Impact Due to Micro plastic Pollution along Aquatic Environment in Chennai Coastal Region, India

S. Ramesh[a], R. Nagalakshmi[b]

Department of Civil Engineering, SRM Institute of Science & Technology,Kattankulathur, Tamil Nadu , India – 603203.

[a)]Corresponding Author : *rameshs@srmist.edu.in*

Abstract: Increasing micro plastic concentration in the coastal environment is a severe threat to the marine ecosystem and indirectly to human society depending on the marine environment. Also, the surface and subsurface water quality parameters are the indicators of the usability of the water sources for human activities. The primary source of micro plastic is the river systems from land to sea. This study establishes a correlation between water quality parameters and micro plastic concentration to find the most suitable quality parameter for finding the micro plastic concentration in urban coastal estuaries of Chennai coast, Tamil Nadu, India. Twenty water and sediment samples from Adayar,Coovum,Kovalam estuaries and mangroves area were collected. The samples were tested for basic physico-chemical parameters such as temperature, pH, salinity in the field by hand instruments, EC, Turbidity, TDS, DO, BOD and CODin the laboratory by standard procedure and micro plastic concentration was analyzed using Fourier Transform Infrared Spectroscopy (FTIR) study and imaging has done with Digital Microscope after digestion of organic matter, density separationand filtered by vacuum filter. From this analysis,were identified the predominant kinds of micro-plastics are polyethylene, polypropylene, and polystyrene by FTIR and were identified filaments, pellets and fibers by microscope imagine. Correlation tests such as Pearson’s and Spearman’s are performed based on the initial Normality and Homogeneity test. The results show that all the parameters are significantly not correlated with the Micro plastic Concentration. This study should be one of the first baseline studies for microplastic loads in South Indian streams and should be complemented with further environmental sampling before, during and after the monsoon season to get more detailed information on the storage and transportation of fluvial microplastics under different weather conditions.

Keywords: Marine environment, Micro plastic, Fourier Transform Infrared Spectroscopy, Digital Microscope, Pearson and Spearman Correlation test.

INTRODUCTION

Contamination of the marine atmosphere by plastic litter from shallow seaside zones to open seas is a global concern and has been recorded all over (Ivar et al . , 2014). In view of the increasing interest, usage example and design habits of plastics, the improper removal of plastic waste would lead to the expansion of flotsam and jetsam plastics in the seas (Thompson et. al., 2009). The contribution of micro plastics from land to the oceans can be due to the direct existence of spills from heavily inhabited or industrial areas and the resulting dissolution of plastic debris by physical (wind , waves and flows), material (UV radiation) and organic debasement (Ivar et al . 2014). Boats and vessels, offshore oil and gas phases and hydroponics institutions are part of ocean-based plastic litter springs (UNEP 2005). Several experiments have recently revealed that microplastics are broad and universal within the aquatic climate (Van et al., 2013).

The most commonly used manufacturing plastics remain small and great thickness polyvinyl chloride (PVC), polyethylene terephthalate (PET), polyethylene (PE) , polystyrene (PS) and polypropylene (PP), (Andrady et al., 2009). Normally, the high thickness of the polymer particles sinks and aggregates into the residue, while the low thickness of the polymer particles increases on the ocean floor. Since micro plastics appear in sedimentary living spaces and are small in scale, both benthic suspensions and feeders can correlate with or directly ingest sinking and sedimentary micro plastics (Cole et. al., 2011) & (Thompson et. al., 2004).

Studies say that hydrophobic pollution presented in salinewater adsorb to plastic garbage under ecological conditions (Cole et al., 2011). Subsequently, an absorption of microplastics by a lower trophic life types has a propensity for the bioaccumulation of poisons. Numerous experiments have demonstrated that pieces of plastic can be used in marine biota under test conditions. (Ribeiro et. al., 2017); notwithstanding in situ conditions, microplastics are introduced to creatures during their lifespan as compared with brief exploratory times. Constant intake andaggregation of microplastics by living organisms may have predicted toxicological consequences.

India is one of the world's top plastic consumers, with an annual utilisation rate of 05.60 million tonnes. Water and estuarine structures have been established as micro plastic degradation hotspots (Wright et. al., 2013). However, as far as anyone is concerned, there has been no detailed examination of the presence of micro plastics in biota from Indian waterfront waters. In the present investigation, attempts have been made to determine the frequency and form of micro plastics in benthic spineless creatures from the beachfront waters of Kochi, the south western coast of India,which are powerless against plastic degradation.

Goals of study

- To recognize the variables answerable for causing marine contamination
- To gauge the impact and effect because of marine contamination towards aquatic life span.
- Towards examining the Chennai seaside harbour locale and its effect on aquatic climate.
- Towards proposing strategy measures to forestall marine contamination. To establish manageable marineclimate

MICROPLASTICS

While macro plastic flotsam and jetsam have been the focal point of natural concern for quite a while, it's been after the beginning of the last century that small plastic pieces, strings, and globules, commonly referred to as "micro plastics,' have been known to be poisons of their own according to (Thompson et al., 2004). Particulates were already classified different sizes, varying from sample to sample, of measurements< 2 mm (Ryan et al . , 2009)< 1 mm (Browne et al . , 2007) (Claessens et al., 2011)< 5 mm (Barnes et al., 2009),2–6 mm (Derraik et al., 2002)and < 10 mm (Thompson et al., 2009),. Such inconsistency is very risky whenever evaluating information relating to plastic particles, creating this extremely significant towards making a reasonable stock (Costa et al., 2010). As of late, (Andrady et al . , 2011) proposed to use the word "meso plastics" in logical terms, to distinguish tiny plastics visible to the naked eye from solitary ones detectable by microscopy.

Essential Micro plastics

Plastics generated to be small in magnitude are characterised equally critical micro plastics. Such products are commonly seen in genital-chemicals and cosmetic products materials (Zitko et al., 1991) or even as wind-impacting materials (Gregory et al., 1996), while the use as portals for medicines is increasingly common (Patel et al . , 2009). Extent necessary to much more detailed meanings of plastic particles, virgin plastic pellets (usually 2–5 mm now distance) could still remain assumed to be significant pieces of plastic, given that they have been condemned within such a category (Costa et al., 2010). Micro plastic cleaners used throughout the removal of hand toxins and face clears have been substituted by conventional fixings, comprising ground almonds, cereal and pumice (Fendall et al., 2009). Seeing as micro - plastics cleaners were permitted within beautifiers in the 1980s, use of such polycarbonate- containing stripping additives has increased significantly (Zitko et. al., 1991).Regularly seen as "micro beads" or "miniature sheds',' these plastics will fluctuate as fiddles, sizes, and creations that depend on the object. For example, (Gregory et al . , 1996) the appearance of polyethylene and polypropylene gelatin (< 5 mm) and polystyrene circles (< 2 mm) with one correcting item was recorded. Very significantly (Fendall et al., 2009) a significant amount of inconsistently formed micro plastics, usually < 0.5 mm in thickness with a type size < 0.1 mm, has indeed been reported from another rehabilitative commodity. Primary micro plastics have also been provided to be used in air- impacting advancement (Derraik et al., 2002). The process includes the effect of melamine ,acrylic, or polyester micro plastic purifiers on device, motors & pontoon structures towards reducing corrosion and stain. These are often polluted with hazardous metals (e.g. Cadmium, Chromium, Lead) (Gregory et al., 1996) as these cleaners are being used continually once they are diminished in volume and their smashing power is reduced.

