

SARVESH ENGINEERING

PRESENTATION ON
POST CONSUMER PLASTIC RECYCLED
SHEET/BOARD.

To
ROHAN BUILDERS AND DEVELOPERS
PVT. LTD.
PUNE.



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At Sarvesh Engineering we

Aim at

1. Helping business to use scarce resources effectively and efficiently,
2. Minimize waste,
3. To use more recycled materials, recycle more and often,

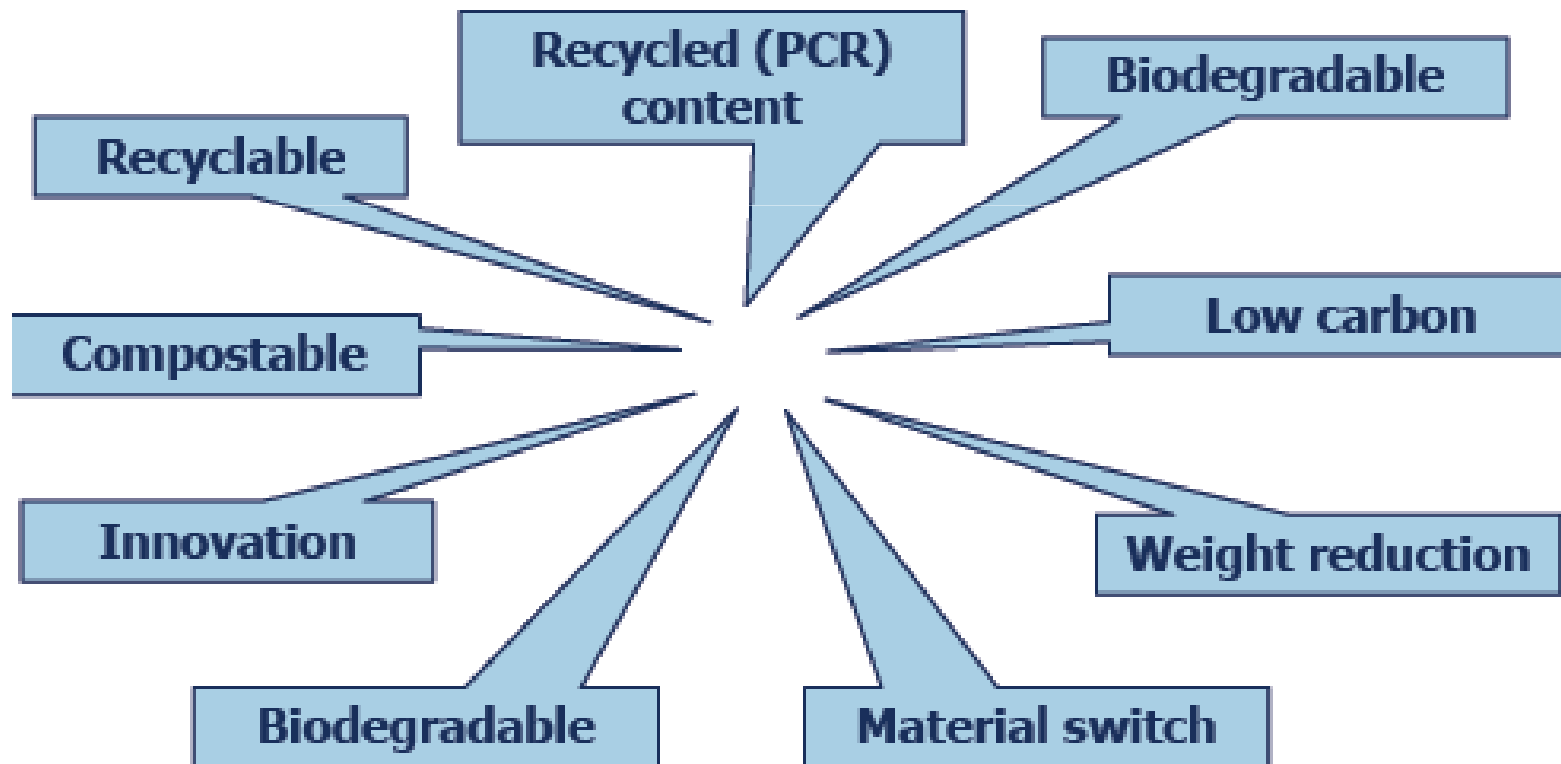
Our role -

“To minimise the production of waste by consumers and maximise the recycling of materials.”

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Expectation from plastic packaging

Challenging time for plastic packaging



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Is this way of disposal acceptable to society?



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What will happen when the land fill sites are full?

Day by day consumption of PET is increasing, and as such the post consumer bottles.

Can our bottlers take the responsibility of re-cycling individually OR collectively, Or promote/sponsor the recycling projects?

Why do we wait till government make the rules and impose?

The photograph here shows the post consumer PET bottles bailed for further disposal.



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WHAT IS RECYCLING?

Recycling refers to the process of collecting used materials which is usually considered as 'waste' and reprocessing them. In this process these used materials are sorted and processed to be used as 'raw materials' for the production of new products.

Recycling varies from 're-use' in the sense that re-use just means using old products repeatedly, where as recycling means using the core elements of an old product as raw material to manufacture new goods.

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Process of Recycling

The recycling process involves three stages.

In the first stage the old products are collected and processed, where they are sorted, cleaned and made ready for recycling or manufacturing new products.

The second stage involves the manufacturing of new products from the raw material obtained by the processing of the old products.

Finally, the process ends with the purchasing of recycled goods by the consumers.

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Why is Recycling Important ?

