

# Techno-Economic Feasibility Study: Use of Waste Plastics with Bitumen for Road Construction

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# Objectives of the study:

- Undertake multidisciplinary investigative work in order to determine the applicability as well as techno economic viability of the use of recycled waste plastics in road making in Bangladesh
- Feasibility study highlighted different issues such as technical aspect considering local context, potential of road maintenance, environmental impacts, climatic and socio economic considerations

# Modified Bitumen:

- Three categories of plastics- LDPE (Low Density Polyethylene), HDPE (High Density Polyethylene) and PP (Polypropylene).
- LDPE and HDPE are together known as PE.
- The bitumen containing waste plastics (PE and PP) as additive is called the modified bitumen
- More than 50% of the total waste plastics produced in Bangladesh is PE & PP are suitable for use in road construction

# Plastic Recycling Process:

- Collection
- (Cleaning + Drying)
- Sorting
- Pelletizing
- Extrusion
- Shredding
- (Pellets or Granules)

# Mixing Process:

- Molten bitumen heated to 240-260C, added shredded plastics slowly by agitating manually.
- The heating was continued until the mix reached 300-320C.
- The agitator was turned on until plastics appeared to be dispersed in the bitumen and not floating as entangled molten mass.
- The agitation was turned off when the mix reached 240-250oC.

# Proportion of waste plastics and bitumen by weight :

- The results indicate that optimum performances were observed with LDPE content around 8% by weight in the bitumen.
- LDPE modified bitumen mix showed decrease in penetration, ductility, specific gravity and increase in softening temperature when compared with unmodified bitumen

# Polymer waste bitumen mix road:

- Road strength is twice stronger than normal roads
- Improved resistance towards water stagnation i.e. no potholes are formed
- Less bleeding during rainy and summer months
- Improve longevity and ride-ability

## Prospect in Bangladesh – Economic :

- RHD maintains about 21,571 Km. highways and regional and zila roads
- LGED has to maintain about 78,105 Km. of paved roads at the upazilla and union level and more than 100,000 Km, of 'Katcha' (unpaved) roads in the Union and rural areas.
- Extensive damages are suffered by the bitumen roads the monsoon period and the flood season (in an average year 20-25% of area are submerged in flood) requiring substantial repairs.

## Prospect in Bangladesh – Economic :

- Each year about 6,480 Crores (1 Crore = 10 Million) of Taka are spent from the Development (ADP) and Revenue budget for construction of roads and their maintenance

*Source: Planning Commission and Ministry of Finance, Bangladesh Economic Review 2006-2007.*

# Prospect in Bangladesh: Economic

- In the road maintenance by the use of polymer mixed bitumen (in lieu of conventional bitumen) the **cost savings is about BDT 31,600.00** per Km of road. The total length of paved road in Bangladesh is 85,000 Km., and therefore the national savings would thus be enormous

## Prospect in Bangladesh - Economic:

- The cost of making such polymer modified bitumen roads may be 5 - 10% higher than normal bitumen roads which is amply justified in view of the higher durability of the roads (1 -3 times) and lower maintenance & costs (6 years compared to 4 years).

# Prospect in Bangladesh – Employment Creation :

- The domestic demand for plastic is around 600000 M. tons now and is growing at the rate of 5 percent per annum
- The packing, storing, transporting, mixing etc. Operations required for using plastic shreds in road works will create around 100,000 nos. of job.

# Prospect in Bangladesh – Environment :

- Significant consumption of waste plastics daily generated - helpful in keeping the environment clean, reducing clogging of drains causing various hazards.
- Burning polythene bags is dangerous as it released dioxin and hydrogen cyanide, the most carcinogenic and toxic substances.
- Inhalation of the poisonous gas caused severe and chronic health problem. These gases also pollute the air .

# International Experience - India:

- K. K. Plastic Waste Management Pvt. Ltd. a Bangalore firm has developed a polymer blend marketed as 'K. K. Polyblend' made out of littered plastic bags, PET bottles, and thin film grade plastics
- Indian Road Congress in 1999 (revised later on) published Guidelines on use of polymer and rubber modified bitumen in road construction.

## International Experience - India:

- The Indian Guidelines deal in details, among others, advantages of polymer and rubber modified bitumen, types of bitumen modifiers and their indicative doses, applications, specifications, design of mixes, controls, methods for elastic recovery and separation tests, etc.

## International Experience - India:

- Indian experience also indicates that normal renewal period of 4 years for bituminous roads may be raised to 6 years by adding polymer.
- The cost may however be 5 -10% higher than normal bitumen roads but that is justified in view of the higher durability of the roads (1 -3 times) and lower maintenance and repair costs

# Recommendations:

- Government agencies like RHD, LGED, City Corporations should come up with at least one comprehensive project of processing waste plastics and constructing roads using the modified bituminous mix
- A Pilot Project may be taken for making a 5 Km. road with waste plastic mixed bitumen
- Road making agencies, research bodies, and major universities should maintain close liaison and exchange views and ideas with the relevant organizations and research centres in India, Australia and in other countries

# Recommendations:

- Initiatives need be taken locally to develop or improve equipment and machinery for shredding and recycling of waste plastics.
- Professional and academic training should be given to different appropriate levels in the implementing chain – Engineers and Technicians in the public sector road making agencies with regard to the new technology

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