Other Micro-Plastics

Optional micro plastics depict small sections of plastic produced by the breakdown of larger, adrift and ashore plastic trash (2004, Thompson et al.). After plenty of age, the intensity of the external, organic and composite progressions could decrease the alternative respectability of waste micro plastic, leading to degradation (Browne et al., 2007). During extended times, sunlight damage can lead in visual impoverishment of plastics; bright (UV) ultraviolet radiation causes degradation of the polymer network, which contributes to oxidation(Rios et al. 2009) & (Barnes et al. 2009); Such debasement can result in added substances, which are intended to boost resistance to strength and use, being discharged from polycarbonate (Talsness et. al., 2009). The moist, oxide situations of the aquatic atmosphere remain important towards preventing the oxidation of images; considering the strong oxygen supply of plastic waste on the coasts of the sea and the direct exposure of sunshine, they would easily corrupt, with time turning poor, frame breaks and "yellowing"' (Moore et al., 2008). With lost auxiliary uprightness, these plastics are increasingly defenceless against discontinuity due to spot scratching, wave action, and clumsiness (Browne et al., 2007). This cycle is continuing, with pieces diminishing after some time before they become micro plastic in size (2007, Rios et al.). This was assumed that micro plastics growing explicitly humiliate to be nano plastic in diameter, provided that the tiny microscopic particle recognised throughout the sea is 1.6 lm in dimension (Galgani et. al., 2010). The occurrence of bio-plastics in the marine environments is predicted to reach in the years to come, and researchers like (Andrady et al . , 2011) have only started to believe that this chemical might have an effect on the aquatic food chain. The production of recycled polymers is commonly seen as a viable replacement for traditional plastics. They may also be a cause of micro plastics, however they may be (Thompson et al . , 2004). Bio plastics are typically blends of manufactured composites and protein, trans fats. or advanced synthetic substances designed to accelerate the period of corruption (Thompson et al., 2004) that, when properly discarded, deteriorate in the mechanical treatment of soil plants under humid, sticky and highly circulated air conditions (Thompson et al., 2006). However, this degradation is only fractional: although the parts of the bio-plastic will disintegrate, a significant amount of engineered polymers will be left behind (Roy et al., 2011) (Thompson et al., 2004). Inside a comparatively cold marine climate, with no terrestrial animals, the degradation processes even of the recyclable components of bio-plastics would be extended, enhancing the likelihood that pollutants would grow. will be trampled on and thus decreasing the UV penetration of which the period of corruption relies (O'Brine et al., 2010). Micro plastics will be delivered to the aquatic climate after the degradation has inevitably arisen (Roy et al . , 2011).

Directing Micro plastics into sea waters

Micro plastics join the aquatic climate through different channels (native and aquatic-based exercises) shown in Figure. 1 (Alomar et. al., 2016, 2016). Micro plastic globules found in sunscreen, e.g. scours, toothpastes, air- impacting media and clothes, may enter the amphibian climate through means of mechanical or home grown sealing frameworks. Fabricated fibers also develop micro plastic sheds which are cleaned as pollutants in groundwater or water treatment plants (Murphy et al . , 2016). Wastewater Treatment Works (WWTW) situated on the Clyde River in Glasgow drainage nearly 65 million micro plastics mad about another sea. (Gouinet et al . , 2011) reported that the US nation produces approximately 263 heaps of yearr−1polyethylene micro plastics, mostly by the use of single pieces. Micro plastic intake per capita has been calculated to be 2.4 mg / day-1. This constitutes 25% of all toxins in the North Atlantic sub - tropical zone. In contrast, micro plastics join the aquatic environment by sewage pipes, winds and rivers (Murphy et al . , 2016). Most are transported to the ocean by drainage (Cole et al., 2011), whereas the impoverishment of marine litter flotsam and jetsam is also another source and the route is also recycled by ocean ports and land fills where adverse environment patterns help to unload macro plastics along coastlines. Sewage muck is another conceivable cause of micro plastic degradation, as it creates more micro plastics than sewage transmitted into the aquatic environments (Alomar et al., 2016). The scale of the micro plastics (b5 mm) as well as the resultant low stiffness lead to the large distribution of the device and to the distribution of the fluid flow (Eerkes-Medrano et al., 2015). Such microscopic sea pollutants are widespread and extensive in all deep ocean marine areas of the world (Cole et al., 2014).

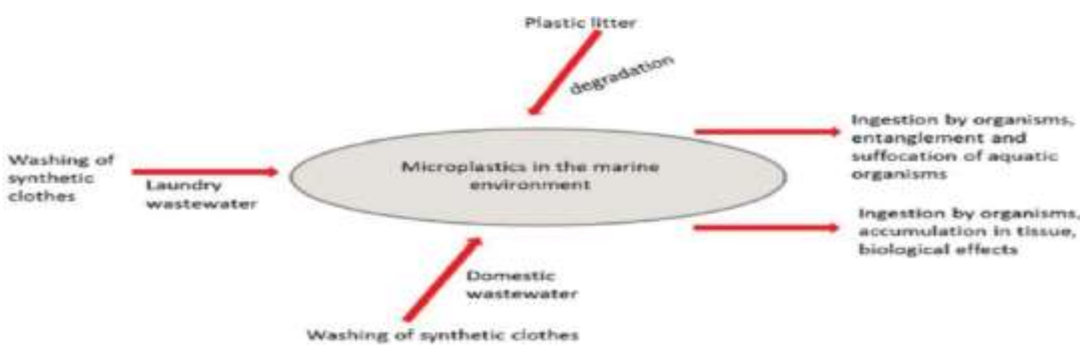

FIGURE 1. Micro plastic Foundations in Aquatic Atmosphere

Micro plastics are found mostly on shore of the seas, shoreline remains of marine waters, in a broad variety of aquatic living species including such sea-winged birds, crabs, invertebrates, warm-blooded animals and seafood (Gauquie et al., 2015). A further path by which micro plastics would reach the oceans would be through the defection of marine organisms. It was shown by an examination (Cole et al . , 2016) of exposed marine organisms (Calanushelgolandicus and C. typicus) into 20.6μM polystyrene micro plastics (1000 micro plastics mL−1). Upon arrival, the living beings actually benefited from the micro plastics that had gone through the stomach, had been represented in the dung, and had been egeted. After egestion, the dung sunk to the bottom of the demonstration structure and the bigger coppod was swallowed. The investigation revealed that micro plastics could be swallowed with the usage of biological particles, thus showing that bacterial beads are a form of micro plastics in the marine world. It has been calculated these out of 269 million tonnes of 5.25 trillion chemicals globally, 92% are micro plastics, and these micro plastics are also smaller than the average on the ocean bottom, supporting the perception that most micro plastics fall to seafloor environment (Eriksen et al., 2014). Most have been found to be regularised in Arctic Ocean ice, that has become a major microplastic drain (Zalasiewicz et al . , 2016).

The Global Distribution of Micro plastics in the Sea

Micro plastic analysis is overwhelmed by the discovery of micro plastic dispersion and plenitude in the aquatic environment (Ivar et al., 2014) from the beach lines on the coasts of the sea to the deep ocean floor and in the water segment. The ongoing assessment recommended that there be between 7000 to 35.000 tonnes of plastic gliding in the untamed sea (Cózar et al., 2014). Another investigation found that more than five trillion pieces of plastic and > 250,000 tonnes of plastic are actually offshore (Eriksen et. al., 2014). When in the water, micro plastics are shipped far and wide by sea currents, where they persevere and collect. Micro plastics are suspended in water, surface waters (Cózar et al., 2014), seawater e.g. (Obbard et al., 2006), estuaries (Browne et al., 2010), lakes (Thompson et al., 2014), seashores (Browne et al., 2011) and distant ocean traces (Van et al., 2013) (Fischer et al., 2015). Suspended in the water portion, micro plastics can be captured by surface flows and aggregates in focal sea areas (Law et al., 2010). Sea gyres and cohesive regions are critical waste disposal sites, since a rotational example of flows allows high plastic centralisations to be caught and transferred to the focal point of the region (Karl et al., 1999). As gyres are available in the world's oceans, micro plastic amassing can occur on a global scale and has been recorded for the past 40 years. In addition, airflow is influenced by wind blending, which affects the vertical production of plastics (Kukulka et. al., 2012). Physical properties of plastic polymers, including their thickness, can have an effect on their conveyance in the water and benthic natural environments (Murray et al., 2011). Light plastics glide on the surface, while thicker micro plastics or those trapped by biota sink to the bottom of the ocean. It has been assessed lately that 50 per cent of metropolitan waste plastics have a higher thickness than seawater, with the ultimate target of quickly falling to the bottom of the ocean (Engler et al., 2012). It is actually not financially feasible or desirable to extract micro plastics from the sea.

