

# Original Article: Investigation of Photocatalytic Degradation Process in Wastewater Treatment Industry

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## ABSTRACT

In the recent century, with the advancement of technology and the development of technology, the construction of various tools that have led to effective and more accessible communication between humans and solving many of their needs, on the one hand, has promised an easier life, and on the other hand, excessive or incorrect use of these tools has destructive consequences for humans and the environment. A clear example in this field is the increasing growth of urban vehicles, which on the one hand has made it easier for people to travel in big cities, and on the other hand, it has caused a lot of pollution, including air pollution and noise pollution, and as a result, it has caused many physical and mental discomforts. Mental and even physical injuries can affect human behavior and affect the way he communicates with others and the environment around him. Of course, we should not neglect the fact that the negative effects of pollution will not only affect humans, but it can have destructive effects on all natural ecosystems, which are certainly not unrelated. No one can deny the fact that water pollution will have destructive effects on aquatic life, and humans who use these resources will not be spared from its destructive effects. Of course, perhaps as much research has been done in the field of physical effects of pollution, it has been neglected in the field of its behavioral effects. Maybe many people cannot make a connection between the two phenomena of pollution and behavior. Therefore, in this research, it has been tried to investigate the effects of these pollutions on the psyche and behavior of humans and other creatures as much as possible. Of course, it is necessary to provide a general definition of pollution and its types before this relationship is determined by the research that has been done in order to get a more accurate understanding of this issue.

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## Introduction

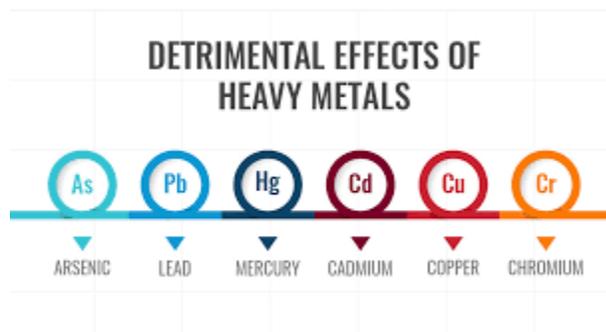
Pollution is any change in the characteristics of the components that make up the resources and life of living organisms in such a way that their previous use becomes impossible [1-3]. Pollution is caused by human activities and directly or indirectly endangers the interests and lives of living organisms. Pollution will cause damage to land, water, and air ecosystems as well as their natural functioning. Biological pollutants are very diverse and are man-made that exist in different forms and can affect different aspects of life. In fact, man causes his own destruction by his own hands. These pollutants directly or indirectly affect the health and quality of human life, and as it was said, they will exist in different forms [4-6].

## Heavy metals

In the industrial society, there is no escape from toxic chemicals and metals. In addition to the many dangers these substances have inside and outside the home, many jobs require exposure to these pollutants. Heavy metals in metallic form have no role in the body and can be very toxic. These metals may be released into the environment. They can be found in the air, drinking water, food or in a few chemical products by humans. There are several ways for these metals to enter the body. These metals enter the body through breathing or along with food or absorption through the skin, and if they accumulate in the tissues at a speed exceeding the speed of the body's detoxification mechanisms, over time they will reveal their toxic effects in the body [7-9].

It should be noted that very high concentrations are not necessary to cause poisoning. As toxic metals accumulate in the tissues of the body, after a while they reach their toxic concentration levels, this situation becomes a warning when we know what heavy metals do in the body. The

research that has been done on the effects of heavy metals emphasizes that these substances can affect directly by disrupting the brain and neurological factors. In fact, their effect will be on neurotransmitters, whose action will be the transfer of cellular messages to different parts of the body and changes in the performance of different metabolic processes inside the body. One of the important systems that will play a big role in controlling behaviors is the endocrine system. Heavy metals cause changes in behavior by affecting this system and disrupting its performance. In the end, heavy metals can be introduced as follows: Heavy metals are trace elements whose density is 5 times that of water (Figure 1). Therefore, they are stable elements, meaning that the body will not be able to break them down.



