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Problems, Challenges, and Removing Methods of Micro Plastics from Water

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***Abstract:** Over the past few years, several studies have reported the presence of micro plastics in treated tap and bottled water, raising questions and concerns about the impact that micro plastics in drinking-water might have on human health. Microplastics are ubiquitous within the environment and are detected in marine water, wastewater, water, food, air and drinking-water, both bottled and water. Microplastics enter freshwater environments in a number of ways: primarily from surface run-off and both treated and untreated wastewater effluent, but also from combined sewer overflows, industrial effluent degraded plastic waste and atmospheric deposition. Further, the limited evidence indicates that some microplastics found in drinking-water may come from treatment and distribution systems for water and/or bottling of drinking water.*
***Keywords:** Fresh water, health, process.*

I. INTRODUCTION

The lack of ordinary methods for sampling and analyzing microplastics within the environment means comparisons across studies are difficult. Additionally, few studies were considered fully reliable. Nevertheless, some initial conclusions are often drawn. In water, the frequency of microplastic particles by polymer type was according to plastic production volumes and plastic densities. An honest range of shapes and sizes were found. For both freshwater and drinking-water studies, the tiniest particles detected were often determined by the dimensions of the mesh utilized in sampling, which varied significantly across studies. Particle counts ranged from around 0 to 10^3 particles/L in water. The tiniest particle size detected was 1 µm, but this result's constrained by current methods. In most cases, freshwater studies targeted larger particles, using mesh sizes that were an order of magnitude larger than those utilized in drinking-water studies. The human health risk from microplastics in drinking-water could even be a function of both hazard and exposure. Particle toxicity depends on a selection of physical properties, including size, area, shape and surface characteristics, also because the chemical composition of the microplastic particle. The fate, transport and health impacts of microplastics following ingestion aren't well studied and no epidemiological or human studies on ingested microplastics are identified. However, microplastics greater than 150 µm aren't likely to be absorbed within the human body and uptake of smaller particles is predicted to be limited. Absorption and distribution of very small microplastic particles including nanoplastics could even be higher, however the database is extremely limited and findings demonstrating uptake in animal studies occurred under extremely high exposures which may not occur in drinking-water. supported this limited body of evidence, firm conclusions on the danger associated with ingestion of microplastic particles through drinking-water cannot yet be determined; however at now , no data suggests overt health concerns associated with exposure to microplastic particles through drinking-water.

To assess potential health risks associated with exposure to chemicals associated with microplastics, WHO developed a conservative exposure scenario, assuming high exposure to microplastics combined with high exposure to chemicals and applied a margin of exposure approach. Chemicals included within the assessment are detected in microplastics, are of toxicological concern and have adequate or accepted toxicological point of exits to derive a margin of exposure. Margin of exposure were derived for each chemical by comparing the estimated chemical exposure for a very conservative exposure scenario to a level of exposure at which no or limited adverse effects were seen. A judgments of safety could then be supported the magnitude of this margin of exposure. Margin of exposure derived from the danger assessment were found to be adequately protective, indicating a coffee health concern for human exposure to chemicals through ingestion of drinking- water, even in extreme exposure circumstances [1].

II. SOURCES AND OCCURRENCE

Microplastics are often found worldwide in coastal regions and aquatic ecosystems in various size fractions because of the transport phenomena including wind and ocean currents. This increases plastic debris availability for being ingested by an outsized kind of organisms and highlights the looks of further environmental hazards [2]. Wastewater treatment plants are also a significant source of microplastics release [3], [4].

Whereas large plastic particles are efficiently removed during wastewater treatment, microplastics often bypass the treatment units, thus entering and accumulating within the aquatic environment. To deal with this issue, many researchers are investigating the fate, occurrence, detection and removal of microplastics within the water treatment plants [4], [5]. Since secondary microplastics are generated for the breakdown of larger plastic materials, there are many sources that can contribute to their presence within the environment. There also are routes associated with the action of natural phenomena (such hurricanes, tsunamis, and powerful sea), agricultural activities, the utilization of synthetic textiles and other different human activities [6].