FIGURE 2. Different size Micro plastics in Marine Environment

Various questions have been raised with regard to the measurement of micro plastic diffusion. There are various mechanisms for the presentation of micro plastics in the aquatic climate we may not provide clear schedules for the speed of corruption (Ryan et al., 2009). Evaluation is complicated by the scale of the oceans compared to the size of the chemicals were sampled (Cole et al . , 2011), which have also been puzzled by wave action and frequent instances of geographical and geographical variation (Doyle et al., 2011). These also are various methods used to evaluate plastic particles in aquatic climates (Löder et al., 2015). The effects of the tests have been taken into consideration in numerous measurements, such as the quantity of micro - plastics in a defined volume of water (particulates m^{-3}) or area measurements (particulates km^{-2}). And that, inconsistency is difficult to consider between considerations, as it is preposterous to expect to legitimately think about outcomes. With the purpose of this study, which is intended to complete a simple evaluation of global knowledge on micro plastic distribution, an adjustment has been made to improve the connexions between the different elements of the estimate. It is prudent to agree that surface examples are obtained in the top 0.20 m of water and, as a result, to make a simple approximation to provide a third measurement (right off the bat changing over the molecular km^{-2} to m^{-2}, at that stage duplicating in addition to changing to a mass estimate by 0.20 m, m^{-3}) we can evaluate different assessment methods in a variety of topographical areas. Even so, considering the ebb and flowing path and according to pontoon and the approximate speed of the water, it is hard to ascertain the estimation of the flowing water through the network. As the nets can be brave of the sea, the exact amount of water flowing through is obscure: estimates must be assumed, in the best case situation, evaluations.

It is important to consider the dispersion of micro plastics in the ocean in order to get a grip on their possible consequences. This section would incorporate numerous analyses of micro plastics in topographical districts, comprising the Indian Oceans, Atlantic, Polar Regions, Pacific, Mediterranean waters and European waters. It will show the presentation techniques that have been used to explain micro plastic diffusion and aggregation around the world.

IMPACTS OF MICRO PLASTICS

Connection with Marine Biota

When the abundance of plastic particles reduces, the solubility of marine ecosystems rises. The pitch, size, shape, distance, loading, complete and vividness of such small plastic pollutants influence their possible bioavailability to aquatic creatures (Van et al., 2015). Organic relationships among micro plastics and aquatic microorganisms are vital to understanding the growth, effect and future of pollutants in the environment (Clark et al., 2016). A number of experiments on the absorption of micro plastic particles by marine biodiversity have additionally been utilized with a massive proportion of the experiments carried out in managed research centres. Ingestion of micro plastic particles has been universally seen in aquatic ecosystems in a large range of marine species (Devriese et al., 2015); (Green et al . , 2016). As a result, the absorption of micro plastics by aquatic life forms is unpreventable in the recognition of the way that the substance is regularly confused for nutrition, while others could be purposely consumed by some animals (Lönnstedt et al . , 2016). Investigations have been performed on micro plastic ingestion of marine creatures and a significant proportion of researches have been published on gastric content analysis (Fossi et al . , 2016); (Rehse et al . , 2016). Plastic particles, as used consumed in aquatic life forms, inflict both synthetic and physical damage. The use of micro plastics by aquatic animals can induce mechanical impacts, e.g. the relation of the polymer to the outer surfaces, as a result of which the flexibility and obstruction of the stomach-related lot may be disrupted or the consequence may be a product, e.g. inflammation, hepatic strain, reduced production (Setala et. al., 2016). Micro plastics are frequently used in a wide variety of aquatic creatures speaking at various trophic stages, including spineless organisms, in particular Lugworms (Besseling et al., 2012), mussels (Avio et al., 2016), barnacles; winged birds, whales, turtles and dolphins, ocean cucumbers, amphipods and zooplankton (Goldstein et al., 2013) and coral-eating (Ferreira et al . , 2016); (Fossi et al., 2016).

Natural pollutants are created by micro plastics, either used during plastic production (Diethylhexyl phthalate (DEHP) or consumed in the form of forages and carriers of natural pollutants in ocean water (Bakir et al., 2014).

Adsorption is a behaviour that is both physical and synthetic.

Physical adsorption is subject to Van der Waals' remarkable special surface area and intensity, while compound adsorption is largely due to the higher affinity of natural contamination for marine-contrast micro plastic hydrophobic surfaces (Teuten et al . , 2007; Wang et al . , 2016). With a quantity of microplastics, the vast surface area forces them to defile waterborne contaminants such as implacable natural poisons (POPs), metals (Ashton et al., 2010) and industrial endocrine-disrupting substances. In the miniature crust of the ocean, these toxic contaminants are found in high quantities, where low-thickness micro plastics also occur in enormous amounts (Teuten et. al., 2009).

The hydrophobic surface of micro plastics may be ingested by organo chlorine pesticides such as dichloro-diphenyl trichloroethane (DDT), polycyclic sweet-smelling hydrocarbons (PAHs), and polychlorinated biphenyls (PCBs). The sorption threshold of micro plastics is affected by the shape and state of the polymer (whether smooth or rubbery). A few studies have taken into account the evidence of micro plastic emissions. (Hirai et al . , 2011) and (Ogata et al . , 2009) revealed that 1-10,000 ng g-1 was the global POP grouping of marine plastic pellets. Accordingly, the adsorption of zinc (Zn) and copper (Cu) in seawater from anti-fouling paint on polyvinyl chloride parts and virgin polystyrene dots was examined (Brennecke et al., 2016), and micro plastics adsorbed all metal particles. There are a wide range of adverse effects on these dangerous substances, such as malignancy and endocrine interruption, birth absconds, safe structure complications, and complications with infant improvement (Setala et al . 2016). In micro plastics, which have demonstrated the potential to trade in the sea-going natural way of life and to cause harm to marine organisms who eat them, added toxins that are poisonous and able to drain into the climate could also be present (Setala et al., 2016). Ventilation steps may result in the ingestion of micro plastics by life forms. That is, by developing water around the base of the living being's appendages, carrying a small amount of particulate matter into the gill chamber (Watts et. al., 2014). Aquatic micro plastic ingestion studies have reported adverse effects , especially on Pomato schistusmicrops (Luís et al . , 2015), zebra fish (Daniorerio) (Khan et al . , 2015), whales (Fossi et al., 2016), microalgae (Sjollema et al., 2015) and North and Baltic cod, spot, flounder and pelagic fish species (mackerel and herring) (Rummel et al., 2016).

