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Recycling of Microplastic and Its Industrial Applications

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Abstract:*Plasticsareutilizedbroadlywhereverinourlife; without plastic, current development would look exceptionally assorted. Plastics are fundamentalmaterialsinpresent-day progress, and numerous items are made from plastics, invarious cases, they are supportive of big dangers to human well-being and the climate.Plasticsarecontained numerous compounds and risky substances like Bisphenol A(BPA),phthalates,antiminitroxide,brominatesfireretardants,poly-fluorinatedsynthetics, and so forth which are genuine dangerous factors for human well-being and theclimate. Diversehumanmedicalconditionslikebotheringintheeye,visiondisappointment, breathing troubles, respiratory issues, liver brokenness, tumors, skinillnesses,lungissues,cerebralpain,wooziness,birthimpact,conceptive,cardiovascular, genotoxic, and gastrointestinal reasons for utilizing poisonous plastics. To reduce these consequences due to these plastics we can reduce the disposal of this waste by which we can make new products from these plastic wastes by recycling. recycling can reduce the huge amount of waste disposal in the environment and increase innovations in all industries. In this project, we would study the effect of these microplastics on the environment and the recycling of these microplastics. These recycled microplastic materials are very much useful to make an eco-friendly material. The materials like plastic fuel, plastic silica block, and plastic bricks, and the utilization of plastic materials in transportation industries, and packaging industries reduce the effect of microplastics on the environment and increase the various economic benefits.*

Keyword:*Plastics, microplastics, environmental effects, human health effects, recycling of microplastics..*

I.INTRODUCTION

Plastic waste production and consumption is increasing at an alarming rate, with the increase of the human population, rapid economic growth, continuous urbanization, and changes in lifestyle. In addition, the short life span of plastic accelerates the production of plastic waste on a daily basis. Global plastic production was estimated at around 300 million tons per year and is continuously increasing every year. In the modern days, the world is moving towards development. How much the world is developing equally the pollutions also increased effectively. Some important issues nowadays the world are global warming, air pollution due to pollutants from industries, burning of plastics, smoke from vehicles, land pollution due to fertilizers, and disposal of plastics and other wastes into the land.

In the present situation, marine pollution is due to the disposal of plastics into oceans. In the current scenario every year we dispose of 8 million tons of plastics are disposed of into the environment among that 3.5 to 4 million tons of waste are disposed into the ocean. The remaining amount of plastic waste 2 to 2.5 million tons are used for recycling. The remaining wastes are disposed into the land which leads to land pollution.

In today's world, increasing plastics-related problems are a concern for every living species, so there is a need to find a solution to this problem. Hence, working on this issue, the main aim of this study is to reduce plastic waste disposal in the oceans and land. This plastic in marine generally undergoes a natural weathering action then it converts into microplastics. These microplastics are generally hazardous to humans and the environment. In this project we are going to discuss microplastics, the effects of microplastics on the environment, the utilization of microplastics by recycling them into different materials, and various industrial applications of recycled microplastics.

II.LITERTURE REVIEW

This section shows the various analyses and the research to have proceeded, which have already been considered or not yet processed. This section shows the ideas that we get from various work done by many researchers related to microplastics and helps to determine the various ways to reduce or recycle microplastics in a better way.

The basic study of the project is done to prevent the environment free from pollution due to these microplastics and various applications of recycled microplastics in various industries. A literature survey was done, to analyze the various possibilities and probabilities to enhance the work and push it to an extent where it can be applied in real-time for further proceedings.

The study, in the year 2017 done by Wei min Wu, and Jun yang done in Stanford University on Microplastics pollution and reduction strategies helps us to understand the pollution that arises due to these microplastics and various effects on the environment and various reduction strategies of pollution due to the microplastics.

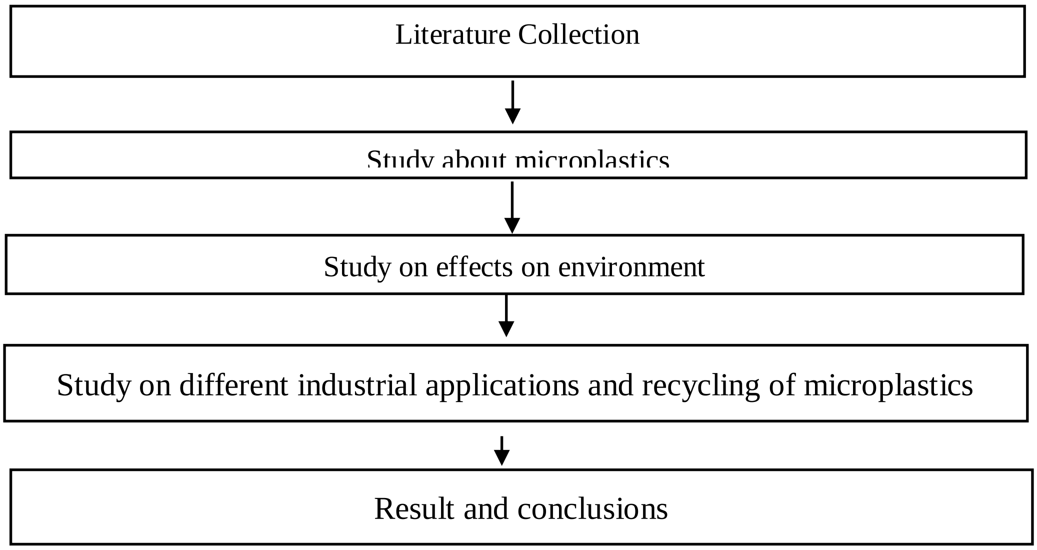
The research done by Marcus Eriksen, Martin Thiel, Matt Prindiville, and Tim Kiessling on microplastics and its solution help us to understand about what are the effects of microplastics while disposed into the marine ecosystem and what are the various solutions to prevent the marine system from pollution caused by microplastics.

