MAYCON
STRUCTURES OF ROAD SAFETY

For Airports

For
Concrete Highways

For Slippery Asphalt

HIGHWAY APPLICATIONS

Road surface condition generally and skid resistance in particular is now in the forefront of all highway authority engineers and highway maintenance contractors.

There is a heightened international interest in the relationship between skid resistance and accident levels and there is commitment to reduce all road accidents, especially fatalities. Recent developments in design of asphalt surfacing materials has produced many benefits including noise reduction, spray reduction, faster laying with reduced cost, but it is still early days for these materials compared to over 100 years of traditional HRA and chips.

The new thin surfacing materials require high levels of quality control, both during production and laying to avoid surfaces with excess bitumen on the surface. Skid resistance of these materials is lower when first laid and may not reach its optimum for up to 2 years.

Blasting to remove the binder from the surface of the agregate particles will give the road surface its maximum skid resistance in a uniform way across the whole cariageway within just a few weeks of the surface course being laid. In addition when in 3 or 4 years the aggregate has become polished and the skid resistance has dropped below an acceptable level, blasting could regenerate it by exposing fresh aggregate and removing the polished surface. This may extend the life of the road by several years.

In addition to this safety aspect of asphalt there is also a modern trend towards using materials with different colours and textures, both for aesthetic reasons to enhance town centres, commercial projects and urban regeneration schemes, and for safety reasons of lane identification, hazard warning and demarcation.

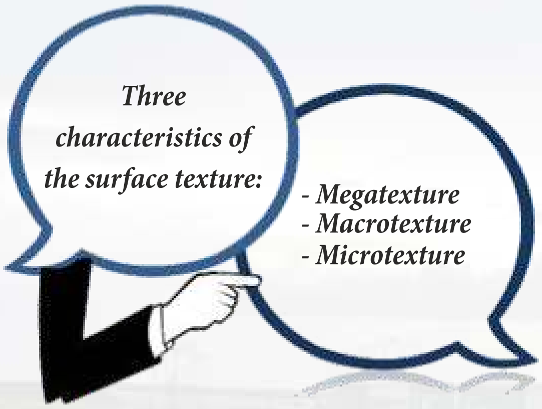
Blasting in conjunction with asphalt mix design can achieve a whole new range of decorative finishes for asphalt, including blends of aggregates of several colours and textures in one surface. Professional blasting of asphalt can offer solutions with significant benefits in all these areas.

28.000 FATAL ACCIDENT IN EUROPE IN 2012

In 24% of accidents found inadequate values of anti slippery conditions on the road

TEXTURE OF A SURFACE COURSE

There are principally 3 types of texture which are important factors in the performance of a runway and road surface. In addition to these the terms Negative texture and Positive texture are often referred to, which are types of Macrotexture and more to do with the method used or type of material laid.



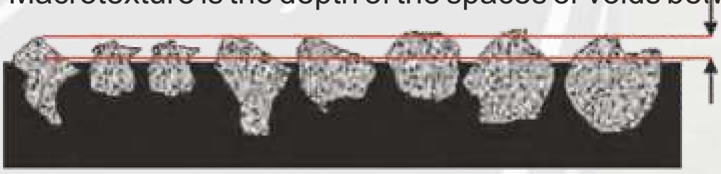
MEGATEXTURE

is a component of surface profile, how flat the surface is. Poor megatexture increases the demands on the suspension, causes vibration to the aircraft structure and gives an uncomfortable ride, it causes patchy drainage and water ponding. Poor megatexture can be a result of surface deformation, rutting or poor laying technique, and can increase the risk of aquaplaning

MACROTEXTURE

is effectively the average depth of the gaps or voids between the coarse aggregate particles in a surface, it is relatively stable, and can be measured by laser profilometers traveling at normal speeds. This is recorded as SMTD sensor measured texture depth.

Macrotexture is the depth of the spaces or voids between the aggregate particels.



It is this macrotexture which allows the water to drain away from the surface and greatly contributes to skid resistance in wet conditions

Macrotexture is an important characteristic of surfaces which affects stopping distances at high speed. There are two mechanisms involved:

1. DRAINAGE

Good texture depth assists water drainage, preventing the formation of a patch or sheet of water across the surface which could cause aquaplaning.