**Figure 1.** Detrimental Effects of Heavy Metals

## The effect of lead on children's behavior

An issue that has attracted a lot of attention today is the potential effect of high contact with lead and its effect on children's neuro-behavioral system. The results show that a lot of contact with this environmental pollutant will cause a decrease in IQ, a decrease in short-term memory, speech disabilities, a decrease in fine motor skills, as well as a decrease in the speed of reactions and a decrease in hand-eye coordination. Epidemiological research has also been conducted to determine the relationship between blood lead levels and behavior in childhood and infancy. Various studies in which the relationship between children's intelligence quotient (IQ) and lead in the environment have been investigated. Researchers have tried to

examine the relationship between full-scale gradation (IQ) in 5-year-old children and their body lead. To investigate this relationship, 26 researches that were conducted in the form of a mycological epidemiologist were reviewed and the final result was that contact with lead will cause a slight decrease in IQ.

### **The effect of lead on the incidence of antisocial behavior in boys**

Indeed, many criminal tendencies during adulthood can be formed before the child is born. According to the four-year research that has been conducted on young boys about the behavioral effects of lead and has been published in the form of articles, this issue has been well demonstrated. These studies were conducted on 800 boys from Petersburg schools and showed that those boys who had high bone lead levels were more likely to commit criminal acts and serious violations than boys whose bone lead levels were low [10].

Of course, none of these boys were physically poisoned by the amount of lead in their bodies. Also, in this study, a direct relationship was established between the amount of lead in the leg bones of children whose behavior was reported by parents or teachers and the amount of their criminal and impolite behavior.

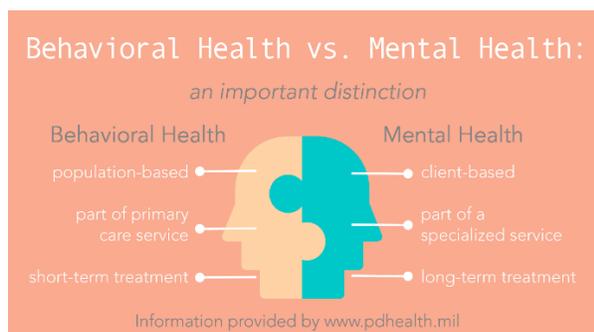
Dr. (Herbert Nidleman), a psychologist and professor at Petersburg University of Medical Sciences, has conducted other studies on the effects of lead and has noticed that even considering the factors that increase the probability of criminal and antisocial behavior. Among the economic, social and family status of those people who had a disordered state in this aspect, those who had a higher level of lead in their bodies showed more tendencies for criminal behavior [11]. Another researcher and psychologist conducted a long-term study on children's antisocial behaviors and concluded that many of children's antisocial behaviors and serious crimes committed by teenagers start from things like alcohol consumption and minor offenses.

Dr. Nidleman states: I do not say that lead is the main cause of social violations, but in my opinion, it is one of the most important factors facilitating these behaviors, and he also states that lead is considered a deadly poison for the brain, which prevents the transmission of nerve impulses and this factor itself will increase the risk of criminal behavior in children [12]. Of course, the previous studies that were conducted in relation to the effect of lead emphasized the intelligence of children and their growth rate and considered the level of lead in the blood as an indicator in the body. However, during the research conducted by Dr. Blinger, a lead researcher who was active in Shahr Bustan Children's Hospital, he stated: Contrary to many previous ideas, bone lead level can be considered a better indicator than blood lead level. For example, a child in a test to measure the level of lead in his body could have higher levels of lead in his bones, but not have a high level of lead in his blood, and he says that many criminal behaviors and serious violations that take place in the society can be due to environmental pollution around us and lead. It is considered as one of the most dangerous pollutants [13]. During the studies that were conducted on various family and social factors that were directly related to such behaviors, such as the economic status and family conditions, such as the number of children or the presence of both parents or one of them in the family, it was found that the amount of lead will be equally effective in the occurrence of antisocial behaviors.