Micro Plastics Present in Fish

The presence of synthetic chemicals in fish tissues which are similar to plastics has also been detailed in studies. In more influential areas, the Hunter Prey Collaboration increases the sharing of hazardous synthetic compounds so it is easy to collect dangerous synthetic chemicals from various sites in the body (Wang et al., 2016). Concerns over the exchange between trophic layers of micro plastics and destructive synthetic compounds have led to a research facility considering completion to demonstrate the influence of micro plastics on marine biota. In order to demonstrate that micro plastics are aperil for fish, a few experiments have also been carried out as the mortality rate is prevalent before they mature due to micro plastic ingestion. (Batel et al . , 2016) studied the exchange of various trophic layers in the marine ecosystem of microplastics and expected dangerous substances. In the research, Artemiasp.nauplii was subjected to high microplastic centralization (1.2 ☐ 106 mg-2) and it was shown that microplastic particles, varying in size from 1 to 20 µm, were consumed and amassed at high fixations and thus transferred to zebrafish benefiting from nauplii. .The investigation has clearly demonstrated that micro plastics and related toxic substances can be passed along natural pecking orders across multiple trophic levels. The fish consumed and bioaccumulated destructive synthetic compounds from the investigation, causing obsessive and oxidative pressure and liver inflammation. In an alternative paper on the absorption and influence of micro plastics by zebra fish, most plastic particles (with a width of 5 µm) were apparently accumulated in the gills, intestines and liver, while those with a diameter of 20 µm could only concentrate in the fish's intestines and gills. The accumulation of plastic particles thus allowed the fish liver to become inflamed and lipid collected. It has also been shown that micro plastics induce oxidative pressure and change fish liver metabolic profiles that interrupt the processes of lipid and energy digestion (Lu et al . , 2016). Rainbow fish (Melanotaeniafluviatilis) have been subjected to micro beads that have been sorbed into micro plastics in a test exploring the exchange of implacable natural toxins sorbed into micro plastics from human subjects. It was observed that exposed fish had aggregated high convergences of PBDEs(ca. 115 pg g−1wwd−1) after absorption in the tissue (Wardrop et. al., 2016). The inquiry consequently showed that the fish tended to hunt for micro plastic particles and eat them instead of the normal diet. The propensity to popular food of polystyrene micro plastic particles can be due to the size and condition of polystyrene micro plastics, which may have made them ideal for ingestion as claimed (Moore et al., 2005).

Micro plastics of Another Aquatic Life

The matter of plastic debris is not restricted to fish alone; zoomicroscopic fish and ocean turtles are likewisevulnerable to micro plastics.

Aspects of open-air mesocosm have been concluded on the effect of microplastics on a well-being and organic working of the European flat clam (Ostreaedulis) and on the composition of the associated full-scale wildlife.

Life forms were exposed to low and high doses (0.8 μgL−1 and 80 μgL−1) of biodegradable and ordinary micro plastics over a multi-day span.

After introduction, it was seen that the respiratory rate of Ostrea edulis was improved in the light of rising portions of polylactic corrosive (PLA) micro plastics, which showed that the oysters were under pressure.

In contrast, the roundness and abundance of the related benthic life types, including periwinkles (Littorinasp.), isopods (Idoteabalthica) and peppery shell mollusk (Scrobiculariaplana), decreased.

Data have shown that life forms at a lower level in the aquatic food chain ingesting microplastic particles, which could be attributable to the inadvertent ingestion in microplastics by animals as microplastic particles, may be mistaken for food (Rochman et al., 2013).Channels that take care of fish are important sections of the marine food system, and their loss in the marine ecosystem may pose an issue.

The bioavailability of microplastics and dangerous natural contaminations (bisphenol A, polybrominated diphenyl ethers, DDT, and so on) that bind quickly to microplastics and, in the long run, bioaccumulate in aquatic biota when ingested is of incredible concern considering the enormous amount of plastic debris affecting the amphibian setting.

Micro plastics of Coastal Salt

Abiotic ocean products are a source of food for organisms, and that there is a possibility that the presence of micro plastics in the water will cause wickedness of sea products and future human trade. These products are ocean salt. The occurrence of plastic particles in coast water was late shown by research (Yang et. al., 2015) that detected 7–204 particles kg−1, 550–681 particles kg−1and 43–364 particles kg−1 of microplastics in 15 brands of rock / well salts, ocean salt and lake salt individually. Identified micro plastics included polyethylene, cellophane and polyethylene terephthalate. It shows that salt tends to be soiled by micro plastics including fish and shellfish (seafood).

Marine-Contaminating Elements

Disposal of manual wastes and drainage Contaminants freely enter waterways and oceans from municipal sewerage and modern waste as toxic, harmful sewage. Several resources produced during mining can create problems that can conflict with coral polyps' history of life and development. These contaminants and thorny materials, for instance, arsenic, influence hydraulic conductivity, the unpleasant condition of the levels of oxygen, and positioned to influence on the continental shelf, that is a favourable location with most forms of species. Ground run-off***:*** water run-off from agriculture much as urban spin-off and run off from road construction, constructing, docks, rivers, and harbours, may reflect soil particles, weighted down with biomass, nitrogen , phosphorus, and minerals, This substitute rich water may allow plump, biological cycles and zooplankton to thrive, in coastal regions known as algal sprouts, that can likely contribute to phytoplankton sprouts.

Residues in boats: Oil pollution may have destroying consequences that are highly harmful to sea organisms. The poly aromatic aromatic hydrocarbon is untreated oil. Those are difficult to clean and keep going in scrapings and aquatic air for a long period? In certain instances, waterways intentionally release load build-ups from mass transporters, amid unknown and domestic rules exempting such practises, may unclean ports, waterways, and oceans. Consequently, ships create chaos that upsets coastal species.

Environmental toxicity: wind-driven pollution and floating debris, like disposable packets, are driven ocean ward from garbage dumps and other area increasing levels of carbon dioxide in the air, chlorinate the waters, thereby adapting, altering the aquatic climate and fish movement.

Offshore marine drilling: Ocean mining locations are major stream areas. 1400-3700 metres below surface. These locations include precious metals, e.g. silver gold copper, manganese, cobalt, zinc. Pressure-driven syphons carry metal to the shore, expel sections of ocean floor, disturb the biotic crust, increased water segment contamination, and dregs crest from ground water. Increasing the depression on water, it may mitigate light entry and affect the area's food network.

Fermentation: Oceans are natural carbon sinks when they ingest carbon dioxide from the environment, which renders them acidic, yet shellfish might only be used to mould shells. Methane clathrate reservoirs located at sea levels trap tonnes of greenhouse methane. This adds to 3-14 metre sea water swelling.

Eutrophication: anaerobic decomposition triggers spikes in compounds supplements, increased plant growth and rot, stimulates oxygen flow, and significant declines in water quality, impacting fish and other species. Waterways empty into the oceans, simple inorganic compounds used as manures, and pollutants from domesticable animals and people produce oxygen-exhausting synthetics, causing hypoxia and no-man 's land to develop.

Flotsam and jetsam plastic: recycled plastic containers, six pack rings and numerous forms of plastic waste that are unloaded into the sea can undermine natural life by trap, suffocation and ingestion. Polycarbonate inserted compounds are present to disturb the endocrine system, can stifle marine structures when spent and decrease multiplication speeds. PCB, DDT, toxins, furans, dioxins, phenols, and radio-dynamic pollution. Substantial metals, such as mercury, iron , nickel, arsenic and cadmium, may accumulate in the tissues of various organisms in a bio collection measure.

Chennai ports-A Contextual Investigation

This paper puts forth an attempt the effect of contamination in the Chennai port district. Chennai is a bustling region with substantial financial exercises, the port area encourages, travel, and payload stacking and emptying, here remains weighty vehicular movement, the fishing seaportremains consistently works now a functioning way, other than there are various, house staying encompassing, schools, business foundations, shops, little cafés, marriage corridor, clinics, some handling, enterprises, synthetic ventures, processing plants, and so forth The framework offices at the port are insufficient, with helpless seepage offices, ill-advised waste freedom, awful streets. The study on quality of water was collected from the Tamil Nadu Pollution Board in 2009. Displayed that the water content tested positive for elevated alkali, elevated nitrite, relatively higher petro carbon levels were detected, in contrast to near proximity to the port, phenols and elevated levels of cadmium and mercury were detected. Elevated levels of phenolic acids and mercury are required to produce structural pollutants without care. Substantial quantities of fragrant salts from sewer disposal, PHC and Hg from pontoon traffic and harbour drills. In order to explain the beach front climate framework, it has mostly been discovered that anthropogenic causes and a few biogeochemical steps are taking place in the aquatic setting. Eutrophication is observed to be strong, which indicates 24-51 per cent. It requires variables such as Doph, SS, alkali N phosphate and silicate-copper emissions, which is as large as 10.61 per cent. Materials, for instance, Zinc are 10.11 per cent of water bodies, estuary, and surrounding shore line bodies of water was observed to be heavily soiled, solid waste dumped from the neighboring regions, windswept flotsam and jetsam are further adding components. Marine fish creation Marine creation is indicating a decrease because of a few reasons marine contamination is the major among them.