2. HYSTERESIS

Good texture depth is necessary to allow mechanical deformation of the tyre (hysteresis) which dissipates energy in the form of heat.

Macrotexture has traditionally been measured by the Sand Patch Test or grease Smear Test which involves spreading a known volume of sand or grease across the surface in a designated pattern until it has all gone into the voids between the aggregate particles. The area of the patch is then measured and a formula is used to calculate texture depth. This method is suitable for small areas or trial work but is slow and labour intensive. Current methods are based on laser measuring devices. Infra-red laser pulses are reflected from the road surface onto a diode array. The position of the returned pulses is used to estimate the vertical distance between sensor and road. The root-mean square distance, a measure of the variation in the vertical distance, is used to calculate the average texture depth, referred to as Sensor Measured Texture Depth (SMTD).

Positive macrotexture

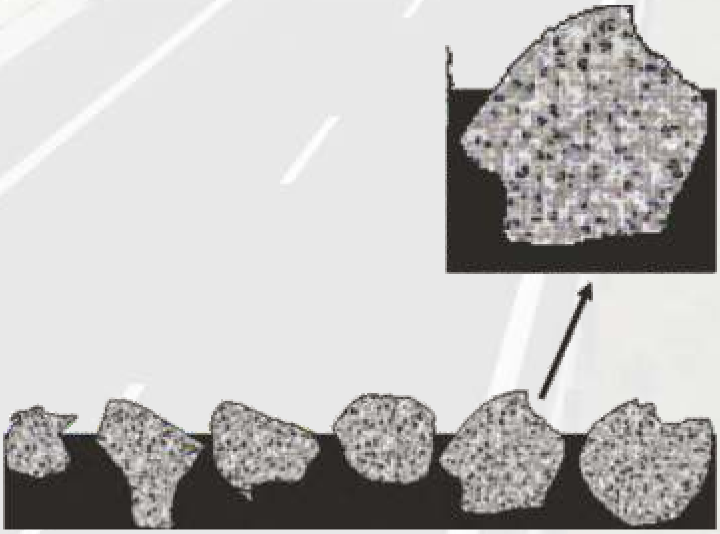
The positive macrotexture generated by the voids between aggregates when they protrude above a certain level surface.

Negative macrotexture

The negative macrotexture generated when aggregates tend to sink below a given area, thereby reducing the gap between them.

MICROTEXTURE

the Microtexture of a surface is provided by the roughness or texture of the surface of the individual aggregate particles.



Microtexture is the fine component of surface texture formed by the tiny interstices on the surface of the aggregate particles. It is the main contributor to providing grip or skid resistance with the tyre, particularly at low speeds. Microtexture is measured by PSV using the British Pendulum Tester or by mobile methods such as the Griptester or ASFT

Aggregates used in asphalt surface courses will typically have PSV figures from 50 to 68, the higher the number the greater the friction or skid resistance

SKID RESISTANCE



As skid resistance, is defined the road's ability to provide to tires of vehicles adequate adhesion.

This is accomplished to avoid any kind of lateral or lengthwise unexpected and accidental shift of the vehicles.

Typically it increases in the first two years following construction as the roadway is worn away by traffic and rough aggregate surfaces become exposed, then decreases over the remaining pavement life as aggregates become more polished. Skid resistance is also typically higher in the fall and winter and lower in the spring and summer.

The skid resistance is affected by factors such as:

- Condition and quality of asphalt surface layer
- Cleanness of road
- Increased humidity content on the road surface
- Speed of vehicles

In the United States, it has been estimated that inadequate highway pavement conditions contribute to 10,000 of the 43,000 annual highway fatalities. Poor pavement friction or surface texture increases total crashes and also contributes to wet-weather crashes resulting in increased fatalities, more serious personal injuries, and significant traffic delays. World estimates are 1.2million highway related deaths and 50million serious highway related injuries annually.

