International Journal of Scientific Research in Civil Engineering
© 2018 IJSRCE | Volume 2 | Issue 4 | ISSN : 2456-6667

Creation of Plastic Marble

Syeda Saba Huriya, R. Ganesh, Ravali, Sandhya, Fahad
Department of Civil Engineering Vaageswari College of Engineering Ramakrishna Colony, Thimmapur, Karimnagar, Telangana, India

ABSTRACT

Plastics are polymers and environmentally, a growing disaster. Daily, millions of new plastic bags are manufactured and used by us in our day-to-day life in the form of carry bags, wrapping the objects etc. But disposal of plastic wastes leads to many hazards causing harm to environment as well as life. Most of the plastics are non-biodegradable and lasts for decades may be centuries and thus, making it difficult to dispose. So best way is either to recycle or reuse them for other purposes. By reusing the plastic, we are going to create a marble or marble like objects which will be super strong but not as much as natural marbles which exists. So the procedure follows, firstly we collect different kinds of plastic bags made from ADPE and HDPE etc. After separating them, it is shredded in the shredder or can normally be cut into small pieces. Then later it is heated(or)burned at certain temperature, and compression, moulding etc. Procedures are carried out step by step lastly forming it into a fine marble. At last, finally obtained marble surfaces are made smooth and polished before using them for various purposes. The sustainable way of treating plastic waste is as a resource so, In this way plastic bags can be reused in manufacturing different things which are required in our daily life.
Keywords : HDPE, ADPE, PLASTIC, EVA, PMMA, PVC

I. INTRODUCTION

This project involves re-using of Plastic waste (Plastic Bags).In this, Plastic is reused by melting them out at certain temperatures and converting them into marble like material which can be used as tiles, different objects for various interior purposes. This project further discusses the different types of plastics with suitable temperatures on which it can be easily modified.

1.1 WHAT IS PLASTIC????

The word plastic is in our mouth day in & day out, but what does it really mean? The word itself is derived from the Greek (plastikos) meaning "capable of being shaped or moulded" and refers to their malleability during manufacture, that allows plastic to be cast, pressed, or extruded into a variety of shapes—like films, fibres, plates, tubes, bottles and much more.

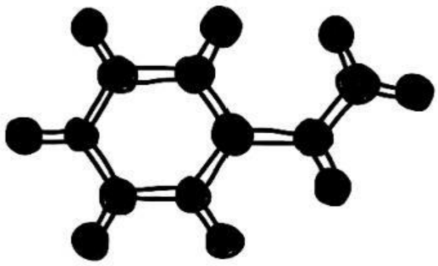

Figure 1

Plastics are made from natural materials such as cellulose, coal, natural gas, salt and crude oil through a polymerisation or poly-condensation process.

Plastics are synthetic chemicals extracted mainly from petroleum and made of hydrocarbons (chains of hydrogen and carbon atoms). Most plastics are polymers, long molecules made up of many repetitions of a basic molecule called a monomer. This structure makes plastic particularly durable and long lasting.

Due to their relatively low cost, ease of manufacture and versatility, plastics are used in an enormous and expanding range of products, from shampoos (micro beads) to space rockets. Plastic is causing serious environmental concerns regarding its slow decomposition rate (recent studies say 500 years) due to its strong bonding molecules. Think it this way, all plastics ever used from your parents and grandparents are still around today and will pollute the planet for another four centuries.

Most plastics contain other organic or inorganic compounds blended in called additives to improve performance or reduce production costs. The amount of additives ranges widely depending on the application and plastic type.

In developed countries about 3rd of plastics is used in packaging and other 3rd is used in buildings such as piping works, other uses include automobiles up to 20% plastics and furniture, toys. For example, reportedly 42% of plastic consumption in India is used for packaging. In medical fields as well as it is used in plastic surgery. However its reshape of flesh. Plastic decomposition rate is very slow (recent studies shows 500 years) due to its strong bonding molecules.

Plastics are the source of innovations that contribute to sustainability, safety, longer lives and better performance.

1.2 History of Plastics

The development of plastics started with the use of natural materials that had intrinsic plastic properties, such as shellac and chewing gum. The next step in the evolution of plastics involved the chemical modification of natural materials such as rubber, nitrocellulose, collagen and galalite. Finally, the wide range of completely synthetic materials that we would recognise as modern plastics started to be developed around 100 years ago.

