Concoction of Eco-Crumb Shell Paver Blocks

R. Sabaresh Kumar[1], M. Mohamed Irshad[2], P. Bavish[3]
R. Sakthivel., A/P., Civil Engineering
Dr. M.Sivaraja, M.E., Ph.D., P.D., [USA]
N.S.N. College of Engineering and Technology,
Karur.

***Abstract*:- The main motto of starting up this project is to investigate the potential of using crumb rubber and sea shell crushed SBP (Seashell By Product) also called as the coral organic waste material as a partial substitute for coarse sand in the production of concrete paving block (CPB). Laboratory trials were conducted to investigate the effect of crumb rubber particle size. A comparison was also made between CPB and crumb rubber paver block (CRPB) to determine the strength. Styrene-butadiene rubber (SBR) latex was added to the mixtures of crumb rubber CPB and mechanical properties were evaluated.It gives more strength then compared to the normal paving blocks. The accumulations of discarded tyres provoke fire and health hazards. In order to prevent environmental pollution, the policy is evolving and much effort has been put into solving waste tyres problem on a world-wide basis. This will also acts as an environmental friendly blocks. It was found that the natural aggregate can be substituted by SBP (Seashell By-Product) without affecting the delicate balance of a pervious concrete mix. It is evident that the natural resources consistently deplete while the demand for concrete constituent materials still remains increasingly high. Hence, diverse waste materials have been investigated for reuse and/or recycling in full or partial replacement for both fine and coarse aggregate in concrete production. In this we assure that, this will give great impact and thus we give eco-friendly paver blocks.**

Keywords:- Crumb rubber, sea shell, styrene-butadiene rubber, eco paving blocks, seashell by-product (SBP), crumb rubber paver block (CRPB).

I.INTRODUCTION

General

Now a Days Paver Blocks uses is increasing day by day, Interlocking concrete Pavement has been extensively used in a number of countries like India, China, Japan, Pakistan etc. Intermediate concrete block pavement (ICBP) technology has been introduced in India in construction a decade ago, as a specialized problem solving technique for providing pavement in areas where conventional types of constraction are less durable due many operational and environment constraints for specific requirements viz. footpaths, parking areas etc. but now being adopted extensively in different uses where the conventional construction of pavement using hot bituminous mix or cement concrete technology is not feasible or desirable. Interlocking concrete pavements or pavers are a special dry mix pre-cast piece of concrete commonly used in pavement applications. As per IS 15658 Standard thicknesses of paver blocks are 60mm (for light traffic), 50mm (no-Traffic), 80mm (heavy traffic) is common used in India . Paver block required high compressive strength, flexure strength, Residual compressive strength, water absorption to use it in paver blocks. The advancement and progress of nations is measured by the possibility of their use and application of latest invented technologies in all aspects of life. The amount of waste tires has been increasing due to increased number of vehicles. This has led to future problems relating to the environment issues.

Accumulation of discarded waste tire is a major concern because waste rubber is not biodegradable even after a long period of landfill treatment. Therefore the demand for more effective applications for recycling waste tires has been intense. Existing or commercial concrete is characterized as a composite material with high compressive strength, moderate tensile strength and with a low toughness. For pavement traffic application, it is anticipated that an ideal CPB should have high tensile strength and high toughness. Therefore, high strength and high toughness concrete paver block has to be developed. It is found that the higher the strength, the lower the toughness for a normal concrete. Therefore, without modifications, it is difficult to develop high strength and high toughness concrete paver blocks. Owing to the very high toughness of waste tires, it is expected that adding crumb rubber into concrete mixture can increase the toughness of concrete. Previous laboratory have shown that the introduction of waste tire rubber considerably increase toughness, impact resistance, and plastic deformation of concrete, thus offering a great potential to be used in sound barriers, retaining structures and pavement structures.

Therefore there is a need to investigate the applicability for the CPB mixtures with crumb rubber. However, polymers such as styrene-butadiene rubber (SBR) latex could improve the strength, toughness and bonding of cement matrix. Hence, this study investigates the potential of using crumb rubber as a partial substitute for sand replacement in the production of CPB.

