Material News

Corrosion, metallurgy and welding • No. 12 • June 2011

This issue

Editorial

Dear Reader

Welcome to the latest edition of Material News.

How does automated equipment for welding and NDT examinations function? Can you use it in your company and will you benefit financially? Learn more at the fair hi[11] on 6 – 9 September 2011. Here we shall present our new equipment for both automated welding and NDT examination.

Streamlining and upgrading technology are also key factors in our project with Topsoe Fuel Cells under The Danish National Advanced Technology Foundation which backs our work on improving the fuel cell technology.

Further, you may read how it is possible to assess the residual service life of components in production plants and start maintaining in time as regards especially safety but also financial aspects.

We have also news about the staff and a CIMAG task force meeting.

Enjoy your reading.

Ernst C. Kristensen
Vice President

FORCE Technology will have a stand at the hi[11] fair

FORCE Technology will have a stand at the hi[11] fair in Herning from 6 to 9 September 2011, where we shall show our automatic equipment for weld and NDT examinations.

FORCE Technology holds many years' experience with mechanical and automatic welding, and, at the hi[11], we can therefore show and demonstrate a system for submerged arc welding facilitating welding of e.g. wind turbine towers without operator monitoring. The system is based on laser sensors and mathematical models comparing the geometry of the weld groove with optimal weld parameters, simultaneously ensuring correct positioning of the filler material. The system thus offers a more uniform quality and increased productivity compared to the traditional methods applied.

Automating the welding process holds many advantages

We shall also show a fast, efficient and documented examination of welds on wind turbine towers. The use of automatic testing provides both a better quality and a better financial situation. Automation improves the quality of the examination, which is simultaneously documented 100 %. This technology radically reduces the tower manufacturer's testing costs. With the associated business model, the tower manufacturer's fixed costs for NDT may be converted 100 % into variable costs.

By the introduction of EUROCODE 3 and

FORCE Technology's automated NDE-equipment

EUROCODE 9, which e.g. lay down the requirements for welding and NDT of steel and aluminium structures according to Building Code 2008, new requirements for welding were established for the manufacturers. At the hi[11] fair, it will be possible to learn about the requirements for documentation, materials, quality control of welding, qualification of welding procedures and welders as well as inspections laid down by the EUROCODE series.

At the fair, you may also get FORCE Technology's welding keys which give an overview and an introduction to "Certification of welders and welding operators", "Quality control of welds in accordance with ISO 3834" and "Execution of steel and aluminium structures".

Further information

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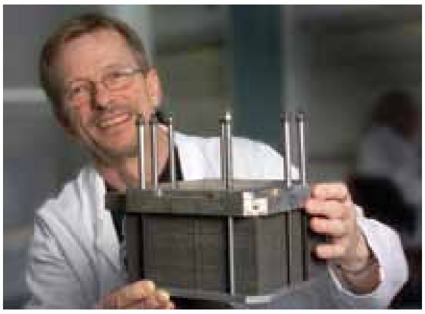
Thermal spraying improves fuel cell technology

FORCE Technology's state-of-the-art atmospheric plasma equipment and real-time analysis equipment have made it possible to improve the quality and reduce the cost of components for fuel cell technology.

The incentive is well-known: Better, less expensive and sustainable
We all have a tendency to do as we usually do; maybe because we are not aware that we might benefit from doing something else, maybe because we fear the consequences. But great cost savings and other undetected gains may be hidden in a locked procedure for manufacture of components. FORCE Technology has proven this in close cooperation with Topsoe Fuel Cell in a project under The Danish National Advanced Technology Foundation.



Employee with a fuel cell stack. Photo courtesy of Topsoe Fuel Cell.

Topsoe Fuel Cell focuses on the development of SOFC (Solide Oxide Fuel Cell) fuel cell stacks that produce electric current and heat directly from e.g. natural gas, diesel or biogas. The fuel cell process takes place at high temperatures, and thus it places severe demands on stack design, quality and repeatability during manufacture of each component in the stack.

FORCE Technology contributes with spraying a specially designed metal oxide that serves several purposes including e.g. corrosion protection in a micro thin layer on a so-called "interconnect" that is part of the cell stack.

