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Emerging Contaminants in Drinking Water and Wastewater, Effects on Environment and Remediation

J K Bwapwa and AT Jaiyeola

Mangosuthu University of Technology, Faculty of Engineering, Department of Civil Engineering, P.O Box 12363, Jacobs 4026, Umlazi, Durban, South Africa, Corresponding author

Abstract

The contamination of drinking water and wastewater can cause a significant threat to the public health. The contaminants affect the society in various ways, including causing diseases, developmental and growth problems. The causes of the problem are identifiable and can be managed by using the most applicable strategies. As such, necessities for the adoption of strategies that will help identify the contributing factors, results and adopt effective strategies that will prevent and reduce waterway pollution. Therefore, the research provides analysis on the effects, studies, and recommendations appropriate in reducing drinking water and wastewater contamination.

Keywords: Wastewater contamination, drink water, adsorption, pharmaceuticals products, personal care products

INTRODUCTION

The various chemicals added to food, water and care products play significant roles in influencing human activities. They enable the development of new technologies and improve the standards and quality of life. Chemicals enter the environment because of the widespread industrial activities taking place in our surroundings. These activities can release effluents (liquids or gases) and solid residues that can be harmful to the environment. Some chemicals like pesticides, CO_2, CO and CH_4 are released deliberately from industrial and manufacturing sector into the environment, although it is unintentional in most cases. When compared to the normal levels defined by environmental legislation, the levels of chemicals are higher, in this case they are known as contaminants or pollutants. Water is a major and significant means by which these chemicals reach the living organisms in the environment, which exert their effects upon consumption, or accumulate in the water bodies such as rivers, lakes and groundwater. Therefore, water carries the imprint of all the activities performed by human beings. The chemicals in the water can be either macro-pollutants or micro-pollutants depending on the concentration of the chemical in the water body. Micro-pollutants and macro-pollutants have significant impacts on the environment depending on the concentration of the chemicals. The increasing amounts of pollutants have raised concerns worldwide regarding the adoption of strategies that will help reduce the consequences associated with the high levels of pollutants in the environment (Altaf, Masood, and Malik, 2008). This study analyzes different emerging contaminants in water, wastewater and drinking water as a result of industrial development, lifestyle, and advancement in technology in today’s world. It also focuses on their effects on public health and the environment including the remediation techniques. This is achieved by investigating different methods of removing contaminants in water, wastewater and drinking water. This study also suggests ways of minimizing the contaminants and strengthening the treatment methods.

EMERGING CONTAMINANTS

Emerging contaminants refer to the materials or chemicals in the water, air, soil, or river sediments at relatively low concentration. The contaminants are perceived as actual or potential threat to any living organisms and the environment. They are referred as emerging contaminants because new technologies can easily detect them and they also have a new portal of entry into human beings and the environment. According to Richardson and Ternes (2005), emerging contaminants can be classified as either pharmaceuticals and personal care products (PPCPs), or chemicals that disrupt the endocrine functioning (EDCs), or Nanomaterial. They could also be classified as contaminants of emerging concerns (CECs), persistent organic pollutants (POPs), and Organic wastewater contaminants (OWCs) (Mitch et al. 2003).

Endocrine disrupting compounds (EDCs) interfere with the normal functioning of the endocrine systems of the mammals. The disruption results in conditions such as cancer, birth defects, and developmental disorders. Endocrine disruptors stimulate cell mutation that results in the formation of cancerous cells. The effects will present in forms of learning disabilities, attention deficit hyperactive disorders, and deformities of body parts such as the limbs. Exposing animals to low level of the EDCs causes similar effects as those seen in the human beings. Organisms are exposed to the EDCs when they consume food products containing the compounds. Xenoesstrogens, alkyl phenols, and bisphenol-A are some of the examples of the endocrine disrupting compounds (Richardson and Ternes, 2005). Persistent organic pollutants are organic compounds considered non-biodegradable through the action of biological, photolytic, and or chemical processes. These pollutants persist in the environment and accumulate in the animal and human tissues, thereby, posing a significant threat to the human and animal health. Most of the POPs were used in the past as pesticides. Persistent organic pollutants disrupt the endocrine functioning as the EDCs Richardson (2003). Pharmaceuticals, personal care products (PPCPs) and organic waste contaminants (OWCs) are active compounds that passed through human bodies and also transferred to drinking water and wastewater. These compounds are not removed by conventional treatment methods. They cause a significant environmental threat by promoting the emergence of bacteria resistant to antibiotics, which later combine with other chemicals in the environment resulting in the complex chains (Focazio et al, 2008). Nanomaterials are tiny particles which have significant threat to the environment. Their presence in the environment causes changes of the ecological balance as a result of the change in the hematologic functioning of the aquatic animals and its interaction with other pollutants. This change occurs due to the disturbance of the normal flora and the functioning of the living organisms because of the enhanced toxic effects of the organic compounds (Peabod et al., 2006).

