

Beat Plastic Pollution

My Experience



**Dr. R. Vasudevan ,
(Padma Shri Awardee)**

**Dean & Prof. Department of Chemistry
Thiagarajar College of Engineering
Madurai-15**

MY GURU



My Faith

"sincerity in the work with the faith in GOD takes you beyond limitations"

- Srimad Bhagavad Gita

My Team



MY COLLEGE



Awards – Padma Shri 2018 Awards – Tech Icon 2015

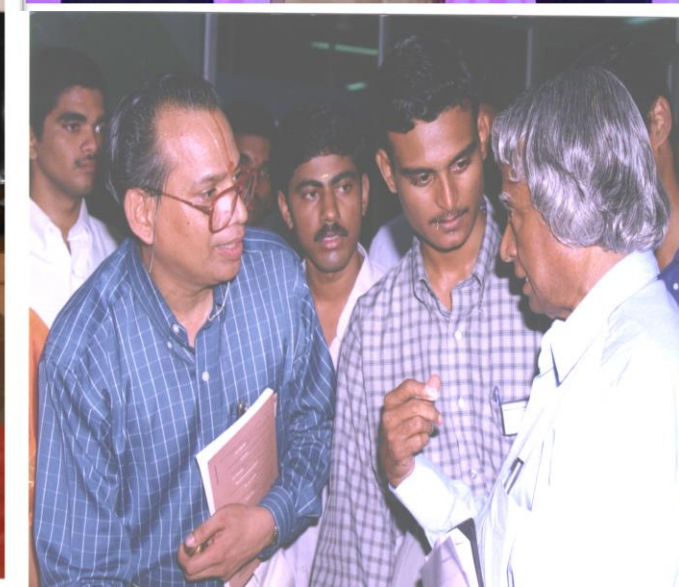


President of India

@rashtrapatibhvn

Follow

#PresidentKovind presents Padma Shri to Prof Rajagopalan Vasudevan. He patented a method to reuse plastic waste to construct roads. He gave the technology to the Government for free and 5,000 km of road has been built across 11 states



Recognition



Five Indian inventions that you have probably never heard of by TOI



Invention : Plastic Roads

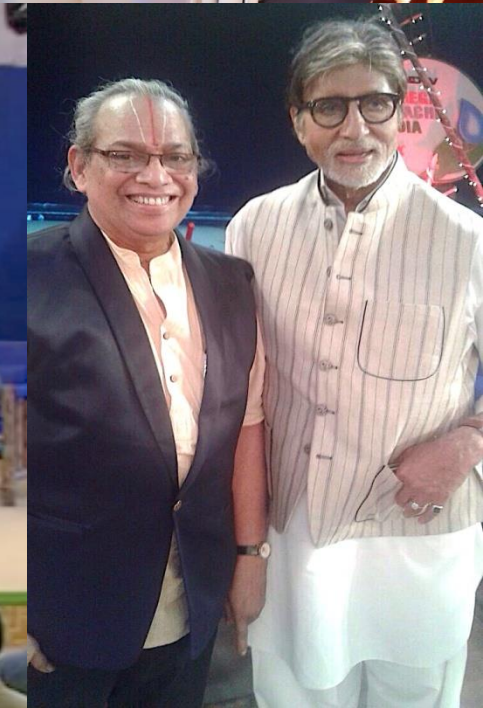
Plastic is usually considered a bane, but a chemistry professor found a way to use old plastic to lay roads that last longer. In 2006, Vasudevan patented a road-laying process that involves sprinkling shredded plastic waste over hot gravel, coating the stones in a thin film of plastic, and then adding the plastic-coated stones to regular molten tar and laying the road.

What's Unique: Lasts longer and brings down road-laying maintenance costs by 50% as plastic does not allow water to permeate into the road.

Source: <http://timesofindia.indiatimes.com/home/sunday-times/Five-Indian-inventions-that-you-have-probably-never-heard-of/articleshow/53357956.cms>



Plastic is toxic to humans and animals and takes thousands of years to decompose. Toxins from the plastics have entered the food chain, threatening human health. Contamination of water bodies like lakes, rivers, oceans and groundwater is a serious threat to the environment. Plastic bag litter has become an environmental nuisance, which if not treated effectively can be quite



Own Your Ownership



Change in Attitude

(Impression of our foot print)

**Let us not say,
Go Green
but
Come Green**



GREENATHON

Fighting for Plastic Pollution Free Life

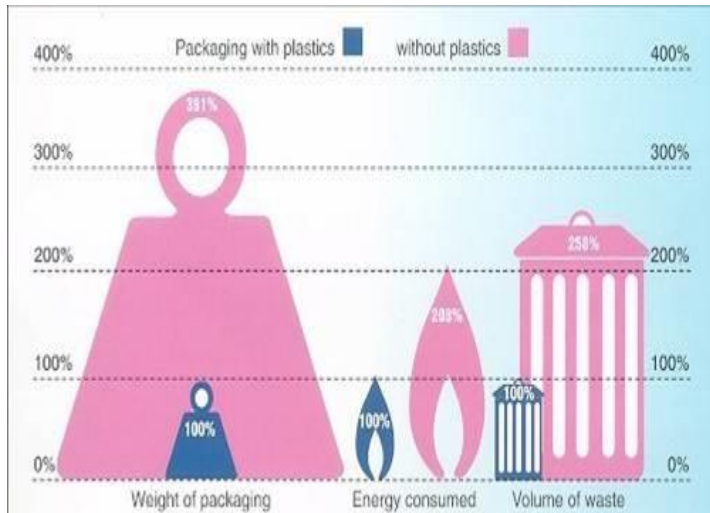
Rain Rain go away come again another day!!!!

Plastic Overview



Advantages

Plastic > Non Plastic



	Non Plastic	Plastic	Ratio
Weight of Packaging	391%	100%	~ 3.9:1
Energy Consumed	200%	100%	~2:1
Volume of Waste	254%	100%	~2.5:1
Durability	Average	Good	-
Reusability	Manure	Sustainable Product like better road and Structural Materials	-

Safe Plastics - Single time use & Characteristics

Most of them soften below 170⁰c except Poly vinyl chloride and Polyethylene terephthalate



Commercial Plastic material	Nature of Plastics	Thickness μ	Softening Point ^{Deg C}
Cup	Poly ethylene	70	100-120
Carry bag	Poly ethylene	10	100-120
Parcel cover	Poly ethylene	50	100-120
Milk Pouch	LDPE	60	100-120
Film	Polyethylene	50	120-130
Foam	Polyethylene	NA	100-110
Chocolate covers	Polyester + Poly ethylene + metalized polyester	20	155
Supari cover	Polyester + Poly ethylene	60	120-135
Biscuit covers	Polyester + Poly ethylene	40	170
Water bottle	PET	210	170-180
Cool drinks bottle	PET	210	170-180
Decoration papers	BOPP	100	110
Foam	Polystyrene	NA	110

Plastic Ban - Is it a Solution ?



Plastics

Most Useful

Poor Man`s
Friend

What is Lacking?



Garbage
Culture
& Collection

Waste Plastics

Resource

Useful as
Construction
Material
(Road, Etc.,)

