

25/1/07

Energy from asphalt

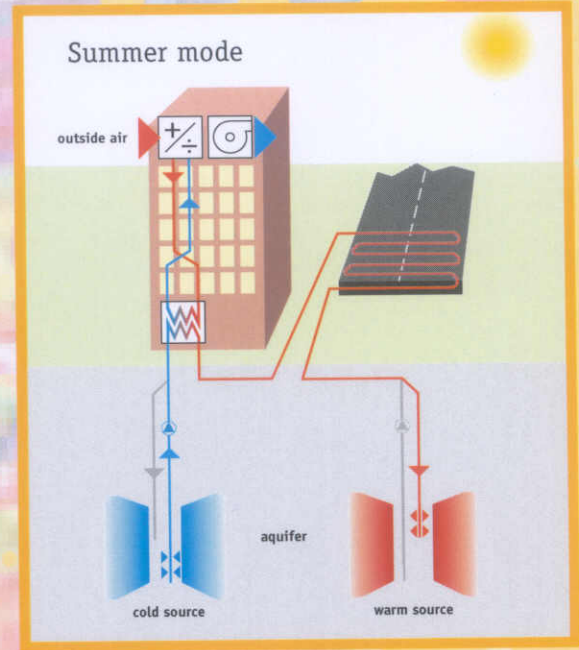
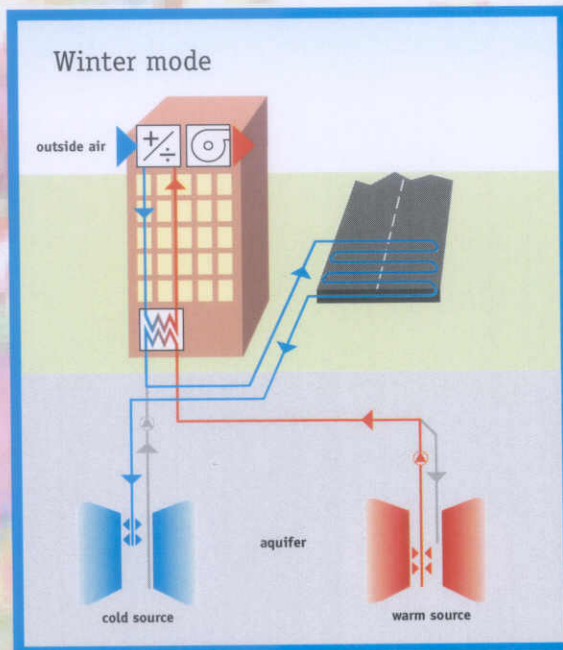
for heating
and cooling
buildings and roads