ANALYSIS OF EMERGING CONTAMINANTS IN WASTEWATERS

One of the most important factors or elements in the analysis of the "emerging contaminants" is always the lack of the analytical methods that can be used for the measurement of the low focus (Frimmel & Niessner, 2010). The preconditions or the requirement for an absolute assessment or the measurement of the proper risk and looking after of the waste, surface and the quality of the drinking water is the availability of a multi method (Lee & Neff, 2011). This method allows the low adsorbents, since, the factual that these mixtures are not in the list of regulatory as pollutants of environment which came out as a result in a very short attention (Frimmel & Niessner, 2010). The methods for the analysis of the emerging contaminants are increasing by every day (Lee & Neff, 2011). Though, the analysis of the adsorbents is in need of different terms that are sensitive, selective and special for all the complicated matrices such as "wastewater" (Frimmel & Niessner, 2010). Consequently, analytical methodology for different groups of emerging contaminants is evolving and the number of methods described in the literature for the determination of emerging contaminants has grown considerably (Castiglioni, Zuccato & Fanelli, 2011). Still, the analysis of this group of contaminants requires further improvements in terms of sensitivity and selectivity, especially for very complex matrices, such as wastewater (Castiglioni, Zuccato & Fanelli, 2011). A commonly used analytical method is inclusive of the use of "octadecylsilica, polymeric, or hydrophilic-lipophilic balanced (HBL)". It supports the samples of water (Castiglioni, Zuccato & Fanelli, 2011).

EMERGING CONTAMINANTS IN THE ENVIRONMENT

The emerging contaminants are increasing with such a frequency that many of the chemical and microbial fixing or constitutions that have been considered (Agarwal, 2009). The emerging contaminates that are aforementioned are most copied or limited from the areas like agricultural, industrial, urban and other resources and places. (Agarwal, 2009).

A survey made by the United States Geological (USGS), New York State Department of Environmental Conservation, and "U.S. Environmental Protection Agency" was started to measure the incidence and focus of "emerging contaminants" in "central and southeast New York State" (Agarwal, 2009). The outcome of the study by the end of first year shows that many of the mentioned compounds can be detected in the effluent and receiving streams below many of these "wastewater treatment plants (WWTP)" (Castiglioni, Zuccato & Fanelli, 2011). Outcomes are were also made in use by United States Geological Survey in association with consultants of New York state to start a research on the efficiency of practices of treatment at the five Water Waste Treatments Plants in getting rid of the focus on "emerging contaminants" (Castiglioni, Zuccato & Fanelli, 2011). A concentrated and demanding sampling structure will help to calculating the capability of particular standard and developed (Lee & Neff, 2011) "wastewater treatment" procedures (Agarwal, 2009). For example "activated sludge, trickling strainers, deep bed sand/anthracite screening, membrane screening, chlorination and ultraviolet (UV) disinfection" to delete or alter a variety of "emerging contaminants".