III. MICROPLASTIC TRANSPORT

Sea and ocean are viewed because the major sinks for microplastics, whereas freshwaters and terrestrial environments are the most sources. This implies that freshwaters and soils also are sinks of microplastics, as evidenced by high concentrations of microplastics in some terrestrial and freshwater areas [7]. As rivers carry an enormous volume of plastic particles over massive distances, microplastics probably settle out alongside sinking sediments, particularly where flow energy drops, as an example in retard-moving riverbeds. Accordingly, further sediment deposition of microplastics in lakes where water flow is that the lowest and erythrocyte sedimentation rate is high should induce high accumulation [8].

The shape diversity, small size, lightweight and rarity of microplastics contribute to their widespread transport and facile dispersal across large distances ashore and within aquatic systems by storm sewers, wind and other natural currents [9]. Larger size and better density end in facile sinking and sediment deposition of the microplastics [10]. Furthermore, irregularly shaped microplastics with jagged geometry and sharp ends are more likely retained under-water, instead of returning to the surface, whereas spherical particles show a better tendency to remain at the surface [11], [12]. Microplastics transport pathways within the air aren't fully understood [9]. Noteworthy, within the air, there are few dispersal boundaries, compared to water systems. Nonetheless, microplastics transport within the atmosphere isn't totally independent of aquatic and terrestrial pollutions, and here further investigations are needed to elucidate the mechanisms [13]. As another major concern, thanks to their hydrophobicity and high surface area/volume ratio, microplastics are highly vulnerable to sorb and carry persistent organic pollutants like polychlorinated biphenyls (PCB), dichlorodiphenyltrichloroethane (DDT) and polyaromatic polycyclic aromatic hydrocarbons (PAH), which can be subsequently transferred to coastal regions and be desorbed inside living organisms [14]. Consequently, the concentration of organic pollutants in coastal areas is predicted to extend several orders of magnitude as a result of pollutant transport by microplastics.

IV. TREATMENT

A. Electrocoagulation

Electrocoagulation provides a less expensive tertiary treatment process that doesn't believe chemicals or microbes are utilized in general chemical coagulation and traditional activated sludge processes. Electrocoagulation is a metal electrode to produce electrically coagulants, consequently making the coagulation simple and robust [15], [16]. Electrocoagulation is a complex process because the merchandise of electrolytic reaction within the process of electrocoagulation is merely ion, no oxidant or reductant is required, and no or little pollution is produced to the environment, it is called an environmentally friendly water treatment technique. Electrocoagulation has the benefits of environmental compatibility, easy automation, sludge minimization, energy efficiency and low cost of capital [17]. It was found that removal of microplastics from water by electrocoagulation is effective and the removal efficiencies of microplastics all exceeded 90%. The optimum removal efficiency was to be 99.24% observed under the condition of pH 7.5 [18]. At high current density, the reduction of the removal efficiency of PE microplastics is especially thanks to the rise of energy consumption, but the development of the removal efficiency is not obvious. Water conductivity has no obvious impact on removal efficiency, and therefore the removal efficiency increased with time and reached a gentle state after 40 min [18].

B. Magnetic Extraction

Magnetic extraction may be a separation technology that uses magnetic seeds and acid with external magnetic flux to enhance the separation speed. Fe nanoparticles were chosen as magnetic seeds during this research thanks to their low cost, high specific area and ferromagnetic properties. Fe nanoparticles were coated with hex- adecyltrimethoxysilane to form them hydrophobic, thereby allowing the isolation of microplastics from water by magnetic extraction [19]. The recovery was low because soil particles prevent Fe nanoparticles from encountering microplastics (for sediments). Therefore, the authors reported that this method might be better suitable for beverage treatment[19].

C. Membrane Separation

Membrane separation technology is usually used for advanced treatment of beverages, which has the benefits of stable effluent quality and straightforward operation. Contingent upon the size of the layer, film partition innovation can be isolated into ultrafiltration, nano filtration and opposite assimilation. The membrane has strong selectivity and separation, which may effectively remove organic pollutants, multivalent ions and disinfection by-products and at an equivalent time, reduce the hardness of the water. Under the action of pressure difference, the dimensions of membrane pore are employed to intercept particles in raw waters. Membrane separation technology has been successful in removing bacteria, suspended solids and irons from beverages [20]. Now it provides a practical method to combat microplastic contamination found in beverage streams. Membrane separation tFilm division innovation fills in as an actual boundary against microplastics. Unlike other devices, that aren't generally designed to get rid of microplastics, the particle size of microplastics is within the same range as that of membranes, which empowers them to adequately eliminate microplastics from waters [21]. Microplastics and other separated impurities are safely retained during a small volume ready for further treatment. Nonetheless, there are little researches on the removal of microplastics from beverage by membrane separation technology. [21]explored the destiny of microplastics in wastewater treatment plants in Sydney, Australia. The wastewater treatment plant operated primary, secondary and tertiary treatment processes to treat wastewater, including screening, sedimentation, biological treatment, flocculation, disinfection, and ultrafiltration, reverse osmosis and decarbonization.

