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WATER POLLUTION OF WORLD AND HUMAN HEALTH

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ABSTRACT

In the twenty-first century, water deficiencies are a massive obstacle for mankind. Here, we look at the many types of aquatic pollutants, their impact on human health, and how to protect freshwater resources from contamination. Chemical pollution is emphasized, especially inorganic and organic micro pollutants such as hazardous metals and metalloids, as well as a wide range of synthetic organic compounds. Some elements of waterborne illnesses are also addressed, as well as the urgent need for better sanitation in poor nations. The study looks at recent scientific advancements in dealing with a wide range of contaminants. It's divided into sections based on the many temporal and geographical dimensions of global water pollution. For more than five decades, persistent organic pollutants (POPs) have had an impact on global water systems; throughout that period, geogenic pollutants, mining activities, and hazardous waste sites were the most significant causes of long-term regional and local water pollution. On a regional to local scale, agricultural chemicals and wastewater sources have a shorter-term impact.

KEYWORDS: *Agriculture, Geogenic, Micropollutants, Mining, Pathogens, Wastes.*

1. INTRODUCTION:

Many of humanity's main challenges in the twenty-first century are linked to issues of water availability and/or quality. Climate change will exacerbate these issues in the future, resulting in greater water temperatures, glacier melting, and an amplification of the water cycle, possibly leading to more floods and droughts. The most immediate and severe effect on human health is the absence of better sanitation, which is linked to the lack of clean drinking water, which presently affects more than a third of the world's population. Exposure to infections or chemical toxicants via the food chain (e.g., as a consequence of irrigating plants with contaminated water and bioaccumulation of toxic chemicals by aquatic creatures, including shellfish and fish) or while leisure are examples of additional risks (e.g. swimming in polluted surface water).The contamination of freshwater resources, such as lakes, rivers, and groundwater, is the subject of this review [1]. Chemical contamination is being given greater attention as a result of many studies that have lately emerged that address all elements of waterborne illnesses in depth.

More than a third of the world's available renewable freshwater is utilized for agricultural, industrial, and residential uses. Given that the majority of these activities result in the contamination of natural water with a variety of synthetic and geogenic natural chemicals, it's no wonder that chemical pollution of natural water has become a significant public issue in virtually every country. Indeed, according to a 2009 Gallup survey, drinking water contamination is the most serious environmental issue in the United States. The relatively modest number of macropollutants, which usually occur at the milligram per liter level and comprise nutrients such as nitrogen and phosphorous species, as well as natural organic components, may be classified into two groups. Although the origins and effects of these prevalent traditional contaminants are very well known, developing long-term treatment solutions for them remains a research problem High nutrient loads, for example, may result in increased primary biomass production, oxygen deprivation, and hazardous algal blooms. Another long-term issue is increased salt loads entering surface water from road salt and excessive irrigation. The presence of high salt concentrations precludes direct usage as drinking water. In agriculture, this may stifle crop growth. Marine salt intrusion into groundwater is exacerbated in many coastal regions, such as India and China, due to overexploitation of aquifers and rising sea levels [2].

Technical and political solutions to these basic issues have been thoroughly explored in the literature, therefore they will not be covered here. The hundreds of synthetic and natural trace pollutants found in natural water at the monogram to microgram per liter level are the subject of this review. Many of these micropollutants, especially when used together, may have hazardous effects even at low doses. However, due to the vast number and structural diversity of micropollutants, assessing such detrimental effects, which are often not acute but rather subtle, chronic impacts, is sometimes challenging (5). This contrasts with the very few well-known pathogens that may be found in contaminated water and their frequent, acute health consequences. Given the difficulty of assessing the effects of micropollutants on aquatic life and human health, as well as the fact that appropriate, affordable water treatment methods for their effective removal are not available in many parts of the world, major efforts (such as restricted use, substitution, or oxidative treatment) must be made to prevent these chemicals from reaching natural water sources. However, as the examples in this study demonstrate, this job is often a daunting one, not just from a technical but also from an economic, social, and political perspective. Micropollutants in natural water come from a variety of places. Industry and municipalities consume around 30% of the world's renewable freshwater [3], resulting in massive amounts of wastewater carrying a wide range of pollutants in different quantities. These wastewaters are still untreated in many areas of the globe, particularly developing countries like China, or are treated in a way that does not efficiently remove the bulk of the micropollutants present. The latter is likewise true in the case of industrial effluent.

