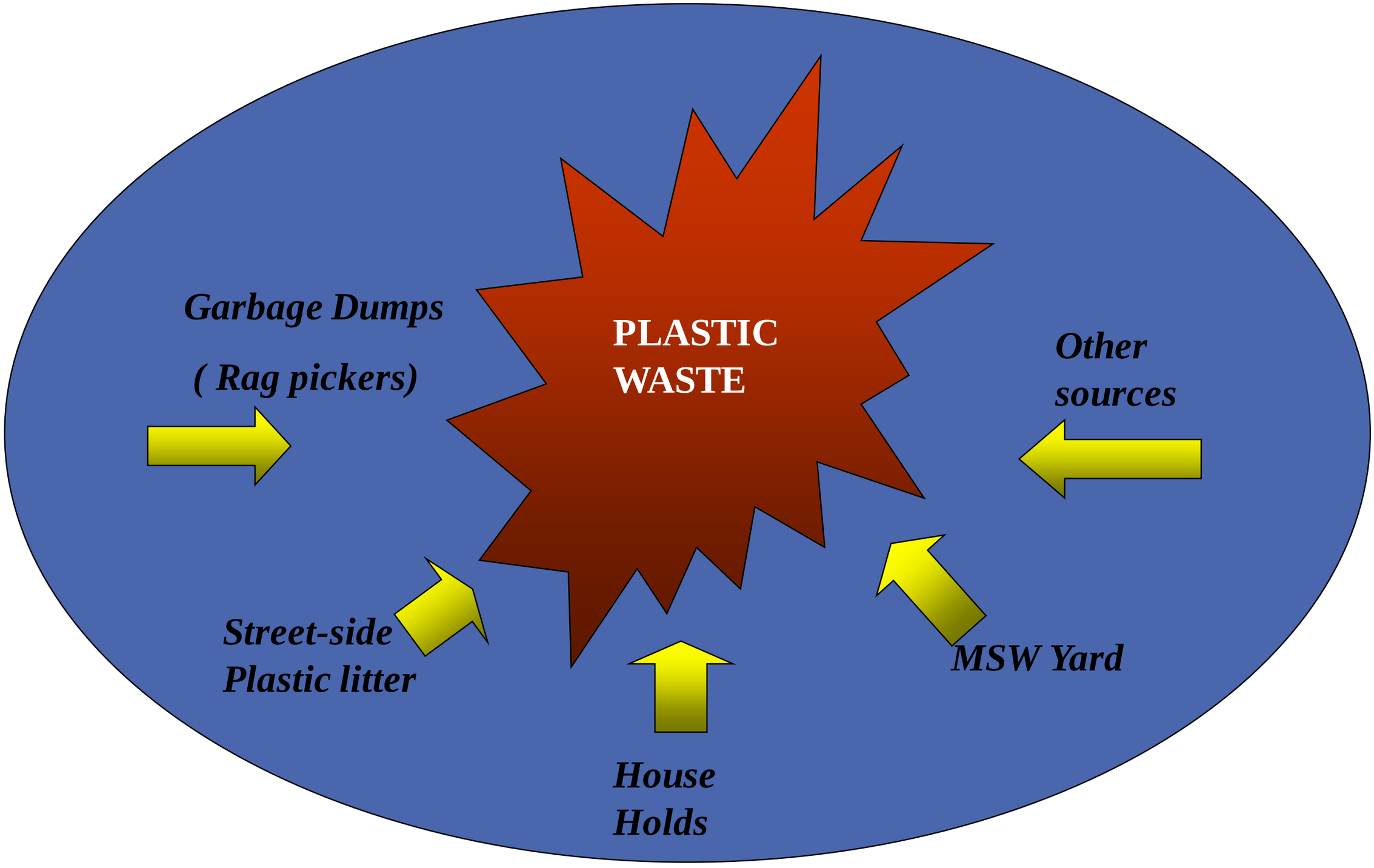
National Policy Workshop Webinar Series
On
Countermeasures for Riverine and Marine Plastic Litter in India
12 -22 May 2020

Session 3: Activities and Best practices to counter plastics litter by sustainable waste management and circularity

Use of Waste Plastic in Bituminous Road Surfacing

‘The Circle of Influence’

Sources of Plastic Waste



Disposal /Utilization options & their limitations

- Landfill — Insufficient capacity of landfills -----Gazipur Tragedy
- Incineration — Air pollution is generated by incinerators
- Recycling in other products — Already in Practice for many years