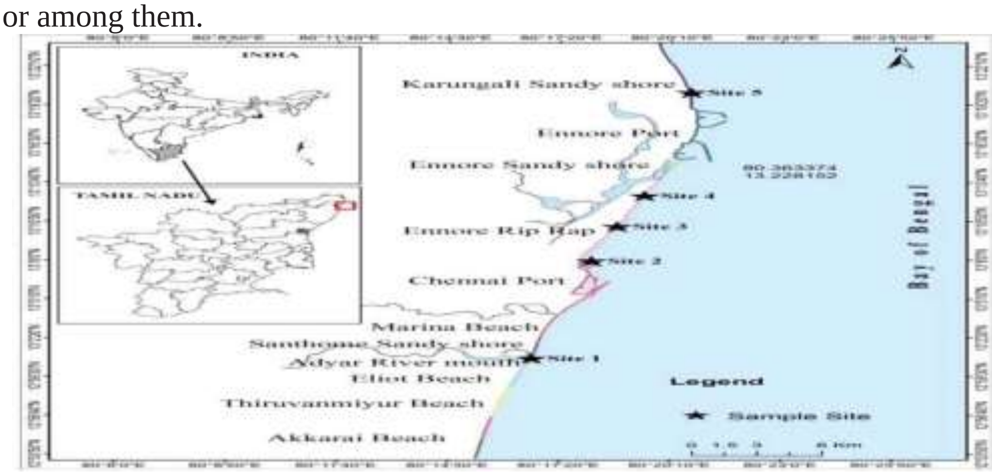

FIGURE 3. Shows the Reason of Study of Chennai, TN

Reasons for decreasing marine creation

- Catch assets seem to be the explanations attributable to either outdated or dropping,
- Overexploitation of characteristic assets, remote ocean fish net
- Over the top increment in fishing armada automated, and mechanized vessels
- Release of sewerage, and seepage into ocean
- Release of strong waste into the ocean
- Release of modern effluents into the ocean
- Land blown trash plastics, Rubber, and so forth
- Oil slicks, increment in hydrocarbon into the ocean.

PRESENT STATUS

Regardless of a few estimates taken to improve stylish states of the streams, there has been a proceeded with debasement in the waterway climate fundamentally because of expanding the inhabitants of the area and the intrusion on the banks of the rivers as well as the disposal of the drainage. Uncollected sewage from uncontaminated regions, processed sewage from sewage treatment plants to the unique CMWSSB in Koyambedu, sludges from business- founded sewage derived from broken slums, and wastewater from the waste treatment plant eventually arrives at the cooum drain. The component of Kodungaiyur Sewage Treatment Plant treated sewage is released into the Buckingham Channel, that is connected with the Cooum River. Like other city drains, Cooum River has no daily stream, and is being polluted by the release of sewage treatment plants from – anti-modern sources. The waste that is permitted into the water distribution base is about 532 mld and more than the waste is treated by the CMWSSB water treatment facility.

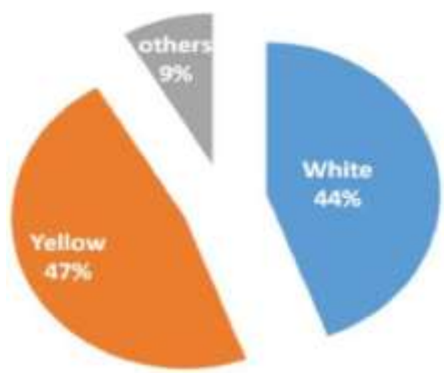

FIGURE 4. Shows Distribution of Pellets (Micro plastics) on Chennai Coasts

Winning pattern

The Tamil Nadu Pollution Management Board under the Monitoring of Indian National Aquatic Resources (MINARS) is tracking the water quality at River Cooum in 11 regions. The limits tested are BOD, TSS, COD, PH, Amonic Nitrogen, TDS and Chloride. Observable analysis of the level of water in the river reveals that there has been little change of the level of water in the river since 1991. The sewage is emitted by Koyambedu Sewage Treatment Plant at an outfall near Aminjikarai. The BOD and TSS levels here follow guidelines. The level of BOD and the loss of oxygen reduces as the water moves into the Bay of Bengal. All the while there is a rise in the amounts of TDS, COD, Chloride and TSS when the water enters the ocean. With the example of Aminjikarai, this may be credited with the discharge of processed water from koyambedu sewage treatment plants. Throughout the entire range from inside city of Chennai, the Water is in the septic state of both records.

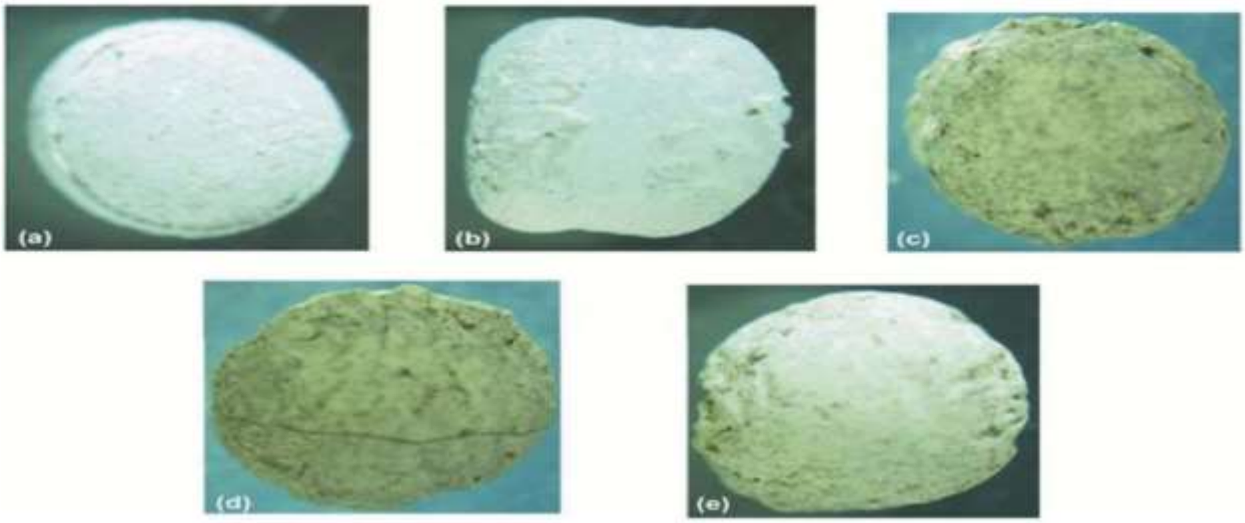

FIGURE 5. Shows Plastic Resins pellets distribution along coasts of Chennai

Owing to the high tide operation and the influx of ocean water, the TDS levels at Napier Bridge, Laws Bridge Chindadiripet and Quai-de-Milleth Bridge are unusually high. Strategic management initiatives for wastewater treatment and marine climate protection in Chennai can assist:

- In order to restore the integrity of the rivers, all violations should be withdrawn from the Cooum River Bank and the overt discharge of the waste should be avoided. The rivers can also be dug and de-iced in order to remove ooze. The body of water can be cleaned with rain water after the rainfalls. This loop will ensure that the flow is re-established in a preferred manner.
- Severe adherence to guideline and permitting by the administration so as to utilize high innovation for treating effluents and sewerage from family unit, business foundations, and ventures. Also, practice dependable waterfront the board.
- To give, offices and foundation in port,
- To control and forestall uncontrolled increment in mechanized and automated pontoon armada which isresponsible for the secretion of pollution and hydrocarbon into the sea.
- To forestall remote ocean mining and secure the sea depths, and spare the widely varied vegetation of themarine living beings.
- To boycott checking the Radiation Complex Experiments in the water bodies, since they pose a challenge tocoral reefs and coastline mount.
- To make attention to public, by data by instructing them to defend the climate, forestall a dangerousatmospheric devation, and receive economical fishing and harbor exercises.
- Lessening the human populace, and guaranteeing vocation to networks which rely on beach front occupationsfor their living.