Another study was made by the United States Geological Survey and the "Centers for Disease Control and Prevention (CDC)" (Agarwal, 2009). Total 24 samples of water were gathered from different places within a drinking-water-treatment (DWT) capability and from the two watercourse that serve the facility to measure the work for wastewater-related "organic contaminants" to endure a conventional treatment procedure and carry on in supplies of potable-water. Some of the samples were not filtered; some of the samples were filtered (Berridge & Gorsky, 2012). All the mentioned samples were measured for 106 "emerging contaminants" that shows a different group of widely chemicals to be used. Nearly 40 "emerging contaminants" were aware of one or more samples of flowing water or the untreated supplies of water in the treatment plant; 34 of the contaminants were noticed in more than 10 % of the given samples (Berridge & Gorsky, 2012). Many of the mentioned mixtures also were constantly noticed in samples of the treated water; these mixtures that are inclusive of "selected prescription and non-prescription drugs" and their metabolites, fragrance mixtures, flame retardants and plasticizers, mixtures of cosmetics, and a mixture (Sanghi & Singh, 2012). Easily available absorbents are being used for the treatment of water waste that contains pollutants. The key problems that come in way to achieve the maximum removal type of pollutant that depend on the adsorbent are the most appropriate adsorbent (Berridge & Gorsky, 2012). The efficiency of the treatment is dependent on many of the elements. These elements are just not depending on the adsorbent and adsorb ate, but it is also dependent on the conditions that are related to environment (Sanghi & Singh, 2012). These are also depending on several variables that can be used for the procedure of adsorption (Berridge & Gorsky, 2012). The example of such type of absorbents are "pH, ionic strength, temperature, existence of competing organic or inorganic mixtures in the solution, earlier adsorb ate as well as the focus of adsorbent, time period of the contact and the speed of rotation, actual size of adsorbent, etc (Berridge & Gorsky, 2012).

Various combinations of treatment options including: activated sludge, media filtration, chlorine disinfection, ultraviolet disinfection, and reverse osmosis were applied. It was observed that the removal of majority of the PPCPs was influenced by an increase in Solid Retention Time (SRT) (Sanghi & Singh, 2012). The removal is compound-specific, but normally it can achieve more than 80% of efficiency at SRTs of 5-15 days (Castiglioni, Zuccato & Fanelli, 2011). Caffeine, ibuprofen, oxybenzone, chloroxylenol methylparaben, Benzyl salicylate, 3-Phenylpropionate butylbenzyl phthalate, and Octylmethoxycinnamate were among those compounds detected frequently with significant removal efficiencies. BHA, DEET, musk keton, and galozide were detected frequently and had poor removals. Generally, not all the pharmaceutical and personal care products are removed from the treatment plant (Berridge & Gorsky, 2012).

REMOVAL OF EMERGING CONTAMINANTS BY ADSORPTION

Emerging contaminants can be explained as the mixtures that are somehow lawless or unfettered or they are still in the progress of being normalized. It can be a danger or risk for the environmental characteristics or to the human health. The word, "emerging compounds" goes through a number of "pollutants", which are inclusive of "PPCPs", "synthetically and naturally" happening and being used for industrial purpose and households (Berridge & Gorsky, 2012). These mixtures are based on the environmental changes. It depends that how these mixtures are being used and how these mixtures, used in a product, are set out. Contaminants of drinking water and wastewater have numerous risks to the environment (Sanghi & Singh, 2012). The effects of the contaminants range from developmental, growth, and reproductive effects. The causes of these effects can be identified. Adopting the most effective strategies will contribute to the reduction of the incidences of adverse environmental effects brought by drinking water and wastewater contaminants (Sanghi & Singh, 2012). Therefore, it is highly recommended that interventions aiming at determining the source of contamination, and responding to the challenges should be adopted to ensure environmental safety and sustainability (Sanghi & Singh, 2012).

ADSORPTION AS GREEN TECHNOLOGY

Different studies show that the process of adsorption can be thought as effective and efficient treatment that can be used for removing the emerging contaminates from the water (Simeonov & Sargsyan, 2008). These water wastes can be removed by using the techniques of adsorption. This procedure allows us to remove the percentage (Simeonov & Sargsyan, 2008). Moreover, as it is a physical procedure, it can obviously not be implemented by the formation of the products and it cannot be considered as deadly as the parent mixtures are. It is truly obvious that the procedure of the adsorption goes through a procedure of "integrated treatment system". This integrated treatment system contains many of the elements (Xu, Wu & He, 2013). These elements are inclusive of the treatment facilities of the construction, the finished water quality that is desired, the investment and the cost that will be needed for the whole operation (Xu, Wu & He, 2013).