Current Options

- Waste to Energy (WTE) — Limited No. of WTE Plants
- As a fuel for Boilers (Indore,M P) — The shredded plastic packed in 100 Kg Bags and supplied to Cement Plants to be used as a fuel

Other Options

- **Utilization in Road Construction and Maintenance (Green Technology)**
- To reduce Plastic Use — Govt. putting BAN on water bottles,Polythenes etc
- Garbage Café

Use of Waste Plastics in Bituminous Road Surfacing

Need for the use of waste plastic in Bituminous mixes

- DELHI city generates approx. 9000 Tonnes per Day solid waste
- More than 650 Tonnes per Day constitutes waste plastics
- Disposal of such voluminous waste plastics is a major problem
- Non-biodegradable ,Pollute our environment ,River and sea
- Chock drainage system, Hazardous to Animals and sea animals

- **It's Utility in bituminous mixes (used for road construction) was proved through Lab study and field performance of roads constructed with waste plastics .**

  Outcome Durable Roads. And

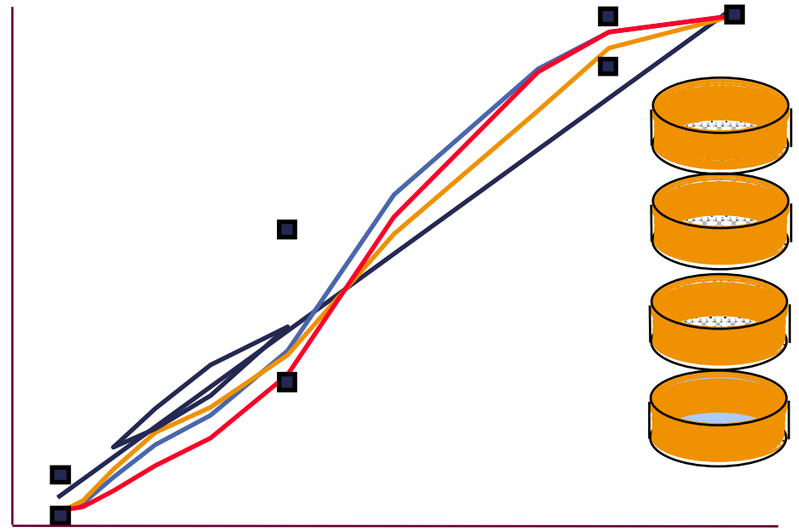
- **Maintenance of city roads** in environment friendly manner
- To contribute towards **Modern and fast development** of Road Network including **smart cities**
- **but No Guidelines were available till 2013**

Technology Process - Dry & Wet

Materials Used

- Aggregate of 20mm, 10 mm, Stone Dust and Lime as Filler
- Bitumen
- Polythene bags in shredded form
- **Two Processes** : Dry (Sucessful)
- Wet (yet to be developed for commercial scale)

Material properties		
Shredded Mix Plastic	Specific Gravity	Vary
	Melting Temperature	100-200 deg C
	Decomposition Temperature	200-400 deg C



