A

ENVIRONMENT PROJECT REPORT

ON

"Study of plastic and its effect"

Submitted

To

Shivaji University Kolhapur

For the practical Fulfillment of the degree of

B.C.A.II (SEM lll)

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Year 2016-17

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CERTIFICATE

2016-17

This is to certify that the following student of B.C.A. II year have carried out project entitled "**Study Of Plastic and Its Effect**"

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In guidance for environmental study by Principle of Miraj Mahavidyalya Miraj

Place: Miraj

Date:

Declaration of Students

We undersigned hereby declare that all information regarding environmental study of "**Study of Plastic and Its Effect**"

Sr.No	Student Name	Roll No
1	Munde Pooja Bhagwan	01
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The study of this project is not submitted in, on or before, for any other reason. The information of this project is collected by us personally.

Place :- Miraj

Date :-

Acknowledgment

We are the students of **(B.C.A.II) as** per the revised syllabus of environmental studies by "Shivaji University Kolhapur".
We have prepared the project on the subject **"Study Of Plastic And Its Effect"**

We are thankful to the department of environment for organizing this project.

We also express our lot of thanks to our respected **Principal Dr.C.T.Karande** and the Librarian to give us books for this project. Further we would like to thanks you, our friends and all those who have directly and indirectly helped us for completion of this project.

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Introduction

Plastics have many benefits and without plastic, modern society would indeed look very different. However, plastics also have numerous disadvantages, such as toxic substances that may leak out and adversely affect humans and other organisms. Plastic degradation in nature is very slow – a piece of plastic may last for several hundred years. This means that almost all plastic ever produced, still exists in some form in our environment. Around the globe, we find plastic in the form of road-side litter, around dumps, in the ocean, and in the starving bellies of birds. Moreover, when a piece of plastic is torn, small plastic fragments are released, known as microplastics.

Environmental pollutants may stick to the microplastics and can thereby be led into aquatic organisms mistaken the plastic particle for food. Few environmental problems are as prominent as that of plastic litter. Almost everywhere you travel you can see traces of human presence in the form of plastic debris. This type of pollution also involves a more subtle but clear problematic aspect – the chemicals hiding in the so often handy material.

In a global collaboration funded by the Swedish International Development Cooperation Agency (Sida) and the following environmental organizations: Swedish Society for Nature Conservation (SSNC), EcoWaste Coalition from the Philippines, ESDO from Bangladesh, groundWork from South Africa and ToxicsLink from India, the plastic's presence and influence at all levels of society, based on each individual organization perspective are summarized in this report. In the European Union, the plastic-related problems are mostly related to chemical safety and the migration of chemicals from all of the plastic products in our immediate environment, whereas in the Global South, problems with blocked waterways due to the unabated and unconscious use of plastic bags and inadequate waste disposal are higher on the agenda.

Global mismanaged plastic waste

Rank	Country	Percentage of waste that is mismanaged	Quantity of mismanaged plastic waste (MMT/year)	Percentage of global mismanaged plastic waste	Quantity of plastic marine debris (MMT/year)
1	China	76	8.82	27.7	1.32–3.53
2	Indonesia	83	3.22	10.1	0.48–1.29
3	Philippines	83	1.88	5.9	0.28–0.75
4	Vietnam	88	1.83	5.8	0.28–0.73
5	Sri Lanka	84	1.59	5.0	0.24–0.64
6	Thailand	75	1.03	3.2	0.15–0.41
7	Egypt	69	0.97	3.0	0.15–0.39
8	Malaysia	57	0.94	2.9	0.14–0.37
9	Nigeria	83	0.85	2.7	0.13–0.34
10	Bangladesh	89	0.79	2.5	0.12–0.31
11	South Africa	56	0.63	2.0	0.09–0.25
12	India	87	0.60	1.9	0.09–0.24
13	Algeria	60	0.52	1.6	0.08–0.21
14	Turkey	18	0.49	1.5	0.07–0.19
15	Pakistan	88	0.48	1.5	0.07–0.19
16	Brazil	11	0.47	1.5	0.07–0.19
17	Burma	89	0.46	1.4	0.07–0.18
18	Morocco	68	0.31	1.0	0.05–0.12
19	North Korea	90	0.30	1.0	0.05–0.12
20	United States	2	0.28	0.9	0.04–0.11

MMT = million metric tons
Adapted from Jambeck et al. [2015]

Examples from the Real World

Interviews with Faculty Members from the Foreign Countries

The interviews with faculty members provided us information of the recycling programs prevalent in different countries and how people think and behave regarding plastic wastes and environmental issues. Faculty members from Turkey and European countries, Germany, Italy, Netherlands, Switzerland, and Denmark, told that the recycling programs in their countries are mostly run by the government and that people are required to take recyclables to recycling centers and sort them into right bins, unlike curbside recycling programs.

On the other hand, faculties from Japan and India mentioned that recycling programs are run by individuals or companies in their countries. Exchanging recyclables with other products is common in these countries. Also Professor Zhou, from China, mentioned that the recycling program in Shanghai is almost impossible to launch, since there is not enough space in residents' apartments to fit in recycling bins for different materials. Most of the faculty members were not sure about more efficient recycling program between the U.S. and their respective countries, as they are both quite different.

For example, the curbside program in the U.S. is more convenient for people, since they do not have to go to recycling centers, however if people go to such centers, they can learn a lot more about sorting recyclables by themselves.

One of the questions which was asked to all Faculty members was whether people use more plastics in the U.S. or in their home countries. Most of the Faculty members answered that people use more plastic materials in the U.S. compared to their home countries. One of the main areas where Americans use more plastics was in grocery 55 bags.

Most of the countries do not give out plastic shopping bags for free charging a few cents similar to the U.S. Also most of them said people generally use more plastics in the U.S. on packaging.

For example, bottled water in plastic containers is not common in China and India since many people boil tap water before drinking. In European countries, water comes in glass bottles to make recycling easier. Also most of the grocery stores in Europe have containers placed outside for people to drop off any unnecessary plastic bags to recycle them.