Macropollutants: a limited number of mainly inorganic pollutants that occur at the milligram per liter level. Thousands of inorganic and organic trace pollutants that exist at the nanogram to microgram per liter level in trialed nations are referred to as micropollutants (see below). Inputs from agriculture, which uses several million tons of pesticides each year; oil and gasoline spills ; and the human-driven mobilization of naturally existing geogenic hazardous substances, such as heavy metals and metalloids, are all significant sources of micropollutants. Biologically generated taste and odor molecules, which are not mainly a toxicological issue but are of significant aesthetic importance, are also natural micropollutants. There are also millions of municipal and, in particular, hazardous waste sites, such as abandoned industrial and former military sites, where harmful substances may enter natural water, particularly groundwater. Finally, given that over 100,000 chemicals have been recorded, the majority of which are used on a regular basis, one can readily envision many more ways via which chemicals might reach the aquatic environment. We try to provide a representative picture of the dimensions and breadth of this worldwide water pollution issue by addressing a number of very diverse kinds of micropollutants from various sources, without making any claims to completeness. We begin with some basic comments on the difficulties and challenges of evaluating micropollutants in natural water as an introduction to these chosen subjects [4].

2. DISCUSSION

The wide range of mineral phases and potential interactions between solutes, both of which are important in adsorption processes, make it more difficult to evaluate the environmental impact of metal pollution and its consequences on human health. Rapid because the technique was helpful in revealing the structure of metal ions adsorbed on mineral surfaces, advancements in X-ray spectroscopy were instrumental in elucidating the structure of metal ions adsorbed on mineral surfaces. provides for the identification of metal ions' particular molecule companions in complicated mineral settings. This kind of molecular-level information aids in the development of understanding one of the variables influencing the mobility of hazardous substances Ions of metal. Metal ions' potential capacity to bind to biological molecules is a prerequisite for biological activity [5]. Cell membranes are crossed. Minerals with strong bonds particles and macromolecular complexes that are stable Typically, uptake is thwarted. As a result, direct techniques for assessing the risk have been established. Metal pollutants' mobility and bioavailability in complex media, such as soils or sediments. In order to figure out how metals get up in the environment and where they go, you'll need some knowledge. research at the molecular level and in the area After that, observations may be scaled up using simple methods. or more complex reaction/transport models, which include physical, chemical, and biological factors. Biological (micro) processes. The consequences of biological uptake are addressed as part of an evaluation process.

An example of this is the examination of nanoparticles' possible impacts. In recent years, there has been a significant increase in the Engineered nanoparticles are becoming more widely used in a variety of applications. Caused by industrial and commercial uses Concerns regarding this type's biological consequences for the aquatic environment of a new anthropogenic contaminant Human health and the environment There is currently one. preliminary evidence that these particles aren't harmful only release harmful metals at regular intervals, may potentially have direct and particular negative consequences, things need to be investigated further [6]. So far, so good. There has been a lot of progress in clarifying related geochemical processes, molecular mechanisms integrating microbial reactions in biogeochemical models, as well as combining reaction and transport routes. Enteric infections are transmitted mostly via water that has been polluted with excrement from sick people and animals. As a result, accurate hygienic drinking water quality criteria are required for evaluating treatment schemes, including the possibility for water recycling, in terms of the transmission of waterborne pathogens. Despite the critical need for so-called pathogen indicators, quick, low-cost, and simple-to-use techniques for a global application remain unavailable. The detection of indicators such as a hygienic drinking water quality parameter and the enteric bacteria E. coli is utilized globally as an indication of potential fecal contamination in today's hygiene concept. The total number of colony-forming bacteria growing on a nutrient agar plate (the heterotrophic plate count, HPC) is also used to evaluate the overall microbiological condition of water. Because the HPC technique significantly underestimates the number of heterotrophic microbial cells present in a water sample, it was recently removed from WHO, the European Union, and the United States' lists of hygiene criteria . As a result, relying only on the presence or absence of E. coli to determine the hygienic quality of drinking water is becoming commonplace. This method, on the other hand, is unsuitable for monitoring the sanitary quality of water treatment and distribution.