The development of plastics has evolved from natural plastic materials to completely synthetic molecules (e.g., epoxy, PVC). Parkesine (nitrocellulose) is considered the first man-made plastic (1856). After World War I, improvements in chemical technology led to an explosion of new plastics, with mass production beginning in the 1940s and 1950s. World War II lead to greater research and development into plastic and the discovery of many new plastic types with different properties and applications. As the war ended, these new plastics made their way into society through a multitude of consumer goods.

Arguably the birth of modern plastics era came in 1907, with the invention of bakelite by the belgian born american Leo Baekeland. It was the first synthetic plastic, the first to be derived not from plants or animals, but from fossil fuels. But what really drove the industry's growth was the war effort, as plastics were used in everything from military vehicles to radar insulation.

One of the earliest examples was invented by Alexander Parkes in 1855, who named his invention Parkesine. We know it today as celluloid. Polyvinyl chloride (PVC) was first polymerised between 1838-1872.

The creation of new materials also helped free people from the social and economic constraints imposed by the scarcity of natural resources. Inexpensive celluloid made material wealth more widespread and obtainable. And the plastics revolution was only getting started.

1.3 FUTURE OF PLASTICS

Despite growing mistrust, plastics are critical to modern life. Plastics made possible the development of computers, cell phones, and most of the lifesaving advances of modern medicine. Lightweight and good for insulation, plastics help save fossil fuels used in heating and in transportation. Perhaps most important, inexpensive plastics raised the standard of living and made material abundance more readily available. Without plastics many possessions that we take for granted might be out of reach for all but the richest Americans. Replacing natural materials with plastic has made many of our possessions cheaper, lighter, safer, and stronger.

Since it's clear that plastics have a valuable place in our lives, some scientists are attempting to make plastics safer and more sustainable. Some innovators are developing bioplastics, which are made from plant crops instead of fossil fuels, to create substances that are more environmentally friendly than conventional plastics.

Others are working to make plastics that are truly biodegradable. Some innovators are searching for ways to make recycling more efficient, and they even hope to perfect a process that converts plastics back into the fossil fuels from which they were derived. All of these innovators recognize that plastics are not perfect but that they are an important and necessary part of our future.

II. USES OF PLASTIC

From past to present and present to future Plastics are used in our day to day life in numerous ways because of their low relative density and light weight material and also cheap in cost, many are corrosion resistant and durability is also more In this we discuss about uses of plastics in different fields of works such as healthcare, packaging etc. Let us discuss its different applications in different fields.

2.1 STORAGE OR PACKAGING

The features like strength, flexibility, lightness, stability, im-permeability and ease of sterilisation makes plastic an ideal packaging material for all sorts of industrial as well as commercial uses in the present world.

Figure 2

Plastic packaging material doesn't change the taste of the food and quality of food in that and it also protects it from external contamination. It is used in manufacturing of bottles& beverages, yogurt cups, films for edible oils etc.

2.1.1 ADVANTAGES

The advantages of plastic packaging materials are listed below

1. Light weight
2. Food conservation
3. Food preservation
4. Convenient
5. Innovative
6. Safe and hygienic
7. Low cost

2.1.2 DISADVANTAGES

1. Longevity
2. Environmental impact
3. Bad odour
4. Emission of toxic fumes on continous exposure to heating.

2.2 BUILDIND AND CONSTRUCTION

Around 10 million tonnes of Plastics is utilised every year for the construction of buildings making it second largest application after plastic packaging material. Although, plastics are not visible more in the buildings from the appearance but it is widely used for insulation, piping, window frames and interior designs.

Figure 3

Plastic pipes have life span of more than 100 years and 50 years for underground and external cables. It is used in insulation works in order to reduce the noise pollution that too in a very affordable cost. It is also used as floor coverings so that it becomes very easy in cleaning. Most of the plastics used in construction are fire resistant and underground plastic pipes easily cope with the soil movements.

Now-a-days Plastic is also used as a soil stabilisation , forming bricks in order to increase its strength and durability. It is also used in the construction of road pavements, highways etc.

2.2.1 ADVANTAGES

1. Durability
2. Resistant to corrosion
3. Insulation
4. Cost efficiency
5. Hygiene
6. Sustainability
7. Fire safety
8. Easy to install and maintain

2.2.2 DISADVANTAGES

1. They are embrittlement at low temperature and deformation at high pressure.
2. Plastic materials have low heat resistant and poor ductility. But they are combustibility and release toxic fumes after burning.