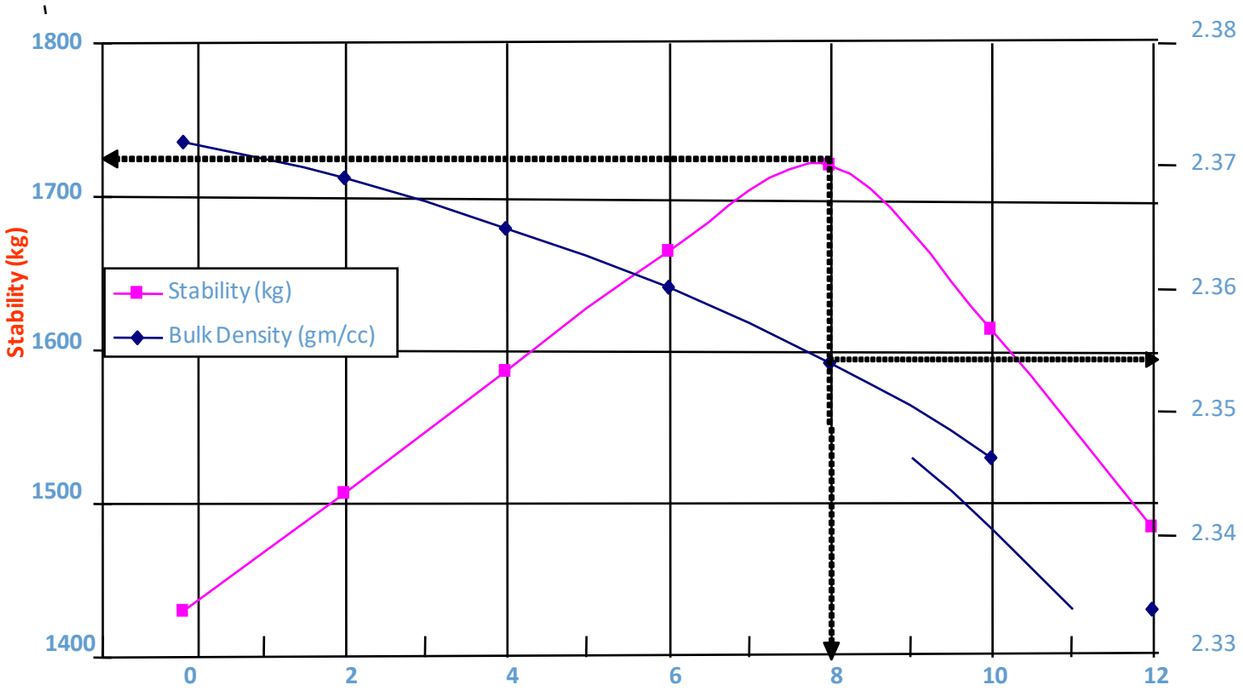
Graded Aggregates

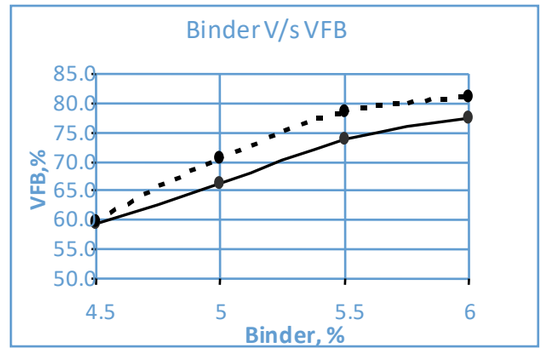
Waste plastics

Bitumen

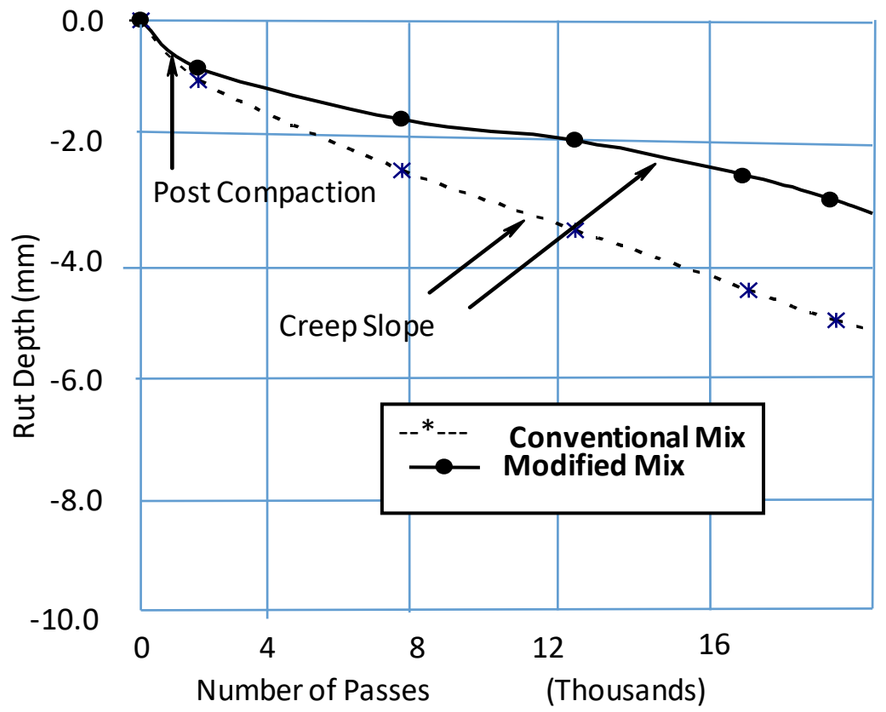
Optimization of quantity of waste plastic in Bituminous Mixtures (Marshal Method of Mix Design)

