

# Questions and Answers to Ecopave Australia™

Sandra Lawson Interview

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Sandra Lawson [Thursday 1 September 2005]

I interviewed Mr Eerik Owerhall™ of Ecopave Australia™, we talked about their world first Asphalt bitumen from Renewable Resources™ GEO320™, Biobitumen™, MRH™, Bioasphalt™, Biopave® inventions and other related issues. Ecopave Australia was established in 2002 to commercialize the GEO320™ Bio-Bitumen™ adhesives technology, which the family has worked on since 1982. They have struggled against all odds, over-coming endless false smear campaigns to discredit their humble reputations, character and credibility and they have persisted with the bureaucratic system that has always been inherently pro-petroleum, from financial markets, policy makers to government departments.

### Q: 1, How long has your family been researching GEO320™

Our family began the research program in 1982 to find an alternative Asphalt Bitumen from Renewable Resources™ binder that could be applied in the manufacture of Mastic and Dense Graded Asphalt DGA that was suitable for Australian and European conditions, which has been tested by numerous organizations since.

### Q: 2, What is GEO320™ biobitumen™ made from?

Bioasphaltbitumen™ is made from low molecular weight (Molecular mass) materials such as sugar and molasses, vinasses, natural tree and gum resins, natural latex rubber and vegetable oils, also suitable raw materials are, palm oil waste, coconut waste, peanut oil waste, canola oil waste, lignin and cellulose, potato starch, corn starch, rice starch and wheat starch etc.

GEO320™ can also be made from the distillation bottoms fractional distillation derived in the process of cleaning used motor oils etc. GEO320™ and MRH™ biobitumenasphalt™ can be manufactured from wide variety of water soluble renewable resources (non-petrochemicals) as well as from recycled petrochemical materials.

The process of manufacturing GEO320™, MRH™, Bio-Bitumen™, Biopave® and biopavement™ is the ability to convert water-soluble material e.g., sugar or molasses into an insoluble material, thus being able to control the Cross-linking and branching reactions in the binder matrix formulations very precisely. The benefit of this system is that the end product is entirely non water-soluble and highly immune to common solvents such as gasoline, naphtha and aviation fuel [avgas] acids etc. It is essential to note that the full solvent resistance is gained in the final asphalt composition thus benefiting the end user i.e., petrol terminals, petrol stations and anywhere where solvents and acids are exposed to the asphalt surface. Since GEO320™ can be made from non-petroleum waste and pure [neat] raw materials, the environmental benefits are numerous, for example, there are no harmful by-fumes emitted at the time of the bitumen and asphalt manufacturing stages or at the time of asphalt placement on the road.

The fact that GEO320™ is made from renewable resources encourages sustainability. Also because GEO320 can be pigmented economically, the lighter asphalt surfaces contribute positively to the Urban heat island Effect. GEO320™ does not compete with global food resources and since it can be manufactured entirely from waste food i.e., molasses etc and vegetable and plant [biomass] raw materials i.e., cellulose lignin etc.

GEO320™ BioBitumen™ and Bio-asphalt™ encourages the production of more food and plant cultivation of which waste materials can be further utilized and converted to GEO320™ road grade bio-bitumenasphalt. Conventional residue Bitumen has always been un-safe to work with due to the potential grievous burns to plant and road work crew because normal bitumen has to be held in a hot liquid suspension by storing in heated containers.

Since GEO320 comes in dry granulated form, it can be stored indefinitely and is only introduced at the hot aggregate asphalt Mixing [(process engineering] stage. From the point of Occupational Health and Safety OH&S, this is a great benefit since there is no more exposure hazards to fumes for asphalt plant and road workers, which hence make the work place safer.

Asphalt made with GEO320™ MRH™ [Mastic roller hybrid™] bitumen is less slippery due to two crucial features a) it has a lower oil content than conventional residue bitumen b) the mix design that was designed in the mid eighties in the MRH asphalt formulation has a micro aggregate protrusion MAP profile meaning that once the surface has undergone roller compaction the asphalt surface retains fine silica particles and resembles very much standard sand paper. The surface finish is therefore comparable to a properly

constructed mastic asphalt with the addition of having zero air voids 0% all the way up to 20% if drainage asphalt and Permeability is required.

### Q: 3, What are the Environmental benefits of using GEO320™?

Since GEO320 can be manufactured from non-petroleum raw materials the environmental benefits are numerous, for example, there are no harmful by-fumes emitted at the time of the bitumen or asphalt manufacturing stage or at the time of the asphalt placement on to the road. The fact that GEO320 is made from renewable resources promotes sustainability.

Also because GEO320 can be colored economically using the pigment coloring system specifically developed by Ecopave Australia™ for this purpose. The lighter asphalt surfaces impart positively to the Heat Island Effect, the US EPA web site describes the heat island effect very well, "The heat island effect is a phenomenon that describes urban and suburban temperatures that are [1-6 Deg C] hotter than nearby rural areas. These Elevated temperatures can impact communities by increasing peak energy demand, air conditioning costs, air pollution levels, and heat-related illness and mortality".

GEO320 MRH Asphalt is also beneficial where water permeability (drainage asphalt) is desired, permeable asphalt made with GEO320 bitumen is also cheaper per square meter than conventional cement or brick pavers and the manufacturing process does not emit huge CO2 emissions in the same way that cement production does, conventional cement concrete production accounts to around +5% of all the global CO2 emissions and is therefore an un eco friendly construction material.

### Q: 4, What are the performance benefits of GEO320™ compared to normal bitumen?

GEO320™ MRH™ has many performance benefits compared to conventional road grade bitumen and asphalt and they are:

- Higher rheological and mechanical performance properties
- is made into granulated form hence no hot storage required but can be stored hot if desired
- higher durability and fatigue properties
- resistance to solvents and acids
- lower volatile emissions low heat absorption
- light reflecting surface [retro reflectivity] in colored form.
- fully pigmentable
- wide variety of recycled plastics and tyre rubber can be used
- non fuming
- coloring system used is wear, efflorescence and fade resistant
- is made from renewable resources e.g., sugar and water soluble waste materials such as molasses, is highly resistant to damage caused by i.e., wear, ice, salinity, heat, plant growth and to sub-grade deformation etc.
- optional glass spheres [balotini] in the asphalt mix to give strength, lower infrared heat absorption and increased light reflectivity to increase road safety
- lower application and workability temperatures of asphalt Warm Mix Asphalt - WMA
- Increased skid and abrasion resistance to conventional roller (compacted) and stone mastic asphalts Micro-Mastic-Matrix™ and MRH™ Technology
- is non toxic
- Warm mix asphalt
- Thinner and stronger road construction.
- High anti slip and skid resistant GEO320™ MRH™ Prevents Asphalt Failures.