A team of researchers from Illinois Sustainable Technology Center B.K. Sharma and Kishore Rajagopalan along with the US Department of Agriculture have successfully converted plastic bags into fuel. By using high-density polyethylene bags from local retailers and feeding them into a pyrolysis unit, they were able to create plastic crude oil (PCO). As a result, they distilled the PCO to make gasoline and two different types of diesels. From this we can understand the process of making fuel.

A curbell industries which conducted a new research related to application of microplastics in transportation industries in order to reduces the plastic wastes disposal into environment and utilizes the plastics into different parts in transportation industries. The research done by manishkothari, rajnikantpaghadhar, yogeshchauhan, ashitdesai, rashmikothari on silica plastic block which describes about utilization of microplastics on construction industries which applies to replace about 20 to 25 percentage of plastics in fly ash and clay bricks.

III.METHODOLOGY

This section clearly explains the method implied in the work and ways to proceed with it, starting from how the data is to be collected, and the various steps involved in the water purification process.



IV.STUDY ABOUT MICROPLASTICS

Plastics:

Plastic is a non-bio-degradable substance which takes thousands of years to decompose that creates land as well as water pollution to the environment. The quantity of plastic waste in Municipal Solid Waste (MSW) is expanding rapidly. It is estimated that the rate of usage is double for every 10 years. The Plastic usage is large in consumption and one of the largest plastic wastes is polyethylene (PE). Our everyday life has been transformed by Plastics. We are involved with plastic made products in various ways varying from domestic to industrial. Plastic plays an important part in our life. Plastic makes our life easier and better. They are composed of a network of molecular monomers packed together to form macromolecules of extensive use in human society. The dependence of people on plastics increases on a daily basis due to the characteristics of plastics such as inert, durability, flexibility and versatility and so on.

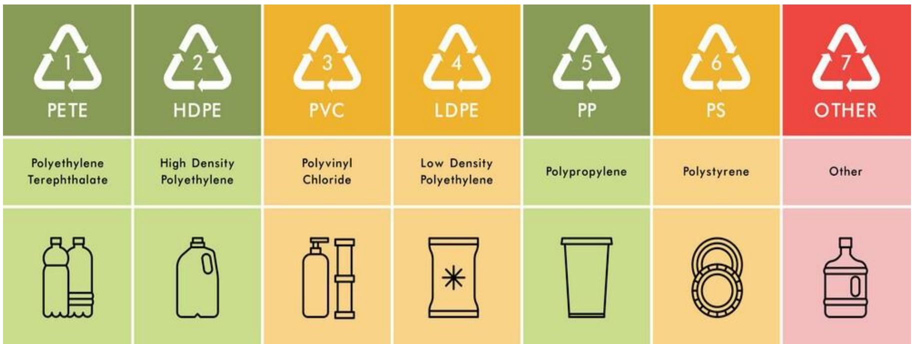


Figure 1: Types of Plastics

The durability of plastics and their potential for diverse applications, including widespread use of disposable items, were anticipated. But the problems associated with waste management and plastic debris are not majorly considered when dealing with major environmental issues. Plastic has some special properties such as: high heat combustion, lower water content of Plastics when compared to Biomass, plastics do not absorb much moisture and increasing availability in the local community. Advantages of plastic are predominantly for medical uses and applications in public health. Plastics are cost-effective, require little energy for production and are lightweight with high biocompatibility. They are soft, transparent, flexible or biodegradable and many different types of plastics function as innovative materials for use in engineered tissues, absorbable sutures, prosthetic devices and other medical applications. However, it has numerous disadvantages, such as toxic substances that may leak out and adversely affect humans and other organisms.

Plastic, polymeric material that has the capability of being molded or shaped, usually by the application of heat and pressure. This property of plasticity, often found in combination with other special properties such as low density, low electrical conductivity, transparency, and toughness, allows plastics to be made into a great variety of products. These include tough and lightweight beverage bottles made of polyethylene terephthalate (PET), flexible garden hoses made of polyvinyl chloride (PVC), insulating food containers made of foamed polystyrene, and shatterproof windows made of polymethyl methacrylate.

The composition, structure, and properties of plastics

Many of the chemical names of the polymers employed as plastics have become familiar to consumers, although some are better known by their abbreviations or trade names. Thus, polyethylene terephthalate and polyvinyl chloride are commonly referred to as PET and PVC, while foamed polystyrene and polymethyl methacrylate are known by their trademarked names, Styrofoam and Plexiglas (or Perspex).

Decomposition: The main disadvantages of plastic bottles is the shear amount of time they take to decompose he averages plastic bottle takes 500 years plastics decomposition can be agented by various factors, such as the types of plastic, the climate and acids in the landfill; plastic still lasts a long time, filling landfills for an indefinite period.

Non-renewable: Plastic is manufactured using oil by products and natural gas material that could be used in numerous other applications or conserved were plastic usage lower. Natural gas for example, can be used to heat houses and cook food. using plastic in the volume we currently do reduces the availability of these resources, which are gone forever when used up.The standard disposable plastic bottle is meant for one use, not many. recycled plastic bottles are not refilled in mass they glass beer bottles are , and flimsy plastic bottles do not lead themselves well to at home re-usage.

Difficult to recycle: Glass bottles can be meted and easily reused as can tin cans. Recycling plastic is not so simple. Instead recycled plastic bottles are used to make non-recyclable products, such as t-shirts, lactic lumber or parking lot bueners. This means more raw materials need to be used to create new plastic bottles than is the case with easily recycled material, such as glass or tin.

Microplastics

Microplastics, small pieces of plastic, less than 5 mm (0.2 inch) in length, that occur in the environment as a consequence of plastic pollution. Microplastics are present in a variety of products, from cosmetics to synthetic clothing to plastic bags and bottles. Many of these products readily enter the environment in wastes.