Design of Optimum Waste Plastics Content in BC Mixtures

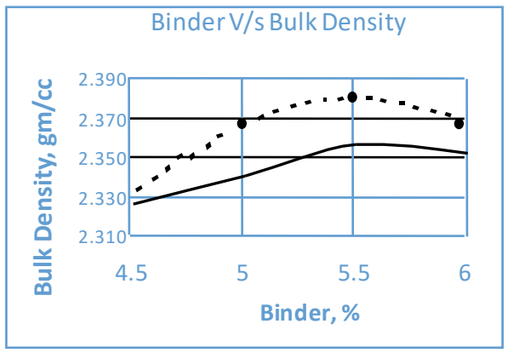


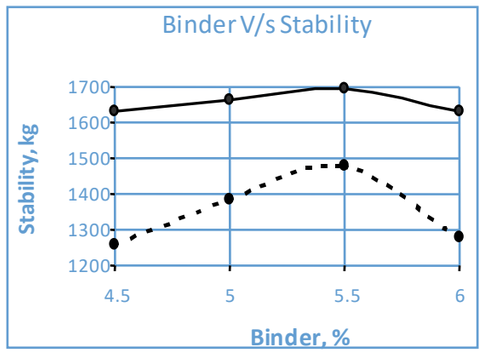


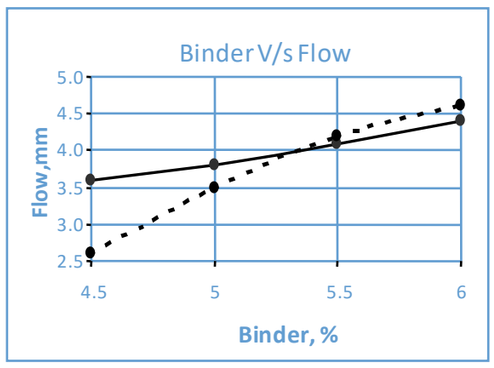
Rutting Potential of the Bituminous Mixtures

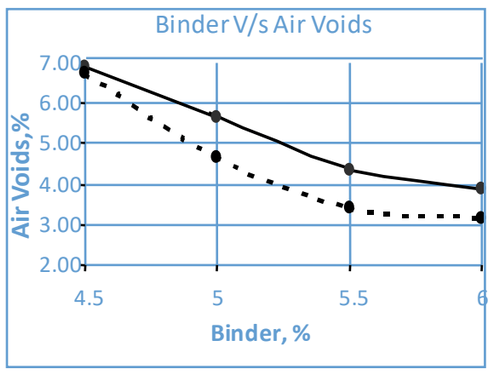


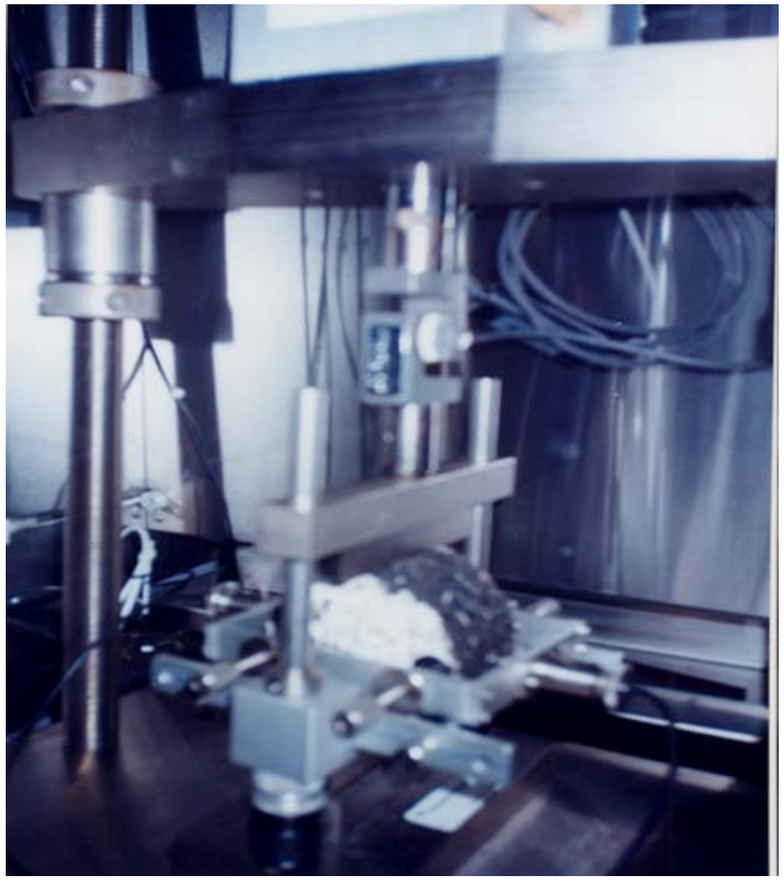
Comparison of Properties of Bituminous Mixtures