2.3. AGRICULTURE

Plastics usage in agriculture is growing day by day. It helped farmers a lot in increasing their productivity and reduce the ecological footprint of their activity. Because of this vegetables and fruits are grown throughout the year irrespective of seasons.

A wide range of plastics are used in agriculture, including, polyolefin, polyethylene (PE), Polypropylene (PP), Ethylene-Vinyl Acetate Copolymer (EVA), Poly-vinyl chloride (PVC) and, in less frequently, Polycarbonate (PC) and poly-methyl-methacrylate (PMMA).

These Plastics are used in various technologies of agriculture such as greenhouse, tunnels, mulching, plastic reservoirs and irrigation systems, silage, other applications include boxes, crate etc.

Figure 4(a)

Figure 4(b)

2.3.1 ADVANTAGES

1. Innovative and sustainable solutions
2. Recycling and Recovery opportunities

2.4. HEALTH CARE

Figure 5

Plastics are everywhere in hospitals. It is used for gloves to sterile syringes and adhesive bandage strips ,in blood banks and heart valves. Plastics packaging is particularly suitable for medical applications only. It also safe guards from contamination.

Figure 6

It is used in unblocking blood vessels, prosthesis, hearing aids, artificial corneas and plastic pill capsules etc.

2.5. SPORTS AND LEISURE

Plastics are widely used in the field of sports. It increase the performance characteristics that modern athletes demand. For example, the Maracanã stadium at the Rio 2016 Olympics used millions of recycled plastic bottles to produce more than 6,700 seats in the stadium. In addition, the ribbons on the medals awarded to athletes were made of 50% recycled plastic bottles.

Figure 7

It is used in manufacturing of all sports balls, sports footwear , plastic in tennis, plastic in water sports, plastic in winter sports and leisure goods.

2.6. MOBILITY AND TRANSPORT

Designers strive to find the ideal balance between high material performance, competitive pricing, style, comfort, safety, fuel efficiency and minimal environmental impact. The sustainable solution is reflected by an optimal balance of all these parameters and requirements.

Airplanes are a good example of how plastics and design innovation are connected in a highly modern and material challenged application. Since the 70s, the **use of plastics in airplanes has grown from 4 to around 50%**.

The car features a range of high-quality thermoplastics that bring design flexibility, but more importantly, the light weight of these plastics means that the car uses an average of **3.3 litres of fuel every 100km and emits only 86g of CO2 per kilo-meter.**

2.7. ELECTRONIICS

In the field of electronics, Polymers can help store energy for longer. LCD (liquid crystal display) flat screens consume less power than traditional cathode ray tube devices and have replaced them in today's homes.

Figure 8

Many electrical and electronic applications rely on plastics, these include resource efficiency as Televisions, computers, light weight smartphones, electrical and mechanical resistance and fire safety etc.

2.8. ENERGY

Figure 9

In buildings, plastics provide effective insulation from cold and heat and prevent air leakages. Plastic insulation materials consume approximately 16% less energy and emit 9% less greenhouse gases than alternative materials.

There is a major contribution of plastics in following ways such as efficient insulation, renewable energy, preventing food losses, light weight applications, reduced greenhouse gas emissions during manufacturing.

III. METHODOLOGY

This chapter deals with the types of plastics and plastic wastes and mixing of plastics and also preparation steps or key steps to be carried out before proceeding with the experiment. In this all basic steps required to prepare a plastic marble from the plastic waste is discussed.

3.1 TYPES OF PLASTICS

Plastics are divided into two major categories. They are 1.Thermooset or Thermosetting plastics 2.Thermoplastics

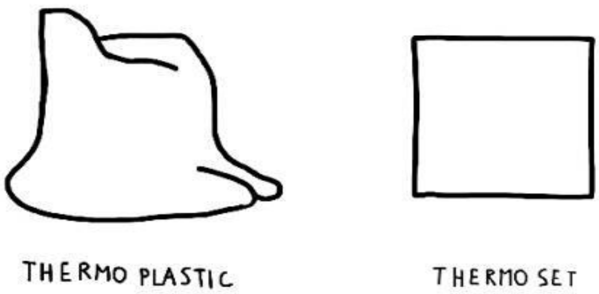

Figure 11

Further, Thermoplastics are grouped into seven different sub categories.

