GOT (Generation, Operation and Transformation) of Electricity through Smart Pavement

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Abstract : Electricity generation capacity has all ways been struggled to keep pace with country's raising demand. And there is a less focus on energy mix with renewable source either generated by natural forces or by Human activities which are continuously discharged into the atmosphere. This free energy can be synthesized and utilized in an effective manner by transforming it as per the required demand. The aim of this project is to focus on the sustainable, economical and ecological utilization of power that is generated due to various action by vehicular moment that results in developing dynamic and static energy. By tapping this energy on to a smart road construction which involve in the generation of potential difference. Galvanized Iron strips or copper strips which is laid under pavement maintain the potential difference developed by induction of EMF: Electro Motive Force achieved by electro magnets attached to the base of the vehicle, and generation, transfer, accumulation and conduction of free electrons generated by the static friction produced due to rubbing and rotational action of the tires which is sustainably used. Using a insulators formed by composite materials determined by blending the plastic with bitumen which is further blended with the different road layers under the pavement increases the load transfer capacity, lifespan and reduces the deformation of pavement. Thereby adding this features of smart road which accomplish smart township. The power from the grid which is utilized for lighting up the loads can be used for rural development programs. With the efficient utilization of the harvested energy leads to rectify and decrease in the demand thus helping in building of better socio economic relationship in society in the state and its adjoining territories.

IndexTerms **- Renewable energy, Economical, Sustainable utilization of free energy, Static energy, Reduction in demand of electricity.**

I. INTRODUCTION

Population outburst is leading to high demand for various energy needed to make the daily life simple. This simpler life style comes with high cost, and most of our planet resources are getting exhausted, and the methods of harvesting energy from renewable sources are limited and alters with the geophysical and geographical characteristics of our planet. One of the most common and highly demanded source of energy is electricity. Electricity is considered as the ELIXIR of our modern life style which includes the usage of 90% of electrical and electronic gadgets and equipments, that makes our life much simpler, luxurious and velocious. The world now is leaping towards the various methods of 2 harvesting electricity using renewable sources like solar, wind, geothermal etc. This renewable sources alter with the various geographical characteristics of our planet, thus making it expensive and complicated to harvest electricity from this renewable sources. Another major resource that is used by the humans in there daily life is the plastic, it is considered as the discovery of the millennium as it has its uses in every aspect of human life, but the major concern with the plastic is its disposal, the plastic degradation takes about 1000 years, and when dumped into the environment causes major problem. To overcome the various complications of harvesting electricity and its demand, GOT(generation, operation, transformation) of Electricity Through Smart Pavement offers a sustainable, economical, ecological and efficient solution of generating of electricity. The project focus on the various operations involved in the embedding the conducting material, its connections and developing of binding materials through composite mixing of various insulating materials with pavement binders that are lay between the various layers of pavement in turn acting as insulators and also load distributors between the layers and increasing the durability of the pavement by better water resistance system. This project also focus on the principles of conduction pavements that can be utilized to increase the temperature of the pavement to resist the frost action and snow clearing on the pavement thus reducing the workloads. Thus this project also helps in solving the various problems related to the harvesting of electricity and helps in building a better socio economic and environmental societies.

1.1 Existing Method:

Batch Mix Plant for Surface Course Asphalt Pavement (Single Drum Mix) Single Drum Mix: The procedure used in Single drum mix follows same as the Asphalt Batch mix plant, where the aggregates are graded and as per the ratio provided by the authorities obtained through trial and error methods, till the limits are satisfied, specified as per the MORTH BOOK. The graded aggregates is further heated to the specified temperature and bitumen is weighed as per the specified percentage for different layers, and mixed with the aggregates. The mix is further subjected to the Marshall stability test which gives the stability and flow value of the mix, if satisfied the mix is approved for the pavement construction. The single drum mix consists of a raised platform on to which multiple funnel sections with controlled out put is fixed, into which the aggregates of approved gradation are hauled and stored, each funnel section holds aggregates of different size, and the funnel opening is controlled in a manner that the out put from each funnel satisfy the gradation ratio. The lower conveyor belt carries the aggregates to the heating Drum, where the aggregates are heated 160 degree Celsius, and then the bitumen is sprinkled and the mix is further carried by the conveyor belt and transfers the mix to the trucks which hauls the mix to construction site. In this process the percentage of the plastic used is restricted to 10% in most of the cases the replacement is done upto only 5% of the weight of the asphalt.