- **Recycling Saves Energy**
 - **Recycling Saves Environmental Conditions and Reduces Pollution**
 - **Recycling Saves Natural Resources**
 - **Economic Benefits**
 - **Recycling process creates employment opportunities**
 - **Recycling Saves Space for Waste Disposal .**
- RECYCLING IS NECESSECITY OF THE TIME.**

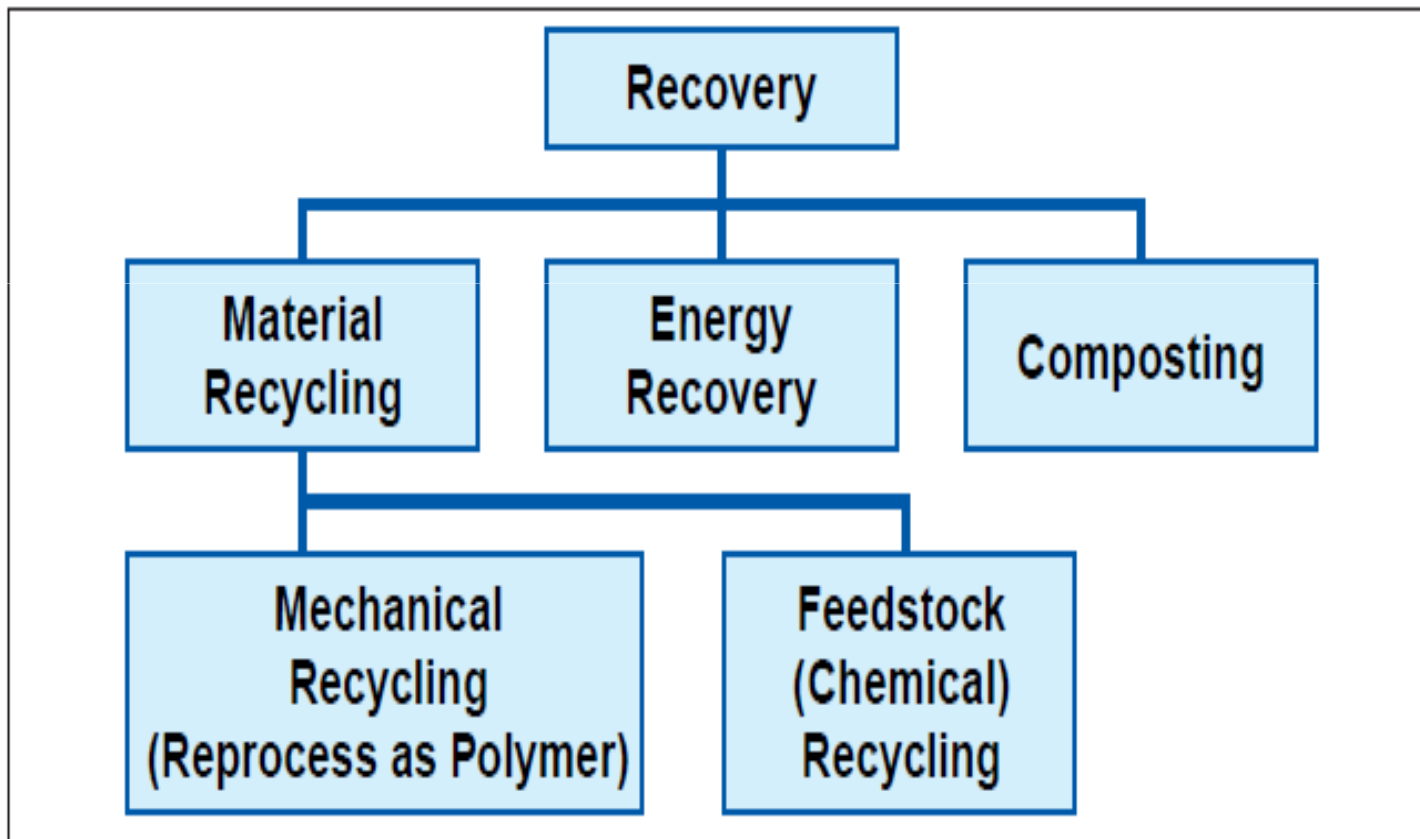
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Important issue is -----

The reduction of packaging materials and the recycling of them is currently on the top priorities for the everyone involved like Government, large Supermarkets, Food processors, etc. and end user—all of us.

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A TYPICAL RECYCLE MATRIX



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Recycling technology for Plastics like Poly ethylene, Polypropylene, PVC, PET, and other engineering plastics is a most mature and common case among all polymers.

Recycled Plastics can be used again to produce plastic products, e.g. bottles, containers, bags, sheets, films etc. for various packaging applications.

This recycling chain not only reduces the pollution to environment but also reduces production cost.

The recycled materials can be used solely or blended with the virgin materials as per choice and end use.

Recycled materials granulated on the under water granulator with die face cutter, having uniform bulk density like virgin materials, can be used with automated loading systems.