3.1.1 THERMOSET OR THERMOSETTING PLASTICS

Thermosets are the type of plastics which once cooled and hardened, they cannot retain their shapes and cannot return to their original form. It can be shaped only once and stays forever in that shape. They are hard and durable. In this process, a chemical reaction occurs which is irreversible.

Thermosets can be used for auto parts, aircraft parts and tires. Examples include polyurethanes, polyesters, epoxy resins and phenolic resins. So in this project we mainly concentrate on thermoplastics.

3.1.2 THERMOPLASTICS

Thermoplastics are the plastics that can be recycled. Thermoplastics can be melted back into liquid and moulded many times. Think of this as butter, butter that can be melted and cooled many times and take various shapes. Thermoplastics make up to 90% of global production.

It is less rigid than thermosets, thermoplastics can soften upon heating and return to their original form. It can be extruded into films, fibers and packaging. Examples include polyethylene(PE), polypropylene(PP) and polyvinyl chloride(PVC). Each plastic type has its specific chemical composition, properties and applications and is given a specific number, called SPI code to differentiate between them. Today, most manufacturers should follow this coding system and place the SPI code on their products, usually moulded at the bottom of the product. Knowing what plastic type you're working with is crucial when working with Plastic Marble. This will tell you its melting temperature so that you can set your Plastic marble machines at the correct temperature and run a smooth recycling process.

The different plastic types are:

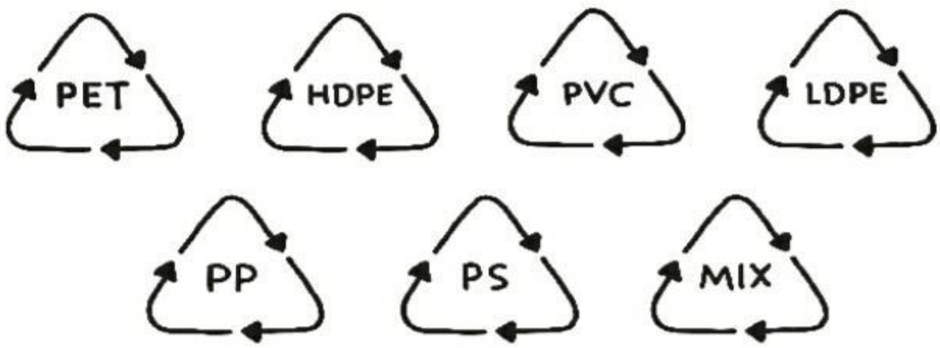

Figure 12

1. **PET or PETE (POLYETHYLENE TEREPHTHALATE)**

This is a very strong plastic that can be easily recognised for its transparent look. All beverage bottles containing your favourite sodas are PET. This plastic is also used in many other products like jars, combs, bags, tote bags, carpets and ropes. Items made from this plastic are commonly recycled. Most recently, PET is often recycled into yarns to make clothes. This plastic is a bit more complex to work with, we advise to start with other plastics. Its the main plastic in zip-lock food storage bags.

2. **HDPE (HIGH-DENSITY POLYETHYLENE)**

This plastic is often used for food or drink containers. Items made from this plastic include containers for milk, motor oil, shampoos, soap bottles, detergents, and bleaches. Many toys are also made from this plastic. This plastic works very well with Plastic Marble. This linear form produced tighter, denser, more organized structures and is called as HDPE. These are the harder plastics with a higher melting point than LDPE and it sinks in alcohol-water mixture.

3. **PVC (POLYVINYL CHLORIDE)**

This is toxic and we do not work with it. PVC is most commonly found in plumbing pipes and releases chloride when heated up. Do not use with Plastic marble .

4. LDPE (LOW-DENSITY POLYETHYLENE)

Plastic wrap, sandwich bags, squeezable bottles, and plastic grocery bags all are made from LDPE. Usually, LDPE is not recycled from the industry but works rather good with Plastic marble. In this polymer strands are loosely packed so its soft and flexible.

5. PP (POLYPROPYLENE)

This is one of the most commonly available plastic on the market. This type of plastic is strong and can usually withstand higher temperatures. Among many other application, it is consistently used for products that get in contact with food and drink (Tupperware, yoghurt boxes, syrup bottles etc..). PP works very well with Plastic Marble. Polypropylene is used in car trim, battery cases, bottles, tubes, bags etc.

6. PS (POLYSTYRENE)

PS is most commonly known as Styrofoam. PS can be recycled, but not efficiently; recycling it takes a lot of energy, which means that few places accept it. Disposable coffee cups, plastic food boxes, plastic cutlery and packing foam are made from PS. Very good to work with Plastic marble.