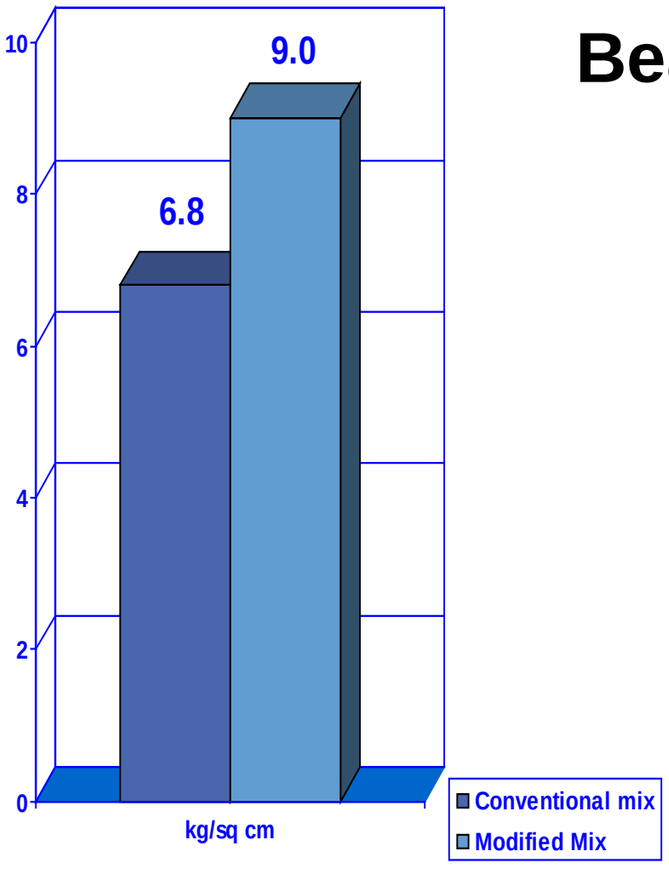




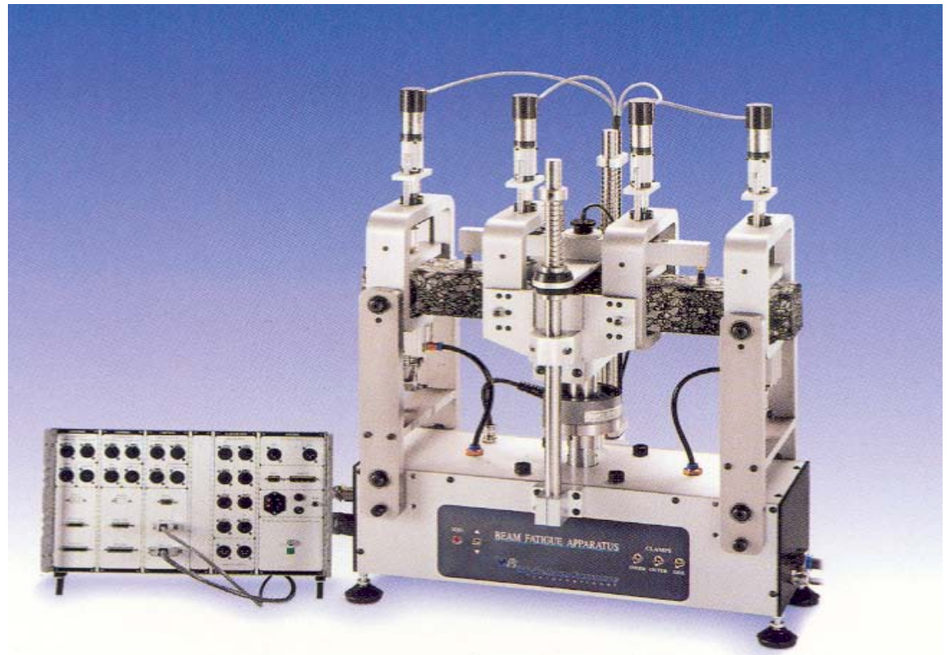






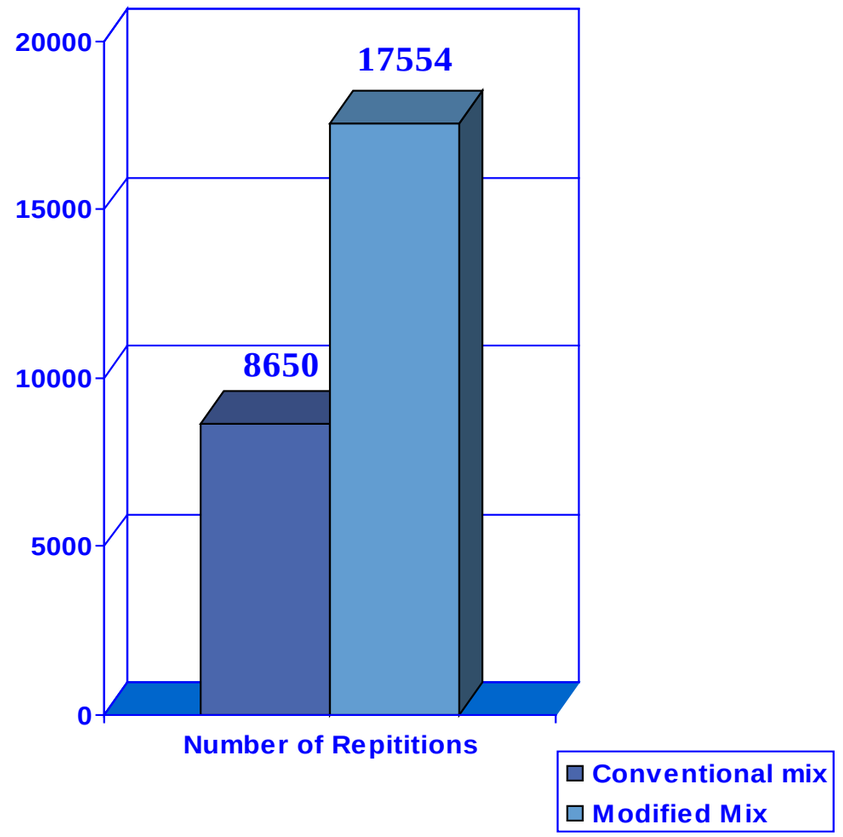


Beam Fatigue Testing Machine



Indirect Tensile Testing Machine

Rutting potential



Plastic Waste

1.Laboratory Study to Determine the Suitability of Polymer Waste Modifier in Construction of Bituminous Concrete Mixes through Dry and Wet Process (*Phase –I & II)* (PL)

Aim: To find out potential application of **mix modifiers (CHEMICALLY MODIFIED waste plastic)** for development of high performance modified mixes.

Methodology: Dry process

Waste Plastic Powder or Shredded form (Supplied by M/S SK Polymers)

Outcome: High Strength Mixtures indicated Durable Roads

Properties Tested	Conventional mix (60/70 bitumen)	Modified mix (8% Waste Plastic)	Modified mix (15% Waste Plastic)
Marshall Stability (kg)	1300	1567	1539
Flow (mm)	3.8	5.6	5.7
Retained Stability (%)	76	90	87
Air Voids (%)	4.5	3.6	2.9
Bulk Density(gm/cc)	2.391	2.351	2.349
ITS , kg/cm^2	6.4	10.7	8.2

How much Plastic Required?

The optimum quantity of waste plastics is 6- 8% by weight of bitumen depending on Type and thickness of Road Surface.

Nearly 2-3 tonnes of shredded waste Plastic is required