### **The effect of cigarette smoke on behavioral and mental health**

Cigarette provides the way to enter the world of enchantment and addiction. In most cases, smoking can provide the basis for the use of other types of drugs for the user. In fact, smoking will cause the resistance behaviors of the smoker to decrease and the person without any resistance will strengthen the special desire and temptation to use drugs and seek pleasure from it. Studies by researchers show that there is a clear relationship between smoking and drug

addiction. Most of the people who are addicted to one of the types of drugs easily admit that the reason they got caught in the vortex called addiction was because of their initial acquaintance with cigarettes (Figure 2).



**Figure 2.** Schriever clinic welcomes new internal behavioral health consultant > Schriever Space Force Base (Archived)

### Biphenyl poly chloride

Poly biphenyl chloride is a mixture of unique chemicals. PCB compounds are created by connecting carbon atoms to the biphenyl molecule.

### Molecular structure of biphenyl poly chloride

This substance has long been discontinued in the United States of America, but despite this, a significant amount of it is still found in the environment. This substance has many physical and mental effects on humans. Its physical effects include skin rashes in adults and changes in the behavior of children's nervous system. The effects of this substance are not only limited to humans, but also affect animals and cause severe behavioral changes in them, and research in this field is still ongoing. PCB is found in nature as a clear yellow liquid or solid. Some of it evaporates when exposed to air. Unfortunately, this substance cannot be recognized by smell or taste so that it can be avoided (electric-safety. blog spot.com). Its brand name in the United States, known by this name, is Akler. It is used in the industry as a

cooling and cooling agent for transformers, capacitors and other electrical equipment, but its production was stopped in the United States in 1997 due to its harmful effects, but according to research, its remaining amount exerts its harmful effects on humans and animals [14].

### The effect of lead and biphenyl poly chloride on the behavior of rats

Both lead and polychlorinated biphenyl can reduce the quality of intelligence and normal behavior of children who are exposed to these two toxic substances. Scientists have used Ezrats to evaluate and find out the effective mechanisms of this substance. Then the behavioral changes of these animals have been compared with children infected with these toxins. LTP (Long-term potentiation) is an electrocardiographic measurement tool to measure detection ability. Scientists investigated the effects of these two substances on the brain of the unborn fetus, which is very sensitive to these substances. In this way, pieces of the brain were separated from two levels in the hippocampus and the effects of these two substances were tested for these areas [15].

The results showed that both of these substances reduced the cognitive abilities at the CA1 level in 30- and 60-day-old animals, but at the CA3 level, only in the 30-day-old animals, this ability was severely reduced. However, neither lead nor PCBs altered the basis of sympathetic transmission in low excitatory voltages. At high concentrations, these two substances exerted similar effects. Finally, this experiment showed that although these two substances are two completely different compounds, they exert similar effects on the brain, and the main of these effects are pharmacological and developmental. Behavioral studies of rats that were infected by eating fish contaminated with these toxins showed hyperactivity and a targeted decrease in functions compared to the control group, and it was determined that these substances exert a similar effect on behavior and the sympathetic system, and it is possible that these two

substances have compounds that act through a similar mechanism [15].

### **The effect of toxic pollution on behavior**

Pollution with poisons has a lot to do with psychology, because the effect of poisons on behaviors, developmental and cognitive processes is clearly known. Many chemical pollutants will destroy hormonal systems that will affect many human behaviors such as aggression, learning, motivation and reproduction. Many common pesticides can lead to developmental disabilities, behavior and depression. According to Penn, sometimes the severity of the negative effects of these toxins on behavior and cognitive function is not apparent. The discussion about the psychosomatic effects of poisons remains incomplete without education and showing ways of prevention. Many think that the impact of industrial pollutants is related to these businesses themselves, but the reality is that many of these substances are also found in common household products. But how can people be encouraged to stop using these substances? While the consumers of these products feel that they need some of these materials at home? But the answer is not only educating people about the hidden and dangerous effects of these substances, because a person may be aware of the dangers and harms of these substances, but use them because of his own satisfaction and others or necessity [16].

