

A TECHNOLOGICAL APPROACH TO UTILIZE TANNERY SOLID WASTE IN ROAD CONSTRUCTION

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ROAD PAVEMENT

- **CLASSIFIED**
 - FLEXIBLE PAVEMENTS
 - RIGID PAVEMENTS

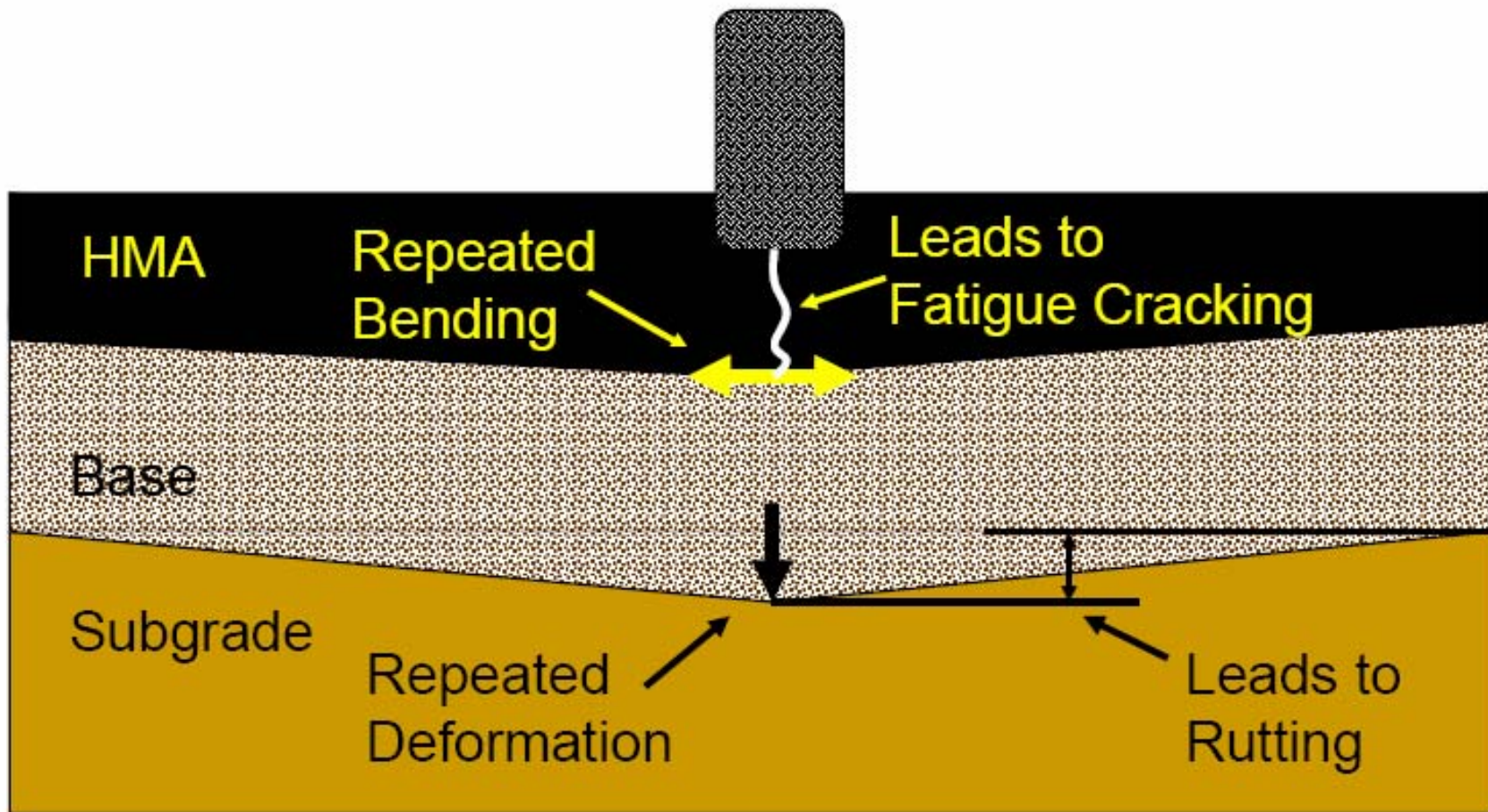
ROAD CONSTRUCTION MATERIALS

- **CEMENT**
- **AGGREGATES**
- **LIME**
- **BITUMEN**

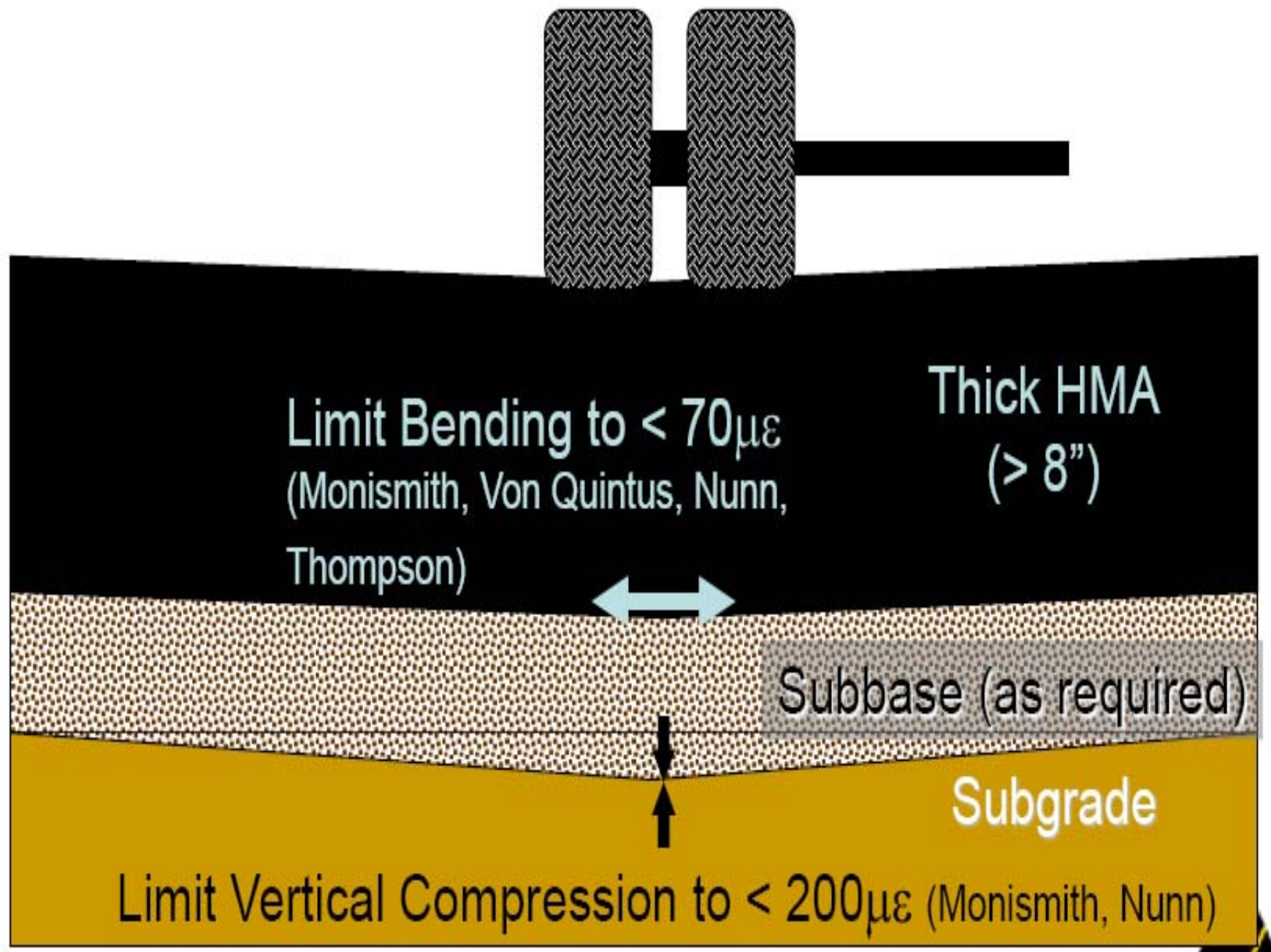
REASON FOR FAILURE

- **Increased Traffic**
- **Slow moving vehicles**
- **Channelised traffic movement**
- **Over loading in combination**
- **Insufficient degree of maintenance**
- **Extreme climatic - caused frequent deterioration of flexible pavements particularly in urban areas.**

Design asphalt layer thickness to avoid fatigue cracking and rutting in the subgrade



(from APA)