7. OTHER(MIX)

This code is used to identify other types of plastic that are not defined by the other six codes. ABS, Acrylic or Polycarbonate are included in this category and can be more difficult to recycle. Plastic marble can work with some of this.

3.2 COMMINGLE OF PLASTICS

Different types of plastics should be never mixed with each other because when they are mixed it will be impossible to recycle them again. Sometimes mixing various types of plastics gives an adverse result as they can form separate layers of oil, water. In short it would end up their cycle and also weakens the structure and lowers the quality of the products. So never mix up the products while working with the plastic marbles. For example, if making a plastic marble then completely use any one of the type of plastics mentioned above. In plastic marbles we don't work with the thermosets as it cannot be moulded again whereas thermoplastics works best with the plastic marbles.

3.3 PLASTIC WASTE

Daily, millions of new plastic bags are manufactured and used by us in our day-to-day life in the form of carry bags, wrapping the objects etc. But disposal of plastic wastes leads to many hazards causing harm to environment as well as life. Most of the plastics are non-biodegradable and lasts for decades may be centuries and thus, making it difficult to dispose. So best way is either to recycle or reuse them for other purposes.

Plastic pollution is the accumulation of plastic products in the environment that adversely affects wildlife, wildlife habitat and humans. Plastics that act as pollutants are categorized into micro-, or macro debris, based on size. Plastics are inexpensive and durable, and as a result levels of plastic production by humans are high. Moreover, the chemical structure of most plastics renders them resistant to many natural processes of degradation and as a result they are slow to degrade. Together, these two factors have led to a high prominence of plastic pollution in the environment.

As of 2018, about 380 million tonnes of plastic is produced worldwide each year. From the 1950s up to 2018, an estimated 6.3 billion tonnes of plastic has been produced worldwide, of which an estimated 9% has been recycled and another 12% has been incinerated.

Chlorinated plastic can release harmful chemicals into the surrounding soil, which can then seep into groundwater or other surrounding water sources and also the ecosystem. This can cause serious harm to the species that drink the water.

Landfill areas contain many different types of plastics. In these landfills, there are many microorganisms which speed up the biodegradation of plastics.

Due to the pervasiveness of plastic products, most of the human population is constantly exposed to the chemical components of plastics. 95% of adults in the United States have had detectable levels of BPA in their urine.

Figure 13

As we all know, plastic has become a threat to entire ecosystem and society. It is deteriorating our planet and people lives.

A Plastic is a material which is manufactured to use only for minutes and made to last hundred of years but disposal of these plastic wastes leads to many hazards causing harm to environment as well as people's life since, most of the plastics are non-biodegradable. So this is all about recycling (or) reusing them for other purposes by undergoing several process like collecting, melting, shredding, compressing, polishing etc. This may be used as one of the best way to eliminate plastic pollution.

3.4 PREP FOR PLASTIC MARBLE FROM PLASTIC WASTE.

By using different types of thermoplastics we will be making a marble like material which will be hard enough to use it in any civil engineering works, interior works. This is one of the way to eliminate the plastic pollution.

By reusing the plastic, we are going to create a marble or marble like objects which will be super strong but not as much as natural marbles which exists.

In this, we learn how to make plastic ready for melting and to make it into plastic marble and also collecting and sorting of raw materials required to make it.

3.4.1 COLLECTING

The first thing required is plastic to recycle. It is essential to have enough of plastic to recycle. However, plastic at this stage i.e. the collected plastic will be still dirty and mixed. The actual collection of plastic depends on the cultural and economic context of our country.

The ways to get the plastic waste from

1. Collect it from the surrounding environment friends and families
2. We can also collect it from the local shops who wants to get rid of their plastic waste

3. Collecting directly from the manufacturing units where the left over pieces or waste plastic will be left off in enormous.
4. Local waste pickers
5. Find the streams who can constantly supply you plastic such as industry, agriculture, fishing etc.
6. We can also purchase the plastic bags or collect them from the shopkeepers to eliminate the already manufactured plastic.

Figure 13

3.4.2 SORTING

This is the most difficult as well as time consuming but in todays world even in the large scale industries this work is done manually. In this firstly after collecting the plastic we sort them according to their types. Plastics have the SPI code on them either at the bottom of the bag or anywhere on the bag. It will be in the form of numbers or words in a triangular recycling symbol. Most of the plastics don't have number or word. In that case you can keep them separate or if u have same in enough quantity and identify which type of plastic it is and its suitable melting temperature. Every plastic has its own melting temperature.