II. OBJECTIVES

Activities under the GOT of Electricity through Smart Pavement include the following:

- Improved utilization of free energy harvested from human activities.
- Improve stability and durability of the pavement by using asphalt replaced plastic pavement
- Improve environmental conditions by utilizing excessive waste plastic
- Increase economic efficiency of services of harvested energy.
- Improved Smart City planning through smart pavement.

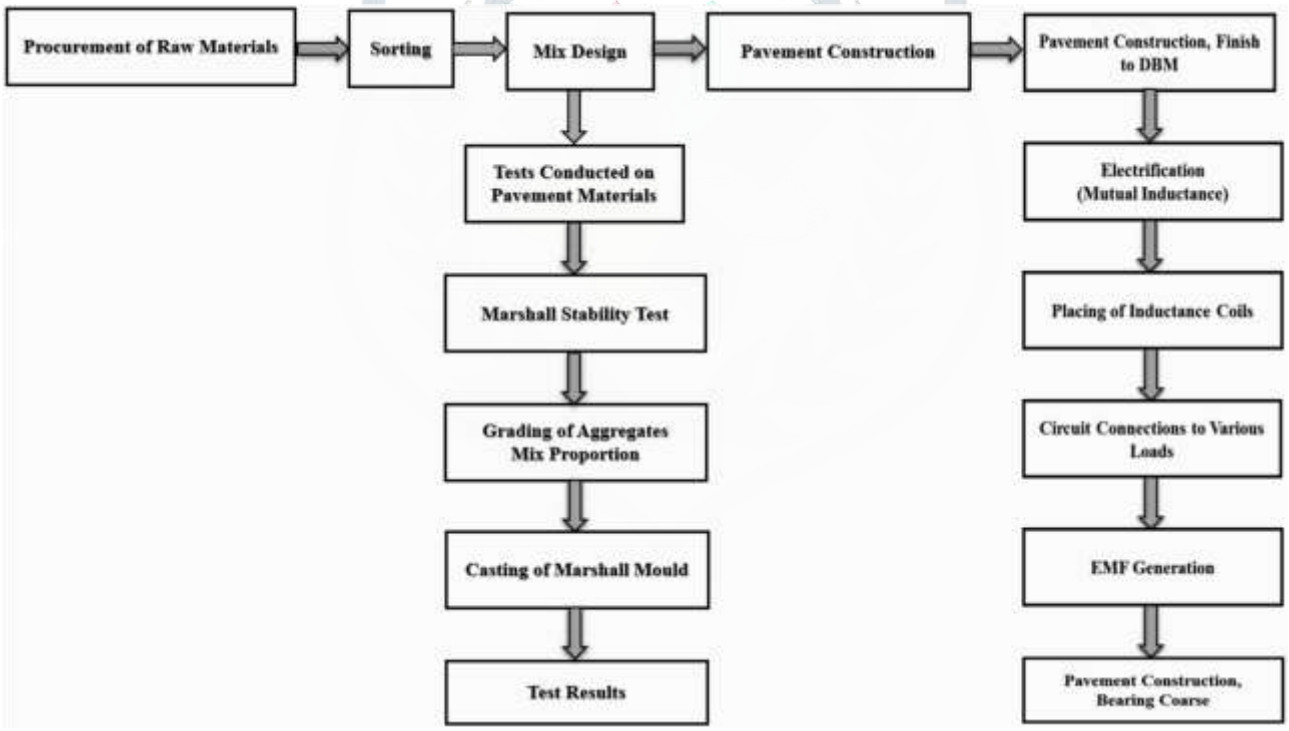
III. EASE OF USE

3.1 Test Site Details: 3 Test site where considered for carrying out the project as it was related to two different streams, the Plastic raw 3 material and its processing centre was situated at yalahanka Bangalore and the company that aided was SWACCHA ECO SOLUTIONS. The test site for the testing of the modified pavement was carried out in Assistant Executive Engineer head office National Highway Anand roa Circle Bangalore, and the last for electric works the test site considered was MC Sarovar Apartment Medahalli Bangalore.

Test Report of the Bitumen without any Replacement is given below, The methodology follows as per the MORTH book specified by Indian Road Congress.