Microplastics consist of carbon and hydrogen atoms bound together in polymer chains. Other chemicals, such as phthalates, polybrominated biphenyl ethers (PBDEs), and tetrabromobisphenol A (TBBPA), are typically also present in microplastics, and many of these chemical additives leach out of the plastics after entering the environment.

Microplastic contamination poses a threat to ecosystems and human health is a major worry. However, there is a lot of confusion around this topic. To assess the risk of micro plastics to the environment and human health, data on exposure and impacts of microplastics is required. The adverse effects on organisms that are exposed to microplastics can be separated into two categories: physical effects and chemical effects. The former is concerned with microplastic particle size, shape, and concentration, whereas the latter is concerned with harmful microplastics. Chemicals linked to microplastics .While data on micro plastic exposure levels in the environment and in organisms has rapidly expanded in recent decades, there is little information on the chemicals linked to plastics.

Micro plastics contain two types of chemicals:

(i) additives and raw materials (eg: monomers or oligomers) originating from the plastics, and

(ii) chemicals absorbed from the surrounding ambience.

Additives are chemicals that are added to plastic during the manufacturing process to give it features like color and transparency, as well as to improve its resistance to ozone, temperature, light radiation, mold, bacteria, and humidity, as well as chemical, thermal, and electrical resistance. They include inert or reinforcing fillers, plasticizers, antioxidants, UV stabilizers, lubricants, dyes, and flame retardants

Properties of Microplastics:

- Durable and corrosion resistant.
- Good Insulation for cold, heat and sound saving energy.
- It is economical and has a longer life.
- Maintenance free (such as painting is minimized)
- Hygienic and clean
- Ease of processing / installation
- Light weight

Types of Microplastics:

Microplastics are divided into two types: primary and secondary. Examples of primary microplastics include microbeads found in personal care products, plastic pellets (or hurdles) used in industrial manufacturing, and plastic fibres used in synthetic textiles (e.g., nylon). Primary microplastics enter the environment directly through any of various channels—for example, product use (e.g., personal care products being washed into wastewater systems from households), unintentional loss from spills during manufacturing or transport, or abrasion during washing (e.g., laundering of clothing made with synthetic textiles). Secondary microplastics form from the breakdown of larger plastics; this typically happens when larger plastics undergo weathering, through exposure to, for example, wave action, wind abrasion, and ultraviolet radiation from sunlight.

Primary microplastics

Microplastic particles are used as exfoliates in certain product segments of specific personal care products, such as hand cleaners, facial cleaners and toothpaste. In the US patent for skin cleaners containing plastic microparticles, polyolefin particles with a size of 74–420 µm and an amorphous shape without sharp edges were described as appropriate for use as exfoliates. The used polyolefin's include polyethylene (PE), polypropylene (PP) and polystyrene estimated that in 2012, approx. 6 % of the liquid skin cleaning products marketed in the European Union, Norway and Switzerland contained microplastics. Based on a survey conducted by Cosmetics Europe, PE accounted for 93 % of the microplastics used in skin cleaning products in these countries in 2012. The products typically contained between 0.05 and 12 % of microplastic particles, with the size of most particles rangingfrom 450 to 800 µm. When analysing skin cleaners, spherical particles (mostly with a rough surface), threads and irregularly shaped particles consisting of PE and PS, and mainly having a blue or white colour were identified. Microplastics are also used in medical applications, e.g. in dentist tooth polish, and as carriers to deliver active pharmaceutical agents. After use, microplastics from personal care products and such medical products can reach the environment via wastewater.

Raw materials used for the fabrication of plastic products (pre-production plastics), namely plastic resin pellets or flakes and plastic powder or fluff, are another important source of primary micro plastics. They can reach the environment after accidental loss during transport or with run-off from processing facilities, i.e. often as a result of improper handling. Similarly, residues from plastic processing factories and regranulate produced during plastic recycling can end up in the environment. Concentrations of plastic resin pellets in the environment were high from the 1970s to the 1990s. Highest concentrations of pre-production pellets (up to 100,000 pellets/m of beach) were often found on beaches close to plastic producing or processing sites. In subsequent years, concentrations of pre-production plastics in the environment generally declined, probably due to improved practice during handling. Still, high concentrations have been found in some studies close to production facilities.

Secondary microplastics

Since secondary microplastics are generated when larger plastic materials fragment, sources of macroplastics and their routes of entry into the environment are considered in this section. It has been estimated that about 75–90 % of the plastic debris in the marine environment originates from land-based and about 10–25 % from ocean-based sources. General littering, dumping of plastic waste and loss from inappropriately managed landfill sites and during waste collection are assumed to be the most important routes of entry of plastic materials into the environment. Windblown litter is also lost from recycling facilities. In this context, it should be noted that a large percentage of the produced plastics is used for packaging, i.e. for products with a short service life. In industrialised countries, waste that is deposited in landfills is usually covered regularly with soil or a synthetic material, and the landfill is surrounded by a fence to prevent that debris is blown away. However, in developing regions this is often not the case. In addition, large amounts of plastic debris can enter the marine environment during natural disasters such as hurricanes, tsunamis and strong sea. Low-density polyethylene (LDPE) films, which are used in large volumes to protect agricultural crops, suppress weeds, increase temperature and retain irrigation water in the soil ('plastic mulching'), are a further relevant source of microplastics in the environment. If these thin plastic foils embrittle, the fragments can end up in the soil Synthetic polymer particles, such as expanded PS flakes with a size of approx. 5–15 mm (Styromull®) and polyurethane (PU) foam, are also used in horticulture to improve soil quality and as composting additive.

Ocean-based sources of marine litter include material lost or discarded from fishing vessels, aquaculture facilities, merchant ships, recreational boats, offshore oil or gas platforms and during military activities. Cargo lost from merchant ships may lead to a significant input of plastics into the marine environment. Although dumping of plastic wastes at sea is prohibited since 1988, there are indications that plastic waste from a considerable number of vessels has still been dumped at sea—mainly due to economic reasons.