It is truly an international problem and FHWA and AASHTO representatives have conducted scanning tours to discuss and observe some of the best safety-related practices used around the world. The United Kingdom revised skid resistance policy based on 15 years experience is considered as best practice. Research has shown increasing the texture depth from 0.3mm to 1.5mm reduces the accident rate by about 50%, and increasing the skid resistance from 0.35 to 0.6 reduces the accident rate about 65%.

POLISHED STONE VALUE

Polished Stone Value (PSV) is a measure of how resistant an aggregate is to become polished or lose it’s skidfriction properties, usually referred to as its "microtexture".

The PSV test assesses the susceptibility of aggregate to polishing. The test is a 2 stage process, firstly accelerated polishing and secondly determination of the resulting friction value using the British pendulum tester.

Aggregates used in asphalt surface courses will typically have results from 50 to 68, the higher the number the greater the friction or skid resistance.

In addition to the aggregates skid resistance properties or Microtexture it is also important to know how durable these properties are, this is usually measured by AAV.

Aggregate Abrasion Value (AAV) is a measure of the resistance of an aggregate to surface wear by dry abrasion. Aggregates with poor AAV will wear away quickly and this will have a significant effect on road surface texture depth "macrotexture". AAV is measured by preparing two specimens which are pressed against the surface of a steel disc rotating in a horizontal plane, with a force of 0.365 newtons per sq. centimetre. Sand, fed by hoppers, is used as an abrasive. After 500 disc revolutions the amount of material abraded is measured by calculation of the weight loss of the aggregate.

The percentage loss in mass of chippings is known as the 'Aggregate Abrasion Value' (AAV), and ranges from about 1 for hard flints to over 16. Aggregates used in asphalt surface courses will typically have results from 10 to 16, the lower the number the less wear.

Note: Both PSV and AAV are important for skid resistance, but a high PSV aggregate does not necessarily have a good AAV and vice versa.

FĖİ ĜĠÎ Ī K	Í Î Í – SKID [-]
Very Good	μ > 0,75
Good	0,75 > μ > 0,59
Sufficient	0,59 > μ > 0,49
Poor	0,45 > μ > 0,38
Very Poor	μ < 0,38

The small skid resistance is the main factor of an accident

SURFACE TEXTURE

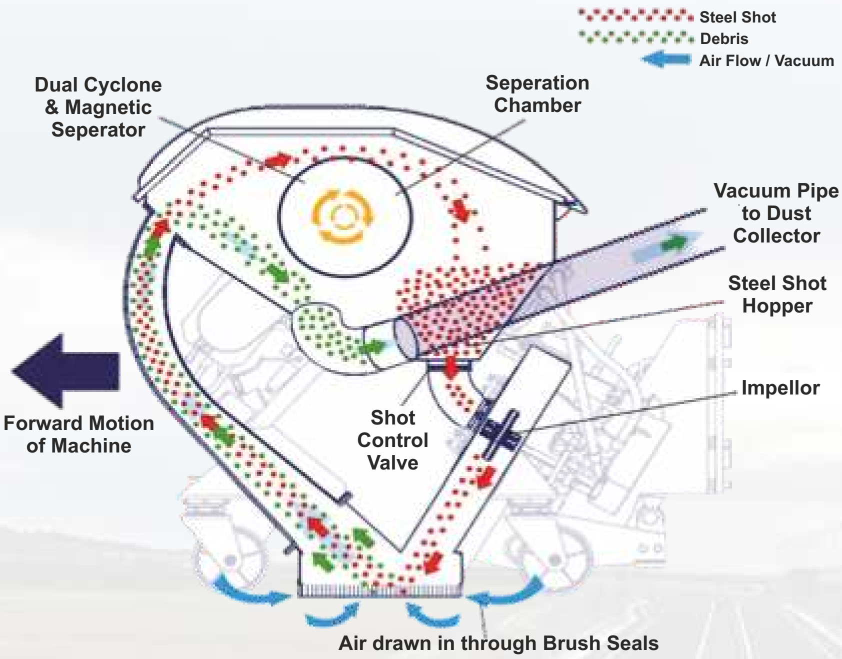
There has been growing concern internationally regarding the relationship between skidding accidents and road surface texture. Over the last few years there have been many conferences discussing the subject in infinite detail, at an international conference last year it was the main subject Earlier in this paper the details and benefits of thin surfacing, SMA materials and HFS were explained, but as with all products there are usually some disadvantages or difficulties. In some situations these can be serious and different techniques or remedies have to be explored. Firstly the problem of;