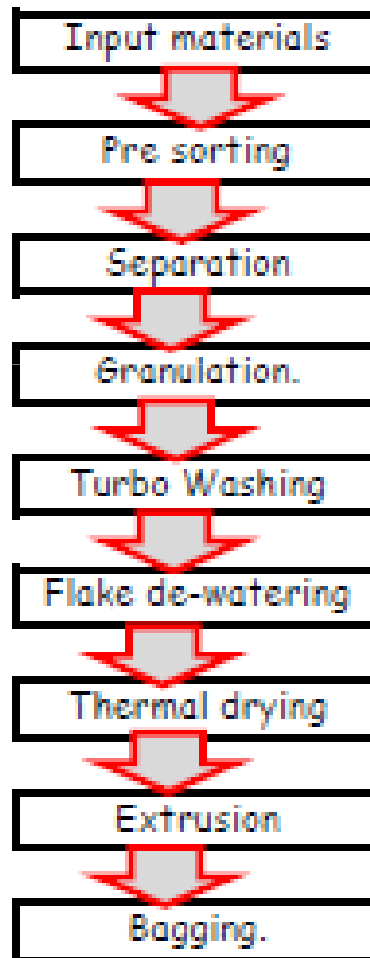
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Most of the plastics in India is reused prior disposal. Waste disposal systems and segregation systems for waste are not in place, as such most of the plastics is going in a municipal waste system.

Post consumer plastics are adhered with lot of dust and dirt, contaminated with syrup, gum, label etc., and needs proper cleaning prior its reuse.

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Flow diagram for post consumer plastic recycling system.



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FULLY AUTOMATED WASHING LINE FOR RECYCLING POST CONSUMER PE/PP/PVC MATERIALS CONSIST OF FOLLOWING EQUIPMENTS.

- Material feeding
- Separation of loose contaminated material
- Metal separation
- Manual or automatic colour and PVC sorting
- Pre-cutting
- Friction-Intensive-washing-unit
- Separation of dissolved contaminated material
- Rinsing basin
- Mechanical drying unit
- Hot air drying
- Bagging

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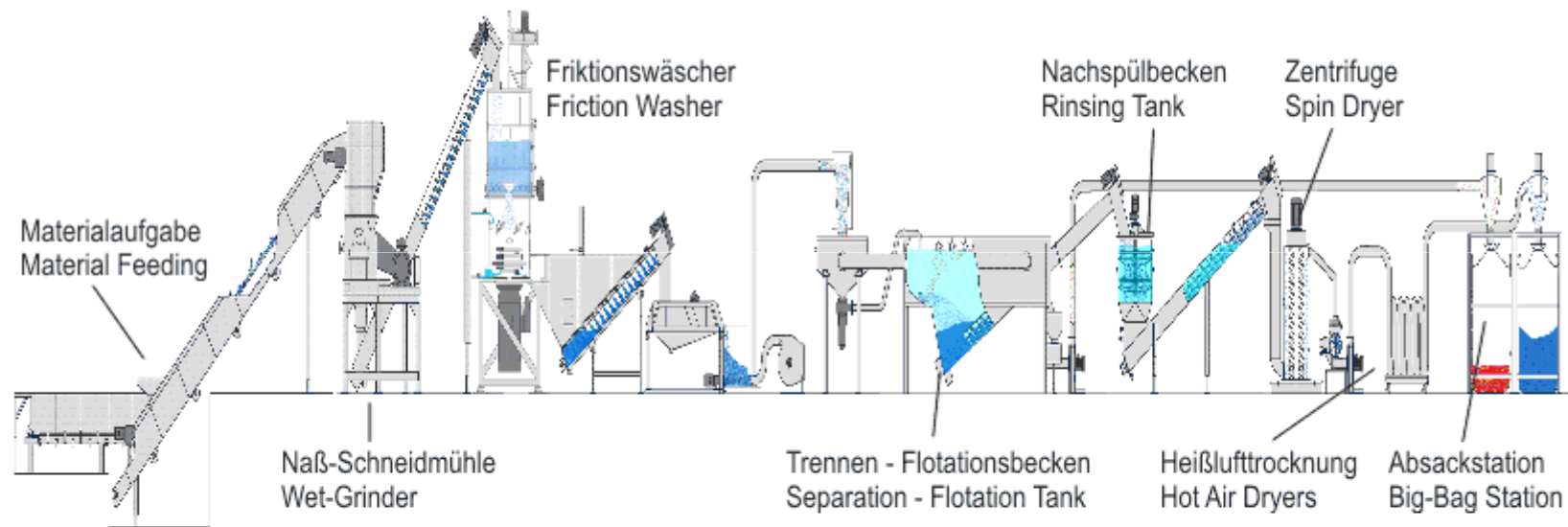
Typical washing line for PE/PP materials.

For effective and efficient washing of highly contaminated materials chemical dosing is a standard facility in the turbo friction washer. Chemical dosing pump can be used as & when required.



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Schematic - typical automated washing line.



SIKOPLAST Waschanlage - Washing Plant

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CURRENT PRACTICES FOR RECYCLING IN INDIA.

As we all know, recycling is a non organized business in India.

Majority of the recyclers are working in a crude way. Post consumer plastics collected are sorted out and then grinded, and grinded flex is washed manually, in some cases with locally fabricated washing tanks using caustic soda OR other detergents.

Since the washing is either manual or with stirrer type washer, the dirt, Oils, Glue and contamination adhered to Plastics is not cleaned effectively.

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Washed plastics then dried in open spaces under sun, where again it may attract contamination.

Washed flex are packed in the re-used bags (mostly).

The granulation is done mostly by third party, with coarse filters, to get the maximum throughput. This allows the recycled granules with dust, dirt, and foreign bodies, which ultimately lowers the quality of granules, and limit the end use.

Such plants also have limitation on the volumes as well, and they can not be partners for reliable supply of high volume & quality recycled materials.

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Recycled plastics are widely used in domestic & house hold market, Industrial sector, Automobile sector, etc. locally as well in the overseas market.

Recycled materials can be used solely or mixed with the virgin materials to make new item.

Items made with recycled materials have the similar appearance and other properties.

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Exploring a new field for Indian market.

