Autobahnplus Services GmbH

Innovation Report 01/2025

02.04.2025

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1 Introduction

As part of the "Corporate Objectives 2024 - EXPECTED BUSINESS STANDARDS FOR O&M COMPANIES" by Erwan Huerre, dated 10/01/2024", we as an operating company are required to submit a quarterly innovation report to the Innovation Division of BU Conseil & Exploitation.

2 Overview and description of the innovations under examination at a+S

2.1 Processing of sludge in retention basins

Idea provider resp. source of innovation:	Autobahnplus Services Driven by contractual requirement to completely clean and de-sludge the rainwater retention basins before the end of the concession period in connection with extremely high disposal costs

Idea provider resp. source of innovation: a+S, is due to the contractual requirement to completely clean and de-sludge the rainwater retention basins before the end of the concession period.

Problem definition: The concession/operating agreement for Autobahnplus A8 stipulates that all water retention basins must be completely cleaned and desludged by the end of the concession period in 2037.

The sludge produced is highly chemically contaminated and must be disposed of as Class 3 waste (Class 3 applies to hazardous waste: special waste that can be deposited above ground). There are no landfills in Bavaria that accept class 3 waste. The closest landfills to the concession that accept class 3 waste are Puschwitz (520 km) and Selmsdorf (826 km).

According to an available cost calculation, the share of disposal and transport to a suitable disposal site is therefore approximately 65% of the total cost of basin cleaning.

This cost structure led to the idea of looking for a method of in-situ decontamination to reduce the pollutant load of the sludge removed, change the waste class to category 2 (thus utilising the landfill options in Bavaria) and thus significantly reduce the disposal and transport costs.

The Egis sanitation expert had in mind the "biosynergy solution" for the in-situ treatment of polluted soil and sediment (treatment using bacteria adapted to the pollutant in question). They have experience in treating high concentrations of hydrocarbons.

After studying the pollution problem(s), BIOSYNERGIE's methodology consists of applying the product directly to the site in question using a patented application technology.

- Applications in urban and industrial environments:
- Optimise the treatment performance of existing plants without modification
- Degradation of refractory pollutants (hydrocarbons, PCBs, PAHs, etc.)

- Create units for the purification or accelerated elimination of organic matter at source (sewage sludge)
- Treat contaminated soil in situ or after excavation

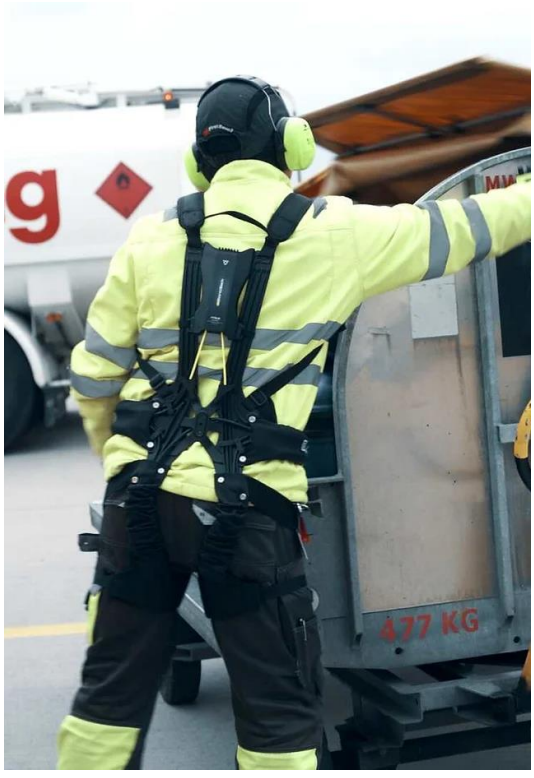
2.2 Passive Exoskeleton (NEW)

Definition: A distinction is made between passive and active exoskeletons. Passive exoskeletons work purely mechanically, e.g. using spring systems or rails, and reduce the load, e.g. during dynamic and static work in a bent posture.

The passive exoskeleton relieves the human back during daily work, prevents back pain and thus reduces sick leave.

The passive exoskeleton helps to make workplaces more ergonomic, where employees often have to lift heavy loads repeatedly.

Whether it is dynamic bending and lifting of loads or a static forced posture, the passive skeleton provides the optimal relief.



The exoskeleton is designed for use in jobs that require repetitive lifting. In the field of road maintenance, this could include:

- Installing traffic safety equipment (handling traffic signs, beacons, beacon bases, traffic cones, barriers)
- Paving work, lifting work (gully cleaning see 2.17)
- Damage repair work in the event of an accident
- Loading operations, vehicle loading
- Workshop work, vehicle refitting, etc.