In Milwaukee in 1993, chlorine-resistant Cryptosporidium oocysts from an upstream cow farm polluted the drinking water, demonstrating the fragility of this idea. Despite chlorination and the lack of E. coli, over 50 people died as a result of drinking polluted water, and 400,000 individuals had cryptosporidium diarrhea. Although the detection of E. coli will remain the hygiene parameter for the next several decades, a variety of cultivation-dependent HPC: heterotrophic plate count and -independent microbiological techniques for the detection and quantification of pathogens and indicators are presently being suggested. Flow cytometry (FCM) is one of the most promising methods for practical assessment of treated water samples. FCM provides for on-site and online enumeration of microbial cells regardless of cultivability, rapid screening for particular pathogens, and monitoring of microbial activity after disinfection . Within 15 minutes, a complete microbial cell count may be acquired. However, FCM-based methods necessitate a paradigm shift in terms of the number of microbes expected in raw and disinfected water: instead of a tolerable HPC count of less than 300–500 bacterial cells per milliliter, FCM counts in high-quality (nondisinfected) drinking water range from 100,000–200,000 cells per milliliter. On an epidemiological scale, complementary methods are presently being tried to combat the spread of infectious illnesses. As a result of climate change, rising water temperatures, as well as extreme rainfall and flooding events, are expected to affect the transmission patterns and frequency of infectious disease epidemics. Because the development of water-related illnesses is linked to heavy rainfalls and/or elevated water temperatures, satellite surveillance data for weather and climate forecasts may become an important early warning system for water-related diseases .The ability of this method to forecast epidemics of infectious illnesses such as dengue, West Nile fever, yellow fever, and malaria demonstrates its promise [7].

2.1.APPLICATION

The main cause of toxic elements leaching into drinking water supplies in some parts of the world is the geological composition of aquifers. Arsenic, fluoride, selenium, and a few other elements, such as chromium and uranium, are the main sources of concern. Arsenic has produced the most significant health consequences and worldwide concern among all of these geogenic pollutants. As a result, arsenic is used as a representative example. Arsenic-contaminated groundwater affects between 35 and 75 million people in Bangladesh alone. About 6 million people are at risk in West Bengal, India, and other areas of concern include Cambodia's and Vietnam's densely populated river deltas . Arsenic poisoning has become a problem in these areas over the last decade as a result of efforts to provide safe drinking water. Most people in these rural areas relied on untreated drinking water from rivers and ponds until the 1970s, which is often a source of infectious diseases. In Bangladesh alone, the high mortality rate of up to 250,000 children per year prompted large-scale programs to install groundwater wells to provide safe drinking water. More than 95 percent of the population now relies on groundwater pumped from approximately 10 million tube wells.

Arsenic levels exceeding the World Health Organization's guidelines are found in about 60% of these wells along the Ganges-Brahmaputra River system in Bangladesh. High weathering rates of arsenic-rich source rocks in mountain ranges, deposition of organic-rich deposits in river floodplains, and a flat and humid terrain with long water residence times in the aquifer, leading to anoxic conditions where adsorbed arsenic is released into the water, are all factors that contribute to arsenic contamination. In dry regions, such as the Midwest of the United States, eastern Australia, and Central Asia, high-pH conditions mobilize arsenic in oxygen-rich groundwater, resulting in a second route of arsenic mobilization. The danger of arsenic contamination in groundwater has been predicted at a worldwide scale since the chemical variables controlling arsenic mobilization are well known. Chronic arsenic poisoning causes a buildup of the element in the skin, hair, and nails, causing symptoms such as keratosis (darkening of the hands and feet), high blood pressure, and neurological problems [8]. Another issue is arsenic's carcinogenic impact i.e. a higher risk of skin, lung, and other internal organ cancers, which has been recognized for a long time. When consuming water with a maximum contamination level of 50 g As/L, the estimated risk of arsenic-induced cancer may be as high as 1 in 100 people. WHO lowered the safe drinking water criterion to although this still leaves a narrower margin of safety than usual organic contaminants having carcinogenic characteristics as a result, arsenic exemplifies the tension between public health concerns and economic viability. High safety margins would necessitate widespread use of extremely expensive drinking water treatment. For developed nations, a wide variety of methods for arsenic adsorption are available to meet or exceed the WHO standard (92). In certain cases, switching to bottled water may be more cost-effective than treating the whole water supply. Simple but effective household-level treatment technologies, on the other hand, must be implemented in rural areas in developing countries.