The adsorbents that are studied and used mostly are often the carbons that are activated for "synthetic and real water" (these are commonly known as surface water and the wastewater). Instead of making a great or huge use of these adsorbents (Xu, Wu & He, 2013), the whole indication is to decrease the basic use of the carbons that are activated just because of the high cost that is used. Since, the research for the adsorbents that can be found on low cost is still going on (Xu, Wu & He, 2013). This is to reduce the pollution of the water (Xu, Wu & He, 2013). Moreover, such types of adsorbents are not cost effective, but they are taking many costs. This is the reason that the cost issues, considering as a big problem toward the low cost adsorbents is the usage of the agricultural and the industrial waste goods, so that the life of such type of waste materials could be enlarged or increased without even making their introduction to the environmental materials as adsorbents (Xu, Wu & He, 2013). The characteristics of a suitable and cost effective adsorbent should be inclusive of the characteristics mentioned below:

1) To be effective to let go most of the contaminants.
2) To have extremely high capacity of adsorption and the rate of adsorption.
3) To have extremely high choice of selection for distinct focuses.

It is difficult for us to decide that which adsorbent is good in quality and which adsorbent does not imply to have good characteristics. The cost of the adsorbent is an important factor that should be kept in mind before using it (Xu, Wu & He, 2013). The cost of the adsorbent depends on many elements which are inclusive of the availability of the treatments, the quality of the treatment and the recycling. Another factor that is necessary to be kept in mind and which plays an important role in the factors to be kept in mind is the places where the adsorbents are produced and the products for which the adsorbents are to be produced. In the final, the exact and accurate evaluation or the measurement of the cost is linked and connected to the scale of application. Though, many of the researches about the low cost of the adsorbents or low-cost adsorbents can be seen in the studies. These adsorbents are limited to a scale of particular laboratory (Xu, Wu & He, 2013).

OCCURRENCE OF EMERGING CONTAMINANTS IN DRINKING WATER AND WASTEWATER

The level of the contaminants in drinking water and wastewater depends on the source of the contamination (Xu, Wu & He, 2013). Experimental studies show that contaminants attach themselves to different particles and compounds while being transported to the sewage plants.