"Early life skid resistance of thin asphalt surfacing"

Quoting from a report by Dorset County Council about SMA it said "When laid the material at the surface of an SMA will be the binder mortar, a combination of bitumen binder, filler, stabilizing additives and some fine aggregate particles. At this stage it is unlikely there is any of the high PSV aggregate which is to provide the skid resistance exposed on the surface.

The MSSC values indicate a lower level of skid resistance in the initial year after re-surfacing. As the bitumen binder mortar is abraded from the surface and the aggregate is exposed skid resistance improves and continues to improve over the next two or three years. This will depend very much of the traffic intensity of the road. After this the polishing process of the aggregate by the vehicle tyres will gradually reduce the skid resistance of the surface."

THE BLASTING PROCESS



The basic blasting process has been around for over 100 years and Blastrac was the inventor of the first mobile shot blasting process in the early 80's. Blastrac are now the undisputed global leader in this field. The Blastrac system is a mechanical process which is designed to remove surface contaminants, surface imperfections and coatings. The process is fully controlled, safe and environmentally sound. It uses no water, no chemicals or solvents, emits no pollutants or dust to the atmosphere and the removed material can often be fully recycled.Steel shot is fed by gravity through a control valve into an impellor. The impellor turning at high speed throws the steel shot through an adjustable opening at high velocity and at a specific angle on to the surface over which the self propelled machine is travelling. The steel shot impacts the surface and bounces off, as it does so material from the surface whether this is contaminants, coatings or the surface material itself is abraded and loose material together with the shot is drawn up into the machine by the airflow created by the vacuum unit.