2.2.ADVANTAGES:

The redox state of organic and inorganic pollutants determines several physical and chemical characteristics. As a result, redox conditions in subterranean settings have a direct influence on pollutant destiny, and redox management is critical for the design of effective mitigation methods. Metal pollutants from radioactive waste dumps or reprocessing sites, such as uranium (U) or a fission product like technetium (Tc), are often found in contaminated soils and groundwater in their oxidized form [U(VI), Tc(VII)]. The same may be said for tannery waste containing chromium [Cr(VI)]. Although these metal anions are highly mobile and therefore pose a danger to people and the environment, their reduced forms [U(IV), Tc(IV), and Cr(III)] are very sparingly soluble. As a result, establishing or sustaining reducing conditions in the subsurface, such as via in situ microbial activity stimulation using organic substrates, is regarded as a crucial step for metal immobilization and hazardous material containment. Organic pollutants need different methods since they may be mineralized to carbon dioxide and other non-problematic molecules. Organic water pollutants, such as the explosives di- and trinitrotoluene and the solvents tetra- and trichloroethene, however, are persistent due to their high oxidation levels. Only after transitory reduction by metal catalysts or microorganisms is complete transformation feasible. These reactions produce reduced products such as aromatic amines or vinyl chloride, which are much more hazardous than the parent pollutant. However, bacteria are far more likely to completely oxidize these electron-rich compounds [9].

2.3. WORKING:

One of the most important aspects of enhancing sanitation and preserving public and ecological health is the mitigation of wastewater discharges from homes and businesses. The goal of municipal wastewater treatment is to remove nutrients (carbon, nitrogen, and phosphorus) as well as harmful microorganisms. The biological oxygen demand (BOD) of effluent water is reduced as a result of nutrient removal, resulting in less eutrophication of inland water bodies and coastal regions. Connectivity to municipal wastewater treatment facilities ranges from 50% to 95% in industrialized nations, while more than 80% of municipal wastewater in low-income countries is discharged without treatment, contaminating rivers, lakes, and coastal regions of the oceans. Industrial wastewater, on the other hand, is not only a source of BOD, but also a point source of heavy metal and synthetic organic compound pollution. Internal water recycling and recovery systems, as well as end-of-pipe treatment utilizing sophisticated technologies such as activated carbon, advanced oxidation, or membrane processes, have substantially decreased these contaminants in industrialized nations. The water efficiency of industrial wastewater treatment (i.e., product revenues per treated volume of process water) varies widely, ranging from around US$140 per m^3 in Denmark to barely US$10 per m^3 in the United States , and much less in low-income nations. These figures vary depending on the kind of industry. There is already a significant possibility for water reuse, which would significantly decrease the outflow of possibly contaminated water. For example, wastewater has been recycled in Windhoek, Namibia, since 1973, utilizing a variety of sophisticated technologies to produce potable water. Direct or indirect potable or industrial reuse is done on a considerable scale in several other water-stressed metropolitan regions (California, Australia, Singapore). To treat secondary wastewater effluent, these systems mainly depend on membrane technology (microfiltration followed by reverse osmosis). Enteric infections are transmitted mostly via water that has been polluted with excrement from sick people and animals. As a result, accurate hygienic drinking water quality criteria are required for evaluating treatment schemes, including the possibility for water recycling, in terms of the transmission of waterborne pathogens. Despite the critical need for so-called pathogen indicators, quick, low-cost, and simple-to-use techniques for a global application remain unavailable[10]. The detection of indicators such as a hygienic drinking water quality parameter and the enteric bacteria E. coli is utilized globally as an indication of potential fecal contamination in today's hygiene concept. The total number of colony-forming bacteria growing on a nutrient agar plate (the heterotrophic plate count, HPC) is also used to evaluate the overall microbiological condition of water. Because the HPC technique significantly underestimates the number of heterotrophic microbial cells present in a water sample, it was recently removed from WHO, the European Union, and the United States' lists of hygiene criteria . As a result, relying only on the presence or absence of E. coli to determine the hygienic quality of drinking water is becoming commonplace. This method, on the other hand, is unsuitable for monitoring the sanitary quality of water treatment and distribution. In Milwaukee in 1993, chlorine-resistant Cryptosporidium oocysts from an upstream cow farm polluted the drinking water, demonstrating the fragility of this idea. Despite chlorination and the lack of E. coli, over 50 people died as a result of drinking polluted water, and 400,000 individuals had cryptosporidium diarrhea. Although the detection of E. coli will remain the hygiene parameter for the next several decades, a variety of cultivation-dependent HPC: heterotrophic plate count and -independent microbiological techniques for the detection and quantification of pathogens and indicators are presently being suggested. Flow cytometry (FCM) is one of the most promising methods for practical assessment of treated water samples. FCM provides for on-site and online enumeration of microbial cells regardless of cultivability, rapid screening for particular pathogens, and monitoring of microbial activity after disinfection . Within 15 minutes, a complete microbial cell count may be acquired. However, FCM-based methods necessitate a paradigm shift in terms of the number of microbes expected in raw and disinfected water: instead of a tolerable HPC count of less than 300–500 bacterial cells per milliliter, FCM counts in high-quality (nondisinfected) drinking water range from 100,000–200,000 cells per milliliter.

