Versatile Mobile Cleaning Device for open Processing and Packaging Lines

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The increasing product variety and number of necessary changeovers in processing and packaging lines are leading to a higher demand for automated cleaning systems, which need to be versatile, adaptive and able to monitor the cleaning process. The Mobile Cleaning Device (MCD), developed by the Fraunhofer IVV Dresden, is a novel solution with the aim to cover those increasing requirements set by the changing industry.

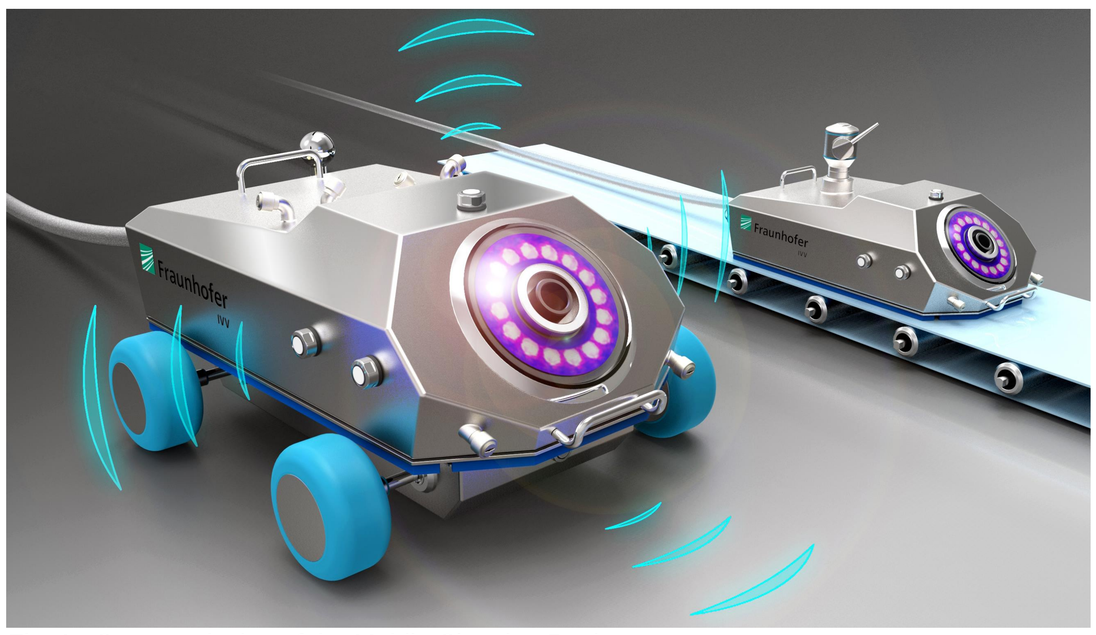

Fig. 1: Concept design of the Mobile Cleaning Device

The MCD was developed in order to clean flexible and modular packaging and processing lines, where it is not suitable to implement stationary cleaning systems into every single module. It is carried through a production line by a conveyor belt on the product way or it can be self-driving. Thereby, it cleans its surroundings with various nozzles and monitors the soiling state with an optical contamination sensor. By recognizing its current position it can adapt to the needs and sizes of the different modules by using a variety of different cleaning nozzles, which can all be controlled separately.

A mobile docking station, which is also connected to a central tank and a pump, supplies the MCD with the cleaning fluid. It can also transport the MCD so that it can be used for more than only one production line.

Fig. 2: Self-driving prototype of the MCD

The MCD has on on-board control system and is completely battery-driven as well as controlled via WiFi. Therefore, it is very easily automatable and requires only very few adaptions of the production line to use it. The only physical interface needed during the cleaning procedure is a hose connection to the supply with the cleaning fluid.

The MCD concept is adaptable for a big variety of applications. Carried by conveyor belts it can be used for the cleaning of product contact areas in a processing line. However, with the self-driving version also other use cases are possible, like e.g. the cleaning of tanks, smoke chambers or the external cleaning of machines. The degree of the MCD's complexity (e.g. regarding nozzles, sensors, software etc.) can also be adapted to the requirements of the different use cases. For very simple applications on the one hand, some flat fan nozzles without further sensor support can be sufficient. For complex machines on the other hand, it can be possible to use e.g. robotic jet cleaners in combination with an optical contamination sensor and a digital twin of the production line so that the MCD can allocate soiled areas and clean them very precisely and demand-based. A cleaning simulation can then also support this system in order to automatically choose the best parameters for efficient cleaning.

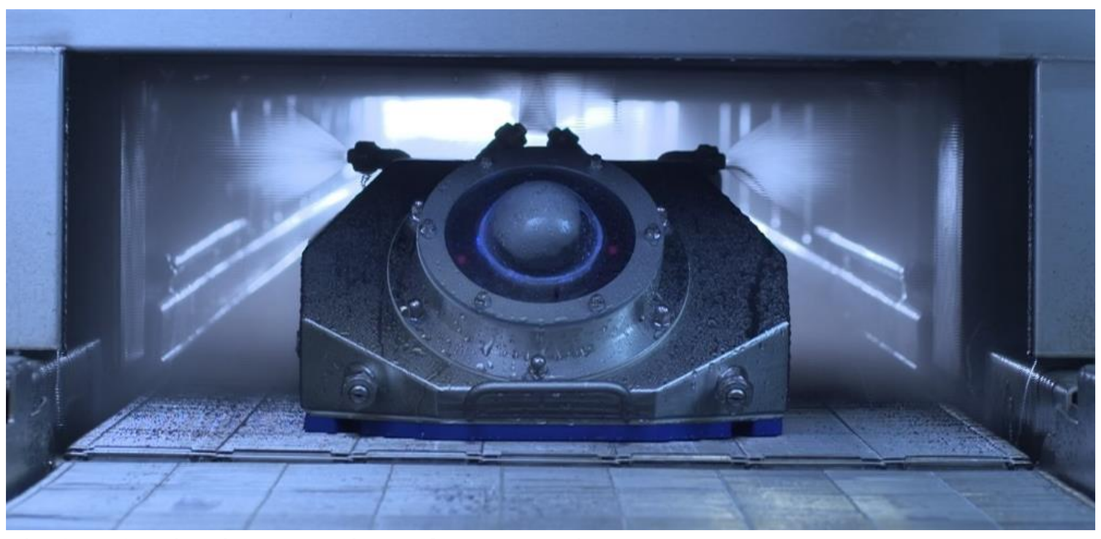

Fig. 3: MCD cleaning a tunnel oven for meat products

Spray shadow simulations and cleaning tests showed that the MCD can reach nearly the same cleaning performance as common open plant cleaning systems although it uses fewer nozzles. The results also showed that due to the movement of the MCD spray shadow areas can be reduced what improves the cleaning performance and process safety in comparison to efficiently designed cleaning systems with only stationary nozzles. First cleaning efficiency tests also showed that the MCD can reduce the water consumption in comparison to common open plant cleaning systems (40 % savings on a robotic module).

The technology of the MCD is a further step in the direction of need-based cleaning. It is able to realize versatile and efficient cleaning according to the changing requirements within a production line and adaptive with regard to the soiling state. The MCD provides several opportunities for individual adjustments according to one's requirements.

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