From the early developmental stage to process optimisation ripened for large-scale production
To market this flexible energy technology, it was necessary to improve the quality and reduce the price. FORCE Technology therefore worked systematically and analytically by determining the properties of metal oxide and substrate, adjusting the plasma spraying process and performing real-time material analyses. On this basis, the potential candidates for a new procedure were chosen and further analysed in our metallurgical laboratory. Subsequently, the coatings were tested under accelerated conditions in cooperation with Topsoe Fuel Cell.

The result so far is that the rate of utilization of the metal oxide, which is expensive, has more than doubled simultaneously with obtaining an improved quality and a markedly reduced production time.

Further to the necessary knowhow and equipment, cooperation and a common responsibility for development are crucial factors. FORCE Technology always strives to focus on that when working with project management and problem solving for a given application.

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CIMAC Users Working Group 10

FORCE Technology hosted a CIMAC Users working group meeting on 18 November 2010.

CIMAC WG 10 is one of team working groups that consist of 27 members from 12 countries, distributed in Europe, the Far East, the Middle East and the U.S.A. FORCE Technology became a member of the CIMAC Users WG 10 in June 2010 in connection with the CIMAC congress in Bergen. The working group primarily consists of users and operator of ships and stationary powerplants, which makes our membership rather special, since we neither operate ships nor machinery, but often only see parts and components from ships and/or machineries after failures and breakdowns, as the damage investigation would need clearing up and answers as to why this happened and how to avoid similar incidents in future.

Peter B. Mortensen, Jens Thomsen, Nico Hansen, Jørn Dragsted, Lars. E. Egeberg, Piet Jansen, Theodore Mavraidis, Curt J. Christensen and Peter Koch

Due to extraordinary work pressures with the members, the number of participants was somewhat lower than usual and including a couple of last minute cancellations, attendance in the event came from Hanseatic Lloyd, Leonhardt & Blumberg, Euronav Ship Management and Bergesen World Wide Gas.

Michel Honoré from Welding Technical Innovation explains about the Ariane project and laser welding.

Prior to the planned 2½ hours long internal meeting, the members were given a thorough presentation of FORCE Technology's comprehensive competences, especially focusing on our own area, materials and welding, succeeded by visits to laboratories within metallurgy, SEM-scanning, mechanical testing and in the department for laser welding, which houses Northern Europe's largest laser system equipment at 4 and 17 kW, respectively. ESA's rocket nozzle for the Ariane 5 rocket, including approx. 3.000 meter extremely precise laser welding of the cooling channels are performed here.

After the internal group meeting, the participants were bussed to DMI (Division for Maritime Industry, which is part of FORCE Technology) in Lyngby, where their activities were briefly presented and this was followed by a guided tour of the laboratories for hydro – and aerodynamic as well as ship simulators.

The CIMAC Users WG day which was a great success work as well as event wise, was completed at DMI by a dinner before the participants were bussed to the Copenhagen Central Station.

Further information
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Creep tests safeguard your operations and maintenance costs

Creep testing enables planning maintenance and replace components if necessary, before damages become critical.

High-temperature plants make up some of the core in many production plants, for instance in the petro-chemical and gas industries and in power plants. It is often million investments, in which operation and maintenance are crucial to ensure high operational and personal safety and good financial standing. Thus it is of paramount importance to regularly gather information about the condition of the plant. This may be done by localising and assessing operation stress and failures before they become critical to the operation and thus also to safety. For example, creep in components included in the plants may have catastrophic consequences, but the use of test methods can elucidate the condition, significance and development of creep at an early and noncritical stage benefiting both personal and supply safety.

Pipe with high thermal stress in reformer plant used for production of ammonia. Photo courtesy of Haldor Topsøe A/S.

What is creep?

Creep is a decomposition which, as mentioned, may lead to serious damage to plant and personnel. When a material is exposed to long-term, static stress below the yield stress, the temperature impact may cause plastic deformation. This mechanism is called creep.

When the material is deformed by static stress and raised temperatures, creep will occur in three stages. In the two last stages, cavities (microvoids) are formed in the material. Over time, these cavities will grow in number and develop into microcracks, whereupon fractures will begin at continued stress. The temperature level for initiation of creep depends on material and type of alloy. For aluminium alloys, creep may start at approx. 200 °C and for low alloyed steel at approx. 370 °C.

When is creep testing used?