Recycled plastic use for construction sheets, mainly for the purpose of shuttering during RCC process.

Recycled plastics has been use for many other application in construction industry, in overseas market.

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Some other applications in the construction industry are like Indoor application, flooring, outdoor decking, Fencing, Frames, columns, temporary construction, furniture, garden railings, stairs etc.

A reusable construction board made from recycled plastics is available off the shelf in most countries like USA, UK, Australia, Newzealand, China etc.

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PHOTOGRAPH OF PC PLASTIC WASTE.

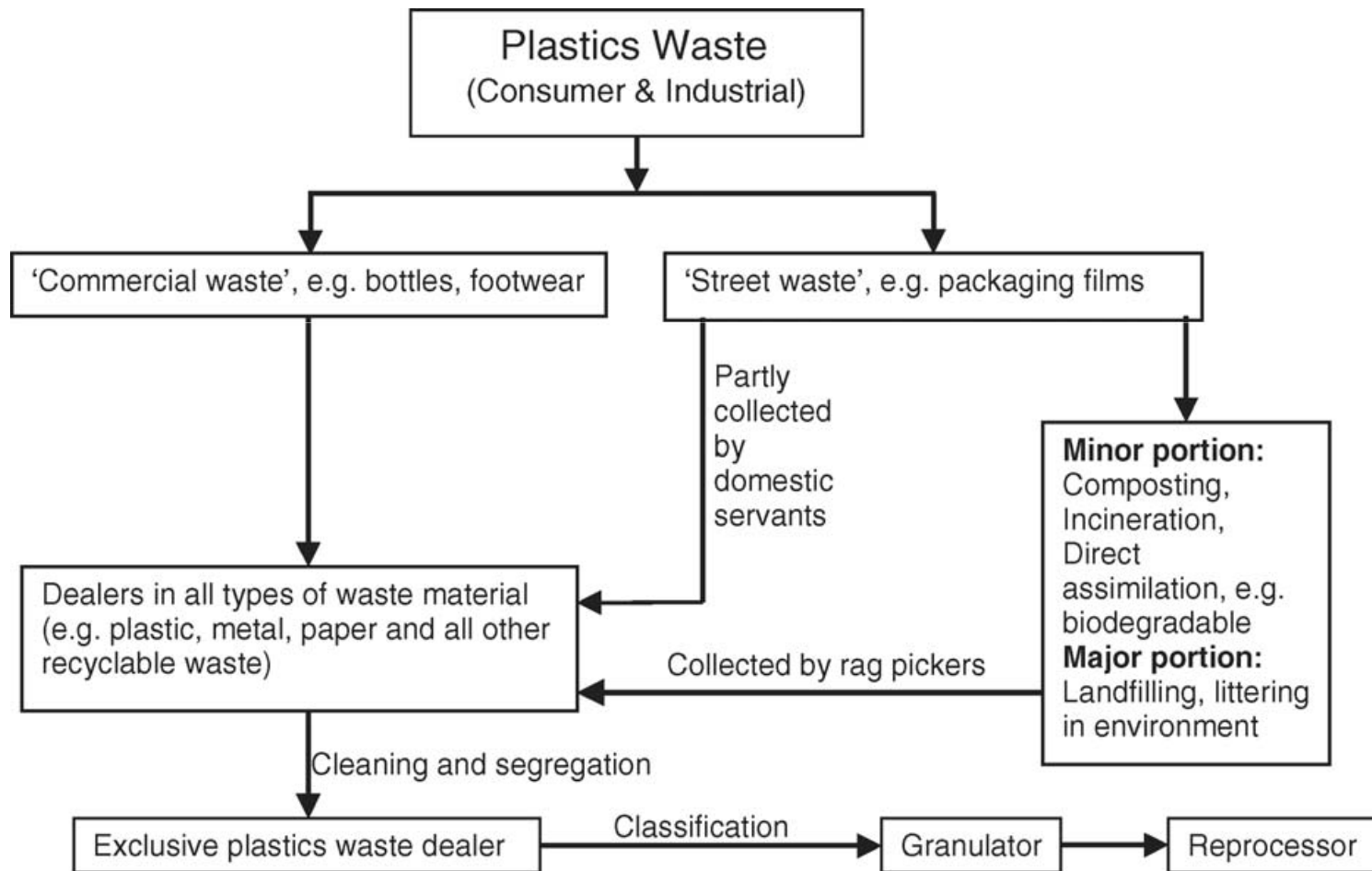


TYPICAL COMPOSITION OF PC WASTE OBSERVED.

Polymer Type		Generic Composition (%)
Flexible	PE	25%
	PP	5%
Rigid	PP	17.2%
	PE	13.5%
	PET	15.3%
	PVC	3.5%
	PS	4%
Contamination		16.5%
Total		100%

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Flow chart for post consumer Plastic waste.



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The language of Plastic Recycling:

Common Plastic Scrap Terms

- **Rigid Plastic Container:** *A package (formed or moulded container) which maintains its shape when empty and unsupported.*
- **Plastic Bottle:** *A rigid container which is designed with a neck that is smaller than the body. Normally used to hold liquids and emptied by pouring.*
- **Plastic Film:** *A thin flexible sheet which does not hold a particular shape when unsupported.*
- **Recycled Plastic:** *Plastics composed of either post-consumer or recovered material or both.*
- **Recovered Plastic:** *Plastic materials which have been recovered or diverted from the solid waste stream. Does not include materials generated from and commonly reused within an original manufacturing process.*
- **Post-Consumer:** *Products generated by a business or consumer that have served their intended end use and have been separated or diverted from the solid waste stream for the purpose of recycling.*
- **Natural:** *Plastics that have no colour and are clear or slightly opaque such as milk jugs, and the typical clear uncoloured water bottles. Natural is different from White.*
- **Pigmented/Dyed:** *Plastics that may be clear or opaque and are coloured white, black or any other colour. A clear water bottle that is green is considered pigmented. Additionally, white plastics are considered pigmented*

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Demand of plywood board in construction use

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Option to Plywood in construction use.

