

## Review Article

# Water pollution and industries

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### Abstract

A review of literature on various kind of waste from industries which are exploiting the aquatic life and its control measures along with the description of Ganga's pollution due to sectors describe in this review paper. In Cleveland's Cuyahoga River, the fire was observed in 1969 due to the pollution by industrial wastes. This river was not polluted before the industrial wastes. Water constitutes more than half of our planet, and it is getting polluted day by day due to different causes including human activities, one of the most limelight is industrial chemicals and wastes. Generalize view of water pollution and its sources along with a description of polluted groundwater elaborating its side effects. The colored wastewater from industries and its biological, chemical, and physical methods explains to control water pollution. Effects of industrial water pollution are very harmful to animals, plants as well as human beings, which may cause severe kinds of diseases, including stunt growth and skin cancer. Other factors, including pH, light, turbidity, and temperature of water bodies, are also affected by industrialization and, in return affecting aquatic life, including flora and fauna. Proper treatment including physical, chemical and biological techniques for the control of water pollution due to industries apply for the welfare of society. The principal goal is to spread knowledge about water pollution from industries and their control measures.

**Keywords:** Aquatic life; Groundwater pollution; Ganga; Industrialization; Turbidity

### Introduction

Water is the most critical component of this Earth, which is necessary for the survival of life on this planet. Water is that essential and mandatory part which constitutes about 75% of our world, Earth the Earth's crust. It is one of the vital natural ingredients needed for the survival of all kinds of lives present on the surface [1, 2]. Water is a critical component that we can find in all the three types of state or forms of matter that are liquid, solid, and

gas. But the main issue is that this natural source is affected by different kinds of natural and anthropogenic activities performed by human beings. These are changing water by releasing harmful chemicals, organic and inorganic products, which are directly or indirectly affecting this natural source of water very severely. As a result of which the properties of freshwater and the human beings living in this water are affected adversely by getting in contact with

these chemicals, which may include pesticides [3].

The disposal of wastes does the contamination of water bodies into it. The waste product may contain various kind of pollutants which may be thrown into the water body by not doing its direct or indirect treatment [4]. Different types of harmful chemicals from the industries cause life in the water body to get destroyed by the action of these toxic chemicals with the physiological system of the living beings, including animals as well as plants [5].

One of the most significant origins of water pollution is due to the wastes from the industries and sewage [6]. Through different researches, it proves that the primary cause of all this pollution by the addition of harmful material in water bodies is mainly because of the human activities (anthropogenic activities) rather than the natural or geogenic processes [7]. In many developing countries, it is proof that the primary source of degradation of water bodies is the massive rate of growing industries and urbanization as well. Due to the presence of these chemicals in water, it became unhealthy for the drinking purpose. The availability of inadequate drinking water for survival is causing harm to the economy of the country. It harms the ecosystem as well as the overall human health. [8].

#### **Water pollution**

Due to water, the possibility of life is only on Earth. Sea consumes 96.5% water, glaciers, and Earth surface 3.5%, and domestic water is only 0.07%. Most human activities, increasing inhabitants and industries (paper, leather, cosmetics, etc.), are involved in polluting water. These contaminants present in water are death-causing and affects many water bodies by damaging their body parts [9, 10].

Polluted water is a global issue. It causes demise and disorders on the worldwide level and death of 14000 people per day [11, 12, 13]. Emergent nations and developing nations, both are affected by polluted water [14].

#### **The point and non-point sources**

If the origins of contaminants are familiar, these are point source e.g., tube, manufacturing, drain pipe, etc. [15]. It is notable as compared to the other pollution origins [16].

If the origins of contaminants are not familiar, these are non-point sources [17]. It is hard to manage as, and it has multiple roots e.g., manufacturing barren, plant food, etc. [18]. In USA, it is the main reason for polluting water. Point and non-point sources can be treated by biological physical and chemical methods which are described below in detail. Purification, adsorption, ultrafiltration and centrifugation are some common techniques which can be used to remove waste from water and make it clear. These techniques are used for the treatment of both pollution from point and non-point sources. [19, 20].

#### **Pollution of ground water**

When contaminants (bacteria, viruses, protozoa, etc.) enters into the mass of water, it causes contamination of groundwater. When polluted water comes to the underground, it makes it unhealthy for drinking and domestic purposes. Different disorders like Cholera etc. are created by using contaminated water [21, 22]. In Romania and Bulgaria, nitrates enter groundwater and give rise to childhood diseases, also known as a blue baby. When the amount of nitrate rises above 10 mg/L, the chance of syndrome also rises [23, 24]. Plant food containing a high amount of nitrate is also the factor of water pollution. The plant uses only a small amount of nitrate while most of the nitrates assemble in the ground that then enters groundwater [25-27, 29]. Fluorides polluting water affects the teeth and bones [30].

#### **Colored wastewater from industries**

Various colored components utilized in routine. Many kinds of industries (paper, textile, leather, food, makeup products, medical industry, etc.) use color in their products. When these factories emit their excess into the water, it causes pollution of water. Fabric factor, paper industry absorbs

the excess amount of dyes and energy [31]. The paper industry emits waste in water and causes damage to aquatic life by generating toxic colors, products, slime, etc. [32].