Effects on Environment

Microplastics are not biodegradable. Thus, once in the environment, primary and secondary microplastics accumulate and persist. Microplastics have been found in a variety of environments, including oceans and freshwater ecosystems. In oceans alone, annual plastic pollution, from all types of plastics, was estimated at 4 million to 14 million tons in the early 21st century. Microplastics also are a source of air pollution, occurring in dust and airborne fibrous particles. The health effects of microplastics inhalation are unknown.

By 2018, in marine and freshwater ecosystems combined, microplastics had been found in more than 114 aquatic species. Microplastics have been found lodged in the digestive tracts and tissues of various invertebrate sea animals, including crustaceans such as crabs. Fish and birds are likely to ingest microplastics floating on the water surface, mistaking the plastic bits for food. The ingestion of microplastics can cause aquatic species to consume less food and therefore to have less energy to carry out life functions, and it can result in neurological and reproductive toxicity. Microplastics are suspected of working their way up the marine food chains, from zooplankton and small fish to large marine predators.

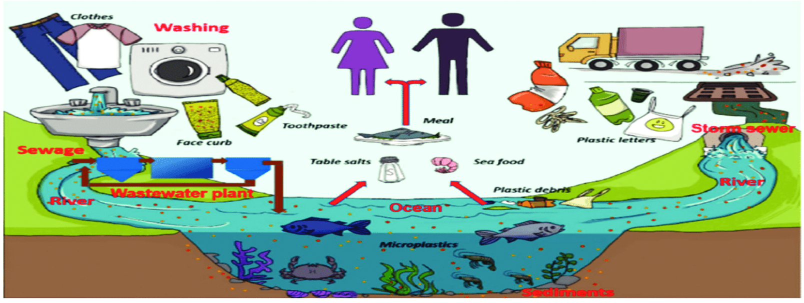


Figure 2: Microplastics on Environment

Microplastics have been detected in drinking water, beer, and food products, including seafood and table salt. In a pilot study involving eight individuals from eight different countries, microplastics were recovered from the stool samples of every participant. Scientists have also detected microplastics in human tissues and organs. The implications of these findings for human health were uncertain. Microplastics may have very different types of effects on the environment: they may physically (mechanically) affect organisms, act as vectors for hydrophobic pollutants and as substrates for organisms, and affect sediment properties.

Microplastics in the environment are a diverse array of particles with varying sizes, shapes, chemical compositions, and specific densities that come from a range of sources. The following two sections provide an overview of the environmental sources of primary and secondary microplastics. Secondary microplastics emerge from the fragmentation of bigger plastic materials; primary microplastics are microplastics created (and released to the environment) in the micro-size range.

Primary microplastics are utilized as exfoliants in a variety of personal care products, including hand cleaners, face trainers, and toothpaste. Polyolefin particles having a size of 74-420 m and an amorphous shape without sharp edges were characterized as appropriate for use as exfoliants in a US patent for skin cleaning including plastic microplastics. Polyethylene (PE), polypropylene (PP), and polystyrene are among the polyolefins used (PS). According to Gouin et al., around 6% of liquid skin cleaning solutions sold in the European Union, Norway, and Switzerland in 2012 included microplastics. PE accounted for 93 percent of the microplastics used in skin cleaning products in these nations in 2012, according to a survey done by Cosmetic Europe. Microplastic particles ranging in size from 450 to 800 micrometers were found in between 0.05 and 12 percent of the items. When looking into skin cleaners, researchers discovered spherical particles (usually with a rough surface), threads, and irregularly shaped particles made up of PE and PS that were generally blue or white in color. Microplastics are also employed in medical applications, such as dental tooth polish and as carriers for active pharmacological substances to be delivered. After use, microplastics from personal care products and such medical products can reach the environment via wastewater. Microplastics are also utilized in oil and gas exploration drilling fluids and industrial abrasives, such as air blasting to remove paint from metal surfaces and cleaning various types of engines.

Physical effects of microplastics

Microplastics physically affected marine organisms. Especially for air-breathing animals, entanglement may result in death. The ingestion of microplastic items may reduce the amount of consumed food and, consequently, the organisms' fitness. Macroplastics can also block the intestinal tract and cause internal injuries. It has been assumed that microplastics cause similar effects in smaller organisms, mainly with regard to the physical obstruction of feeding and digestion. Sharp-edged microplastics may injure gilltissues and the intestinal tract. In the following, the available data on the physical effects of microplastics on aquatic organisms are summarized. While studies dealing exclusively with the effects of nano plastics were not considered, results of comparative studies of nano- and microplastics have been included. Microplastics have significant environmental impacts, most studied in marine environments. Once released or broken away from their original plastic product, microplastics can travel through waterways and end up in the ecosystems that serve as homes to a range of marine life, including algae, zooplankton, fish, crabs, sea turtles, and birds. Shemitz points out that there are many cases of entanglement, where marine life becomes trapped in pieces of plastic like old fishing line and are strangled to death. "Microplastics are also a concern particularly in the ocean because they are so easily ingested by living things," Anastas says. "When a fish or invertebrate absorbs these microplastics by eating them, they can experience health problems such as a severe interference to or an abrasion with their digestive tracts, which can be fatal."

Further, other pollutants from the water tend to collect on the surface of these microplastics; when animals ingest the plastic, they are also ingesting those toxic chemicals. These substances begin to accumulate in their body and slowly make their way up the food chain. Ecologists have found that microplastics often make their way into drinking water as well as foods like salt, honey, and sugar; some research suggests that humans are consuming more than 100,000 microplastic particles a year. However, there are many unanswered questions about the impacts of microplastics on humans and how the human body responds to the microplastics that we eat, drink, or inhale. That we do know that inhaling very fine particles of any type of material can also cause respiratory irritation that could lead to more serious cardiovascular problems, but some of the long-term, hidden health concerns are not yet known. "Plastics are made simply by connecting small chemicals together in chains until they become big chemicals that can be used as materials, and these are called polymers,". "In addition to most man-made materials, polymers are the foundation of many things in nature. Every tree is a polymer. Your skin is a polymer. Every food you eat is a polymer." That our bodies are accustomed to breaking down, processing, and disposing of natural polymers every day, but newer man-made polymers come with many unknowns. “We just don’t know to what degree these human-made polymers are different and affect our bodies differently ,”“Our bodies evolved to process all of these other natural polymers over countless years, but our bodies and the environment have not been given the chance to evolve to process these man-made polymers.

