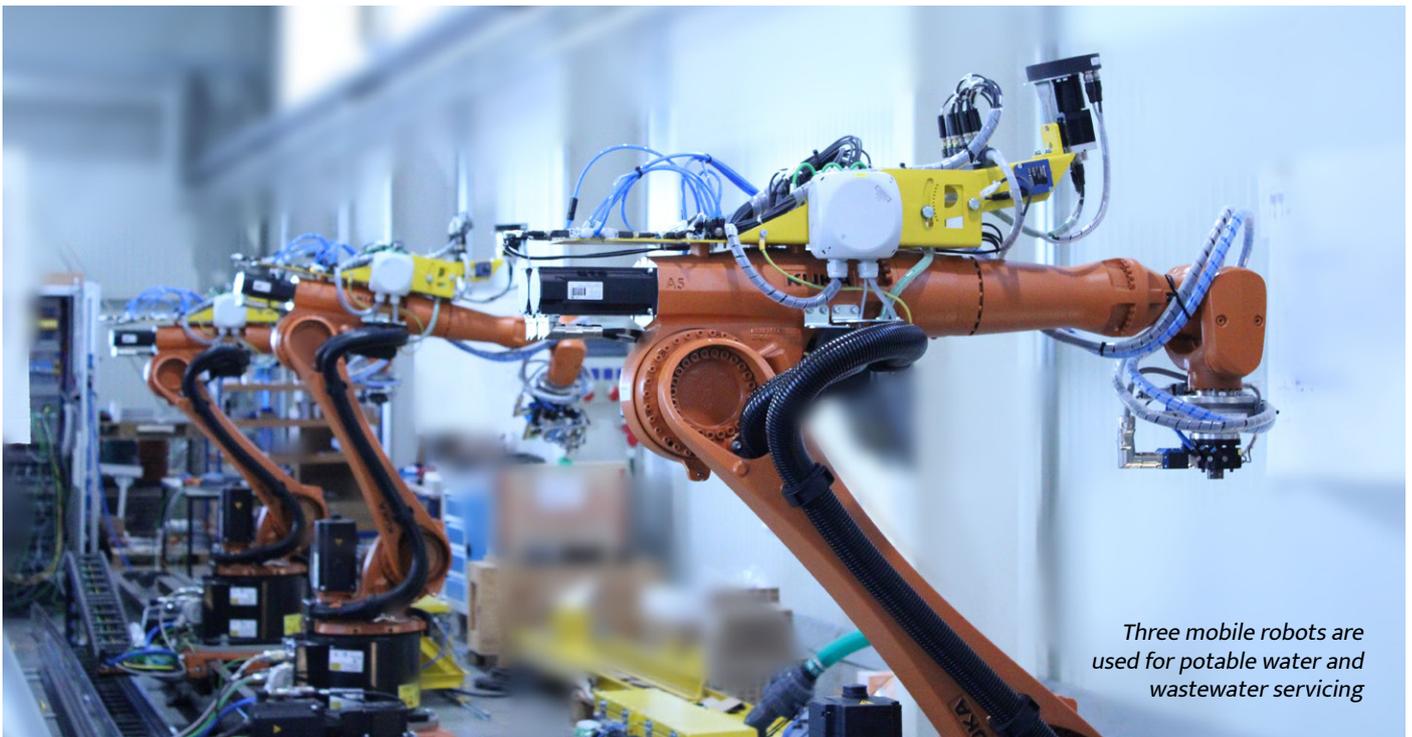


Aqseptence

Outlook: Automated Supply & Disposal Systems for Trains



Three mobile robots are used for potable water and wastewater servicing

Many of us have already experienced the unpleasant situation that the toilets have been blocked off during a train ride. At this point, no one really cares about the cause of this circumstance. It's simply

annoying for the traveller and damages the image of the railway operator.

A major cause is often the lack of staff availability. This can be remedied by automating the service processes of the trains inside the service and maintenance depots.

Therefore, more and more railway operators are considering the use of robots to provide fully automated solutions for a train's water supply and wastewater disposal processes.

The automation should meet the following new requirements and raised expectation of railway operators:

- Increase of efficiency in order to increase availability of trains
- Increase of reliability of train servicing systems
- Reduction of dependence on lowly-skilled operators
- Significant reduction of servicing time

First Pilot Installation

Aqseptence Group GmbH with its Roediger brand – a specialist for water supply and wastewater disposal systems and a key supplier for Deutsche Bahn and other railway operators – joined forces with bip technology GmbH – a company specialised in automated maintenance systems for trains. Together they developed a solution that has already been tested at a pilot installation.

The aim of the solution was to replace the physically strenuous and labour-intensive activities involved in service work on trains with automated solutions.