The constituents of sewerage depend upon coloring agents used in factories or on the final product. Factory utilizes various types of yes, including sulfur, acidic, basic, liquefy and swing solids, etc. Manufacturing uses over 1 million dyes to generate 70,000 tons annually [33].

#### **Treatment for colored wastewater**

The publication review discloses the ways and processes to eliminate dye from water. These acts physically, chemically, and biologically. [14].

#### **Physical method**

It includes the adsorption method, filtration method, coagulation method, etc. colored wastes usually apply by the partition method. Reverse osmosis, Nanofiltration, and Ultrafiltration utilize for the recycling of water. Sieves used according to the size of the contaminants [35].

#### **Chemical method**

This method applied with the oxidizing agents to remove dye from polluted water. These agents are ozone, hydrogen peroxide, and permanganate [36].

#### **Biological method**

In this method, dye removed with the help of microbes that are particular for their dyes called anaerobic process. This method demands space, time, and shows sensitivity to some agents. This process not completely removes all stains [37]. In the wastewater of tannery, paper, textile manufacturing, etc. fungal performs its significant role in degradation [38].

Degradation by fungal is more effective as compared to the deterioration by bacteria either to highly polluted water or too poorly contaminated water [39, 40]. It proves that dye having an aroma compound in itself shows a non-cooperative towards aerobically degradation [41]. Azo reductase is the enzyme that generates aromatic amines from the azo compound by breaking it [42].

#### **Industrial pollution in Ganga**

In India, the largest river is named Ganga, which moves through the area of different cities and falls into the Bay of Bengal. It flows through the plains of India. The plains include West Bengal, Bihar, Jharkhand, Uttar Pradesh, and Uttara hand [43]. Ganga is the 15th largest river in Asia, and it is 29th in ranking in case of the whole world [44].

In the river, Ganga different industries, including tanneries, dying factories, pesticide units, coal factories, dairy farms, rubber factories, paper, and pulp industries, jute and sugar mills, thermal, textile, and electrical industries discharge their waste [45]. It observes that a vast amount of waste is present in the basin of river Ganga [46].

Just before Kanpur, the contamination of Ganga studies, and it has been showed that when we move from upstream to downstream, then the level chromium derived from industries increases with the effect of the season as well, which in lesser in monsoon and the higher rate found in summers [47]. During the study of contaminated water of Ganga, it observes that chromium is higher at the Jajmau. Just beside Jajmau, the higher amounts of Pb and As are found [48]. Other than Cr, there are many different metals released from industries into Ganga, including Pb, Cu, Mn, and Zn also [48-51]. Along with tanneries, effluents from other industries are too washed out into Ganga [52-55].

The observation of chemicals according to different seasons and specific sites of Ganga are also studied [56-58]. A considerable amount of Mn, Ni, Fe, and Cd observes at different locations of Ganga [59]. It has clearly shown that heavy metals are exceeding the WHO limits in the Ganga River [48, 52, 60]. One of the primary sources other than industries is the agricultural runoffs after the irrigation process. The level of Hg observes, which was maximum in West Bengal [61].

#### **Effect of industrial pollutants on water bodies**

Industries release the heavy metals which reach to different kind of areas including

water bodies and harming the biotic life within that aquatic body. The heavy metals which are released by the industries harm the animals, humans, and plants as well in either a direct or indirect manner. When these heavy metals or chemicals from industries rise to a limit, it may damage the whole ecological system and make water toxic as well as harmful to drink [62].

Different chemicals from industries cause various kinds of diseases. For example, arsenic present in the water bodies is causing infections in people of that area. Conditions include skin cancer, keratosis, and hyperpigmentation [63].

In a study, it notices that water was drunk by children, which contain 0.8 ppm of arsenic. As a result of this, the children got a different kind of skin diseases. In some cases, it also observes that death occurs after drinking arsenic-containing water for some time [64]. Cases of skin cancer were also noted in Taiwan, where well-containing arsenic was present. In this area of Taiwan, black foot disease and keratotic lesions were also observed [65]. Well containing arsenic was also noticed in the USA, which has a high content of sodium bicarbonate [66]. In another case of the USA (Utah, Millard Country), skin cancers observe in people of that area where arsenic is was found [67].

Different types of heavy metals discharging from the industries are causing directly or indirectly affecting the geochemical cycles of our environment. The elevated level of metals like arsenic is also affecting the deep groundwater [68]. Some of the heavy metals are very important for the survival of plants, but when they cross a specific limit, they may cause severe kinds of diseases. These metals include zinc, copper, molybdenum, nickel, manganese, and selenium [69].

It observes that the production of heavy metals is increasing day by day with the increase in industrialization. The chemicals from industries usually constitute of heavy metals [70]. Heavy metals have adverse effects on the health of animals, plants as well as human beings. It is tough to remove heavy metals from land and water because

they are found all around and increasing due to industrialization, which is necessary for the development of any state [71, 72]. There are many types of industries found all around, which are releasing harmful material in water bodies daily. Some of these industries include ghee, food, and chemical manufacturing industries [73-78].