SHOT BLASTING BENEFITS

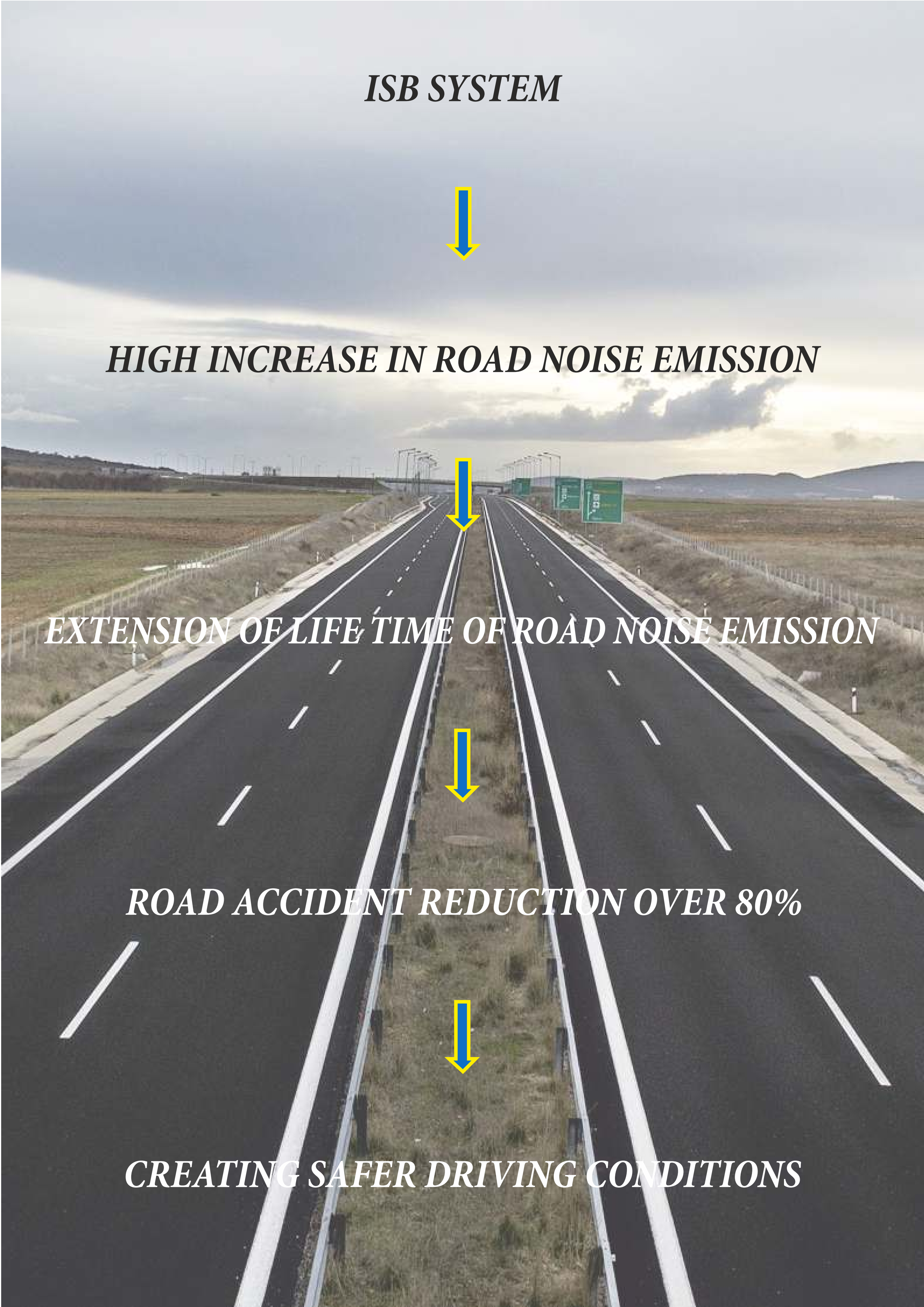
- Adhesion improvements for vehicles and therefore limitation for car accidents
- Cost-effective application for road protection and care compared with placement of new asphalt (shot blasting method is approximately one-tenth cheaper)
- During the execution of work, the shot blasting vehicle is operated at a speed from 1 to 1.5 km/h which in terms of productivity, means approximately between 1000 to 1500 square meters per hour. This process without the requirement of interruption of the traffic circulation which is normally performed.
- The shot blasting vehicle absorbs additionally to residual steel shots, all minor rubbish and asphalt remnants. Using a special separator, steel shots are retrieved for reuse, as well as, remaining materials are channeled at the rear part of the vehicle and are placed into special bags. Substantially, there is no dust and no material residue.

Shot blasting application uses specifically high technology and quality mechanical devices and so regenerates the appropriate texture quality of the road.

Applied with a special machine which ejects a high speed miniature steel balls in the pavement as a result, create a rough surface asphalt increasing the skid resistance greatly.

The whole method is applied with a special machine located on triaxial truck, fully automated whose amplitude crossing offers a performance measure of 1.15m.

Our equipment is now regularly being used on roads and highways throughout the world. Blasting asphalt not only improves skid resistance, but also improves appearance. In some situations, especially in residential areas with low traffic levels, blasting can be used to identify parking areas and traffic management issues. This can eliminate the need for painting lines and markings, reducing cost and providing a more subtle approach to the requirement for area identification.


ISB SYSTEM
HIGH INCREASE IN ROAD NOISE EMISSION
EXTENSION OF LIFE TIME OF ROAD NOISE EMISSION
ROAD ACCIDENT REDUCTION OVER 80%
CREATING SAFER DRIVING CONDITIONS

SOME OF OUR WORKS

AIRPORT APPLICATIONS

Today's busy international airports handle even increasing levels of traffic and the turn around times for aircraft are becoming even shorter. Modern airport runways have to be capable of safely landing turbojet aircraft with their greater weight and high landing speeds.

The braking performance of pavement surfaces has become far more critical and under certain conditions, hydroplaning or unacceptable loss of traction can occur, resulting in poor braking performance and possible loss of directional control.

Runway surface condition is therefore critical to the safety of the airports operation. There are many elements which can effect this including, structure, materials used, surface type, snow, ice, water, and contamination from various sources, but especially from rubber deposits.