### Q: 5, Why is GEO320™ MRH™ bitumen less hazardous to use than conventional bitumen?

Bitumen has always been hazardous to work with due to the potential serious burns to plant and road crews because normal bitumen has to be kept in a liquid suspension by storing it in heated containers. Because GEO320™ comes in a dry granulated form, it can be stored indefinitely and it is only presented at the hot aggregate asphalt mixing stage. From the point of Occupational Health and Safety, this is a benefit since there is no more exposure hazards to fumes for the asphalt workers, which make the work places safer?

### Q: 6, How does the cost of GEO320™ compare with normal bitumen?

GEO320™ MRH™ is very economical to produce, if roads are made in the conventional black in GEO320™ case natural [off brown], color, then the cost would be around \$A 0.20 - \$A 0.35 c/kg [in 2008]. It must be noted that the bitumen content in an asphalt mix is only around 5% or 50kg per1000kg of asphalt. Asphalt sells for around \$A 120 - \$A 150 p/ton [in 2008] the average asking price per sq meter is around \$A 40 - \$80 per square meter at an average thickness of around 50mm. The coloring of GEO320™ is also economical because we only need to use 0.3% pigment loading for pastels or 1.0% for vivid [bright colors] using our own developed pigmenting color system.

### Q: 7, Why is GEO320™ asphalt surface less slippery than conventional asphalt?

Asphalt made with GEO320™ MRH™ bitumen is less slippery due to two important characteristics 1. it has a lower oil content than conventional bitumen and 2. the mix design that we designed in the late 1980s in the MRH asphalt formulation has a micro aggregate protrusion (MAP), meaning that once the surface has gone through roller compaction the asphalt surface retains these fine silica particle sand resembles very much your regular sand paper or cement concrete. The surface finish is therefore comparable to a properly constructed mastic asphalt with the added benefit of having void content anywhere from 0% and up to 20% especially when permeable paving construction is desired drainage asphalt.

Road paving made with cement concrete have traditionally exhibited better higher anti-slip surface characteristics compared to bituminous asphalt, which is why GEO320™ MRH™ asphalt surface texture was designed to resemble that of well constructed cement concrete paving. Due to the internal composition of conventional residue bitumen such as the addition of oil contributes greatly to the slipperiness of road surfaces even in dry weather conditions. One of the reasons is that the passing motor vehicle traffic excrete hydrocarbon material on to the road surface such as motor oil, gasoline, brake fluids, power steering fluids, transmission fluids and greases including soot etc, which all encourage the softening and degradation (dilution) of the bitumen within the asphalt composition. The voids (air pockets) in asphalt pavement help in the absorption of these contaminants which in time leads to the premature failure of the asphalt road construction exhibited by cracking, chipping and rutting (Asphalt Failures).

In the years gone by many roads were manufactured around the world using cement concrete as a preferable paving material but were discontinued due to the developments of more economical, faster and easier ways to construct roads by the use of bitumen as a binding agent. Road surfaces made from cement have always exhibited excellent anti-slip qualities due to the lack of internal binders that have reacted to heat (Thermoplastic) within the aggregate matrix subsequent to its application on to the road surface. These are one of the reasons why Ecopave Australia™ Research developed the MRH™ range of GEO320™ and Bio-Pave™ asphalt technologies, to be able to offer asphalt surfaces that performed even better than cement concrete with (no voids or excessive oil content) and therefore increase the slip-resistance behavior and durability of asphalt roads compared to conventional residue bitumen (petroleum bitumen) asphalt. In reality a properly manufactured asphalt road using zero-void [air pocket] mix design, is no different to a properly constructed road using cement concrete in terms of water permeability and slip resistance, the two are identical in these respects.

### Q: 8, What does the term MRH™ Mastic Roller Hybrid stand for?

MRH™ stands for Mastic Roller Hybrid™, apart from representing new bitumen adhesives technology, GEO320™ comprises of new asphalt paving technology also, what this means is that Ecopave Australia™ Research has designed GEO320™ MRH™ asphalt to be utilized in the same roller compaction technique as conventional Dense graded Asphalt DGA that yields structural performance and road safety to that of Mastic Asphalt.

The significance's of this combination of technologies is a very important asphalt improvement, roller compaction gives us the usual benefits of the ease and speed of paving and manufacturing of asphalt and the MA Mastic Asphalt gives us the benefits of increased resistance to Fatigue, cracking and the ability to create water tight [zero voids] pavement structures when desired hence the anti skid surface.

Broadly speaking the Ecopave Australia™ Research has also demonstrated that asphalt matrix does not need to contain voids (air pockets) to aid water dispersion, but rather the water penetration or Permeability of decently constructed road surfaces can be successfully replaced by allowing adequate amount of slope [run off] at the road construction design stage.

One of the benefits that GEO320™ MRH™ adds to Mastic Asphalt is that the GEO320™ MRH™ asphalt composition is made with only 4-5% bitumen content, which eliminates any possible bleeding [surface oozing] problems as may have been experienced in the past with conventional dense graded asphalt with its 5% bitumen loading and SMA Stone Mastic Asphalt with 7-10% bitumen loading .

Since GEO320™ Bitumen in it-self is slip resistant it provides increased road safety and It is important to distinguish between stone mastic and mastic asphalts in general, Stone mastic has a diametrical aggregate mix design with larger stone sizes and which has less fine end aggregates, Mastic on the other hand has a micro matrix structure all the way to maximum stone size of around 10mm. Micro Mastic matrix™ or (MM™) is more durable, is highly resistant to rutting, cracking and solvents and has high anti-skid characteristics Note; that conventional Stone Mastic asphalt is prone to slippery surfaces caused by excess bitumen build up on the surface "Binder-shift™" mainly due to contractor or manufacturing error [excess bitumen], and the slippery nature of petroleum based residue bitumen is also a highly contributory factor.

#### Q: 9, How does GEO320™ compare to petroleum based Class 320 or Multi grade bitumen?

GEO320™ was designed to be a Multi grade [Universal Bitumen] bitumen from the outset since it is much easier to employ one grade of bitumen binder and eliminate the juggling between different bitumen grades. GEO320™ can be manufactured to perform anywhere from class 600 to class 170. As far as the conventional Class 320 or multi grade is concerned, GEO320™ out performs in durability, fatigue and crack resistance by a considerable margin.

