

## RETRIEVATION OF DAMAGED ASPHALT PAVEMENT BY HELIANTHUS

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**ABSTRACT** — The self-healing technology for the asphalt pavement is indeed a good approach to achieve economy and enhance the life of the pavement. The pavements which are usually subject to failures are healed on their own by introducing the additives such as the self-healing agents. There are various healing agents such as steel fibers, glass fibers, Nano rubber, Nano clay, etc. these materials are not economically available. Helianthus possess a mending property which alters the viscosity of the asphalt based products. Hence this property of Helianthus can be used in construction of pavements which will have self-healing capabilities. As the asphalt also has the viscoelastic properties, helianthus can accelerate the healing process. The study focuses on various techniques adopted for suitability of pavement healing. The study also reflects on suggesting a suitable material which can help in achieving the self-healing capabilities within economy.

**KEYWORDS**—: Self healing Asphalt, Viscoelastic Properties, Helianthus

### I. INTRODUCTION

Pavements play an important role in development of any nation. The road network are spread through different cities, towns, villages and to many different parts which results in communication between them and make way for development. The pavements are of two types i.e. Rigid and Flexible from which flexible pavements is used widely for highways. These flexible pavements are made up of asphalt as the binder material Asphalt is a sticky, black and highly viscous liquid or semi-solid form of petroleum. This asphalt is of two types i.e. natural asphalt and artificial asphalt. Asphalt in natural deposit is found as rock asphalt and lake asphalt whereas artificial

asphalt is obtained by distillation of crude oil. The asphalt has good binding property also it is used for waterproofing purposes. These pavements are subjected to heavy vehicular load which may result in fatigue cracking, resulting potholes and many other defects. Also there are different conditions which may also leads to defects in pavements such as low temperature, oxidation of asphalt and faulty materials. In this, fatigue and thermal cracking are dominant. [7].

So a self-healing approach is an efficient method to overcome these defects. Self-healing technique has tendency to recuperate the damage or defects happened to pavement. The asphalt has the viscoelastic nature which is advantage for the intrinsic healing that gives 10% increase pavement lifetime [1].

By adopting self-healing technique, defects mending process is enhanced. The restoration of pavement can be done by techniques such as Rejuvenators, Nanoparticles and Induction heating [10]. The rejuvenators are proposed as promising technique to compensate the revival of pavement in an optimum and efficient way [4]. In induction heating self-healing agent such as glass fibre [5] is heated to achieve restoration of pavement. To achieve self-healing mechanism in simple manner, helianthus can be used as the self-healing agent. This may prove economical and easier than other self-healing techniques. So a self-healing approach by using helianthus is carried out.

### II. LITERATURE REVIEW

Self-healing has great potential to extend the service life of asphalt pavement and it is regarded as important strategy when designing sustainable infrastructure. The self-healing concept is a natural phenomena which help to recover, repair cracks and extend the life span and it can be divided into two types in liquid based and solid based [9]. Asphalt has intrinsic healing

capacity but it may need to be modified to enhance its healing capacity. Adding a binder can help in improving the optimized pavement design [1]. Also Fundamental Understanding of chemo-mechanical properties of asphalt can lead to significant impact on the sustainability of highways and impact on environment. Various techniques and materials are used for it [5] used glass fibres from which he concluded that Glass fibre Modification of Asphalt Mix at low temperatures of 25°C has indicated increased flexure stiffness, increased resilient modulus and higher fatigue lifecycles which indicated improvement in viscoelastic behaviour. [3] used steel wool fibres in their research which also proved in improvement in healing capacity. Fibres offer excellent mechanical properties and these fibre pavement restoration processes are done by induction heating.