It must be determined whether the exoskeleton is personal protective equipment (i.e. must be purchased individually for each worker) or can be passed from one worker to another (hygienic aspects and ease of individual fitting are important when selecting the product).

2.3 Mechanical gully cleaner (NEW)

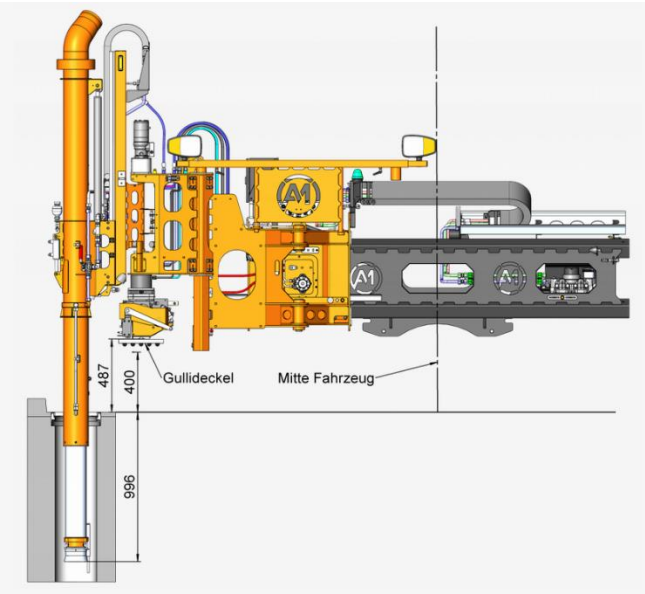
The cleaning of the gullies on the concession route is carried out manually. At least 2-3 employees of the road maintenance department carry out the work under the protection of a traffic safety plan. Usually, other work is carried out at the same time (street cleaning with the sweeper). The gully traps, which can weigh up to 25 kg (depending on the model), are repeatedly lifted by the workers and then closed again after cleaning. This means that the workers are also exposed to traffic. A complete cleaning cycle takes about 4-6 weeks and is repeated three times a year.

The mechanical gully cleaners (Allroundmaster SKR 700 and GC B900 systems) allow the gullies to be cleaned by just one operator. This not only reduces the resources (and costs) required, but also contributes to greater occupational safety and significantly reduces the physical strain on employees.

The gully is cleaned from the comfort of the cab using a telescopic jet and suction pipe. Leaves, sand, gravel, and other debris are collected by the suction pipe into the machine's 3.5 cubic metre hopper. The machine is designed for double-sided use (gullies on the hard shoulder or on the central reservation, depending on the gradient of the road).

The driver is not exposed to the weather or to physical labour. Electro-hydraulic operation and the fully mechanised cleaning process ensure fast and efficient cleaning and high daily output.

The gully cleaner is an attachment for the Unimog (in the version required by autobahnplus Services). Other carrier vehicles are also possible.


487
400
996
Gullideckel
Mitte Fahrzeug

3 Status a+S in the examination and review of innovations

No.	Innovation	Status of the review or implementation	
2.1	Processing of sludge in retention basins	Contact established by a+S with Pierre Agostini, an expert in hydraulics from the Transport BU, and Blandine Goussebayle, an expert in "nature-based solutions" from the Sustainable Cities BU. Handover of test reports on the already cleaned basins under the responsibility of SPV. At the beginning of February 2024, the test basins were selected and the data sent. A+S was asked to provide the chemical limits allowed in Germany. Status IR 02/2024: Consultation with Egis (BU Villes et Transports) is ongoing. a+S has been appointed as an additional contact for the technical department. The aim is to launch a pilot project at the end of 2024/beginning of 2025. Status IR 03/2024: Following discussions with Egis (BU Villes et Transports), we have requested an appointment with the local environmental authority. The date has not yet been set. The aim of the meeting is to clarify the limits of chemical pollution in order to improve the sludge's pollution class. Status IR 04/2024: There has been no substantial progress on this issue. a+S has secured the services of an environmental office for 2024 and will use this as a competent interface with Egis. Egis is very interested in this issue. It has been declared one of the priorities for 2025. Status IR 01/2025 This technical development is one of the company objectives for 2025. A new kick-off meeting on this topic will take place in April 2025.	
2.2	Passive Exoskeleton	Status IR 03/2024 Request for an offer for test equipment initiated.	

