Delft Outlook
MAGAZINE OF DELFT UNIVERSITY OF TECHNOLOGY 2011 • 3

Waterpurification
The new standard

Mijnbouwplein
Living in a lab

Karin Laglas
'BK City is an icon'

Ecomarathon
Energy-efficient driving is possible

no. 3 2011

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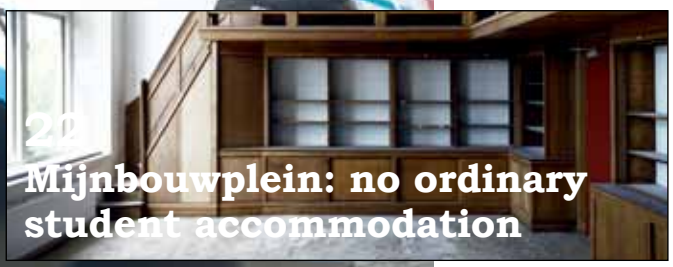

Editorial

"It's just like sitting in a womb." Tightly squeezed into the hydrogen-powered Ecorunner, energy efficiency seems to be second nature to student Jasmijn Kok. Saving energy is essential, also in the field of wastewater treatment. The Nereda granular sludge technology not only uses less energy; the operational costs are lower, too. In the words of Professor Van Loosdrecht: "Apart from being better, an innovation needs to be cheaper as well." This positive take on Dutch thriftiness is shared by Professor Stankiewicz, who received a 2.3 million euro grant to make chemical reactions more efficient. "I want to create a 'perfect' reaction environment," he explains. Energy lies not just in the machine and the process, but also in the engineers who create these innovations. There is plenty of energy at TU Delft, as was immediately obvious to the new Dean of Architecture, Karin Laglas: "Everyone here is really enthusiastic about their field; they radiate a lot of positive energy." Let this be a wise lesson for the politicians in The Hague: you achieve efficiency by investing money, and you get energy in exchange.

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Colophon

Coverphoto
Tomas van Dijk

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Helter skelter robot

It runs, tumbles and regains its equilibrium. Whether the terrain is sandy, grassland, strewn with rocks, Dr Gabriel Lopes' legged robot goes on. About ten years ago Lopes started working on a six-legged robot inspired by a cockroach at the University of Michigan. The robot was quite successful, as Lopes demonstrates by showing videos in which the robot mountain climbs and runs over grids full of big holes. At TU Delft, where Lopes has worked for two years (at the Delft Center for Systems and Control), the researcher wants to take the robot a step further. "We've worked on the mathematics to control the synchronization of the legs. Now that we understand the mathematics, we can use them to change the gaits - the way the robot moves its limbs," he says. Ultimately Lopes' robot must be able to switch gaits autonomously.
Youtube.com (Rhex Robot and Edurobot)

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Photo: Tomas van Dijk

Scanning tree skeletons

Laser scanners can come in handy for monitoring construction sites, helping to verify that there is no subsidence of structures over time. Delft researchers have quite some experience with this application. Dr Alexander Bucksch however, who works at the remote sensing department of the faculty of Aerospace Engineering, focused on something completely different: "I scanned six honey crisp apple trees in Canada. And I worked with a German ecologist who is interested in the exact structure of the trees, in order to better study the physiological processes."
A laser scanner, one can quantify the environment by creating point clouds, in which each point is a reflection of one of the leaser beams on an object. To obtain all the available information about the tree structure, one must scan the tree from different angles. But owing to the scanned surface properties and the fine structure in orchard tree crowns, the result is blurry images. Bucksch developed an algorithm that solves this problem by extracting the skeletons of trees from the massive point cloud.

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Programmable implants

In their quest to develop a treatment for patients with tinnitus (hearing phantom noises), scientists of the University Hospital Antwerp, and the Antwerp's Monica hospital occasionally send electrical pulses through their brains. Commanding the device that is attached to the guinea pig professors and generates the pulses is Dr Christos Strydis. During his PhD research Strydis developed an application on his smart phone for this purpose. Depending on the frequency of the pulses, the test subjects might feel energetic, euphoric or sleepy, to name but a few of the possible states.
Strydis is part of a large team of researchers from the faculties of EEMCS and AS, who over the years have been working with the Belgian medics on biomedical implants.

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Photo: Christos Strydis

Superbus

Although the Netherlands may have limited space for special Superbus roadways, the deserts of the United Arab Emirates offer slightly more room. In April, Professor Wubbo Ockels (AE) demonstrated his prototype Superbus to the Emir of Dubai, Mohammed bin Rashid Al Maktoum, during a conference on public transport in Dubai. In Ockels' vision of the future, the electric bus will travel at 250 kilometres per hour along special Superbus roadways and transport passengers for the price of a train ticket.

Photo: Danielle Brinkhuis

Tinkering scientists on tour

With a bus full of self-built, McGyver-like equipment for giving demonstrations, Delft hydrologists went to the annual assembly of the European Geophysical Union in Vienna. On the return journey they took samples of Rhine river water every 20 kilometres or so. Home-built equipment is a bit of a Delft passion, Rolf Hut MSc (CEG) admits, with a preference for using devices that were never meant to use that way. With a stainless steel bucket they sampled for remnants of medicines. They expected the load of anti-depressive and ibuprofen to increase with every major city they passed. In fact, they wanted to test drug remnants as an indicator of human civilisation along the banks.