According to Richardson (2003) the ability of a contaminant to remain unchanged in a treatment plant depends on the medium it attaches itself while under transportation to the plant. In his study, he also discovered that sand and quartz particles have an efficient retention capacity and are also able to stop the release of the contaminants outside the treatment plant. Consequently, this shows that the retention capacity of a transporting medium determines the fate of a drinking water and wastewater contaminant. Srinivasa et al., (2010) added that the rate of escape of wastes into the environment is influenced by the type of lining used in a treatment plant and it also forms a barrier to transport of contaminants and its ultimate release to the atmosphere. Biological activity allows the degradation of waste and this contributes to the removal of wastewater and drinking water contaminants. This was also confirmed by Richardson and Ternes (2005) in their study. They discovered that biological degradation contributes to the removal of pharmaceutical and personal care products in the wastewater treatment. Triclosan and tribocraban are some of the drinking water and wastewater contaminants that can be removed by biological treatment. Mitch et al., (2003) noted that the aerobic reactions taking place during the loading of the contaminants contribute significantly to the degradation of these products. In a study carried out in Germany, the concentrations of triclosan in the influent (1000 ng/L) and in the effluent (50 ng/L) for a sewage treatment plant are compared to the concentrations of triclosan in sludge (1200 ng/L). The outcome of the study shows that only 30% of the triclosan was attached with weak bonds to the sludge. Also, it was noted that some amounts of triclosan was absorbed as residues in the sludge and only 5% was dissolved in the effluent. These results show that most of the influent triclosan was likely converted to other metabolites or unrecovered bound residues. Triclosan removal efficiency was greater than 90% with 30% retained by the sludge (Bester , 2003). In a study completed by Stephenson and Joan (2007) the removal of 20 PPCPs commonly found in the influent of six full-scale wastewater treatment facilities operating in the U.S was investigated. Various combinations of treatment options including: activated sludge, media filtration, chlorine disinfection, ultraviolet disinfection, and reverse osmosis were applied. It was observed that the removal of majority of the PPCPs was influenced by an increase in Solid Retention Time (SRT). The removal is compound-specific, but normally it can achieve more than 80% of efficiency at SRTs of 5-15 days. Caffeine, ibuprofen, oxybenzone, chloroxylenol methylparaben, Benzyl salicylate, 3-Phenylpropionate butylbenzyl phthalate, and Octylmethoxycinnamate were among those compounds detected frequently with significant removal efficiencies. BHA, DEET, musk keton, and galozide were detected frequently and had poor removals. Generally, not all the pharmaceutical and personal care products are removed from the treatment plant. According to Richardson and Ternes (2005), pharmaceutical products such as the beta-blockers exit the plant effluent without its removal. This contributes to the contaminants found in the drinking water and wastewater. According to Srinivasa et al., (2010), the environmental fate of the contaminants in drinking water and wastewater depends on both physical and chemical properties of the media that transports the contaminant. Biodegradation plays an important role in removing the endocrine disrupting compounds as it is the case of pharmaceutical and personal products. Also, volatilization contributes to the removal of the endocrine disruptors and the pharmaceutical care products. Richardson (2009) discovered that leaching into the groundwater contributes to the removal of some contaminants with low vaporization abilities. Atmospheric fate contributes to the elimination of the Nonatoms, which occurs through a reaction between the particles of the contaminant with the hydroxyl radicals in the atmosphere. According to Richardson (2003), chlorination and reductive de-chlorination contributes to the fate of the organic waste contaminants. The fate of persistent organic pollutants (POPs) varies depending on its geographical location. For instance, the level of POPs in the arctic regions is different from that found in desert environment. POPs are non-biodegradable in nature, so they are transported into different compartments of the earth system by the moving water. The moving water also carries the contaminant into remote regions that might be minimally proximal to animal access (Richardson and Ternes, 2005).

ASSESSING THE EMERGING CONTAMINANTS IN WASTEWATER AND DRINKING WATER

To Assess the impact of emerging contaminants in drinking water and wastewater it is necessary to identify the source of the contaminant and the seriousness of its effects to the environment. The purpose of this assessment is to determine the amount of contaminants released to the environment and to adopt approaches that aim at minimizing the release and effects of the emerging contaminants. Petrović et al., (2003) stated that risk assessment of the emerging contaminants is very important because it helps in the formulation of goals that assist in protection of the environment. Assessment enables the involved parties to be able to determine the effectiveness of the planned goals. This is important because it will reduce the impacts of the emerging contaminants in the environment. Successful assessment of the emerging contaminants involves evaluating the occurrence of the emerging contaminant, evaluating the exposure of the contaminant and compliance choices for the regulatory alternatives. Furthermore, it requires the assessment of the alternatives available to prevent and reduce occurrences of emergence of contaminants. To facilitate the success of the assessment process it is advised to use epidemiological studies (Pruden et al., 2006).

REMOVAL OF EMERGING CONTAMINANTS IN DRINKING WATER AND WASTEWATER

According to Mitch et al. (2003), there are various methods of treating water and wastewater alongside removing the emerging contaminants. These techniques include advanced oxidation processes (AOPs), adsorption, Reverse Osmosis (RO), and Nano-filtration (NF). In another study carried out by the US Environmental Protection Agency (EPA), treatment such as reverse osmosis, ozonation, ultrafiltration, ultraviolet disinfection, activated sludge, fixed film biological treatment and biological phosphorus removal among others were reviewed (EPA,2010). From this study, data shows that high removal efficiencies were recorded using ozonation process especially for contaminants like Naproxen, Trimethoprim, and Estradiol with removal efficiencies of more than 95%. Reverse osmosis was also performed on the same wastewater with removal efficiency of 100% on contaminants such as Meprobamate, Naproxen, Triclosan. Ultrafiltration and ultraviolet disinfection were also used to treat wastewater the removal efficiencies vary from 69 to 99% while for the ultraviolet infection low removal efficiencies were recorded ranging from 0.85 to 63 %. The detailed analysis is presented in table 1 .In the same study drinking water was treated using methods such as chlorine disinfection, granular activated carbon, ozonation and ultraviolet disinfection. Removals efficiencies vary from 5.3 to 99% for contaminants such as polynuclear aromatic hydrocarbons (PAH), PPCP, pesticides, steroids and hormones (SH) (EPA,2010). More detailed information about this study can be found in EPA (2010) report