Different Administration Methodologies for Micro plastic Contamination

Plastic development has observed an incremental growth for a very long time, and it seems unavoidable that the volume of micro plastic particles would continue to rise in the years to come.

As a rising pollution of enormous concern, there is virtually no available and private-area understanding of the possible harmful risks faced by micro plastics and nano plastics when opposed to macro plastics.

The first origins and groups of plastics and micro plastics entering the aquatic environment should be established in order to reduce the proportion of micro plastics in the oceanic environment.

In addition , public awareness-raising by education in the general population, corporate, and government sectors can go a long way towards bringing micro plastic problems to light. As (Ivar et al . , 2013) gave a first internal and external analysis of the impacts of micro plastics on aquatic environment and biota. They called attention to the science network on the observation of sullied pellets in order to decide on temporary instances of various hazardous synthetic compounds that might aid dynamically in potential work.

The question over micro plastics has contributed to the improvement of the board rules by a few associations.

For example , the United Nations Environmental Program (UNEP) Panel of Experts called for guaranteed activity to free the oceans of micro plastics, when they acknowledged that micro plastics are devoured by innumerable aquatic living creatures, and that this poses damage to both the physical and the material. In this way, UNEP has considered a programme affecting more than 40 million people from 120 countries and has placed in motion informative steps to ensure that plastics are not utilised, to empower re-use and to determine removal offices (Caruso et. al., 2015).

Effectively, the United Nations Environment Policy / Mediterranean Action Plan (UNEP-MAP), the Oslo / Paris Policy (North-East Atlantic Maritime Climate Assurance Program (OSPAR) and the Baltic Maritime Environment Protection Commission (HELCOM) have developed guidelines for the evaluation of marine debris, including micro plastics. The agreement involves the setting up of a series of workshops to promote the building of boundaries and the dissemination of good practises among citizens.

The plastics company was initiated in 2011 by the Joint Resolution of the Global Plastics Organizations on maritime litter structures, which included initiatives to eliminate litter and the obligation to support the numerous litter evaluations. The Joint Community of Experts on Science Issues of Maritime Environmental Conservation (GESAMP) advocates that all countries can guide vital initiatives to minimise the amount of plastics entering the sea by adopting a decreased reuse roundabout economy (3-Rs), as this would speak to a financially sound way of minimising the volume of plastic articles and microplastic fragments entering the marine ecosystem.

The California Microglobul Ban, AB 888, was confirmed in 2015. Boycotting is intended to include the most grounded insurance against plastic miniature dab pollution in the world, including the prohibition of a broad variety of plastic micro beads. The bill encourages companies to make normal decisions, such as pecan husks, ocean salt, and apricot pits. Abdominal muscle 888 aims to avoid the 2020 offer of recycled plastic (Casebeer et al., 2015).

POTENTIAL SOLUTION

Misuse of microorganisms for the remediation of debased micro plastic conditions:

The contamination of the aquatic environment by micro plastics has now become too boundless, and their determination tends to increase, although it seems to be extremely impossible to eradicate physically, considering their tiny scale and less permeability.

Similarly, the level at which microplastics reach the climate replaces the pace of evacuation. Realizing the possible sources of oceans and land-based access points for plastics and microplastics can go a fair way to allowing the higher performance of regulation techniques. However, the usage of species that may corrupt microplastic polymers in a cycle called biodegradation could offer additional motivating methodology. Biodegradation is the cycle during which microorganisms are used to debase engineered polymers. Organisms use polymer as a medium of carbon and electricity (Caruso et al . , 2015). Microbes are entrepreneurial and will strike and adapt in any environment.

A few animal types of microorganisms have been known for in order to debase plastic polymers. For eg, (Singh et al . , 2016) revealed the debasement of polyethylene by Staphylococcus sp., Pseudomonas sp., and Bacillus sp., which was confined to soil. Asmita et al . , 2015, thus, isolated species from different soil samples that may have corrupted polyethylene terephthalate (PET) and polystyrene (PS). The segregates included varieties of gillusniger, Pseudomonas aeruginosa, Bacillussubtilis, Staphylococcus aureus, and Streptococcus pyogenes.

Rhodococcusruber was shown to be capable of debasing polystyrene in a completed examination (Mor et al., 2008). This genus of microorganisms are reported to have formed a biofilm that helped to enhance the debasement of polystyrene. Microorganisms separated from the Andhra Pradesh and Telangana regions of Hyderabad have been reported as having the power to corrupt polyethylene using the unmistakable zone and weight-reduction technique used to investigate the capacity for micro plastic degraders (Deepika et al., 2015)..

CONCLUSION

Micro plastics are extremely tiny plastic fragments that make their way through the aquatic atmosphere from two basic sources; restorative artefacts, and big, where larger plastic flotsams and jetsams are hardened through smaller parts. As a rule, this form of plastic reaches the aquatic ecosystem by means of rivers, seepage frameworks, spills over from wastewater treatment facilities, and wind, flow, and wave action. Micro plastics are used worldwide in the oceans where accumulation exists. Extensive delivery of water, surface waters and residues in Europe , Asia , Africa and North America is normal. Owing to the general tiny scale, micro plastics are effortlessly consumed by aquatic living organisms and are found to be aggregated in tissues, circulatory frameworks, and cerebrum. The degree to which micro plastics represent a threat to the entire ecological environment is articulated with the extent of consumption by a broad variety of aquatic biota and the existence of ocean salt. This is of particular significance in the context of the possibility that micro plastics can inflict serious damage to sea animals and humans. Micro plastics minimise the leisure, taste and heritage estimation of the environment, and it seems likely that these contaminants will continue to expand for a very long time to come, since methods to reducing the presence have not been feasible. Decreasing the problem of micro plastics can not happen without the general public, financial regions, the travel industry and organisations acquiring realistic expertise in squandering the board. Study roads are still being checked on aquatic inception microbes with properties that could debase aquatic micro plastics. These microorganisms may then be included in the remediation of sullied environments. Bridling animals for the debasement of micro plastics is a promising and environmentally friendly activity strategy that can empower the management of micro plastics without harmful impacts and will effectively favour the common recycling of despoiled environments.

The study established the elements that are responsible for aquatic pollution and established the impacts. It clarifies the topographical format, it contains the weight of the people, the vulnerability of the seaside networks and the shameful condition of the ports, the water bodies of the streams and how polluted water enters the ocean. It also emphasises the growth of ghettos along the banks of the Chennai River from the outset, how this can be achieved by offering elective destinations and offices. It also took into account the intense port and harbour drills, the powerless base, the state's horrible organisation to preserve and avoid damage. This investigation underscores how mindfulness and evidence and public and private collaboration contribute together to a practical maritime environment, a simple means of moderating global temperature rises and protecting and securing important marine properties.

