emerged in the 1940s, brought about changes in the physical, chemical, and biological characteristics of human life (the environment). This change had harmful effects on humans and their property [21–24], disrupting many of the previously balanced ecosystems, replacing them with harmful pollution that often encompassed all aspects of human life: material, health, psychological, and social [25, 26].

Pollution has become a negative manifestation of technological progress, pursued with all its might, without realizing that it has contributed, intentionally or unintentionally, to the most serious damage to the environment. Many organizations have become aware of the seriousness of the state of environmental

pollution today, and its imminent threat has become the primary concern of numerous scientific bodies and agencies. To arrive at an appropriate definition of environmental pollution, it must be firmly established that an environment conducive to life depends on specific specifications and standards that characterize the necessities of life within that environment or the milieu in which the organism lives. If additional factors that are necessary for life are introduced into this environment, suddenly or successively, the result is danger or harm to the organisms present in this polluted environment. Thus, pollution, in general, is: "The introduction of substances or energy into the environment, directly or indirectly, that can endanger human health or existing living organisms, harm vital resources and ecosystems, constitute an assault on life processes, or impede other legitimate uses of the environment". Thus, the concept of pollution includes any change in the natural characteristics of a medium (water, air, soil) such that it becomes unsuitable for its intended uses. This can be achieved through the addition of foreign substances, increased quantities of certain substances present in the medium under natural conditions, or the indiscriminate consumption of natural resources in a manner that is not replenished by the natural ability to regenerate. Simply put, pollution occurs when any substance or energy is present in the wrong place, time, or quantity [27–30]. It is evident from this that pollution can either be natural, arising from natural factors such as earthquakes, volcanoes, and floods, or it can be human caused, resulting from human actions due to increased emissions resulting from the exploitation of natural resources through the technology used [31–34].

The Harmful Effects of Environmental Pollution

Scientists say that outdoor particulate air pollution is responsible for health problems such as respiratory, lung, and heart diseases, and cancer. It also has a negative impact on fertility and fetal development. Globally, environmental pollution causes significant damage. Sulfur dioxide and nitrogen oxide are responsible for acid rain (snow, rain, fog, and dew that become acidic under the influence of these pollutants). This alters ecosystems, increases the acidity of lakes and rivers, and changes soil properties, thus threatening aquatic plants and animals. Alchemists in the Middle Ages suffered from debility and other diseases due to the harmful effects of explosive and toxic materials with which they worked. Serious environmental problems began to appear in Europe at the beginning of the 17th century due to dust emitted from mines, in addition to the production of dyes and other chemicals from coal tar in Germany during the 18th century [35–38], which led to the emergence of toxic and environmentally polluting secondary compounds. The quantities and numbers of chemical compounds produced in the 19th century increased steadily, including steel and iron residues, lead battery waste, and petroleum refineries. With them, the number of pollutants and harmful substances released into the environment increased. At the beginning of the 20th century, human concerns shifted from protecting themselves from environmental hazards to protecting the environment from its dangers. Before World War II, the production of harmful substances from sources increased. Various industries such as the manufacture of chlorine, pesticides, plastics, paints, etc., and large sums of money are spent to clean places of pollutants and harmful chemicals, in order to avoid their transmission to living organisms, especially humans, through the accumulation of pollutants of one of the components of the environment in which they are present (air-water-soil), even in small quantities and over time. This leads to chronic poisoning that a person does not feel until its concentration in the body becomes very high to the point of acute poisoning because of regular reactions occurring within the living body due to the mutual influence between the accumulated chemical substance and the living body. Oil pollution is one of the most important sources of pollution in marine waters, in addition to heavy elements such as nickel, lead, and mercury. Ammonia is one of the most prevalent river pollutants, resulting from factories or sewage discharged into rivers. Herbicides are also among the largest sources of organic matter pollution of agricultural land and groundwater. Nitrogen oxides are also released from the fermentation of nitrogenous fertilizers in the soil by bacteria, which leads to the depletion of the ozone layer that protects the Earth from ultraviolet radiation. The harmful effects of chemicals vary depending on their type, but the most harmful effects lie in two main areas: the toxicity of chemicals and their ability to induce cancer [39–41].

Chemical Pollution from Petrochemical Derivatives

Oil contains hydrocarbons and toxic carcinogenic compounds. Oil is considered one of the most dangerous pollutants, especially for the marine environment, as it floats on the surface of the water, either in an oily state or mixed with water to form an emulsion. Its light or volatile derivatives evaporate easily when exposed to the atmosphere. Oil moves on the surface of the water according to the movement of winds and water currents, and pure oil oxidizes. Note that the layer of pure oil or oil prevents gas exchange between water and air, making the process of dissolving oxygen in the water difficult and depriving aquatic organisms of the necessary oxygen. It also contaminates the sediments on the bottom after they settle.

One gallon of oil covers an area of 8,222 m^2 and forms a thin layer that blocks sunlight from reaching the water, affecting the growth of aquatic organisms such as fish and plants such as plankton. It is well known that a single liter of oil spill leads to the consumption of oxygen in approximately 422,000 l of seawater due to bacterial activity.