Behavioral studies are very promising in the field of discovering the lethal effects of these chemical poisons. Studies on the behavioral effects of these pollutants are still not well-founded. The methods that are usually used to determine the behavioral effects of pollutants are fish that are exposed to these pollutants and the tendency of fish towards that substance or avoiding it is recorded by researchers.

These tests are theoretically oriented to maintain the health of wild populations in the environment and are used to predict the long-term effects of these substances on the survival of individuals or populations. The ability of fish to avoid various pollutants has been proven by several studies. The researchers used several

different fish species in laboratory tests, each of which avoided a specific type of toxic metal. For example, Green Sunfish avoided Chlordicel while Lindon did not. Also, Fathead minus avoided cold water containing a lot of phenol. As mentioned, the preference or avoidance of a toxic pollutant is still not well-founded, but research suggests that petroleum hydrocarbons may cause the absorption and excretion of aquatic organisms.

### **Neurobehavioral effects of Methyl Mercury (MeHg) on infants and animals**

There are certain toxic chemicals that can affect the fetus before birth and cause abnormalities in the physical and mental growth of the child. Known agents that act as poisons in the body and specifically damage the central nervous system are called Neurotoxicants.

These toxins are considered a great danger to public health. There are many documents that can confirm the strong effects of these toxins on important parameters of children's behavioral development. Laboratory research has shown that humans are very sensitive to toxins such as lead, alcohol, and MeHg, and children who are continuously exposed to these toxins will experience severe physical, mental, and behavioral changes, and in more severe cases, it will cause their death.

In general, today, the effects of these toxins on the nervous system are being paid much attention. Although the number of these toxins is not small, here we will examine the behavioral-neurological effects of MeHg, which is considered a very dangerous environmental pollutant. MeHg is released as an inorganic substance in the environment. Among the natural sources that cause this substance to enter the environment, we can refer to industrial pollution, release of volcanic materials, burning of fossil fuels, mine laying, burning and incineration of combustible materials, etc. In addition to the mentioned sources, consumption of contaminated food such as fish can also cause this substance to enter the body [17]. It changes from inorganic form to organic form. The effect

of MeHg on premature infants and fetuses is very different from its effect on children and adults.

### The effect of mustard gas on chemical warfare veterans

During the imposed war, the Iraqi Baath regime repeatedly used chemical weapons against Iran. At the beginning of the war, the amount of use of these chemical weapons was limited, but later they were used on a large scale. Investigations have shown that most of these weapons included mustard gas and cyanide nerve agents. Considering that mustard gas was used widely and in high concentrations many times in war zones. This gas, with its acute and destructive effects, caused a lot of panic and worry in the injured and disturbed their mental health. In numerous studies that have been done on American soldiers exposed to mustard gas, significant psychological and behavioral changes have been seen in them. It should be considered that mental health is more than the absence of mental illness. The positive dimension of mental health, which has been emphasized by the World Health Organization, is included in the definition of health.

### The effect of air pollution on the behavior of plant parasites

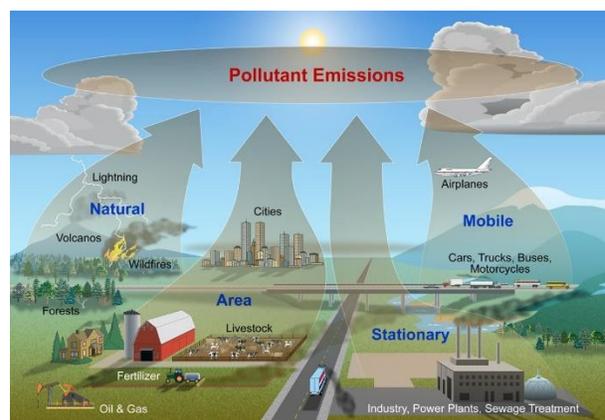
Here, the impact of pollutants on natural enemies, including predators, parasites and pathogens that directly or indirectly affect their host plants is evaluated. Parasitic insects are an important group of plant enemies that play a role in the biological control of pest plants. This study investigates the effects of air pollution (through  $O_3$ ,  $SO_2$ ,  $NO_2$ ) on the behavior of insects after being contaminated with these pollutants. Part of the test was done in filtered rooms free of air pollutants and in rooms contaminated with vapors of these pollutants. The tested parasite was *Asobara Sabobscara*. The analysis of the results of the chambers showed that  $O_3$  vapor will cause a clear reduction in the parasitic behavior of this parasite [18].