% of Bitumen (total mix)	Bulk Density	Stability	Flow	Va	VMA	VFB
5.3	2.32	11.34	2.57	5.42	17.58	69.20
5.6	2.34	13.11	3.08	4.67	17.16	72.88
5.7	**2.34**	**14.15**	**3.44**	**3.47**	**16.15**	**73.78**
5.8	2.37	13.73	3.98	2.97	16.05	74.37

3.2 Process involved:



3.2.1 Plastic Road (Insulating Roads)

The process replacing asphalt with Plastic takes place in two different methods based on the quantity of the blend. The methods are

- Single Drum Mix (Existing Method)
- Dual Drum Mix

Dual Drum Mix: The procedure of the determining the gradation ratio follows same as the single drum mix. The blending process takes place in two different rotating heating drums. The set up of the batch mix plant is same as the single drum mix, with addition of extra conveyor belt and a heating drum.

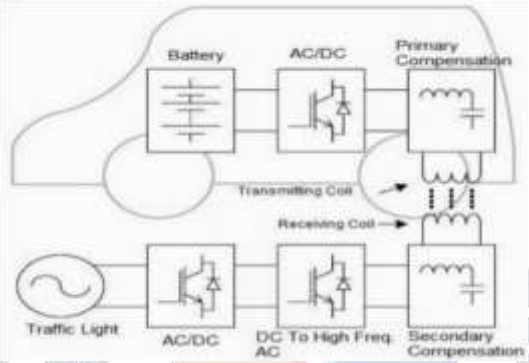
Drum 1: The graded coarse aggregates that are stored in funnels as per there size fall on to the conveyor belt where the plastic is added with specific quantity is transferred into the heating drum. In the drum the temperature is maintained 4 at 180 deg Celsius to

200 deg Celsius, at this temperature the plastic melts and blends with the coarse aggregates giving them a proper plastic coating, and the mix is further transferred to the second drum.

Drum 2: The Drum 2 consist of Fine aggregates that are hauled by the extra conveyor belt from the funnel sections, the temperature in the drum 2 is maintained at 160-180 deg Celsius, the fine aggregates are heated to average of 175 deg Celsius and the asphalt is sprinkled, the plastic coated coarse aggregates from the drum one enters the drum two where it get mixed with the blended Fine aggregates and bitumen. The whole mix is then transferred to the truck through the conveyor belt which is further hauled to the construction site. The laying temperature for the plastic pavement should be between 140 to 160 deg Celsius. Using dual drum mix the plastic replacement can be carried out upto 35%, i.e 3.5% higher then that of the single drum mix. With which the cost of the adhesive material can be reduced to 35%.

3.2.2 Electric Roads

The process of electrification takes places in accordance with the construction of pavement. Before laying the Conducting Coils the pavement is constructed upto Dense Bitumen Mix, the conducting secondary coils are then layed on the dense bitumen mix layer, and then the surface coarse layer of 30mm to 50mm is placed over it and compacted. The primary coils are fixed to the alternators of vehicles, which provides a output of 14volts, 40amps at 50 hz. As the coil is coreless the fuel consumed by the alternator to power the coils is negligible. The output of the secondary coils depends on the vertical and the horizontal distance between the coils, the coupling time of the coils governed by the velocity, and the number of vehicles passing through the coil in minute. The secondary coil is further connected to the power booster and step up transformer for better out put, which inturn is connected to the battery which gets charged over a period of time.
The circuit connections follows:



IV. RESULTS AND DISCUSSION

3.1 Marshall Stability Test Results

3.1.1 Percentage of Asphalt Replaced by Plastic

Adhesive material	Bitumen %	Plastic %	%w.r.t Dry Aggregates
Mould 1:	85	15	4.5
Mould 2:	75	25	5
Mould 3:	65	35	5.5

3.1.2 Comparative Results of Single Drum Mix (Standard Batch Mix Plant) and Dual Drum Mix

% of ADHESIVE (total	Bulk Density		Stability		Flow		Va		VMA		VFB	
	Single Drum Mix	Dual Drum Mix	Single Drum Mix	Dual Drum Mix	Single Drum Mix	Dual Drum Mix	Single Drum Mix	Dual Drum Mix	Single Drum Mix	Dual Drum Mix	Single Drum Mix	Dual Drum Mix
4.5	1.74	1.914	19.72	17.85	9.15	7.327	28.1	20.9	35.85	29.43	21.62	28.98
5	1.78	1.913	20.08	18.39	8.48	6.107	26.08	20.54	34.89	30.01	25.26	31.56
5.5	**1.78**	**1.916**	**21**	**19.27**	**7.28**	**5.31**	**26.08**	**20.43**	**35.77**	**30.13**	**27.1**	**32.17**