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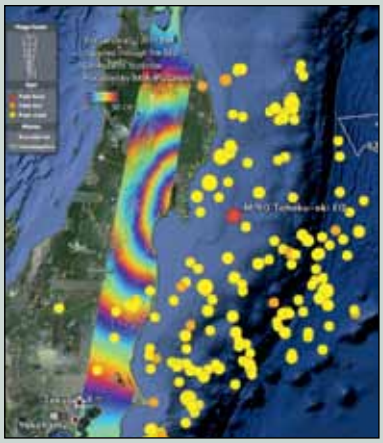
Shaken Japan



Professor Ramon Hanssen (Aerospace Engineering) has a picture from ESA on his desk on which brightly colored circles show how Japan changed shape. Thanks to the work of dozens of research groups around the world, the deformations caused by the recent earthquake are slowly becoming clear.
"Based on the motions observed in Japan until now, we expect that most of the energy in the crust has probably been discharged," the earth observer says.
But to date only the rough contours of the deformations have been sketched. In order to model the tensions left in the earth's crust along the boundary between the tectonic plates, radar data must be analyzed more accurately and combined with GPS and seismic data.
Even better however would be to add another information source to the data set: the tsunami. Prof. Hanssen teamed up with colleagues of the Delft Institute for Earth-Oriented Space research and hydraulic engineers from the faculty of Civil Engineering and Geosciences, who are presently modeling the tsunami. The team of hydraulic engineers – which includes tsunami expert, Dr Julie Pietrzak – use data obtained from buoys in the Pacific Ocean. "We can use our model to verify if the models of the earth are correct," Dr Pietrzak comments.
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www.delta.tudelft.nl/22975

Demo opens micro-workshop

The Electronic and Mechanical Support Division (Demo) opened a new workshop on 26 May, specialising in manufacturing ultra fine mechanical prototypes for researchers.
The new microcenter itself isn't very large – how could it be – but it does have some of the world's best machines for fine mechanics: a micro-milling machine, a micro-drilling machine (which works by sparking away the material) and a spark-sawing machine. A vertical boring mill, and a micro-welding machine capable welding wires together down to 0.1 millimetres, complete the set.
The microcenter has been set up in response to the trend that Demo-director Gerrit Kahlman noticed in the demand for smaller, finer and

evermore complex instruments.
Demo, which employs 90 people at various locations around campus, works primarily for (PhD) researchers and YesDelft startups.
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demo.tudelft.nl

High ropes

Space ropes and ribbons may have applications, ranging from futuristic space-lifts to destroyers of space debris. After ten years of relative quiet, interest in space tethers is picking up, Michiel Kruiff (MSc), of Estec in Noordwijk, observes. He graduated cum laude on the subject of space tethers from TU Delft's faculty of Aerospace Engineering. Together with Delta-Utec's Erik van der Heide, Kruijff flew two tether missions with the European Space Agency (ESA). The most successful called Yes2 was launched on 14 September 2007. The 8 kilogram ejection mass, which pulled out the rope from the satellite in space, contained a 6 kilogram capsule, called Fotino. The capsule was to return to Earth as a demo for Space Mail. Despite some hiccups the mission was largely successful and it won Kruijff an entry in the Guinness Book of Records for having realised the tallest structure (32 km) in space.
The most promising application of space tethers may be conducting ribbons, which through the

Lorentz force they experirience, can pull floating space debris down to the atmosphere. Kruijff: "Within a couple of years, 98 percent of the space junk can be eliminated.
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The occasional cyclist

Bicycle-commuters are a poorly researched group compared to car drivers, yet they offer a number of societal benefits, including less congestion, no pollution and physically fitter employees. Dr. Eva Heinen (TPM) researched the commuting behaviour of 4,300 people in the flat Netherlands. Of those surveyed, 40 percent cycled to work, of which 17 percent did so every day and 23 percent only occasionally.
The various groups of cyclists had diverse motivations. Full-time cyclists either have no alternative or are strongly motivated. Part-time cyclists however do have alternatives, be it car or public transport, and base their choice on practical considerations.
Changing people's habits and customs is notoriously difficult. There is room for change, however, especially among the group of occasional cyclists. This group may well be tempted to use their bikes more often. "If employers wish to increase the share of cyclist commuters, they should make cycling possible for those who are interested," Heinen explains.
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Balancing bicycles

Run next to your bike and let it go. Now give it a sideward smack. Even after such abuse the bike will steer itself back on the right track. Although the stability of bicycles has been studied for almost 150 years, a bit of a mystery still remains. Last April, TU Delft researchers, Dr Arend Schwab and Ir. Jodi Kooijman (Msc), together with American colleagues from Cornell University, added another sequel to the bicycle studies in Science.

It was commonly believed, they explain, that the gyroscopic effect of the wheels is essential for a bike's balance, as is a certain amount of trailing (the point of contact of the front tire is some centimetres behind the steering axis). A clever experiment however has proven that neither aspect is essential for balancing the bike. Basically, as Schwab explains, it's the ability of a bike to bring its wheels back underneath it. Once a bike banks over (after a smack on the side), it is essential that the steering wheel falls even quicker than the rest of the bike. By steering into the fall, the bicycle brings its wheels once again underneath it and restores the equilibrium.

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TU in China

On 11 May, TU Delft became the first Dutch university to open a branch in China. The Delft University of Technology - Beijing Research Centre is intended to raise TU Delft's international profile. The centre is part of the Institute of Semiconductors in the Chinese Academy of Science (CAS) and will begin by appointing several PhD students. They will be conducting research on improved LED lighting and will be supervised by professors from TU Delft and CAS. TU Delft Professor Guo Qi Zhang is coordinating the scientific programme.