But for  $SO_2$  and  $NO_2$ , the results were not like this. In fact,  $O_3$  vapor reduced the percentage of

parasitic behaviors by 100%. The parasites that were in the filtered chambers and the chambers with vapors of the aforementioned pollutants, both groups avoided the injured non-host plants. But it seemed that the parasites that were exposed to  $O_3$  and  $NO_2$  had less ability to differentiate their hosts. This study suggests that perhaps these pollutants exert their effect on the responses that depend on the parasite's sense of smell. In general, it can be concluded that air pollutants, especially  $O_3$ , will have a negative effect on the searching behavior of parasites, which will reduce the effect of natural enemies that are necessary for the biological control of many pest plant species.

### Various ecological factors caused by air pollution and their impact on humans

At the end of this chapter, it is not bad to mention a series of ecological factors that will be affected by the environment in some way and see what effects these factors can have on humans. Heat and humidity: Both humidity and heat, like noise, cause negative reactions in a person. with the difference that because the scope of the person's influence on it is small and there is less ability to control them, they cause more aggressive behaviors. The noteworthy point is that if these factors are controlled, their adverse effects can be avoided or their severity can be reduced (Figure 3). [19].



**Figure 3.** Where Does Air Pollution Come From?

Part of these arrangements can be implemented during the design, such as considering the green spaces needed by cities. Congestion: Today, the ever-increasing population of cities and the

increase in their density, followed by the creation of noise and air pollution, are grounds for all kinds of behavioral problems and stress

### **Psychological and behavioral effects of noise pollution**

The impact of noise pollution on people's social behavior is quite visible. The amount of aggression increases in proportion to the duration and intensity of the noise. One of the bad effects of noise is the decrease in the performance of people who work in noisy places. Experiments showed that predictable noise makes people more stressed than unpredictable noise. Another harmful effect of noise is the indifference of people towards social indicators. Also, creating tension and stress in people who are placed in such places. Stress is actually the pressure that is imposed on the body due to changes in the environment. Some stressors are useful, but when they get out of control, the body will suffer from their harmful effects in various ways. Behavioral changes that stress, including stress caused by noise, can cause in a person, including excessive mental fatigue, nighttime sleeplessness, decreased irritability threshold, increased violence and aggression, decreased concentration, increased depression, anorexia or anorexia nervosa. And it will be... All of the mentioned cases have an adverse effect on people and will weaken their mind and body.

Of course, one of the body's ways to deal with stress is to increase the secretion of hormones that act as the body's natural response to stressful conditions. Epinephrine hormone is one of the hormones produced during stress and helps the body to have more energy to cope with new conditions as effectively as possible. Here, only the behavioral effects of noise are mentioned, but the physical effects of noise pollution should not be overlooked. Roger Masters says: Psychological-social-economic factors affect people's behavior, but not all abnormal behaviors can be justified by these factors. The available statistics about environmental pollution can justify the prevalence of antisocial behavior. In his research, he has investigated the statistics of

human crimes collected by the FBI organization, as well as the information collected about the chemical pollution of the environment in different areas. The environmental protection agency collects this information. After considering other variables such as population size and economic and social factors, this American researcher has realized that environmental pollution has an independent effect on violent and antisocial behaviors.