3.1.4 Comparatives Test Results of Single and Dual Drum Mix

SI NO	Binder %			Test Results					
	Trial 1	Trial 2	Trail 3	Trial 1		Trial 2		Trial 3	
	Single Rotating Drum Mix		Dual Rotating Drum Mix						
	Asphalt	Plastic-Asphalt Binder	Plastic-Asphalt Binder	Stability (KN)	Flow (mm)	Stability (KN)	Flow (mm)	Stability (KN)	Flow (mm)
1	5.3	4.5	4.5	11.34	2.57	19.72	9.15	17.8533	7.32667
2	5.6	5	5	13.11	3.08	20.08	8.48	18.3933	6.10666
3	5.7	5.5	5.5	14.15	3.44	21	7.28	19.2733	5.31
4	5.8			13.73	3.98				

3.2 Electric Roads Test Results

3.2.1 Trial 1: With Vertical distance of 100mm and velocity at 1km/h. Input 12v

SI NO	Power Supply to Primary Coil, Volts(v)	Vertical Distance between two coil, (cm)	Horizontal Distance Between two Coils, (cm)	Speed of The Vehicle, km/h	Time of Contact, at a distance of 30cm between two Coils, (s)	Output of the Secondary Coil, Volts
1	12	10	0	1	0	5.8
2	12	10	10	1	0	5
3	12	10	20	1	0	4.8
4	12	10	30	1	0	4.2
5	12	10	40	1	1	0.1
6	12	10	50	1	1	0.01
7	12	10	75	1	1	0
8	12	10	100	1	1	0

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3.2.2 Trial 2: With Vertical distance of 20mm and velocity at 0.5 km/h. Input 12v

SI NO	Power Supply to Primary Coil, Volts(v)	Vertical Distance between two coil, (cm)	Horizontal Distance Between two Coils, (cm)	Speed of The Vehicle, km/h	Time of Contact, at a distance of 30cm between two Coils, (s)	Output of the Secondary Coil, Volts
1	12	20	100	0.5	0	0
2	12	20	75	0.5	0	0
3	12	20	50	0.5	0	0
4	12	20	40	0.5	0	0
5	12	20	30	0.5	2	3
6	12	20	20	0.5	2	3.1
7	12	20	10	0.5	2	3.1
8	12	20	0	0.5	2	3.3

3.2 Data and Sources of Data

For this study secondary data has been collected. From the website of KSE the monthly stock prices for the sample firms are obtained from Jan 2010 to Dec 2014. And from the website of SBP the data for the macroeconomic variables are collected for the period of five years. The time series monthly data is collected on stock prices for sample firmsand relative macroeconomic variables for the period of 5 years. The data collection period is ranging from January 2010 to Dec 2014. Monthly prices of KSE - 100 Index is taken from yahoo finance.

3.3 DISCUSSION

With the conducted experiments based on the different methods and the interpretation of the acquired results, it was noted that in single drum mix, with increase in the percentage of the plastic the stability or the strength of the pavement increased to 60% to 80% (Replacement of Asphalt:15%-35% respectively) as compared to the Surface course constructed using Asphalt as the binder, the flow rate also increased with the increase in percentage of plastic as it led to increase in the void ratio of the mix, that led to increase in deformational characteristics of the pavement, where on application of excessive load above the bearing strength led to excessive deformation. With the Dual Drum Mix procedure the issues rose in the single drum mix was arrested, i.e the flow rate value was decreased to 5 % with increase in the percentage of plastic, and the stability was maintained between 45% to 60% as compared to the asphalt pavement. The electric roads, the EMF induced is purely based on the clearance between the vehicle and the coils, i.e the EMF generated is directly proportion to the vertical and Horizontal distance between the coils and to the number of the vehicles passing through one point in a minute, also the velocity of the vehicle, the above mentioned parameters governs the efficacy of the system.

V. CONCLUSION

The project was successful and able to optimize the design of a cost effective, yet efficient method of managing available reusable Resources. Intrinsically, GOT of Electricity through Smart Pavement has considerable potential for offering a balance between the elements of waste reusable plastic, the energy harvesting using both renewable and non renewable energies with considering the environmental aspects. The design is currently optimised to overcome the issues with the flow value of the pavement, with higher energy output from the electric roads, and also to develop a design that can be used for all types of pavements. The current system posses no threat of instability, and leaks of the generated EMF.

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