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Plywood demand in construction industry was 22.1 Million m^3 and expected to be 26.1 m^3 by the year 2015.

In India, wood based panel consumption for the year 2010, was estimated at over 2000,000 m^3 .

The recycled plastic content of PIM board is about 80%, consisting of a un-segregated mixed plastic waste which can also include problematic waste such as Electrical and Electronic equipment, which is normally difficult to reuse or recycle.

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Recycled Plastic board is one of the important option to Plywood.

Recycled plastic board or sheets can be made by three different processes.

- A) Extrusion process.
- B) Molding process.
- C) Powder Impression molding process.

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There are two main processes for manufacturing the recycled plastic board/sheets intended for construction industry.

A) Extrusion process -

In this process molten polymer is extruded in to continuous sheets, to the desired thickness and then cut to the required lengths. Extrusion process use only one polymer for one layer. No. of layers in the sheet may vary as per requirement. Extrusion process can be used for composite fillers like calcium carbonate, wood dust, rice husk, fly ash, etc.

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Up to 70% of the composite materials can be added to get the finished sheets.

Depending upon the end use and requirements different additives are added to enhance the properties.

Sheets with additives can be antistatic, fire retardant, with very high strength, and very good esthetic finish.

Extrusion process is most established and proven process. Extrusion equipments are manufactured in India, Taiwan, China, Korea, and European countries.

Recycled extruders have totally different requirement than the virgin extruder, as the recycled materials may have some contamination, dust and dirt etc. The materials for screw and barrel needs to be of very high quality and abrasion resistant to ensure the longer life.

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Recycled plastic extruders also requires a very good filtration system and gas venting arrangement. Most of the high throughput extruders are equipped with hydraulic screen changer. Fine filtration gives good finish and texture on the sheet, however the frequent screen changes are required. Vented extruders allow the escape of gases generated, resulting better quality of the finished products.

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B) Powder-impression molding -

As indicated by name, mixed recycled materials in powder form is spread over and covered with polymer skin, sintered and heated to form the sheet of desirable shape or form of impression. PIM is mainly used for making various different shapes, which are difficult to make with extrusion or molding.

During the process air is blown through the sandwich to create a spongy looking core. Foaming agents are used to acquire the better results and the desired properties. Once the materials has cooled and hardened, it acquires mechanical strength from its composite structure.

In PIM process all types of mixed plastics can be used for making sheets/boards.

PIM has found excellent use in construction industry, automobile industry and furniture use.

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PIM enables up to seven waste polymers to be processed in to one, and can incorporate organic materials that are attached to the plastics, such as wood or food waste.

The sheets has much longer life compared to Plywood, can also be re-molded at the end of life time.

This process accept up to 15% organic waste.

In the process Styrene or Polyolefin based plastics are used as the binder.

A cell foam core is applied to the centre of the sheet being molded using chemical blowing agents, which release nitrogen gas, once the mould reach certain temperature, generating the formed structure of board. Solid laminates can be added to out side if required.

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PIM process is developed and licensed in Europe in 2007.

The equipment for this process is available only from Europe.

The carbon footprint of the board is similar to that of the plywood when transportation, reuse and disposal is taken into account.

The recycled plastic content of PIM board is about 80%, consisting of a un-segregated mixed plastic waste which can also include problematic waste such as Electrical and Electronic equipment, which is normally difficult to reuse or recycle.

Since the powder materials are sandwiched between the two sheets, any odd shape which can be imagined and drawn and machined, can be made with process. The formed mould holding the skinned materials is heated at about 280⁰ Centigrade to form the shaped article. Recycled plastics with the pressure and heat mingled with each other to form a strong bond. The form shape needs to cooled prior removal.

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Although the equipment for PIM is currently not available in India/china, the equipment can be developed in India/China, subjected to availability of funding and the co-partner for developing the equipment.

The technical knowhow and technology transfer facility shall be done arranged by us.

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Five layer sheet.

Five layer sheet with two layer skins, two layers reinforced materials and one layer recycled foamed materials can also be used in construction industry.

