



# *Green asphalt*

- a few words about roads and the environment

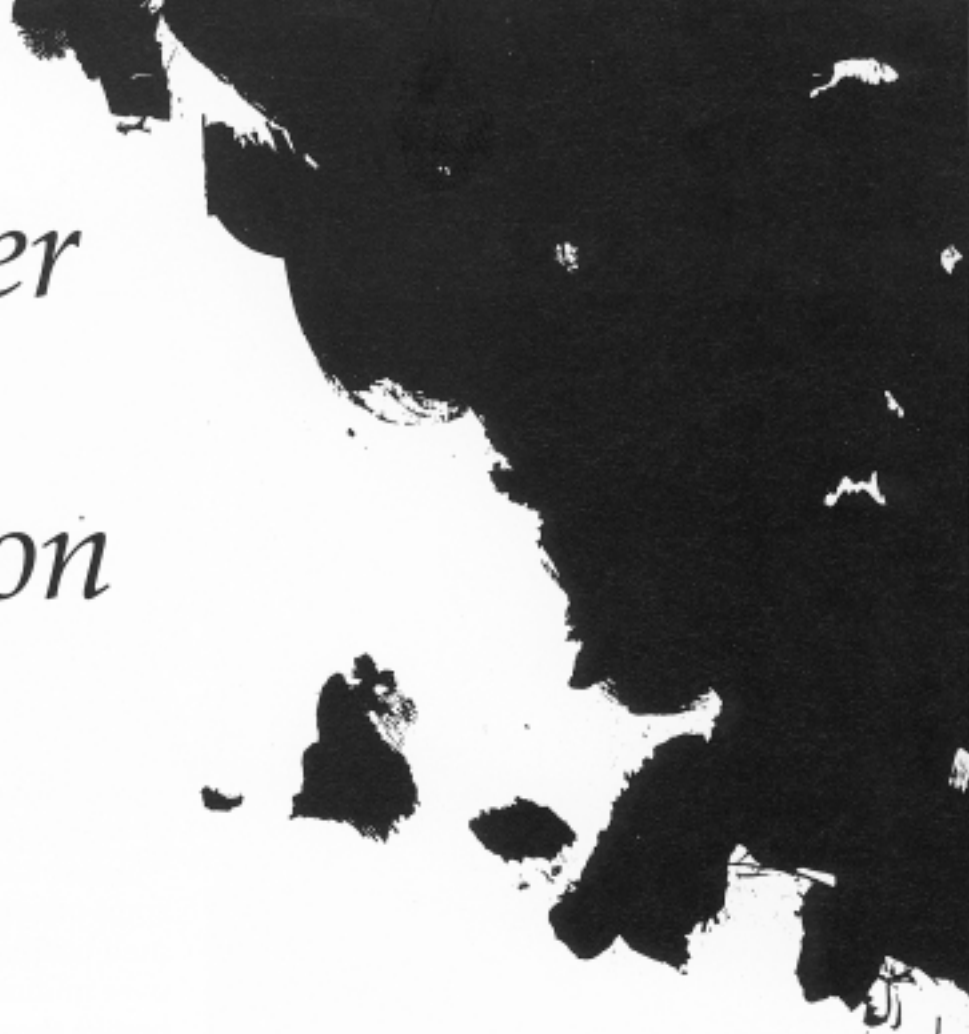
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# *Far better than its reputation*

It's black, it's sticky, and it smells funny.

Perhaps it isn't so strange that a great many people believe that asphalt is a threat to the environment. That they believe that asphalt is a new and unnatural material which is dangerous to both nature and humans.

In fact, however, asphalt is a natural material that humans have been using for thousands of years.

It is certainly true that asphalt handling has negative environmental effects, just as any other industrial operation. But asphalt isn't as dirty as it looks. Asphalt does

more good than harm and provides the solution to many environmental problems.

We in the asphalt industry work hard to lessen the negative impacts upon the environment that, despite our best efforts, sometimes occur. And we've set some rather high goals for ourselves: not to squander the Earth's resources and not to damage the environment.

We've come a long way. And we're making progress all the time.

That's what we would like to tell you about in this brochure.



# *An ancient, natural product*

Asphalt wasn't invented by humans; we discovered it in its natural state many thousands of years ago.

Natural asphalt consists of the heaviest components of crude oil, which was formed underground from organic matter over millions of years. When this oil breaks through the surface, it solidifies and turns into asphalt.