		Status IR 04/2024 The passive exoskeleton was presented and briefly tested on three employees. An 8-day test under operational conditions has been agreed free of charge. The test will take place during the cleaning of the drainage systems in February 2025. During this process, the manhole covers will be lifted to evaluate the effectiveness of the exoskeletons under real conditions. Status IR 01/2025 The exoskeletons have been tested by autobahnplus since mid-March. REX will be available for IR 02/2025.	
2.3	Mechanical (automated) gully cleaner	Status IR 03/2024 The test was carried out with the operator on our concession route. This has raised technical issues which are currently being investigated. Clarification of issues relating to the equipment/vehicle configuration: The attachment consists of the suction nozzle and a water and dirt tank (which can also be connected to a sweeper). a+S will check to what extent the attachment can be mounted on the sweeper (instead of the Unimog) and whether the tank can be avoided. Status IR 04/2024 will be under further observation Status IR 01/2025 The Mechanical (automated) gully cleaner is currently being tested in the context of road surface cleaning. REX will be available for IR 02/2025.	

4 Implemented Innovation

4.1 Sustainable traffic Signs - Dibond Traffic

Idea provider resp. source of innovation:	Autobahnplus Services Product information about technical publications and information from our suppliers

The innovative DIBOND panel material consists of two thin aluminium cover sheets separated by a polyethylene core material. This sandwich concept has been used in the field of lightweight construction for many years and enables the manufacture of advanced products.

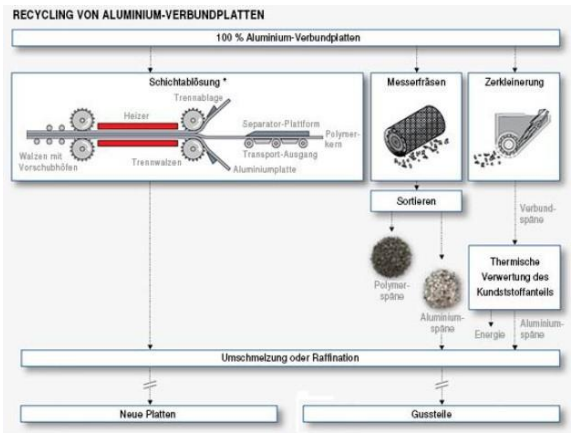
DIBOND is fully recyclable, i.e., the core material and the aluminium cover sheets are returned to the material cycle and used to produce new material.

Thanks to the high-quality alloy EN AW-5005A (AlMg1), the secondary aluminium can be reused for advanced alloys. In the form of alloy tablets, this aluminium is returned to the cycle or used directly to produce sheets or profiles.

Once processed into granules, the core materials can be used in a variety of applications. Primarily, the supplier (3A Composites) seeks to reuse the plastic in the production of aluminium composite panels. In addition, the recycled pellets are also used on the open market for applications such as turf paving or heavy-duty profiles.

Global warming potential (GWP)

Global warming potential (GWP) is an index that measures how much infrared heat radiation a greenhouse gas would absorb over a given period of time after being added to (or emitted into) the atmosphere. The GWP makes different greenhouse gases comparable in terms of their "effectiveness in causing radiative forcing": It is expressed as a multiple of the radiation that would be absorbed by the same mass of added carbon dioxide (CO2), which is used as a reference gas. So, the GWP for CO2 is one. For other gases, it depends on how strongly the gas absorbs thermal infrared radiation, how quickly the gas leaves the atmosphere and the time frame considered.



Thanks to the resource-saving sandwich concept, the amount of aluminium used in the production of DIBOND traffic signs is at least 66% lower than for signs made of solid sheet metal. As a result, the energy required to produce one square metre of sandwich element is significantly lower for the same rigidity. The environmental footprint of these materials is assessed through an Environmental Product Declaration (EPD).

An Environmental Product Declaration (EPD) is defined by the International Organisation for Standardisation (ISO) 14025 as a Type III declaration that "quantifies environmental information on the life cycle of a product to enable comparisons between products performing the same function". The EPD methodology is based on the Life Cycle Assessment (LCA) tool, which follows the ISO 14040 series of standards.

Production of STVO compliant traffic signs in all performance classes. The supplier manufactures to RAL quality standards and CE conformity.

4.2 Damage assessment and analysis of road surfaces and structures with AI

Idea provider resp. source of innovation: Operator´s Club Egis 2022 -Iris
Egis Innovation Team 2024 – Vaisala AI

The aim of the following systems is the automated detection and registration of damage, events, etc. in the context of inspections of structures or patrols, supported by KI. The findings are to be processed in such a way that work orders for road maintenance can be generated and the orders can be processed quickly from start to finish. Ideally, the products should also interface with and complement existing maintenance management products. Two products are currently under in focus:

Vaisala AI

In 2024, the Egis Innovation Team has reviewed around 10 products for AI-supported road inspections. Autobahnplus Services has been involved in the final product selection. In January 2025, initial trials with Vaisala AI took place.

