



Environment & Climate Change

Eco-Roads and Surfacing

Six main technology areas with significant potential for beneficial exploitation for road surfacing and paving purposes have been identified. The following are interesting extracts from the report ([Eco-Road Building for Emerging Economies](#)):

Wood or Palm Lignin

Lignin is one of the most abundant organic polymers in the world, containing 30% of non-fossil organic carbon, about 50 million tons is produced annually as residue in paper production. In the form of Lignin sulphonate, a paper pulp industry waste stream, it has been used for about a 100 years to control dust and stabilise gravel on unpaved roads in the USA and Sweden. Furthermore, the new biofuels industry is expected to deliver abundant fibrous lignin from palm oil extraction.

Pine Resin or Tall Oil

Tall oil, also called liquid rosin or tallol, is a viscous yellow-black odorous liquid obtained as a by product of the Kraft process of wood pulp manufacture. Tall oil is a mixture of fatty acids and resins which tend to be separated into "Tall oil rosin", "Tall oil pitch" and Tall oil fatty acids, and have been employed as a tar/bitumen substitute often in combination with other bio materials.

Drying oils and Semi drying oils

A "drying oil" is an oil which hardens to a tough, solid film after a period of exposure to air. The oil hardens through a chemical polymerization reaction in which oxygen is absorbed from the environment. This property is the basis of conventional paint technology. The cross linking process can be manipulated by catalysis heat and oxygen. Unsaturated vegetable oils are widely available from a range of oil seed crops and, through the new biofuel industry, non food vegetable oils such as Jatropha are becoming available. In combination with other locally available biopolymers it should be possible to devise waterproof sealing systems with sufficient resilience for low volume road surfacing.

Oil, Resin and Biomaterial blends

After a long history of patented mixtures and often inadequate performance in low maintenance surfacing, recent innovations using blends and emulsions of pine



pitch, rosin and vegetable oils have begun to reach commercial success as ecologically acceptable alternatives to bitumen based products. Kraft paper can be bleached to produce a high quality white paper which does not yellow with age.

More sophisticated control over polymerisation conditions using oxidation catalysts and various pre-treatments may have led to this success. Examples are Vegecol tm colourable pavement system from Colas, and Ecopave -tm- from Australia which appears to use a wide range of organic waste streams and may be adaptable to a variety of local resources. Initially, this group of materials is probably the most promising approach for replacement of bitumen/asphalt binders as both technology and experience in use is available. The main challenges will be affordable cost and appropriate technology implementation.

Pozzolanas as Cement Substitutes and other waste streams

One of the most exciting opportunities is the replacement of Portland cement with rice husk pozzolanas and lime. Up to 130 million tonnes of husk could be available annually on a global basis for pozzolana production. As the ash content by weight is about 20%, there are potentially 26 million tonnes of Rice Husk Ash (RHA) available as a pozzolana. Other sources of Pozzolanas include fly ash from power stations, kilns and furnaces. Apart from the attractions of cost and foreign exchange savings and zero net carbon footprint, there is scope for encouraging local low technology industries. The main challenges will be achieving high yields through combustion temperature control in simple combustion units.

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Geotextile and Biofibre Reinforcement

This opportunity would access the approximately 2x10¹¹ tons of lignocellulosics produced every year world wide, making them one of the world's most abundant natural raw materials. Numerous useful fibres are produced as secondary or waste streams in tropical agriculture, from primary sisal, through coir fibre to maize stalks, rice straw and bagasse (from sugar cane). There is an opportunity to incorporate such materials as textiles or random fibres for soil stabilisation and as fibre reinforcement for pavement structures, possibly in combination with biopolymers and pozzolanas.

In summary, there is enormous potential to escape from the high-energy, environmentally damaging, dependence on petrochemical and cement based industries, to develop sustainable, low carbon footprint solutions utilising local resources and initiate productive local employment in developing countries. This could create a fast-track solution to the universal provision of affordable, sustainable, basic access to the more than a billion people living in poverty in developing countries.

Kraft paper: Is produced by the kraft or sulphate process which removes the lignin from wood chips by heating with sodium hydroxide and sodium sulphide to yield a pulp which is almost pure cellulose. The paper made from it is strong but initially brown in colour. Kraft paper can be bleached to produce a high quality white paper which does not yellow with age.

For further information

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