REFERENCES

1. Adame, F.M.,Neil, D., Wright, S.F., Lovelock, C.E., 2010. Sedimentation within and among mangrove forests along a gradient of geo morphological settings. Estuar. Coast. ShelfSci. 86, 21–30.
2. Alomar, C.,Estarellas, F., Deudero, S., 2016. Micro plastics in the Mediterranean Sea: deposition in coastalshallow sediments, spatial variation and preferential grainsize. Mar.Environ. Res. 115, 1–10.
3. Andrady, A.L., 2011. Micro plastics in the marine environment. Mar. Pollut. Bull. 62,1596–1605.
4. Antunes, J.C., Frias, J.G.L., Micaelo, A.C., Sobral, P., 2013. Resin pellets from beaches of the Portuguese coast and adsorbed persistent organic pollutants. Estuar. Coast. Shelf Sci.130, 62–69.
5. Ashton, K., Holmes, L., Turner, A., 2010. Association of metals with plastic production pellets in the marine environment. Mar. Pollut. Bull. 60, 2050–2055.
6. Asmita, K., Shubhamsingh, T., Tejashree, S., 2015. Isolation of plastic degrading microorganisms from soil samples collected at various locations in Mumbai, India. Curr.World Environ. 4 (3), 77–85.
7. Avio, C.G., Gorbi, S., Milan, M., Benedetti, M., Fattorini, D., d'Errico, G., Pauletto, M.,Bargelloni, L., Regoli, F., 2016. Pollutants bioavailability and toxicological risk frommicroplastics to mussels. Environ. Pollut. 198, 211–222.
8. Bakir, A.,Rowland, S.J., Thompson, R.C.,2014. Transport of Pops by micro plastics in the estuarine conditions.Estuar. Coast. Shelf Sci. 140, 14–21.
9. Barnes, D.K., Galgani, F., Thompson, R.C., Barlaz, M., 2009. Accumulation and fragmentation of plastic debris in global environments. Philos. Trans. R. Soc. Lond. B Biol. Sci.364, 1985–1998.
10. Batel, A., Linti, F., Scherer, M., Braunbeck, T., 2016. The transfer of benzo(a) pyrene from micro plastics to Artemia nauplii and further to zebrafish via trophic food web experiment-CYP1A induction and visual tracking of persistent organic pollutants. Environ.Toxicol. Chem. http://dx.doi.org/10.1002/etc.3361.
11. A Mohan, K. S. Dhaya Chandhran, M. Jothilakshmi, L. Chandhrkanthamma, Thermal Insulation and R- Value Analysis for Wall Insulated with PCM, International Journal of Innovative Technology and Exploring Engineering volume 12 S, 912-921, 2019.
12. Tholkapiyan, M., Mohan, A., Vijayan, D.S. Spatial And Temporal Changes Of Sea Surface Phytoplankton Pigment Concentration Over Gulf Of Manner, India Oxidation Communications, 2021, 44(4), pp. 790–799
13. Boucher, C., Morin, M., Bendell, L.I., 2016. The influence of cosmetic microbeads on the sorptive behavior of cadmium and lead within intertidal sediments. A LaboratoryStudy. Regional Studies in Marine Science 3, 1–7.
14. Brennecke, D., Duarte, B., Paiva, F., Cacador, I., Canning-Clode, J., 2016. Micro plastics asvectors for heavy metal contamination from the marine environment. Estuar. Coast.Shelf Sci.:1– 7http://dx.doi.org/10.1016/j.ecss.2015.12.003.
15. Browne, M.A., Dissanayake, A., Galloway, T.S.,Lowe, D.M., Thompson, R.C., 2008. Ingested microscopic plastic translocate to the circulatory system of the mussel, Mytilus edulis(L). Environ. Sci. Technol. 42, 5026– 5031.
16. Tholkapiyan, M., Mohan, A., Vijayan, D.S., Tracking The Chlorophyll Changes Using Sentinel-2A/B Over The Gulf Of Manner, India, Oxidation Communications, 2022, 45(1), pp. 93–102.

17. TropWater.Carr, S.A., Liu, J., Tesoro, A.G., 2016. Transport and fate of micro plastic particles in wastewater treatment plants. Water Res. 91 (2016), 174–182.
18. Caruso, G., 2015. Plastic degrading microorganisms as a tool for bioremediation of plastic contamination in aquatic environments. Pollution Effects and Control 3, e112. http://dx.doi.org/10.4172/2375-4397.1000e112.
19. Carvalho, D., Baptista Neto, J.A., 2016. Micro plastic pollution of the beaches of Guanabara Bay, Southeast Brazil. Ocean Coast. Manag. 128, 10–17.
20. A Jothilakshmi, M. , Chandrakanthamma, L. , Dhaya Chandhran, K.S. , Mohan Flood control and water management at basin level-at orathur of Kanchipuram district International Journal of Engineering and Advanced Technology, 2019, 8 , International Journal of Engineering and Advanced Technology 8 (6), 1418-1421
21. A Mohan, K Sharan Kumar, M Siva, M Vignesh, P Ramshankar, Geo-Polymerisation Of Industrial Waste using Construction And Demolision Waste As Fine And Coarse Aggregate, 2023; Volume -12 , Issue-2 : Page: 33-38, doi: 10.31838/ecb/2023.12.2.006
22. Castañeda, R.A., Avlijas, S., Simard, M.A., Ricciardi, A., 2014. Micro plastic pollution in St. Lawrence River sediments. Can. J. Fish. Aquat. Sci. 70:1767–1771. http://dx.doi.org/10.1139/cjfas-2014-0281.
23. Chang, M., 2013. Micro plastics in facial exfoliating cleansers. Spring 2013.

24. Chua, E.M., Shimeta, J., Nugegoda, D., Morrison, P., Clarke, B., 2014. Assimilation of polybrominated diphenyl ethers from micro plastics by the marine amphipod, Allor chestes compressa. Environ. Sci. Technol. 48 (14):8127–8134. http://dx.doi.org/10.1021/es405717z.
25. Claessens, M., Van Cauwenberghe, L., Vandegehuchte, M.B., Janssen, C.R., 2013.New techniques for the detection of Micro plastics in sediments and field collected organisms.Mar. Pollut. Bull. 70, 227–233.
26. Mohan, A., Saravanan, J.., Characterization Of Geopolymer Concrete By Partial Replacement Of Construction And Demolition Waste – A Review., Journal of the Balkan Tribological Association, 2022, 28(4), pp. 550–558.
27. Cole, M., Lindeque, P., Halsband, C., Galloway, T.S., 2011. Micro plastics as contaminants in the marine environment: a review. Mar. Pollut. Bull. 62, 2588–2597.
28. Cole, M., Lindeque, P., Fileman, E., Halsband, C., Goodhead, R., Moge, R.J., Galloway, T.S.,2013. Micro plastic ingestion by zooplankton. Environ. Sci. Technol. 47:6646–6655. http://dx.doi.org/10.1021/es400663f.
29. Cole, M., Webb, H., Lindeque, P.K., Fileman, E.S., Halsband, C., Galloway, T.S., 2014. Isolation of Micro plastics in biota-rich seawater samples and marine organisms. Sci.Rep. 4:4528. http://dx.doi.org/10.1038/srep04528.
30. Cole,M.,Lindeque,P.K.,Fileman,E.,Clark,J.,Lewis,C.,Halsband,C.,Galloway,T.S.,2016. Micro plastics alter the properties and sinking rates of zooplankton faecalpellets.Environ.Sci.Technol.50:3239–3246. http://dx.doi.org/10.1021/acs.est.5b05905.
31. M. Tholkapiyan , A. Mohan, D. S. Vijayan.,Variability Of Sea Surface Temperature In Coastal Waters Of Gulf Of Manner, India, Oxidation Communications 45, No 3, 562–569 (2022) .
32. Cozar, A., Echevarria, F., Gonzalez-Gordillo, J.I., Irigoien, X., Úbeda, B., Hernàndez-Leon, S.,Palma, A.T., Navarro, S., Garcia-de-Lomas, J., Ruiz, A., Fernandez-de-Puelles, M.L.,Duarte, C.M., 2014. Plastic debris in theopen ocean. PNAS 111, 10239–10244.
33. De Witte, B., Devriese, L., Bekaert, K., Hoffman, S., Vandermeersch, G., Cooreman, K.,Robbens, J., 2014. Quality assessment of the blue mussel (Mytilus edulis): comparison between commercial and wild types. Mar. Pollut. Bull. 85:146–155. http://dx.doi.org/10.1016/j.marpolbul.2014.06.006.
34. Deepika, S., Jaya, M.R., 2015. Biodegradation of low density polyethylene by microorganisms from garbage soil. Journal of Experimental Biology and Agricultural Sciences 3(1), 15–21.
35. Deheyn, D.D., Latz, M.A., 2006. Bioavailability of metals along a contamination gradient in San Diego Bay (California, USA). Chemosphere 63:818–834. http://dx.doi.org/10.1016/j.chemosphere.2005.07.066.
36. D. S. Vijayan , A. Mohan , C. Nivetha , Vidhyalakshmi Sivakumar , Parthiban Devarajan , A. Paulmakesh , And S. Arvindan: Treatment of Pharma Effluent using Anaerobic Packed Bed Reactor, Journal of Environmental and Public Health, Volume 2022, Article ID 4657628, 6 pages (2022).
37. M. Tholkapiyan, A.Mohan, Vijayan.D.S, :A survey of recent studies on chlorophyll variation in Indian coastal waters, IOP Conf. Series: Materials Science and Engineering 993 , 012041, 1-6 (2020).
38. Devriese,L.I., van der Meulen, M.D., Maes, T.,Bekaert, K., Paul-Pont, I., Frére,L., Robbens, J.,Vethaak, A.D., 2015. Micro plastic contamination in brown shrimp (Crangon crangon,Linnaeus 1758) from coastal waters of the southern North Sea and channel area. Mar. Pollut. Bull. 98, 179–187.
39. Dubaish, F., Liebezeit, G., 2013. Suspended micro plastics and black carbon particles in the