Further information:
www.delta.tudelft.nl/23137

Reducing congestion

Existing versions of intelligent cars could halve traffic congestion levels, the experts say, and prevent 25 percent of all accidents. So what's holding them back?

In her PhD research, Dr Leonie Walta (TPM) interviewed the four parties involved: the automotive industry, public authorities, insurance companies and car users. Walta concluded that the initiative for introducing adaptive cruise controls will most likely come from the car industry. If government were to support this driving assistant with a tax reduction of 1,500 euros, one out of every two drivers would buy an Advanced Driver Assistance Systems (Adas) option. A breakthrough could come from a driving assistant on offer in ordinary car brands, but up to now Adas only features in the executive class cars.

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Roadmap 2020

What does the future hold for TU Delft? In the next few months, the Executive Board will be posing this question to students, PhD students, staff and representatives from the business world, government and TU Delft affiliates. According to Executive Board Chairman Dirk Jan van den Berg, TU Delft might consider merging with the universities of Leiden and Rotterdam.

"That could be part of our strategy for the future." The debate has been inspired by a strategic memoranda issued by the Executive Board. This will culminate in a new institutional plan, entitled Roadmap 2020.

Further information:
www.delta.tudelft.nl/23095 and 23019

Cooking with solar radiation

The energy bills at the orphanage in the Kenyan town of Malindi are proving exorbitant. So Master's students in Architecture Margit Heine and Evelien van Winsen, and Hester van Zuthem (Industrial Design Engineering) are introducing solar-powered ovens.

The fact that this spring was the sunniest for years was very helpful for the group as they were preparing the project. The students spent weeks experimenting in the garden of their student accommodation. The ovens can easily reach a temperature of 120 degrees. They are made from a diverse collection of waste materials. The insulation is made from pieces of system ceiling; old cycle tyres are used to hermetically seal the double-glass plating and the woodwork is in part an old slatted bed base.

Further information:
www.cookingforkenia.nl
www.delta.tudelft.nl/23157

Purely based on character

In Epe, the Veluwe Water Board is pioneering a new generation of sewage water purification. The Nereda granular sludge technology saves around a quarter of the energy, while taking up just a quarter of the space. "In ten year's time, this will be the standard."

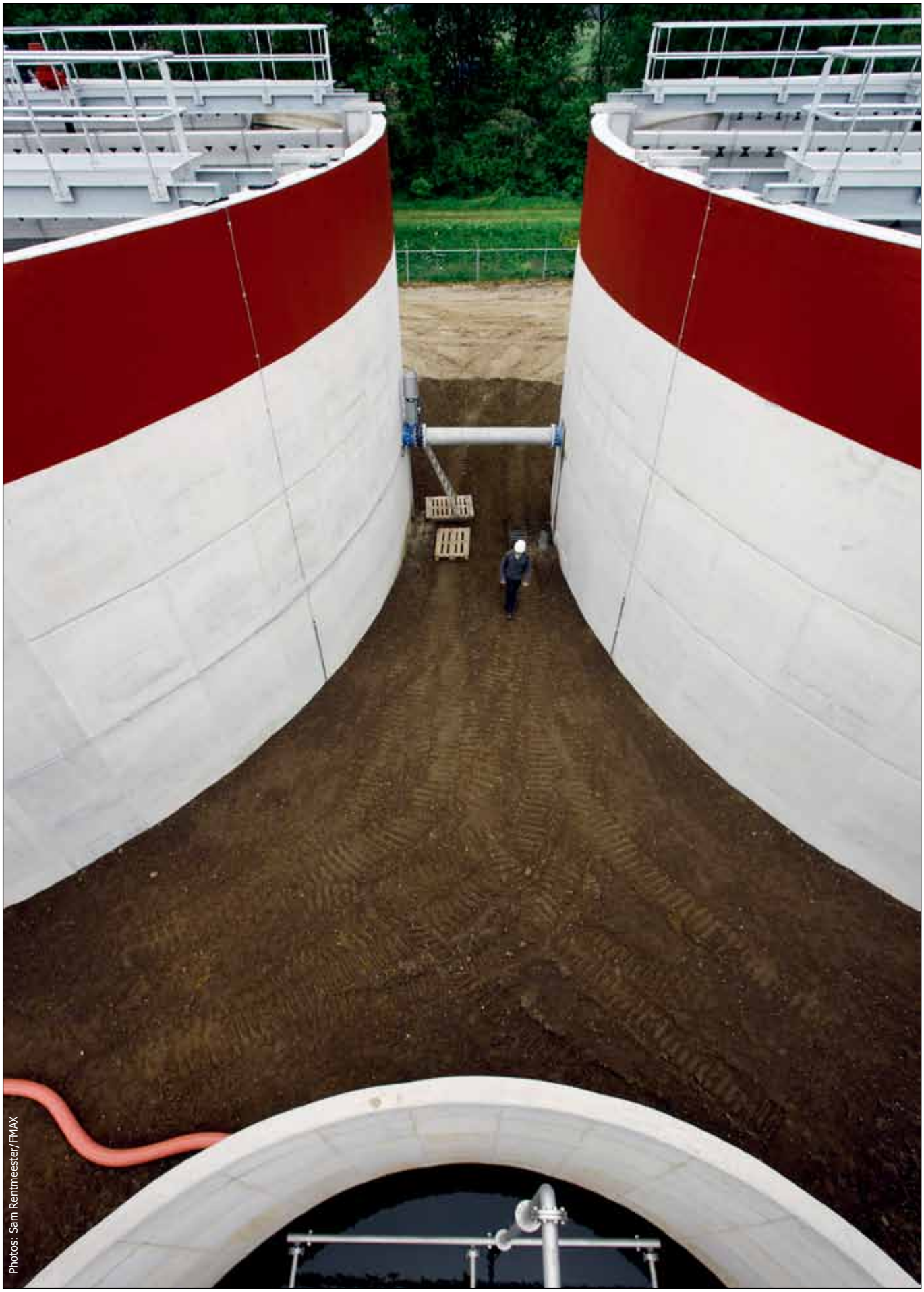
Project manager André Welmer, from the Veluwe Water Board, has his work cut out for him: Having just given a guided tour to two people from the Municipality of Epe, in comes a journalist wanting the same. Here, on the edge of an Epe industrial estate, there is a sense that the job is almost done. The major construction work involving cranes and concrete trucks is complete; it is now the turn of the consultants, project workers and various specialists to connect the cables, test subsidiary systems and agree on the final details.
Three huge concrete tanks - 9 metres tall, with a capacity of 4500 cubic metres - are lined up in a row. In front of them stands a small black building housing air compressors and the electronics that control the system. From various directions, cables emerge from the sand and run into the building via pipes.