Sustainabledevelopmentalgoalsonmicroplastics

Plastics are very easy to produce, but recycling them or disposing of them off is a majorissue. Most of the plastic debris gets accumulated in landfills or gets discarded into theenvironment, which eventually ends up in the oceans. As a result, the UNEP estimatedlastyearthatatleast51trillionmicroplasticparticleswerealreadyintheocean.Sustainable Development Goal (SDG) target 14.1 aims at preventing and significantlyreducing marine pollution of all kinds, providing opportunities for addressing the plasticpollutionthreat.

UNEPhashighlightedthesocial,environmental,andeconomicimpactsofplasticpollution in the ocean as well as on the land in several reports and resolutions over thepast few years. For instance, In the article “Microplastics Debris”, UNEP identifies themainland-based and sea-based sources of macro and microplastics, as well as their types.UNEP also details how marine litter affects the whole life cycle, the socio-economicdevelopment, and how it hinders environmental protection, which could enable us tounderstandthelinkagesbetweenplasticpollutionandseveralSDGs.

Since the launch of the United Nations (UN) Sustainable Development Goals (SDGs) in 2015, the SDGs have been widely adopted by governments and corporations in an effort to improve their sustainability. There are 17 SDGs, comprising 169 targets, which are measurable against 247 unique indicators.

Despite pervasive global pollution from (micro)plastics, there is only one indicator (14.1.1b) under Goal 14, specifically related to reducing impacts from (micro)plastics. Reliable reporting and monitoring of 247 SDG indicators present unique challenges for governments and organizations to implement, which may be further exacerbated by the pervasive nature of (micro)plastic pollution if not properly monitored across these indicators. This review focused on recent literature to provide a critical overview of the key challenges specifically related to (micro)plastics as they may undermine the implementation of sustainable strategies and action plans required to achieve the UN SDGs.

Figure 3: SDG 14

Both macro- and microplastics can damage the marine habitat and it can lead to species entanglement as well, so one can assume that marine plastics could make SDG 14(LifeBelowWater)moredifficulttoreach;asthemarineplasticsbreakdownintothemicroplastics. They can be easily ingested by marine species and it can end up consumedbythehumansconsumingseafood,whichcouldreducethepaceofachievementofSDG3 (Good Health and Well-Being); altered marine ecosystems might also generate a loss ofrevenue for fisheries and the tourism industry, impacting on SDG 8(Decent Work andEconomic Growth).

As the potential risk of plastic leakage into the ocean is a highpossibility in all phases of a product's life cycle, the report further recommends changingtheplasticeconomyfromalinearonetoacircularone. InitsResolutiononMarineLitter and Microplastics, embraced in December 2017,UNEAnotedwithconcernthesocial, monetary, and ecological effects of high andquickly expanding levels of the marine plastic litter too, emphasizing the requirement forbroadexaminationonmarineplastics.Itfurther underlined that "preventive activitythrough squander minimization and earth sound waste administration ought to be giventhemostnoteworthyneed".

Activities pointed toward meeting SDG 12 through ecologically strong administration ofplastic items and waste through their life cycle are a successful method to lessen themeasureofplasticlitterwindingupinthesea,subsequentlytoarriveattarget14.1andthe remainder of the 2030 Agenda. It is similarly essential to distinguish the part ofgovernments,organizationsandresidentsinthebattleagainstplasticcontamination.

V.RECYCLING OF MICROPLASTICS

Various measures are required to recycle microplastics in order to reduce the pollution due to these microplastics and move towards development and innovations. Reduce, Recycling, recovering, redesigning, Reuse is some measures need to think for microplastic pollution reduction. The following points are related to reducing microplastic pollution. Microparticles cannot be efficiently removed from marine ecosystems. Therefore, it is important to turn to source reduction. In addition to reducing, reuse, and recycling, “recovering and redesigning” and “refusing and rethinking” have been suggested as additional measures for protecting the environment. Both the innovative (recover and redesign) and conservative (refuse and rethink) approaches are valuable for well-informed and good decision-making consumers.

Recover and redesign: one way to minimize harmful plastic waste is the production of “eco-friendly” polymers that are biodegradable or recyclable. Consumers should note that biodegradable plastic based on synthetic polymers, which are popular today, can act as a source for microparticles if released into aquatic ecosystems. Better alternatives include biobased polymers, such as starch-based or polylactic acid (PLA) plastic. However, it is also important to consider the environmental tradeoff for producing these alternatives. For instance, the environmental benefit of biopolymers is debatable, as a high amount of water, energy, and agricultural area are needed for their production. There is also the possible emission of natural gasses such as methane.

Refuse and rethink: Consumers can also rethink their use of plastics by making simple changes without having to worry about environmental tradeoffs or greenwashing. For example, for every consumer who substitutes plastic straws with glass or steel alternatives, 584 plastic straws are eliminated from the oceans. A steel lunch box elimates 540 plastic sandwich bags from the oceans and a reusable water bottle keeps 116 plastic bottles out of the oceans. A to-go cup eliminates 500 disposable coffee cups from the oceans and bringing your own bag to the store prevents 330 plastic bags from entering the oceans . These simple alternatives are surefire ways to reduce plastic waste.