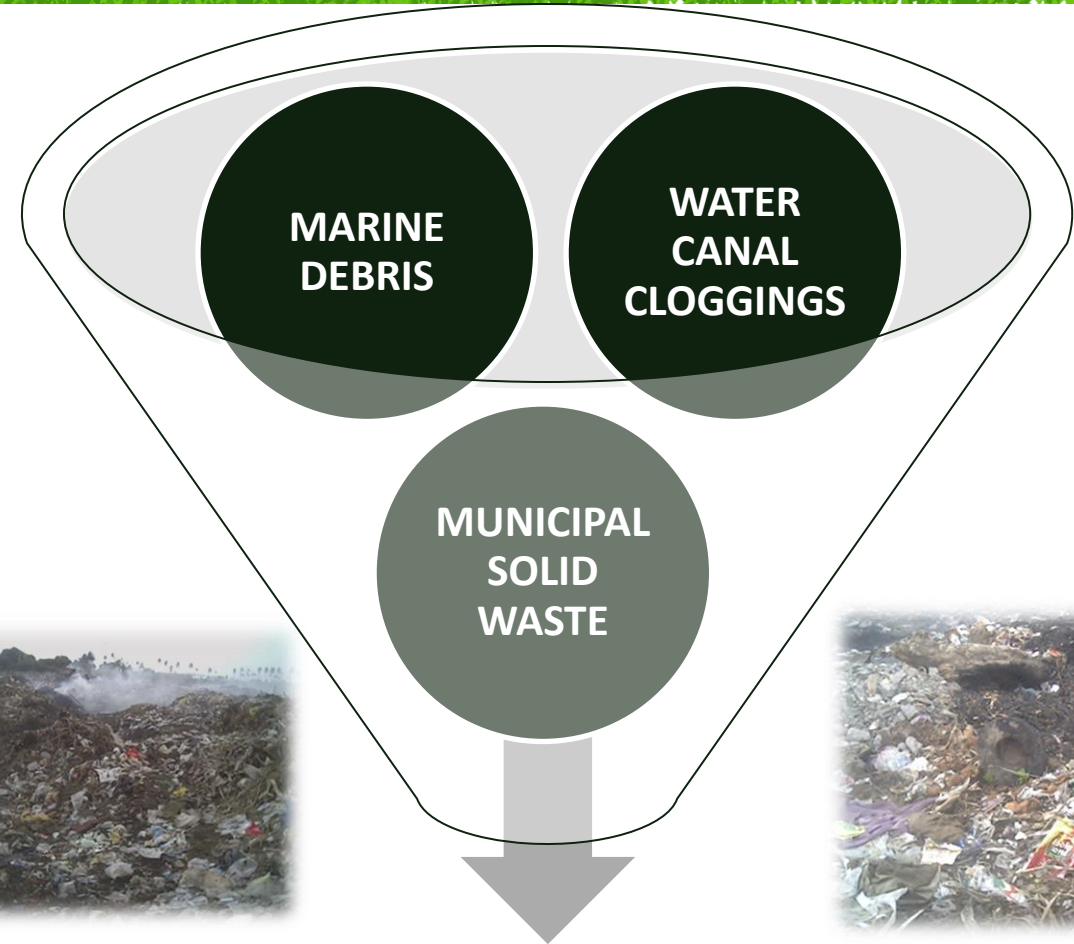
SOCIETY/ DOMESTIC - PRIME CONTRIBUTOR WITHOUT ANY WORRIES



WHAT WE DO



**BAD GARBAGE
CULTURE /
PRACTISE**



WHAT WE HAVE TO DO



1. Land Filling – Postponement of Problem
2. Incineration – Toxic Gas / Global Warming & Health Hazard (CO₂ & Dioxin)

PRESENT DAY MAN – CARED LESS AND CARE LESS



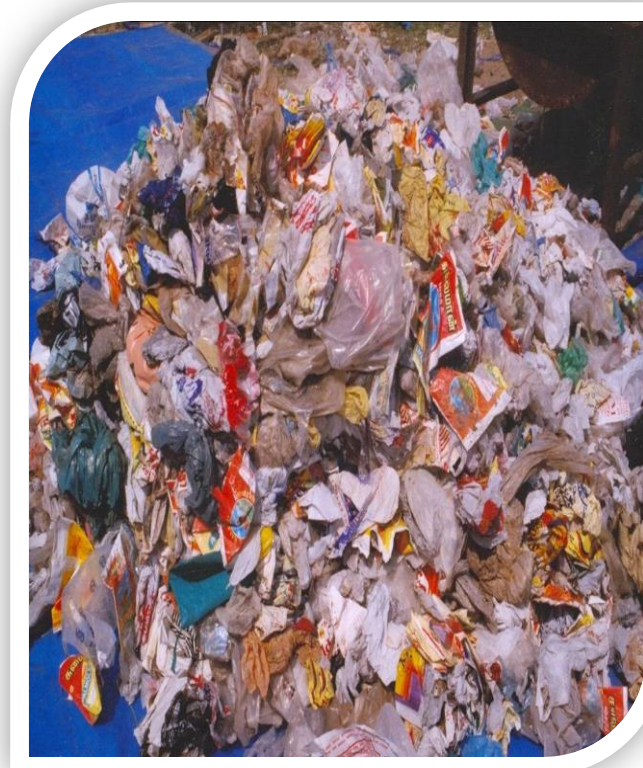
INDUSTRIAL PHILOSOPHY

Produce	Market It	Forget
Tooth Paste	“	
Plastic cover	“	



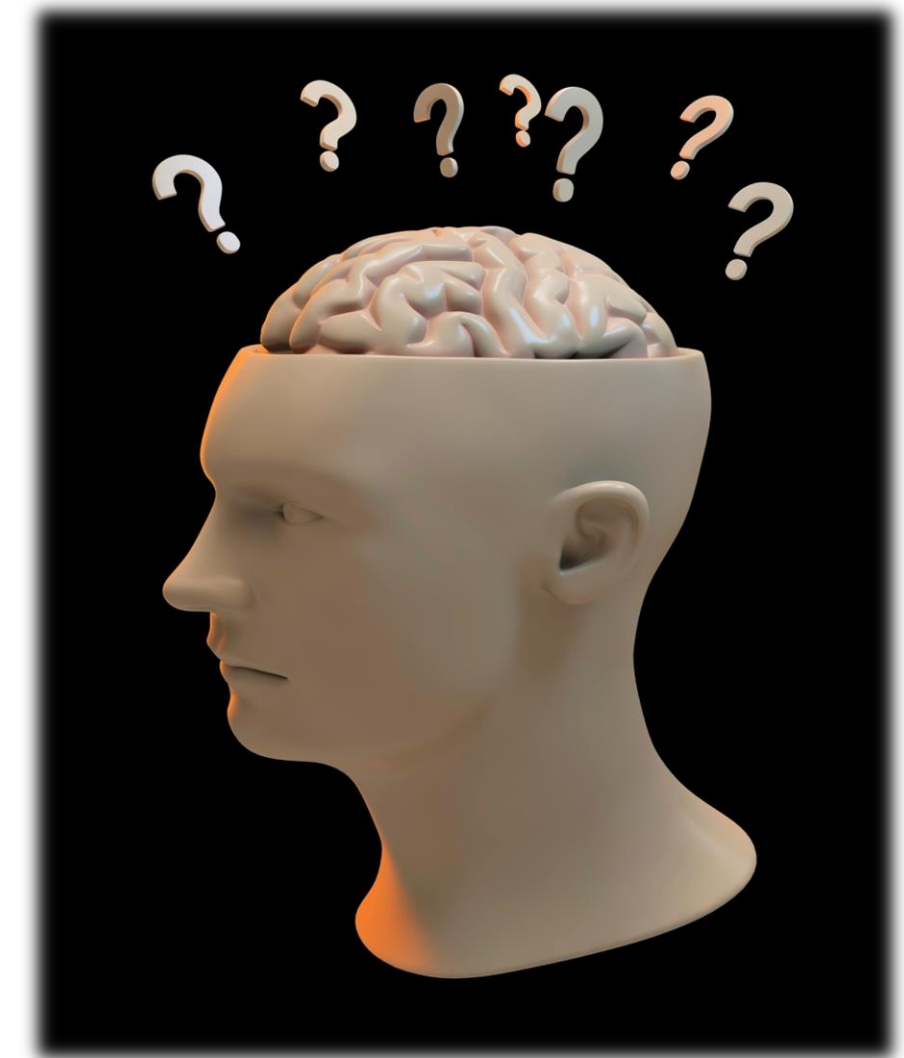
DOMESTIC PHILOSOPHY

Consume	Use and throw	Forget
Tooth Paste		
Plastic cover		



GOVERNMENT PHILOSOPHY

Improper Collection	Dumping	Forget