The new granular sludge settles so quickly that no sedimentation tank is required

A thick steel drainage tube runs along the upper edge of the tanks, underneath a skywalk. From that height, the old installation is clearly visible. It is the type you see everywhere in the Netherlands: a large circular sedimentation tank and the noisy splash of blades moving air through the water. Welmer explains how this will soon be a thing of the past. In partnership with various Dutch water boards, TU Delft and engineering firm DHV have developed the Nereda® granular sludge technology. The new granular sludge – a type of bacteria that removes the organic carbon, nitrogen and phosphate from the waste water - sinks so rapidly that a sedimentation tank is no longer required. And as part of a new aeration technique, compressors blow bubbles from the bottom of the tank – much quieter and more energy-efficient than the splashing blades.
It was the favourite lab demonstration of biotechnologist, Dr Merle de Kreuk, when she was doing her PhD research under the supervision of environmental biotechnologist, Professor Mark van Loosdrecht (Faculty of Applied Sciences): To illustrate the difference between regular water purification and granular sludge technology, she would bring two closed cylinders of sludge along to the presentations and turn them around. In one of the cylinders, a murky layer spread out through the whole of the water column, while in the other granules of just a few millimetres in size whirled down through the clear water to the bottom in just a few seconds. What could be clearer?
The benefits offered by the granular sludge technology were equally clear: the new generation of water purification saves space (three-quarters of it, according to its designers), as well as a quarter of the energy due to more efficient pumping and aeration, buoyed by the fact that the waste water does not need to be pumped back and forth as much. The installation's limited surface area and low energy consumption also reduce the construction and operation costs. As Prof. Van Loosdrecht puts it: "Apart from being better, an innovation needs to be cheaper as well."
Finally, the water quality is better than with conventional purification, as demonstrated in a pilot project that preceded construction in Epe. The technology won the Vernufteling 2005, an award given by Kivi-Niria (the Dutch association for engineers, ed.)and NLingenieurs for the most innovative project by an engineering firm, before going on to win seven more awards.
So why has it taken 12 years for such award-winning technology to move from the laboratory into practice? "It's taken far too long," agrees Helle van der Roest, a leading professional at the engineering firm DHV. "Speed is essential, even more so than patents. You have to assume that technology which is so promising will be copied. You can only be sure of earning back the investment made on research if you stay ahead of the competition."

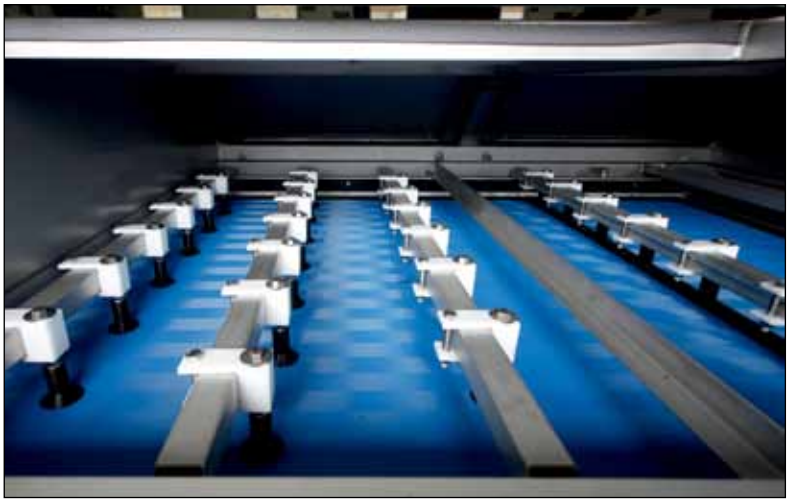
Granular sludge

What exactly is granular sludge? It looks like little balls, ranging from a few tenths of a millimetre to several millimetres in size, consisting entirely of bacteria. The crux is that, under certain conditions, the bacteria >>



Photos: Sam Rentmeester/FMAX

The purification process in Epe takes place in 3 tanks of 9 meters in height and 25 meters in diameter.



This machine filters the granular sludge out of waste water.