In wastewater treatment, in the case of biological and chemical processes, there is an excellent effect of pH [79]. Most of the industrial effluents that are acidic disturb the stability of the water body by changing the pH. As a result of this, the overall water's fundamental properties are disturbed severely [80-82].

Those industrial effluents which have higher ranges of CODs and BODs play a crucial role in the life of aquatic biota. When these chemicals from industries enter the water body, it decreases the oxygen-carrying capacity of water. The oxygen can't reach the flora and fauna present there. As a result, death may occur [78, 83, 84]. When reliable content is higher in any water body due to industrial waste, the light passing capacity will reduce. As a result of which the microorganism present in the water body will not continue their normal functioning of purifying the environment [85].

Another critical factor that can affect the beauty of the water body is turbidity created by industrial waste. It also plays an adverse role in light penetration by providing a cloudy or muddy look [86]. Another scientist explains that water containing waste material disturbs the activities of microbes within the water body and also the pH, which affects the metabolic processes [87, 88].

Temperature is another factor that increases due to the addition of factorial water after passing from different types of machinery and releasing in the water body. It increases the temperature of the water body and some aquatic biochemical reactions [86, 89].

#### **Treatment**

Before the removal of waste products and spreading it into the water bodies from the industries, it must purify well. For this

purpose, we can use biological as well as the physiochemical integrated processes [90]. For the separation of waste products, one of the names of the essential techniques as adsorption. Adsorption chromatography is also well known for the termination of the complex mixture. This technique has a high rate of selectivity so that it can separate the industrial wastes [91, 92]. Heterogeneous catalysis is a process that uses in the chemical industry has one of the most critical steps of adsorption [93]. This technique of adsorption also uses to remove pollution from the water bodies, which is occurring due to the presence of different kinds of pollutants, including surfactants, dye, and various types of metallic species. We should take measure to control this pollution. [93].

For the treatment of water having higher salinity is done by the process of solar heating. As a result of this process, the concentration of salts and other harmful organic compounds concentrates as a result of which the volume of the industrial harmful saline content reduces. As a result of which the water turns to healthier conditions for drinking purposes and other daily use. This process of removing industrial saline waste from water uses to treat the wastes from hides and skin, which are soaked in the leather industries [94].

A unique process uses to move out the colloidal COD from the harmful industrial water. This technique is named as coagulation-flocculation. It practices in the case of cuttlefish, and the turbidity of water also reduces by about 90% [95]. Hard water can also be treated or converted into soft water by using the ion-exchange technique in this process of ion exchange the cationic, as well as the anionic exchangers, are used to reduce the salt concentration. One problem is there that ion exchangers are expensive devices to use [96].

Membrane techniques can also use to treat industrial saline water. It process removes particular molecules based on the electric field or difference of pressure or concentration gradient. Ultra-filtration can

use to remove the colloidal particles, but salt cannot remove by UF. In a study, it observes that proteins recycle from seafood by using ultrafiltration [97]. If we use centrifugation along with Ultrafiltration, we can separate up to 90% of colloidal particles from the industrial wastewater in the water bodies [98]. By doing comparative study we come to know that membrane techniques are best to remove wastes from water but it is quite expensive so we can use filtration, centrifugation and other purification techniques as well. [98].

### **Conclusion and recommendations**

Water is a vital component of life on Earth. With the development of any country, the water is getting polluted. Industrialization is increasing and causing pollution within water bodies along with surface and groundwater. With the increase of this pollution, there are several harmful effects, including many types of diseases. The aesthetic value of water bodies is also decreasing. Human beings, along with animals, are affected directly or indirectly by industrial water pollution. The rise in temperature is disrupting the metabolic processes of aquatic biota. pH change is also making unstable conditions in water bodies. With an increase of turbidity, the oxygen supplement reduces to deep water species. Different kinds of diseases are occurring in animals as well as human beings. The process of growth is affected by the polluted water. Proper techniques have been discovered to control the industrial pollutants, which may harm humanity in one way or the other. These techniques are described in detail, above in the main text. As water is the main constituent of our life, we must keep it clean for better survival. There should be awareness campaigns for clearing the water, and one must follow the precautionary measures for preventing pollution. Authorities should make the rules and legislation to control industrial water pollution. Substantial fines charges in case of violation of rules/ laws related to environmental stability. Heavy metals should remove as the wastewater from

industries is discharging. Ultrafiltration should be done for the wastes of all the industries so that it may affect very less on the ecosystem. The treatment techniques should be strictly used by every industry to maintain a healthy environment. Enterprises built away from the residential areas so that the human being and other animals get less affect comparatively. Every sector should strictly follow the rules and regulations formed by higher authorities for control of water pollution by industries.

#### Authors' contributions

Conceived and designed the experiments: A Arif, F Arif & SZ Malik, Supervised and mentored Designing: MF Malik, Execution of research: MF Malik & A Arif, Analyzed the data: F khurshid, A Afzal, S liaqat, A Aslam & A Arif, Contributed materials/ analysis/ tools: DM Ch, R Javed, K Nisa & K Mumtaz, Wrote the paper: A Arif & F Arif.

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