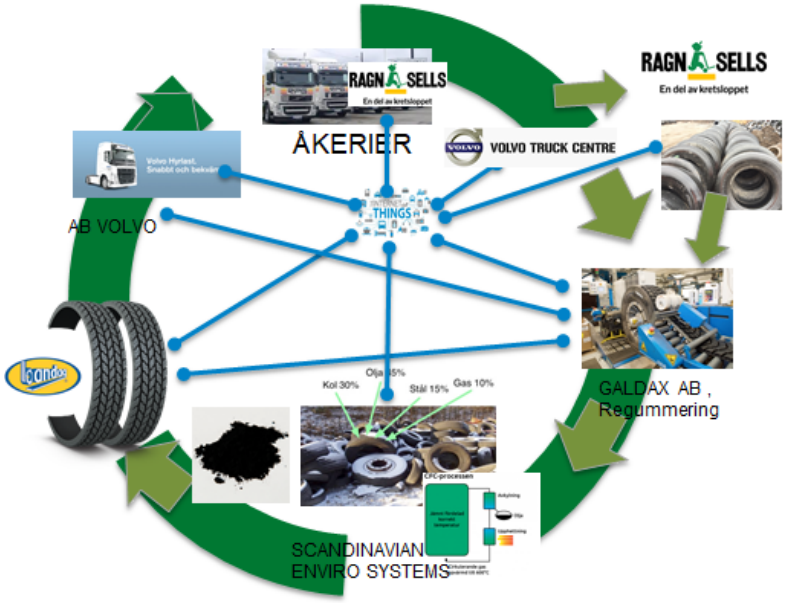


White paper: Sensors and recycling for heavy vehicle tyres

How can we use innovative sensor technologies in order to sense health parameters of tyres in real time, leading to and that will result in increased resource productivity??

Summary

* Passive piezoelectric sensors integrated in tyres can monitor dynamic forces subjected to the tyres in real time (e.g. collisions or improper air pressure), without the need for external power supply (e.g. battery).
* Real time sensor monitoring has the potential to provide drivers, fleet management, re-treading companies, vehicle manufacturers and recyclers with valuable tyre health information for development of services of tyr

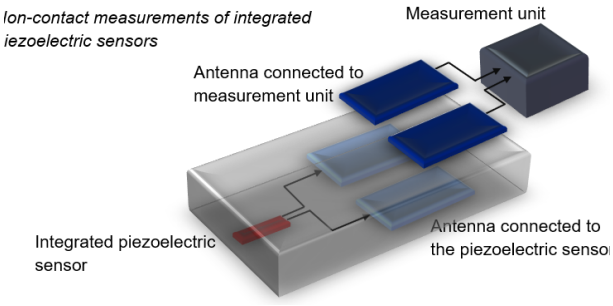
About the project:

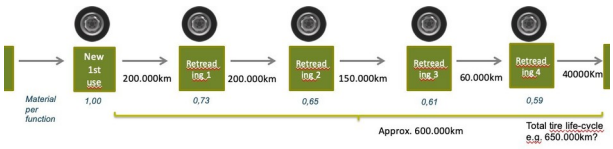
"Circular economy in a business ecosystem: Integrated sensors and new recycling technology for heavy-duty vehicle tyres" is a collaborative project that builds knowledge about how the heavy vehicle tyre system in Sweden could become more circular and resource efficient. New service-based business models supported by integrated sensor data as well as new recycling technology are the underpins for the development of more circular business ecosystems. Usage and reuse of tyres can be optimized through real time information of ´health´ and ´health´ history of tyres that can be obtained by monitoring tyres with different sensor technologies. The project is financed by the Swedish Innovation Agency (Vinnova) and implemented by RISE (Research Institutes of Sweden) in collaboration with Volvo Truck Center (part of AB Volvo), Galdax, Ragn-Sells and Scandinavian Envirosystems. The project has been underway for 2.5 years, from the end of 2016, and is expected to be completed in 2019.

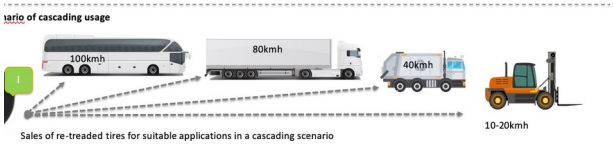
The problem:
Limited sensing solutions that monitor health parameters of tyres makes it hard to recirculate tyres
The global increase in vehicle and tyre usage creates a great need for material circulation of tyre raw materials (approx. 1.2 billion vehicles in 2014). Globally, million tonnes of car tyres are discarded annually, and current handling of end-of-life vehicle tyres can be significantly more resource-productive. One option for resource optimization of the use of heavy-duty vehicle tyres is to retread/reuse the material in several use cycles compared to today's end-of-life solutions. In a circular economy, economic value is created through material cycles with a high proportion of re-use, remanufacturing, material recycling and ultimately energy recovery.
which, during use of the tyre, can identify damage due to collisions or improper air pressure and provide the retreading companies, vehicle manufacturers and recyclers with valuable information for the development of, is today not used to its full capacity.

The solution: Non-contact force monitoring in tyres

By using passive piezoelectric force sensors integrated in tyres and an innovative non-contact sensing technique of the piezoelectric signal, impacting forces can be measured in real-time. Since the measurements are wireless the piezoelectric sensor can move relative to the measurement unit and the antenna connected to the unit.
This sensor method has previously been used to measure nip pressures in rolls in paper machines (Sweden based company Vasasensor AB) and, as we show in the project, the method can also be utilized by integrating piezoelectric sensors in tyres in order to monitor dynamic forces that ares subjected to the tyre, as well as tyre rotation speed and vehicle speed.
The integrated piezoelectric sensor is passive and does not need any power supply in order to sense the forces. It delivers electrical charges when the sensor is subjected to dynamic forces that is picked up by the antenna connected to the measurement unit. The measurement and signal analysis unit convert the measured signal to the actual time dependent force at the sensors.
The sensors are made of polymeric piezoelectric material and can be manufactured as thin (in the range of some µm) and flexible films (thickness in the range of 50 µm), as well as very thin piezoelectric active polymer fibres (diameter in the range of 50 µm). All the







More information

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used techniques, e.g. manufacturing of the piezoelectric sensors as well as electronics and signal analyses are performed by RISE.