In recent years improvements in surface finishes and design of surfacing materials has greatly improved surface drainage and reduced hydroplaning. Pavement grooving was the first major step in achieving safer pavement surfaces for aircraft operations in wet weather conditions.

Studies in 1983 showed that a high level of friction could be achieved on wet pavement by forming or cutting closely spaced transverse grooves on the runway surface, which would allow rain water to escape from beneath tires of landing aircraft.

Other research conducted both in the United Kingdom and the United States determined that an open graded, thin hot-mix asphalt (HMA) surface course called “porous friction course” (PFC) also could achieve good results. This permits rain water to permeate through the course and drain off transversely to the side of the runway, preventing water build up on the surface and creating a relatively dry pavement condition even during rainfall.

The FAA Technical Center study demonstrated that a high level of friction was maintained on PFC overlays for the entire runway length.

Regardless of pavement type, runway friction characteristics will change over time depending on type and frequency of aircraft activity, weather, environmental issues, and other factors. In addition to ordinary mechani- cal wear and tear from aircraft tires, contaminants can collect on runway pavement surfaces to decrease their friction properties. Contaminants such as rubber deposits, dust particles, jet fuel, oil spillage, water, snow, ice, and slush, all cause friction loss on runway pavement surfaces.

- None of our technologies are using chemical substances or are wasting valuable drinking water
- Perfectly clean (closed circuit precess, no waste to dispose)
- Safe (no risk of underground deterioration by the process itself or by frozen water, no damage on built-in lightning devices
- Very fast evacuation of the airfield if necessary
- Permanent control can be made through grip testing devices / CFME (Continuous Friction Measuring Equipment)
- Can prolong the life by a number of years without the need to immediately invest in new top coat

Tyre rubber while part of the tyre is relatively soft and flexible and designed to absorb some of the shock of the landing aircraft, but as rubber accumulates on the runway surface its characteristics and properties are changed. When the aircraft approaches and lowers the under-carriage the wheels are not turning, but as they make contact with the surface they rapidly gain rotation speed. At this point extreme pressures are involved, considerable friction and heat is generated, this causes polymerisation and chemical change making the rubber deposits hard and tightly bonded to the surface.

With repeated landings of aircraft, this hardened rubber covers the entire surface of the landing area, filling the surface voids and creating loss of both micro-texture and macro-texture thereby causing loss of aircraft braking capability and directional control especially when runways are wet.

Accidents and near accidents can occur from planes overshooting or veering off contaminated runways. It is therefore essential to maintain the airports runways to the highest possible standards and to ensure adequate surface drainage and grip, especially in areas of take off and landing.

Work continues by many companies to develop and improve technologies in many areas including, different braking mechanisms to slow aircraft, methods to prevent build up of snow and ice, better technologies for snow and ice removal, more effective removal of rubber contamination and the effective regeneration of texture and skid resistance to existing surfaces. The development of enclosed mobile blasting systems to remove contamination and at the same time retexture the surface to provide a clean skid resistant free draining runway to land on, is now well advanced and becoming the normal method at many international airports.

SKID RESISTANCE

SURFACE GRIP

is necessary to enable acceleration, deceleration and change of direction on the surface. This grip is provided by the friction generated between the tyres and the surface, and in turn this friction provides the force necessary to transmit the energy into the manoeuvre being attempted. Characteristics of the aircraft and actions of the pilot define the magnitude of the friction force required to complete the manoeuvre successfully. If the friction generated is insufficient, grip is lost and control of the intended manoeuvre is lost. An adequate combination of both Macrotexture and Microtexture is required to provide sufficient frictional properties for aircraft to manoeuvre safely throughout their landing and take off speed range.

MAINTENANCE

Over time, the skid-resistance of runway pavement deteriorates due to a number of factors, the primary ones being mechanical wear and polishing action from aircraft tyres rolling or braking on the pavement and the accumulation of contaminants, chiefly rubber, on the pavement surface. The effect of these two factors is directly dependent upon the volume and type of aircraft traffic. Other influences on the rate of deterioration are local weather conditions, the type of pavement (HMA or PCC), the materials used in original construction, any subsequent surface treatment, and airport maintenance practices.