There are entire seas of natural asphalt around the world. They are found in Trinidad, California, Peru, and the Caucasus, among other places.

As early as 4000 BC, natural asphalt was used in Mesopotamia to make ships watertight, to fix jewels and mosaics in place, and to attach handgrips to weapons.

In Ancient Egypt, asphalt was used for embalming and to strengthen the walls in the pyramids' sepulchres in order to keep them airtight and moisture-proof for thousands of years.



Illustration: Gustave Doré

Moses floated along the River Nile in a basket waterproofed with asphalt.





Asphalt is a natural material.

*Photo: Dorkell Dorkelsson*

Asphalt - or "pitch" as it was called - even appears in the Bible several times.

Noah used asphalt to make the Ark watertight. And when the Tower of Babel was erected, soon after the Flood, asphalt was used as mortar.

Moses was able to travel safely down the River Nile in a basket only after his mother had coated the fragile vessel with asphalt.

The actual origin of the word asphalt is a little unclear, but linguists believe that it is taken from the Greek *a sphallo*, which

means "does not fall down". This could refer to the fact that asphalt, a highly valued binding agent, prevented walls from collapsing.

Modern asphalt - which is actually called bitumen - isn't really the same as the pitch of days gone by. Today, bitumen is produced by distillation of crude oil in refineries.

This means that the advantages of the old natural asphalt are retained, while at the same time a more useful, versatile product is created.

# *Almost just gravel and stones*

A common characteristic of all asphalt roads is their low asphalt - or, more correctly, bitumen - content!

Usually, an asphalt pavement contains only about 5% bitumen. The rest is gravel or crushed stone, just like in all other types of road.

Bitumen is used to bind the gravel and crushed stone. However, this small addition of bitumen is extremely important for road quality and durability. An asphalt road is superior to a gravel road in

all ways including safety, accessibility, comfort, economic, and environmental aspects.

Asphalt pavements can be adapted to different needs. A heavily trafficked road requires another type of surfacing than, say, a garage driveway. Different climates require asphalt pavements with different characteristics.

Sometimes, in addition to stone material and bitumen, small amounts of other substances are used to further improve



Photo: Lars-Göran Wälgren

If you examine an asphalt pavement, you'll soon see that it mainly consists of stones.

the asphalt properties. Additives such as powdered limestone, polymers, or cellulose and mineral fibres, for example, can be used.

Many years ago, coal tar was also used as an additive, but this is no longer the case due to environmental considerations.

Two types of asphalt surfacing are commonly found on streets and roads in the Nordic countries: asphalt mixes and surface treatments.

Asphalt mixes are made from bitumen and aggregates mixed in an asphalt plant. The mix is spread out on the road surface and then compacted by a roller.

There are different types of asphalt mixes. Their respective mixing temperature determines whether they are called hot mixes, warm mixes, or cold mixes.

Surface dressings are produced by a different method. In this method, the binder is spread on the road and chippings are dropped into the binder and compacted.



# *Effects on the environment*

The construction of roads alters the landscape, but it does not otherwise damage the environment any more than other industrial operations. Notwithstanding, the industry must carefully consider the environmental impact of asphalt - from the extracting of raw materials to the wear of paved roads.

## **Raw materials**

The fact that crude oil, gravel, and aggregates are used when manufacturing asphalt means that we consume some of the Earth's limited resources. One must remember, however, that only a fraction of the oil pumped from the Earth is used to produce bitumen.

North Sea oil is unsuitable for refining bitumen products. As a result, the crude oil used for bitumen production in the Nordic countries is obtained mainly from Venezuela and the Middle East.

The crude oil is transported to the Nordic countries by sea - the most environmentally friendly method.

However, the asphalt industry's best way to save the Earth's oil resources, is to recycle asphalt.

Previously, the quarrying of aggregates led to extensive environmental damages. Today however, the quarries are carefully chosen and restored after operations are finished. As a result, damage is negligible. The quarry sites can even provide unique living environments for animal and plant life.

In order not to deplete natural gravel supplies, crushed rock is used more and more in asphalt production. This also means that asphalt and crushing plants no longer need to be situated near groundwater sensitive areas, which has a positive effect upon the environment.

Quarrying and crushing rock does, however, cause some disturbance in the form of noise, vibration, and dust. In order to minimise these negative effects, new crushing plants are often enclosed and fitted with effective dust separators.