Table 1: Treated wastewater removal efficiencies for a full-scale treatment plant (EPA,2010)

GENERAL CLASS KEY: NP/APEs - nonylphenols, octylphenol, and alkylphenol ethoxylate compounds; PPCP - pharmaceuticals and personal care products; S/H - steroids and hormones; Other - category for analytes that do not fit into another category

General Class	CEC	Ozonation				Reverse Osmosis				Ultrafiltration				Ultraviolet Disinfection			
		Min	Max	Avg	Count	Min	Max	Avg	Count	Min	Max	Avg	Count	Min	Max	Avg	Count
PPCP	Ketoprofen	72	100	86	2	80	80	80	2								
PPCP	Lincomycin					90	90	90	1								
PPCP	Mefenamic Acid	>64	>99	82	2												
PPCP	Meprobamate	25	70	38	4	>100	>100	100	2	70	70	70	1	6.2	6.2	6.2	1
PPCP	Metoprolol																
PPCP	Monensin					98	98	98	1								
PPCP	Musk ketone					>84	>84	84	1								
PPCP	Nalidixic Acid					86	86	86	1								
PPCP	Naproxen	>92	>100	97	4	>100	>100	100	3	>98	>98	98	1	0.85	0.85	0.85	1
PPCP	Norfloxacin					97	97	97	1								
PPCP	Norfluoxetine	>69	>69	69	1					>69	>69	69	1				
PPCP	Oleandomycin					75	75	75	1								
PPCP	Oxybenzone					>63	>98	86	3					63	63	63	1
PPCP	Pentoxifylline					>97	>99	98	2					12	12	12	1
PPCP	Primidone					89	89	89	1								
PPCP	Propyphenazone	>59	>59	59	1												
PPCP	p-TSA					100	100	100	3								
PPCP	Roxithromycin					93	93	93	1								
PPCP	Salinomycin					80	80	80	1								
PPCP	Sulfamethoxazole	>90	>99	93	4	>44	>100	81	3	99	99	99	1	>15	>44	28	3
PPCP	Sulphasalazine					88	88	88	1								
PPCP	Thymol	87	97	92	2												
PPCP	Triclosan	>69	>100	89	4	>99	>100	100	2	>98	>98	98	1	47	47	47	1
PPCP	Trimethoprim	97	97	97	1	>94	>100	98	3	97	97	97	1	4.8	12	8.4	2
PPCP	Tylosin					95	95	95	1								
S/H	Androstenedione													1.1	1.1	1.1	1
S/H	Estradiol	>93	>97	95	2	>88	>98	93	5								
S/H	Estriol	>55	>78	66	2	>67	>98	85	4					7.2	30	19	2
S/H	Estrone	>29	>100	76	3	>99	>99	99	2					>58	>58	58	1
S/H	Testosterone					>92	>100	96	5					9.3	9.3	9.3	1