 to construct 1 Km length of 3.75 m wide road depending on the thickness of Layer(20 to 50 mm)

Case Studies in India

City Roads(Delhi, Bangluru, Kerala, Indore, Pune ,Gurugram Haryana

Rural Roads (Under PMGSY Many Roads constructed by NRRDA)

National Highways (First trial was done on NH-10 Rohtak ,1 Km long road By PWD Rohtak Haryana under supervision of CRRI)

- Field studies were completed between **2000- 2003** by CRRI on a 500 m section at **Bangalore** Municipality Road
- In **Maharastra(Pune)** Trials were done in 2007-2008.Now Reliance is making more roads with WP
- More Trials were done in South India ,Karnatka,,Kerla during 2004 and 2008.
- **Field trials on 3.5 Km. Road were also conducted by CRRI in DELHI city with the assistance of PWD, DELHI and DSIIDC in 2008.**
- Till Date Road length of about 25 km has been constructed in bits and pieces in DELHI city.
- **Chhattisgarh(Ambikapur)** 2015 one Km road was constructed with waste plastic in Bhagwanpur
- In December **2019** ,MCG constructed road using waste plastic in **Gurugram,** Sector 51 apart from 10 Km Road in Sushant Lok and Palam Vihar
- **Indore** The shredded plastic packed in 100 Kg Bags and supplied to Cement Plants to be used as a fuel for Boilers. Also used for road construction purpose