VI.INDUSTRIAL APPLICATIONS

Plastic fuel:

The plastic fuel which is manufactured from the plastic waste by the process called pyrolysis with the help of zeolite as catalyst. Pyrolysis is a decomposition process of long-chain hydrocarbon (polymer) molecules into smaller sizes (monomer) with the use of high heat (450–800 ºC) .

In a shorter duration and a condition with the absence of oxygen generating products in form of carbon, as residues and volatile hydrocarbons which can be condensate as fuel and non-condensible as gaseous fuel. The reaction of this polymer is a weak bond chain and is damaged by increasing temperature, followed by the formation of the free radical propagation stage. These free radicals will then separate again to form smaller ones which produce more stable compounds. These smaller free radicals produce stable compounds in the form of paraffin compounds, isoparaffins, olefins, naphthene's and aromatics with the general reaction mechanism for plastics thermal degradation.

Pyrolysis of waste plastics PP has been investigated by many researchers who discovered liquid pyrolysis products to be similar to crude oil. However, its products show the presence of ash and wax from raw materials, which reduces the quality and the result of condensate analysis using Gas chromatography. An analysis of the derived gases and oils indicated that pyrolysis gave a mainly aliphatic composition consisting of a couple of hydrocarbons (alkanes and alkenes).

The liquid fuel obtained from the pyrolysis process cannot be directly used as fuel, due to the presence of impurities (ash) and wax from the feedstock. The purification of the pyrolysis products was conducted using distillation bubble cap tray column which reduces the ash and wax content in fuel products. Moreover, used for separate the pyrolysis product has based on different boiling points.

The effect of temperature on the pyrolysis results which have been integrated with the bubble cap distillation column. This is carried out by utilising the heat from the reactor to separate the liquid product in a vacuum condition which minimises the oxygen entering the reactor.

However, in vacuum conditions, organic vapour leaves the reactor faster, thereby reducing vapor residence time and shifting evaporation to lower temperature areas, thus reducing the average vapor temperature. This establishes a more favorable mass transfer condition, and obtains the highest liquid yield. The obtained liquid product is analyzed of physical characteristics to determine the specific type of product and compare fuel oil with the fossil.

The feedstock is shredded and mixed with the catalyst into the pyrolysis reactor.

The stainless-steel reactor is a fixed bed. The micro plastic is heated to reach a maximum temperature of 550 ◦C, at a heating rate of 15 ◦C/min. The products of the pyrolysis process are oil and gas vapor. The catalyst used for this process is called natural Zeolite. These products go through a condensation process to produce fuel oil, heavy oil, and light hydrocarbon gas .

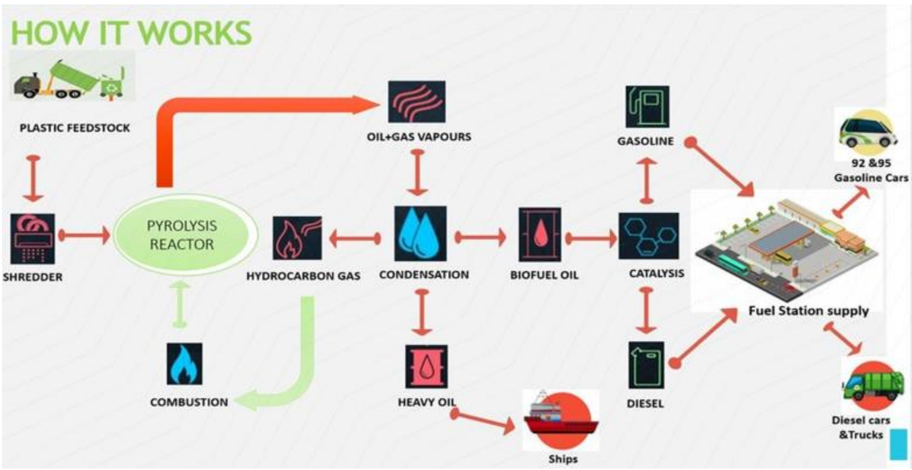


Figure 4: pyrolysis process

Hydrocarbons are stored and reused in the combustion process, so the energy in this system is self-sufficient. Biofuel oil is transported to refineries and converted to gasoline and diesel using the previously mentioned catalyst. Heavy oil is supplied to ships. The cost of this process is calculated to determine the economic feasibility of this process. One of the important properties of a fuel on which its efficiency is judged is its calorific value.

The calorific value is defined as the energy produced when the unit mass of fuel is burned completely in sufficient air. The calorific value of the fuel produced from micro plastic waste was estimated according to the IP 12/58 method. Its calorific value was 9829.3515 kcal/kg, which is close to the calorific value of diesel. This plastic fuel which is economical when it compared to the normal fuel. This fuel which emits high sulphur emission but compared to ordinary fuel it is not so much problem.

Micro plastic In Construction Industry:

Micro plastics are used in a growing range of applications in the construction industry. They have great versatility and combine excellent strength to weight ratio, durability, cost effectiveness, low maintenance and corrosion resistance which make plastics an economically attractive choice throughout the construction sector. Microplastics in construction are mainly used for seals, profiles (windows and doors), pipes, cables, floor coverings, and insulation. Microplastics have further uses as they do not rot, rust or need regular re-painting, they have strength with lack of weight, they are easily formable, and their light weight enables them to be easily transported and moved on site. The construction industry has a tendency towards traditional materials, tried and tested methods and products **- but microplastics offer opportunities for innovation.** The future of the construction industry has always been dependent on economic conditions.

Changes to the industry are now being accelerated through an increase in demand for housing coupled with new regulations which are intended to make the industry more energy efficient, manage waste, recycle and take LCA (life cycle analysis) into consideration. The future will see the growth of **intelligent buildings** and methods such as prefabrication which will move work away from construction sites and into factories. New materials and a range of polymeric composites and glass-reinforced plastic materials have implications for structures. One of the principal advantages of plastics is their ability to be designed to a wider range of uses. Their resistance to corrosion, lightweight, and strength make the potentiality of load-bearing structures as opposed to architectural features a possibility.