#### Q: 10, What is the difference between roller compacted and stone mastic asphalt?

The roller compaction of dense graded asphalt or DGA differs from mastic in that it softens at lower temperatures and is generally formed by using a softer grade bitumen by adding volatiles and cutters so that it can be handled and compacted and maintain workability and particularly after long transporting distances to the construction site, and to be able to withstand long hot storage conditions without excessive degradation Oxidation.

The bitumen content in conventional rolled asphalt mix or DGA using this bitumen is around 5%, whereas conventional Mastic Bitumen are difficult to process due to their hardness aspect, the bitumen is made harder by blowing air through molten bitumen by Oxidation. Mastic asphalt is generally manufactured using paddle type mixers melting the bitumen and adding aggregates and is Green [raw] cooked at around 200°C for many hours until a uniform asphalt, mixture is achieved. The manufacturing of asphalt in this way is much more critical in terms of maintaining the correct bitumen to aggregate proportions and paying attention not to burn the bitumen by over cooking.

The application of Stone Mastic also differs in that it is traditionally handled much in the same way as cement concrete is by hand the asphalt is poured whilst very hot and using spreading implements or paving machines to achieve a straight and smooth pavement surface. The bitumen content of conventional Mastic is around 7-10%, it must be noted that bitumen that are desirable for the use in Roller Compaction or DGA asphalt in general are from the softer Class or multi grade groups and are not suitable for conventional Mastic or Stone Mastic asphalt paving applications due to their resinous character, to use them would induce bitumen pooling [bleeding] which in turn would cause the road surfaces to become slippery for pedestrians and passing traffic.

It is therefore paramount that the correct bitumen grade is selected from the harder bitumen groups to insure positive paving outcome when SMA Stone mastic asphalt is manufactured.

### Q: 11, What is the meaning of the term binder-shift?

Binder Shift™ is basically a term Ecopave Australia coined to describe the effect of an oily residue that remains on the road surface after it has been constructed which in effect is transferred by traffic from one area of road to another and therefore contribute to the slipperiness of road surfaces and is a major road hazard. More of this residue is generated to the asphalt surface in hot summer months when roads become softer.

This oily residue is continually forced leaked to the surface under hydraulic pressure over time as the open voids become smaller under the weight of the passing traffic. Mastic Asphalt partly resolves this problem but not as well as our developed Micro Mastic™ MM™ or Mastic Roller Hybrid™ MRH™ asphalt which can have zero void content pores and its suitability for full load bearing road construction.

### Q: 12, How does GEO320™ differ from normal bitumen?

Since GEO320™ is a non-Newtonian fluid it exhibits rheological behavior contrary to normal bitumen. This difference brings important benefits that when controlled properly equate to improvements in performance characteristics compared to petroleum based residue bitumen. GEO320™ is made from environmentally friendly renewable resources and the fact that we can like wise incorporate recycled plastics and tyre rubber in to the binder and asphalt formulations which in turn contribute advantageously to the environmentally friendly renewable re-cycle.

### Q: 13, Where did your family get the idea to develop GEO320™?

Our Family realized in the early 1980s that due to the hot summer conditions normally used mastic asphalt made with its bitumen content of around 10% was susceptible to undue softening and hence bleeding meaning it ascends to the road surface which was a major problem. In 1982 we were impelled to endeavor to discover alternative bitumen that we could use and little did we know that a long and hard journey was a head of us.

We were confronted with a mountain of information and we had no choice but to draw a long list of appropriate raw material candidates for experimentation that came from petroleum and non-petroleum resources. We proceeded systematically from one raw material to the other and testing their characteristics in asphalt formulations, we were impelled to study everything we could lay our hands on from adhesives and plastics to manufacturing methods and industrial design and the whole petrochemical area including oil refining and as the years rolled on.

We were able to have formulations tested by different testing organizations, we amassed Large amounts of data that took also numerous years to analyze and turn into practice by coming up with mathematical models that we could apply to help in the evaluation and testing of suitable raw materials.

Due to our financial constraints at the time, we were forced to fabricate ad-hoc in house testing apparatus and processes to be able to process all these raw materials and asphalt mix designs at our disposal and the ones we were unable to construct we were forced to hire.

After many years of testing, assessing, and attempting to find suitable combinations of raw materials that would perform as bitumen replacement, we faced the Global warming (Climate change) issue in the early 1990s, this was a potential calamity for us since to date all we have been exploring is bitumen substitute made primarily from petroleum raw materials and this Global warming issue Green House Effect was possibly capable of making our efforts futile i.e., who would want petroleum based products any more? Grueling work and our bloody-minded tenacity was at last beginning to show benefits since we were now able to adjust very rapidly to the environmental demands by applying our mathematical methods and testing experience to be able to formulate a synthetic Bio-Bitumen™ based on renewable resources that was derived exclusively from non-petroleum and on naturally based raw materials.

It only took us a short while maybe a year in 1991 which we had a workable commercially viable completely non-petroleum based Bio-Bitumen™ formulation that already out performed its petroleum cousin. We had already used in the past a GEO320™ MRH™ BioBitumen™ prototype based on one of our surrogate research binders based on a non-petroleum formulation i.e., natural or synthetic resin, SIS/SBS rubber and fatty amide additive Hostalub FA3 since 1986 which included recycled plastics, waxes etc, these surrogate binder formulations helped us to test different asphalt mix design configurations and laying methods

especially in the development of the Mastic Roller Hybrid™ MRH™ and Micro Mastic Matrix™ MM™ asphalt technologies.

#### Q: 14, What technical support have you received towards developing GEO320™?

There have comprised only a handful of testing organizations that assisted us over the years with testing of various GEO320™ formulations etc and their help has been absolutely tremendous and I really don't know where we would be today if it were not for their testing support, see acknowledgements to organizations under Testing on our web site.

#### Q: 15, Why is GEO320™ MRH™ Asphalt Bitumen not yet patented?

Our greatest concern has always been to keep our IP, know-how and expertise a trade secret prior to officially launching our products and our awareness of how easily one can actually lose the rights to a patent. Being aware of these threats we approached our first official non-petroleum (renewable resources) prototype field trial in Newport Melbourne in 1991 made with our GEO320 Bio-Bitumen™ (non-petroleum based bitumen) and Bio-Pave™ [Biopave™] and MRH™ asphalt paving technologies. we lodged PCT patent application for "one of our research surrogate prototype binder formulations" with WO/1989/006259 in 1987.