In 2019 Kerala (Ernakulam and Alappuzha); Constructed Experimental Stretches with waste Plastic

- Recently Cane Dept. **Lucknow** has mandated use of plastic waste in Road surfacing

Before Laying of Waste Plastic Road

Technology Impact

Based on R&D and Technology Demonstration project, in Delhi, approx. 20 Km. of road sections were sponsored to CRRI by PWD and MCD for supervision of construction with waste plastic

Field Evaluation Data , Road No. 43 ,Delhi Test Section

Parameters	2008	2009
Roughness, mm/Km	1721	1877
Deflection , mm	0.45	0.51

After 2 yrs of Laying

View of Roads

Roads in East Delhi Area Constructed with Waste Plastic

PLASTIC WASTE MATERIAL TESTED AND APPROVED BY CRRI

1) M/s SK POLYMERS

Placed at : Delhi
contact no. 9810168110

Name: Sanket Gupta

2) M/s KK Polyflex

Placed at : Bangluru and Gurugram

Name: Ahmed Khan & Rasool Khan

3) For Guidance on Use of Plastic Waste in Roads

Dr. Sangita
Former Chief Scientist & Head
Flexible Pavement Division,
Central Road Research Institute
New Delhi Mo. No. 9871064747

IRC:SP:98-2013

GUIDELINES FOR THE USE OF WASTE PLASTIC IN HOT BITUMINOUS MIXES (DRY PROCESS) IN WEARING COURSES

INDIAN ROADS CONGRESS
2013

Table 1_Typical Thermoplastic and Thermosetting Resins

Thermoplastic	Thermosetting
Polyethylene Terphthalate (PET)	Bakelite
Polypropylene (PP)	Epoxy
Poly Vinyl Acetate (PVA)	Melamine
Poly Vinyl Chloride (PVC)	Polyester
Polystyrene (PS)	Urea - Formaldehyde
Low Density Polyethylene (LDPE)	Alkyd
High Density Polyethylene (HDPE)	

Table 2 Waste Plastic & its Source

Waste Plastic	Origin
Low Density Polyethylene (LDPE)	Carry bags, sacks, milk pouches, bin lining, cosmetic and detergent bottles.
High Density Polyethylene (HDPE)	Carry bags, bottle caps, household articles etc.
Polyethylene Terphthalate (PET)	Drinking water bottles etc.
Polypropylene (PP)	Bottle caps and closures, wrappers of detergent, biscuit, wafer packets, microwave trays for readymade meal etc.
Polystyrene (PS)	Yoghurt pots, clear egg packs, bottle caps. Foamed Polystyrene: food trays, egg boxes, disposable cups protective packagine etc.
Polyvinyl Chloride (PVC)	Mineral water bottles, credit cards, toys, pipes and gutters; electrical fittings, fumiture, folders and pens, medical disposables; etc.

Advantages of Using Waste Plastic as Modifier and Binder

- Higher resistance to deformation.
- Higher resistance to water induced damages.
- Increased durability and improved fatigue life.
- Improved stability and strength.
- Disposal of waste plastic and thereby environment friendly.

Precautions of Using Waste Plastic as Modifier and Binder

- The material shall consist of only low density polyethylene (LDPE) or high density polyethylene (HDPE), PU (available in limited quantity as waste) in shredded form.
- Black colored plastic waste is a result of repeated recycling and should not be used.
- PVC shall not be used since they release lethal levels of dioxines.
- The Thermo Gravimetric Analysis (TGA) of thermoplastics has revealed gas evolution and thermal degradation may occur beyond 180°C.
- Misuse or wrong implementation of this technology may result in release of harmful gases, premature degradation, if the temperatures are not maintained during construction.

Guidelines Contd…….