Planning

Nowadays rapid increase in population and economy were leads to demand in all systems. The main idea of inducing this project is to create an impact between all people who directly access to satisfy their needs. It is also the job of a creative engineer to plan in the eco-friendly manner without disturbing the other natural resources. It is to give satisfactory needs of people and in an environmental efficient manner.

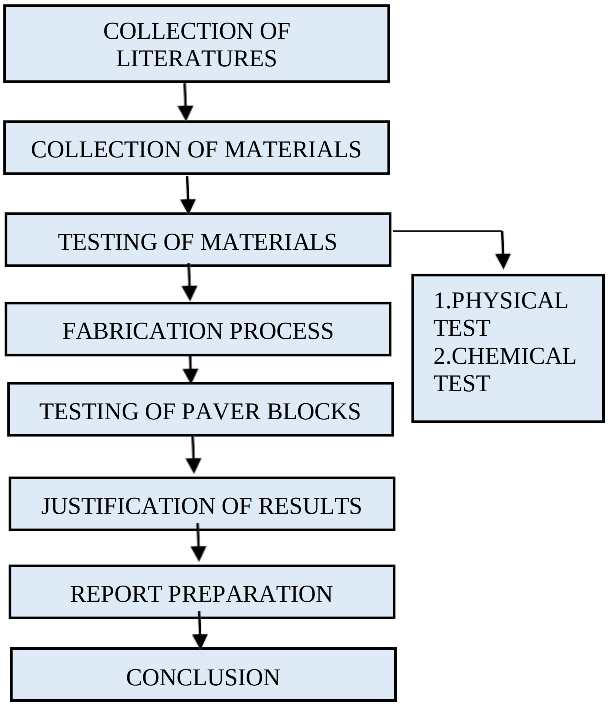
Scope of the Project Work

On this fast world, as the technologies grows faster, we must come up with the challenges around us. To meet out these needs, one has to make the waste to reusable material as a user friendly to do all the jobs not only in time but with accuracy. Since we have got many ideas and some implementation, it will helpful for our higher studies and to work in better forth coming environment.

Objectives

1. To know the structure model and its components.
2. To know how to arrive the materials on various natural resources.
3. To expertise in fabrication and result analysis.
4. To make use of waste into reusable material.
5. To get familiarity in all standards and in manufacturing aids.
6. To reduce the demand of up-coming materials.

II. METHODOLOGY



III. MATERIAL AND PROPERTIES General

As up to the core as possible, the current practice is followed in the paver block manufacture and usual test on paver block was continued.

Materials

- Coarse aggregate (stone chips)
- Fine aggregate
- Cement – PPC
- Crumb rubber (partial replacement)
- Crushed sea shell (partial replacement)
- Water

Coarse aggregate

Aggregate is a broad category of coarse particulate material used in construction, including sand, gravel, crushed stone, slag, recycled concrete and also geo-synthetic aggregates. Aggregates are the most mined materials in the world in the need of construction. Aggregates are a component of composite materials such as concrete and asphalt concrete and so on, the aggregate serves as reinforcement to add strength to the overall composite material.

Basic properties of aggregates used in concrete

1. Composition

Aggregates consisting of materials that can react with alkali in cement and cause excessive expansion, cracking and deterioration of concrete mix should never be used. Therefore it is required to test aggregates to know whether there is presence of any such constituents in aggregate or not.

2. Size and shape

The size and shape of the aggregate particles greatly influence the quantity of cement required in concrete mix and hence ultimately economy of concrete. For the preparation of economical concrete mix on should use largest coarse aggregates feasible for the structure. IS-456 suggests following recommendation to decide the maximum size of coarse aggregate to be used in P.C.C & R.C.C mix. Maximum size of aggregate should be less than- One-fourth of the minimum dimension of the concrete member.

Stone Chips

3. **Surface texture**

The development of hard bond strength between aggregate particles and cement paste depends upon the surface texture, surface roughness and surface porosity of the aggregate particles. If the surface is rough but porous, maximum bond strength develops. In porous surface aggregates, the bond strength increases due to setting of cement paste in the pores.