### **Noise in the workplace**

The noise of the working environment has been considered a very dangerous and dangerous invader because it destroys a large number of hearing cells every day. When a worker or employee feels that their hearing is reduced, it is already too late. Because ear heaviness or deafness caused by noise is irreparable. The damage caused by noise is not only limited to hearing, but also affects people's psyche and behavior. In the environment where there is noise pollution, people will show their own reactions which indicate that their mental health and behavior are at risk. Today, it has been proven that even the fetuses of women who work in noisy environments, such as factories, are more exposed to damage than other women, and later they will suffer more academic failure in school. Noise pollution in the workplace can seriously endanger the safety of workers and employees.

Because it does not allow people to hear the suspicious sounds of devices and the cries of colleagues for help and the sound of factory alarms. Likewise, the decrease in concentration and the resulting decrease in the quality of work and the reprehensible attitudes of the employers can have an adverse effect on the mental health and behavior of these people. The noise of the working environment affects the family life of these people. When these people return home, they are so tired that they don't even bother to leave their house to have fun with their family to see and visit family, visit city parks and walk around for a few hours. These people are gradually isolated and their mood decreases. It is certain that this type of life will be very difficult for these people and their families.

## The effect of underwater sounds on the behavior of marine mammals

According to the research conducted, the aquatic life of the Mediterranean Sea is threatened by human activities such as fishing, excessive shipping and noise pollution. For example, chemical pollution that can cause the pollution of all food networks in this area or noise pollution that will affect the aquatic life itself. The underwater environment has special features and the creatures of these areas have compromised with these features. Mammals that live in these areas have privileges such as living in low light. However, different sounds can be propagated in this logic for very long distances. Marine mammals use these sounds to investigate the environment and find prey and attack it. But the effect of sounds of the sea environment is a new and very interesting topic for scientists. Of course, the information in this field is very limited and recently many studies are being conducted in this field. Among these sources, we can mention the sound of large and small passenger ships, sea drilling, sound produced by exploratory submarines (sonars), oceanographic experiments, marine explosions and many other sources. But there are sources of sound production in the sea environment itself, such as water, rain, wind, earthquake, etc. It is clear that all these will affect the life of animals in these areas in various ways.

### Water noise pollution and suicidal behavior of dolphins

It was in September of 2007 that journalists reported the suicide of dolphins in the southern waters of Jask city. The reason for the death of these dolphins has not yet been determined, but the news of the death of other groups of dolphins, which reached a total of 150 dolphins, surprised the community of environmentalists and mariners. After this incident, many studies were started on the cause of dolphin suicide. At the beginning of the studies, various reasons such as fishing, marine vessels, pollution of the waters of the Persian Gulf, and in some opinions, suicide as the cause of death were investigated. According to some experts, in some coasts of the world, these beautiful mammals get stuck on the beach and a large number of them perish, and

the causes of this phenomenon are classified into two categories: Natural and human.

- Natural factors include storms, sea currents, high tides, and shallow beaches, slope, steep sandy beaches, infectious diseases, predators, feeding from the coastal area and poisoning due to algal blooms
- Human factors include oil and gas discoveries, sound activities, radar sounds in military ships, sea water pollution, fishing and shipping.

According to experts, all these factors were investigated in this environmental disaster.

### Water pollution

Any substance that prevents the natural use of water is considered as a water pollutant. The Environmental Protection Association of the United States of America has estimated that approximately 1.3 of the water flow is clearly polluted and the principle of water quality has been disturbed.

### The effect of chemical solvents on behavioral health

About 49 million tons of organic matter are produced in the United States. Solvents, despite their many uses, will have adverse effects on the health of the human body and mind. Solvents affect the nervous system, liver and kidneys. The neurological effects of the substance are related to solvents with psychoactive properties that have obvious effects such as confusion and dizziness. Chronic effects that can be caused by non-recyclable solvents include the reduction of mental activities. The suppressive effects of chemical solvents are now well known. Some solvents are used as intelligence.

Solvents' ability to cause irritation will cause the most damage to health. The acute effects of solvents are in their cognitive methods, and solvents affect the brain function with different intensities according to their concentration.