✓**Materials** Bitumen, Aggregates, Filler and Waste Plastic

✓Collection of waste plastic
✓Cleaning and shredding of waste plastic
✓Shredding Machine
✓Mixing of shredded waste plastic, aggregate and bitumen in central mixing plant

- **Design of Mix**
- **Manufacturing of Bituminous Mix using Waste Plastic**
- **Construction and Controls**
- **Appendix - 1 Case Studies**
- **Appendix -2 Processing Details**

Recommendations

- Use of waste Plastic in Road construction should be Mandatory as done by Cane Department,Lucknow
- Majority of Tenders related to road construction should be floated making mandatory use of waste plastic
- Zero Plastic waste Policies Should be framed
- Well organized Plastic Collection Centre
- More Garbage Café (a Model set up in **Chhattisgarh(Ambikapur)** To spread Awareness against the use of Plastic, Feeding Homeless people, rag pickers & Empower women by employing them in Cafe
- Instead of putting Ban on use of Plastic ,we should solve the problem by implementing the well established available Technology dicussed in this presentation

Recommendations

- ❑ As a Policy matter Segregation of organic waste and plastic waste shall start from houses by introducing Two Bin System mandatory

- ❑ To educate the person collecting daily waste from our houses

- ❑ Partnership with Citizens, RWA and other private players for better waste management

- ❑ Awareness Programs at School level and Plastic waste management shall be part of curriculum in Schools

- ❑ Define Single use Plastic in eradication Plan

- ❑ Guidelines from Ministry to construct all Rural Roads, city roads and state highways using waste plastic including single-use plastic .
- ❑ High Power Committee for Guiding and implementation of above stated recommendations as well as Technology

PLASTIC WASTE MODIFIER FOR ROAD SURFACING

- **SK POLYFLEX** – PLASTIC WASTE MATERIAL MANUFACTURED BY M/s S.K POLYMER'S IN DELHI .

- APPROVED AND ACCREDITED BY CENTRAL ROAD RESEARCH INSTITUTE IN 2007.

- **SK POLYFLEX** MATERIAL CONTAINS SHREDDED PLASTIC WASTE ALONG WITH CHEMICALS USED TO MAKE COATING ON STONE / PREMIX DESIGN OF CARPETING.

- USING ONLY SHREDDED PLASTIC IN BITUMINOUS MIX, RESULTS IN SEPERATION OF PLASTIC MATERIAL FROM GRID AFTER COOLING OFF

- LAID AROUNG 600 KM'S STRECH OF ROAD USING SK POLYFLEX

THANKS to ALL

MATERIAL PICTURE

PRACTICAL IMPLEMENTAION SO FAR

- AROUND 100 KM'S OF STRETCH IS LAID UNDER PRADHAN MANTRI GRAM SADAK YOGNA (PMGSY)

- PWD – DELHI LAID ALL DENSE CARPETING WORKS USING SK POLYFLEX/PLASTIC WASTE MATERIAL FROM 2010 TILL DATE

- CANE DEPARTMENT – LUCKNOW USED THIS MATERIAL TO LAY RURAL ROADS IN BAREILY , MUZAFARNAGAR, MEERUT, LAKHIMPUR, SHARAN PUR, LUCKNOW , SITAPUR, HALDOI.

- MANY ROAD ARE LAID IN CHATISGARH USING SK POLYFLEX.

- SK POLYFLEX MATERIAL BEST SUITED : IN RURAL ROADS, URBAN ROADS AND NATIONAL HIGHWAYS

TECHNICAL AND SOCIAL BENEFITS OF USING SK POLYFLEX

- ROADS STRENGTH INCREASES FROM 5 YEARS TO APPROXIMATELY 7 YEARS.
- ROADS ARE LESS SUSCEPTIBLE TO POT HOLE FORMATION AFTER USING PLASTIC WASTE MATERIAL
- SOFTENING POINT OF ROAD INCREASES TO 60 DEGREE CELSIUS

- **SOCIAL BENEFITS:-**
- TILL DATE WE HAVE ACHIEVED TO CONSUME 2000 TONNES OF PLASTIC IN ROAD CONSTRUCTION
- NO EXTRA COST INVOLVED IN USING PLASTIC WASTE MATERIAL IN ROAD SURFACING, AS BITUMEN GET REPLACED FROM PLASTIC WASTE
- UPLIFMENT OF RAG PICKERS/ UNPRIVILEGED PEOPLE OF SOCIETY

RECENT PICTURES OF MIXING MATERIAL IN DRUM MIX PLANT

MIXING AND ROAD LAYING PICTURES

THANK YOU

- SANKET GUPTA – DIRECTOR – SK POLYMERS
- 9810168110
- sanketgupta@hotmail.com