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S&S
Sensors and Systems
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Sensors & Systems #27 Content:

Using a SEAGUARD® to map conditions in and around a stranded algae belt

Mapping of O^2/Temp/Sal in and around the algae belt by walking.

These investigations were done after the stranding of a belt or mat of filamentous red algae along Sweden's southern Baltic coast. The stranding of massive amounts of red algae that grows along the Swedish coast is common and is generally considered to be a result of coastal eutrophication (excessive amounts of nutrients in the water). It contributes to impoverishment of the marine ecosystem, e.g. through depletion of oxygen and has a large impact on tourism. This algae belt was estimated to have a volume of 18 000 m^3 and to contain 110 tons of Nitrogen (N) and 10 tons of Phosphorous (P) which is approximately equal to the amount of N and P removed yearly from the waste water of a medium size Swedish city.

In this study about 20 m^3 of algae was harvested with a modified pea harvesting machine (Fig 1) and transported to a biogas production plant for testing. When producing biogas it is important to know at what stage of decomposition the algae are. The fresher they are the more biogas they can produce during fermentation. One way to assess if the algae are still alive is to study their ability to perform photosynthesis and produce Oxygen over a day/night cycle; here the SEAGUARD® plays an essential role.

Oxygen varied from 10-35 % in the Algae belt and the temperature was up to 2°C higher than in the surrounding water. Salinity was around 7 psu in the water. Oxygen varied from 2-87 % saturation during the 24 hour deployment and seemed to be governed by primary production during the day and consumption during the night (Fig 2) which indicates that a large part of the algae at the rim are still alive. Currents were mainly along the coast and shifted with water level which varied by 0.7 m.

This report is from the first trials with the SEAGUARD® in stranded algae belt studies. In the future the measuring capabilities of the instrument could be expanded with additional sensors to get better information about the ecosystem and about the freshness of the algae. One envisaged expansion is to use several oxygen and CO_2 optodes in parallel. Measuring both oxygen and pCO_2 should significantly expand the possibilities of understanding the system. For more information about

Pushing the SEAGUARD® into the sediment at the rim of the bet leaving the sensors 10-15 cm above the sediment surface.

the project please contact Dr. Sven Bertil Johnson biomarin@bredband.net.

Fig 1: A rebuilt pea harvesting machine is used to gently collect algae excluding as much beach sand from the biomass as possible.

AADI has made reliable, technically advanced, user friendly and robust instruments since 1966. SEAGUARD® is a multiparameter platform introduced by Aanderaa in 2005 offering multiple possibilities for research and environmental monitoring in shallow coastal waters and up to 6000 meter ocean water depth. It supports a distributed network of more than 20 plug-and-play smart and third-party sensors with different signal formats (e.g. on long sensor strings and octopus type connections). Depending on the application the user can select the sensor needed including AADI smart sensors for Currents, Temperature, Salinity, Pressure, Wave and Tide, Oxygen, Turbidity, CO_2 (soon available) and third-party sensors with analog output for e.g. Chlorophyll, Light, pH, Methane. The instrument is straightforward to set-up either using the internal touch screen running Windows CE or directly connected to a PC. On-line two way communication, data transfer, data presentation, data storage into database, data off-load, data analyzing and automatic production of monitoring reports are made easy by different and well proven software packages. In the described configuration the instrument can log data at 10 minute interval internally (on SD card) using internal batteries for more than 600 days. More information at: www.aadi.no.

Fig 2: Oxygen variations at the rim of the algae belt. Variations are important and seem to follow the light cycle with highest concentrations at the end of the day and important consumption during the night. This is an indication that some of the algae is still alive.

New CO_2 optodes submitted to intensive tests

There are several reasons to monitor CO_2 in aquatic environments. In aquaculture high pCO_2 will be toxic to the animals and inhibit growth. At most tank based aquaculture facilities pCO_2 is stripped off by excessive air bubbling. This costs energy that, to a large extent, could be saved if pCO_2 was monitored and regulated.

In climate/ocean acidification studies it is essential to assess if different marine environments are sinks or sources of CO_2. To understand the ocean carbon system two of four parameters pH, pCO_2, Alkalinity, Total Carbonate = Dissolved Inorganic Carbon (DIC) needs to be measured. Commercially available systems for pCO_2 measurements exist already but these are bulky and consume relatively high amounts of energy.