Lastly from the interviews, we gathered information on whether people in their home countries participate more on recycling programs in general and if they were more aware of plastic wastes compared to the people of the U.S. Most of the faculty members answered that peoples' participation and awareness on the matter is more except in case of a few countries like China, India, and Turkey.

In European countries, government and social organizations run recycling programs and set goals and policies for recycling. Also, people are more aware about the limited resources they have including the small land area, which makes the idea of landfill not very practical. As a result, countries are encouraged to come up with viable solutions.

For example, one of the towns in Japan had bad pollution problem, but now despite its small geographical size, it has one of the best recycling programs in the country. Many faculty members also agreed that educating people on the matter is important for recycling programs to run efficiently. People in most of foreign countries are encouraged to educate themselves about plastics pollution and recycling programs since they have to be able to sort out recyclables themselves and can be fined if it is not done properly. In countries like China, recycling programs are not as well developed and people are not used to participating in recycling. However, they are more aware of the plastic wastes and pollution caused by them as large population 56 poses a possible threat. On the other hand, most of the faculty members feel that people in the U.S. are not as aware as the people in their countries. However, recycling has become part of lives of people in the U.S. and they still participate without much know.

Case study

Polyblend , a Remedy for Plastic waste :

Ahmed Khan of Bangalore has been producing plastic sacks for 20 years. When he realized that the plastic waste is a real problem, his company developed, **Polyblend,** a fine powder of recycled modified plastic. In collaboration with Bangalore City Corporation and R.V. College of Engineering A. Khan proved that, if Polyblend is mixed with bitumen and is used to lay roads, road life is increased. This is because; Polyblend enhances bitumen's water repellant properties.

Using Khan's technique over 40kms of road in Bangalore has been laid. Formerly, rag pickers used to get Rs. 0.40 for 1kg. plastic waste, Khan offers them Rs. 6.

This was in 2002, at this rate; soon Bangalore City will have better roads and will run short of plastic.

Definition of Plastics

Plastic is a kind of material that is commonly known and used in everyday life. To define plastic at molecular level, plastic is a kind of organic polymer, which has molecules containing long carbon chains as their backbones with repeating units. The structure of these repeating units and types of atoms play the main role in determining the characteristics of the plastic. These long carbon chains are well packed together by entanglements and Van der Waals forces between large molecules, and form a strong, usually ductile solid material. Also, additives are usually added when manufacturing of commercial plastics is carried on, in order to improve the strength, durability or grant the plastic specific characteristics. Generally, there are two kinds of commercial plastics, thermoplastic and thermosetting plastic. Thermoplastics can be reheated, melted, and molded into different shapes, while thermosetting plastic will degrade and turn into other substances if reheated after molding. The molecules of thermoplastics are packed together by entanglements and Van der Waals forces. When a thermoplastic is heated up, it loses its entanglements and its molecules get farther away from each other, which causes the plastic changing from solid to liquid without breaking the bonds within the molecules.

On the other hand, the molecules of thermosetting plastic are packed together not only by entanglements and Van der Waals forces, but also by the cross-links between molecules. When a thermosetting plastic is heated up, the cross-linking 11 bonds between molecules break apart and the plastic turns into another substance when it melts, usually by decomposing (Callister and Rethwisch, Fundamentals of Materials Science and Engineering, 3rd Ed. 2008)

Aim and Objectives

The aim of the study is to evaluate the impact on environment that has
occurred already with the following objectives:

¾To assess the existing air quality.
¾To assess the extent of pollution of water bodies due to developmental
activities.
¾To assess the quality of soil and extent of soil pollution and soil degradation.
¾To assess the extent of noise pollution.
¾To assess the quantities and types of solid wastes generated, assess the
Efficency of present disposal method
And to propose suitable methods of
Disposal.
¾To assess the amounts of sewerage generated and its quality.
¾To assess the efficiency of existing sewage system and propose sewage
treatment facilities.
¾To assess the existing biotic components in Pudukkottai town (flora and
fauna).
¾To assess the socio-economic impact of urbanization in Pudukkottai.

The overall objective of the project is to reduce plastic in waste streams saving non-renewable resources and enabling carbon neutral energy production from waste.

More specifically, the project aims at:

- Identifying the main challenges and barriers for reducing plastic waste in mixed waste and residual waste streams, hereby stimulating prevention and recycling of plastic waste
- Promoting recycling of plastic polymers as a substitute for virgin plastic
- Diverting waste plastic from the residual waste going to incineration (creating a carbon neutral energy source) and landfill

An important feature of the Plastic Zero project is to set up cooperative forums involving public and private stakeholders, by bringing stakeholders together with shared responsibility. The forums and networks will identify and analyse relevant interfaces between the partners in the value chain, and provide the necessary production technology, infrastructure, physical planning, information, waste services, and technologies for reprocessing. By involving all stakeholders in the value chain there will be an opportunity to rethink product design through cradle-to-cradle methods.

Hyphothesis

Rapid loss of environmental quality today is perhaps the most serious threat humanity has ever faced in the history of mankind. Environmental degradation is a global problem and is directly related to natural resource depletion in quality and quantity. This is as a result of population explosion and industrialization related unsustainable and changing life styles of the modern society. The situation is causing overuse, depletion and degradation of the finite and non-replenishable vital resources.

- The importance is given to save Earth from Global Warming all over the world.

- The environmental pollution is due to cutting down the trees, increase in vehicles which resulting in giving out carbon dioxide, cutting down the hills, closing the lakes and converting them into residential and commercial lands, etc…

- The nature is God given gift to the mankind which is hidden with many preventive measures in itself which man cannot think of.

- The earth has its own tolerance level which man cannot test it. When the tolerance limit of the earth exceeds, mankind should suffer its after-effects.

- Today, we think it is government's job to save our planet. We are not ready to own any responsibility in this regard.

- Today a lot of NGOs, Giant IT Companies and Other Top companies in India as well as worldwide have come forward to work towards reducing Global Warming and prevent environmental pollution so that attempting to save our natural resources.