Sand

Sand is a naturally occurring granular material composed of finely divided rock and mineral particles. The composition of sand is highly variable, depending on the local rock sources and conditions, but the most common constituent of sand in inland continental settings and non-tropical coastal settings is silica (silicon dioxide, or SiO2), usually in the form of quartz. The second most common type of sand is calcium carbonate, for example aragonite, which has mostly been created, over the past half billion years, by various forms of life, like coral and shellfish. It is, for example, the primary form of sand apparent in areas where reefs have dominated the ecosystem for millions of years like the Caribbean.An optical microscope was used to study the average grain size of both the sands. The grain size was observed using "1-10" microscopic scale provided in the eyepiece under a magnification of 40X. It was observed that the average grain size of the river sand is smaller compared to sea sand though the river sand appears larger than sea sand when viewed with naked eye.

River Sand

Cement

Cement is made by heating limestone (calcium carbonate) with small quantities of other materials (such as clay). In this project Pozzalano Portland cement of conforming to IS456-2000 was used. Tests were carried out on various physical properties of cement and the results are shown in test data of materials. Cement will act as a binding material. PPC is manufactured by inter-grinding 65% of cement clinker with 30% of fly ash and 5% of gypsum in a closed circuit ball mill with a high-efficiency separator to achieve the required fineness.

Pozzolanic Portland Cement

Chemical composition of Cement

S.NO.	COMPOSITION	CEMENT (%)
1	CaO	41-43
2	SiO_2	28-32
3	Al_2O_3	7.0-10.0
4	Fe_2O_3	4.9-6.0
5	MgO	1.0-2.0
6	Alkalies (K_2O, Na_2O)	3.0-3.5
7	SO_3	2.4-2.8

Crumb Rubber

Crumb rubber is recycled rubber produced from automotive and truck scrap tires. During the recycling process, steel and tire cord (fluff) are removed, leaving tire rubber with a granular consistency. Continued processing with a granulator or cracker mill, possibly with the aid of cryogenics or by mechanical means, reduces the size of the particles further. The particles are sized and classified based on various criteria including color (black only or black and white). Granulates are sized by passing through a screen, the size based on a dimension (1/4 inch) or mesh (holes per inch 10, 20, etc.). Crumb rubber is often used in artificial turf as cushioning.

The use of rubber product is increasing every year in worldwide. India is also one the largest country in population exceeds 100cr. So the use of vehicles also increased, according to that the tires for the vehicles also very much used and the amount of waste of tire rubber is increasing. This creates a major problem for the earth and their livings. For this issue, the easiest and cheapest way of decomposing of the rubber is by burning it. This creates smoke pollution and other toxic emission and it create global warming. Currently 75-80% of scrap tire are buried in landfills. Only 25% or fewer are utilized as a fuel substitute or as raw material for the manufacture of a number of miscellaneous rubber goods.

Burying scrap tire in landfills is not only wasteful, but also costly. Disposal of whole tire has been banned in the majority of landfill operations because of the bulkiness of the fires and their tendency to float to the surface with time. Thus, tyres must be shredded before they are accepted in most landfills.So many recycling methods for the rubber tyre are carried according to the need. From this one of the processes is to making the tyre rubber in to crumb rubber. It is used in many works such as Road construction, Mold making etc.

Crumb Rubber

Sea Shell (Coral Organic Waste)

These wastes are available in huge volume in certain countries, and, hence, have the potential to be re-used in large-scale concrete production. The utilization of waste materials in concrete could moderate the problem of excessive consumption of conventional materials as well as reduce the amount of waste generated. Another potential waste material that is available in abundance is waste seashells. There are many different types of waste seashell available, such as oyster shells, mussel shells, scallop shells, periwinkle shells and cockle shells. In China, which is the largest producer of shellfish in the world, about 10 million tonnes of waste seashells are disposed of in landfills annually.

This amount of seashell waste primarily consists of oyster, clam, scallop, and mussel shells, most of which are landfilled with only a small fraction re-used for other purposes, such as fertilizers and handicrafts. The re-use is limited due to the restriction on the amount that can be used, the problem of soil solidification, and economic problems. In addition, there are problems with illegal dumping of these waste seashells into public waters and reclaimed land. These waste seashells, if left untreated for a long period of time, can cause foul odours due to the decay of the remaining flesh in the shells or the microbial decomposition of salts into gases, such as H2S, NH3 and amines.