[10] Nanoparticles such as Nano clay and Nano rubber prove to be feasible and enhance the ageing, rheological and warm properties of black top-blend asphalt. [6] used polythene in Hot Mix Asphalt with the aim to utilize plastic waste efficiently and contribute towards wellbeing of environment. Also economy and sustainability is achieved by using polythene in the mix. Rejuvenators in the form of embedded capsules restore the original properties of binder and increase the self-healing rate by closing the crack or limiting its growth. [4] developed two encapsulation methods; polymeric shell and porous aggregate. These microcapsules can release their active agent by both ways i.e. in response to stimulus and by diffusion.

### III. MATERIALS USED FOR SELF HEALING PAVEMENT:

**Asphalt:** Asphalt is a black sticky highly viscous material obtained in natural deposits and by distillation of crude oil. It is soluble in carbon disulphide. Use of asphalt is 70% in road construction, where it is used as binding material. It is also used as water proofing product. The composition of asphalt include floor main classes of compound, they are naphthene aromatics, polar aromatics, saturated tests on asphalt.

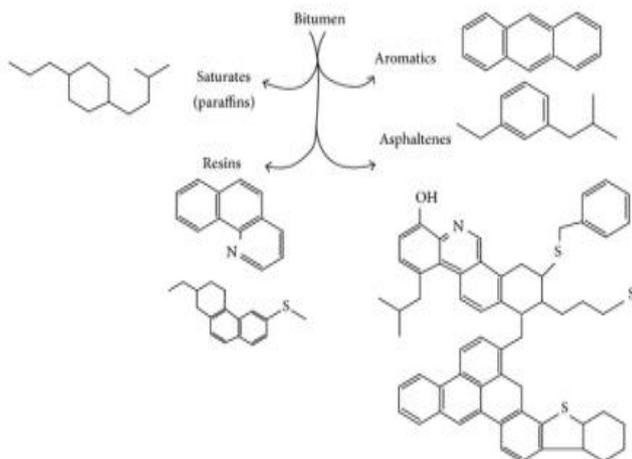


Fig. 1: Molecular structure of Asphalt (researchgate.net)

Laboratory Tests conducted on Asphalt:

- Penetration test – 30/40 grade  
60/70 grade  
80/100 grade
- Ductility test – Should not be less than 35<sup>0</sup> C
- Softening point test - 35<sup>0</sup>C to 70<sup>0</sup>C

**Aggregate:** Aggregate is a collective term for the mineral materials such as sand, gravel and crushed stone that are used with a binding medium to form compound materials. In pavements, aggregates are used for base and sub-base courses for both flexible and rigid. Aggregate can either be natural or manufactured.

The various test to be performed on aggregates include, Abrasion test – permissible range 30% to 40% max abrasion allowed

Impact test – permissible range 30% to 35%

Shape test:

Flakiness index – value should be less than 15

Elongation index – value should be less than 15

Aggregate crushing test – permissible range is upto 45%

**Helianthus Oil:** Helianthus oil is also known as sunflower oil prepared from the seeds of sunflower. It is a mixture mainly of polyunsaturated fat, linoleic acid (59%), monounsaturated fat, oleic acid (30%) flavour and has a rich content of vitamin E.

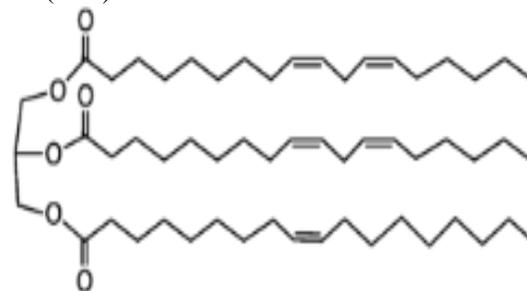


Fig. 2 : Molecular structure of Helianthus oil (en.wikipedia.org)

### IV. LITERATURE OUTCOMES:

- i. From the various researches it is known that Helianthus oil was not used before as self-healing agent.
- ii. Helianthus oil possess property of altering the viscosity of asphalt hence help in accelerating the healing process.
- iii. From various studies it is found that the self-healing asphalt methods are not economical. Also most of the chemicals are not readily available. Hence similar properties can be obtained in form of helianthus oil which is natural extract of sunflower.

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