Tooth Paste		
Plastic Cover		



APPROPRIATE RESEARCH

AS I SEE IT



TODAYS MANTRA

R – REUSE

R – REDUCE

R – RECYCLE

RE THINK

Inn(d)ovation

Appropriate
Research

Own your
ownership

PLASTICS

- FILMS
- CUPS AND
- FOAMS
- E- Waste

ROAD
BLOCK
ROOFING
CORROSION PREVENTION
Polymer Modified Bitumen

ORGANIC WASTE

SEEDS Locally Available
WEEDS
ORGANIC WASTE

BIODIESEL
ALGINATE
MANURE

SOLID WASTE

WASTE RUBBER
SLAG, CERAMICS, FLY ASH AND
GYPSUM and Concrete Debris

MODIFIED BITUMEN
CONSTRUCTION MATERIALS

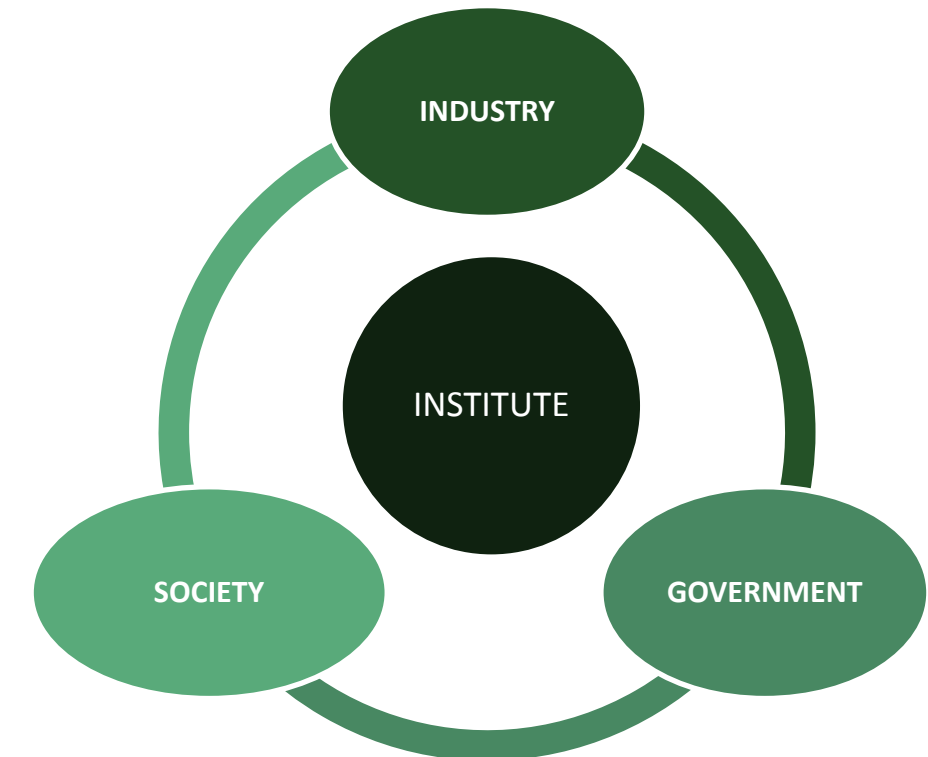
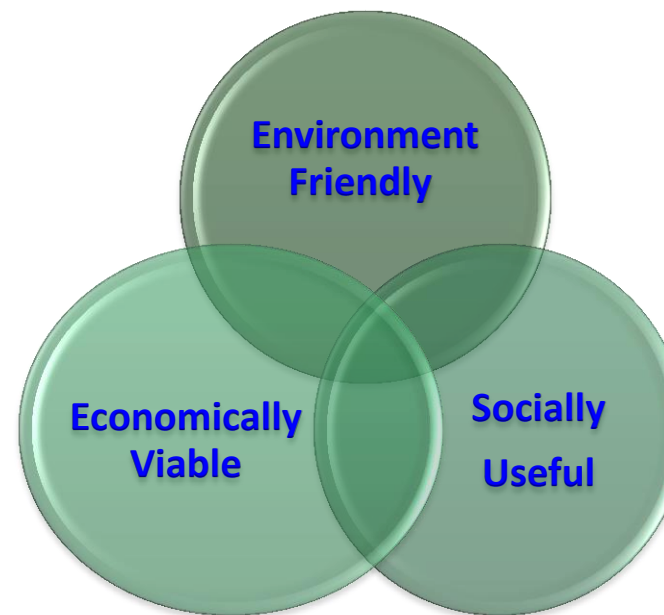
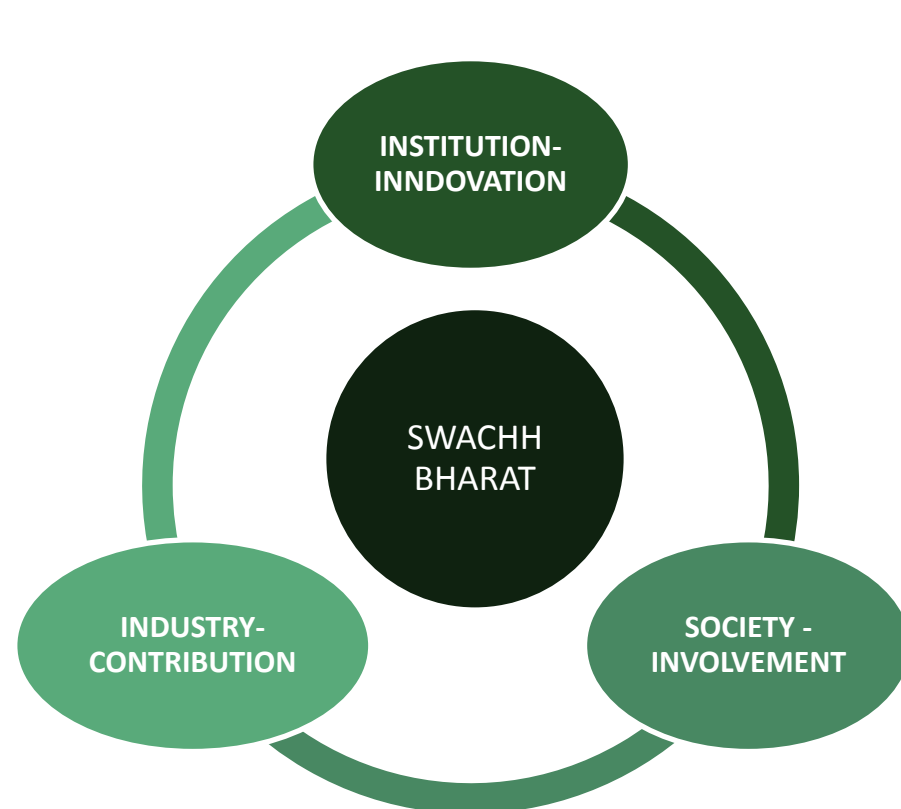
WASTE WATER