The operator of any airport with significant jet aircraft traffic should schedule periodic friction evaluations of each runway that accommodates jet aircraft. These evaluations should be carried out using continuous friction measuring equipment (CFME). Every runway for jet aircraft should be evaluated at least once each year. Depending on the volume and type (weight) of traffic on the runways, evaluations will be needed more frequently, with the most heavily used runways needing evaluation as often as weekly, as rubber deposits build up.

There are many manufacturers of CFME and these devices can be incorporated within vehicles or trailed behind standard vehicles. All are linked to computer equipment and are able to provide the airport authority with accurate data and graphic formats. This equipment makes regular testing easy and can give the authority important information to show the rate of change for any surface and assist in planning remedial action.

Simply explained the equipment has a wheel which has an exact specification of tyre, load, pressure and resistance. As this wheel moves along the surface at a set speed, water is placed in front of the wheel at a measured rate and the resistance of tyre to surface (grip) is measured. This is referred to as the "friction coefficient" and is usually given as μ (Mu) typically between 0.4 to 0.7

SCHEDULING RUNWAY FRICTION SURVEYS

The table below can be used as guidance for scheduling runway friction surveys. As airport operators accumulate data on the rate of change of runway friction under various traffic conditions, the scheduling of friction surveys may be adjusted to ensure that evaluators will detect and predict marginal friction conditions in time to take corrective actions.

RUNWAY FRICTION SURVEYS	
NUMBER OF DAILY MINIMUM TURBOJET AIRCRAFT LANDINGS PER RUNWAY END	MINIMUM FRICTION SURVEY FREQUENCY
less than 15	1 Year
16 to 30	6 Months
31 to 90	3 Months
91 to 150	1 Month
151 to 210	2 Weeks
Greater than 210	1 Week

Research has shown that visual evaluations of pavement friction are not reliable. An operator of an airport that does not support turbojet operations who suspects that a runway may have inadequate friction characteristics should arrange for testing by CFME. Visual inspections are still essential, however, to note other surface conditions.

The table below taken from FAA AC No 150/5320-12C lists various manufacturers equipment accepted for carrying out surface friction testing.

FRICTION LEVEL CLASSIFICATION FOR RUNWAY PAVEMENT SURFACES						
	40 mph			60 mph		
	Minimun	Maintenance Planning	New Design Construction	Minimum	Maintenance Planning	New Design Construction
Mu Meter	.42	.52	.72	.26	.38	.66
Dynatest Consulting, Inc. Runway Friction Tester	.50	.60	.82	.41	.54	.72
Airport Equipment Co. Skiddometer	.50	.60	.82	.34	.47	.74
Airport Surface Friction Tester	.50	.60	.82	.34	.47	.74
Airport Technology USA Safegate Friction Tester	.50	.60	.82	.34	.47	.74
Findlay, Irvine, Ltd. Griptester Friction Meter	.43	.53	.74	.24	.36	.64
Tatra Friction Tester	.48	.57	.76	.42	.52	.67
Norsemeter RUNAR (operated at fixed 16% slip)	.45	.52	.69	.32	.42	.63

The FAA Advisory Circular 150/5320-12C recommends the following texture depths.

A. NEWLY CONSTRUCTED PAVEMENTS

The recommended average texture depth to provide good skid- resistance for newly constructed concrete and asphalt pavements is 0.045 inch (1.14 mm). A lower value indicates a deficiency in macrotexture that will require correction as the surface deteriorates.

B. EXISTING PAVEMENTS

- When the average texture depth measurement in a runway zone (i.e., touchdown, midpoint, and rollout) falls below 0.045 inch (1.14 mm), the airport operator should conduct texture depth measurements each time a runway friction survey is conducted.

- When the average texture depth measurement in a runway zone is below 0.030 inch (0.76 mm) but above 0.016 inch (0.40 mm), the airport operator should initiate plans to correct the pavement texture deficiency within a year.

- When the average texture depth measurement in a runway zone (i.e., touchdown, midpoint, and rollout) falls below 0.010 inch (0.25 mm), the airport operator should correct the pavement texture deficiency within 2 months.