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Proposed Five layer sheet

Five layer sheet as planned will have a combination of -

Layer one - Polymer skin,

Layer two - Glass fiber cloth for strengthening,

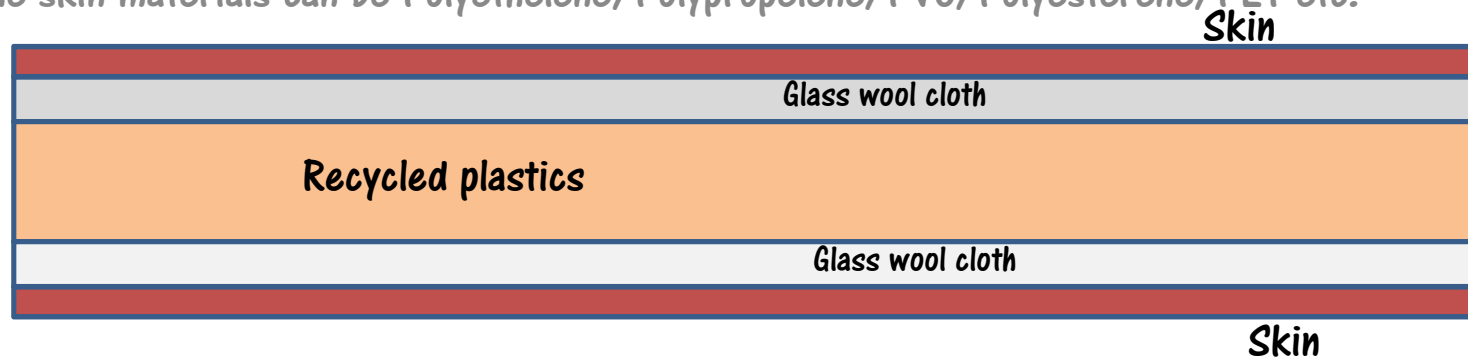
Layer three - Recycled mixed plastics,

Layer four - Glass fiber cloth,

Layer five - Polymer skin.

Board thickness about 14 mm, higher thickness may have some limitations.

The skin materials can be Polyethelene/Polypropelene/PVC/Polyesterene/PET etc.



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Requirement for manufacturing five layer board.

Five layer board with recycled plastic of *only one type*, can be made with a multi layer extrusion process.

For the production of this board, three single screw extruders with three set of dies, and two sets of glass fiber cloth feeding devices will be required.

Recycled plastic has to be of only one type, as the different materials will have different melting temperatures, and they may not melt and extrude effectively. Simultaneously some PE grades and PP if mixed together the materials becomes very brittle and break like paper.

PET having very high melting temperature like 285° centigrade and above, if other materials are mixed with, they will burn at this high temperature.

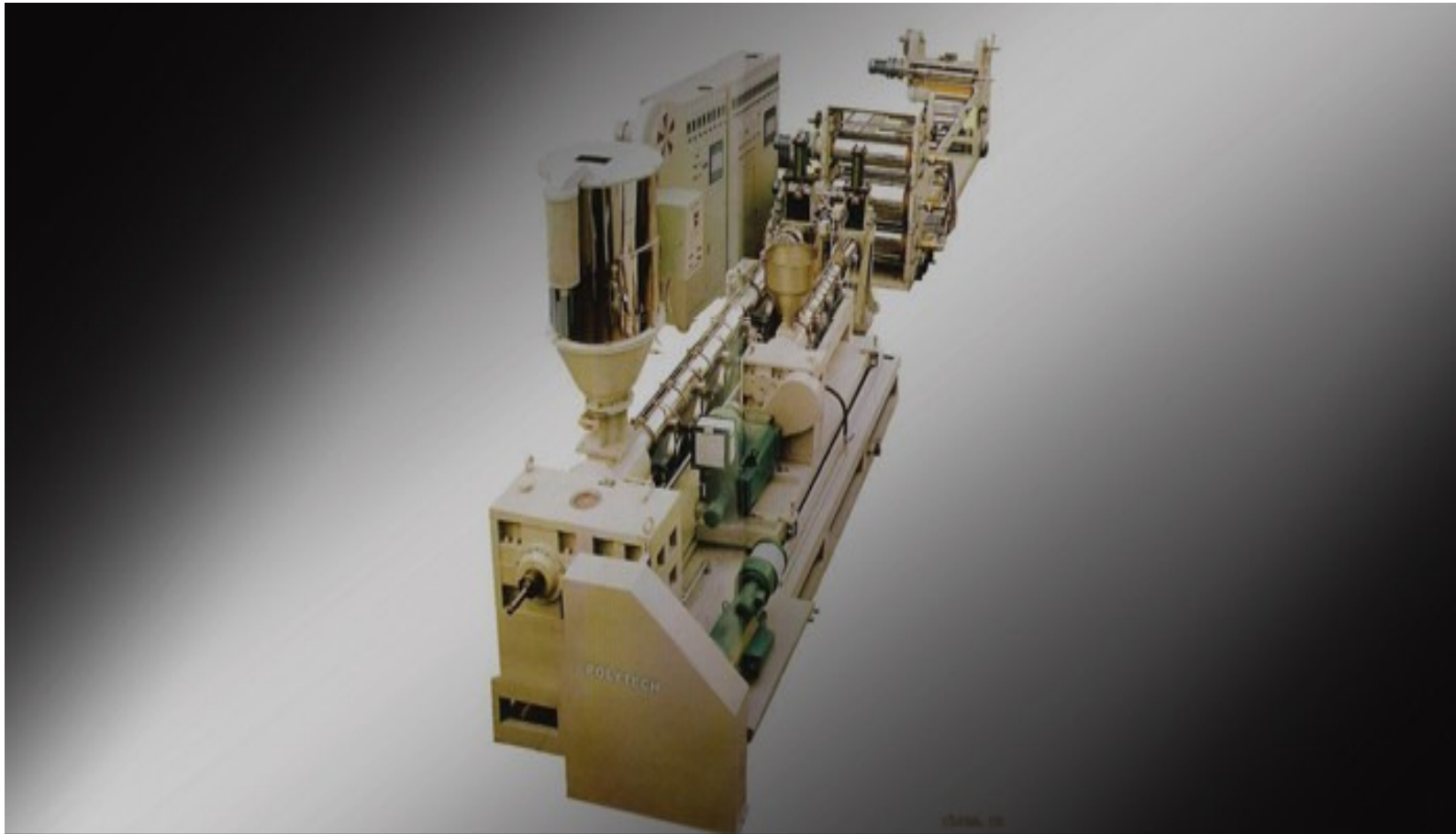
This means the post consumer materials need to be separated prior recycling, prior reducing in the size.

