Development of calibration process for alcolock

Project within FFI Production technique

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Content

FFI in short

FFI is a partnership between the Swedish government and automotive industry for joint funding of research, innovation and development concentrating on Climate & Environment and Safety. FFI has R&D activities worth approx. €100 million per year, of which half is governmental funding. The background to the investment is that development within road transportation and Swedish automotive industry has big impact for growth. FFI will contribute to the following main goals: Reducing the environmental impact of transport, reducing the number killed and injured in traffic and Strengthening international competitiveness. Currently there are five collaboration programs: **Vehicle Development, Transport Efficiency, Vehicle and Traffic Safety, Energy & Environment and Sustainable Production Technology.**

For more information: www.vinnova.se/ffi

1. Executive summary

We have built a Swedish Research Park for development and test of calibration processes for alcolock prototypes, aiming at a future high-volume production. The demonstrator unit is placed at SenseAir and is presently running with various kinds of prototypes. Now, we are able to:

* Calibrate alcolock prototypes in a correct environment concerning ethanol, carbon dioxide as well as temperature
* Generate a well-tempered and exact ethanol vapour / carbon dioxide, correctly mixed with purified compressed air
* Use a newly built and accurate reference sensor unit to control the above gases
* Perform the calibration in a specially designed chamber composed of optimised materials which do not introduce large deviations during the calibration process
* Communicate with every individual alcolock sensor during the entire calibration process
* Utilise a safe product / production line communication interface
* Minimize the environment influence during each production sequence thanks to a shortened production time and gas consumption.

2. Background

In Sweden, a large part of traffic killed drivers have an alcohol level above 0,2‰. The corresponding figures are even higher in the US and within EU. The combination alcohol and driving is an enormous problem for our society, costing a lot of money and causing unmeasurable pain for all involved persons.

After several years of research and technique investments, **Autoliv** has developed an unique Alco sensor concept which will revolutionize the global alcolock market. Also, **Volvo Cars** and **Volvo AB** have participated in this work. Moreover, the alcolock projects have been globally supported by **DADSS** in the US (Driver Alcohol Detection System for Safety) which do trust this new technique approach: to analyze the gases in the out-breath by IR spectroscopy.

Market analyses indicate the this business segment has a potential to increase the Swedish export by more than 10 billion SEK within 10 years, creating over 400 new jobs. Since it is necessary to use an automatic and safe production system for this novel alco sensor platform this FFI project **Development of calibration process for alcolock** was initiated.

3. Objective

SenseAir plans to be **Autoliv´s** main supplier of high-performance alcohol sensors in large volumes. To manage the high demands within Automotive the production technology must be developed and quality certified. In addition, the production costs must be minimized by smart and efficient solutions which in parallel make the environment safer.

4. Project realization

The project has been running for nearly two years, 2012-09-01 – 2014-06-30, but during approximately 6 months the speed was lowered due to a lack of prototypes to test.

The work was led by Professor Ingrid Bryntse at SenseAir together with responsible persons in various areas. Active members at Autoliv, Hök Instrument and SP have contributed to the excellent results. The project management group was led by Rauno Pyykkö at SP, Technical Research Institute of Sweden.

The first calibration chamber prototype.

5. Results and deliverables

5.1 Delivery to FFI-goals

Here we describe the project relevance for the following FFI goals:

- Possibility for the industry to contribute to knowledge-based production in Sweden, in a competitively strong way

If Swedish industry will not support highly automatic and correct calibration of gas sensors we will loose market shares to low-cost countries.

- Support a future competitive Automotive industry in Sweden

Swedish cars are well-known for their safety systems. Accurate and self correcting alcolock sensors fit well into this direction – if they can be produced in an efficient and smart way.

- Industrial technique- & competence development

Thanks to this project, the company SenseAir has significantly increased its technique and competence level. New solutions have been tested and of course the human resources have gained knowledge thanks to this. Simultaneously, the co-operation within the company improved which has led to a better general mood.

- Safe employment, growth and increased R&D

Sweden has a unique opportunity to be first with production of accurate alcolock sensors. This will give new jobs at Autoliv, Hök Instrument and SenseAir, which in turn will give increased occupation levels in the inland of Southern Norrland.

- Contribute to production improvement at contributing companies

The general knowledge and conclusions from this project will gain other types of gas sensor production (for example SenseAir´s ususal CO_2-platforms) so that the production routes will be more accurate, in turn increasing yield and competitiveness - in a period when there is hard rivalry from new Asian sensor companies, which in some cases have copied the Swedish technique.

- Support research and innovation

The main result of this project is a small and well-functioning demonstrator for calibration of gas sensors operating in both high and low gas concentrations. The research park has already been demonstrated for visitors such as the network Fiber Optic Valley and the company SenSic. The latter is a competing gas sensor company, focussing on other gases for example CO, carbon monoxide.

- Strengthened co-operation between Automotive industry and Society, Universities and Research Institutes

The co-operation between the participating companies and the Technical Research Institute of Sweden (SP) has been stronger thanks to this project, which was successfully led by Quality Engineer Rauno Pyykkö at SP in Borås, who also scrutinized the final result.

6. Dissemination and publications

6.1 Knowledge and results dissemination

Some project resources are also connected to the European network EuNetAir which gathers scientists and manufacturers of Air Quality Sensors targeting gases, odors, particles, etc. After sharing the main results, this project might support the European competitiveness within the gas sensor market segment.

A start-up of large-volume manufacturing of alcohol sensor prototypes, such as handheld alcolocks or keylocker sensors, will of course give development opportunities to this calibration research park. It is crucial that we achieve more statistics to be able to safely evaluate the calibration performance well in advance - before real high-volume production is started.

6.2 Publications

At this moment, there are no scientific articles underway but Hök Instrument has a PhD student within this field, giving us good opportunities to make a comparative study between Hök´s manual ethanol calibration method and this new and more automatic process.

7. Conclusions and future research

In conclusion, the project result shows that it is possible to perform automatized alcolock calibration in high-volumes. It is extremely valuable to have access to this research park in order to further optimize the manufacturing process on a detailed level. There are a lot of aspects to be further considered such as:

- Which is the maximal number of sensors that can be calibrated at the same time without changing the chamber performance? For example, temperature stability might be negatively influenced by the heat generated from a large number of sensors. In addition, a large population perhaps causes an irregular gas concentration. More studies are necessary!
- The quality of both the reference gas sensors as well as the reference gas quality will limit the accuracy of the produced alcohol sensors. More gas suppliers should be tested / certified in this calibration research park.
- This project has developed several methods for yielding ethanol vapour for filling into a calibration chamber. It is necessary to evaluate which method that is safest for future high-volume production.
- We need to check the gas concentrations at several points within the gasflow; measurements before, inside and after the calibration chamber are highly important.
- A highly automatic final test station of alcohol sensors would drastically lower the manufacturing costs. Such a test station could be useful both before delivery to Autoliv and after their assembling into Automotive adopted systems. Any alcolock reaching a final customer should of course be 100% perfect!

8. Participating parties and contact person

The project management group consisted of

- Rauno Pyykkö, Quality Engineer SP (head of management group)
- Håkan Pettersson, Project Manager Autoliv Development
- Bertil Hök, Project Manager Hök Instrument
- Hans Martin, CTO SenseAir
- Tomas Eklöv, Quality Engineer Autoliv Electronics
- Ingrid Bryntse, Project Manager SenseAir (secretary of the management group)

Parts	Role in the project	Name	Contact
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