A tube removes the purified water.

spontaneously clump together to form granules. "The phenomenon was first identified in the late 1960s," explains Prof. Van Loosdrecht. Professor Lettinga, from Wageningen University, had identified bacterial sludge granules in anaerobic water purification at CSM [a global food-bakery supply company, ed.]. This led to the idea that it might be possible to speed up water purification by using granular sludge, because this sludge sinks more rapidly. The technology based on anaerobic (without aeration) granular sludge became a successful export product in the 1980s and 90s. The bacteria removed organic pollution from wastewater, creating biogas as a by-product. However, nitrogen compounds and phosphates were left behind and the process proved less effective at low temperatures. Consequently, the search was on for aerobic granular sludge, which was expected to produce better results.

"Originally, the idea was that anaerobic bacteria were particularly suited for granular sludge because they form complex communities to convert the substrate [nutrients, ed.]," explains Prof. Van Loosdrecht. Personally, however, the professor was not convinced. In the early 1990s, his discovery of aerobic bacteria in granular-sludge form caused quite a stir among biotechnologists. His PhD student at the time, Dr Janneke de Beun, had demonstrated that even simple, fast-growing bacterial cultures could grow as granular sludge. "You have to exert the right selective pressure," he says now. "The biology will then adapt accordingly." In Epe, this selection involves the bacteria passing through a cycle of one period of nutrition under anaerobic conditions, followed by two periods of aeration. New waste water then flows into the tank and the purified water passes on. The alternating regime of anaerobic nutrition and aerobic growth promotes the development of slow-growing bacteria that can more easily form stable granules.

The engineering firm DHV became involved with the granular sludge technology in 1999, following a visit by Van de Roest to Prof. Van Loosdrecht's lab. "Helle was the driving force within DHV," Prof. Van Loosdrecht says. For the development process, a subsidy was obtained from the STW technology foundation, and financial support from the Stowa knowledge centre. PhD student Merle de Kreuk was enlisted to enable the bacteria to also remove nitrogen and phosphate compounds. In 2007, STW awarded her the title of Simon Stevin Fellow for the way in which she served as a linchpin between scientific research at TU Delft and the engineering work at DHV.

"Merle did an outstanding job," Van der Roest says. "She played an instrumental role in the development of Nereda." From 2005, Nereda was the trade name of the anaerobic granular sludge technology, derived from the name of a water nymph in Greek mythology.

Crisis

The process of upscaling and research went hand in hand. Van der Roest had the enviable job of challenging the biotechnologists to modify the process conditions for practical application, for example where the pump capacity is limited and the oxygen content can never be as high as in a laboratory setting.

Switching to real waste water instead of the laboratory concoction proved trickier than expected. A pilot set-up, 6 m in height and 60 cm in diameter, was the site of a Stowa study involving sewage water at the waste water purification plant in Ede (not Epe), designed to run from 2003 to 2005.

"It was completely different to the lab," recalls Van der Roest. "We became quite desperate at times because the granular sludge refused to grow." When, nine months later, some granular sludge was starting to develop, a disaster occurred. A computer was stolen one weekend, which meant that the process could no longer be monitored. When the researchers returned to work after that weekend, they also discovered that a technical fault had caused all the granular sludge to be washed away. This put DHV in a difficult situation. The losses almost equalled the turnover, but stopping the project would have meant both the commissioning parties and the water boards losing face. The project workers were so motivated that they decided to continue the work in their own time. But this crisis had also revealed something new. Van der Roest: "We realised that we had to treat the micro-organisms so badly that they had no choice but to grow in granular form, having to depend on each other for survival." So the engineers' stress led to stress for the

Prof.dr.ir. Mark van Loosdrecht with granular sludge: "Apart from being better, an innovation needs to be cheaper as well."

bacteria. And, lo and behold, after four months the test reactor was full of granules and the removal of nitrogen and phosphate (nutrients) was even more effective than expected.

In the ensuing period, TU Delft and DHV established the National Nereda Development Programme (NNOP), in alliance with six Dutch water boards. The programme will run until the end of 2012 and include the construction of several purification plants.

For the construction of the first full purification plant, a water board was needed as the commissioning body along with a guarantee fund in case the plant did not operate as predicted. The Hollandse Delta Water Board came forward as the first commissioning party back in 2007. But it proved impossible to secure the guarantee fund. "The first Nereda purification plants could have been up and running years ago," claims Van der Roest, "if a guarantee fund had been available." But what actually happened was different, and after three years of delay, the first Nereda purification plant is located not in Zuidland, but in Epe (Veluwe Water Board), soon to be followed by Dinxperlo (Rijn & IJssel Water Board) and Vroomshoop (Regge and Dinkel Water Board).

'The micro-organismen and granules have to depend on each other for survival'

Prof. Van Loosdrecht, who received a knighthood this year for his services to water purification, is hard at work on new purification concepts, including the use of anammox bacteria at low temperatures and the production of chemicals from waste streams. "Universities shouldn't hold on to their inventions too long," he believes, "while continuing to pursue research into the questions that emerge as the scale increases."

Van der Roest, who describes himself as a "positive kind of guy", refuses to indulge in finger-pointing. "You can feel disappointed at times, or just accept the fact that innovation always involves setbacks." He does feel that rules often create obstacles for innovation and that the innovation process itself is in need of innovation. Experience has taught him to start by seeking out people with the courage to kick-start developments. "People like Merle de Kreuk, Douwe-Jan Tilkema [head of the water purification sector at the Veluwe Water Board, ed.] and Jacques Leenen [STOWA Director, ed.] had the courage to persist in the face of setbacks. That's crucial, because there will be many more obstacles to overcome." (JW)

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Helle van der Roest: "Innovation always involves setbacks."

<<

Purification in three phases
In the granular sludge technique, all the purification processes take place in a single reactor tank that is periodically filled and emptied. The total purification process takes three hours and consists of three stages.