Several projects dealing with CO_2 storage in the ground on land or in the seafloor are being considered. Monitoring potential seepage and CO_2 migration out of rocks and ocean sediments is, and will be essential. A grid of compact in-situ sensors seems well suited to detect potential leakage in time and space.

Based on a similar concept as the successful AADI Oxygen Optode an optical CO_2 sensor was recently developed. The development was done together with the Michelsen Centre (www.michelsencentre.no) which is a Center for Research-based Innovation funded by The Research Council of Norway and in collaboration with PreSens GmbH (www.presens.de).

The new CO_2 Optode uses fluorescent dual lifetime detection of pH. When CO_2 diffuses into a gas permeable foil the pH in an embedded buffer will change, subsequently changing the fluorescence of the pH sensitive indicator.

In aquaculture applications, with relatively high pCO_2 levels, these sensors have already demonstrated their high potential with long stability and accuracies sufficient for precise regulation of the living conditions in e.g. fish tanks and pens. Here we report on experiences from the first field trials in the marine environment, which is challenging due to lower concentrations and generally higher demands on accuracy and resolution.

The field work was led by University of Gothenburg (UGOT) within the frames of the EU-HYPOX project (www.hypox.net). The work focused on the role of low oxygen conditions in Baltic Sea eutrophication, excess of nutrients. Seven stations were visited, depth 30 - 210 m, east of the Swedish island Gotland.

A SEAGUARD® data logger equipped with conductivity sensor, oxygen optode and three CO_2 optodes, two measuring inside

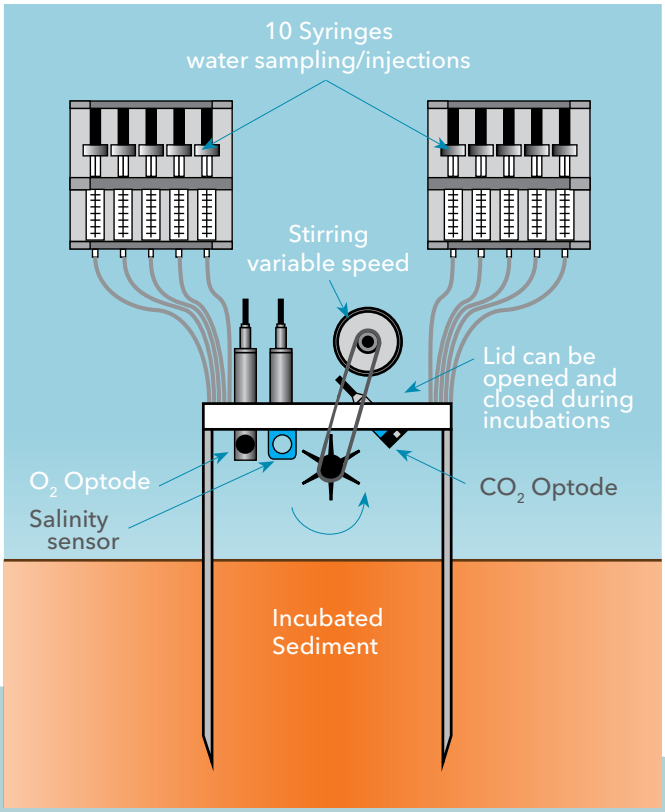


Fig 1: Incubation chambers on UGOT landers.

Fig 2: UGOT big lander being deployed in the Baltic Sea.

incubation chambers (Fig. 1) and one outside, were installed on one of the autonomous UGOT bottom "landers" (see Fig. 2). Advanced experiments are carried out in the chambers by injecting e.g. labeled Nitrogen and Cyanobacteria (Fig. 1).