Clean air is the lifeblood of life on Earth, given that living organisms require the oxygen it contains. Therefore, air pollution with chemicals, which alter the quality and quantity of its components, is the most harmful type of environmental pollution to various types of life. The average length of time a substance remains in the atmosphere is called its residence time, and this period ranges from minutes to years, depending on the substance itself and climatic conditions. Chemical air pollution is attributed to several chemical pollutants, the most important of which are: carbon oxides (carbon monoxide and carbon dioxide), sulfur oxides (sulfur dioxide and sulfur trioxide), nitrogen oxides (nitric acid and nitrogen dioxide), in addition to other gases such as ammonia, hydrogen sulfide, hydrocarbons, and halogenated gases. Suspended particles (aerosols) are also considered chemical pollutants of the atmosphere. Carbon dioxide from fuels is considered one of the most important pollutants introduced into the air by humans. The ecological balance process that dissolves excess carbon dioxide in seawater and oceans forms a weak acid known as carbonic acid, which reacts with sediments to form bicarbonate and calcium carbonate. Plants also contribute to the use of a large portion of it in the process of photosynthesis. It is worth noting again that the excessive use of fuel, deforestation, and the reduction of green spaces have contributed to an increase in the level of carbon dioxide in the atmosphere, which may lead to a rise in the Earth's temperature, known as global warming. The increase in carbon dioxide in the atmosphere leads to difficulty in breathing and a feeling of congestion, along with irritation of the mucous membranes, bronchitis, and throat irritation [41, 42].

Effects of Environmental Pollution

The effects of environmental pollution are numerous and serious, affecting all living organisms, including humans, animals, plants, and even historic buildings.

- *Carbon monoxide (CO):* It causes respiratory disturbances, headache, dizziness, gastrointestinal disturbances, and suffocation. It is a deadly gas in high doses.
- *Fine particles (including pollen and tobacco smoke):* Allergy and increased sensitivity. The extent of their effects depends on the pollutants they carry.
- *Volatile organic compounds (including formaldehyde and benzene):* Suspected reproductive toxicity and suspected carcinogens.
- *Formaldehyde and benzene:* Proven carcinogens.

Experts propose solutions to avoid environmental pollution and its risks. These include reducing polluting activities and encouraging organic production while respecting environmental management and environmental protection (ISO 14001). At the same time, waste generation must be reduced and resource depletion avoided by all countries adopting waste recycling and processing. This gas enters the bloodstream and binds to hemoglobin, depriving the body's cells of the oxygen needed to burn sugars and produce the energy needed for the human body to function. This leads to poisoning, which

ultimately leads to death. Fertilizers, food additives, medicines, cleaning products, fuels, and other chemicals pose serious risks to both human health and the environment when used unsafely. They are essential for our food (fertilizers, food additives) and our health (medicines and cleaning products). However, these substances can endanger our health and pollute our environment if not used properly. The production and use of chemicals have become essential factors in the economic development of all developing and developed countries. Increased production means increased storage, transportation, handling, use, and waste disposal. This entire life cycle of a chemical must be taken into account when assessing its risks and benefits. Sulfur dioxide is a colorless, pungent, and foul-smelling gas. Sulfur dioxide in the air turns into sulfuric acid (H_2SO_4) because of its oxidation to sulfur trioxide ($3SO_3$) and its reaction with water vapor [42, 43].

Illegal Techniques of Clearance of Chemicals

Chlorofluorocarbons (CFCs) are used in liquid form in air conditioning and refrigeration units in home refrigerators. Incomplete burning household waste also releases these compounds into the atmosphere. These compounds are concentrated in the atmosphere 81 km above polar regions, and the amount of these compounds released into the atmosphere is estimated at more than one million tons annually. Many countries have become aware of the dangers of these compounds, and some have begun banning their production, such as the United States, Sweden, Canada, Norway, and others, since 1910. There are also attempts to replace it with other useful materials, including the use of a mixture of butane gas and water called aqua sol, which does not contain chlorine or fluorine [43, 44].

Methods for Addressing Environmental Pollution with Heavy Metals

- Avoiding the disposal of chemical waste into waterways and promptly treating wastewater before it reaches the soil or other water bodies. Wastewater can be reused for irrigating agricultural land, but without contaminating the soil or plants eaten by humans and animals.
- Eliminating maritime transport activities and oil spills into seawater or navigable rivers through burning or suction.
- Attempts to bury radioactive waste in specific deserts, as it leaks and threatens the safety of groundwater.
- Attempts to recycle some factory waste instead of discharging it into drains and allowing it to reach groundwater, as long as reuse does not cause harm.
- Periodic chemical and biological analysis of water by specialized laboratories is carried out to ensure water quality standards are met and that it is free of contamination.
- Reducing air pollution, which contributes to rainwater contamination and acidification, raises many interconnected problems [44].

CONCLUSION

To address chemical pollution: reducing the use of nuclear energy, disposing of chemical waste in proper ways, and focusing on green chemistry and environmentally friendly materials. Given the danger of chemical pollutants resulting from industrial activities, especially petrochemical industries, the government focused on isolating industrial areas during the structural planning phase of Iraq. It located industrial areas away from residential areas, created a buffer zone around them, and worked to plant trees in those areas. The General Authority for Industry focused on granting industrial licenses to various industries, taking into account their quality. It also played a major role in rejecting some industries with negative environmental impacts, such as the aluminium factory, which was sufficient to supply neighboring areas with aluminium panels. Iraq limited itself to the assembly industry of these panels. The General Authority for the Environment must monitor and control all types of pollutants (solid, liquid, and gaseous). In the field of industry, it conducts laboratory analyses of seawater samples and installs monitoring devices in fixed locations to monitor gaseous pollutants in Iraq. It also works to establish environmental controls and requirements to limit pollutant emissions from various industrial activities in country.

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