Between the years of 1985 and 1997 we carried out dozens of small scale asphalt field trials around Melbourne made with petroleum and non-petroleum based bitumen binders using only heated screed box and a motorized hand roller. These field trials were based on assorted renewable resource waste and neat (pure) raw materials e.g., low molecular weight (Molecular mass) materials such as sugar and molasses, vinasses, natural tree and gum resins, natural latex rubber and vegetable oils, also suitable raw materials that we tested were, palm oil waste, coconut waste, peanut oil waste, canola oil waste, lignin and Cellulose, potato, rice and wheat starches.

We also tested GEO320™ made from the distillation (fractional distillation) and "Hydrogenated" distillation bottoms, all which performed exceptionally well in our GEO320™ bitumen formulations.

We also tested these GEO320™ bitumen [binder] compositions in our MRH™ asphalt mix design using alternative recycled rock and aggregate sources made from crushed brick, cement concrete and crushed recycled glass, all which performed equally as well as the conventional quarried road metal (crushed rock). The 1991 field trials were placed in Newport with extreme caution since we were already well-advised by our patent attorneys Edward Waters and Sons (Watermark) back in 1989 that we should keep the idea as a know-how (trade secret) since it could be possible to by-pass our formulations. We were aware that once our non-petroleum formulation was out in the open it was vulnerable to copying and plagiarism (piracy) and could jeopardize our future plans in establishing manufacturing operations to commercialize and exploit the Ecopave GEO320™ bitumen and MRH™ asphalt technology.

When attempting to decide in year 2000 which asphalt company we should approach with our GEO320™ Technology, Boral Asphalt was chosen directly due to the recommendation by the Roads and Traffic Authority (RTA) of New South Wales. We proceeded with our second GEO320™ field trial this time based instead initially on our surrogate petroleum clean hydrocarbon prototype which was laid on Boral Asphalt plant in Deer Park Melbourne December 2 2000,

#### Q: 16, What were your major obstacles in the preparation and placement of your GEO320™ BioBitumen™ asphalt prototypes?

Our major obstacle to date with the GEO320™ MRH™ BioBitumen™ has been the invention to convert bitumen binders into easily stored dry granules hence eliminating the need to store bitumen in hot storage containers. We prepared over 4 tons of GEO320™ MRH™ granules for the Boral field trial and it was certainly a very labor-intensive task just for the two of us Sakary and myself.

Prior to the Boral field trial we had to solve a major problem of how to get the granules to load easily into the pug mill (mixer) which rested at a height of some 6 meters. Boral Asphalt built a special ramp specifically to cater the loading of the granules and another problem was how to physically lift the granules to the ramp.

The answer turned out to be a simple cherry picker, we decided to load the 4.3 tons of GEO320 granules

into heavy-duty cardboard box containers each weighing in excess of 500kg each. We discovered very early on at the Merola Way Campbell field factory that once these granules were in the boxes we would need some how to empty them also. We were forced to cut holes into the box containers to aid dispersion but they refused to budge, we also realized that to aid off loading all that was necessary was to tie the boxes to the cherry picker and by tilting it would do the trick.

This approach failed to work since the granules conglomerated in the boxes and in the process of shoveling the granules, one of the guys on the ramp almost lost his footing and fell in to the mixer while forcing these granules to move down the slide, luckily he had a safety harness on this could have been a major OHS issue for Boral. Later on we realized that the slide was installed (constructed) the wrong way around and the rough corrugated side was facing upwards preventing the granules from sliding freely. Anyhow, the box containers were abandoned on the day of the field trial and it was decided to place them on the ground instead and manually load them into the cherry picker.

Our research has since solved the granule delivery problem, we now pulverize the GEO320 bitumen or any sticky adhesive and any material transfer is now handled by a mechanical suction [vacuum] system. The placement of GEO320 asphalt for the field trial worked precisely as we had planned and it had to be spot on the first time around since we only had the financial resources to perform this field trial once. The Boral Asphalt field trial cost our then company Thermoline and the three investors around A\$100,000 and was lost when Boral Asphalt withdrew unexpectedly declining to commit to their earlier promises on joining forces to commercialize the GEO320 technology once the field trial had met expectations, which it did.

This extraordinary Boral back-flip caused Thermoline to go into voluntary liquidation, we were advised that the Boral Asphalt maneuver appeared to have been predatory and evidently Boral has an apparent notorious reputation in the market place and we are obviously not the first company that has experienced this kind of treatment having had dealings with them. Boral owes us and the Thermoline investors and all mum and dad investors in Australia an explanation as to their hostile methods of conducting business, their behavior is not only Un-Australian but their ability to be a credible trust worthy partner organization that people can feel comfortable doing business with is of serious concern. Ecopave Australia™ previously [Thermoline] temporarily lost the GEO320 surrogate prototype bitumen adhesives formulation to Shell [a foreign company] due to Boral's maneuvering and conduct an act that was nothing short of traitorous which proved to be nothing less than against the best interests of Australia.

#### Q: 17, How can you make bitumen from water-soluble materials, asphalt roads have to be non-water soluble don't they?

Our method of manufacturing GEO320™ MRH™ Bitumen is such that we are able to convert any water-soluble material e.g., sugar or molasses into an insoluble material, thus controlling the cross linking and branching reactions in the binder matrix formulations very accurately. The great thing about our system is that the end product is totally non water-soluble and highly resistant to common solvents such as gasoline, naphtha (diesel) aviation fuel (Avgas) etc. It must be noted that the full solvent resistance is realized in the final asphalt composition therefore benefiting the end user i.e., petrol terminals, petrol stations and anywhere where the asphalt surfaces are exposed to solvents.

There is also a very fascinating phenomenon associated with the solvent solubility of GEO320™ BioBitumen™ in that the binder is highly immune to hydrocarbon based solvents but is highly sensitive to alcohol based solvents, in other words the "solubility sensitivity" has changed away from the traditional hydrocarbon solubility to now the safer alcohols which is a great new OHS and environmental benefit that accompanies this technology.