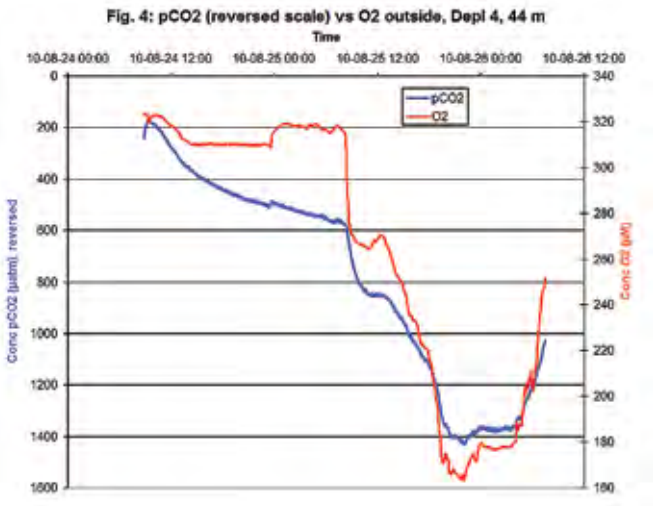
Results: When deployed together with oxygen sensors pCO_2 data tracks well from one deployment to the next and show no signs of drift. The increase of pCO_2 with time inside the incubation chambers (see Fig. 3), flux out from the sediment, corresponds well with the consumption of oxygen in the same chambers. As expected at oxic stations O_2 and pCO_2 are inversely correlated (see Fig 4). At anoxic stations, where hydrogen sulfide (H_2S) is present, the optodes seem to be influenced by H_2S which makes accurate measurements difficult.

There are significant differences in absolute readings between the three CO_2 optodes in Fig. 3. A plausible explanation for this is that the sensors were not calibrated for this low range (200-6000 µatm). The first marine field trials of the sensor demonstrated a resolution of ±15 µatm and a 63 % response time of about 5 minutes which was sufficient for monitoring in the ambient water and for chamber flux measurements.

A first pilot series of CO_2 optodes are now submitted to a series field tests which intend to reveal strengths and weaknesses of the technology. The long-term stability of the sensor is tested in two buoy deployments, six and twelve months long. Sensors are also being used in CO_2 storage project and tested in rivers and lakes. Upcoming tests are planned in coral reef environments and in deep water.

Results from the first marine field trials with new CO_2 optodes look promising. The sensors appear to have low drift and there is potential to improve both accuracy and resolution by better calibrations. The size, robustness and low energy consumption of the CO_2 optodes could make them attractive in many applications. For example a SEAGUARD® string logger with four CO_2/Temp and four O_2/Temp optodes connected could run for more than a year with internal batteries if logging at 30 minute intervals.

At AADI an advanced in-house calibration facility for CO_2 and O_2 is being set-up to handle future needs of higher accuracy.



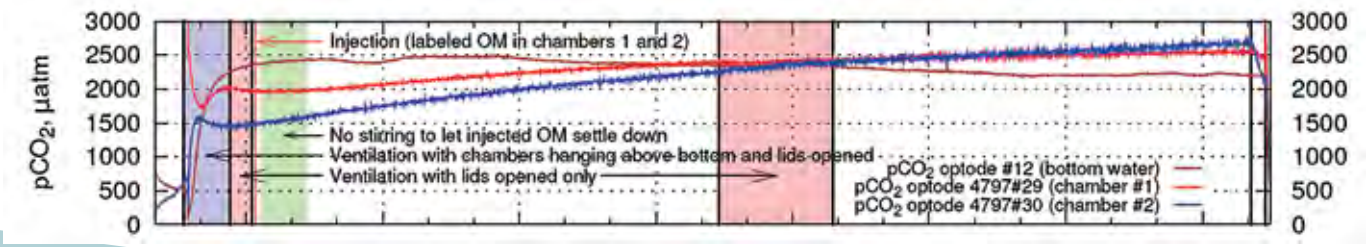


Fig 3: pCO² in chambers & outside.

Road and Weather – a good combination

AADI has a long history of supplying the road authorities in Norway with advanced traffic classifying systems and road weather stations.

In a project called "Vegvær" (translated: Road Weather), the concept of combining traffic measurements with weather measurements is taken to the next level.

The new system for gathering real-time weather information from road stations has been developed as a collaboration project between the road authorities, the Norwegian Meteorology Institute and AADI among others.

The backbone is a standardized server and database where data is transmitted at regular intervals from the stations along the road.

From this, data is sent to a central database where various user groups utilize the data for their purposes.

Applications include SMS services with prognosis for conditions, various web applications for dynamic data available on the internet, meteorology services etc.

A program is underway to upgrade the existing road stations in Norway to the "Vegvær" specifications.

This summer, the first 5 systems were delivered from AADI including a wide range of sensors such as wind, air temperature, relative humidity, ground temperature in two levels, road conditions, camera, etc.

More stations will come online over the next couple of years all in all increasing the level of knowledge of conditions along the roads of Norway.