PURIFICTION USING GRANULAR SLUDGE

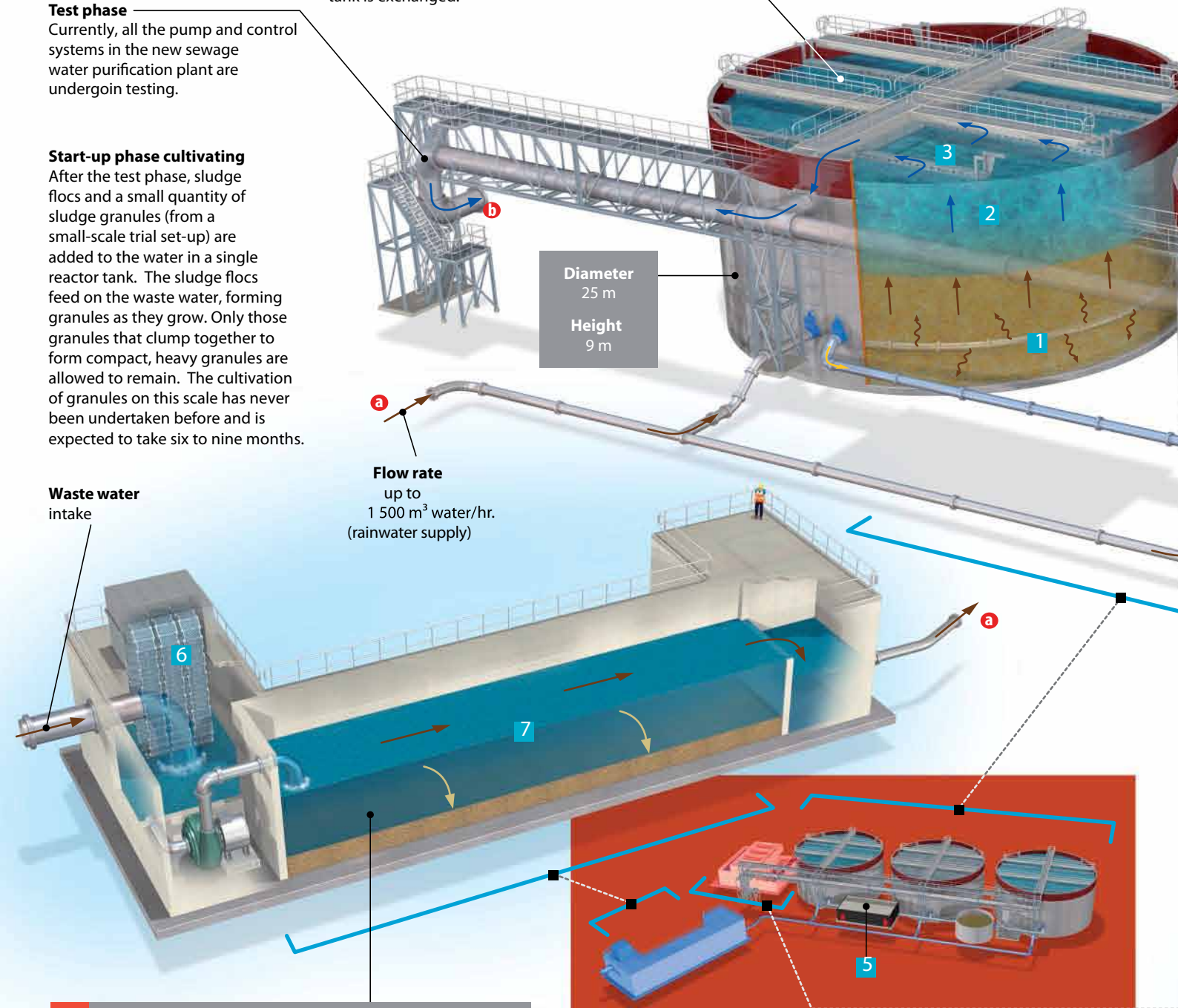
1 **Filling and draining** — **1 hour**

The reactor tank is filled 1 with waste water from below. The granules remain at the bottom while the rising waste water propels the clean water 2 out of the reactor. The key is adding the dirty waste water in equal amounts without creating turbulence, which would cause the dirty water to mix with the clean water. The purified water flows away through a network of drainage gutters 3. In each purification cycle, 25-50% of the contents of the reactor tank is exchanged.

Sludge granules
The innovative Nereda® water purification technology uses sludge granules rather than floccular sludge. Sludge granules sink far more rapidly than sludge flocs, enabling the separation of the granular sludge and purified waste water to occur in the reactor tank itself. There is no need for large sedimentation tanks.

Test phase
Currently, all the pump and control systems in the new sewage water purification plant are undergoin testing.

Start-up phase cultivating
After the test phase, sludge flocs and a small quantity of sludge granules (from a small-scale trial set-up) are added to the water in a single reactor tank. The sludge flocs feed on the waste water, forming granules as they grow. Only those granules that clump together to form compact, heavy granules are allowed to remain. The cultivation of granules on this scale has never been undertaken before and is expected to take six to nine months.



0 TRADITIONAL PRE-TREATMENT

Screening filter & sand and grease trap

Screening
The waste water passes through a screening filter 6 (with 2 mm holes) that removes any undissolved substances, such as plastic and wood, from the water.

Aerated sand and grease trap
The water flows through a shallow container 7 . Aeration generates vertical whirlpools in the water forcing the sand to the bottom of the container where it remains. A scraper collects particles of fat and grease that remain floating on the surface.