One of the test methods that may assist considerably in gathering information about the plant's condition is creep testing. Basically, creep testing is used to determine the residual service life of the component from which a sample has been taken. In practice, it means that it becomes possible to plan maintenance and possible replacement of pipe sections or components before the damage becomes critical. Concrete examples of situations in which creep testing and calculations of residual service life are applied are:

- Long-term, operating stressed high-pressure steam pipes
- Heavily and unevenly stressed headers
- Hot components in turbine plants
- Reformer pipes in refineries
- Acceptance check of high-temperature components

Creep testing with FORCE Technology

FORCE Technology has several test stands for carrying out creep testing by use of miniature samples according to either the ISO-stress method or the ISO-term method. Simultaneously, the creep laboratory is integrated in the department of Corrosion and Metallurgy that employs experienced materials specialists and technicians and has a special workshop for cutting and producing miniature samples. We therefore provide creep testing and determination of residual service life combined with full metallurgical and mechanical tests of the materials. The creep test is performed in furnaces where the miniature samples are protected by argon. Testing is planned so that the creep process is accelerated by raising the temperature and/or the load. By the subsequent determination of residual service life, e.g. by creep testing according to the ISO-stress method, results can be extrapolated to relevant operation temperatures. Thus the residual service life of the component can be estimated.

Creep tests can show the residual service life of the tested material and thus be of assistance in a more optimal planning of replacements, if any.

On-site creep tests

Further to materials investigations in one of FORCE Technology´s metallurgical laboratories, we hold many years' experience in materials investigations on site. For example, it is possible to examine the materials' microstructure and possible cracks by use of the replica method. This also includes examination of incipient damage emerged by creep. The replica method thus provides a picture of the material's general condition in the examined positions.

Further information
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New appointments within Materials and Welding

FORCE Technology has employed six people, who are to undertake tasks related to welding coordination, supervision, audits and condition assessments on windmill farms.

Kim Holler Foget

is employed as a welding technician by our department of Welding Services in Aalborg. He is trained as IWI and IWIS.

He has previously been employed by Metal College in Aalborg where he taught welding technology for many years.

At FORCE Technology Kim shall work with welding procedure tests and certification of welding personnel. He shall also perform quality control of welds and wps documentation among others. In addition, he is studying to become a Lead auditor in ISO 9001 and ISO 3834.

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Henrik Holm Nielsen

is employed as a welding technician and is affiliated with FORCE Technology's activities in establishing Lindoe Welding Center. He is trained as IWI and IWIS.

Henrik has previously worked at Lindø, Odense Steel Shipyard as a welder in the production and in the development department, where he worked on optimizing production and participated in the development of a welding tractor in collaboration with FORCE Technology. Henrik shall also work with quality control and participate in the work of e.g. the Swedish nuclear power plants.

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Kaare Jensen

is a trained welding specialist and is employed in the department for Welding Services in Brøndby as a welding technician.

Kaare was previously employed as product manager for welding equipment, automation equipment and welding consumables at V. Løwener A/S.

At FORCE Technology he will deal with teaching, supervisory functions and QA/QC documentation. Moreover, he will be engaged in welding-related troubleshooting.

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Klaus Kjærgaard Mortensen

is originally trained as a machine operator, and he is now employed as a QC inspector by our department of Welding Technology, Advisory Services, in Esbjerg, Denmark.

Having worked as e.g. a mechanic with Arriva Trains, Klaus upgraded his skills and became a technical manager offshore. With FORCE Technology, he will be a QC inspector in e.g. Swedish nuclear power plants, and his tasks will include inspection of welds, materials, certificates and WPS documentation.

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Henrik Sørensen

is trained as a welding specialist and inspector and is now employed by our department of Welding Technology Services in Qingdao in China.

He has previously been employed as a welding/robot specialist by ELO Automated Stainless Steel in China.

His task is to build up on-site welding consultancy services in China for Danish and other foreign companies.

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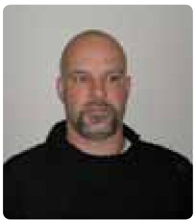
Carsten Brønd



a chief engineer has been employed as a senior inspector with our Esbjerg Department.

Carsten has worked within the energy sector worldwide over the past 20 years, with operations of electricity, water and heat supplies, production, gas-generator plants, wind turbine tasks and installation of wind turbine farms.

With his extensive network in the wind turbine business, Carsten is to organise FORCE Technology's business area including inspection and condition assessments on new and existing on- and offshore wind turbine farms.

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Material *News* is a newsletter on corrosion, metallurgy and welding and is published twice a year.
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