An experimental study on recycling of bituminous pavement waste

Business, Manufacturing

Abstract— This paper represents an experimental study on recycled bitumen pavement aggregate and also to study the properties of the recycled aggregates. Mix design and testing procedure can be considered under the conditions given in the MoRTH for testing the materials. Graphical representation generated for the strength variation of various mix proportion along with the combination of fresh crusher dust and DPA (Deteriorated Pavement Aggregates). Recycling of bituminous pavements will be a valuable approach for technical, economical, and environmental reasons. The main scope of the thesis is to study the strength variation of DPA and fresh crusher dust with fresh common binder. The process of recycling the bituminous pavements tends to reduce the waste generated from existing pavement and also the process will concede the environment as clean and green.

Index Terms — DPA, Deteriorated Pavement Aggregate, Recycled Bituminous Aggregate, Bituminous Extraction, Pavement Waste, Pavement Recycling, Recycled Material Stability

INTRODUCTION

The bituminous pavement rehabilitation alternatives are mainly overlaying and reconstruction. In the recycling process of the material from deteriorated pavement aggregate (DPA), is partially or fully reused in fresh or re-construction of any roads or highway. Some of the advantages in pavement recycling are conservation of energy, saving the environment, less construction cost, preservation of the existing pavement geometrics etc.

DPA bituminous mix that contains aged bitumen and aggregates, hence its performance is poorer when compared to the fresh mix. The purpose of this bituminous pavement recycling is to regain the properties of the recycled aggregate, so that it has to perform as good as fresh mix. Thus, the process of recycling involves mixing of the DAP with fresh bitumen and new aggregates in suitable proportions.

Recycled DPA is almost always returned back into the roadway structure in some form, usually incorporated into bituminous paving by means of hot or cold recycling, but it is also sometimes used as an aggregate in base or sub base construction. It is estimated that the amount of excess bituminous concrete that must be disposed is less than 20 percent of the annual amount of DPA that is generated.

In most cases, recycled hot mix bituminous can be obtained from central DPA processing facilities where bituminous pavements are crushed, screened, and stockpiled for use in bituminous concrete production, cold mix, or as a granular or stabilized base material. Most of these processing facilities are located at hot mix bituminous plant sites, where the DPA is either sold or used as feedstock for the production of recycled hot mix bituminous pavement or recycled cold mix.

The properties of DPA are largely dependent on the properties of the constituent materials and bituminous concrete type used in the old pavement. Since DPA may be obtained from any number of old pavement sources, quality can vary. Excess granular material or soils, or even debris,

can sometimes be introduced into old pavement stockpiles. The number of times the pavement has been resurfaced, the amount of patching and/or crack sealing, and the possible presence of prior seal coat applications will all have an influence on DPA composition. Quality control is needed to ensure that the processed DPA will be suitable for the prospective application. This is particularly the case with in-place pavement recycling.

METHODOLOGY

Literature has been collected for preceding the project, and DPA has been collected where the road process carrying out.

Methods of extracting aggregates from DPA: (i) In-Place Recycling (Hot Process and Cold Process) (ii) Central Plant Recycling (Hot Process and Cold Process). These methods can be used for high volume of materials to be recycled and can be applicable in practical implementation for the proposed project as the above mentioned methods are used for high volume of materials recycling using bitumen extractor can be used to extract aggregate from the DPA.

The further process continues with testing of DPA to study the properties (gradation of aggregate, shape test, impact value of aggregate, abrasion test, crushing value of aggregate, specific gravity and water absorption test). It continues with mix design for DPA and followed with testing of pavement sample (Marshal’s stability test). Finally strength variation study and conclusion can be carried out by graphical representation also suitable

recommendations and the Practical applicability for rehabilitation can be evaluated.

RESEARCH PROCESS

Aggregate is the major component of all materials used in road construction. It is used in granular bases and sub base, bituminous courses and in cement concrete pavements. The strength of aggregates are proves to Pavement strength and Durability. On behalf of the objective the rehabilitated pavement materials has been collected. The materials have the property of wear and tear. The material has been collected and it was stockpiled with consideration of temperature and other constraints. Similarly fresh binder and fresh crusher dust has also been collected and stockpiled. For research process two samples has been collected from two different sites, first sample has been collected from Tanjore (NH-67) and second sample has collected from Neelambur (NH-47).

Aggregate from DPA can be obtained by extracting the acquired material from the rehabilitated pavement, further the material undergone lab recycling process with the help of bitumen extractor. The extraction process is conducted by the benzene solution which dissolves the bitumen content from the deteriorated pavement.

Properties of DPA,

1. Strength: The aggregate should be sufficiently strong to withstand the stresses due to traffic wheel load

2. Hardness: Aggregate should have hard enough to resist the wear due to abrasive action of traffic

3. Toughness: Aggregate should have resistance to impact or toughness

4. Durability: The aggregate used in pavement should resistance to disintegration due to the action of weather Shape of aggregate: Should not be Flaky and elongated

5. Adhesion with Bitumen: Should have good affinity to bitumen.

MARSHALL STABILITY TEST

The Marshall stability of a bituminous mix is defined as a maximum load carried in kg at the standard test temperature of 600C when load is applied under specified test conditions. The flow value is the total deformation of Marshall Test specimen at the maximum load expressed in mm units. The Marshall Stability value of a compacted specimen of bituminous mix indicates its resistance to its deformation under applied incremental load and the flow value indicates the extent of deformation it undergoes due to loading or its flexibility.

From the lab practice, maximum stability, air voids and flow value can be found out by the graphical representation between binder content as a constant and Marshall Stability, flow value, voids.