DRINKING WATER

SWACHH BHARAT - MANTRAS - IN(N)DOVATION



APPROPRIATE RESEACRH INN(D)OVATION



SWACHH BHARAT - MANTRAS - IN(N)DOVATION

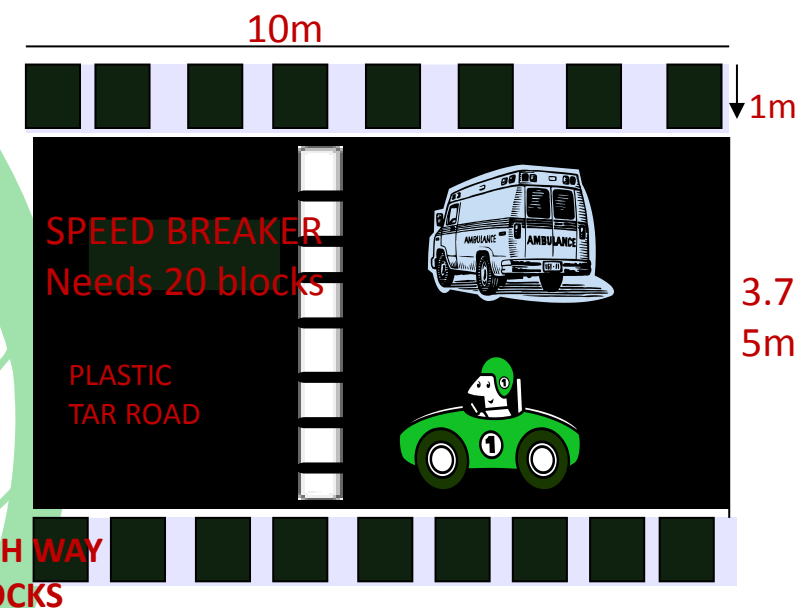


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Reused

Plastic Tar
Road
with
Plastone
Pathway
Block

1 LAKH CARRY BAGS DISSAPPEARS IN 10M2 AREA



Road Area: Bitumen- 100kg, Plastics – 10kg

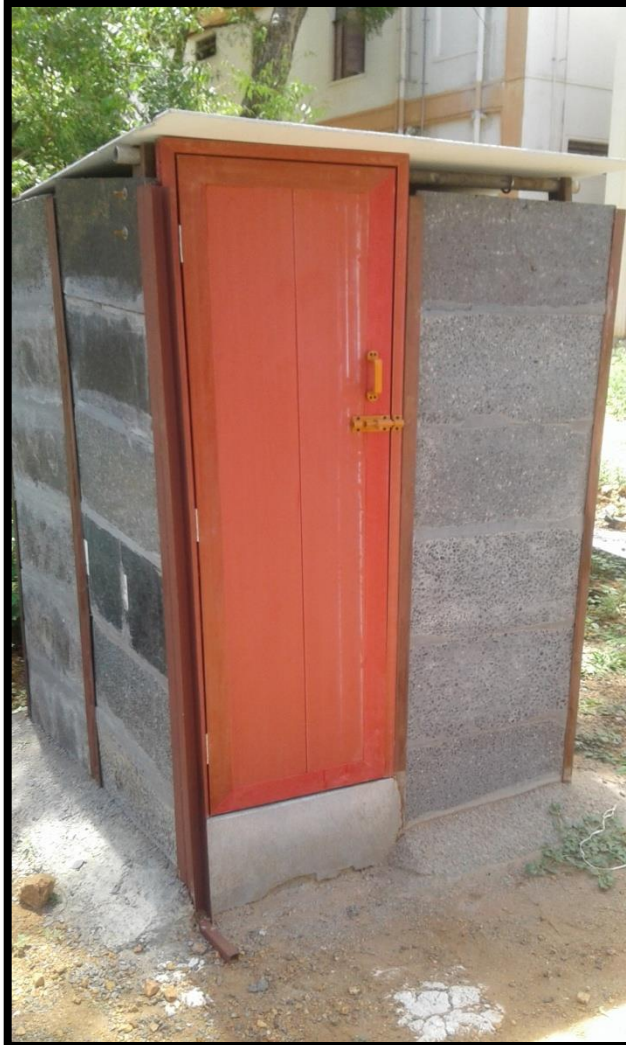
Block: Plastic-88kg

Speed Breaker: Plastics- 6.25kg

SOLUTION TO POLLUTION - Reuse of Waste Plastics



PLASTONE



PLASTIC TAR ROAD



Other Products



Plastic Tar Road - A New Path way










- **Use of Waste Plastics**
- **Better Road**
- **Saving of Bitumen**
- **Cost Less**
- **Solid Waste into Manure**
- **Job for Self Help Group**
- **Less Maintenance**
- **No Pot Holes**

Specialties





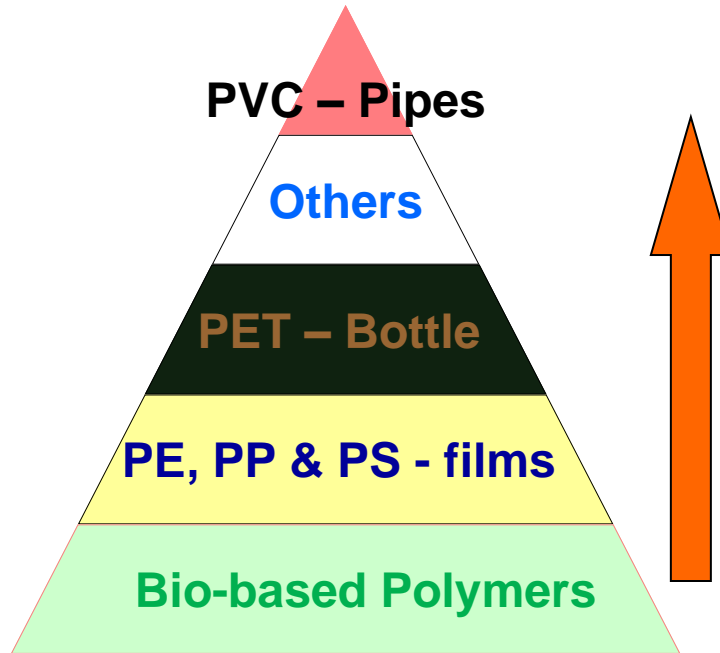
Plastic waste	Chemical nature	Use
	LDPE and HDPE	Carry Bags
	PP	Biscuit Cover and Chocolate Covers
	Polystyrene	Packing Materials
	Poly Styrene and Polypropylene	Cups
	PET	Water Bottles
	Polystyrene Foam	Packing Materials
	PVC	Cables and Wires

THERMAL BEHAVIOUR- BASED ON TGA MEASUREMENTS

Polymer	Softening Temp in Deg.C	Products reported	Decomposition Temp Deg.C	Products reported	Ignition temp. range in Deg. C	Products reported
PE Film	100-120	No gas	289-335	CH ₄ , C ₂ H ₆	>700	CO,CO ₂
PP	140 - 160	No gas	271-329	C ₂ H ₆	>700	CO,CO ₂
PS	110-140	No gas	300-350	C ₆ H ₆	>700	CO,CO ₂
PE Foam	120-125	No gas	309-385	CH ₄	>700	CO,CO ₂
Tea Cup	130-150	No Gas	313-420	C ₂ H ₆	>700	CO,CO ₂

NO TOXIC GAS EVOLVED PVC – not considered

Know Your Plastic used for Road



Toxic Nature -

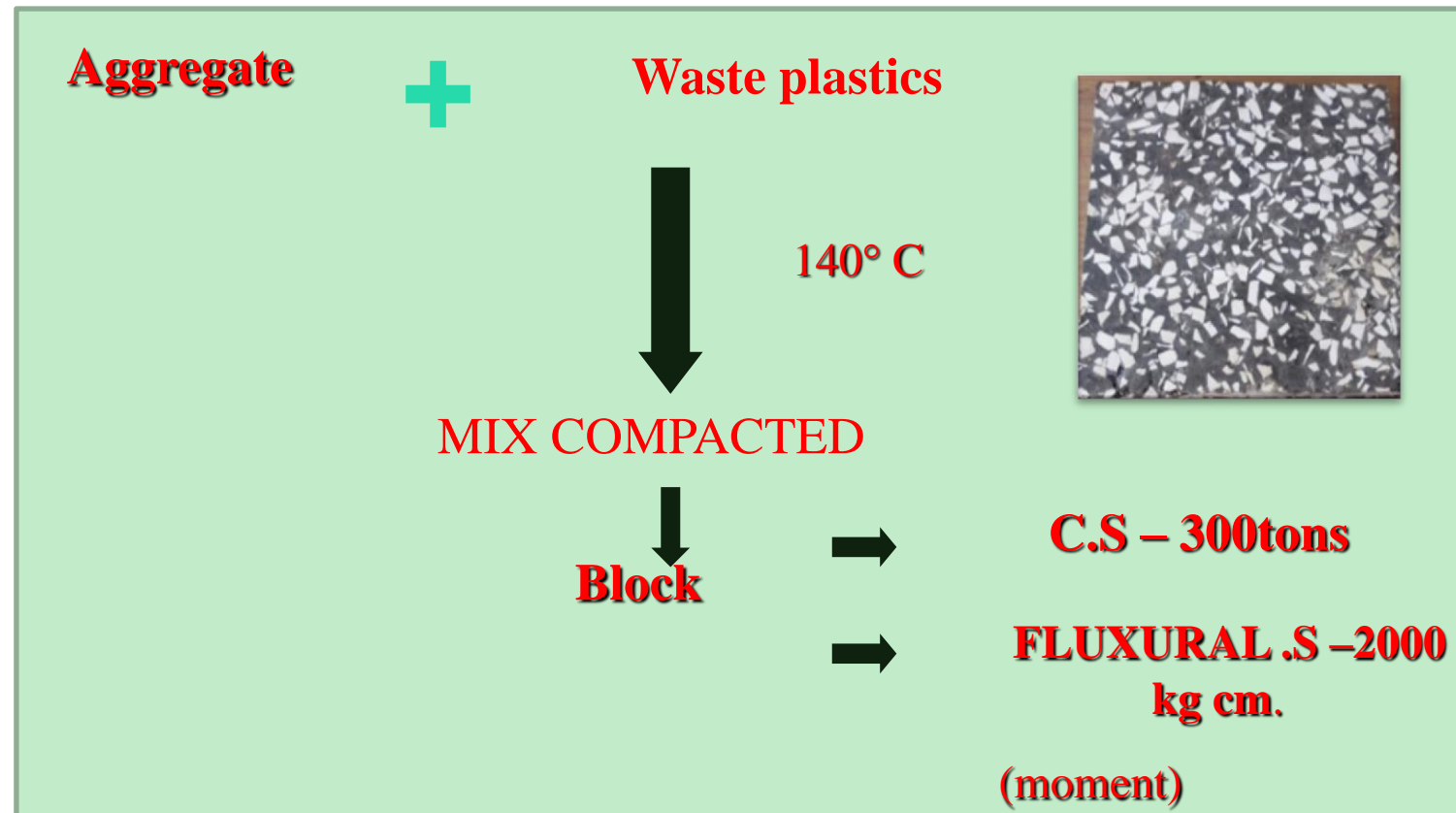
No for PE, PP and PS and Multi Layers

Thermal Stability

(up to 250 ° C)