These substances can cause it to sting and not stop. Exposure to high concentrations of these can cause initial side effects of drugs such as confusion, dizziness, nausea, para stasis, increased salivation, and tachypnea. These symptoms are immediate and disappear quickly, of course, if the treatment is done. There have been researches on retirees or researches related to the disabilities of people exposed to these solvents. In general, the risk of disability in neurobehavioral diseases has been seen to be high. In order to compare the two groups of painters and roofers, they considered the ceilings [20]. According to the research that has been done. Nervous asthenic syndrome and organic affective syndrome, to express the symptoms of employees exposed to chemical solvents and words such as case control between occupational exposures and mental complications of people who needed to be hospitalized, medical disability was seen in chronic neurological complications of mental diseases and brain damage. The gradual development of these symptoms has caused them to talk about personality changes or personality disorders, which are evaluated by standardized personality tests.

### **Behavioral effect of lead acetate in black catfish**

In this study, the acute toxicity of lead was investigated in the aqueduct fish. Experiments were conducted with 15 control treatment groups in 20-liter aquariums based on E, C, D, 0 methods and in a static manner. For this purpose, 580 pieces of black fish with an average size of 12.28 and an average weight of 16.64 were used. After determining the amount of losses during 95 hours, 50 LC of lead acetate was calculated using standard statistical methods. Based on the results, the average lethal concentration of 50LC of lead acetate on the tested fish at time intervals of 24, 48, 72, 96 hours in light water is 333.9, 10.10, 992.594, and 7.575 (PPM) respectively.

Meanwhile, the lethality range was determined with a minimum concentration of 4 PPM and a maximum of 5.12 PPM. Lead acetate was toxic to black fish in light water and had little toxicity in

heavy water, which is aqueduct water. This problem can be due to the high tendency of lead to react with solutes, especially carbonates and calcium. The toxicity of lead decreases drastically with increasing water hardness. Calcium probably has protective effects against it by inhibiting the absorption of lead, and this is the reason for the resistance of black fish to the pollution in the aquatic habitat of this creature. Also, in this experiment, it was found that those black fish that were poisoned with lead acetate showed unusual behaviors. These behaviors include extreme impatience and fast rotation of this fish [21].

### **The behavioral effect of copper on aquatic organisms**

During a study, they investigated the behavioral effect of copper in concentrations that were lethal to the tested species. This study was done on the aquatic species Nauplii Barnacle. In this study, swimming distance and light orientation were investigated in this creature. The experiment was conducted at three temperatures of 15, 20, and 30 degrees Celsius and salt concentrations of 15 and 30% with different concentrations of copper. The results obtained during this research showed that when concentrations lower than the lethal limit of copper were used, the swimming speed of this creature decreased and this decrease increased with increasing copper concentration. At 30% concentration, two concentrations of 50 and 100 ppb) were added and it was observed that in these conditions the amount of positive photosensitivity responses decreased. When the concentration of copper was increased to 150 (ppb), negative phototropism was observed.

In general, at concentrations of 100 (ppb) copper, the optical behaviors of this creature decreased, and at a concentration of 150 (ppb), these movements were no longer observed. A group of individuals of this species were exposed in the conditions of 15% salt and 150 (ppb) copper concentration. The obtained results proved that copper as a biological pollutant can have destructive effects on the swimming behavior and photosynthesis of this creature. He generalized these results in a wider

range to other planktonic species and investigated whether copper will apply the same changes on their behavior or not? Also, the importance of these effects from an ecological point of view should also be investigated [22].

### Light pollution

Scientific definition of light pollution: Light pollution is the unwanted illumination of the night sky that is caused by human activities. It can also be considered as artificial lights, which are out of standard at the wrong time and place and disturb the environment and the night sky. Giver makes Light pollution is a broad term that refers to many problems. All those things that are created by the unnecessary use of light.

**Inappropriate time:** Lighting may be used at an inappropriate time when there is no need to keep the place lit at that time. So, if we have as much light as we need, but we still use the lamp, this can be an example of the inappropriate time of light pollution.

