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**UTILIZATION OF PVC, LDPE & HDPE MATERIALS IN BUILDING  
CONSTRUCTION: A REVIEW**

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**ABSTRACT**

A suitable approach for this situation is using some part of urban rubbish or waste as required materials for building construction. Plastic is considered as urban junk .but with sustainability characteristic it can be used as construction material instead of some conventional material in building construction. The work intends to investigate the application of various type of plastic such as PVC, LDPE and HDPE which is one of the urban waste in building construction and that how it can lead to sustainable development .It also mentions some ways for self-standing and insulating them in thermal and sound point of view and some positive points which this material have versus others.

**Keyword:—Plastic, PVC, LDPE, HDPE, Utilization, Sustainable Material, Construction material.**

**1. INTRODUCTION**

Nowadays, human apply all of its potentiality to consume more. The result of this high consumption is nothing unless reducing the initial resources and increasing the landfill. In recent times, human from the one hand is always seeking broader sources with lower price and from the other hand is following the way to get the rid of the wastes. The waste today can be produced wherever humans footprints be existed, and remind him that they have not chosen the appropriate method for exploitation of the nature At the present time, the possibility of utilizing the renewable resources such as solar, wind, geothermal has been provided for us more than before, and development of this science is making progress. But those energies can be chosen as one of the renewable and alternative energies instead of fossil fuels which are cheap as possible and have fewer environmental impacts. Since no attention to economic issues lead to that the use of these energies be just for groups dedicated to specific segments of society. Whilst many renewable energy projects are large-scale, renewable technologies are also suited to rural and remote areas, where energy is often crucial in human development. With population growth in today’s world, the need to the building has increased and to respond to this demand, the countries tend to use the industrial building materials and decline the use of indigenous and traditional materials. These factors in spite of increasing the energy consumption in the industry section; they can also raise the cost of house and are considered as the barrier for users to obtain the basic needs of the life. The problem of users is losing the power and ability of design and building their own homes by themselves. Two factors that prevent aboriginal people from building their homes are high cost building materials and labor and also maybe long transportation. One of the solutions for this problem can be Solve In following Manner. Use of affordable recycled materials in buildings using the method of regenerating through proper education to people In the past, the glass was common in packing some foods such as milk and etc. They could be returned to the factory for using again for the same purpose. But now by changing the human’s disposal culture, glass bottles have been replaced by plastic bottles, as they have increasingly become one of the substances of destruction of the landfills because they decompose in a long time. Two alternative solutions against the plastic bottle disposal are recycling and reusing process. Recycling needs additional energy to treat the materials for producing something usable. Moreover, the recycling process produces wastewater and air pollutants. So the best solution is reusing for which no additional energy is required and does not contribute to pollution. Indeed, when we reuse junk, we are helping to save the obtained energy which would otherwise be wasted. It is focused on not only the financial

aspect but also the environmental aspect. Plastics are produced from the oil that is considered as nonrenewable resource. Because plastic has the insolubility about 300 years in the nature, it is considered as a sustainable waste and environmental pollutant. So reusing or recycling of it can be effectual in mitigation of environmental impacts relating to it. It has been proven that the use of plastic bottles as innovative materials for building can be a proper solution for replacement of conventional materials. The use of this material has been considered not only for exterior walls but also for the ceiling of the building. This work is to investigate the using of plastic bottles as municipal wastes in the buildings, the key and positive characteristics of this product and the benefits obtained by using it in building. It also intends to compare the characteristics of some construction materials such as brick, ceramic and concrete block with bottle panel. Plastic have many good characteristics which include versatility, lightness, hardness, and resistant to chemicals, water and impact.

Plastic is one of the most disposable materials in the modern world. It makes up much of the street side litter in urban and rural areas. It is rapidly filling up landfills as choking water bodies. Plastic bottles make up approximately 11% of the content landfills, causing serious environmental consequences. Due to the consequences some of the plastic facts are as follow: More than 20,000 plastic bottles are needed to obtain one ton of plastic. It is estimated that 100 million tons of plastic are produced each year. Plastics are produced from the oil that is considered as non-renewable resource. Because plastic has the insolubility about 300 years in the nature, it is considered as a sustainable waste and environmental pollutant. So reusing or recycling of it can be effectual in mitigation of environmental impacts relating to it. It has been proven that the use of plastic bottles as innovative materials for building can be a proper solution for replacement of conventional materials. The use of this material has been considered not only for exterior walls but also for the ceiling of the building. The objective of this work is to investigate the key and positive characteristics of this product and the benefits obtained by using it in building. It also intends to compare the characteristics of some construction materials such as brick, ceramic and concrete block with bottle. One can use solar bomb (bottle filled with bleaching powder solution) will be fitted on the roof for light source.