Tasks & Challenges

The main tasks and challenges in the implementation of the project were as follows:

- Definite registration of train positions
- Visual detection of train connection nozzles
- Development of composable technology packages for the activities required for the operation (e.g. opening and closing of covers and valves)
- Monitoring and documentation of supply and disposal processes
- Communication with other train service systems



The Roediger skid-mounted vacuum station generates and maintains the required negative pressure

Application Technologies & Implementation

Based on these requirements, a solution was developed that implements the processes for specific trainsets without the requirement of modifications at the trains. With appropriate adaptations to the tools, the system could be extended for different train types.

The solution is characterised by the fact that, on the one hand, the spatial and technological requirements of the intended installation site and, on the other hand, the different configurations of the location of the nozzles on the trains were taken into account.

To implement the task, a 15m long linear guide rail was selected on which three robots can move in synchronisation. The middle robot was assigned the wastewater disposal process and the two

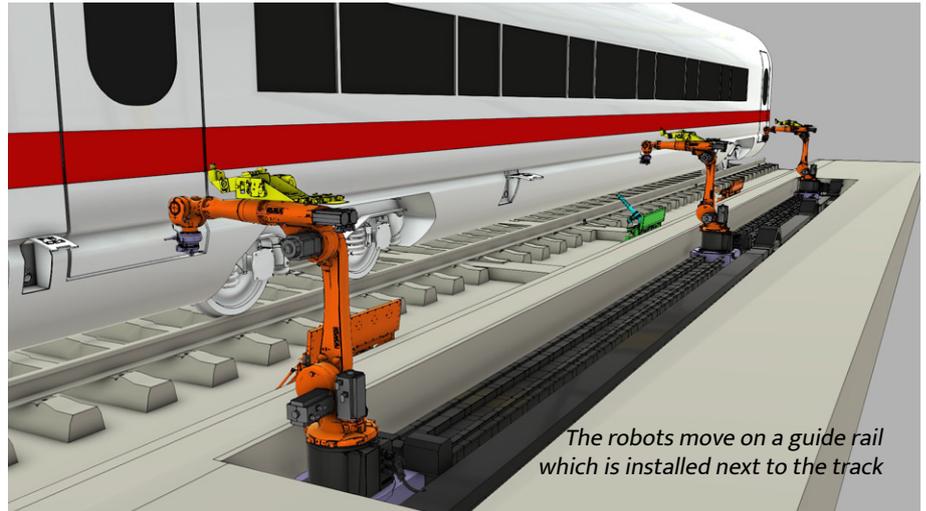
outer robots for the potable water supply process (depending on the position of the potable water and wastewater covers of the train).

In order to test the functioning of the various tool sets and the control system, the entire pilot installation was set up in original size. The position of the covers was simulated with original train parts and the entire motion sequence was tested.

The following sequence has been defined for the supply and disposal processes:

- Train stops in the designated window
- Robot searches for the exact position in longitudinal and vertical position with camera and image analysis
- Robot fetches opening tool and opens the cover
- Robot checks condition by means of camera and image evaluation

- Robot fetches tool for supply or disposal and initiates the process
- The shutdown (tank filled resp. emptied) is done by sensors or camera monitoring
- Robot fetches closing tool and checks the locking of the cover by force after closing
- Robot documents the correct closing of the cover by means of an image
- Robotics releases the train



The robots move on a guide rail which is installed next to the track

The extensive simulation of the operation shows that the path of automating recurring processes is a promising way to achieve better train availability.

Advantages of the Automated Concept

In addition to the automation of processes that are always identical, the following main advantages are to be gained from the use of robots:

- 24-hour operational readiness of the system
- Operational readiness even for unscheduled tasks

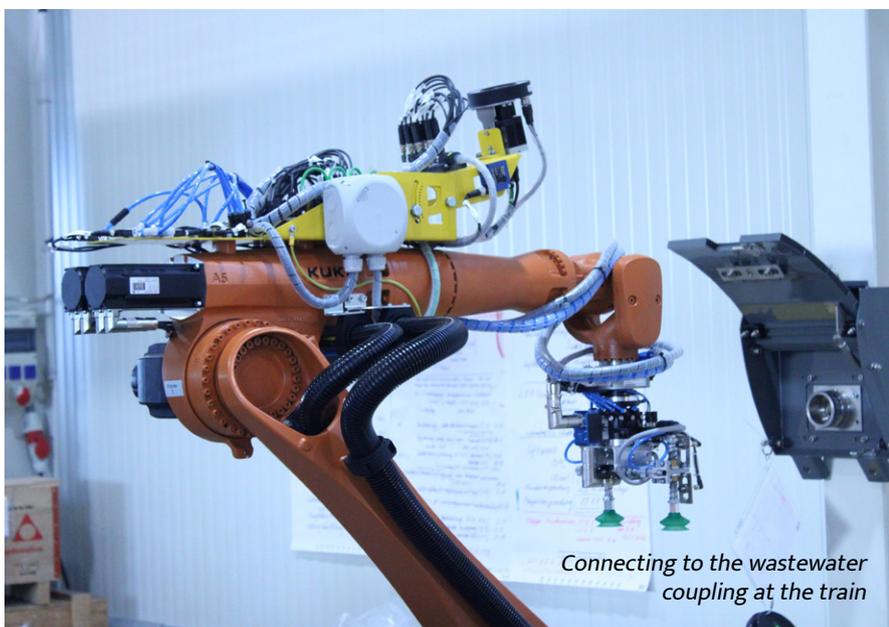
- Personnel-independent use
- Real-time monitoring and documentation
- Preventive maintenance (e.g. documentation of the covers that have to be maintained)
- Statistical evaluation
- Maximisation of reliability
- Reduction of dependence on low-skilled operators
- Significant reduction of servicing time