RDCP 600 & SEAGUARD RCM - new, easy to use Report Generator

An intuitive easy to use Report Generator is now available for the RDCP 600 and the SEAGUARD RCM.

The application generates a Water Flow and Quality Analysis Report of the water conditions based on datasets exported from RDCP Studio and SEAGUARD Studio (i.e. based on quality assured data).

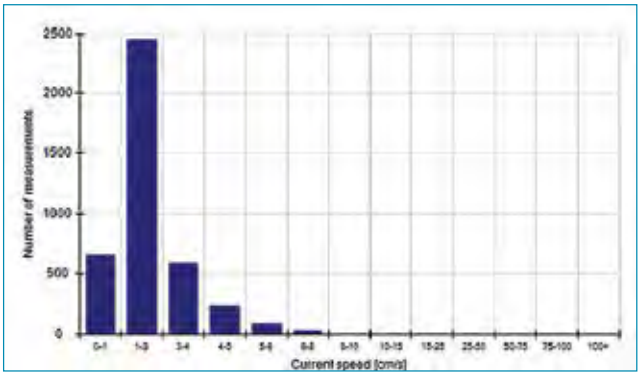
The report is intended for documentation of site surveys in respect to e.g. an aqua culture site, wind mill location, harbour etc.

It is also an excellent tool for other users (i.e. scientists, surveyors etc.) giving a rough overview of the conditions in the sea before going deeper into details on any specific issue.

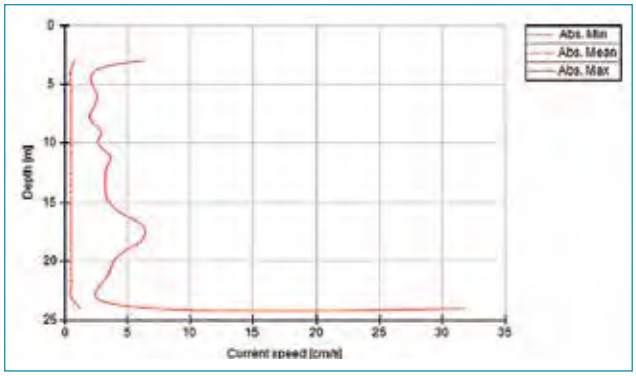
The report is in Microsoft Word 2007 format and enables the user to edit the report as any other word document.

The Report Generator requires activation with a license key. A fully functional 5 day demo version is also available.

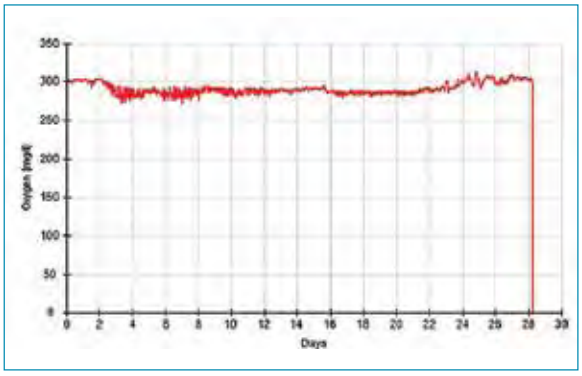
Examples of some of the many charts easily generated by the Report Generator:



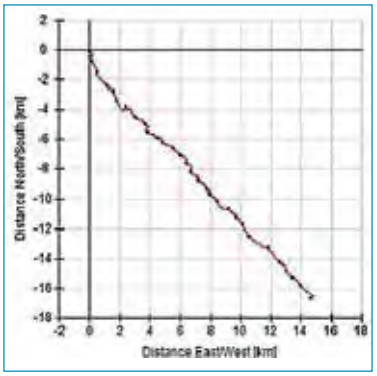
Current Speed - Bar Chart



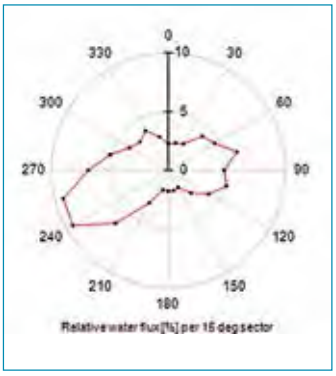
Vertical Current (surface referred)