Decomposition (Beyond 250 o C)

Binding Property – Good



Softening Temperature

(120 ° C to 140 ° C)

POLYMER COATED AGGREGATE & Its Characteristics



PLASTIC COATED AGG



NIL SOUNDNESS

**NIL MOISTURE
ABSORPTION**

ZERO VOIDS

**IMPROVED CRUSHING
VALUE**

**IMPROVED ABRASION
VALUE**

**IMPROVED AGGREGATE
IMPACT VALUE**



Shredding

plastics up to 70 microns are shredded to a size of 2mm to 4mm



Mixing

aggregate transferred to paddling chamber for mixing of waste plastics



Add bitumen

hot bitumen (160°C) is mixed with the plastic coated aggregate



Road laying

the polymer-tar road can then be laid

Cleaning

using a rotating machine to remove dust



Heating

the stone is heated to 170°C in the heating zone of the road laying machine



Add plastics

shredded waste plastics are sprayed over the hot aggregate, where it gets melted and coated over the aggregate



Ready

the mix is now ready for road laying



Waste Plastics Coated Aggregate - Bitumen Mix & Its Stability



AGGREGATES



170 °C

HOT AGGREGATES



**Shredded
Waste
plastics**

POLY.COATED AGGREGATES



**HOT
BITUMEN
160 °C**

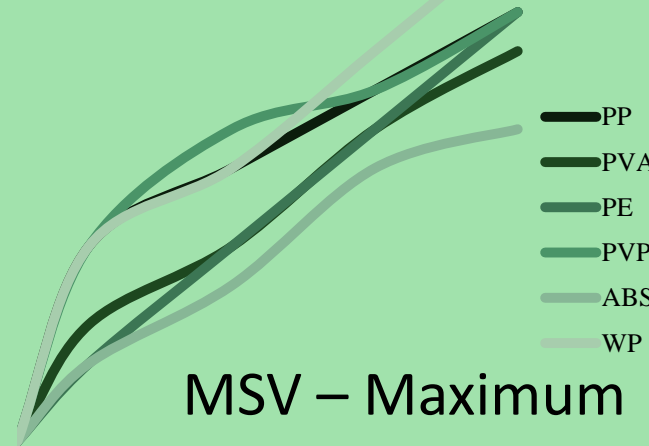
**POLYMER –BITUMEN –
AGGREGATES MIXTURE**



ROAD LAYING (120°.C)

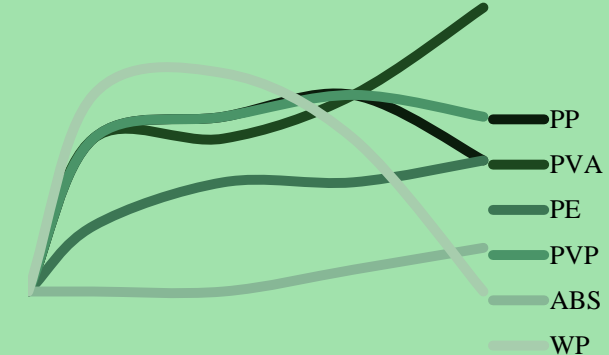


Marshall Stability Value (Kg)



Percentage of Polymer loaded

Flow Value mm)



Percentage of Polymer loaded

Removal of Bitumen & Coating Over PCA



REMOVAL OF BITUMEN

% of Plastics added (gm)	5 Minutes	10 Minutes	15 Minutes
	Bitumen Removed (%)	Bitumen Removed (%)	Bitumen Removed (%)
-	96.0	98.0	99.0
5	63.5	88.7	92.3
10	63.2	86.7	90.7
15	61.3	76.7	83.6

Removal of Bitumen Difficult due to

Improved binding – possible using decaline solvent

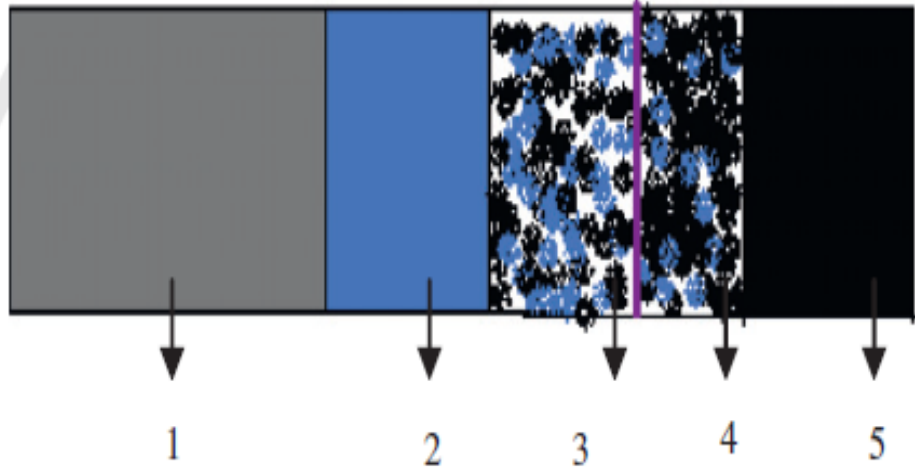
BITUMEN COATING OVER PCA

Type of Aggregate	Time	Stripping %
Plain Bitumen coated AGG	24hrs	5%
Polymer coated aggregate	72hrs	Nil