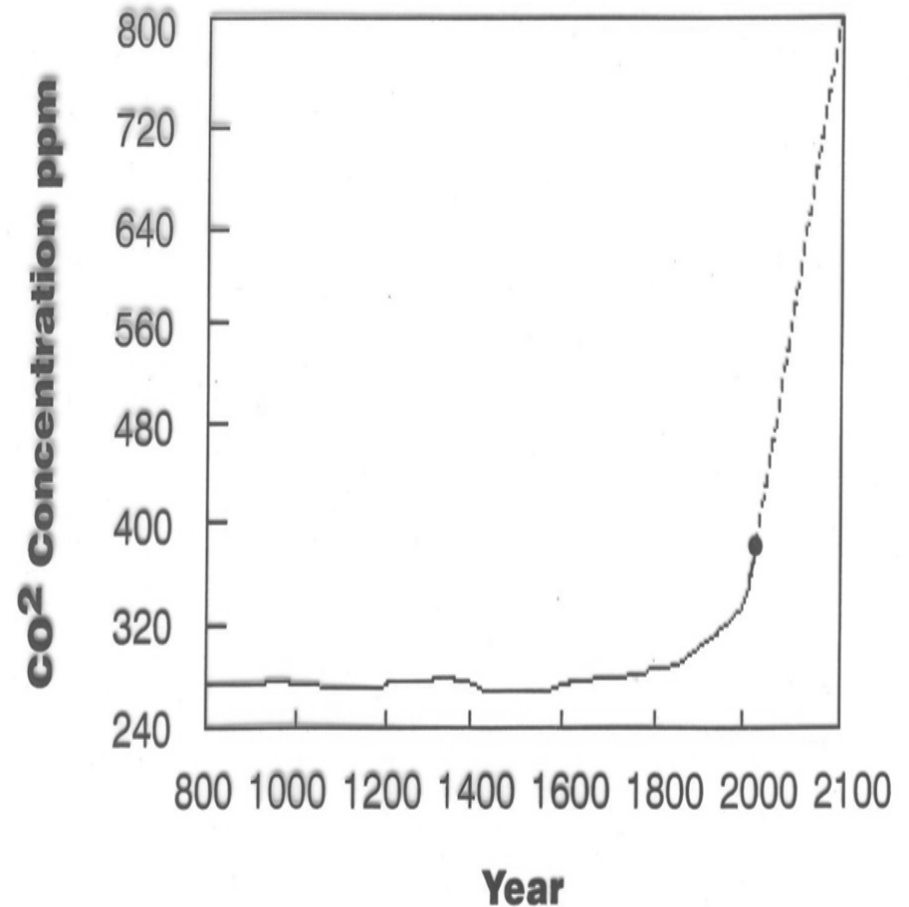


EMERGING TOPICS

- **THE MOST URGENT SUSTAINABLE ISSUE -GLOBAL WARMING**
- **CEMENT INDUSTRY'S CO₂ EMISSIONS, AND TOOLS FOR CUTTING CO₂**
- **SUSTAINABLE TERNARY-BLENDED CEMENTS: COMPOSITION AND PROPERTIES**

CO₂ EMISSIONS - THE MOST URGENT GLOBAL PROBLEM

- The Earth's atmospheric CO₂ during 1950 - 2000, it rose to 390 ppm.
- Today, it is 400 ppm, and rising at the rate of 2- 3 ppm every year.
- About 450 ppm is the critical threshold that must not be crossed to prevent irreversible climate change.



CO₂ EMISSIONS - A REPORT CARD FROM THE CEMENT AND CONCRETE INDUSTRY

- **Over 90% of carbon emissions are from the concrete industry during the clinker production in cement kilns. Approximately 1 tonne CO₂ is generated for making 1 tonne of clinker.**
- **In 1990, direct CO₂ emissions from cement kilns were about 940 million T/y, compared to 1740 million in 2005. During the last 15 years, the carbon footprint of the cement industry has almost doubled.**
- **Recently, world cement production is growing at the rate of 8 - 10% per year. With business as usual, in next 20 years it is projected to grow at a rate of 6% per year, which is unacceptable because, compared to 1990, this will triple the cement industry's carbon footprint by 2030.**

TOOLS FOR CONSUMING LESS CONCRETE

- **Note that 45% of the world's concrete is consumed by new buildings, 15% by infrastructure projects, and 40% for repair and renovation of the built environment.**
- **Use highly durable concrete mix designs for foundations and other massive elements of new structures and for repair of old structures.**
- **An emerging technology shows that 50 to 70% Portland cement can be replaced with one or several complementary cementing materials, such as coal fly ash, granulated BFS, natural pozzolans, silica fume and rice husk ash, with dramatic improvements in properties of concrete. This can be done either by blending in a cement**

SOLID WASTE

- **During the processing of skin into leather significant quantities of solid wastes are generated.**
- **Solid wastes obtained are in the form of hair, fleshing, trimmings, leather strips and cuttings.**
- **Chrome shavings (CS) are another major solid waste generated during leveling of wet blue (chrome tanned pelt).**
- **Considering the quantum of organic and inorganic waste available in tanning sector, a pilot scale project may be undertaken to utilize these waste in the following thrust areas.**

THRUST AREAS

- **LIGHT CONCRETE USING CHOPPED LEATHER TO IMPROVE INSULATION AND NOISE CONTROL IN BUILDING CONSTRUCTION**
- **CaSO₄ (NEUTRALIZED LIME FROM FLESHING) IN CEMENT FORMULATION (TERNARY MIX)**
- **CHROME SHAVINGS AS FILLER IN BITUMINOUS MIX**
- **ANIMAL PROTEIN AS AIR ENTRAINING AGENT IN CEMENT CONCRETE**

