

Vinnova report (in Vinnova portal)

Project information and results

Project summary - outcome

The global goal is to reduce CO₂ in the atmosphere and Sweden's goal is zero emissions by 2045. The asphalt industry in Sweden contributed 2% of emissions in 2011. Innovative technologies based on electrical energy must be developed with new ways of working to achieve sustainability.

The SMMART project has developed methods where asphalt is heated with electrically based microwave technology. It involves magnetite, a ferri-magnetic iron ore, which is used as an absorbent of energy. Full-scale tests on a bridge show that the material is equivalent to or better than traditional products for machinability and function. A prototype for heating cast asphalt in batches of just over 0.5 tonnes has been developed. Consumption of energy and time has been investigated as a function of asphalt mass and proportion of magnetite. Appropriate size of the magnetite particles has been identified, as well as optimal content. Low levels of low energy absorption and high large surface heating. Leakage of radiation and other work environment aspects have been studied. The technology is clean, minimal leakage of radiation, small emissions of harmful substances and low noise levels. The technology means that the heating can be controlled digitally, remotely and at set time intervals.

Gender equality is promoted by the use of new, clean, digital technology with less physically heavy work steps. The technology normally enables family life and social sustainability is promoted.

The conclusion from the consideration of policy instruments is that the EU regulations for EPDs, as well as the Swedish Transport Administration's climate report, do not burden the biogenic emissions that occur during the combustion of biomass. This reduces the potential for electric solutions where electricity comes from wind, solar and hydropower. Climate emissions in climate declarations and procurements, with electricity as the energy source, find it difficult to compete with emissions generated by biomass combustion.

Goals for the project - fulfillment

The goal is to develop, market and initiate the implementation of electricity-based microwave technology for CO₂-free heating of asphalt. Optimal magnetite content was determined by tests in a household micro. With electrified technology, carbon dioxide emissions are reduced, cleaner technology provides a better working environment and makes the industry more attractive.

The technology is suitable for heating thin layers of material.

The dimensions of the sample shall be optimized with respect to the penetration depth in order to obtain an efficient heating. Other aspects affect the heating, including the design of the vessel, stirring and heat loss. Solutions for upscaling have been identified and various concepts have been developed. The challenge is to get electric power outside the electricity grid, tests were done with successful results at the demo together with suppliers of mobile battery solutions. Mobile solutions can provide new opportunities where mixing takes place at the site of installation and can provide a smaller number of transports. Laboratory tests and field tests show that the asphalt material is not affected by magnetite or by microwaves.

Control can be done remotely with important temperature control. Machinability has been tested by experienced asphalt pavers with positive reviews, with an improved working environment. Before broad implementation, technology development with an industrial player is required. Equipment pre-industrial scale for continuous production of about 100 tons / hour needs to be developed. The parties see great potential in the project and will continue with a next step.

Marketing with a press release has taken place at the beginning of the project and at the end with demo pre-invited parties. Then it was also shown how the technology is used in the field without access to electricity with Vattenfall's and Northvolt's battery solution. A film has been

produced for publication on Youtube.

Project summary for publication

Purpose and goals – fulfillment

The aim is to develop a CO₂-free heating for asphalt. A method with microwave technology has been tested where magnetite, an energy absorber, is mixed into the asphalt. Amount of magnetite and size have been determined by calculations, laboratory work and full-scale experiments. Tests were done with a pilot <0.5 tons. Heated asphalt meets the requirements for pavements. Working environment is better, we get less emissions including radiation and lower noise levels than with today's technology. There is a market, large amounts of asphalt are laid annually. Gender equality is improved.

Results and expected effects

Heating of asphalt by microwaves/electricity reduces CO₂ emissions. Cleaner technique will give better working environment and more attractive working sector to both women and men. Sustainability will be in focus. The degree of reused asphalt can increase with economy by the new technique. New logistic patterns will develop when heating and mixing of asphalt take place close to construction sites, i.e. less long transports with heavy cargo. Heating process can be digitalized and be more accurate, thus reducing the risk of overheating. The technology can get a world widespread.

Layout and implementation

The project has consisted of 10 parties with different experiences, knowledge and areas of expertise. Progress has been created by collaborating and sharing knowledge between each other. Meetings have mainly been held digitally. Studies have taken place through theoretical studies, interviews with people in the industry and through practical experiments. The project has worked with recipes, pilots and field trials, governance, market and business, work environment, gender equality and communication.