3.4.3 SHREDDING

Shredding is the process where plastic in large sizes are cut into small pieces so that it will be easily for washing and melting processes.

Figure 14

Once the plastic is sorted by their specific plastic type it's time to shred it. At this stage, bigger plastic objects are chopped into small granulate to reduce its size, enable washing, store more efficiently and be used with the other machines. It is good practice at this stage to separate plastic by colour.

3.4.4 WASHING

Washing the plastic waste is necessary before it undergoes recycling process because the dirty plastic will result in low quality output. But ensure that plastic is completely dry at the time of melting.

If plastic isn't clean collectors can wash it in barrels filled with water. A more efficient way is to wash after shredding using a basic filtering system. Plastic flakes are placed on a mesh and immersed in water. It is then thoroughly stirred 5-10 times and taken out. At this point, you should place the plastic on a drying plate for a few hours waiting for water to evaporate. It is important that the plastic is dry before being melted.

3.4.5 STORING

Lastly after collecting, sorting, shredding, washing, we have to store it according to the SPI codes.

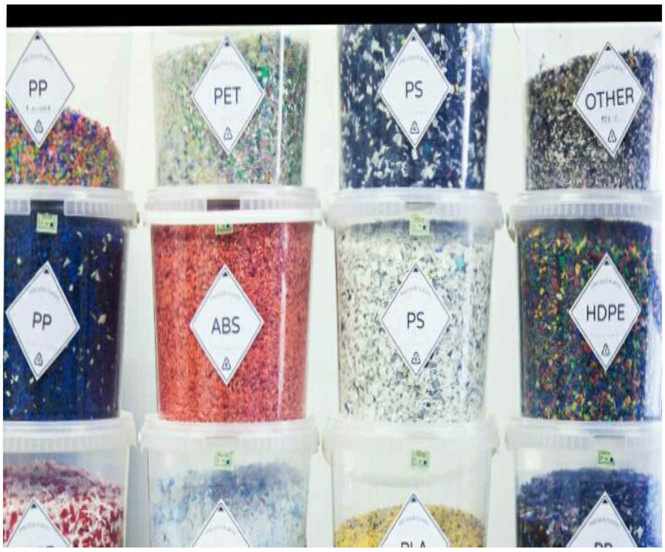

Figure 16

Once the plastic is dry it can be stored in the provided buckets. Ideally, buckets should be stackable, strong and transparent so you can see the colour and nature of the plastic. The SPI coding should be respected when storing the plastic using the provided Precious Plastic stickers. For example, if you have sorted, shredded and eventually washed PS it is essential that you put it in a bucket with the PS code sticker so that plastic does not get mixed up.

IV. CREATION OF PLASTIC MARBLE

This procedure requires mainly four machines. The machines apply heat to the plastics, plastic melts and later it will be moulded or shaped according to required measurements and then finally it is cooled to regain its solid state. Lastly final steps includes polishing and finishing of the obtained products.

There are many plastics to choose from. But starting with PP, HDPE, etc. Types of plastics makes the process easier because these plastics can be easily melted. Temperature is also a key point hence it is very important to know the melting points of different plastics.

4.1. SHREDDING PROCESS

In this plastic covers will be directly added into the shredder machine. This will be chop the plastic into number of small pieces which makes us easy for rest process. Do not mix different types of plastic in order to receive the different colour combinations in the final object but if you have enough of plastic of same type then we can mix all together.

The figure below shows the diagram of the shredder.

Figure 17

4.2. MELTING PROCESS

After shredding the plastic, collect different type and colours of plastics and store them into separate boxes with the labels on it mentioning the type of plastic. Later, for the heating process different plastic have different melting points. Few plastics melt easily and few doesn't melt even at higher temperatures. Firstly when plastic is kept in oven, it should be heated for 40 minutes and then in between we can add more plastic of same type and different colours to get a colourful output.

Never burn the plastics, as it releases the highly toxic fumes which causes air pollution as well as it can lead to serious health issues whoever consume those fumes. Every plastic has its own melting points so its better to melt the plastic in the limits of their melting points. Going beyond those points can burn the plastic. So avoid burning of the Plastics.

Chart below illustrates the different melting points of different types of plastics through their behaviour on heating.