In summary, this innovative and new concept for water supply

and wastewater disposal systems for trains makes work processes physically easier, significantly faster and more reliable. It also makes the entire process safer and more documented.

The system is open and can be adapted to on-site conditions. Thus, it can be used for all train types in the future.

As a result, conditions such as those described at the beginning should be a thing of the past, and only pleasant things should be associated with a train ride.

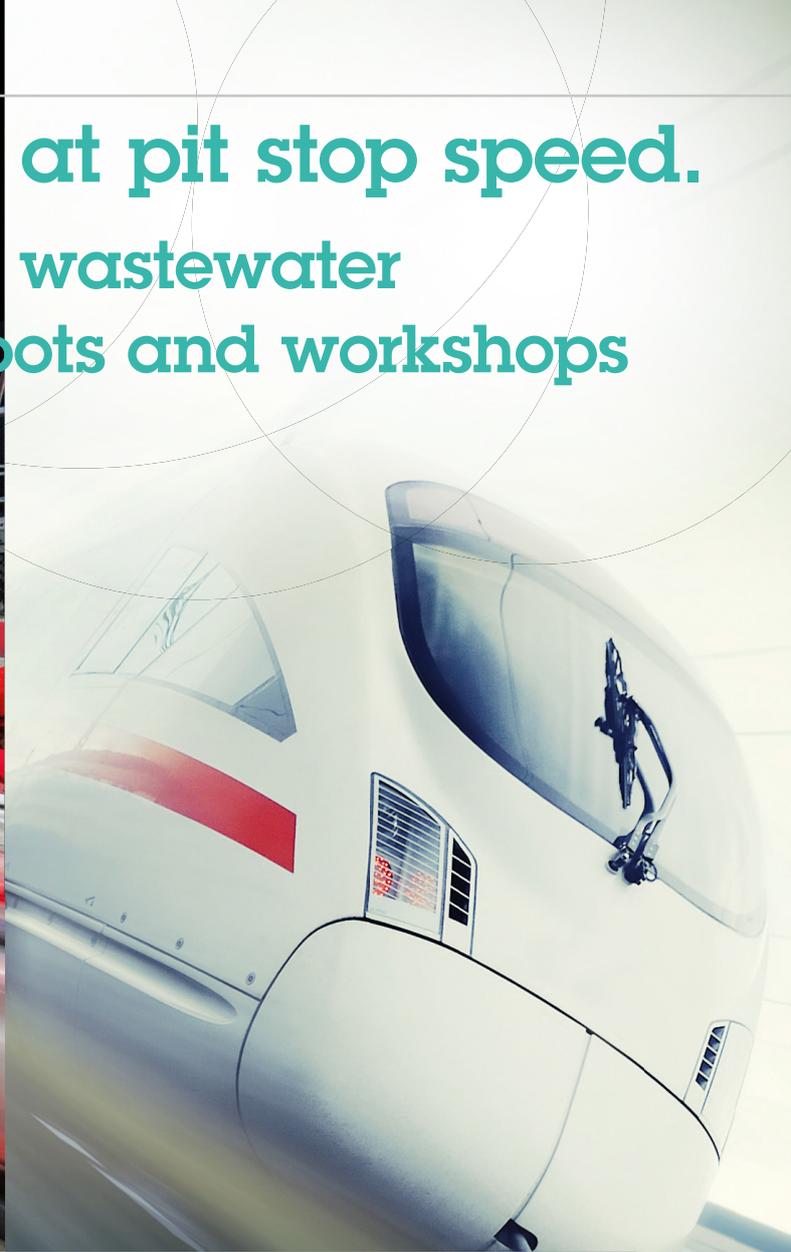


Connecting to the wastewater coupling at the train

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