#### Q: 18, What kind of interest and resistance have you received for GEO320™?

The states in Australia that have shown interest in GEO320™ to date have been Queensland and Western Australia. We have also received over whelming interest from overseas especially from the US, India and Indonesia, One venture capital company from Los Angeles has requested a sole license to manufacture GEO320 as well as several US based asphalt companies and sugar growers.

The Australian cane growers have been a bit of a mystery to us, we approached them in early 2004 and to our astonishment they failed to indicate any interest at all?

We have also had absolutely no interest from RTA in NSW or Vic-roads, in fact RTA is not even returning our phone calls or emails? I wonder if it had anything to do with the surface-applied angular particles that increase skid resistance on road line markings (Road Surfaces), which we already presented with our GEO320™ MRH™ asphalt technology which was tested by RTA South Australia and New South Wales already back in 1996, and which passed the AS4049 standard, or was it because RTA NSW referred us to Boral in 2000 and therefore were now possibly distancing themselves from any possible fall out?

Incredibly, no one has shown any real interest to date to this globally important eco-product with a \$200 billion bitumen market, we have only encountered attitudes that could only be regarded as rather reactionary from countless other organizations, I mean what the Shell is going on here?... It has been sad to witness how Greed and negative delusions and opinions surrounding some one else's [potential] success and prosperity seem to have outweighed the benefits that could be gained from a world first break-through binder technology for the Nation as a whole e.g. Boral and other companies attitudes and conduct towards us and the product.

The main side effect of this disease is the eventual manifestation of the so called brain drain which affects many people who have through their journey tried to in good faith commercialize their inventions and innovations but instead have been forced to look and move overseas to attract investment capital and success for their ideas. Since it is hard to believe that there would exist a lack of intelligence or guts among the investment community that can't differentiate between a worth while [beneficial] idea or an invention and a worth less-one, and that politics [see Greenhouse Mafia] which seems to have played a major role and is the only rational explanation? .

#### Q: 19, What are your professional qualifications?

A part from our family asphaltting background my personal forte has always consisted of Art, I am a trained mechanical design draughtsman by trade turned visual artist "Surrealist", self taught painter, specializing in Automatism and Surrealism and Photo-realism I was painting professionally in the eighties and I was forced to juggle between painting and our GEO320™ BioBitumen™ RandD, I also ran my own graphics business catering for the Real Estate industry in the 1990s. I am a naturalized Australian since 1984. My step brother Sakary is a qualified stone mastic asphalt layer he performed his apprenticeship at 14 and went on to work the next twenty years in our family's asphalt business. My mother Sirkka [Wendy] has been an integral part of our partnership also and for her experience and insight of our family asphalt business in Finland.

#### Q: 20, Why has it been so hard for you to attract investment for GEO320™?

**Firstly**, I think that one of the main reasons has been the fact that we don't possess qualifications in either Chemistry or Engineering and having dealt in an area that has traditionally required such qualifications. I think that ultimately qualifications ought to be based on how one applies one self [aptitude] keen interest, sound moral beliefs [honesty] and proof of competence rather than the reliance on someone's potential abilities just because they have ground and endured a title borne most likely due to pressures for the need for peer group recognition, improvement of self image [self esteem] or for financial gain, all are reasons that are anti productive and ultimately a hindrance to progress.

University education has its merits don't get me wrong, people do need to be shown the direction and help find their area of interest [calling], the problem is that Universities used to be grouped by quality, a practice that was eventually ceased because it was thought that it placed limitations on the lower ranking Universities and benefited the top ranking ones, I believe this thinking to be totally erroneous since quality of education should never be compromised.

My concern and issue towards University education has always been the "Flexible access" to a degree qualifications, the standard of difficulty of the final exam and thesis which I believe should be made more stringent than it is at present, not only to make the process more challenging but to be a test of the individuals interest and aptitude which after all is an indication of how well they will eventually perform in their chosen fields. I'm also a firm believer that Universities should conduct aptitude tests for their entrants since this would promote academic quality over quantity and protect the individuals academic and professional career against failure which could otherwise become a costs burden for the society to bear later on.

It is clear that one of the main reasons as to why our society is burdened with so many spectacular negligence law suits against academic and professionals today who have ended up leading multinational corporations and have managed to steer such companies into oblivion. This has most likely been due to their lack of aptitude and or the inability to make sound moral judgments or simply just out of pure greed or

just having made the wrong career choice in the first place due to outside pressures or the flexible access to university education as I mentioned earlier.

It is fair to say that if these individuals had been aptitude tested earlier on, there is a chance that their particular character traits and tendencies would have been picked up by these tests and these negative outcomes could have been minimized, which is why I think Universities have a moral and social obligation to the society to uphold quality of education.

**Secondly**, why its been so difficult to attract investment funds for our GEO320™ project ?, Well I would like to present a classic case in point concerning "aptitude" coupled with "bad will" of an individual such as our ex CEO who has degrees in economics and commerce from the university of Queensland with an impressive cv to boot. We have unknowingly believed, followed and engaged people such as this individual who had absolutely no acumen for the nominated task. Our ex CEO [Professional Director], having multiple bankrupts under his belt being an associate of the Australian society of practicing accountants, and associate of the securities institute of Australia, consultant to International Public Relations Pty Ltd, National Industry Extension [NIES] and Better Business Grants Schemes, consultant to Corporate Adviser Pty Ltd on Information Services on corporate regulation mergers and acquisitions and new capital raisings etc. This character worked on the Established Companies and Securities Bulletin an Australian journal on corporate regulation and advice. Having sat as a director on the board of numerous Australian public and private companies that all wound up going to the wall for one reason or the other that left investors losing their money. The string of failed companies included, **Investment and Business Research Ltd, Ausdaq, GEO2 Ltd, Greenchip Investments Ltd, Atsa Yeaman, Glo-tech, Solace Ltd, AI2 Gateways [ai squared], Australian Corporate Research, The ATeam etc. ,**

From our experience having dealt with this person in Thermoline and the more recent up until January 2009 in Ecopave Australia, I must say that any director who has such a colorful and infamous corporate record should be thoroughly investigated by ASIC - Australian Securities Investments Commission and prevented from ever holding another Australian company directorship and prevented from losing further shareholder funds. Where did we find this character,? Well I called the Australian Stock Exchange ASX in Melbourne in 1997 and was referred to Australian Corporate Research which was run by this individual. I would like to emphasize by saying that we are not blaming ASX for this, its just interesting to note how "another" referral lead to a disaster such as the one we experienced with Boral later on.