D. Coagulation

Because of the great productivity and low speculation, compound coagulants, for example, aluminum salts (AlCl3$6H2O, Al2 (SO4)3$18H2O and KAl (SO4)2$12H2O) and iron salts (FeCl3$6H2O and Fe2(S-O4)3$9H2O) are generally utilized. This interaction is constrained by surface charge and grouping of contaminations and pH of water. Ecological microplastic surface generally shows negative charge ([21], [22], which will in-wrinkle the association with substance coagulants. As needs be, microplastics may by implication increment the measure of coagulants needed for coagulation measure.

E. Membrane Fouling

Membrane separation technology has its own detachment attributes and can accomplish ideal treatment impact. In any case, the particular activity measure likewise has weaknesses, and film fouling is common delegate issue. Layer fouling is a marvel where particles and macromolecule substances, like microplastics, truly and artificially cooperate with film during the time spent the treatment, adsorb and store on layer surface or in layer pore, and the pore size be-comes more modest and more modest or blockage happens [23]. The immediate results of contamination are the decline of porous water stream and the increment of transmembrane pressure, consequently causing expanded running time, energy expenses and upkeep necessities. [23] showed that centralization of microplastics in crude water was pretty much as high as 106e107 particles/day, imperceptibly expanding the collaboration among microplastics and layer surface. Since the normal pore size of the film is more modest than microplastics, a lot of microplastics represent a danger of dirtying the surface and impeding the pore, consequently decreasing the layer filtration execution [24]. Notwithstanding broad examinations on the defilement of suspended solids like silica [25], microbes and colloids [26], no exploration has been distributed on the layer fouling attributable to microplastic filtration. Besides, a new exploration proposed that microplastics can be disintegrated into nanoplastics by wastewater treatment plant measure, which builds the quantity of miniature (nano) plastics in water [23]. Another review showed that about 25% of designing nanomaterials were delivered into water treatment plants and dismissed in optional or tertiary treatment [27]. These particles will total to frame a layer fouling. What's more, microplastics are considered as unignorable vectors for amphibian microorganisms, which choose microplastics by framing biofilms on a superficial level [28], which might total the film organic foul during water treatment. As indicated by the crude water quality, picking sensible pretreatment measure, streamlining measure plan and choosing right and proficient layer cleaning interaction can viably forestall and diminish film fouling. Film division doesn't totally eliminate poisons during the time spent drinking water treatment, however just through actual capture attempt [23]. In this way, countless concentrated water will be created during film activity. In the event that the concentrated water and cleaning water are straightforwardly released into normal water, it will cause water and soil contamination. This is as yet an issue worth contemplating and settling in the improvement of layer partition innovation. Layer detachment innovation can more readily meet the drinking water quality norms, making a significant piece of drinking water treatment, while the film fouling brought about by miniature (nano)plastics will turn into a significant issue [23]. Nonetheless, the effects of miniature (nano) plastics on layer filtration measure execution are not yet completely clear in view of the absence of relating expulsion strategies and investigation techniques.

Investigating the fouling component of miniature (nano) plastics on layer frameworks is essential in order to decide their impacts on filtration execution. Thusly, more endeavors are wanted to work on the recognize on miniature (nano) plastic fouling.