jade system, Southern North Sea. Water Air Soil Pollut. 224:1352. http://dx.doi.org/10.1007/s11270-012-1352-9.

40. Duis, K., Coors, A., 2016. Micro plastics in the aquatic and terrestrial environment: sources(with a specific focus on personal care products), fate and effects. Environ.Sci. Eur. 28(2). http://dx.doi.org/10.1186/s12302-015-0069- y.
41. Eerkes-Medrano, D.,Thompson, R.C., Aldridge, D.C., 2015. Micro plastics in freshwater systems: a review of the emerging threats, identification of knowledge gaps and prioritization of research needs. Water Res. 75, 63– 82.
42. Eriksen, M., Mason, S., Wilson, S., Box, C., Zellers, A., Edwards, W., Farley, H., Amato,S., 2013. Micro plastic pollution in the surface waters of the Laurentian Great Lakes. Mar. Pollut. Bull. 77:177–182. http://dx.doi.org/10.1016/j.marpolbul.2013.10.007.
43. Eriksen, M., Lebreton, L.C.M., Carson, H.S., Thiel, M., Moore, C.J., Borerro, J.C., Galgani, F.,Ryan, P.G., Reisser, J., 2014. Plastic pollution in the World's oceans: more than 5 trillion plastic pieces weighing over 250,000 tonnes afloatatsea.PLoSOne9(12),E111913. http://dx.doi.org/10.1371/journal.pone.0111913.
44. Eriksson, C., Burton, H., Fitch, S., Schulz, M., Van Den Hoff, J., 2013. Daily accumulation rates of marine debris on sub- Antarctic island beaches. Mar.Pollut. Bull. 66, 199–208.
45. Fauziah, S.H., Liyana, I.A., Agamuthu, P., 2015. Plastic debris in the coastal environment:the invincible threat? Abundance of buried plastic debris on Malaysian beaches.Waste Manag. Res. 33 (9), 812–821.
46. Fendall, L.S., Sewell, M.A., 2009. Contributing to marine pollution by washing your face: micro plastics in facial cleansers. Mar. Pollut. Bull. 58, 1225–1228.
47. Ferreira, P., Fonte, E., Soares, M.E., Carvalho, F., Guilhermino, L., 2016. Effects of multi-stressors on juveniles of the marine fish Pomatoschistus microps: gold nanoparticles, micro plastics and temperature. Aquat. Toxicol.170, 89–103.
48. Fossi, M.C., Marsili, L., Baini, M., Giannetti, M., Coppola, D., Guarranti, C., Caliani, I.,Minutoli, R., Lauriano, G., Finoia, M.G., Rubegni, F., Panigada, S., Bérubé, M., Ramirez,J.U., Panti, C., 2016. Fin whales and Micro plastics: the Mediterranean Sea and thesea of Cortez scenarios. Environ. Pollut. 209, 68–78.
49. Free, C.M., Jensen, O.P., Mason, S.A., Eriksen, M., Williamson, N.J., Boldgiv, B., 2014. High-levels of Micro plastic pollution in a large, remote, mountain lake. Mar. Pollut. Bull.85, 156–163.
50. Gallagher, A., Rees,A., Rowe, R., Stevens,J., Wright, P., 2015.Micro plastics in the Solent estuarine complex, UK: an initial assessment. Mar. Pollut. Bull. http://dx.doi.org/10.1016/j.marpolbul.2015.04.002.
51. Galloway, T.S., 2015. Micro- and nano-particles and human health. In: Bergmann, M.,Gutow, L., Klages, M. (Eds.), Marine Anthropogenic Litter http://dx.doi.org/10.1007/978-3-319-16510-3_13.
52. Gauquie, J., Devriese, L., Robbens, J., De Witte, B., 2015. A qualitative screening and quantitative measurement of organic contaminants on different types of marine plastic debris. Chemosphere 138, 348–356.
53. GESAMP, 2010. In: Bowmer, T., Kershaw, P. (Eds.), Proceedings of the GESAMP International Workshop on Micro plastic particles as a vector in transporting persistent, bio accumulating and toxic substances in the oceans.Paris, UNESCO-IOC 28th–30th June, 2010.
54. GESAMP, 2014. Micro plastics in the ocean - a global assessment. GESAMP -IOC, Paris(France); IMO/FAO/IOC/WMO/UNIDO/IAEA/UN/UNEP. Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection 2014.
55. GESAMP, 2015. Sources, fate and effects of micro plastics in the marine environment: a

global assessment. In: Kershaw, P.J. (Ed.), IMO/FAO/UNESCO-IOC/UNIDO/-WMO/IAEA/UN/UNEP/UNDP. Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection Reports and Studies. GESAMP No. 90 96pages.

56. Ghosh, S.K., Pal, S., Ray, S., 2013. Study of microbes having potentiality for bio degradation of plastics. Environ.Sci. Pollut. Res. 20:4339–4355. http://dx.doi.org/10.1007/s11356-013-1706-x.
57. Goldstein, M.C., Goodwin, D.S., 2013. Gooseneck barnacles (Lepas spp.) ingest micro plastic debris in the North pacific subtropical gyre. PeerJ 1, e184. http://dx.doi.org/10.7717/peerj.184.
58. Gouin, T., Roche, N., Lohmann, R., Hodges, G., 2011. A thermodynamic approach for assessing the environmental exposure of chemicals absorbed to micro plastic. Environ. Sci. Technol. 45:1466–1472. http://dx.doi.org/10.1021/es1032025.
59. Green, D.S., 2016. Effects of micro plastics on European flat oysters, Ostrea edulis and theirassociated benthic communities. Environ. Pollut. 216, 95–103.
60. Green, D.S., Boots, B., Sigwart, J., Jiang, S., Rocha, C., 2016. Effects of conventional and bio-degradable micro plastics on a marine ecosystem engineer (Arenicola marina) andsediment nutrient cycling. Environ. Pollut. 208,426–434.
61. Gregory,M.R., 1996. Plastic ‘scrubbers ‘in hand cleansers: a further (and minor) source for marine pollution identified. Mar. Pollut. Bull. 32, 867–871.