RESISTANCE TO STRIPPING

No Pot Hole Formation

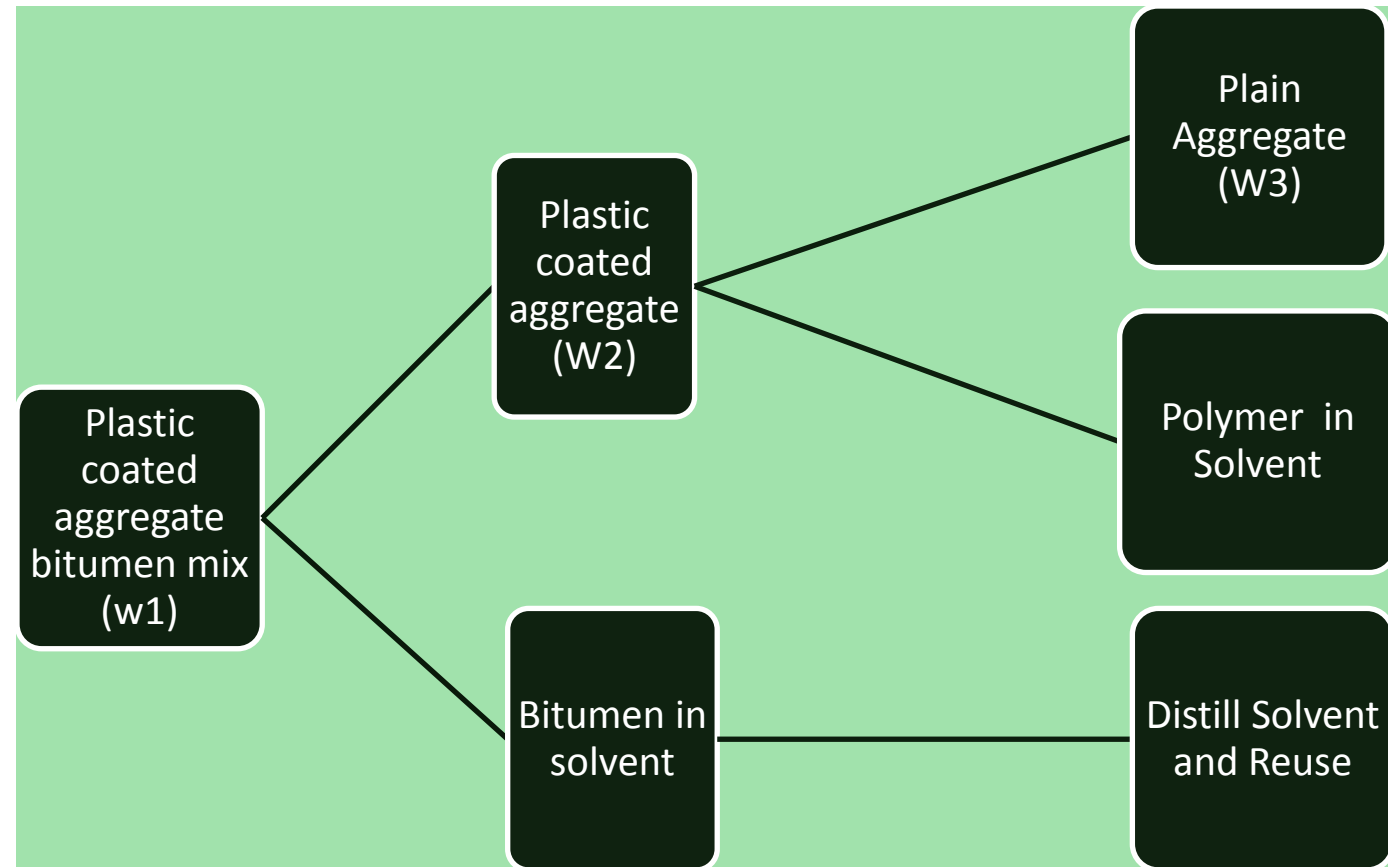
Bitumen & Coating of Plastic



Key: Black- Bitumen; Blue- Polymer; Grey - Aggregate

1. Aggregate.
2. Area of Plastics bonded with aggregate (polymer coating).
3. Area of bitumen-plastics blend (due to diffusion between molten plastics and hot bitumen).
4. Area of Loosely bonded bitumen with dispersed plastics.
5. Area of Plain bitumen layer.

FLOW CHART – POLYMER BITUMEN ESTIMATION



Amount of Bitumen : $W1 - W2$
Amount of Plastics : $W2 - W3$

SALIENT FEATURES



Plastic Tar Road

- Strength increased by 100%
- No pot holes, rutting and raveling formed
- Withstand heavy load
- Decreased bitumen consumption
- Construction cost reduced
- Value addition to waste plastics
- Nil maintenance cost for more than 7 years
- No effect of radiation like uv
- Life of the road – doubled

Plastic Tar Road - Process

- Multi layer films can be used
- No new machinery required
- No Industry Involvement
- No granulation or Powdering of plastics- only shredding
- In-situ process
- Eco friendly process
- Only stone is modified and not Bitumen
- Scraps can be used
- Value addition to waste plastics
- No need for land filling and Incineration



**NO NEED FOR
SEGREGATION**

**ALL TYPES OF PACKING
MATERIALS CAN BE USED**

NO CLEANING REQUIRED

**SHREDDING ALONE
NEEDED**

**NO TOXIC GAS
EVOLUTION**

**NO BURNING OR LAND
FILLING**

**CO₂ EMISSION IS
PREVENTED**





PERFORMANCE COMPARATIVE STUDY

Test	Bitumen Road	Plastic tar Road	Reasoning – plastic tar road
Skid Resistance <65	More than the expected value 76	Within the limit 45	Not very smooth – supported by texture value
Sand Texture .6-.8	More depth 0.83	Less depth >0.6	Due to bonding- in permissible limit
Roughness 4000	More bumps 5200	Less Bump >4000	Better binding- less rutting and ravelling
Benkelman beam 0.5-1	Rebound slightly High 1.55	Rebound Less 0.5-1	Supported by bonding- base surface defect is taken care of by the plastic tar road
Density 2.86	Moderate 2.88	Moderate Value 2.55	Better binding

COST FACTOR

Material Needed	Plain Bitumen Process	Plastic-tar road
80/100 Bitumen	11250Kg	10125Kg
Plastic waste	-----	1125Kg
Cost	Rs. 393750	(BIT) Rs.354375 + (plastic) Rs.13500 = Rs. 367875
Cost Reduced	NIL	Rs. 25875.00
Carbon Credit Achieved on avoiding burning of plastics	NIL	3.5tonnes

Benefits of laying Plastic Tar Roads



Ref: ROADS - Statistical Year Book India **2017**
(Ministry of Statistics & Programme Implementation)

In Kms	Total	Surfaced
National Highways	97991	97991
State Highways	167109	165272
Other PWD Roads	1101178	973088
Panchayati Raj Roads	1831043	986075
JRY& PMGSY Roads	606212	499994
Rural Roads	2437255	1486069
Urban Roads	467106	346796
Project Roads	301505	88590
Total	4572144	3157806

Plastic Available Only 5.5 MMT

	Total Road	Rural Road
In Kms	46 Lakhs	24 Lakhs
Plastic Reused	10 MMT	2.5 MMT
Bitumen Saved	10 MMT	2.5 MMT
Bitumen Cost Saved	Rs. 50 Billion	Rs. 12.5 Billion
Co2 Emission Reduced	30 MMT	7.5 MMT
Maintenance Cost (10 Years)	Very Minimum	Very Minimum

PLASTIC TAR ROAD - Today



**All States of India are Implementing
Road Laid So for ~ 1 Lakh KM**

Departments

**DRDA – All Districts (2000 Kms)
Corporations – All Hq's
Panchayat Boards
High Ways
Private Promoters**

Government of India
Ministry of Road Transport & Highways

Parivahan Bhawan
1, Parliament Street,
New Delhi- 110001.

Dated the 07th November, 15

No. RW-NH-33044/24/2015-S&R (R)

To

1. The Chief Secretaries of all State Governments/Union Territories
2. The Principal Secretaries /Secretaries of all States/U.Ts. Public Works Department dealing with National Highways, other Centrally Sponsored Schemes and State Schemes.
3. The Engineers-in-Chief and Chief Engineers of Public Works Departments of States/U.Ts dealing with National Highways, other Centrally Sponsored Schemes and State Schemes.
4. The Chairman, National Highways Authority of India, G-5&6, Sector-10, Dwarka, New Delhi-110 075
5. Managing Director, NHIDCL, Room No 101, Parivahan Bhawan, 1, Parliament Street, New Delhi. 110001
6. Director General (Border Roads), Seema Sadak Bhawan, Ring Road, New Delhi-110 010.

Sub: Use of plastic waste in bituminous mixes in construction of National Highways

With the rapid urbanization, a large quantum of plastic waste is being generated. Safe disposal of the plastic waste is a serious environmental problem. Studies have revealed that use of waste plastic improves the desirable properties of bituminous mixes leading to improved longevity and pavement performance. The Indian Roads Congress (IRC) has already published IRC: SP: 98-2013 Guidelines for the use of waste plastic in hot bituminous mixes (dry process)

Our technology in other countries

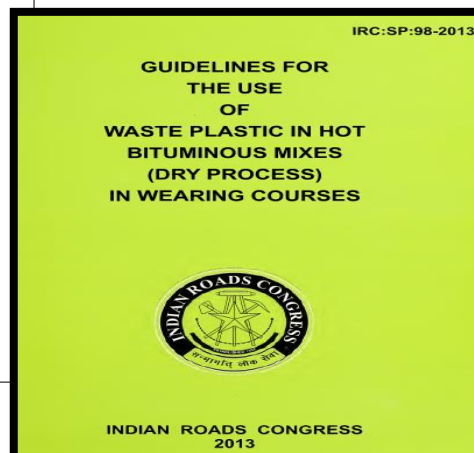
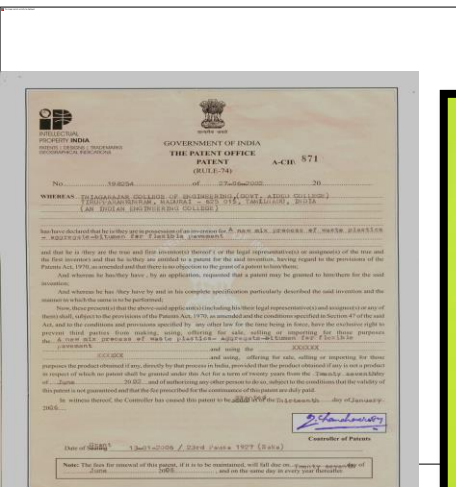
- Indonesia – Mou Signed
- Nairobi- Under Process
- Dhubai- Under Process
- U.S.A- Under Process

Our technology in Industries

- GHCL – Gujarat
- Kewaunee- Bangalore
- Sripathi mills – Sivakasi

Our technology with Central Govt.