An old quarry has been transformed into a pleasant lake for fishing.

photo: stefan rohn

### **New products**

The asphalt industry has worked actively to develop more environmentally friendly products, by reducing the volatile substances released. Oil gravel has been replaced by soft asphalt, while bitumen cut-backs, which are used for bonding and in surface dressings, have been replaced by bitumen emulsions in many countries.

Products with longer life cycles and durable thin pavements have been developed. This results in less need to use limited natural resources, less pollutants

from asphalt plants, and a corresponding reduction in the amount of transport and freight to construction sites.

### **Production**

The production of asphalt mixes has various effects upon the environment. Obviously, energy is consumed and the process can result in disturbances caused by noise, dust, and air pollutants released into the surrounding atmosphere.

To find solutions to these problems the asphalt industry has made significant investments. One result has been the



New asphalt plants are enclosed to minimise noise and dust problems.

*Photo: Uno Tikk*

installation of effective systems for minimising the spreading of dust and other particles. In addition, new asphalt plants are often completely enclosed, which reduces noise pollution.

The switch to low sulphur fuel oil, LPG, or natural gas has also reduced the amount of air pollution caused by asphalt plants. Surface water are purified in oil separators.

We also keep better documentation

today of chemical purchase, use, and waste disposal than before.

The industry is working to reduce energy consumption, which has a positive effect upon the environment.

One important advantage of asphalt production is that no process water is used. This means that there is no risk of polluted water being released into the environment during production.

### **Transport**

All transport of goods has a negative effect upon the environment in the form of energy consumption, noise, and air pollution. The transition to more environmentally friendly engines and fuels, together with improved transport planning, has reduced exhaust and air pollution.

### **Laying**

The smoke that usually surrounds men and machines when asphalt is being laid on roads is primarily steam. However, the smoke also includes volatile organic compounds. These pose an environmental problem, but improved process techniques, the use of more environmentally friendly products, increased temperature control, and better transport planning have reduced these pollutants considerably during recent years. These measures have also, quite naturally, improved the occupational safety of the asphalt workers.

Releasing agents are used to ensure that asphalt does not stick to vehicles, machinery, or shovels. Work is underway to replace fuel oil with a more environmen-

tally friendly alternatives, such as rapeseed oil or stonepowder.

### **Quality control**

The asphalt laboratories perform quality controls that release some volatile solvents. These have, however, been reduced via increased reuse. The transition to other test methods will eliminate such pollution in the future.

### **On the road**

The asphalt pavement also affects the environment. In the Nordic countries, this is primarily the effect of particles being torn up from the surface by studded tyres. The dust problem is not limited to asphalt roads, however, it is even more serious on other roads. Dust is a huge problem on gravel roads.

During the 1990s, the wear of the pavement has been greatly reduced, according to studies made in Finland and Sweden. This is the combined result of the industry's development of considerably more durable pavements and motorists' more widespread use of stud-free winter tyres or studded tyres with lightweight studs.



# Careless drivers the greatest threat

Asphalt is not classified as a hazardous substance; asphalt is even used as a sealing material in drinking water reservoirs. Medical studies also show that the incidence of lung or other cancer is no greater among asphalt workers than among the population in general.

However, there is still reason to protect workers from the bitumen fumes that are released when laying hot asphalt mixes. Many machines have been fitted with advanced computer technology and operational controls. Insulated, air-conditioned driver cabins help to protect drivers from fumes, exhaust gases, and noise. Other surveys have shown that ergonomic complaints, such as neck, shoulder, and back pain, are more common among asphalt workers than among other construction workers. These problems have also been partially solved by improved machines.

The main problem related to the occupational health of asphalt workers is the fact that they work in the midst of traffic.

Drivers often fail to pay attention to warning signs, and often approach construction sites at dangerously high speed.



Photo: Industrietechniken AB

Asphalt workers do not have greater health risks than other workers.

# *Improved traffic safety is also an environmental issue*

When we work to improve the environment, we strive to a large degree to prevent people from being injured or killed - both now and in the future.

Consequently, traffic safety is also an important environmental issue.

It is a known fact that well maintained asphalt roads increase traffic safety in various ways.

- Improved tyre grip.
- Shorter braking distances.
- Traffic rhythm becomes steadier -reducing the number of overtaking and other accidents.
- An asphalt pavement is an excellent base for permanent road markings and speed traps, such as pumps.
- Coloured asphalt can be used for information and safety marking of cycle and pedestrian paths.