JOINT WORK BETWEEN CRRRI AND CLRI

- **CRRRI AND BIO-TECHNOLOGY
DIVISION OF CLRI ARE NOW JOINTLY
WORKING ON:**
 - **TO DEVELOP A NEW CEMENTITIOUS
BINDER USING TERNARY MIX FOR FRESH
CONCRETE**
 - **CHROME SHAVINGS AS FILLER IN
BITUMINOUS MIX**

SOURCE OF TERNARY MIXES

- The total hide/skin available is about 1359085 ton. To process these about 815451 ton of $\text{Ca}(\text{OH})_2$ being used to generate 1467812 tons of CaSO_4 . Binary or ternary blend will be formulated using CaSO_4 to develop a new cementitious binder for road application.
- In India the annual production of fly ash is nearly 45 million tones per year. This is likely to increase to 70 million tons per year by 2010.
- At present most of the fly ash are being dumped in about 14000 Hect which makes environmental concerns.
- In order to utilize these waste as a constituents in cement concrete, a research project has been

TERNARY BLEND

- **THE TERNARY BLEND WILL BE THE COMBINATION OF CALCIUM SULPHATE (WASTE LIME FROM LEATHER INDUSTRIES) + FLY ASH + SILICA FUME.**

LITERATURE SURVEY

- **K.Kovier reported in his project that a blend of 70% gypsum (Calsium Sulphate), 20% Portland cement and 5% silica fume was recommended for having improved properties of fresh concrete.**
- **Brain et.al reported that the ternary mix having calsium sulphate shown dominant ingredients to develop adequate strength in dry environments.**

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- **Adnan Colak reported that the gypsum content in the concrete mix play very important role for improving the compressive strength of the concrete. Also concluded that a blend of 41:41:18(gypsum-portlandcement-natural pozzolon) with 1% super plasticizer give excellent property retention after ageing of 95 days.**
- **J.Jasiczac et.al reported that the animal protein in the cement mortar has a significant impact on basic physical and mechanical properties of the hardened mortor. The intensity of the property is about 10-fold higher than the chemical air entraining substances.**

ANIMAL PROTEIN AS AIR ENTRAINING AGENT IN CEMENT CONCRETE

- **The ancient Egyptians, Greeks, and Romans, who started using various natural protein substances such as blood, animal fat or milk in concrete**
- **A small quantity of powdered protein at the rate 0.2 – 1% by weight of cement is sufficient to entrain 5-25% of air.**
- **When mixing the ingredients, air entraining additives have foaming properties, improve the dispersion of cement grains and create air bubbles of 20-250 μ m which are well distributed in the whole mortar.**
- **During the hardening of the cement, bubbles partly get mineralized and become stable component of the mortar.**
- **Air entraining admixtures increase the workability of the fresh mortar, increase its waterproofing and freeze-thaw properties as well as resistance to corrosion.**

CHROME SHAVING POWDER AS FILLER IN BITUMINOUS MIX

- **TYPES OF BITUMINOUS MIX**
 - **OPEN GRADED BITUMINOUS MIX**
 - **STONE MATRIX ASPHALT(SMA)**
 - **DENSE GRADED BITUMINOUS MIX**
 - **BITUMINOUS CONCRETE (BC)**

- **IN SMA ABOUT 0.3 % FIBER (BY WEIGHT OF MIX) ARE BEING USED AS STABILIZING AGENT**
- **IN BC ABOUT 2% FILLER ARE BEING USED**

LEATHER

- PDBaffa and J.Akasaki reported that 10 to 100% chopped leather by weight of cement can be added to formulate light concrete.
- They also concluded that 50% of chopped leather can be used in other non-structural application such as filling in slabs and walls to improve insulation and noise control.
- The chopped leather in the concrete sample was below 10 mm size. The leather waste has pH less than 7 and in this case can be neutralized with $\text{Ca}(\text{OH})_2$ that do not affect the cement.
- The deterioration of the leather piece can happen with chemical reaction in pH below 2 and above 14 after several days, or subjected to higher temperature more than



CONCLUDING REMARKS

- **Cement less concrete will be formulated to have CO₂ free environment in future.**
- **Binary or ternary blend will be formulated using CaSO₄ to develop a new cementitious binder for road application.**
- **Chrome shavings as an alternate filler in bituminous mixes**

REQUEST TO THE AUGUST FORUM

- COLLOBRATIVE WORK
BETWEEN CLRI-CRRI-
LEATHER INDUSTRY TO
OPTIMISE THE POTENTIAL
USAGE OF LEATHER
INDUSTRY SOILD WASTE IN
ROAD CONTRUCTION**

Thank You