C. RETEXTURING

Retexturing of the pavement surface should improve the average texture depth to a minimum of 0.030 inch (0.76 mm). The FAA Advisory Circular 150/5320-12C refers to the Blastrac method of removing rubber and retexturing as the HVIM (High Velocity Impact Method) and describes it as follows:

HIGH VELOCITY IMPACT REMOVAL

This method employs the principle of throwing abrasive particles at a very high velocity at the runway pavement surface, thus blasting the contaminants from the surface. Additionally, the machine that performs this operation can be adjusted to produce the desired surface texture, if so required. The abrasive is propelled mechanically from the peripheral tips of radial blades in a high speed, fan like wheel. The entire operation is environmentally clean in that it is self-contained; it collects the abrasive particles, loose contaminants, and dust from the runway surface; it separates and removes the contaminants and dust from the abrasive; and it recycles the abrasive particles for repetitive use. The machine is very mobile and can be removed rapidly from the runway if required by aircraft operations.

THE FAA RECOMMENDS THE FOLLOWING FREQUENCY FOR RUBBER REMOVAL.

NUMBER TURBOJET AIRCRAFT LANDING DAILY PER RUNWAY END	MINIMUM RUBBER DEPOSIT REMOVAL FREQUENCY
less than 15	2 Years
16 to 30	1 Year
31 to 90	6 Months
91 to 150	4 Months
151 to 210	3 Months
Greater than 210	2 Months

BLASTING TO REMOVE RUBBER AND IMPROVE SURFACE TEXTURE

The Blasting system is a mechanical process which is designed to remove surface contaminants, surface imperfections and coatings. The process is fully controlled, safe and environmentally sound. It uses no water, no chemicals or solvents, emits no pollutants or dust to the atmosphere and the removed material can often be fully recycled.

Steel shot is fed by gravity through a control valve into an impellor. The impellor turning at high speed throws the steel shot through an adjustable opening at high velocity and at a specific angle on to the surface over which the self propelled machine is traveling.
The steel shot impacts the surface and bounces off, as it does so material from the surface whether this is contaminants, coatings or the surface material itself is abraded and loose material together with the shot is drawn up into the machine by the airflow created by the vacuum unit.
Brush seals enclose the blast head to the surface and air is drawn in through and under the brushes from the surface to ensure no shot or material from the blast head escapes to atmosphere. This is around 99% efficient but when the machine goes over any bumpy or uneven surface some shot particles can escape.

Accurate control of the blast pattern and the degree of removal or texture created is controlled using various machine settings and operational practices.

These include:

- Shot type
- Shot size
- Shot delivery control valve setting
- Impellor / Rotor speed
- Dust collector vacuum (airflow) setting
- Number and direction of passes

Other variables outside of the control of the operator include:

- Forward speed of machine
- Humidity
- Temperature
- Type of surface
- Type of aggregate in surface
- Type and depth of contaminant
- Required finish

It is therefore clear that while the required finish to the surface can 99% of the time be achieved, to initially set the machine correctly and find the best practice for each site requires time and test areas before work begins.

Of course experienced operators are frequently able to identify all these things and set off almost immediately after arriving on site with the correct settings.

IN CONCLUSION

The shot blasting process provided by Blastrac equipment has significant benefits when used for rubber removal and surface retexturing of airport runways.
The system can effectively remove rubber deposits without the need for water, solvents or chemicals.

The process is dry, enclosed and removes all debris from the surface, leaving a clean dry surface ready for immediate use, or for application of sealers or coatings/lines.
Removed material can be recycled at asphalt or concrete production factories.

The Macrotexture can be significantly improved bringing it up to the required level and improving surface drainage.
The microtexture is brought back to that of the original aggregate property. The Blastrac process exposes the aggregate particle with a completely fresh surface, as it was when quarried, thus providing it’s full properties.

This sharpness of the aggregate is important to penetrate through any water film and connect with the tyre. Other cleaning processes do not achieve this.
The Blastrac process is safe, environmentally friendly, fast, clean and very cost effective. In the event of the work having to be interrupted for airport operational reasons, the truck can simply leave site and the runway can be in use moments later.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