F. Disinfection

Drinking water climate is undermined by numerous contaminations and climate contamination will build a wide range of hurtful sub-position in drinking water. Sterilization is a powerful technique to kill pathogenic microorganisms in water and forestall the spread of infections. Sterilization is generally the last treatment venture during drinking water treatment, so miniature (nano) plastics that accomplish this cycle might be probably going to interface with microorganisms in drinking water. The arrangement of biofilm on the outer layer of microplastics may lessen the proficiency of sanitization measure [23]. Chlorination, ozonation, and bright light are three normal sanitization methods ([29]. Chlorination causes bacterial passing by restraining the action of their compounds. Notwithstanding, the event of micron suspended solids in water blocks the impact of chlorine on miniature creatures, since they might be tapped by flocs or suspended particles [30]. Subsequently, microplastics with comparative actual properties can go about as defensive substrates for microbes, which can oppose the sterilization interaction [23]. Yet, microplastics can associate with ozone, along these lines diminishing the quantity of ozone atoms accessible to respond with microorganisms and leaving unaffected microbes in water [23]. In this manner, microplastics may diminish the exhibition of bright sanitization measure.

V. CHALLENGES OF PREVENTING MICROPLASTIC POLLUTION

There are many difficulties identified with the examination of microplastic contamination about avoidance. Likewise, there are contrasts between the systems applied on the examinations; thus, the outcomes are not generally equivalent between themselves. When it goes to the down to earth application, one of the difficulties to forestall microplastic contamination on the water bodies is the absence of innovation that successfully holds this sort of material at wastewater offices. However, even with high expulsion, little amounts would be released into water bodies and would keep making destructive outcomes the climate. Layer bioreactors are a model after essential and optional treatment, utilizing cross-stream filtration, diffusing just water and little particles. One more disadvantage of this innovation is the popularity for energy and subsequently greater expense of activity two distinctive channel media were explored as far as stopping up, retro filtration limit, and momentary solidness. In Canada, there are numerous offices which use layer innovation during the treatment cycle, however it isn't accounted for that it is a job explicitly for microplastic evacuation. Past examinations in different areas have shown that film cycles can lessen the measure of microplastic in the last gushing water, yet there are many inquiries regarding the monetary practicality of its use because of the significant expense of execution[6].

VI. DISCUSSION AND CONCLUSION

Examinations identified with the event and destiny of microplastics in oceanic climate have been speeding up overall particularly during the last decade, considering the expansion in plastic creation and therefore the danger of little plastic particles defiling our current circumstance. Microplastics might be released to the climate from plastic enterprises for example by means of spillages and transportation mishaps. Different sources incorporate the tear and wear of plastic things, the utilization of individual consideration items and washing of manufactured materials. In this specific situation, microplastics may go about as vectors for unsafe added substances and pollutants and they can possibly be moved inside the planktonic food web, which may influence the natural destiny of various harmful substances. Examination endeavors on the conduct and effect of microplastics in oceanic climate appear to be flexible, which makes similar investigations testing. As the expanding measure of microplastics found in the climate have been seen to have a place with significantly more modest size range the lower size limit was diminished under 50 mm and even to the scope of nanoplastics. Microplastics have additionally been disengaged from ecological examples by utilizing variable methodologies) and afterward distinguished either outwardly or utilizing more solid recognizable proof investigations.

The presence of microplastics is turning into a hazardous natural concern. A contributor to the issue comes from the way that it tends to be hard to pinpoint the specific wellspring of the miniature plastics in view of their moderately divided nature, little size, and a wide scope of likely sources. Microplastics have turned into a danger to the climate, a worry reflected by locales with curiously high fixations and a chance of significantly more prominent focuses later on. As an outcome, the utilization and resulting arrival of microplastics should be definitely diminished as a feature of a worldwide drive even before the accessibility of examination studies illustrating the drawn out chances included. Observing projects can assume a vital part in the counteraction and the executives of microplastic contamination.

Most of nations, then again, have not fostered an essential way to deal with exploring the essential wellsprings of microplastics collecting in the water sources or techniques for viably tending to their particular appropriate ties. Some not-for-profit associations have focused on gathering and exploring information from different locales trying to follow and grill these worries worldwide, explicitly in hard to-get to or separated areas. Specialists need to work together on a work that can give a useful methodology to limiting utilizations of microplastics. Albeit a few exploration projects have analyzed the impacts of microplastics comparable to the last emanating, the specific elements associated with the microplastic evacuation during each different advance of the wastewater treatment plant are as yet unclear. In this manner, it is important that minimal expense and energy-proficient layer bioreactor frameworks are planned and carried out, for applications, for example, essential and optional medicines at wastewater treatment plants.