We were persistently told by our ex CEO who claimed expertise in venture capital, equity capital raising and in stock market dealings in general, that our company would never be able to attract venture capital for the project and it was impossible to find investment in Australia. Interestingly he personally invested around \$70k [\$70.000] into our project which is ironic, he initially chose and registered Thermoline [a shelf company] under his own name without consulting us, he was obviously eager to dress the company up for a future takeover which in hind sight makes perfect sense when you consider that he chose to find two people who would be prepared to invest just \$30k, enough to get the Boral field trial over the line. Because when we approached our ex CEO and his Investors 1 and 2 after the Boral field trial for more capital, they instead demanded more equity in the company which was already at 49%, the share holding up to that point was split by us the inventors holding 51% and the Investors 49%.

Our Lawyer advised in 2001 that if we were to go along with this [share dilution strategy] our ex CEO and the two investors would end up controlling Thermoline and the associated intellectual property and effectively put us on to the street which is exactly what happened to my father and why our family was forced to migrate to Australia from Finland in the first place. Had we accepted this [hostile] further share dilution strategy, we would have un doubtedly lost our invention to these guys. Our ex CEO and his apparent misleading dishonest conduct towards his fellow directors wasted many years.

Furthermore, we made a huge mistake not following our lawyers advice back in 2000 when he conducted a background check on this person and warned that this guy was a concern due to his shady corporate background and that we should discontinue to associate with him. We the directors found this to be difficult to believe since at face value our ex CEO seemed such a nice person but in hind sight he was a master salesman [Simon the likable] he obviously had a highly honed talent [gift] for convincing people which he obviously used for evil rather than good, since he was able to sweet talk people into believing any idea he put forward. Such as his [put and call option] to raise capital for the company which failed to bear fruit. Our ex CEO talked the company and us from approaching banks, venture capitalists, wealthy business individuals etc but he was hell bent on pushing our technology and know how to Shell, Boral Asphalt and other of our bitumen [adhesives] competitors. This guy failed to pursue and hold Boral accountable for their betrayal of the assurance of commercializing the GEO320 technology after the 2000 field trial, this person

even refused to draw up a business plan to raise capital for the company even though he agreed to do so when we signed him up initially, we were misled from the beginning, the list goes on and on.

One important example worth mentioning of the devious conduct of our ex CEO was when he deliberately misled us the inventors and directors in Thermoline Pty Ltd by not informing the board when he told one Merchant Banker (Investor-1) that our IP was in the company prior to the investor injecting \$20k [\$20,000] in to the company, when in fact we the inventors [directors] had not yet decided whether to roll the IP into Thermoline or not. Investor-1 was obviously very disgruntled having later found out in our board meetings that the IP was not in the company and he threatened to sue our ex CEO for providing false information prior to him investing the \$20k.

I believe that if investor-1 [Merchant Banker] would have sued our ex CEO or complained to ASIC, this action would have been understandable and we have remained curious as to why he declined to do so?. Several years later we came across one potential farmer investor in Melbourne who in the process of conducting his due diligence came across a vicious rumor that claimed that our family had lost money to some investor in Thermoline, a brief investigation and interview by our Lawyer with this farmer revealed the source of these rumors which pointed to investor-1 [Merchant Banker], this appeared clearly to be an attempt by investor-1 to sabotage our reputation and efforts to seek further capital towards our GEO320 project.

Our ex CEO misled the Thermoline Pty Ltd board of directors that the [investor-2] who he knew personally once having injected \$10k [\$10,000] in to the company and becoming a shareholder he would apparently inject a further \$1Mill in to Thermoline later on, but once we approached investor-2 after the Boral field trial in 2001 investor - 2 denied having ever made such an undertaking to our ex CEO and refused to invest further funding in to the company while knowing that we had passed the Boral field trial and the company was in need of urgent capital. The question remains, did our ex CEO and the two investors attempt to conspire to take over of our company and the intellectual property with a global bitumen market worth \$200 billion for only \$30,000? This begs the question, did our ex CEO either under false pretences acquire the investors 1 and 2 on board Thermoline, or was it a mutually pre orchestrated scheme between them?. Between the years 1997 - 2008 all the potential investors from Australia and Overseas who had previously shown extreme interest in our technology and invention ended up walking away from any commitment to the project once they had been introduced and in contact with our ex CEO who also requested to have a "mandate" agreement to approach potential investors which we later withdrew when we became aware of an emerging pattern in his conduct. To compare the conduct of our ex CEO against the backdrop of his chequered past, it all falls nicely into place when compared to all the other failed prior companies that this person was a career director in. What I have outlined here is a perfect example of the harm one individual can inflict on others when armed with convincing university qualifications that enable them to take advantage of the age old human weakness which Sigmund Freud once identified as "*the human desire to follow authority blindly*".

**Thirdly**, The reason why it has taken us so long to further the GEO320 project is that we have wasted lot of time and effort before we recognized that the asphalt industry is unable to provide any support due to them having a master and servant relationship with the Oil refining (bitumen) industry, I mean our family should know since they have dealt with the oil industry since 1927.

The asphalt industry is totally at the mercy of the Oil Industry in the same way as the public is using their products. Although ironically and sadly this scenario is squintingly understandable when we consider the fact that for our society to have achieved its current level of technological standard it could not have achieved without Big Oil so we do have to give some credit where its due, the emergence of ethanol and bio-diesel as alternative transport fuel sources have only answered half of the equation because for the society to be totally independent from the Oil monopoly and be self-sufficient and not hooked on fossil fuels as an energy source, it has to be able to produce an economical environmentally friendly method of producing energy and constructing roads that support infrastructure.

Roads are the arteries of our economies without them our economies would not exist, therefore asphalt bitumen made from renewable resources is the link that has been missing from this equation of the road to self-sufficiency which can only be achieved from the use of non-finite renewable sources. We have obviously become an easy target and people have mistaken our "good-natured" character with that of naivety and people having masqueraded as the gun-ho [Entrepreneur Investor] and the so called [Professional Director] such as our ex CEO, these guys were only interested in our formulations, know-how, and hell bent on getting as much information that they could lay their hands on with little or no financial outlay or commitment and only a bus-load of broken promises. The irony in dealing with these guys was that

they preferred to gamble their investment dollars on high risk share market strategies instead, a good example of this mentality is the now infamous and disastrous sub prime mortgage fiasco that we are all now paying the price for.