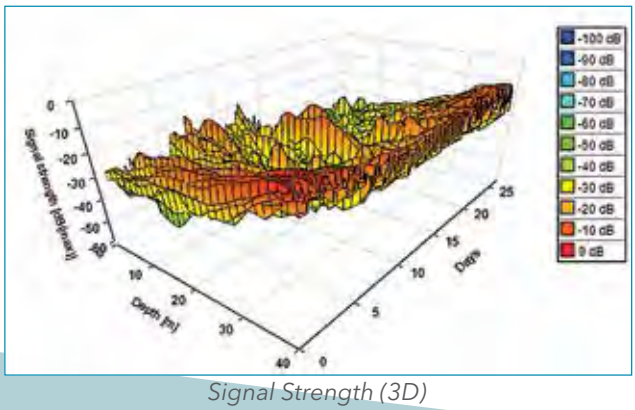
Oxygen



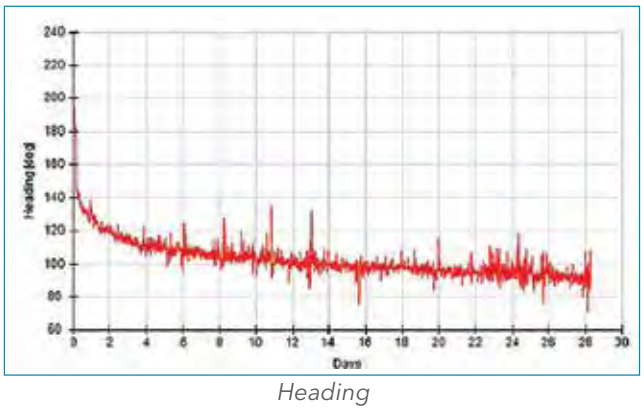
Progressive Vector



Relative Water Flux



Signal Strength (3D)



Heading

Smart sensors are getting even smarter

Real-Time Collector

Aanderaa Smart Sensors

AADI Smart Sensors has been around for a while and will soon become even smarter by speaking the full vocabulary of the AADI real-time protocols.

Connected to a computer through a standard serial interface the sensors will identify themselves and show their capabilities and parameters. The AADI Control Panel is available for the user to set up and configure any connected AADI Smart Sensor (one or more!) and the Real-Time Collector will record, display and/or distribute the data to other local or remote applications on the whole network.

Connected to SEAGUARD® or SmartGuard by the AiCaP bus these Smart Sensors are just plug-and-play whether replaced or added. This is taken even further on the String where up to 20 sensors can be relocated, added or removed in complete plug-and-play manner.

AADI Smart Sensors processes all data internally, including linearization, scaling and necessary compensation and provides engineering values at the output. Calibration coefficients are stored within the sensor together with sensor identifiers and limit values. Excessive readings and other malfunctions will be reported together with the data as part of the built-in quality control.

The AADI real time protocols enabling this plug and play functionality are based on well-structured XML formats made to handle current as well as future data from new and improved Smart Sensors. The details of the changes to our Smart Sensors can be found at:

Product Change Notification, Smart Sensors.pdf

Aanderaa real-time sensor information

Datarec Loop Monitor - traffic counting or monitoring system

Datarec Loop Monitor is AADIs latest product in the traffic counting and vehicle classification family.

We have been a supplier of traffic registration systems for nearly 30 years.

The product can be delivered as a stand-alone traffic counter or as an advanced part of a complete traffic monitoring system.

The system can also provide input to speed information signs.

Short description of Datarec Loop Monitor

One unit can detect traffic from 8 lanes. Traffic registration is based on advanced inductive loop-technology: passing vehicles can be length classified, or classified by advanced inductive pattern recognition of the electronic signature. The classification is according to national standards.

The system can detect up to 70 vehicles per minute per lane. The time of passage resolution is 1/100s.

If one of the two loops in the lane fails, the system can still detect vehicles with the remaining loop.

Full classification requires two functional loops in the lane. Datarec Loop Monitor communicates with motorway systems/ITS by sending serial data telegrams in ASCII.

The output parameters are given in engineering units.