**Fig-1: Plastic Waste**

## **2. APPLICATIONS OF PVC, LDPE AND HDPE MATERIALS**

### **1. Roofing**

A roof is an essential part of a house, so when it comes to home building, there have been many innovations in roofing methodologies over the years. Using recycled plastics to build roofing tiles is a great way to resemble other more expensive materials, while providing the same high-quality you can expect with materials such as slate.



**Fig -2: Roofing Tiles**

Corrugated plastic boards are essentially plastic cardboard, and are made from three layers of thin, polypropylene plastic substrate. The product consists of a zigzagged layer of plastic sandwiched between two smooth layers of plastic sheeting – also known as twin-wall plastic sheeting.



**Fig-3: Roofing Sheets**

Mostly used in agricultural buildings, corrugated roofing sheets feature repetitive folds on their surface. Because of their unique shape, they offer years of reliable utility and enhanced strength. Their corrugated design with ridges and grooves make them stronger than before. The wavy construction paves the way for increased strength across smaller surface areas.

Benefits of Plastic Roofing

- Durable And Easy To Install
- Extreme Climate Resistant
- Protection Against UV Rays
- Easy To Clean
- Lighter material
- Lower carbon footprint

## **2. PVC flooring & Flooring tiles**

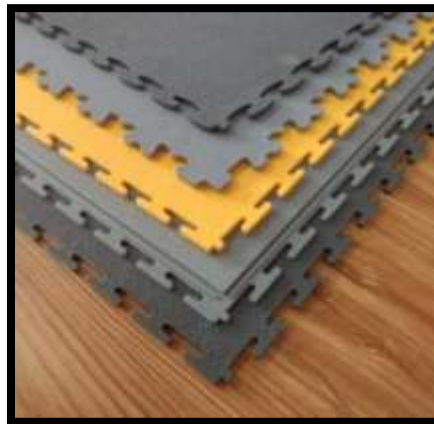
Polyvinyl chloride, more correctly but unusually poly vinyl chloride, commonly abbreviated PVC, is the third-most widely produced synthetic plastic polymer, after polyethylene and polypropylene. PVC sheet used as flooring material is inexpensive and used in a variety of buildings covering the home, hospitals, offices, schools, etc. There are two kinds of PVC floorings. One is flexible, which is available in sheet form and the other is rigid

which is available in standard tile sizes. Flexible PVC flooring is suitable for comparatively lighter traffic, either for rigid floors such as concrete and stone flooring or for flexible floors such as timber flooring, etc. PVC products are fire retardant. This is because they contain more than 70 % PVC which turns 57% Chlorine. This contributes efficiently to the flame retardant. Further, it has very high ignition temperature 400°C against 210°C of wood and has an index of 50% against 21% for wood.



**Fig-4: PVC Flooring**

The floor covering in your house is one of the most essential aspects in creating your dream home, and it has become more common to utilize floor tiles that contain recycled plastics.



**Fig-5: Floor Tiles**

Advantages:

- Easy installation process
- Easy to clean
- Quiet and warm
- Affordable
- Resistant to plastic deformation.
- Fire resistant.

### 3. Decorative laminates and moldings

As the name implies, decorative film laminates are plastic films made of multiple layers, laminated together to provide various types of decoration – from wood grain to chrome appearances. Sometimes called “foils,” the various materials carry the same basic makeup: a cap, or clear layer, decorative layers, and a substrate layer.



**Fig-6:** Lamination Mould Placement

Decorative film laminates are often used in the creation of large pressure-sensitive decals. In this case, the substrate layer is replaced with a pressure-sensitive adhesive and backing. Decals are precision trimmed from the flat laminate, the backing is removed and the decal is applied to an existing component. Pressure is imparted during the application, activating the adhesive system. Common uses include automotive striping and “blackouts” such as b-pillars.



**Fig-7:** Decorative Laminations

Advantages:

- High Efficiency- Fast Production
- Flexibility- Material and Color
- Reduced Waste
- Enhanced Strength

#### **4. Window and door frames**

PVC Windows are especially made to suit the Indian climate. The profiles are made to adapt to various Indian climates like extreme heat & cold, heavy rainfall. The PVC Windows can be broadly categorized in 2 types

PVC Sliding Windows system can be Two Track - Three Track or multi Track shutters with the provision of Dust & moisture proof wire mesh shutter with modern locking, technically design, strong durable, no chocking of shutters, Airtight, Sound proof and suitable to all weather condition.