Construction of new plant in Epe

The world's first, full-scale sewage water purification plant that will purify waste water using aerobic sludge granules has been constructed in Epe. The purification process starts with pre-treatment, followed by biological purification using sludge granules, and ends with the final treatment. The waste water that arrives is always sent to one of the three reactor tanks in the filling phase, making it possible to have a continuous stream of household waste water. With its new plant in Epe, the Veluwe water board can biologically purify the waste water from 59,000 residents every 24 hours.

PURIFICATION USING GRANULAR SLUDGE

2 Aeration

110 minutes

Aeration plates at the bottom of the tanks are used to add oxygen 4 to the water. The sludge granules mix throughout the whole reactor tank. The bacteria in the granules break down the pollution in the water The three compressors 5 that compress the air account for most of the energy consumption in the purification plant.

ADVANTAGE

75% reduction in surface area

The concentration of bacteria in a granule is greater than in a floc, which means that pollution is removed more effectively. It is therefore possible to use a smaller reactor tank. No large sedimentation sinking tanks are required, either. Consequently the capacity of existing plants can be increased without the need for extra land.

ADVANTAGE

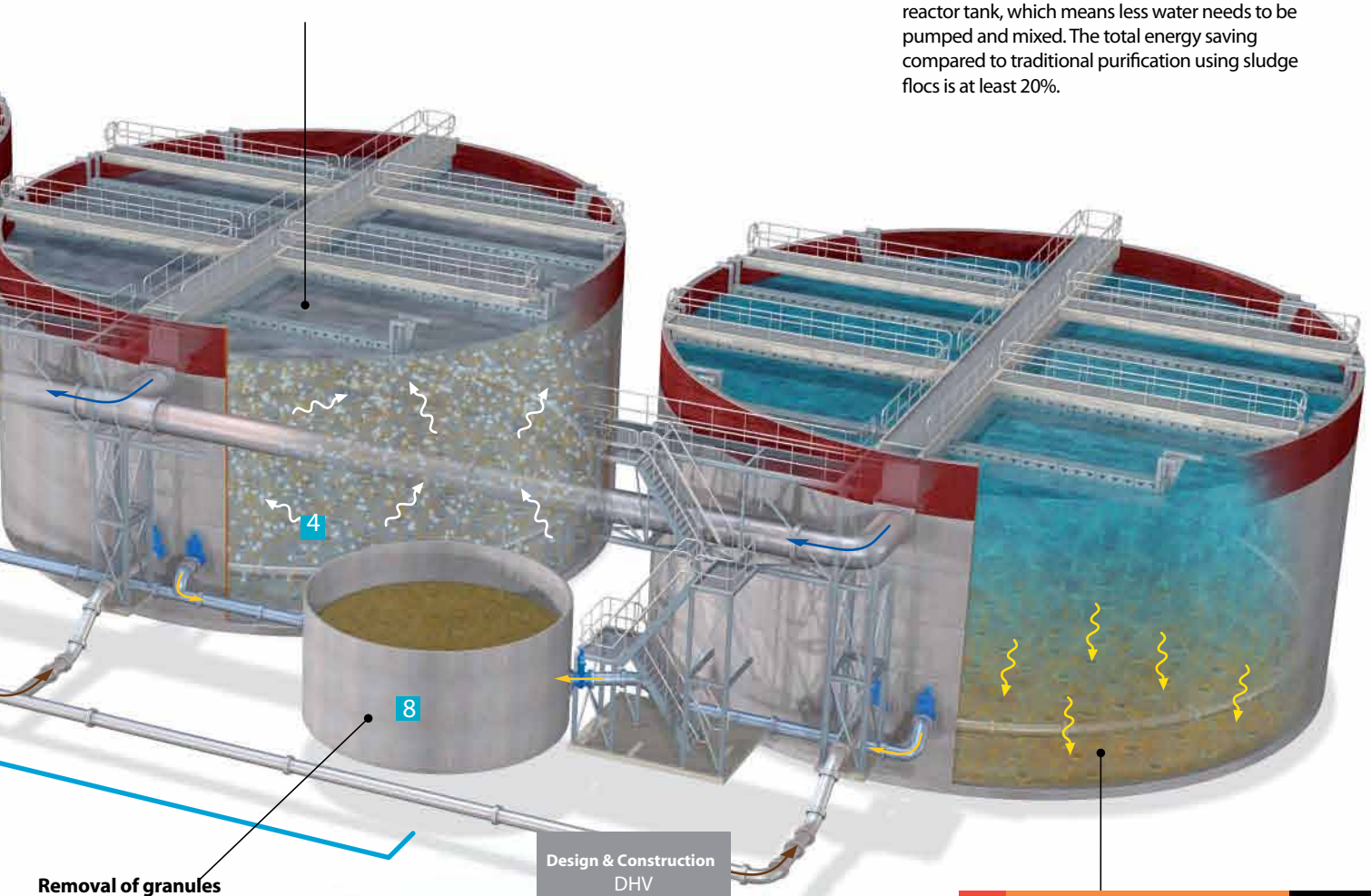
20% reduction in construction and operation costs

Construction and operation costs for the compact and relatively simple reactor tank with only one compartment are significantly lower than for conventional purification plants.

ADVANTAGE

20% reduction in energy consumption

All the stages of purification take place in a single reactor tank, which means less water needs to be pumped and mixed. The total energy saving compared to traditional purification using sludge flocs is at least 20%.