Norwegian weighing system for coal giant

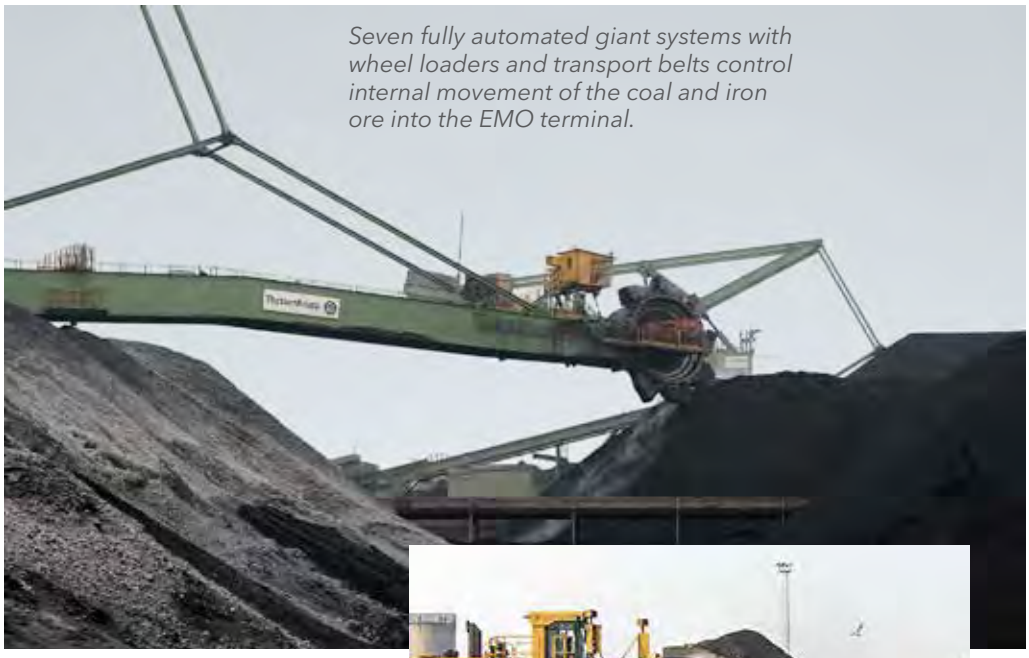
by Thomas N. Witsø-Bjølmer

all images thanks to Anlegg&Transport

35 million tonnes of raw material are reloaded every year at Europe's largest terminal for coal and iron ore. Key to the entire operation: Gigantic Caterpillar wheel loaders and a Norwegian developed weighing system. Aanderaa Data Instruments (AADI) in Bergen has supplied its self-developed weighing system for tipper trucks, Loadtronic 3, to the EMO Dry Bulk Terminal in Rotterdam. "It's really great to be able to supply our weighing systems to such a large, international player," says Harald Jørgensen of AADI.

To give an idea of its size, EMO is Europe's largest terminal for coal and iron ore. The enterprise, which occupies 160 hectares, is used by boats transporting up to 300,000 deadweight tonnes from around the world to unload up to a total 35 million tonnes per year. Norway and Svalbard also supply iron ore and coal respectively to EMO.

The quays along the gigantic area outermost in the Rotterdam harbour total five kilometers in length. Its daily unloading capacity of 200,000 tonnes is just one example of its size. This is where the Bergen firm has made a breakthrough with its Loadtronic 3.



Seven fully automated giant systems with wheel loaders and transport belts control internal movement of the coal and iron ore into the EMO terminal.

35 million tonnes of raw material are reloaded every year at the EMO Terminal, Europe's largest terminal for coal and iron ore. Key to the entire operation: Gigantic Caterpillar wheel loaders and a Norwegian developed weighing system from the Norwegian company AADI.

To the right rail cars, each loaded with 100 tonnes.

Loadtronic 3 comprises many different elements. This image shows the information screen in the driver's house and two sensors installed on the tipper truck.

780 extra tonnes

The first version of the Loadtronic was developed in 1991. After this new versions were developed, all of which were based on the same idea, that the cargo is weighed directly in the shovel and that the system must not lead to any restrictions on the wheel loader. "It can be run on a very poor surface without stopping to find the accurate weight of the load," says Jørgensen.

The wheel loaders at the EMO plant are used to load railway cars. These freight coal onwards into Europe to coal power stations in Germany, France, Belgium and the Netherlands. Each railway car has a capacity for 100 tonnes of coal.

"Under the previous system, which was not as accurate, we had to include a safety margin of at least 15%, which meant that we couldn't load more than 85 tonnes in each car," says Paul Hinskens, Manager of Machinery at EMO.