- As a first step, we have to bring this awareness among our people so that they could teach their children about starting saving our natural resources from home itself.

Lack of environmental awareness and concern in the society is basically responsible for the degradation of environment. It is often forgotten that human existence and also life of other creatures is solely dependent on the health of the planet earth.

Despite the technological advancement and material development, the modern societies are facing serious environmental problems due to the negative impacts of human activities. It is therefore very much necessary to approach the issues arising out of the situation with proactive rather than attitudes.

Methodology

For this project, our research was primarily done by reading online sources, such as newspaper articles and data from different organizations.

Although there is information available in books about the traditional plastics, the concept of biodegradable plastics being relatively new, it was easier and more convenient to look for online sources, where contents are updated regularly. Also, data on plastics consumption and recycling were easily found on websites of environmental and chemistry- related organizations on their annual reports.

We prepared a set of questions focused on recycling programs for plastics and awareness in people about plastic waste as well as comparison between their home.

In addition, we asked specific questions to some of the Faculty members from what we have learned about the recycling program in their home countries through research. We also focused on how other alternative options could be implemented to reduce the use of plastics.

Information Collection

Types of Plastics

Introduction

Describing the types of plastics is a bit like looking at a giant family tree; unless you know some of the people it does not make much sense. This section will help you get a general idea of the various types, and how they are related. The resource: 'curing' explains the basic chemistry of plastics, and describes the difference between thermoplastic and thermoset plastics. They are like two branches of the family, and this section deals with the largest branch, thermoplastics.

One difficulty with describing plastics, is that the same material with the addition of just a single additive like a blowing agent or plasticiser, can make what appears to be a very different material. Take polyurethane for example. It can be used as a clear coating like varnish, expanded and rigid to form the core of a surfboard, and with a plasticiser it can become a soft car seat.

With plastics there are about 45 basic families, many with hundreds of offspring. We will look at five main branches, mainly because they are plastics which you will be familiar with. The five branches are; polyethylene, polypropylene, polystyrene, vinyl, and polyethylene terephthalate. Let's look at them in a bit more detail.

Plastics can be divided into two major categories

1. **Thermoset or thermosetting plastics.** Once cooled and hardened, these plastics retain their shapes and cannot return to their original form. They are hard and durable. Thermosets can be used for auto parts, aircraft parts and tires. Examples include polyurethanes, polyesters, epoxy resins and phenolic resins.

2. **Thermoplastics.** Less rigid than thermosets, thermoplastics can soften upon heating and return to their original form. They are easily molded and extruded into films, fibers and packaging. Examples include polyethylene (PE), polypropylene (PP) and polyvinyl chloride (PVC).

Common Plastics.

Polyethylene terephthalate (PET or PETE):

John Rex Whinfield invented a new polymer in 1941 when he condensed ethylene glycol with terephthalic acid. The condensate was polyethylene terephthalate (PET or PETE). PET is a thermoplastic that can be drawn into fibers (like Dacron) and films (like Mylar). It's the main plastic in ziplock food storage bags.

Polystyrene (Styrofoam):

Polystyrene is formed by styrene molecules. The double bond between the CH2 and CH parts of the molecule rearranges to form a bond with adjacent styrene molecules, thereby producing polystyrene. It can form a hard impact-resistant plastic for furniture, cabinets (for computer monitors and TVs), glasses and utensils. When polystyrene is heated and air blown through the mixture, it forms **Styrofoam**. Styrofoam is lightweight, moldable and an excellent insulator.

Polyvinyl Chloride (PVC):

PVC is a thermoplastic that is formed when vinyl chloride (CH2=CH-Cl) polymerizes. When made, it's brittle, so manufacturers add a plasticizer liquid to make it soft and moldable. PVC is commonly used for pipes and plumbing because it's durable, can't be corroded and is cheaper than metal pipes. Over long periods of time, however, the plasticizer may leach out of it, rendering it brittle and breakable.

Polytetrafluoroethylene (Teflon):

Teflon was made in 1938 by DuPont. It's created by polymerization of tetrafluoroethylene molecules (CF2=CF2). The polymer is stable, heat-resistant, strong, resistant to many chemicals and has a nearly frictionless surface. Teflon is used in plumbing tape, cookware, tubing, waterproof coatings, films and bearings.

Polyvinylidine Chloride (Saran):

Dow makes Saran resins, which are synthesized by polymerization of vinylidine chloride molecules (CH2=CCl2). The polymer can be drawn into films and wraps that are impermeable to food odors. Saran wrap is a popular plastic for packaging foods.

Polyethylene, LDPE and HDPE:

The most common polymer in plastics is polyethylene, which is made from ethylene monomers (CH2=CH2). The first polyethylene was made in 1934. Today, we call it low-density polyethylene (LDPE) because it will float in a mixture of **alcohol** and **water**. In LDPE, the polymer strands are entangled and loosely organized, so it's soft and flexible. It was first used to insulate electrical wires, but today it's used in films, wraps, bottles, disposable gloves and garbage bags.

In the 1950s, Karl Ziegler polymerized ethylene in the presence of various metals. The resulting polyethylene polymer was composed of mostly linear polymers. This linear form produced tighter, denser, more organized structures and is now called high-density polyethylene (HDPE). HDPE is a harder plastic with a higher melting point than LDPE, and it sinks in an alcohol-water mixture. HDPE was first introduced in the hula hoop, but today it's mostly used in containers.

Polypropylene (PP):

In 1953, Karl Ziegler and Giulio Natta, working independently, prepared polypropylene from propylene monomers (CH2=CHCH3) and received the Nobel Prize in Chemistry in 1963. The various forms of polypropylene have different melting points and hardnesses. Polypropylene is used in car trim, battery cases, bottles, tubes, filaments and bags.

Now that we have discussed the various types of plastics, let's look at how plastics are made.

Pre-use plastic

Pre-use plastic waste is likely either to be plastic that has not met the specification required for its designed use, or off-cuts arising during assembly or installation. Examples of off-specification material might include material that has the wrong colour, wrong hardness, or wrong processing characteristics. Although this material is not suitable for its intended use, it may be suitable for other applications and has the potential to be recycled. Off-cuts can be recycled into the same or alternative applications. For example, off-cuts from the forming of cups from polystyrene sheet can be recycled into cups, or into cassette cases.