**Inappropriate place:** In today's world where energy has a special value, accurate calculations have been made on the optimal consumption of all types of energy, including electricity. According to each type of activity that requires a certain place to perform, standards of the amount of light have been defined for each place, and not considering these standards and using light in a tasteful manner will definitely cause light pollution. Special types of light pollution

- Opposite light;
- Illumination of an entire area;
- Rays of light to the sky.

**The quality of light:** Depending on the type of work we want to do; the type or quality of light is different. You must have come across the fact that the color of a fabric cannot be easily recognized in artificial light, which is called color appearance. The closer the light spectrum is to sunlight; the more appropriate color we will see around us. Light pollution can be seen in different areas. In fact, light pollution is a worldwide problem that can be easily seen in

industrial and population levels such as in many parts of Europe, Asia and North America.

**Effects of light pollution: The main effects of light pollution are divided into three categories.**

- Effect on humans;
- Effect on animals;
- Effect on plants.

**Effect on humans:** A hormone called melatonin is secreted in the human body, which is responsible for the growth of cancerous glands in humans. Melatonin is a hormone that is produced in response to the dark and light periods of day and night. Melatonin regulates other hormones in the body. This hormone regulates the 24-hour rhythm of the body's performance and responses. This hormone also controls and regulates the release of female sex hormones and will be effective in the behaviors related to menstruation, puberty and menopause.

**Behavioral diseases:** Since the internal clock of the body, which controls biological systems and behavioral systems such as the sleep-wake cycle, body temperature regulation, etc., is in sync with the time of sunrise and sunset. Any kind of artificial light that creates a disturbance in the darkness resulting from the absence of the sun or the moon can cause depression, increase stress, reduce concentration, weaken the immune system and reduce the threshold of human tolerance.

**Effects on animals:** The types of lights that illuminate the living environment of animals can disrupt their concentration and mating and make it easy for predators to catch them in many cases (such as butterflies and fish), which in turn disrupts the cycle of nature and the behavior of animals to be Artificial light will weaken the ability of orientation and confuse the path of nesting and migration in birds. Also, the red and blue lights of tall towers will attract birds and eventually cause them to collide and kill them. In general, light pollution weakens the ability of

orientation and disrupts wayfinding in birds [23].

**Effect on plants:** In a general classification, plants are divided into two categories: light-loving and shade-loving. For shade-loving plants, 27 luxes and for light-loving plants 4200 lux of light during the day is enough. But shining laser lights in the fields and bringing any artificial light to the trees will upset the balance of the plant and endanger its life. One of the behaviors of plants is to stretch their stems towards the light, which will cause undesirable growth in plants. Finding lasers that shine towards the sky or colorful and rotating spheres that rotate freely in the space outside the stores or huge projectors that are used to illuminate the facade of a building are limited examples of light pollution [23].

Of course, the light by moving on the front and the welding light are also among these. But the fighters of light pollution are not against the use of light lamps, but emphasize the correct and standard use of it. It is necessary that the light rays outside the houses shine down, not to illuminate the sky and the stars. Since 1980, there have been moves to learn more about light pollution [24]. About the role of this type of pollution on the environment and its inhabitants and the ways that will lead to reducing or increasing its effects. Light pollution remains unknown and requires more investigations regarding its behavioral effects on humans, animals and plants.

### Conclusion

As it was observed, pollution of any kind, in addition to physical damage, can bring psychological damage and then behavior, and it was determined that the mechanisms of pollution influence behavior mainly through the effect on the endocrine hormonal system and disrupting the action of the chemical media message of the face will take meanwhile, it is not only humans who will suffer behavioral damage, but this issue includes the state of all creatures. Among the birds, under the influence of light pollution, they will lose their migration and nesting path, which they do instinctively and very skillfully in natural conditions. In this

research, by showing examples of the effects of pollution and the destructive effects that can leave on the mind and behavior, it was tried to draw more attention to finding useful solutions to reduce these pollutions.

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### Conflict of Interest

There are no conflicts of interests.

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