BURNING OR MELTING OF PLASTIC????????

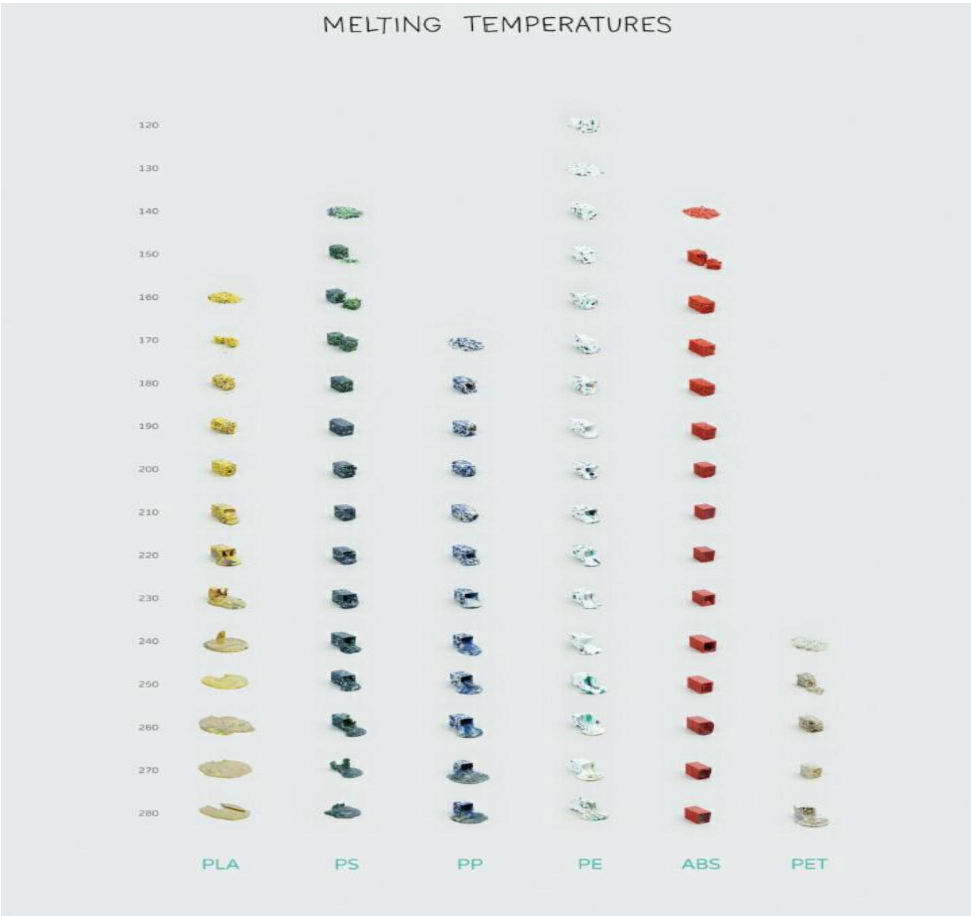

Figure 18

4.3. MOULDING PROCESS

After the heating process, its time for the moulding process. In this after heating we take out the plastic from the oven and mould it for few minutes so that all plastics come more in contact with one another. It should be kept in a mould. Moulds if are of metal made then it will be the tougher tight closely packed object.

Moulds are the integral part of this process because moulds gives shape to the object. Using the metal moulds is better since it has more durability. Our aim is to reduce the plastic waste not to increase the cost of the process. While moulding, one must compulsory wear the gloves because the heated plastic can cause you burns.

Figure below shows the different types of moulds.

Figure 19

4.4. COMPRESSION PROCESS

After this, the moulds which are loaded with the plastic are kept under the compression machines. It slowly applies the high pressure on the moulds and gives it a shape. If two colours are mixed then it gives a nice outlook of the plastic marble. For example if you take black and white coloured plastic then it gives u grey type Plastic marble.

We can also directly put the mould into the oven and proceed with the heating process and then go directly for the compression step. And also make sure that the plastic in the mould is melted properly. Apply the oil (or) mould release to the moulds before compression so that it doesn't stick to the moulds inside. Place the mould and compress it for 20 minutes at-least.

Figure 20

Figure below shows the compression machine.
After compression, the plastic marble figure is attached above.

4.5. POLISHING AND FINISHING

After the compression step, final obtained plastic marble looks like this in the figure below .

Later, the excess one will be scrapped and it will be smoothened and then for the shine purpose it will be polished.