In municipal waste, materials from all streams are there and its segregation is big task. Also the disposal of the unwanted materials is additional problem. The best solution in such case would be to procure the segregated materials from the vendor, which may cost little more.

In the system the extruded board will be up to 1200 mm width, and continuous length, which needs to be cut and cooled to the required length. Thickness between 8 mm to 14 mm should be possible on this process.

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Photograph of multi layer extruder



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INFRA STRUCTURE, ANCILLARY &
CONSUMABLE REQUIREMENTS.

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Typical plant to process 1 ton capacity per hr shall require a land approximately 2 acre, building of about 20,000 sq. feet, water treatment unit, Boiler, Compressor etc.

Water requirement is about 8000 liter per hr, at about 2 bar pressure, water can be recycled and re-used. Water needs replacement once a week or earlier depending on the contamination.

Compressed air at 8 bar pressure is required, air volume depends upon the process layout, process equipment and the automation level.

Electrical power with three phase supply rated at about 1000 KW is recommended.

Man power required for the automated plant is 12 per shift, skilled 2, semiskilled 4, labors 6. Since the recycled materials is directly processed, man power for recycled materials movement is not considered. Materials in put is considered in bailed form, with automated loading arrangement.

Project sourced from China may cost in total about Rs. 2.5 crore, (Sheet extruder 1.25 crore, washing line 0.75 crore, ancillary equipment and material handling equipment 0.5 crore)

Typical plant set up time can be about 4 to 6 months.

Typical yield is about 80% , which depends largely on the contamination of input materials.

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Typical project from Europe, to process 1 ton/hr may cost about five times of Chinese equipment.

Washing line with 1 ton rating from Europe may cost about Euro 700,000/- while the Extruder or WPC extruder may cost over Euro 1,000,000.

European equipment is well proven, reliable, highly energy efficient, and gives extremely good after sales service. Life of the equipment is very high in the range of 25 years and above (with routine maintenance).

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Equipment sourced from China will have a very low life, requires very high maintenance, not reliable, and difficult to get the after sales service.

It is recommended to -

1) Get the maximum spares and consumables along with the machines.

2) To change the electrical and electronics at additional cost to branded one like Simense, Telemecanique, etc. The advantage, spares can be sourced locally in future.

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New Option - Wood Plastic Composite

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WOOD PLASTIC COMPOSITE

As name indicates WPC is a combination of wood and Plastics extruded together or molded together in different forms.

WPC is relatively new materials specially for Indian markets, where as widely used in other parts of world.

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Wood Plastic composite is weather proof, rigid, can be machined and screwed, for fabrication purpose, and recycled at least 5 times. WPC use up to 70% of composite materials and 30% of plastics.

WPC can be used for heat, and sound insulation purpose. It does not content any formeldihyde, benzene and other harmful substances.

WPC is non radioactive materials.

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Process to make WPC

All the recycled plastic material is first processed into pellets which are further processed into WPC products of various forms, mixtures and sizes.

Special coupling agents and additives are used in the manufacturing process to bind the raw material.

The ideal size of saw dust to be used as raw material should be 40-80 mesh. These agents and additives are added in varying quantities, so that the WPC compound / product being made can be customised according to the weather which it will face and the durability desired in there.

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Raw Material & Uses (current and future)

WPC is made of

Wood Flour, Wood Chips, Saw
Dust, Rice Husk, Cotton
Plant Stalk Powder,
Bagasse, Bamboo, Scrap/
Recycled Thermoplastics-
Hdpe, Pp, Pvc

What comes out as WPC?

Outdoor Floor Decking, Railings (In
Staircase), Fences, Park Benches,
Roofing/ Sheds, Portable Cabins,
Pallets, Window & Door Frames,
Indoor Panels, Furniture, Flooring,
Staircase, Highway Construction,
Railway Sleepers, Play Areas,
Portable Toilets, Temp Housing,
Prefab Housing, Playground
Equipment, Site & Leisure
Furniture, Insulation And Finish
Systems, Gardens, Chicken Coops,
Automotive Industry, Building &
Construction

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WPC – main use

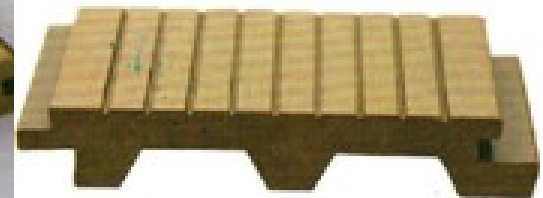
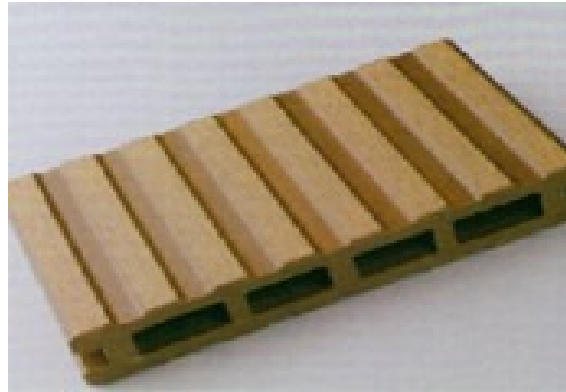
- 1) Interior decoration, furniture, falls sealing, etc.
- 2) Out door use, decking, railing, garden furniture, etc.
- 3) Construction lumber & boards.
- 4) Industrial use, low level heat and sound proofing partitioning, cabin dividers, mezzanine flooring, etc.