The sad thing to come out of this whole experience has been to witness at first hand how corporate greed drives and motivates people and hence having to witness the very ugly side of human nature in action. These are just a few examples of why it has been so hard for us to attract investment for the GEO320 project.

#### Q: 21, How can you color asphalt made with GEO320™?

When colorful (pigmentable) colored asphalt is required GEO320™ bitumen is made primarily from Sugar to give it the translucence necessary for a good color definition in asphalt but can also be made from waste bio based materials as we have outlined earlier. We developed the pigment system specifically for GEO320™ asphalt that resists fading due to wear, efflorescence weathering. We also discovered many years ago how the color in cement concrete faded after a short period of time due to efflorescence (Blooming), we had to come up with better solution and this pushed us in the same way as it did with the development of our GEO320™ bitumen and MRH™ Asphalt product.

#### Q: 22, What is “distillation bottoms”?

“Bottoms up”, When used motor oil is recycled and cleaned it goes through a distillation process (fractional distillation) where a residuum (Residue) waste material is recovered which is processed to remove volatiles and other impurities and the waste material that is left at the bottom of the vacuum tower (VTB) distillation column is called “bottoms” this residue is further processed to remove heavy metals ( lead ), volatiles and other impurities and the resulting left over waste i.e., from (TFE or WFE bottoms) is “clean enough” to be used as a raw material to manufacture GEO320™ bitumen.

#### Q: 23, Why is the distillation bottoms (waste) material suitable to make GEO320™ bitumen?

This helps the oil recycling industry to dispose of this waste material and add value and usefulness to it that would normally end up as land-fill or being destroyed by burning, which is now environmentally un-sound and illegal practice anyway.

#### Q: 24, Why is GEO320™ made from low molecular weight materials?

Our manufacturing process to manufacture GEO320™ bitumen is based on the ability to manufacture bitumen from low molecular weight materials opposed to conventional practice of making bitumen from high molecular weights. the benefit of this is that it presents a broader range of suitable raw materials that can be used to convert into bitumen, most of these low molecular weight materials come naturally from renewable resources anyway and also the benefit of being non-dependant on heavy grade crude oils is important environmental incentive.

In regards to making suitable road grade bitumen only from “heavy crude oil”, well, according to Ecopave Australia Research, the truth of the matter is that there is absolutely no difference weather one uses the waste residue from the distillation bottoms that come from heavy grade crude oil or from light crude oil the end waste residue material is almost identical.

The reason why the oil refining industry “prefers” to use the waste residue from “heavy crude” to make bitumen appears to be because it produces more quantities of it e.g., Venezuelan Heavy grade produces 20% - 60% residuum and is cheaper to produce whereas Nigerian light crude only produces around 1% residuum. The global supply of bitumen appear not so much a case about shortage of supply but of economics of producing bitumen.

About 30% of the world crude oil is heavy grade which is more difficult and more expensive to extract (drill) due to its higher viscosity, but this can be offset by the 70% of the more easily available and extractable low viscosity light crude and even though the oil only produces 1% of residuum there is a lot more of it available.

In other words "every" barrel of crude oil extracted whether heavy or light produces residuum which is suitable for bitumen manufacture.

The possible reason as to why the oil refining industry has always appeared to maintained that it can only use 10% of the 30% globally available heavy grade crude residuum (bottoms) for bitumen production, may not be because of scarcity of supply, but because the 10% is a non waxy oil (i.e., Venezuelan) and is therefore "cheaper" to process. In other words all the residuum that is obtained from the processing (refining) of the 30% heavy grade crude oil residuum is suitable for the manufacture of road grade bitumen, this "knowledge" has already been around since Ecopave Australia™ Research conducted in the 1980s.

### Q: 25, How important is GEO320™ invention in term of its impact if the battle against global climate change?

There is no doubt that unless we do something to combat the ever-increasing threat of Global climate change, our children are going to inherit a planet that will become a very user-unfriendly place to inhabit. I'm amused when I read in the newspapers of some "commentators" arguing that there is no global warming issue since the global temperatures have been in decline since 2002.

The reality is and if these guys took the time to actually "talk" to the climate scientists, that they would discover that Global Warming has obviously been in a temporary "retrenchment" period (cycle) since 2002 but the long term trend is still "long" (UP). Who knows maybe the earth will experience short snippets of some "mini" ice ages at the bottom of these "retrenchment" periods.

This would without doubt bring whole new meaning to the term "hell freezing over" who's to say. There is also no dispute that the oil refining industry is largely to blame for the change in our climate due to the massive emissions and air pollution derived from the use of their products, which has been high price to pay for the technological progress which we unfortunately had to have.

The irony is that without the oil industry we would never had reached the standard of living we all take for granted today. The same way the motorcar over took the horse and cart and the light bulb over took the humble candle, Gaia is forcefully beginning to twist the worlds arm(natural disasters) to force an early election on Sustainability and renewable resources over fossil fuels (finite resource).

### Q: 26, Have you received any Government financial help to research and develop GEO320™ over the years?

We have received absolutely no assistance towards GEO320™ RandD in the last 25 years that our family has worked on this project. We have basically carried the full cost burden of developing GEO320™ Bitumen personally in Australia up until 1999.

Our technology not only benefits the farmers and Cane and crop growers and our salinity affected roads but Australia as a whole especially in potential export earnings. We have desperately sought Federal Government assistance under the Howard Government but in vain, we have sought to pay for some testing we undertook with ARRB Transport Research (ARRB Group) in 2002 under Thermoline Pty Ltd to the tune of \$8000, and later in 2003 with Geopave (Vic-roads) for \$3000.

Its worth mentioning though that we have twice attempted to obtain a COMET grant through Aus-industry but were rejected on the grounds that GEO320™ technology was not "competitive" enough and one of their advisors recommended that we should move to Brussels instead. The second time was in 2006 when we were forced to abandon the COMET grant application due to the consultancy firm who was working to try to secure the grant on our behalf was not able to convince and demonstrate how they would spend the \$50k grant that would have lead to the commercialization of GEO320™ and MRH™ BioBitumenAsphalt™ technology.

The Queensland department of state development and a West Australian Wanneroo city council has been the only interested government organization in Australia that has shown any real interest to date.