The utilization of earth-based clay material resulted in resource depletion and environmental degradation. As amount of clay required for brick is huge, in this project these waste plastics are effectively utilized in order to reduce t heland space required to dump these wastes. This creates the prevention from various harmful diseases. Polyethylene (PE) bags are cleaned and added with fine aggregate at various ratios to obtain high strength bricks that possess thermal and sound insulation properties. This is one of the best ways to avoid the accumulation of plastic waste. It also helps to conserve energy, reduce the overall cost of construction, and hence in this project, attempts made to manufacture the plastic sand bricks by utilizing the waste plastics.

Building materials like bricks, concrete block, tiles, etc. are popularly used in construction. However, these materials are expensive and hence common people find it difficult to easily afford them. Moreover, these building materials require certain specific compositions to obtain desired properties.

Plastic Bricks:

The plastic bricks which have emerged construction material. Which are used now days in order to utilize the eco friendly materials. Because these plastic bricks are more eco-friendly and it does not corrode, weather resistant, economical, water repellent, light weight.

The manufacturing process of plastic brick is explained below:

- The plastics which are collected and shredded into microplastics or directly we collect microplastics are allowed to heat. While it reaches the temperature of 110-degree Celsius these plastics are melt and add fine aggregate with the melted plastics and cast it into the mold.
- And allow it to cool and move to further process.

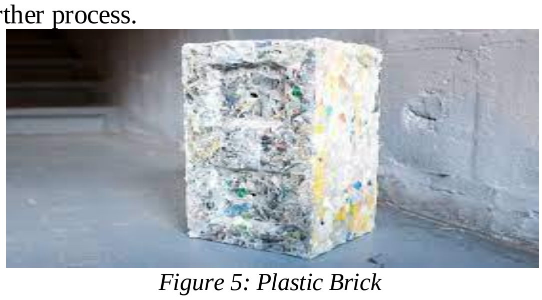


Figure 5: Plastic Brick

The above figure describes the house builds with the plastic brick and plastic roof sheet. This type of building which is constructed because it is economical, durable, light weight, eco-friendly, time saving, Less maintenance.

Figure 6: Plastic pavement tiles

The above figure shows the pavement tiles which it has been used for sidewalks in roads, parks, houses etc., This manufacturing cost is very less and requirement of very less labours, durable, light weight, eco friendly.

Figure 7: Interlocked plastic bricks

The figure shows about interlocking plastic blocks.

Silica Plastic Blocks:

The silica plastic block which is manufactured in order to replace the 20% of brick material into microplastic wastes. This microplastic wastes can be replaced in both red clay bricks and fly ash bricks.

This may led to reduce the weight of bricks, cost, reduction in over utilization of natural materials like clay etc., These silica plastic block which is light weight, durable, economical, eco-friendly.

Advantages of Micro plastics In Construction Industry:

- Micro plastics are strong yet lightweight, and so they are easy to transport &man oeuvre.
- They are durable, knock-and scratch resistant with excellent weather ability.
- They do not rot or corrode.
- Micro plastics are easy to install; many have a snap-fit kind of jointing procedures.
- Micro plastics offer limitless possibilities in design achieved by extrusion, bending, moulding etc.
- They can be given any range of colours by adding pigments.
- The micro plastics are low conductors of heat and thus are used as insulation materials in green building concepts.
- The micro plastics products can achieve tight seals.
- Plastic doesn't break easily
- They can be sawn and nailed employing standard carpentry tools and skills.
- They can be easily removed and recycled.
- They are bad conductors of electricity.

Disadvantages:

- Plastics may be degraded under the action of direct sunlight which reduces their mechanical strength.
- Many plastics are flammable unless treated.
- High embodied energy content
- Low modulus of elasticity: makes them unsuitable for load-bearing applications.
- Thermoplastics are subject to creep and soften at moderate temperatures.
- Thermal expansion for most plastics is high: adequate thermal movement has to be allowed in detailing.
- Many types of plastics are not biodegradable thus cause pollution when they accumulate.

Some Other Products Used In Construction Industry:

- Pipes: Electrical Conduits, Rain Water & Sewage pipes, Plumbing, Gas Distributions.Piping and Conduit are the largest users of polymers in construction and consume 35% of production. Producing cabling, rainwater goods, large diameter pipes for sewage, drainage and potable water made from PVC and Polyethylene.
- Cables: PVC Insulation on cables, Insulation Tapes .
- Floorings: Flooring tiles & Rolls .
- Domes / sky lights: Opaque as well as transparent.
- Roofing:Coloured or Double skinned for insulation.
- Windows & doors: Extruded sections for Door and windows and panels.
- Storage tanks: Storage tanks.
- Hardware accessories: Washers, Nut bolts, Sleeves, Anchoring wires.
- Temporary structures: Guard cabins, tents

- Insulation materials: PVC sheets, insulating membranes.

Microplastics In Transportation Industries:

The cost-effective and safe transportation of people and goods is vital to our economy. As modern modes of transport have evolved to meet increasing demands for safety, environmental protection and speed, the use of plastics in transport manufacture has risen dramatically. All forms of transport require energy to run and fuel represents a substantial part of running costs.

Cutting the weight of cars, airplanes, boats and trains can cut fuel consumption dramatically. The lightness of plastics therefore makes them invaluable to the transport industry. 105kg of plastics, rather than metals, in a car weighing 1,000kg makes possible which can reduce the fuel consumption of the vehicle upto 7.5%.Used externally plastics are durable, do not corrode and require little maintenance.