Photo: Anders Matheson

Asphalt makes it easier and safer to get around - whatever your means of transport.

# *100 per cent recyclable*

The asphalt industry's most effective method to conserve nature's limited resources is the reuse of old asphalt pavements. Asphalt has proven to be a construction material well suited to recycling.

The fact is that old asphalt is 100 per cent recyclable!

Unlike concrete, both the binding agent and the aggregate of reclaimed asphalt can be reused without any waste.

When recycling reinforced concrete, iron reinforcement must be separated. In addition, old concrete can only be reused as ballast, as the cement is no longer a viable binding agent.

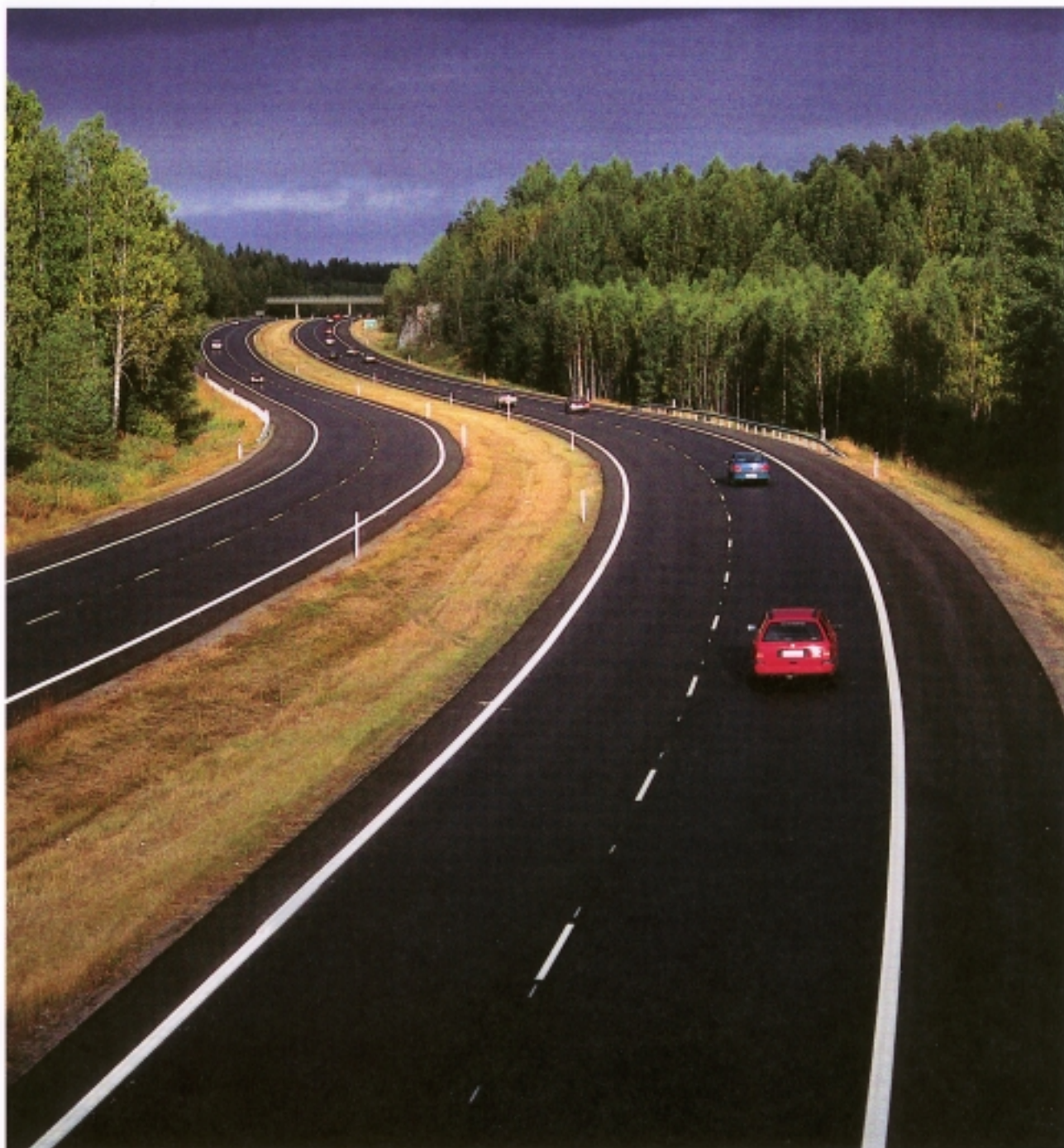
With the technology available today, it is very easy to utilise old asphalt pavements. Equipment used to remove old asphalt have large capacity and old asphalt can be crushed or sieved in relatively simple plants in order to be reused.