PVC products are fire retardant. This is because they contain more than 70 % PVC which turns 57% Chlorine. This contributes efficiently to the flame retardant. Further, it has very high ignition temperature 400°C against 210°C of wood and has an index of 50% against 21% for wood.

PVC windows have grown in popularity because they are easy to design and can adapt to many varying styles. A bonus is that because they are made primarily from plastics, the frames are 100% recyclable.



**Fig -8:** PVC window

Advantages:

- Longer lifetime (up to 40 years)
- Surplus of production material
- Same insulation quality as regular plastic
- Corrosion Resistant.
- Resistant to plastic deformation.
- Water proof and easy to clean.
- Fire resistant.

#### **5. Electrical conduits & Indoor insulation**

PVC casing-capping wiring PVC capping is done in order to cover the wires. It includes casing also. This casing-capping wiring is also known as open wiring, as it is done outside the wall.

Conduit Wiring Electrical conduits are used to protect and provide the route of electrical wiring in an electrical system. Electrical conduits are made of metal, plastic, or fiber and can be rigid or flexible. For workshops and public buildings, conduit wiring is the best and most desirable system of wiring. It provides protection and safety against fire.

Insulation is another essential factor in homebuilding and buying because it keeps your home's temperature regulated all year-round



**Fig-9:** Indoor Insulation

Various insulation companies have begun developing insulation with recycled plastic inside of it because only a minimum amount of plastic will maximize your home’s energy efficiency levels.

Advantages:

- Easy installation
- Durability
- Long-term energy savings

#### **6. Piping system and guttering**

HDPE pipes can carry cables, chemicals, compressed gasses, hazardous wastes, oils, potable water, slurries, steam, drinking water, and wastewater.

LDPE pipes can carry cables and water. Irrigation and agricultural applications commonly use LDPE pipes.



**Fig-10:** HDPE pipes

Properties that make polyethylene popular, as a piping material, are its greater flexibility, dimensional stability, durability, structural strength, toughness, and resistance to household and industrial chemicals. Polyethylene is commonly used as containers for household chemicals. Various sectors prefer and select polyethylene pipes for its distinctive combination of strength mixed with flexibility.

Advantages:

- Corrosion resistance.
- Light weight
- Resistance against non-uniform settlement.

- Long Life-time

### 7. Paver blocks

Plastic is used to manufacture the paver blocks to reduce their cost as well as to reuse the waste generated by the plastic in the environment. The use of plastic material in the paving blocks reduces the cost of the block as well as improves the quantity and by manufacturing these blocks waste management can be achieved. In most of the cities in India this experiment of the paver blocks is taking place.



**Fig-11:** Plastic Paver Blocks

Plastic wastes are heated in a metal bucket at a temp of above 150°. As a result of heating the plastic waste melt. The materials quarry dust, aggregate and other materials as described in previous chapter are added to it in right proportion at molten state of plastic and well mixed. The metal mould is cleaned through at using waste cloth. Now this mixture is transferred to the mould. It will be in hot condition and compact it well to reduce internal pores present in it. Then the blocks are allowed to dry for 24 hours so that they harden. After drying the paver block is removed from the moulds and ready for the use

Advantages:

- Easy Installation
- Light weight
- Economical
- Resistance against non-uniform settlement.
- Long Life-time

### 8. Bricks

Bricks are a stable material to build a home with, and more and more companies are embracing the idea of building bricks with recycled plastic.



**Fig-12: PET brick**

Recycled bricks can be put together in a LEGO-like way, making a home’s building time much quicker than it would be with traditional brick.



**Fig-13: Plastic Brick**

This plastic product can also be fire-resistant, is cheaper, and, of course, is more eco-friendly.

Advantages:

- Light Weight
- Economical
- Long Life Time
- Anti-Corrosive

### **9. Concrete**

Recycled plastics can be used to make stronger concrete structures in the form of sidewalks, driveways and more. Students at IIT have recently conducted experiments with recycled plastic by exposing small amounts of it to gamma radiation, mixing it into a powder and then mixing that into cement paste.



**Fig-14: Concrete with plastic mix**

Doing so can produce concrete that is up to 15% stronger than regular concrete, allowing this form of construction to be both longer-lasting and more eco-friendly.