The tests have been carried out. The REX is positive.

A+S will implement Vaisala AI from 07/2025.

4.3 Waterless urinals at rest areas

Idea provider resp. source of innovation:	Suggested improvement by an employee autobahnplus Services (Quality Management - continual improvement process)

Autobahnplus installed a battery of waterless urinals at the Fuchsberg rest area in 2022. The aim is to significantly reduce water consumption. The test will assess the susceptibility to defects and the general maintenance requirements compared to conventional urinals. Urine scale is a major problem and builds up quickly. If the urine scale is not removed promptly, it will quickly clog the system.

The tests were successful. The car park toilets are gradually being equipped with waterless urinals.

4.4 Netwake – Utilisation of vehicle data for winter maintenance

Idea provider resp. source of innovation:	Shareholders autobahnplus Services

Skid resistance is the amount of frictional resistance, or transmission of force, between a vehicle's tyres and the road surface. Essentially, this includes driving and braking forces as well as lateral forces during cornering. With the latest generation of vehicles, manufacturers can access the data in real time and make it available to customers.

The grip of a road has a significant impact on road safety. For example, dry road surfaces all have relatively high grip values. When the road surface is wet or icy, grip levels drop dramatically, depending on the speed and surface texture. We want to use this information (via our designated software provider) to derive skid resistance information for winter road maintenance.

The aim is to be able to use real-time information to determine more accurately when and in which areas the road surface is slippery enough to require winter maintenance. This will optimise the number of winter maintenance operations and reduce both salt and fuel consumption. The improved driving performance should also result in lower maintenance and repair costs for the vehicles.

Technical Framework: roughness, micro-weather, and road surface conditions
Sensor: Vehicle sensors from the VW fleet (NIRA Dynamics)

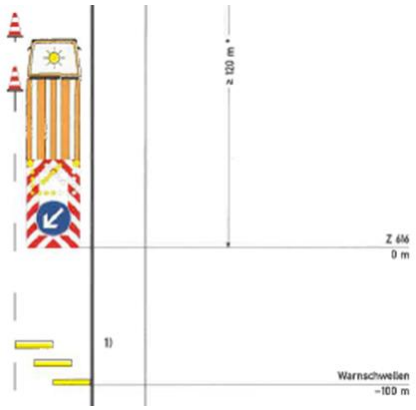
- Measurement data: road surface roughness (e.g. potholes), vehicle ambient temperature, precipitation, road surface condition
- Installation: installed as standard on all vehicles in the VW fleet from 2021
- Data transfer to the NetwakeVision system: via mobile network
- Display of data on digital maps on tablet, smartphone, or PC - data is displayed to the driver in the truck in real time
- Results: high validity due to large number of moving cars, automated measurement, and transmission in rea Results: high validity due to large number of moving vehicles, automated measurement, and real-time transmission
- Benefits: Forward planning of winter maintenance possible, more needs-based use of road salt/brine

Implemented in 12/2024. Due to the mild winter of 2024/2025, the system has not yet been able to be tested extensively.

4.5 Rumble strip handling machine by Frike

Idea provider resp. source of innovation: Frike Verkehrstechnik
Signalstrasse 1
CH-8194 Hüntwangen

In June 2023, a roadshow took place at the O&M Centre of autobahnplus. Frike (https://www.frike.ch/de/) presented a traffic cone setter, a rumble strips handling machine, and a newly developed rumble strip (see 2.13).



The fully automatic rumble strip handling machine, in conjunction with a newly developed rumble strip, makes the safety-critical process of installing and removing the rumble strips required by traffic management plans safer. Added value: Safety

4.6 Rumble strip by Frike

Idea provider resp. source of innovation: Service Provider Frike (Roadshow)

Rumble strip currently approved by the BAST for motorways in Germany:

The yellow plastic rods, three centimetres high and fitted with reflectors, are placed 100 metres in front of the site. They are designed to be safe for all types of vehicles to drive over. They complement the warning and barrier signs installed by road construction companies, which are too often overlooked.

In practice, however, they are often a danger to motorcyclists. Serious falls are the result.

When users drive over the rumble strips in conjunction with braking manoeuvres, the rumble strips are need to be realigned. In these cases, the road operator's employees are exposed to risk situations. In addition, conventional rumble strips are heavy, unwieldy and require manual installation and removal.