Finally obtained Plastic marble is in the figure below.

Figure 21

4.2 PROPERTIES AND CHARACTERISTICS

The different properties such as floating, physical, and visual properties are mentioned in the charts below.

Physical properties

Plastic	Thermal Properties				Strength		Density
Abbreviation - Brand name	Tm	Tg	Td	Cte	Tensile	Compressive	
	°C	°C	°C	ppm/°C	psi	psi	g/cc
PET - Polyethyleneterephthalate	245 265	73 80	21 38	65	7000 10500	11000 15000	1.29 1.40
LDPE - Low density polyethylene	98 115	-25	40 44	100 220	1200 4550		0.917 0.932
HDPE - High density polyethylene	130 137		79 91	59 110	3200 4500	2700 3600	0.952 0.965
PP - polypropylene	168 175	-20	107 121	81 100	4500 6000	5500 8000	0.900 0.910
PVC - polyvinylchloride		75 105	57 82	50 100	5900 7500	8000 13000	1.30 1.58
PS - polystyrene		74 105	68 96	50 83	5200 7500	12000 13000	1.04 1.05

Tm - crystalline melting temperature (some plastics have no crystallinity and are said to be amorphous).

Tg - glass transition temperature (the plastic becomes brittle below this temperature).

Td - heat distortion temperature under a 66 psi load.

Cte - coefficient of linear thermal expansion.

Tensile Strength - load necessary to pull a sample of the plastic apart.

Compressive Strength - load necessary to crush a sample of the plastic.

Density - aka specific gravitymass of plastic per unit volume.

Figure 22

Floating properties

floats on:	alcohol	vegetable oil	water	glycerin
PET 1	no	no	no	no
HDPE 2	no	no	yes	yes
PVC 3	no	no	no	no
LDPE 4	yes	no	yes	yes
PP 5	yes	yes	yes	yes
PS 6	no	no	no	yes

Figure 23

Visual properties

Type	name	properties	common uses	burning
PET 1	polyethylene terephthalate	clear, tough, solvent resistant, barrier to gas and moisture, softens at 80°	Soft drink, water bottles, salad domes, bisquit trays, food containers	yellow flame little smoke
HDPE 2	high-density polyethylene	Hard to semi-flexible, resistant to chemicals and moisture, waxy surface, softens at 75°	Shopping bags, freezer bags, milk bottles, juice bottles, iceacream containers, shampoo, crates	difficult to ignite smells like candl
PVC 3	polyvinyl chloride	Strong, tough, can be clear and solvent, softens at 60°	Cosmetic containers, electrical conduit, plumbing pipes, blister packs, roof sheeting, garden hose	yellow flame green spurts
LDPE 4	low-density polyethylene	Soft, flexible, waxy surface, scratches easily, softens at 70°	Cling wrap, garbage bags, squeeze bottles, refuse bags, mulch film	difficult to ignite smells like candl
PP 5	polypropylene	Hard but still flexible, waxy surface, translu-cent, withstands solvents, softens at 140°	Bottles, icecream tubes, straws, flower-pots, dishes, garden furniture, food containers	blue yellow tipped flame
PS 6	polystyrene	Clear, glassy, opaque, semi tough, softens at 95°	CD cases, plastic cutlery, imitation glass, foamed meat trays, brittle toys,	dense smoke
OTHER 7	all other plastics	Properties depend on the type of plastic	automotive, electron-ics, packaging	all other plastics

Figure 24

1. STRENGTH
2. LONGITIVITY
3. DURABILITY
4. LIGHT WEIGHT
5. HIGHLY AFFORDABLE
6. STABILITY.

V. CONCLUSION AND RECOMMENDATIONS

Plastic recycling is very complicated with corporate interests. So this makes it difficult for general public to get into this. We are also aware of the problems which arises due to burning of plastics and also after reusing them for various purposes creating new problems ahead. We will be working more on this to reduce the elimination of toxic gases which evolves from them due to continuous exposure to the sun etc.

The Plastic marble can be used as low cost marble. Yes it has few disadvantages too such as emission of gases in exposure to sun. In that case, this should be coated with an inflammable gel so that it can overcome this advantage. It can also be used in interior of the buildings to give a nice look that too with a low budget. In this way, we can eliminate the existing the plastic waste in our country as well as all around the world with the profit most importantly plastic marble won't end up in the environment again as it doesn't decompose for at-least 500 years..