During recycling, the old pavement is used as raw material in the production of new asphalt mixes, either in asphalt plants or on sites.

The recycling process can be performed in hot, warm, or cold conditions.

By recycling asphalt, we conserve nature's resources and avoid the need to transport old asphalt to landfills.





Sure, this is a new road. It is, however, made from old asphalt. Recycling is the best way to save the Earth's resources.

PHOTO: JIMMY JOHNSON

# *Asphalt solves environmental problems*

Despite the fact that motor vehicle exhaust fumes are much cleaner today than just a few years ago, traffic still poses a great deal of environmental problems for modern society.

In addition to exhaust fumes, road salt, dust, and noise pollution affect those living and working close to roads.

A well maintained asphalt road enables motorists to hold a more even speed, lessening the need to accelerate or brake rapidly. The result is lower fuel consumption and reduced exhaust fumes.

Asphalt pavements also reduce noise and improve riding comfort, for both drivers and passengers. Certain asphalt types can even replace noise-reduction barriers

The potentially harmful chemicals used for binding dust on gravel roads are not required on asphalt roads.

The use of light coloured aggregates in asphalt mixes has been showed to reduce the need for road illumination.

The environmental benefits of asphalt aren't limited to roads, however. Asphalt is a watertight material and is used as such to waterproof constructions, bridges, car parks, terraces, courtyards and water reservoirs.

Due to increased environmental awareness authorities now tend to require that installations processing harmful substances are built with watertight constructions to avoid groundwater pollution.

This is where asphalt comes into the picture. Asphalt is used for a variety of applications, including basins, reservoirs and in various types of protective structures used on airports and along roads and railways.

Asphalt has many advantages over other waterproofing materials. Asphalt, for example, can cope with heavy loads, allowing vehicles to drive directly on the actual waterproofing layer.





A beautiful gravel road in a Nordic environment with one small problem- it's so dusty. With asphalt pavements, the problem disappears.

*Photo: Mats Wibe Lund*



# *Facing the challenge*

The Nordic asphalt industry's environmental goal is to limit negative environmental effects as far as possible and to promote long-term thinking in natural resource utilisation.

As this brochure shows, much work has already been done to minimise the environmental problems related to asphalt handling. These efforts, however, continue.

Here follow some points we would like to improve:

- Increase the recycling of asphalt. Our goal is that all reclaimed asphalt should be reused.
- Continue to reject raw materials and substances that are harmful to humans and to the environment.
- Continue to reduce energy consumption.
- Continue to reduce the release of particles, dust, and other air pollutants, both in asphalt plants and on construction sites.
- Continue to improve transport planning in order to reduce environmental impact.
- Equip all transport vehicles with environmentally friendly engines and always use the most environmentally friendly fuel.
- Make the work sites of asphalt workers even safer and create a good working environment for all our employees.
- Continue to develop products and methods that are as environmentally friendly as possible.
- Develop new products with even longer lifetimes.
- Work actively with environmental issues throughout our operations, using such aids as environmental management systems.

## Further reading

This brochure is available in five Nordic languages, and also in English. It is a summary of "Asfaltens gröna bok" ("The Green Book of Asphalt"), published by Committee 33 of the Nordic Road Association ( Utskott 33; NVF / Nordiska Vägtekniska Förbundet).

The NVF's purpose is to promote development within the field of road and traffic, through collaborative work between representatives of the road sector in Sweden, Norway, Finland, Denmark, Iceland, and the Faeroe Islands.

In 1998, the NVF - Committee 33 ( Asphalt pavements ) decided to produce a booklet informing rea-

ders of the issues surrounding asphalt and the environment. Efforts surrounding "The Green Book of Asphalt" have been steered by a project group made up of one representative from each Nordic country. Lars-Göran Wågberg from the Swedish National Road and Transport Research Institute in Linköping was responsible for compiling and editing the work. This brochure was prepared by the NVF-project group : Jan-Olof Nordlander, Sweden; Lars Forstén, Finland; Thore Aas, Norway; Erik Nielsen, Denmark and Sigursteinn Hjartarson, Iceland.

"The Green Book of Asphalt" is published as an NVF report in Swedish language. The report and this brochure can be ordered from:

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