road energy systems®

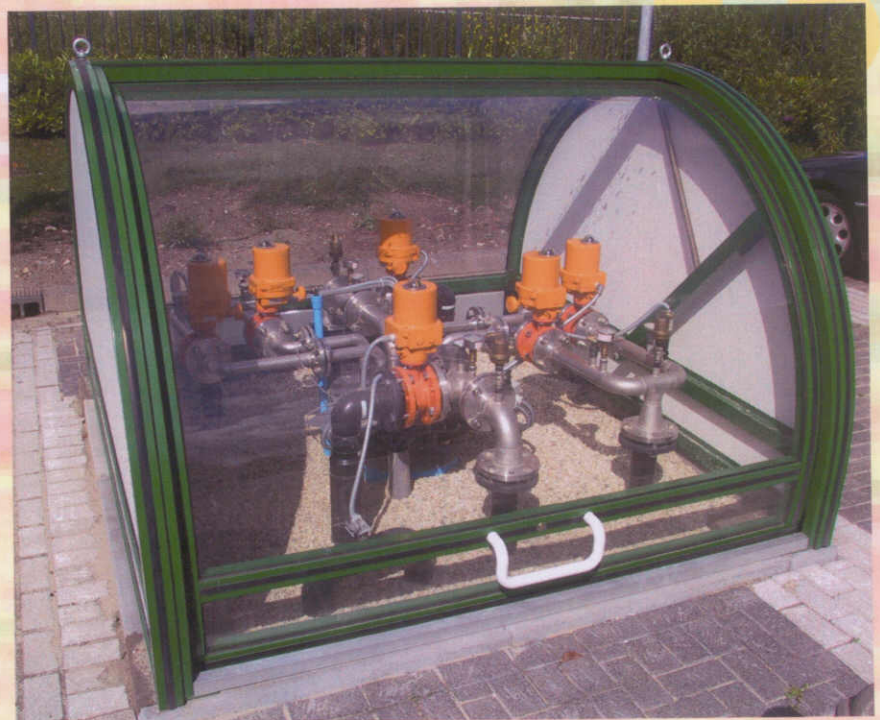
Energy from asphalt

Ooms Nederland Holding and Tipspit have developed Road Energy Systems®, a method for heating and cooling buildings and roads. Road Energy Systems® comprises of an asphalt concrete layer with a reinforced structure and a water-bearing medium. Asphalt concrete's dark colour has an excellent heat-absorbing property. The water-bearing medium is able to cool the asphalt in summer (heat extraction) and heat it during winter (cooling extraction). The asphalt solar collector represents a new way of harnessing solar energy. The longer and more intensively solar energy is used, the more important it becomes as an environmentally friendly way of meeting our energy needs. In recent years it has become increasingly evident that the fossil fuels used to generate energy are not inexhaustible and that their use is harmful to the environment (greenhouse effect). The aim of Road Energy Systems® is to achieve energy savings by using thermal energy stored in e.g. aquifers for cooling and/or heating in commercial and industrial buildings, industry, residential constructions, earthworks, civil and hydraulic engineering and the agricultural sector.



Storing energy in the ground

Storing energy in the ground is an energy-saving, environmentally friendly heating and cooling technique. In summer, Road Energy Systems® generates considerable heat. This heat is stored in the ground and can be pumped up for heating purposes in winter. Conversely, the stored winter cold can be used for cooling in summer. In the Netherlands, the warm and cold water are separately stored in an underground water-bearing sandy layer (an aquifer). The hot and cold groundwater can be pumped up from the aquifer or it can be injected back. The vertical conveyor pipelines running from the hot and cold source are located approximately one hundred metres apart and can be as much



as one hundred metres deep. In winter, groundwater is pumped up from the heat source. After it has been used for heating, by allowing it to go through the asphalt solar collector, it is injected into the cold source. In summer the process works in the opposite direction, with

water being pumped up from the cold source and used for cooling. The heated water is then once again led through the asphalt solar collector, where it is further heated by the sun and then injected into the heat source in the ground.

The combined use of this storage system with heat pumps and modern floor and wall heating/cooling requires the control systems to be thoroughly tuned to match the actual requirement and achieve the fossil fuel saving and CO₂-reduction.

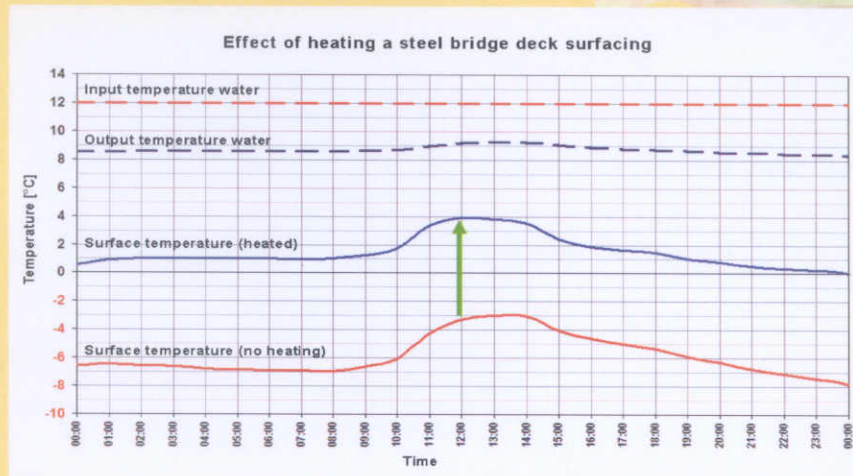
Improved traffic safety

In winter the temperature of the pavement surface can be kept above freezing, thereby preventing the formation of ice on the road. The evaporation rate of rain and meltwater is also speeded up. In summer, cooling the pavement surface to below the temperature at which bitumen begins to soften prevents the structure from being deformed. This in turn prevents the formation of ruts or permanent deformation, which significantly

improves traffic safety, especially under poor weather conditions. The combination of a reinforced asphalt

structure with a heating system ensures that the road surface will show fewer cracks in winter. All in all, this means

less road maintenance, resulting in fewer road closures and traffic jams and hence improved traffic safety.