These problems can negatively affect the quality of living for people in close proximity and result in environmental pollution issues. Oyster shell waste is a common problem in many countries, including China, South Korea, and Taiwan. For every 1 kg of oyster shells, about 370–700 g of waste shells were produced. Of the total amount of seashell waste in China, it is approximated that 300,000 tonnes of oyster shells are available annually, while, in Taiwan, an excess of 160,000 tonnes of oyster shell waste is generated every year. In South Korea, in 1993, it was reported that about 320,000 tonnes of oyster shells were produced, of which only 30% were re-used.

Sea Shell – Crushed Sea Shells

Water

The amount of water in concrete controls many fresh and hardened properties in concrete including workability, compressive strengths, permeability and water tightness, durability and weathering, drying shrinkage and potential for cracking. For these reasons, limiting and controlling the amount of water in concrete is important for both constructability and service life.shrinkage and cracking in addition to decreasing the strength and durability.

Water

Properties of Materials

CEMENT

- Initial setting time = 30 min (minimum)
- Final setting time = 600 min (maximum)
- Drying shrinkage should not be more than 0.15%
- Sulphur content, Fe Oxide, etc.,
- Fineness, Soundness, Bulk density, etc.,

WATER

- Primary binder.
- Hydrate and Solidfy the cement.
- Strength and Workability.
- Organic -200 mg/ lt.
- Inorganic - 3000 mg/lt.
- Chlorides - 500 mg/lt.
- Sulphates - 500 mg/lt.
- Suspended Matter - 2000 mg/lt.

STONE CHIPS

- Grading.
- Durability and Hardnes.
- Particle Shape and Surface Texture.
- Abrasion and Skid Resistance.
- Unit Weights and Voids.
- Absorption, Porosity and Permeability.
- Texture of the Surface.
- Strength and Elasticity.
- Density and Specific Gravity.

RIVER SAND

- High Permeability.
- Highly sensitivity to compaction with many adverse consequences.
- Specific gravity.
- Specific density.
- Fineness.

CRUMB RUBBER

- Reduced slump while maintaining a High Compaction factor.
- Interfacial Bonding Strength.
- Acceptable strength.

SEA SHELLS

- Colour and Shape.
- Conchiolin and calcite content.
- Calcium carbonate crystals.
- Single and Bivalve Shells.

IV. MATERIAL TESTING

GENERAL

The material testing of the paver block is based on the required strength of paver block. The results shows in the material testing are as follows stone chips, cement, and sea shells are added in the various mix ratios. **Material Testing**

TESTING OF CEMENT

- Fineness of cement = 1.5 %
- Consistency test

  i. Initial setting time = 35 min

  ii. Final setting time = 10 hrs
- Specific gravity= 3.148

COARSE AGGREGATE TEST

- Water absorption = 1.75 %
- Specific gravity= 2.63
- Fineness Modulus = 4.48 %

CRUMB RUBBER

- Water absorption = 2 %
- Specific-gravity = 1.72
- Sieve-analysis = passed in 4.75 mm sieve

SEASHELL

- Water absorption = 1.08 %
- Specific-gravity = 3.09
- Sieve-analysis passed in 4.75 mm sieve.

SAND

- Water absorption = 0.50 %
- Specific-gravity = 2.55

Sieve-analysis passed in 4.75 mm sieve

V. FABRICATION PROCESS

General

The material has been collected and the collected materials are properly weighted for the making of hollow blocks. Size of the mould used for block manufacture = 380 x 100 x 180 mm.

Manufacturing process

The production of concrete paver blocks consists of four basic processes: mixing, moulding, de-moulding, and curing. Some manufacturing plants produce only paver concrete blocks, while others may produce a wide variety of precast concrete products including blocks, flat paver stones, and decorative landscaping pieces such as lawn edging. Some plants are capable of producing 2,000 or more blocks per hour.

Material preparation

The collection of materials such as crumb rubber, sea shell (coral organic waste), cement, fine aggregates and aggregate chips were kept in proportion in accordance with the mix design and current practice used in making of concrete paver blocks.