3. CONCLUSION

Fighting global water pollution requires a diverse mix of policies, technology, and scientific breakthroughs. The legacy of persistent priority pollutants such as PCBs necessitates a worldwide phase-out and regulation effort. Volatile chemicals, such as halogenated compounds or mercury, are not biodegradable and accumulate in the food chain, therefore their usage should be limited to applications in closed systems. Water, as a major commodity for agriculture, requires the same level of protection against chemicals with the potential for bioaccumulation as human food production systems. Furthermore, the precautionary principle must be used in the development of possible replacements for such priority pollutants to ensure that today's solution does not become tomorrow's issue. Global agriculture confronts the problem of increasing crop yields while also protecting the environment and the food supply chain from pollution. Improved water quality in agricultural regions necessitates better integrated farming practices. Precision agriculture is centered on local factors such soil type, terrain, irrigation, and drainage systems, and ensures that the best crop management techniques are used in the 126 locations. At regional dimensions, geogenic pollutants serve as diffuse sources of harmful elements, causing chronic illnesses in huge populations throughout the globe.

Geochemical modeling based on hydro geochemical data and geographical analysis may assist identify vulnerable populations and deploy sophisticated treatment technologies for central water distribution systems now that the major geochemical drivers are understood. Rural communities in many areas of the developing world, on the other hand, rely on polluted groundwater wells. Identifying alternate water sources or installing simple, dependable household-centered water treatment technology takes extra work in these situations. To choose the most effective strategies for cleaning up large-scale water pollution from mining activities and groundwater contamination from waste sites, scientists must consider the specific hydrological conditions, microbial and geochemical transformation pathways, and possible remediation technologies. In the long term, reactive waste management strategies based on lifetime assessments and cradle-to-grave stewardship for hazardous compounds will need to be replaced with proactive strategies based on lifecycle assessments and cradle-to-grave stewardship for toxic chemicals. Pollutants should no longer be transported across global water cycles; it is the duty of economic players to keep hazardous chemicals contained in closed loops. Finally, during the next several decades, the numerous point sources of water contamination from metropolitan water systems will need more attention and investment. To meet the MDGs of providing better sanitation and clean drinking water for about 2 billion people, coordinated efforts to design and install cost-effective sanitation systems in rapidly expanding megacities and water-stressed regions are of the utmost importance. Developing the methods and social networks needed to enhance home cleanliness in rural regions will take a comparable amount of time and effort.

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