- Low cost toilet



Further Development

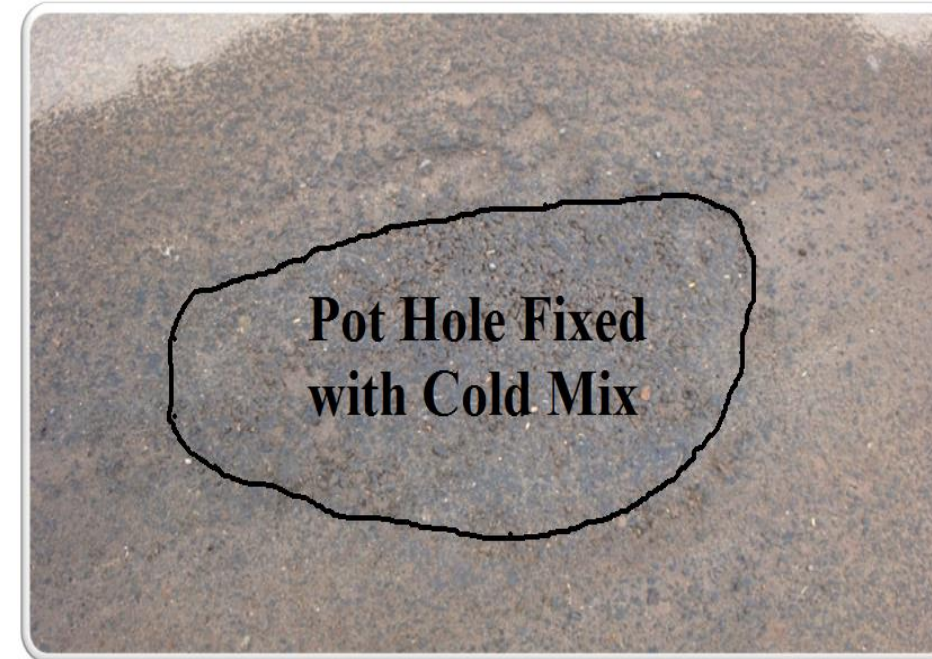


1. Scrap
2. Polymer Modified Bitumen
 - Cold Process
 - Road for Cold Region
3. Raw Material for Road laying
 - Plastic Coated Aggregate



- BITUMEN – 50% SAVED
- AGGREGATE – 50% SAVED
- COST – 50% SAVED
- DISPOSAL OF SCRAP IN AN ECOFRIENDLY WAY
- USE OF SCRAP FOR LAYING RURAL ROADS
- BETTER TRANSPORTATION FACILITIES FOR RURAL AREAS
- LIFE OF THE ROAD IS ALSO INCREASED

Using Cold Mix Process



Reusing Plastic in Construction



Plastone



Block from polymer coated aggregate

- I. No Sand
No Water
No Bitumen
No Cement
No Adhesives
- II. a. Use of Waste Plastics (~ Max Weight 45%)
b. Low graded Stones, Ceramics, Concrete Debris, Etc.,
- III. Load Baring – 300 Tons; Malleable and Ductile
- IV. Reduction in Co2 Emission
 - 1kg Plastic = 3kg of Co2 Emission
 - 1kg Cement = 0.9 kg of Co2 Emission

PLASTONE = NO CO2 EMISSION

P
L
A
S
T
O
N
E

Waste
Limestone

Waste
Ceramic

Waste
Redoxide

Waste
PET



Application of Plastone Blocks

S. No	Products
1.	Path Way Blocks (For Highways 1km – 10000 KG Waste Plastic)
2.	Paver Blocks (1 Foot x 1 Foot = 1 Inch = 1.6 KG Waste Plastic)
3.	Water Cannel Linings
4.	Compound Walls portable walls
5.	Lawns Floors
6.	Bricks as load bearers
7.	Brick for Shock Resisting Walls
8.	Rail Sleepers
9.	Portable Speed Breakers
10.	Surface Modified Decorative blocks (Rubber, Polymer)
11.	Table tops
12.	Plastone Toilets



LIME STONE



RED OXIDE



LIME POWDER



RUBBER POWDER

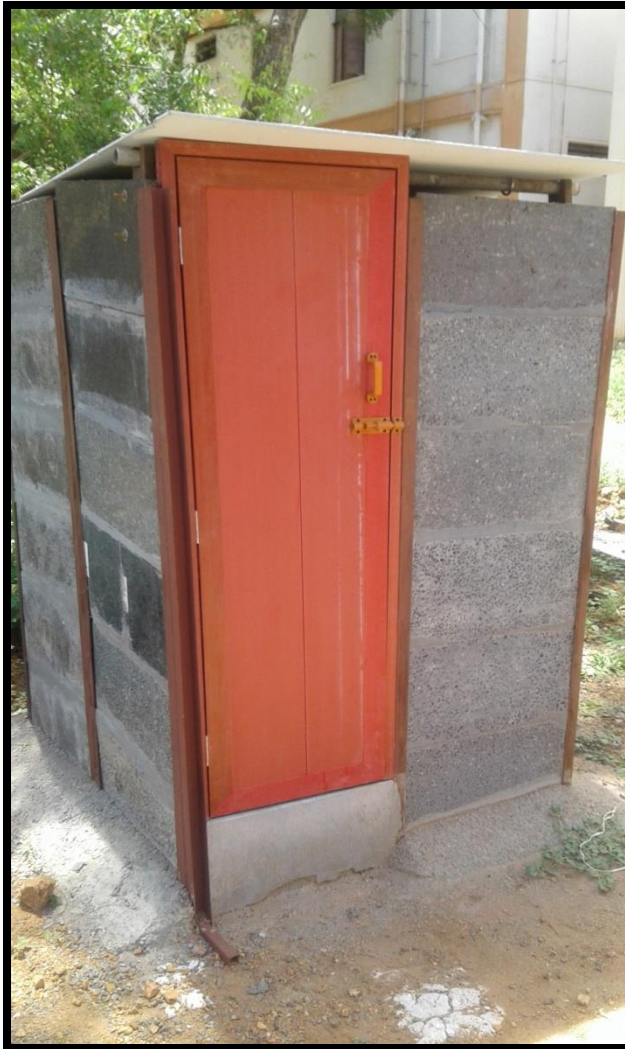


FLY ASH



E-WASTE

LOW COST TOILET USING PLASTONE BLOCKS



- PLASTONE BLOCKS 2 X 2 = 70 NOS
- WASTE PLASTICS USED = 210 KGS / 2, i.e., 10, 000 CARRY BAGS
- APPRX . COST = Rs. 10, 000
- PORTABLE
- TIME OF CONSTRUCTION = 4 hrs
- LONG DURABILITY
- For Concrete Toilet Approx. Cost – Rs. 27000

Our Perspective



i.e., as India is decided to Construct 2 crore Toilets, if the toilets are constructed using this “Plastone Blocks” i assure it will Create a Demand in Waste Plastic

To Build 1 Plastone Toilet we need 500 kg of waste plastic i.e.,

1 Toilet = .5 Tons of Waste Plastic

20000000 Toilet = .5 * 2,00,00,000

Required Plastic = 10 Million Tons of Waste Plastic

Every year India

Producing waste = 5.6 Million Tons of Waste Plastic

Available waste plastic in India is insufficient

Waste Plastic Needed (Based on our technology)

1.	For Plastic Tar Roads	10 Million Tons (2.5 Million Tons for Rural Road Only)
2.	Paver Blocks (Path way Blocks – Highways - 1 lakh KM Only) Width: 1m (both side) Height: 1 Inch	2.2 Million Tons (if for Total Roads in India – 41 Lakhs KM then required is 90 Million Tons)
		10 Million Tons
3.	Toilets for 2018-19 (20 Million Toilets)	???
4.	Plastone for other uses	