WPC advantages –

- 1) Natural materials are used.
- 2) Various colors.
- 3) Anti surge, anti mil-dew, anti decay.
- 4) Heat insulation and sound insulation.
- 5) Anti-aging, fire retardant (with addition of additives).
- 6) Non radio active materials.
- 7) Green materials, as no harmful gases or substances.
- 8) Can be recycled 100% after life.

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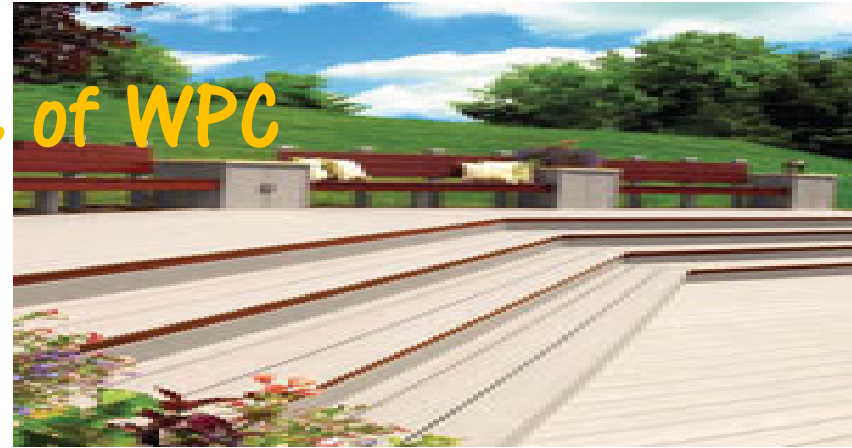
Photograph of WPC decking



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Out door use of WPC



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WPC Market in India

Currently, in India, the market mainly exists for exterior furnishing. Majority of star hotels, restaurants, swimming pools, and fitness clubs use WPC for exterior decking and wall cladding.

The furniture industry is increasingly using WPC for chairs and shelf elements.

So far WPC is not used in the construction industry for shuttering purpose in India, although, it is used extensively overseas. Casting with WPC gives very good finish and does not require further surface treatment like plastering, saving huge labor, materials & cost.

There is huge scope for WPC in coastal areas, where exterior items degrade easily due to extreme climate. WPC is touted as a good option as it is highly durable and requires least maintenance.

WPC is quite popular in the Middle -East and Australian markets.

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With more than 2 million tons of plastic being processed every year in India, and India's forest cover being 21% instead of an ideal 33%.

WPC is the most ideal material that can substitute wood for its durability and that can substitute plastic for its flexibility.

From manufacturer's perspective, it's 100% clean business, with no by-products or pollutions.

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WPC manufacturer's in India.

Currently there is no big player in this business in India. There are few parties importing the materials from China, Australia, and trading.

The market is still unexplored in India, unlike USA, Germany, China, Australia, S.Korea etc.

The big players in industry are trying to tap this business opportunity.

The market for WPC in India is growing every day, and this is the good opportunity to start the business.

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WPC Consumer perspective.

From consumer perspective, the quest of minimal maintenance requirements, excellent weather ability and high resistance to wear and tear in construction application is the reason why WPC is preferred over other materials.

Cost wise WPC cost about 1.5, thermoplastic cost 2 to 2.2, compared to wood.

Life wise WPC is much better and can be used for much longer duration.

Compared with U-PVC (Un-plasticized PVC), MDF, and FJP (finger jointed pine) WPC is aesthetically better, resistant to moisture, and more durable. Also PVC does not give the appeal of wood, and is not recyclable more than once.

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Average Sales Price

Average sales price is about 100 Rs. Per kg, on the whole sale quantities, where as the retailer sales at much higher price, as the sales is in per square foot basis. The price in retail market is having wide gap from region to region possibly due to the logistic cost.

The margin in WPC is typically over 20% and the raw material is easy to find as well cheap.

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WPC as agricultural product.

The raw materials include wood flour/ saw dust/ agricultural waste like rice husk, cotton plant stalk powder, baggasse, bamboo etc. and scrap/ recycled thermoplastics like HDPE, PP, PVC, etc. However rice husk is not recommended to be used in exterior items as it causes drying of the product and degrades faster. On the other hand, if used in excess of 20 per cent in total composition of the product, it is eligible for a waiver on excise duty as it's an agricultural product.

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IMPORTANT CHARACTERISTICS OF WPC.

WPC is bendable, water-resistant (nearly water proof), fire-resistant, formaldehyde-free (no off-gassing), insect-resistant and food safe, just to name a few of its redeeming characteristics.

[Washington State University](#)'s Composite Materials & Engineering Center found:

- Unusually high internal bond, allowing WPC to hold fasteners at 3X the strength of plywood and 4X OSB
- Very low edge swell when immersed in water; 1/8th of water absorption compared to OSB & plywood
- Extremely small coefficient of thermal expansion compared to HDPE panel (1/64th" on 8' length when temperatures rise from 70 to 120 F)

Test results have estimated that recycled plastic will last over 400 years with only minimal degradation.

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WPC USE AS FURNITURE.



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Precaution required prior starting business
In India, consistent quality & quantity supply of raw materials from unorganised sector is a major threat.

Prior starting this business one has to organize a chain of suppliers from the city & neighbouring area to ensure the continuous supply of the materials.

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Sources of post consumer Plastics

Some of the scrap dealers are as listed here below

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- 1) KGN star scrap, Mumbai
- 2) Amco International, Mumbai
- 3) Biyani Polymers, Jalgaon,
- 4) Durga Plastics, New Delhi
- 5) Plastic products, Navi Mumbai

Apart from these traders the biggest scrap trade is done at Dharavi, Mumbai.