Advantages:

- Light Weight
- Easy to Transport
- Thermal and Electrical insulator

- Long life
- Durable

## **CONCLUSION**

- The present study has efficiently and effectively demonstrated the application of plastic into useful constructional materials as well as reducing its menace in our surrounding. The plastic wastes littered all over the environment can be converted to useful constructional materials more economical.
- The utilization of plastic waste in structural designing development extends needs extraordinary regard for tackling this issue and improving the monetary parts of the venture. Plastic waste is being used as total in the substantial, and it goes about as a limiting material in floor tiles. To diminish the measure of waste plastic, the utilization of plastics in the development business is an extraordinary exertion. Plastic material can be utilized rather than totals insubstantial, used in asphalt, air terminals, and streets. In another case, the strength of plastic tiles with no utilization of sand in the middle is highly less when contrasted with the aluminum tiles.
- The supplanting conventional restricting material with squander plastic and quarry dust demonstrates tricky interest in heat impedence, similar to the reflexes in load-bearing. PET may be considered as near egregious thermoplastic in the polyester family. As per comfort and progression in innovative work, the creation of plastic heightens disregarding the "Guideline of Sustainable Development," and the tremendous measure of waste unloaded in the sea and landfill Formation of plastic ordinarily prompts extra adaptability and mechanical property.
- The biodegradation of waste plastics is acquiring fame since it can decrease contamination. Land filling, burning, reusing, and change into vaporous and fluid fills are strategies used to deal with squander plastic. The executives are needed to acquire a more exact handle of the extent of approaches utilized in squander plastics management. This concentrate likewise looked to uncover plastics' applications.
- The utilization of recyclable LDPE plastic waste in tiles is an answer for lessening LDPE plastic contamination. Notwithstanding, it was found that plastics are engaged with basically every other use, either straight forwardly or in a roundabout way.
- The data assembled in this methodical writing survey will help mainstream researchers and specialists determine where to start further review and where to squander plastics should be head. Recycling might lessen the measure of trash that must be discarded, just as CO<sub>2</sub> outflows and oil utilization.
- The standard of reused plastics changes relying upon the utilization and sort of plastic. Reusing is the most inconceivable alternative in the strong waste organization chain of importance to diminish the effects of end-of-utilization and end-of-life post-shopper plastic bundling squanders.

## **REFERENCES**

1. Rochman, C.M., et al., Policy: Classify plastic waste as hazardous. *Nature*, 2013. 494(7436): p. 169-171.
2. Saikia, N. and J. de Brito, Use of plastic waste as aggregate in cement mortar and concrete
3. Preparation: A review. *Construction and Building Materials*, 2012. 34: p. 385-401.
4. Kamaruddin, M.A., et al. Resource recovery from municipal solid waste by mechanical heat Treatment: An opportunity. in *AIP Conference Proceedings*. 2017. AIP Publishing
5. Silva, R., J. De Brito, and R. Dhir, Properties and composition of recycled aggregates from

6. Construction and demolition waste suitable for concrete production. *Construction and Building Materials*, 2014. 65: p. 201-217.
7. Kamaruddin, M.A., M.S. Yusoff, and A.H. Ahmad. Waste to Wealth: Recovery of Recyclable Items and Biodegradable Wastes from Night Markets at Seberang Perai Selatan, Penang. in
8. *Applied Mechanics and Materials*. 2015. Trans Tech Publications. Star, T., Saturday, 21 January 2017 Solving the plastic problem.
9. <http://www.thestar.com.my/opinion/letters/2017/01/21/solving-the-plastic-problem/>, 2017.
10. Biogas, J.A., J. de Brito, and J.M. Figueiredo, Mechanical characterization of concrete produced With recycled lightweight expanded clay aggregate concrete. *Journal of Cleaner Production*, 2015. 89: p. 187-195.
11. Saikia, N. And J. de Brito, Mechanical properties and abrasion behavior of concrete containing shredded PET bottle waste as a partial substitution of natural aggregate. *Construction and building materials*, 2014. 52: p. 236-244.
12. Iucolano, F., et al., Recycled plastic aggregate in mortars composition: Effect on physical and Mechanical properties. *Materials & Design*, 2013. 52: p. 916-922
13. Nivetha, C. Rubiya, M. Shobana, S. Vijayanathi, G. (2016). Production of Plastic Paver Block from the Solid Waste. *ARPN Journal of Engineering and Applied Science*. 11(2).
14. Ganesh Tapkire. Satish Parihar. Pramod Patil. Hemra, R. Kumavat. (2014). Recycled Plastic used in Concrete Paver Block. *International Journal of Research in Engineering and Technology*, 3(09).