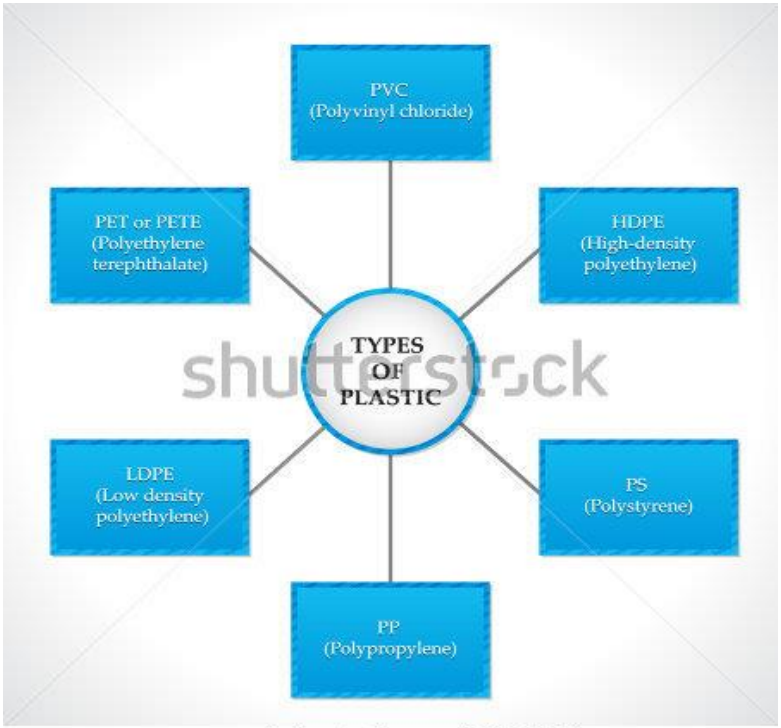
Pre-use plastic waste is likely to be the main source of plastics suitable for reprocessing from manufacturers of plastic products; in many instances off-cuts can be reprocessed in-house. It is typically more valuable than post-use plastics waste, as it generally requires little processing to use in a new product.

Pre-use plastics waste does not count towards plastics recycling targets under the Producer Responsibility (Packaging Waste) Regulations and you cannot claim PRNs or PERNS on this material.

Post-use plastic

Post-use plastic waste suitable for recycling generally falls into one of five main categories:

- Plastic bottles, pots, tubs and trays
- Plastic film
- Rigid plastics, such as crates, pipes and mouldings
- Plastic foams, such as expanded polystyrene (EPS)
- Flexible plastics, such as strapping and cable sheathing



KNOW YOUR PLASTICS

PETE

* bottled water, squash, juice, cooking oil, mouthwash

MODERATE HAZARD

HDPE

* milk jugs, juices, handwash, shower gel, washing up liquid

LOW HAZARD

V

* food packaging, condiments, shower curtains, cling film

HIGH HAZARD

LDPE

* food, bread & frozen bags, squeezable bottles

LOW HAZARD

PP

* bottle caps, dishware, straws yoghurt & margarine tubs

LOW HAZARD

PS

* meat trays, egg carton, cups and plates, foam containers

HIGH HAZARD

OTHER

* sports bottles, large water containers, baby formulas

HIGH HAZARD

* Avoid HIGH HAZARD and MODERATE HAZARD plastics as much as possible

* Store your food and drinks in glassware where possible

Symbol	Plastic Name	Used for	Does it Leach?	Recycles?	Notes	
	**PET or PETE** *Polyethylene Terephthalate*	Bottling beverages	No	Yes	Easy to recycle. Recycled PET is has many uses.	**Good**
	**HDPE** *High Density Polyethylene*	Milk jugs, cosmetics	No	Yes	Easy to recycle. Recycled HDPE is in high demand and is used to make plastic lumber.	**OK**
	**PP** *Polypropylene*	Baby bottles, yogurt, deli containers, reusable plastics	No	Yes	Generally recyclable.	**OK**
	**LDPE** *Low Density Polyethylene*	Shopping bags, plastic wraps, baby bottles, reusable plastics.	No	Yes	Generally not recyclable – some stores will accept, but most pick-ups do not.	**Bad**
	**PS** *Polystyrene*	Plastic cutlery, egg containers.	Yes	No	Banned in some major cities (Portland, San Francisco). Leaches styrene, a neurotoxin and suspected carcinogen.	**Very Bad**
	**PVC** Vinyl or Polyvinyl Chloride	Plastic wrap, toys, spray bottles	Yes	No	Considered one of the worst plastics. Leaches toxic phthalates, off-gas chemicals.	**Very Bad**
	Everything Else	Food packaging	Maybe	No	Difficult to determine which items have BPA and which do not. Check package because this also includes some bio-plastics. Items with polycarbonate (PC) leach BPA.	**Very Bad**

Solution

Since traditional plastic is cheap and convenient, it is widely used around the world nowadays, and replacing traditional plastic with more environmental friendly but also more expensive biodegradable plastic seems difficult. Therefore, if a technology is developed to chemically break down the plastic to non-harmful molecules, it will be a good solution to the plastic pollution problem. Scientists have found a variety of methods to decompose products such as plastic bags made with traditional plastics, but unfortunately, it seems that decomposition of plastic in a large scale is still challenging .

Recently, a Canadian teenager, Daniel Burd, discovered a way to decompose plastic bags in three months, while normally it would take 20 years or even longer for plastic bags to decompose. Since polyethylene (PE), the major component of the regular plastic bags, does decompose under natural conditions after a very long time, he made an assumption that there exists a kind of bacteria that can digest and break down plastic bags. If a method is developed to isolate this kind of bacteria, it is highly possible that they can be used to decompose plastic bags. Hence, he designed a series of experiments to identify the bacteria from the soil sample collected at a local landfill 27 in Waterloo, Ontario, and found out that *Sphingomonas* and *Pseudomonas* are two kinds of microorganisms that can consume plastic bags (Burd 2008).