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REFERENCES

[1] M. Padervand, E. Lichtfouse, D. Robert, and C. Wang, "Removal of microplastics from the environment . A review," Environ. Chem. Lett., no. 0123456789, 2020, doi: 10.1007/s10311-020-00983-1.

[2] R. C. Thompson, C. J. Moore, F. S. V. Saal, and S. H. Swan, "Plastics, the environment and human health: Current consensus and future trends," Philos. Trans. R. Soc. B Biol. Sci., vol. 364, no. 1526, pp. 2153–2166, 2009, doi: 10.1098/rstb.2009.0053.

[3] M. A. Browne et al., "Accumulation of microplastic on shorelines woldwide: Sources and sinks," Environ. Sci. Technol., vol. 45, no. 21, pp. 9175–9179, 2011, doi: 10.1021/es201811s.

[4] Z. Long et al., "Microplastic abundance, characteristics, and removal in wastewater treatment plants in a coastal city of China," Water Res., vol. 155, pp. 255–265, 2019, doi: 10.1016/j.watres.2019.02.028.

[5] J. Sun, X. Dai, Q. Wang, M. C. M. van Loosdrecht, and B. J. Ni, "Microplastics in wastewater treatment plants: Detection, occurrence and removal," Water Res., vol. 152, pp. 21–37, 2019, doi: 10.1016/j.watres.2018.12.050.

[6] H. Westphalen and A. Abdelrasoul, "Challenges and Treatment of Microplastics in Water Challenges and Treatment of Microplastics in Water," doi: 10.5772/intechopen.71494.

[7] L. Nizzetto, M. Futter, and S. Langaas, "Are Agricultural Soils Dumps for Microplastics of Urban Origin?," Environ. Sci. Technol., vol. 50, no. 20, pp. 10777–10779, 2016, doi: 10.1021/acs.est.6b04140.

[8] P. L. Corcoran, T. Norris, T. Ceccanese, M. J. Walzak, P. A. Helm, and C. H. Marvin, "Hidden plastics of Lake Ontario, Canada and their potential preservation in the sediment record," Environ. Pollut., vol. 204, pp. 17–25, 2015, doi: 10.1016/j.envpol.2015.04.009.

[9] A. A. Horton and S. J. Dixon, "Microplastics: An introduction to environmental transport processes," WIREs Water, vol. 5, no. 2, pp. 1–10, 2018, doi: 10.1002/wat2.1268.

[10] A. A. Horton, A. Walton, D. J. Spurgeon, E. Lahive, and C. Svendsen, "Microplastics in freshwater and terrestrial environments: Evaluating the current understanding to identify the knowledge gaps and future research priorities," Sci. Total Environ., vol. 586, pp. 127–141, 2017, doi: 10.1016/j.scitotenv.2017.01.190.

[11] A. Ballent, A. Purser, P. D. J. Mendes, S. Pando, and L. Thomsen, "Physical transport properties of marine microplastic pollution," Biogeosciences Discuss., vol. 9, no. 12, pp. 18755–18798, 2012, doi: 10.5194/bgd-9-18755-2012.

[12] F. Lagarde, O. Olivier, M. Zanella, P. Daniel, S. Hiard, and A. Caruso, "Microplastic interactions with freshwater microalgae: Hetero-aggregation and changes in plastic density appear strongly dependent on polymer type," Environ. Pollut., vol. 215, pp. 331–339, 2016, doi: 10.1016/j.envpol.2016.05.006.

[13] R. Dris, J. Gasperi, M. Saad, C. Mirande, and B. Tassin, "Synthetic fibers in atmospheric fallout: A source of microplastics in the environment?," Mar. Pollut. Bull., vol. 104, no. 1–2, pp. 290–293, 2016, doi: 10.1016/j.marpolbul.2016.01.006.

[14] M. A. Browne, S. J. Niven, T. S. Galloway, S. J. Rowland, and R. C. Thompson, "Microplastic moves pollutants and additives to worms, reducing functions linked to health and biodiversity," Curr. Biol., vol. 23, no. 23, pp. 2388–2392, 2013, doi: 10.1016/j.cub.2013.10.012.

[15] S. Garcia-Segura, M. M. S. G. Eiband, J. V. de Melo, and C. A. Martínez-Huitle, "Electrocoagulation and advanced electrocoagulation processes: A general review about the fundamentals, emerging applications and its association with other technologies," J. Electroanal. Chem., vol. 801, pp. 267–299, 2017, doi: 10.1016/j.jelechem.2017.07.047.