### Q: 27, Why did you decide at one stage to donate the GEO320™ Technology to charity?

Being devoted Christians, we thought at one stage to donate our GEO320™ MRH™ non-petroleum asphalt bitumen technology to the Adventist Church here in Melbourne, even though our family is Lutheran by upbringing, we had no problem in contacting the Adventist Church and they seemed like a good choice since

they were already involved in several business ventures i.e., Sanitarium foods etc, and they would have benefited greatly from the GEO320™ invention by generating massive revenue to help fight hunger and poverty around the world.

I received an initial thank you response acknowledging our offer and a note that it has been passed on to the relevant people in the organization, I haven't heard anything from the Adventists since and this was earlier this year. After this we decided to push ahead by way of normal commercial channels and try to find capital to setup operations to manufacture our GEO320™ MRH™ asphalt, bitumen and Biopave® cement alternative technologies.

### **Q: 28, Why do you contribute Bitumen fumes for your Grand Fathers and your Fathers deaths?**

There is a lot of research being performed globally on the possible negative health effects of ingesting Petroleum based bitumen fumes, and the argument is clear I mean its like spotting a half eaten dead hippo on the banks of a crocodile infested river, you don't have to be very clever to work out what devoured it , right?.

Its the same situation with bitumen, my grand father Werner worked with bitumen all his life and he was eventually overcome and died from a stroke and the complications of having ingested bitumen fumes earlier in his career and he was a non-smoker. Our family business always only used " Shell " bitumen. My Grand father and his brother died at a ripe young age of 68 of lung cancer and he was also a non-smoker. My father Runo Ensio died at the age of 68 back in 1988, he was a non-smoker, he worked also for a long time in our family asphalt business as the CEO which he established with my Grand father in 1950. My step brother Sakary who has always been extremely fit is suffering from breathing difficulties (not Asthma) which he blames on the years of breathing Shell bitumen fumes while working with mastic asphalt, Sakary who is also a non-smoker and is receiving a disability allowance.

### **Q: 29, When did you officially finish the RandD on GEO320™?**

We concluded the research and development on GEO320™ MRH™ Asphalt and Bitumen in December 2003 and we are already exploring the suitability of manufacturing bitumen from sewage effluent, the positive attributes of this new fertilizer material is currently being investigated by several organizations around the world as to its usefulness. Since we are able to prepare bitumen from Water-soluble materials (after conversion).

Theoretically we should in be able to produce GEO320™ from this dry sewage waste, It takes little getting used to the idea though.

### **Q: 30, Why did your family members decide to change their names back in the nineteen eighties?**

What's in a name? well, we confronted a lot of negativity in the 1980s and 1990s from some organizations that we approached, from raw material suppliers to people in the asphalt bitumen and cement concrete industries and consequently we were forced to keep our family asphalt background confidential and remain incognito.

The effect of this was that it started to slowly grind the GEO320™ project to a halt while we were continuing to develop GEO320™ in the eighties, I was forced very reluctantly to adopt my Mothers distant family name and changed it from Peltonen to Tribe (Triebu) by deed pole which was a major inconvenience. When the time finally came for me to go back to my old family name of Peltonen, I decided to adopt a new name due to artistic reasons since I was planning to hold my first one man solo art exhibition at the time anyway and I decided to adopt the name Owerhall™ after Sakary once having made a tongue in cheek comment on how we appear to be always overhauling things, our cars, personal affairs and life in general, and since he was always calling me as the "minor overhaul" and himself as the "major overhaul", the name stuck.

I officially changed my name to Owerhall by deed pole in 1996 and also due to the fact that my father and I never saw eye to eye on matters. Sakary reluctantly chose to adopt his mothers maiden name "Malmberg"

and my mother also adopted the name and changed it from Peltonen to “Malmberg” which she has since converted back. This illustrates very well to the degree of hostile resistance that our family encountered from these companies in those early years.

### Q: 31, What are Ecopave Australia™ Trade Mark developed products?

Biopave™ and (Biopaver™) is based on the GEO320™ adhesives technology and is a bio-polymer (Biobitumenasphalt™) adhesive binder for the use in MRH™ and normal Asphalt and Bio-Bitumen™ Bio-Polymer modified PMB compositions and emulsions. Biopave™ binder is used as an additive in Cement, Masonry, Concrete and paving and bricks, paint sand protective coatings, especially in road line marking applications and general purpose adhesive formulations.

The interesting feature with Biopave™ is that up to 60% can be used as a binder replacement substitute in conventional cement concrete paving and bricks which will help reduce the cement high CO2 emissions (5% globally) in the paving brick manufacturing stage and help combat global warming and help our environment with no loss to the paver performance.

### Q: 32, How will you address the issue of others having patent infringed on your IP and prior art?

There are a large number international PCT and other patents “on our last count” that are from around the world, that have lodged their patents on asphalt, binder, bitumen, emulsion, adhesives coatings and manufacturing processes based on “our inventions” and prior art dating way back to 1985.

It appears that the biggest infringe and violator of our IP to date has been Shell Oil, It would also appear that the main reason as to why Shell keeps lodging patents in the US instead through WIPO is to circumvent the European patent “prior art” laws and regulations. In the United States, inventors and their patent agents or attorneys are required by law to submit any references they are aware of to the United States Patent and Trademark Office that may be material to the patent ability of the claims in a patent application they have filed.

The patent examiner will then determine if the references qualify as prior art and Novelty may then take them into account when examining the patent application. If the attorney/agent or inventor fails to properly disclose the potentially relevant references they are aware of, then a patent can be found invalid for inequitable conduct. Neither Europe, Canada, nor Japan have this duty of disclosure.

### Q: 33, When did you first develop “Warm Mix Asphalt” WMA technology?

We formulated and tested our non fuming low temperature Warm mix asphalt (WMA) first time already back in 1989. One of the reasons we were keen to find a binder and warm mix asphalt WMA formulation that did not give off fumes was because I was unable to work on anything that was emitting irritating fumes, as I suffered from Asthma. Also because my step brother Sak already had breathing difficulties having worked with (Shell) bitumen for all those years, so as you can see that the hardest thing was not only trying to keep everything non-toxic, but non fuming as well.

### Q: 34, How can GEO320™ bitumen be made into and from Chewing Gum?

While performing experiments I discovered that by modifying a chewing gum formulation slightly produced a adhesive binder that performed equally well to our standard GEO320™ specifications. The conclusion I drew from this is that Asphalt Bitumen is basically nothing more than inedible glorified chewing gum. Our asphalt bitumen PHD research friends will learn how GEO-320™ can be made into and from normal and medicated chewing gum base that is also suitable for medical and cosmetic purposes.

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