Although this experiment was accomplished in a small scale, there is a possibility to develop a technology based on this experiment to decompose PE in an industrial scale, since these two kinds of bacteria were simply obtained from landfill soil. However, it might not be economical and also challenging to isolate a large amount of bacteria from soil if the concentration is low, and also collecting plastic bags before they get buried in the landfill or end up in the ocean may be problematic.

Wheelabrator Technologies Inc. is a company that successfully developed technologies to obtain energy from combusting municipal solid wastes, and is currently operating power plants. Their waste-to-energy facilities not only provide safe municipal solid waste, but also generate clean and renewable electricity for thousands of homes and businesses (Wheelabrator Technologies Inc.).

Take the power plants in Millbury as an example. It processes up to 1,500 tons of municipal solid per day, and provides electricity to more than 57,000 homes in central Massachusetts. The power plant operates in a very simple way. The refuse, which is delivered to the power plant by trucks, goes through a complete combustion process in a boiler at a temperature of 2000 Fahrenheit. Air for the combustion process is drawn from the refuse receiving building, so that the pressure in the building can remain negative. This negative pressure prevents odors and dust from escaping to outside. The heat generated from the combustion is recovered by surrounding boilers as a high-pressure steam, which will be turned into electricity later on. Since toxic gas may generate from the combustion of the waste, emission gas control is crucial. In the Millbury plant, several technologies are applied to clean the emission gas, so that harmful byproducts such as nitrogen oxide, mercury, and organic pollutants will not 28 be released to the environment. Today, the Wheelabrator power plants meet all current air-quality requirements with the emission gas control technologies. After the waste is completely processed, and ferrous metals are removed from the residue, the volume of the waste can be reduced by 90%, proving that this is a very efficient and environmental way to process the municipal waste (Wheelabrator Technologies Inc.). However, these waste-to-energy power plants are designed for municipal wastes, not specifically for plastics. They do save some space in the landfill, but do not solve the plastic problem directly. But this is still a very inspiring case, proving that it is possible to build a power plant like the Wheelabrator ones, but just for plastics.

The reality is that the only way this problem can be addressed is by individuals and companies around the world agreeing to implement practices that reduce waste on every level.

Some tips for reducing plastic waste are:

1. **Shop Friendly**

Plastic bags were once a modern convenience but can be efficiently replaced by reusable bags, many of which fold up compactly in order to be portable. Just think about how many bags you typically carry out of a grocery store, and multiply that by the number of times you grocery shop. That's a lot of plastic! Carry a bag and always reuse plastic bags as much as possible if you have them.

2. **Get Rid of Bottled Water**

People are meant to drink lots of water each day, and plastic water bottles have become a great way to stay hydrated throughout the day. However, most of these are only recommended for single use, and that means that every time someone finishes a bottle it goes into the trash. Many companies now sell reusable water bottles as a substitute, reducing plastic waste and exposure to leaking bottles.

3. **Forget to-go Containers**

You would be surprised at how much plastic is involved in the making and packaging of food containers. Think the coffee shop's drink cup is paper? It's likely lined with plastic for insulation (pour a cup of coffee on some cardboard and see what happens).

Plastic food containers, lids, and utensils are all easily replaced by reusable containers, which will cut down significantly on even a single meal's waste.

4. **Educate Businesses**

Speak to local restaurants and businesses about options that they can switch to for packaging, storing, and bagging items. Many companies are starting to come up with excellent low-cost replacements, such as bamboo utensils in place of plastic ones.

5. **Get Involved**

Speak to lawmakers and get involved with government on any level, and you'll see how many special interest groups have made it so that we are dependent on plastic without needing to be. Encourage development of items, and propose alternatives when applicable.

6. **Recycle Everything**

Try and select items that come in non-plastic recycled and recyclable packaging, to do your best to properly handle items that can't be reused. Check everything before you put it in the trash, as more and more items are able to be recycled these days.

Recycling

Among the existing solutions to the problems of plastics, recycling is one of the most convenient and easiest ways for everyone to participate in. There are various ways to participate through government programs or programs run by environmental organizations. More than 80% of the U.S. population has access to the curbside program run by the government (EPA 2007, 2006 MSW Characterization Data Tables). To make it more convenient for consumers, the curbside program requires no sorting of recyclables but allows everything to be thrown into the bin. In addition, there are recycling centers available at the stores in the States with active Bottle Bill.

Also as consumers, the recycling only requires one easy step of putting plastic wastes in right bins by each individual. Unlike other possible solutions, where 65 adjustments in lifestyle are sometimes necessary to reduce or replace uses of plastics in households, it can be done easily. Separating the plastic waste from other waste will prevent plastics to be land filled and will allow it to be recycled with other plastics of the same kind. From the information we gathered about recycling programs and interviews we had about recycling programs in foreign countries, we could say that there is still room for improvement in recycling in the U.S.

One of the things we noticed is that countries with good recycling systems and the states even in the U.S. that have enforced "Bottle Bill" are all geographically located near the places where negative impact of plastics on the environment is more noticeable. Many European countries with good recycling programs and awareness do not have enough land space to land fill wastes or are surrounded by oceans, where plastics are accumulated on shores. Also in the U.S., states like California, Oregon, Massachusetts and other states with "Bottle Bill" are mostly located by the ocean, where plastics in the water accumulate on shore affecting the ocean environment negatively.

In these places, the effect of plastic wastes on the environment is observed explicitly by many consumers which drive national and state governments to take necessary actions. One of the ways to encourage consumers to recycle would be to publicize and educate more people about plastic waste and its threat to the environment.

During the interviews, most Faculty members mentioned the importance of education and awareness in the matter. Unlike the curbside program, in most European countries, consumers are required to take recyclables to the center and sort them out themselves. Because consumers are required to sort recyclables themselves, it is likely that they are more educated and aware about the plastic waste and recycling. On the other hand, the curbside programs require no sorting to make it 66 convenient for consumers. However, this causes confusion as people take it as they can put all recyclables in the bin while the company cannot process certain materials and have problems in the recycling process.