Mixing

The materials are mixed with dry condition manner say dry mix. The water is then added and the materials are mixed with proper mix ratio. So, that the slurry can be made easily and in an proper way.

Placing

The racks of cured blocks are rolled out of the kiln, and the pallets of paver blocks are unshackled and placed on a mold conveyor. The blocks are then molded later kept in vibrator pushed out to the drying area, and the empty rubber molds are fed back into the block machine to receive a new set of molded blocks. If the blocks are to be made into split-face blocks, they are first molded as two blocks joined together. Once these double blocks are cured, they pass through a splitter, which strikes them with a heavy blade along the section between the other further rubber mold.

Curing

After de-molding of paver blocks are taken into the curing process. The paver blocks are curing by membrane curing method at 7days and 28days respectively.

Mix Proportions

S.NO.	Mix Ratios	Partial replaced material
1	5%	Crumb rubber and seashell
2	7.5%	Crumb rubber and seashell
3	10%	Crumb rubber and seashell

Mix Ratio

1:1.5:3

Mix Proportions for 5% replacement

S.NO.	Materials	In Kg
1	cement	0.650
2	Fine aggregate	0.883
3	Coarse aggregate	1.950
4	Crumb rubber	0.049
5	Seashell	0.049

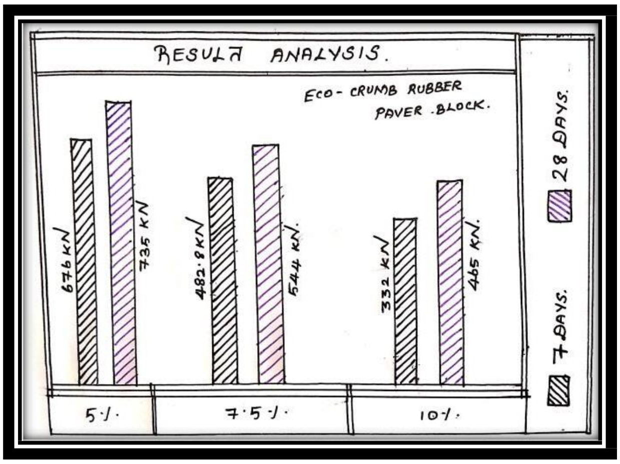
Mix Proportions for 7.5% replacement

S.NO.	Materials	In Kg
1	cement	0.650
2	Fine aggregate	0.835
3	Coarse aggregate	1.950
4	Crumb rubber	0.073
5	Seashell	0.073

Mix Proportions for 10% replacement

S.NO.	Materials	In Kg
1	cement	0.650
2	Fine aggregate	0.784
3	Coarse aggregate	1.950
4	Crumb rubber	0.098
5	Seashell	0.098

Result Analysis



Strength Attained in 7 and 28 days

S.NO.	Mix Ratios	Strength attained	
		7 days	28 days
1	5%	676 kN	735 kN
2	7.5%	482.8 kN	544 kN
3	10%	332 kN	465 kN

VI. CONCLUSION

From this study the effective utilization of rubber tyre waste has been developed and it is made to used in the concrete mixture as fine aggregate. At present the crumb rubber production in the south India is very less than north. Based on the test results the following conclusions were made. These can also include non - primary structural applications of medium to low strength requirements, benefiting from other features of this type of concrete. Even if rubber tyre aggregate was used at relatively low percentages in concrete, the amount of waste tyre rubber could be greatly reduced due to the very large market for concrete products worldwide. Therefore the use of discarded tyre rubber aggregates in concrete shows promise for developing an additional route for used tyres.

□ The compressive strength of crumb rubber concrete with 5% replacement is N/mm^2; it is higher than the strength of normal concrete (N/mm^2) on 28^{th} day.

□ The compressive strength of crumb rubber concrete with 10% replacement, it gives acceptable strength of N/mm^2

In splitting tensile strength the strength of crumb rubber concrete is lower than the strength of normal concrete.

In the flexural strength test conducted on crumb rubber concrete it shows a decrease in strength when compared to the strength of normal concrete.

From the test results, it is found that the crumb rubber possess less bonding ability which has affected on the strength of the concrete.

To produce an eco-friendly blocks to the sustainable development in our construction.

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