Environmental gain

Using Road Energy Systems®:

- to heat and cool buildings means wasting less fossil fuel, which reduces CO₂ emissions;
- to heat roads in winter results in savings on the use of salt on icy roads, thus lowering the environmental impact of salt;
- reduces traffic problems during smog periods (condensation creates a wet road surface, which eliminates dust problems).



Increasing the durability of roads

Road Energy Systems® can be used to reduce variations in temperature that can occur in an asphalt layer, thereby extending the life. Cooling and heating asphalt also reduces general wear

and tear. Because these asphalt structures are less prone to cracking, there will also be less damage caused by freezing and thawing. In addition, the combination of temperature regulation

and a specially reinforced structure will extend the life of the asphalt structure even further.

Increasing the durability of concrete structures

By controlling the temperature of a concrete (bridge) structure within a certain range, it will not expand and contract as much, significantly reducing the joint movements. By using water-impermeable bituminous membranes in combination with

Road Energy Systems®, it is possible to make a jointless/silent transition. By not having to spray as much salt or any salt at all, there is no damage to the underlying concrete from corrosion of the reinforcement as a result of salt penetration.

Energy savings Economic issues

The combination of energy-efficient buildings and Road Energy Systems® can produce substantial savings on energy consumption when compared to traditional buildings.

- Major savings on energy consumption when used to heat and cool buildings;
- Longer life of asphalt structures;
- Reduced maintenance costs for roads and engineering structures;
- Reduced costs of anti-ice measures;
- Government grants;
- Short pay-back period for the extra investment;
- Fewer traffic jams;
- Improved traffic safety;
- 'Green' image.

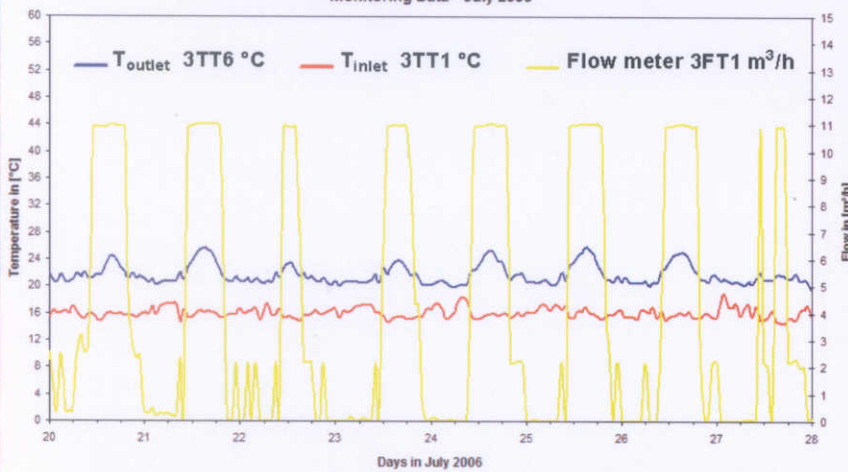
Applications The process

- Heating and cooling buildings;
- Keeping roads, engineering structures, airport runways and loading platforms (at company premises, airports, harbours, bus and train stations) free of snow and ice;
- Heating and cooling sports fields, soils used for cultivation of crops (cold crop cultivation) and greenhouses. The heat can also be used for biological soil sanitation purposes.

Before using Road Energy Systems®, a number of steps need to be carried out during the preliminary stage:

- The energy requirements of the building, road or structure have to be determined;
- Determination of the surface area, structural division and location of the asphalt solar collector;
- The mix composition and engineering properties of the entire pavement structure have to be determined, depending on the level of loading and strength of the subgrade;
- Before deciding on the aquifer system, a geohydrologic study needs to be carried out to assess the ground storage capacity and the quality and flow rate of the groundwater;
- When used in buildings, the measurement and control technology aspects of the various subsystems (asphalt solar collector, aquifer system, heat pump and the heating/cooling system in the building) have to be optimized.

Asphalt Solar Collector I - area 450 m² - project Scharwoude
Monitoring Data - July 2006



Optimized process control strategy



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