Newly developed rumble strips by Frike:

The newly developed rumble strips have a steel core that is mechanically held in place by magnets. This is done under the protection of the truck using automatic rumble strip handling machines.

The rumble strips were subjected to several comparative tests by Autobahn GmbH (with the involvement of autobahnplus), which are documented in the following video:

https://www.youtube.com/watch?v=szDJTZ-Kq8o

Features:

- Warning rumble strip RQ2 incl. reflectors on one long side
- Very good adhesion to the road surface, especially in cold and wet conditions
- Adapts to the road contours (ruts)
- Ideal geometry in terms of rollover and skid resistance
- Very good warning effect in terms of appearance and wake-up effect

- can be installed automatically (using a rumble strip setter)

Technical specifications

- Dimensions : 2280 mm x 330 mm x 23 mm
- Weight: 34 kg. The use of a rumble strip handling machine (see 2.12) is advisable from an occupational health point of view.

BASt / BMDV approved

The purchase process is in progress.

4.7 IoT – Integration of IoT sensor data: road surface temperature (NEW)

Road surface temperatures

- Locations: Pavement (suitable for asphalt and concrete pavement)
- Sensor: Netwake temperature sensor system (proprietarily development)
- Measured data: road surface temperature, measurable at two depths
- Installation:
  - sun in the asphalt or concrete layer at winter maintenance hotspots
  - Only one drill hole is required for this.
  - Installation time: 5 minutes maximum
- Data transfer to the NetwakeVision system: completely wireless via radio and gateway in the reflector post
- Data viewing: on tablet, smartphone, or PC
- Alarm: at thresholds via email or internal system alarms
- Results: cost effective, energy-autonomous system (energy harvesting), long life, automated measurement, and real-time transmission
- Benefits: demand-driven measurement of road surface temperature, resource-saving use of de-icing salt / environment / winter maintenance staff

Ordered in 12/2024.

Due to a delayed patent process, the sensors will not be available for installation until March 2025. It is planned to install them successively at the already defined road locations from May 2025.

5 Discarded Innovation

No.	Innovation	Status of the review or implementation	
2.1	Winterpave	See innovation reports Q1-Q4/2024 Reason: • High costs • Low availability of material	

		• No approval of the BASt (Bundesanstalt für Straßenwesen = Federal Highway research Agency / Germany)	
2.2	Autonomous mower	See innovation reports Q1-Q4/2024 REX: see Innovation Report Q3+Q4/2024 Reason: • technical immaturity Further tests can be scheduled after technical development by Vitirover.	
2.5	Gramitherm	See innovation reports Q1-Q4/2024 Reason: • No production capacities of the company in the Munich area • Alternatively, high transport costs	
2.7	Logikko	See innovation reports Q1-Q4/2024 Reason: • Not technically feasible in all autobahnplus vehicles.	
2.8	LuminoKrom	See innovation reports Q1-Q4/2024 Reason: • No approval of the BASt (Bundesanstalt für Straßenwesen = Federal Highway research Agency / Germany).	
2.9	Tough	See innovation reports Q1-Q4/2024 Reason: • Product not very technically sophisticated (few and only short virtual reality sections) • No added value yet compared to conventionally taught training courses • Competing with Egis products	
2.14	Cooling waistcoat	See innovation reports Q1-Q4/2024 Reason: The cooling vests proved to be unsuitable for use. The vests are uncomfortable and restrict movement. When worn in windy and sweaty conditions, the vests have such a cooling effect that workers suffer from colds, neck pain and aching limbs.	

6 Next innovation report

The innovation report 02/2025 will be sent out on 01.07.2025.

List of abbreviations

a+S	**Autobahnplus Services GmbH**	**Autobahnplus Services GmbH**
ABM	Autobahnmeister	Road Manger
BAST	Bundesanstalt für Straßenwesen	German Federal Highway Research Institute
BMDV	Bundesministerium für Digitales und Verkehr der Bundesrepublik Deutschland	Federal Ministry for Digital and Transport Affairs of the Federal Republic of Germany
DK	Deponieklasse	Waste disposal class
ha	Hektar	hectare
HIS	Wasserstoff-Einspritzsystem	Hydrogen Injection System
IR	Innovationsreport (x/20xx)	Innovation Report (x/20xx)
O&M	Betrieb und Erhaltung	Operation and Maintenance
RSA	Richtlinien für die Sicherung von Arbeitsstellen an Straßen	Guidelines for securing work sites on roads
StVO	Straßenverkehrsordnung	Road Traffic Act (Germany)
VR	Virtual Reality	Virtual Reality