Aerospace Industry

Plastic has a major component in the aerospace industry since 1970. They reduce the weight of the aircraft and improve fuel efficiency. When it comes to military aircraft, they help extend flight range with help jets evade radar detection. Components for propulsion and navigational functions, structural elements and interior components are all made out of plastic. Plastic has several advantages which make them an ideal choice in the aerospace industry:

- Lightweight
- Corrosion-resistance
- Impact-resistance
- Chemical-resistance
- Durable

They allow freedom of design and fast and economical manufacture. Internally, plastics fittings, such as dashboards, flooring, seats and faces. The aerodynamic requirements of aerospace products demand maximum design flexibility and minimal weight. Plastics can be formulated to meet a wide variety of specifications and are ideal for components incorporating smooth curves. Composites are widely used in the panels of military jets and helicopters as well as for wing skins, nacelles, fairings, flaps and helicopter rotor-blades in commercial applications. Plastics are also found throughout aircraft interiors in, for example, bulkheads, galleys, stair units, seating and flooring.

Automobile:

More plastics, by volume, than steel are now used in today's cars for a number of components. At the end of a vehicle's working life, plastics components can be recycled or the energy can be recovered through incineration. Plastics versatility aids the automotive industry in meeting ever more stringent requirements in terms of economical performance, safety, comfort and environmental considerations. Plastics also play a key role in providing cost effective buses and trucks for transporting people and goods efficiently.The primary reason for this is that they help to reduce vehicle mass.

A lighter car consumes less fuel, which also translates into less exhaust emissions. In addition, plastic parts are not prone to corrosion, offer flexibility and resilience for added safety, have very good thermal insulation, reduce noise and allow optimum space utilization. Today, an average vehicle consists of 12-15 % plastic parts[1)]. Assuming that an average car weighs 1300 kg, this amounts to 150-200 kg of plastic per vehicle.

The plastic parts used in the automotive industry are mostly injection molded, such as dashboards, bumpers, fluid tanks, handles, buttons, casings, containers, clamps, and sockets. The recycling challenge here is that very often reinforced plastics (containing fillers such as glass fiber, carbon fiber and glass beads) or plastic blends (e.g., PP compounded with EPDM or TPE), as well as two- or multi-component injection molded parts are used.

Marine:

Plastics' ability to withstand a harsh marine environment makes them essential in all types of marine craft, from ocean liners to sailing dinghies. Plastics do not corrode or warp and need less maintenance than other traditional materials to remain attractive and in good working condition. Boat hulls and sails are the parts which are manufacture from the plastics.

Rail:

Materials used in railway locomotives, carriages and other rolling stock have to withstand wear and tear from heavy use.The durability of plastics is one of the factors making them the first choice for engine and carriage panels, flooring, luggage racks, seating and doors.

Acrylonitrile Butadiene Styrene (ABS)

Acrylonitrile Butadiene Styrene (ABS) is a thermoplastic created by combining styrene polymers, acrylonitrile, and polybutadiene rubber. This plastic is durable, resilient, and ideal for applications, which require high impact resistance. ABS plastic liquefies at its glass transition temperature (221°F), making it easier to machine it. Due to this, it can used for fabrication, 3D printing, or injection molding processes. This plastic exhibits tough heat, and chemical resistance, which makes it perfect for several complex applications.

ABS plastic is used for producing pre-production prototypes because it has excellent dimensional stability, and it can be easily glued or painted. This plastic remains stable in conditions comprising atmospheric humidity and fluctuating temperatures. This plastic can be easily recycled, which makes it a popular choice for several industrial applications. ABS plastic can be heated and cooled several times without degradation. This plastic is inexpensive, and its price range falls between those of polycarbonate and polypropylene. ABS plastic is a human-friendly plastic because it has no carcinogens and gives no adverse effects.As ABS is affordable, reliable, and possesses resilient properties, many industries use it to facilitate their processes.

Following are some industries where this material is largely used.

- Oil & Gas
- Aircraft, Defense, and Aerospace
- Medical Technology
- Alternative Energy
- Food Handling and Equipment
- Material Conveying
- ABS plastic is a structurally sturdy microplastic, which makes it an ideal choice for the following applications.
- Camera Bodies
- Support Blocks
- Appliance Housings
- Power Tool Housings
- Packing Crates
- Furniture Components
- Radio Cases

VII.CONCLUSION

Based on study done about the microplastics which shows the various effects on environment especially these microplastics on marine ecosystem causes a serious effect. To avoid the effects on microplastics on the environment we can move towards a recycling of microplastics because without plastics our life cannot be move so we can move towards these recycling techniques.

The recycling of microplastics we can make a different products like fuel, construction materials, automobile products, packaging materials, and its various products. The plastics which are applicable in various industries. In now a day many industries move towards innovations, these innovations like move towards eco-friendly, economical materials. These plastics are eco-friendly economical durable less pollutant until it disposed it as a waste into the environment so the plastic is considered to be an innovative material.

With the help of these plastics now a day most of the companies are making plastic made products like plastic fuel this plastic made fuel which are the very economical and eco-friendly because these plastic fuels which are pollutant free and less emission of sulphate compared to the normal fuel. The cost of plastic fuel is two times less than normal fuel.

The construction materials which are manufactured from these plastic wastes which are considered to be an innovative material due to its eco-friendly, less maintenance, durability, economic considerations.

While construct using these materials manufacture from plastics which has more advantages and economical mode of construction. These recycled materials are used for different industries like transportation, packaging, and other industries because it is easy moulding, low cost, eco-friendly nature, so that it can be applicable.

By recycling of these waste and application on different industries it can reduce the disposal of waste into environment which reduces the pollution due to these wastes on the marine ecosystem, and also reduces land pollution, air pollution, and also water pollution. It can reduce the health effects on humans like breathing problems etc.

while utilizing these wastes increases the revenue to the government and increases new employment and reduces the unemployedability ratio while introducing different recycling techniques needs lots of workers hence it increases employment. It increases entrepreneurship by means of any person interested to make a new product by using this plastic waste in new usable products and applying it to different industries. Hence people should have an awareness of the effects of these microplastics on the environment. It is the prime duty of every citizen to control waste disposal.

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