For example, plastic grocery bags are excluded from the curbside program and consumers need to take them to stores to recycle, but some people think that all plastic materials can go in the bin. Although the zero-sorting curbside program encourages consumers to participate more in the recycling program, people are likely to be more educated about the recycling and sorting materials when they are directly involved in the process. Also, because they are required to do recycling and sorting themselves, it is obvious that most people participate out of their awareness of the negative impact plastics have on the environment, unlike in curbside recycling where people do it because it is in a way compulsory.

Another option for improvement would be introducing financial incentives. The “Bottle Bill” runs based on granting financial incentives for recycling bottles. However, there are only few states with active Bottle Bill and the Bill itself is limited only to certain beverage bottles. Also while the curbside and recycling centers run free, there are costs associated with throwing the trash away.

People are required to purchase their own trash bags and the bigger volume of trash means they have to spend more on buying trash bags. The curbside is offered for free by government, but because the cost of trash bags is not as expensive, many people seem to put everything in the trash bag. More systems with financial incentives and increasing the cost of not recycling would definitely encourage more consumers to participate in recycling plastics.

However, once the plastic waste leaves the hand of the consumers, it seems to pose several problems in the recycling. Despite the consumer's effort to recycle plastics, there are confusions about what happens afterward as there were rumors about trash being sent to Eastern Europe from the interviews we had. Also only small amount of plastic thrown into the bin can actually be recycled due to how they were originally made. The company's manufacturing containers are not responsible for the waste disposal and the open loop system of recycling poses problem as manufactured products are not suitable for entire recycling process designed by companies.

In addition, when the plastics are manufactured originally, there can be variety of shapes and colors from different chemical and additives added. Because of the contamination, only limited amount of plastic entering the recycling bin can be actually recycled and made into new products. Thus, from the economical and environmental point of view, recycling plastic is not always as favorable as it seems. The biggest problem associated with the recycling is making products with inferior quality, also known as downcycling. Because the additives and chemicals in the plastics and polymer chains are broken during the process of recycling, downcycling is unavoidable for the case of plastic.

Trying to avoid downcycling, businesses cannot make much profit causing them to add more chemicals and additives to retain original strength of plastics which eventually leads to serious environmental threats.

Recycling Technology

Recycling plastics to make new products is not as easy as we might think. For example, obsolete metal containing products such as automobiles and white goods are first turned into fist-sized chunk by giant hammer mills. Then, those chunks go through processes involving air classification of the lightweight fraction, followed by one or multi-stages of magnetic removal of ferrous metals.

After that, trommels and screens are used to remove particles smaller than about 5/8 inch. Then, nonferrous metals are recovered by one or more stages of eddy-current separations that leave the materials called shredder residue behind. It is simply a mixture of polymers containing small fraction of impurities. For each ton of metal, 500 lbs of shredder residue is usually recovered. Historically, this byproduct has been mostly ending up in a landfill, since recycling of metal-containing products is mainly driven by the value of metal.

However, in the past fifteen years, polymers and composites have been more commonly used in automobiles and white good. Therefore, recycling of shredder residue becomes necessary and profitable. In traditional separation processes for polymer recovery, solid particles are separated by their densities and these methods usually work on certain thermoplastics. But shredder residue may have overlapping densities and shapes, which makes it hard to get materials with enough purity. Such impurities will lead to changes in properties when the shredder residue is further processed to produce plastics and cause devaluation in the regenerated plastics.

Summary

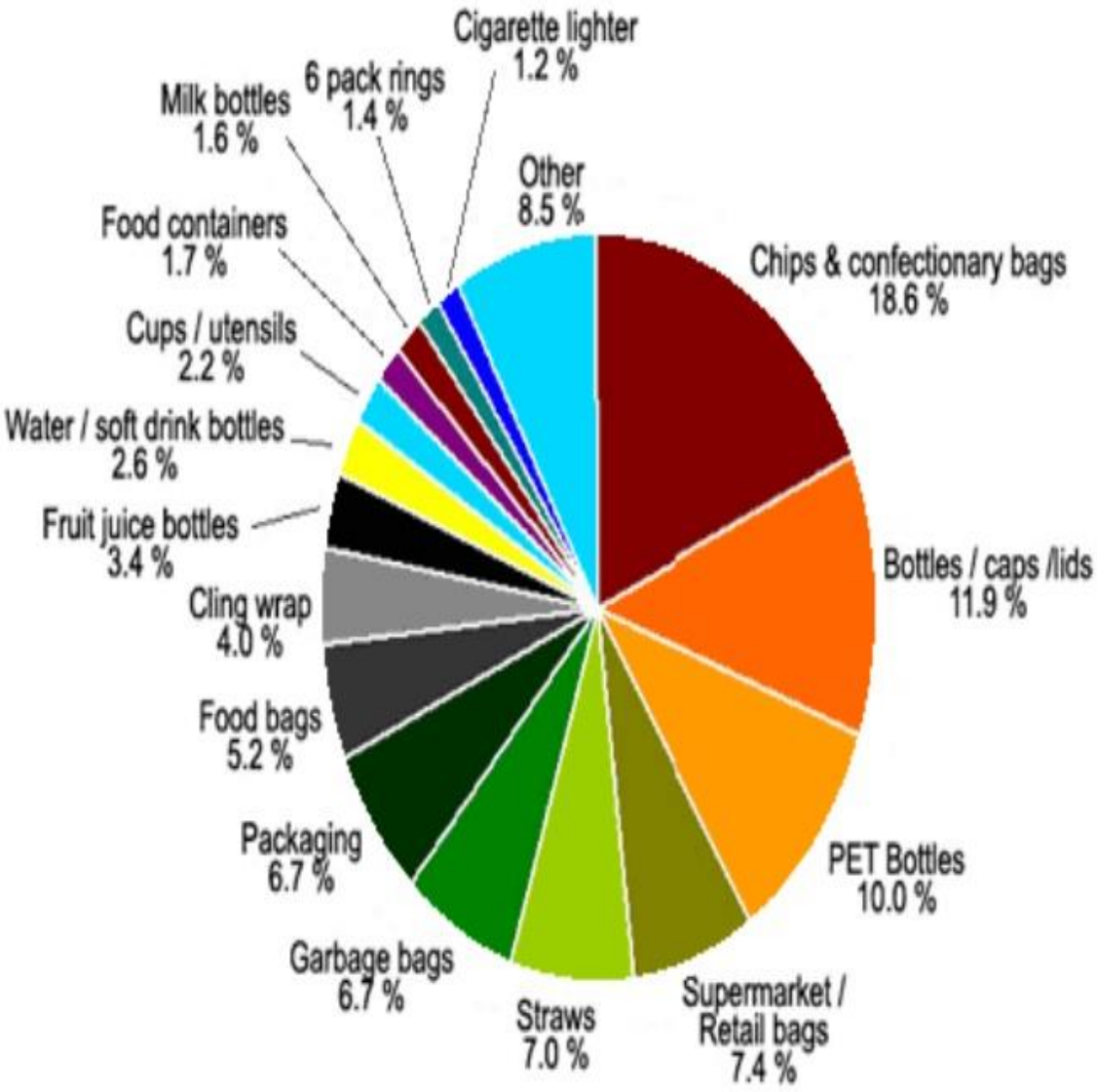
Plastics and rubber are formed by polymers consisting of smaller units known as monomers, which link up (polymerize) in long chains. At present, the vast majority of monomers is produced from petroleum (crude oil/mineral oil) and is therefore non-renewable. Monomers can also be made from biomass, but generally to a higher cost. Except monomers, various additives are added to the manufacturing process of plastics and rubber. Additives are chemicals that are necessary for the actual polymerization process, or to give the final product its specific desired properties, for example, plasticizers, flame retardants, heat and UV stabilizers, biocides, pigments, extenders, etc. Polymers are large in size, which means that they do not penetrate biological membranes, and are not particularly reactive and are therefore not considered toxic. On the contrary, unreacted monomers, solvents, additives or degradation products, can leak and be exposed to both humans and the environment during the whole life cycle of a product. Several common additives are classified as hazardous according to the EU regulation on Classification, Labelling and Packaging of substances and mixtures.