Despite the high removal efficiency recorded for the removal of emerging contaminants using these methods most organizations are still faced with challenges due to the high investment and maintenance costs associated with the methods. Also, the complicated procedure involved in the treatment of emerging contaminants and the massive production of toxic wastes constitute additional challenges associated with the efficiency and implementation of these methods. According to Peabody et al., (2006) physico-chemical treatments are considered effective in the removal of contaminants, except for the removal of endocrine disrupting compounds and pharmaceuticals and personal care products. In another study using membrane filtration carried out by Comerton et al.,(2007), 22 endocrine disrupting and pharmaceutically active compounds were effectively removed through adsorption by ultrafiltration (UF) , nanofiltration (NF) and reverse osmosis(RO). From an experimental study completed by Levine and Asano (2004) the adsorption method of treating and removing emerging contaminant is more effective when compared with other methods. This method does not produce toxic by-products in the water under treatment and its design makes it easy to operate. The adsorption method uses a mass transfer mechanism which involves the accumulation of contaminants in two phases that contribute to their removal. Physisorption and chemisorption are the two key interactions that promote the elimination of the contaminant and water treatment. The adsorption method integrates the principles of Wastewater Treatment Plants (WWTPs) in the partial removal of the micro pollutants through biological degradation, stripping, and sorption. This process is facilitated by the use of adsorbent agents such as activated carbon, clays, minerals, and agricultural wastes. These agents provide a sorption medium for many emerging contaminants (Jones et al., 2005). According to Focazio et al. 2008, emerging contaminants can be also removed by reverse osmosis which uses a semi-permeable membrane to treat drinking water and wastewater. In this process pressure is applied to overcome the osmotic pressure which is driven by a positive chemical potential, consequently, different types of ions and molecules from the water solution are removed and a solute is retained on the membrane side while the pure solvent passes to the opposite side. In this process straining and size-exclusion processes are used to eliminate the contaminants in the solution. However, Chen et al. 2006 reported that this method is less effective when compared to the adsorption method because it does not remove endocrine disrupting compounds, personal care products and pharmaceuticals.

Furthermore, Bolong et al (2009) reported that there is 85% wastage of water used during the treatment process and removal of emerging contaminants because it relies on low backpressure for its effectiveness and enhanced functioning. On the contrary, advanced oxidation process uses hydroxyl radicals to remove contaminants in water through oxidation. The method is effective in the removal of non-biodegradable emerging contaminants. Also, advanced oxidation processes are more effective in treating water contaminated with persistent organic pollutants (Altaf et al.,(2008). The method is based on the use of different chemical principles such as the formation of the hydroxyl ions and reaction with the oxide ions of the contaminant promoting its elimination. Also, Nano-Filtration (NF) removes contaminants as in the case of reverse osmosis (RO) with high removal efficiencies. The method helps in the elimination of endocrine disrupting compounds, pharmaceuticals, and personal care products. However, NF requires high pressure than RO to operate, therefore, energy consumption is high, and this will impact on the operating costs. In another study, the removal efficiencies of 24 pharmaceutically active compounds were examined in a municipal sewage treatment plant during activated sludge treatment, sand filtration and ozonation. It was found that the combination of sand filtration and ozonation achieved a removal efficiency greater than 80% for 22 out of 24 targeted compounds. (Nakada et a., (2007).

CONCLUSION

Contaminants of drinking water and wastewater have numerous risks to the environment. The effects of the contaminants range from developmental, growth, and reproductive effects. The causes of these effects can be identified. Adopting the most effective strategies will contribute to the reduction of the incidences of adverse environmental effects brought by drinking water and wastewater contaminants. Therefore, it is highly recommended that interventions aiming at determining the source of contamination and responding to the challenges should be adopted to ensure environmental safety and sustainability. The removal of all the aforementioned “emerging contaminants” through the “wastewater” and the treatment of the drinking water is not as satisfactory as it should be. The improved treatment and the control of this treatment procedure have to be completely noticed so that the elimination of such micro contaminants becomes as high as it could be. Easily available absorbents are being used for the treatment of wastewater that contains pollutants. The key problems that come in way to achieve the maximum removal type of pollutants that depend on the adsorbents are the most appropriate adsorbents. The efficiency of the treatment is dependent on many elements. These elements do not only depend on the adsorbent and adsorbate, but they also depend on the conditions that are related to environment and several variables that can be used for the procedure of adsorption. The example of such variables are pH, ionic strength, temperature, existence of competing organic or inorganic mixtures in the solution, earlier adsorbate as well as the focus of adsorbent, time of contact, the speed of rotation and actual size of adsorbent.

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