RENEWABLE ECO-FRIENDLY MATERIAL FOR ROAD DUST SUPPRESSION AND PREVENTION

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Abstract:
Most nations, experience the menace of dust pollution as a result of numerous unpaved roads and walk ways. The cheapest solution available to us is the suppression of these particulate matter that is spewed into the environment from these roads. Chemical suppressants are being manufactured and used. The consequence of the use of these products is toxicity impact to our land and water bodies. Despite the claim at environmental friendliness, these products still dumps excess harmful salts in our environment. This paper presents an eco-friendly renewable product for road dust pollution control from a locally engineered, research based, activity. The product is a blend of protein-polysaccharide-acidulated long chain fatty acid materials obtained from locally sourced raw materials. Accelerated degradation of the product gives growth enhancing phosphates ($P_4O_{10}$), Silicates, Nitrogen ($N_2$) and organic materials. Wash offs from the product does not expunge harmful aquatic toxicants. The features of this product include among others, easy-to-use product material, 100% natural raw material input, 100% residual plant nutrient materials and long-lasting product application effect. The use of this product and understanding of the eco-friendly mechanism of action will cuttail the on going use of toxic dust suppressants and help revitalize our soil and water bodies and ensure the possible stabilization of our soil, beaches, gravel paths, walk ways and roads at a relatively cheaper cost.

Keywords: road dust, air pollution, suppressants, eco-toxicity, eco-friendly, natural suppressants, “NARICT STOP”.

INTRODUCTION

The surface layer of the earth’s crust which results from the transformation of the bare rock, and is enriched by organic input, is known as the soil. ‘Dust’, the fugitive particulate matter that is released from the soil as a result of, the laterally projected movement, over the soil surface by agents such as: wind, water, avalanche, human related activities (building and construction, agriculture, mining/industrial activities, vehicle/machine movements etc)[1]. When released into the atmosphere in amounts that is in excess of what nature can contain as at the
given time results into a condition where the environment is said to be polluted.

The fine suspended dust particles, presents a huge amount of particulate loading in the atmosphere, making road dust one major source of air pollution. It pollutes surface waters, impair visibility, increase the wear and tear on moving parts of vehicles, shade and cloggy the pores of plants causing stunted crop growth[2], etc.

With the mentioned resultant effect of dust pollution, the need for its control, becomes a thing of great importance. One way of applying this control is to control the dust emission from our unpaved roads and beaches. Ways/methods for doing this is discussed in this paper and the N.A.R.I.C.T. approach is also mentioned.

INCIDENCE OF DUST POLLUTION

The erosion of the surface of the roads, result in corrugations and potholes which requires costly maintenance or if unchecked may lead to complete loss of land mass, creating gullies and unwanted denudation.

The sinuousness of the dust generation is determined by factors like:

- Abrasive resistance of road/soil aggregates
- Amount of fine in initial aggregate mix[3]
- Climatic condition of the region (how dry/wet)
- Speed of vehicles that ply the roads…

For every vehicle traveling on mile of unpaved roadway once a day everyday for a year, one ton of dust is deposited along a 1,000 ft corridor centered on the road[4].

Soil dust from roads contribute about 10% of the annual total particulate emissions worldwide[5] and has the tendencies to alter weather patterns[6]. Fine dust particles are washed of during precipitation and carried into streams, creeks and lakes consequently increasing their turbidities.

Dust clouds travel over long distances across places with different environment passengers which may be alive to the new host environment such alien passengers like differing strains of bacteria, fungi and viruses may cause severe health complication to the inhabitants of the new, host environment. Road dust is more than soil fines, it is admixed with fine particles from tailpipe emissions and scientists have established a link between upper respiratory illness, cardiovascular diseases like arrhythmia and cancer to road dust[7]. It affects lung function and at a much higher level of exposure, impair lung function parmently[8]. It is known that unpaved roads in the united States produce about 10million tons of particulate matter air pollution annually[9].