[16] D. T. Moussa, M. H. El-Naas, M. Nasser, and M. J. Al-Marri, "A comprehensive review of electrocoagulation for water treatment: Potentials and challenges," J. Environ. Manage., vol. 186, pp. 24–41, 2017, doi: 10.1016/j.jenvman.2016.10.032.

[17] B. Zeboudji, N. Drouiche, H. Lounici, N. Mameri, and N. Ghaffour, "The Influence of Parameters Affecting Boron Removal by Electrocoagulation Process," Sep. Sci. Technol., vol. 48, no. 8, pp. 1280–1288, 2013, doi: 10.1080/01496395.2012.731125.

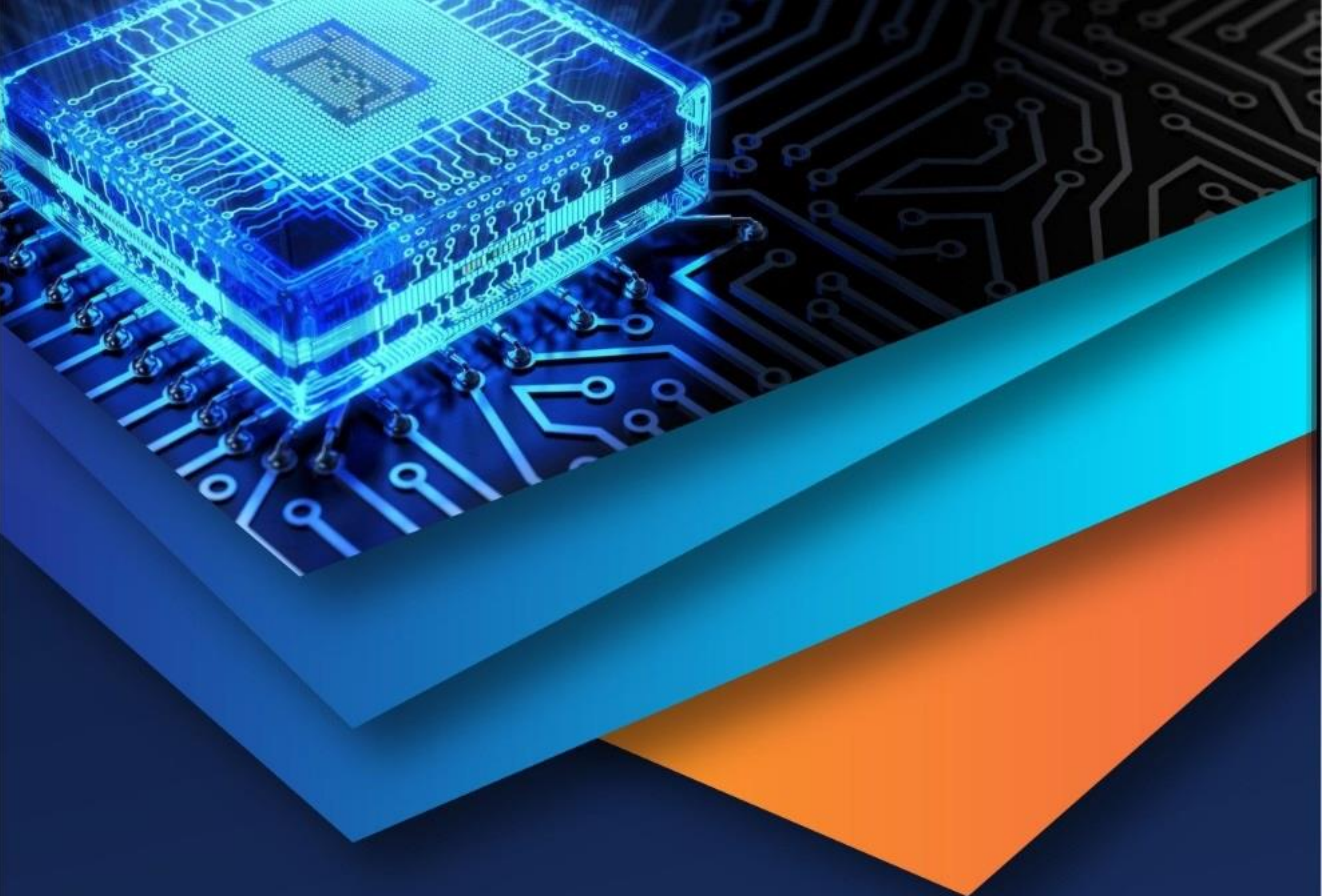
[18] W. Perren, A. Wojtasik, and Q. Cai, "Removal of Microbeads from Wastewater Using Electrocoagulation," ACS Omega, vol. 3, no. 3, pp. 3357–3364, 2018, doi: 10.1021/acsomega.7b02037.