If any of the cars are overloaded the trains are sent back to EMO. A return of this type leads to a heavy fine by the train operator and not least a great deal of extra work for EMO. "Today we can use each car to the maximum level and accurately load 100 tonnes. This is 15 tonnes extra per car, with 52 cars per set of cars, thus a total 780 tonnes extra. Which makes for good economics," says Hinskins.

The quay system at EMO is equipped to receive the world's largest bulk carriers. Here a ship is unloaded using two cranes. The daily unloading capacity at the terminal is 200,000 tonnes.

EMO is Europe's largest terminal for coal and iron ore. The enterprise occupies 160 hectares and has a capacity for 60 million tonnes annually. Last year 35 million tonnes passed through the plant.

Full automation

EMO has grown practically every single year since its start in 1973. In 1975 the enterprise turned over 10 million tonnes, in 1990 the figure was 26 million and today 35 million tonnes of coal and iron ore pass through the system. The proportion of coal/iron ore is approximately 70/30. Five percent of the coal that passes through EMO comes from Svalbard. In the case of iron ore, the Norwegian plant is responsible for 1% of the supply. The raw material comes from major bulk carriers from around the world, which are unloaded by four giant cranes of 50 and 80 tonnes respectively. Giant claw buckets lift the coal and iron ore over onto a transport belt, which transports it further into the terminal. Here it is separated and made ready for onward transport. In some cases the raw material is also washed and/or mixed. There are seven fully automated "stacker reclaimers", large mobile systems consisting of a wheel loader and transport belt, inside the terminal. A range of Caterpillar vehicles also work inside the terminal. The wheel loader park comprises four CAT 990s, three 998s and four 966s. Five of these are equipped with the Loadtronic 3 system from Norway. A further two new wheel loaders, both with the AADI weighing systems, will arrive in the New Year.

All vehicles at the reception centre are equipped with ROPS (Roll Over Protection Structure) in the roof.

Ready for excavation?

AADI's dealer in the Netherlands is the Tiel based company RST. This already sells air-purifying systems for construction machinery as well as filters, cameras, cooling systems and other technical components for industry. In the past Harald Jørgensen was surprised that AADI hadn't achieved the same turnover of Loadtronic for diggers as for wheel loaders. Hitherto the Bergen company had sold ten tipper truck systems for each excavation system. However its collaborator RST is now taking drastic action:

When A&T visited Rotterdam together with RST's Robin A. Veltman, the latter claimed to have "something in progress".

"Today I've been visiting the scrap iron giant EMR's plant here in Rotterdam. They load metal into shipping containers and have a very inefficient weighing system. They have now asked to try the system with one of its diggers. I'm quite sure that they will be asking for more," smiles Veltman. It's well known that EMR, whose head offices are in England, have 120 scrap iron plants around the world.

Vapour rises from the coal that is prepared by machines in the terminal.

Netherlands AADI dealer Robin A. Veltman of RST demonstrates the system in a Caterpillar 990H.

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Aanderaa Data Instruments AS announces new Managing Director

Mr. Thorleif L. L. Gustavsen

AADI, with more than 40 years' experience in serving the industry and the scientific research markets, are pleased to announce the appointment of Mr. Thorleif L.L. Gustavsen as Managing Director for Aanderaa Data Instruments AS in Bergen, Norway.

As Managing Director, Mr. Gustavsen will lead the Bergen facility, with oversight of production, marketing, delivery and all operations in the region.

Commenting on his appointment, Thorleif Gustavsen stated: "It is an honor to be appointed Managing Director of Aanderaa, a leading company in this industry. I look forward to maintaining and reinforcing the company's competitive edge and high-profile position in the market. Aanderaa will continue to provide our customers with unique and state-of-the-art services".

Mr. Gustavsen is committed to working in partnership with the rest of the Aanderaa team and their customers to build a strong culture and a solid foundation for expanding the business. Aanderaa looks forward to his important contribution.

Prior to joining Aanderaa, Thorleif held the position of Managing Director at VTT Maritime AS where he was responsible for future business development, especially in global markets. Additionally, Thorleif has held leadership roles with ROXAR/Emerson and The Royal Norwegian Navy. He is educated at The Royal Norwegian Naval Academy and boasts twelve years of experience from the Royal Norwegian Navy. A recent Executive MBA from Norwegian School of Economics (NHH) completes his formal education.

Visit our website for the latest version of this document and more information
www.aadi.no

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Let's Solve Water

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