Unfortunately, this hydro-headed demon does not occur only from unpaved roads, it may even be considered more dangerous when coming from the paved roads because, apart from the re suspended dust particles, the contact between the vehicle tyre and the paved surface of the roads, generates a complex type of particulate material mix that comes from the tyre, brake-lining and tail pipe emissions[10]. Road pavement particles primarily consist of the rock material of the pavement and a few percent of bitumen. These particulate matter come in sizes of less than 10μm in aerodynamic diameter which makes them nearly invisible to the naked eye and consequently more dangerous[11].
likely result of the damage is an over aggressive immune response to the lungs”[12].

A different kind of allergy is associated with the vehicle tyre, this is known as the allergic reaction to latex[13]. The same latex/rubber substance is also constantly being inhaled by people in the urban areas mostly and one can imagine what will be the cumulative allergenic effect after a prolonged exposure time. All these goes to explain the observed climatic/weather, fruiting and behavioral changes that are found in our ecosystem. Unfortunately, they are not seen as consequential because they occur as: (1) isolated cases, (2) insignificant but cumulative dosages and (3) unseen/microscopic particulate material guest within our environment.

For every cubic metre of air, an increase of 20 micrograms (mcg) of particulate matter means a 1% increase in deaths from all causes[14 and 15].

We do not need to wait for the “dust bowl” experience of 1930s that occurred in the united States [16], before something serious is done about dust pollution in our environment.

**METHODOLOGY (REMEDIES)**

Stabilization of soil of paved or unpaved roads, amongst other things, ensures the conservation of road surface fines preventing the generation of fugitive dust while protecting the surface from deteriorating all these commutate into a reduced road maintenance cost and a marked level of 10m air pollution.

The primary target(s) start of the stabilization process is

(1) Waterproofing,.  (2) Cementation. (3) Increase soil particle cohesion. (4) Improving as well as maintaining soil moisture content.

With these targets in mind, in the event of stabilization of coals (unpaved), road dust control is also achieved.

Invariably, soil stabilization is the modification the physical properties of soil aggregates to meet a specific structural standard capable of resisting the laterally-projected flow movement of objects in contract with its surface area, over a reasonable duration of time despite the climatic and weather conditions; some of these properties that are modified are : small volume changes, strength (measured in terms of the shearing strength of the soil. It determines the ability of the soil to contain an imposing load),durability, permeability (moisture retention and control) and soil layer thickness.

Table. I presents a concise dust prevention methodology suitable for both paved and unpaved road networks. A careful study of table 1, shows that despite the positive attributes of biodegradable products, they still have their limitations and these limitations have been the primary concern of this work. The search for a product with enhanced performance, yet biodegradable and cheap with a 100% local contact led us to the selection of a blend of materials with a resultant optimum dependability.

“NARICT-STOP” is a product blend of a protein isolate, polysaccharide cementing material and a seed oil emulsifier. Though this product is still at the laboratory stage, it is expected to take-care of the short-comings of the lingo sulphonates, chloride salts, tree resins, eliminating the use of synthetics and still presents an environmentally friendly product at a very cheap cost.
The protein isolate is obtained from an alcoholic extraction of a seed carbohydrate at a temperature range of between 40-80°C.

The polysaccharide cementing material is obtained from the alkyl modification of a cellulose material under alkaline condition.

The seed oil emulsifier is obtained from alkaline refining of a seed oil with subsequent acidulation and neutralization.

These are then blended using an optimized blend ratio to obtain the dust suppressant NARICT STOP.

DISCUSSION AND CONCLUSION

A good dust control material is not selected based only on cost and environmental friendliness (though very import), but also on the type and volume of traffic, performance characteristics as well as availability of the products raw material. The State of the road and probable product application quantity that will achieve a desired dust control effect, plays very vital roles in the selection process.

Method of application of the additive(s) also determines ultimate end result. Basically, there are two methods of applying this product depending on the stage of work at the road site. For roads that are still being constructed, the “MIXED –INs PLACE” method is advised. For the maintenance of an already in use road, the “topical-spray” method is the choice. “NARICT-STOP” is engineered to provide the environmental and product service requirements that the already existing additives have failed to provide.

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