Examples of hazardous classes for common additives are: *carcinogenic*, *mutagenic*, toxic for reproduction, harmful to aquatic life, or having persistent negative environmental impacts. A specific additives chemical and physical properties; the surrounding environment; if the additive is unbound; its molecular size in relation to the cavities between the polymers; etc., will determine how prone an additive is to leak from a product. It is difficult to make generalized statements about the health and environmental effects of plastics and rubber, since thousands of potential additives can be used in plastics and rubber and the amount of remaining monomers varies depending on the polymerization technique.

Given the strong indications that chemical exposures are a global threat to human health, it may seem strange that the chemicals issue is not higher on the political agenda. At least within the EU, the manufacturer is obliged to prove that a chemical is safe to human health and environment before putting it on the market. It is obvious; so far the legislation is proven ineffective.

An organism can only be harmed by a chemical if it is exposed to that chemical. Uptake of the chemical can occur through the skin, lungs or digestive system.

Percentage of Plastic used :



Awareness in people about their advantages over traditional plastics

No matter how much involvement scientists show in the field, not much can be achieved unless people are aware enough to realize the differences between these two types of plastics and make the right choice. Hence, public 50 awareness plays a vital role in determining the market of biodegradable plastics.

According to a survey taken among 500 people in April 2007, 70% of Americans were unaware of the fact that plastics are made of crude oil. 40% also believed that all plastics are biodegradable. With the right kind of information, people are willing to make choices that are beneficial for the environment. With simple facts and figures, we can get a point across and make people think and care more. It takes approximately 2 million barrels of crude oil to make plastics each day and only six percent of plastics are recycled according to the U.S. Environmental Protection Agency (Raising environmental awareness 2007). `

Such facts and figures can help people realize why they should choose biodegradable plastics over traditional plastics. Not just from an environmental point of view, plastics production involves great health risks as well. Chemicals released in plastics production can cause birth defects and damage the nervous system, blood, kidneys, etc. Even the plastics used in our households can release harmful toxins especially in case of fire. Health hazards of plastics will be discussed more under the particular topic.

Pop Sustainability is a non-profit organization launched in 1998 in New York City. It has been involved in raising awareness in people about adverse effects of traditional plastics and advantages of biodegradable plastics. New York City government has endorsed and participated in a public private sector effort to raise awareness and educate NYC citizens about biodegradable plastics.

Conclusion

Plastic takes up large part of society, from plastics used for furniture, electronics, to small households needs like containers and grocery bags. Since plastic first became available to consumers, it became widely used, due to the advantages it provides, such as lightweight, durability and its ability to mold into any products with chemicals and additives. However, there are also a number of disadvantages that plastic poses, including health problems starting from manufacturing to consumption and negative environmental impacts created by accumulation of plastic wastes.

Today, the management of plastic wastes has become one of the most challenging problems in our society. It seems even serious if we think about the future generation that has to deal with continuously growing amount of plastic wastes accumulated in the environment. In the course of this project, we did an extensive amount of research on plastics and their types, their impacts on the environment, economy, and many other factors. Based on all of the information we gathered and comparisons we have made, we determined that there is no one best alternative to the plastics problem we have, but different solutions should be combined for the best result.

The alternative that has the most potential in the future is biodegradable plastics. Even though the idea of biodegradable plastics is fairly new, with changing times and needs, they are most likely to be one of the most viable options to replace traditional plastics. There are a number of challenges related to biodegradability that need to be addressed like achieving complete biodegradation. Our research showed that developments have been made, and are being carried out in achieving biodegradability by modifying existing materials, copolymerization of known 75 biodegradable materials, and using biopolymers from genetically modified plants.

By addressing some of these complications biodegradable plastics have along with creating awareness in people about their advantages over traditional plastics, biodegradable plastics can soon be introduced in all major areas of everyday life.