Other Products

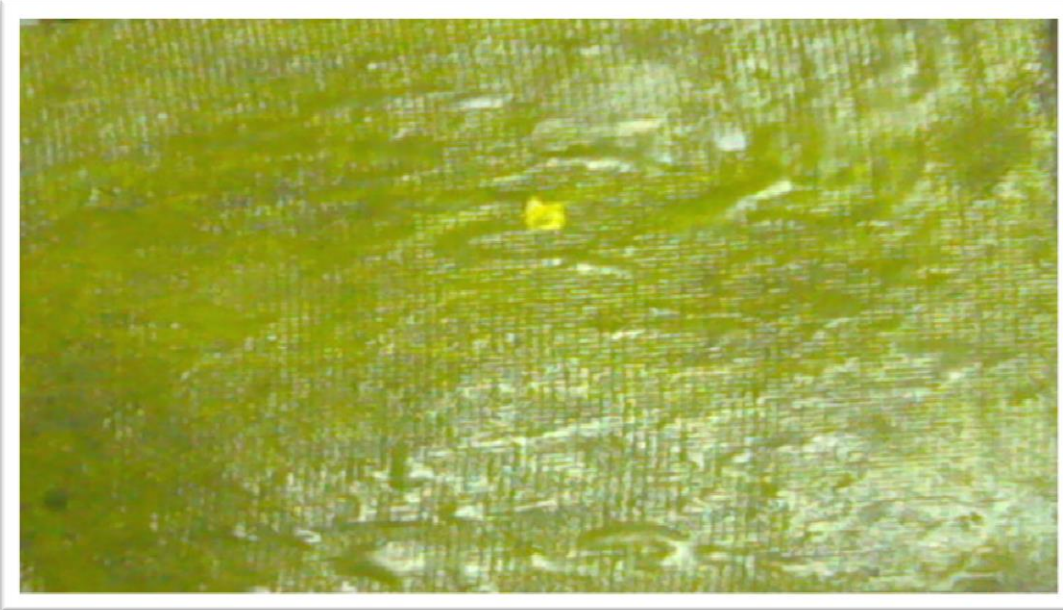


1. Roofing

2. Using E-Waste

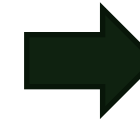
3. Corrosion Resistant Rod

1. Roofing sheets from polymer coated



Seepage free roofing sheets

2. Polymer modified bitumen using E-waste



- INCREASED SOFTENING POINT
- INCREASED PERFROMACNE
- RESISTANCE TO DEFORMATIONS
- E WASTE UTILIZATION

3. Corrosion free iron rods used in reinforcement of concrete

Recognition



Environmental Information System

Under Ministry of Environment, Forest & Climate Change,
Govt. of India



**ENVIS Resource Partner – Thematic Centre for
Plastic Waste Management**

Thiagarajar College of Engineering, Madurai

CONSULTANCY...



ISRO

- Carbon fiber waste utilization

Rite Roofing

- Development of roofing sheets using waste plastics and bitumen blend

Gujarat Heavy Chemicals Ltd

- Lime stone waste
- Lime powder
- Fly ash



Wheel India

- Improvement in Painting Process
- Reuse of paints



Cochin Minerals

- Use of the iron oxide waste in pigmentation

Plastic Manufacturing Industry

- Use of Nylon Fibers
- waste Plastics utilization

CONSULTANCY CAPABILITIES

Material Testing Laboratory	1. Water Analysis 2. Material Analysis
Polymer Lab	All types of thermal analysis using TGA and DSC and Elemental analysis using FTIR method (Liquid, solid, gas)
Road Research Lab (the only lab with all road testing instruments)	All tests for bitumen characterization and all tests for the road performance studies Road job mix formula design Consultancy for plain and plastic tar road construction

BENEFICIARIES

Our valued costumers



INDIVIDUAL

NEED OF THE HOUR

INDUSTRY



- Own your ownership
- Everyone has got the social responsibility
- Life is sharing and caring
- Health Is wealth
- Let us be smart person and create smart organization & finally



- Preferring eco friendly material
- Collection Of Packing Material Should Be In His Agenda
- Dispose His Own Waste Scientifically
- Development/Support Of Waste Management Wing

SMART INDIA



Auto Driver Says

**Don't Throw Plastics
waste on Roads, But
Use it for laying
Plastic Tar Road**

TN 77
V 7777



Lord Sri Krishna Guides

ஸஹ யஜ்ஞா: ப்ரஜா: ஸ்ருஷ்ட்வா புரோவாச ப்ரஜாபதி:
அனேன ப்ரஸவிஷ்யத்வமேஷ வோஸ்த்விஷ்டகாமதுக் (10)

தேவான் பாவயதானேன தே தேவா பாவயந்து வ:
பரஸ்பரம் பாவயந்த : ஸ்ரேய : பரமவாப்ஸ்யத்த (11)

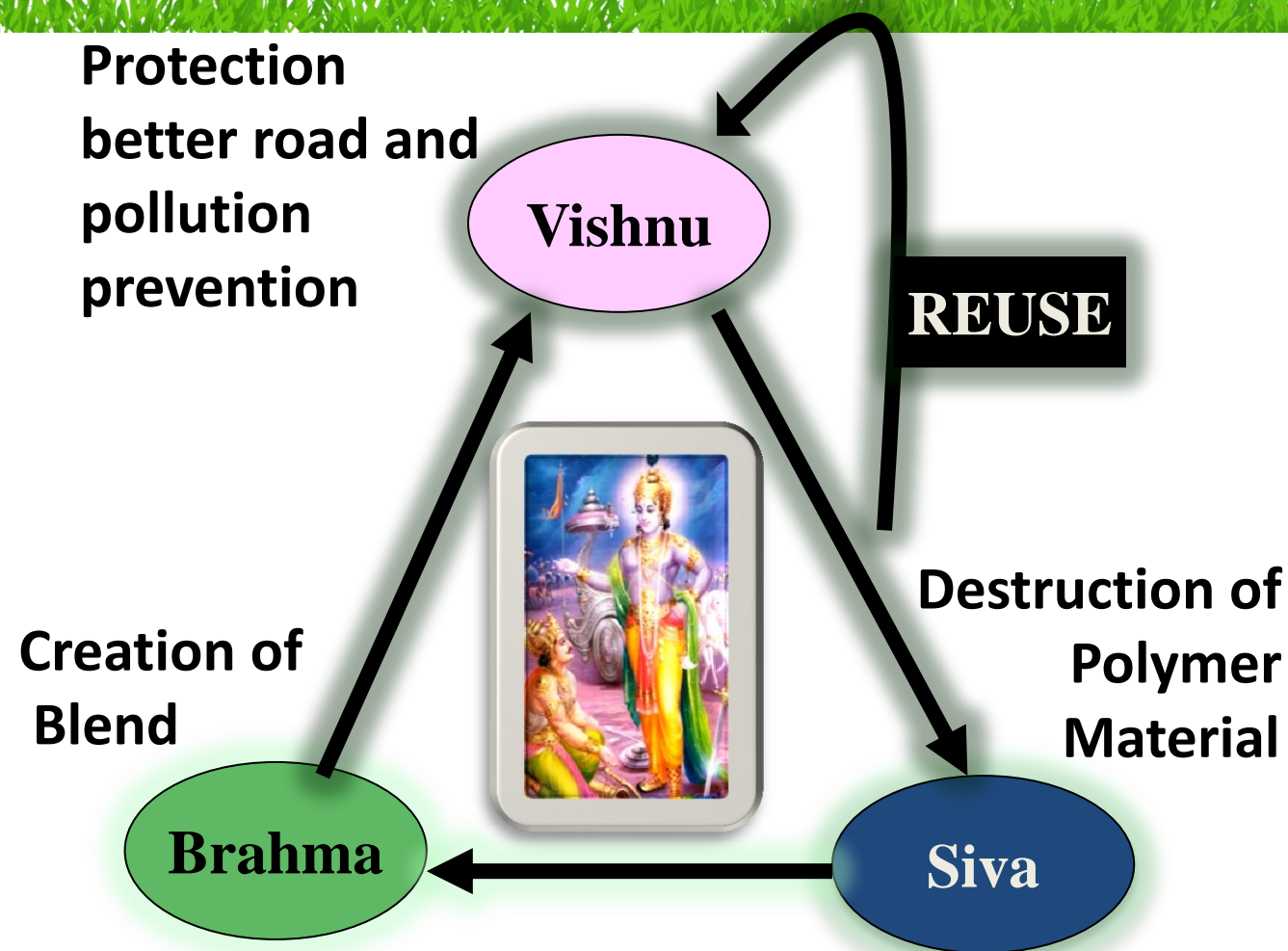
World is Kamadhenu

Follow ethics- we get everything

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Thank You



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