[19] J. Grbic, B. Nguyen, E. Guo, J. B. You, D. Sinton, and C. M. Rochman, "Magnetic Extraction of Microplastics from Environmental Samples," Environ. Sci. Technol. Lett., vol. 6, no. 2, pp. 68–72, 2019, doi: 10.1021/acs.estlett.8b00671.

[20] M. Wu, W. Liu, and Y. Liang, "Probing size characteristics of disinfection by-products precursors during the bioavailability study of soluble microbial products using ultrafiltration fractionation," Ecotoxicol. Environ. Saf., vol. 175, no. November 2018, pp. 1–7, 2019, doi: 10.1016/j.ecoenv.2019.02.077.

[21] J. Talvitie, A. Mikola, A. Koistinen, and O. Setälä, "Solutions to microplastic pollution – Removal of microplastics from wastewater effluent with advanced wastewater treatment technologies," Water Res., vol. 123, pp. 401–407, 2017, doi: 10.1016/j.watres.2017.07.005.

[22] R. Triebskorn et al., “Relevance of nano- and microplastics for freshwater ecosystems: A critical review,” TrAC - Trends Anal. Chem., vol. 110, pp. 375–392, 2019, doi: 10.1016/j.trac.2018.11.023.
[23] M. Enfrin, L. F. Dumée, and J. Lee, “Nano/microplastics in water and wastewater treatment processes – Origin, impact and potential solutions,” Water Res., vol. 161, pp. 621–638, 2019, doi: 10.1016/j.watres.2019.06.049.
[24] B. Ma, W. Xue, C. Hu, H. Liu, J. Qu, and L. Li, “Characteristics of microplastic removal via coagulation and ultrafiltration during drinking water treatment,” Chem. Eng. J., vol. 359, no. November 2018, pp. 159–167, 2019, doi: 10.1016/j.cej.2018.11.155.
[25] X. Chen, W. Ni, J. Wang, Q. Zhong, M. Han, and T. Zhu, “Exploration of Co-Fe alloy precipitation and electrochemical behavior hysteresis using Lanthanum and Cobalt co-substituted SrFeO3-δ SOFC anode,” Electrochim. Acta, vol. 277, pp. 226–234, 2018, doi: 10.1016/j.electacta.2018.05.019.
[26] W. Guo, H. H. Ngo, and J. Li, “A mini-review on membrane fouling,” Bioresour. Technol., vol. 122, pp. 27–34, 2012, doi: 10.1016/j.biortech.2012.04.089.
[27] A. A. Keller and A. Lazareva, “Predicted Releases of Engineered Nanomaterials: From Global to Regional to Local,” Environ. Sci. Technol. Lett., vol. 1, no. 1, pp. 65–70, 2013, doi: 10.1021/ez400106t.
[28] A. McCormick, T. J. Hoellein, S. A. Mason, J. Schluep, and J. J. Kelly, “Microplastic is an abundant and distinct microbial habitat in an urban river,” Environ. Sci. Technol., vol. 48, no. 20, pp. 11863–11871, 2014, doi: 10.1021/es503610r.
[29] G. A. Shin and M. D. Sobsey, “Inactivation of norovirus by chlorine disinfection of water,” Water Res., vol. 42, no. 17, pp. 4562–4568, 2008, doi: 10.1016/j.watres.2008.08.001.
[30] N. Narkis, R. Armon, R. Offer, F. Orshansky, and E. Friedland, “Effect of suspended solids on wastewater disinfection efficiency by chlorine dioxide,” Water Res., vol. 29, no. 1, pp. 227–236, 1995, doi: 10.1016/0043-1354(94)E0117-O.



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