Even though biodegradable plastics might appear to have promising future, from our researches we determined that it cannot replace all the areas where plastics are currently used. One of such reasons is that in some places where plastics are expected to have a long lifetime, biodegradable plastics may pose problems because their biodegradability is not always controllable. In addition, for some areas where plastics are used, other solutions can produce better results than biodegradable plastics.

For example, biodegradable plastics are not tolerable to heat and cannot replace all plastic silverwares and dishes. However, there are other options of reducing the use of plastics by replacing them with china dishes and metal silverware. Also, one of the areas where most plastics are used is probably in grocery bags.

Biodegradable plastics can eventually replace the traditional plastic grocery bags. However, from interviews and other researches, we concluded that the use of plastic grocery bags can be reduced more easily by using financial incentives and encouraging people to bring reusable tote bags. Lastly, one other area where use of plastics can be reduced easily without using biodegradable plastics would be bottled beverage containers. Bottle beverage containers can be recycled easily if people are educated and aware that they need to be placed in proper recycling containers.

However, there are other obstacles to recycling water bottles as the bottles and caps are usually made with different types of plastics. Also, additives are usually added when the bottles are manufactured, and labels and glue are also used in packaging. Such impurities in water bottles might contaminate the recycling streams and 76 therefore cause downcyling.

Thus, if the manufacturers take appropriate steps and make the containers easier to be recycled by recycling companies, it would help reduce the plastic waste in the environment. Combinations of these solutions will definitely help reduce plastic wastes in areas where biodegradable plastics cannot or do not have to replace traditional plastics and will also help reduce the plastic wastes until biodegradable plastics are good enough to be used extensively. Last, but not the least, we concluded that educating people on this matter is very important in order to reduce plastic uses and wastes.

Although we knew about the problems of plastics and alternatives at the beginning of the project, we did not know about the magnitude of the problems and the possible solutions. There are alternatives and solutions available already to reduce plastic use and lessen the negative impact it has. However, it cannot work efficiently unless people are aware and educated about it. Also from the interviews with faculty members from other countries, where less plastic is used and recycling participation is higher, we can conclude that educating people from early on about plastic waste and recycling programs is very important.

For example, there are a number of bins available for recycling plastic bottles on campus, but we can still find large number of plastic beverage bottles thrown away in regular trash bins. In addition, there are signs at local grocery stores that inform people about financial incentives for bringing one's own bag. However, we still see that most people are unaware of the system and majority of them receive plastic grocery bags from the store. Thus, for these solutions to work efficiently and create best results, one of the most important steps is to educate people and make them aware of the problems.

This project enabled us to look at all important aspects of use of plastics, and their impacts on various facets of life. Therefore, if traditional plastics can be replaced in every possible field, then, the lingering issue of plastic wastes and threats they seem to pose will be resolved. Also, as much as the use of plastics is reduced by introducing papers or other less harmful alternatives, the better our environment will be in the coming years.

Reducing Use of Plastics

One of the easiest and simplest ways to reduce plastic waste is to reduce the use of plastics in different areas. In our interviews with international faculty members, most of them agreed that they use more plastics in the U.S. than in their home countries, especially in the field of grocery bags and beverage bottles. In most of the European countries, people usually bring their own tote bags to stores since plastic bags are not given out for free, and glass bottles are preferred rather than plastic bottles. In developing countries such as India and China, people tend to reuse materials due to economic concerns, and they do not usually buy bottled water, but drink boiled tap water instead. However, in the U.S., it is rare that people bring their own shopping bags, and nearly all of the beverages and food are packaged in plastic containers.

According to the Gallop survey in 2007, most consumers in the U.S. prefer bottled water mainly out of three reasons- safety, taste, and convenience (American College of Sport Medicine 2007). However, in recent years, reports and researches show that bottled water is neither healthier not safer than tap water.

Some thought tap water tasted better than one of the most expensive bottled water brands imported from France, Evian (Stossel 2005). Bottled water may be a better option in developing countries where tap water is not safe to drink, but in most areas in the U.S., tap water is tested and proved to be safe. People think bottled water is safer and taste better because of advertisements and fancy labels. In fact, the packaging of bottled water is threatening the earth's health. PET, the plastic that is used to make water bottles, is derived from crude oil, and to meet America's demand, it takes up to 1.5 million barrels of oil every year. Also, making water bottles generates a large amount of unnecessary garbage, given the fact that 86% of water bottles in the U.S. do not get to be recycled (Owen 2006).

Therefore, such unnecessary consumption of plastics should be reduced. However, the impact of reducing the production of bottled water on economy should also be taken into account, due to the huge size of the bottled water market. Statistics show that in 2007, 8,832 millions of gallons of bottled water were produced in the U.S., which gives producer revenues of 11705.9 dollars (International Bottled Water Association 2008).

Grocery and shopping bags is another field where the use of plastics can be reduced because it consumes probably the greatest amount of plastics. Although a lot of supermarkets claim that they recycle the plastic bags they give out, often the 30 collection containers are either missing or not obvious to customers. Charging for plastic bags will be a better solution, giving the customers an incentive to bring their own reusable bags. This policy has already been applied in most of the European countries for years, according to our interviews with faculties. In the U.S., nearly all supermarkets still give out plastic bags for free, generating another huge amount of unnecessary plastic wastes. However, there are some stores that are concerned enough to be taking actions

IKEA was expecting to donate 7 million dollars from the plastic bags sale, but in the end they only gave out 300,000, since most of the customers chose not to buy the plastic bags. However, to call this a drawback is debatable, compared to the advantages this policy brings (Jelveh 2008). These are just a few examples of areas where the use of plastics can be reduced. Nevertheless, there are other products in our household or stores where the use of plastic can be reduced if all of us as consumers pay a little more attention, such as buying products packaged in paper instead of plastic or using reusable containers for food storage instead of plastic bags. For many, it is the lifestyle they used to and might be hard to change ways of life all of sudden, but for the sake of better environment and safer future, it is not hard for everyone to try to reduce the use of plastics in their everyday life.

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