Design & Construction
DHV

Costs
15 million euros

In operation in
2012

Removal of granules

Because the bacteria eat waste materials, they continue to grow. For an optimum effect, the concentration of granules in the reactor tank should not be too high. Sludge containing sludge granules is periodically drained into a sludge tank. 8 The sludge is then mechanically thickened, dehydrated and taken to a waste processing plant

PURIFICATION USING GRANULAR SLUDGE

3 Sedimentation

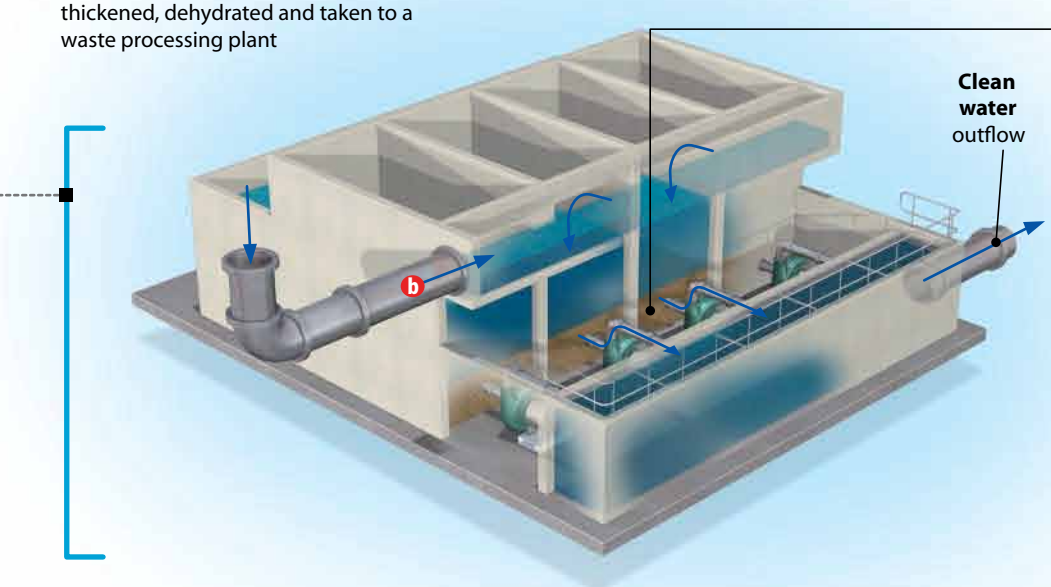
10 minutes

The relatively heavy granules rapidly sink to the bottom. The process repeats itself from phase 1.

TRADITIONAL FINAL TREATMENT

4 Sand filtration

Sand filtration is used to remove the remaining dust and residual phosphate and nitrogen. The addition of a (chemical) flocculating agent causes the residual substances in the water to clump together so that they can be filtered out more quickly and effectively. The water flows down through a sand bed. Any impurities larger in size than a grain of sand are retained. There are pipes under the sand bed with holes that allow the water to pass through, leaving the sand behind.



Clean water outflow

Driving in a womb

Drive thousands of kilometres on just a litre of fuel? During the annual Shell eco-marathon at the end of May, schoolchildren and students – including a team from TU Delft – demonstrated that it can indeed be done.

Photo's Tomas van Dijk

Jasmijn Kok can hardly see anything through the small window.

Jasmijn Kok flashes past silently, with her sneakers pressed against the window in the rocket-shaped vehicle. Just behind her head are the hydrogen tank and fuel cell, with an output power of 60 watts (no more than a light bulb). In her hands - somewhat dehydrated by her salt-free diet to maintain the right weight - she holds a stick, which she uses to steer the vehicle and operate the cruise control. The Bachelor student in Architecture is surrounded by other futuristic-looking vehicles. Now and then, a lady fires her combustion engine and accelerates (nearly all the drivers are girls, weighing around 50 kg). It sounds as if a lawn mower is passing.

The noise detracts a little from the surrealism, but just a few seconds later silence returns to the EuroSpeedway race track in Lausitz, Germany.

Here, some 200 vehicles developed by schoolchildren and students from all over Europe are racing laps powered by conventional fuel, such as diesel, solar power, electric battery, or hydrogen. They have 51 minutes to complete eight laps (25.5 km), using as little energy as possible. The records are astronomical. The Tera TUGraz (Austria) team, driving a battery-powered vehicle, clocked up the highest score of all: 842.5 km/kWh. Converted to the energy equivalent of a litre of petrol, that is 7495 kilometres to the litre.

Faster

Team manager of TU Delft Ecorunner, Thijs Bouquet, shouts down the phone, telling Kok to go faster - "60!" - but it's a bad connection. A colleague holds up a sign showing her the speed, but the dozens of students hanging over the railing near the pit lane, cheering, filming and gesturing wildly mean that Kok may not have even seen the sign. She can't see a thing through the tiny window at

her feet. Kok: "It's just like sitting in a womb."
This is the TU Delft student's second attempt in the 2011 race. Each team has five chances.
At their first attempt, the vehicle came to a standstill just 50 metres from the start. "The fuel cell couldn't generate the necessary power to accelerate and it stalled," explains Master's student, Jayakrishnan Harikumaran (EEMCS).
The TU Delft team also took part in 2008, driving the equivalent of 2282 km /l. The smart aerodynamics used should help to break that record this time around. The students are aiming for 3000 km/l. "I think even 4000 km/l is possible," Harikumaran says.
The Ecorunner is longer than most of the other vehicles and, according to calculations, the airflow is laminar along practically the entire length, resulting in minimum turbulence. Bouquet is decidedly annoyed about the sticker with the Shell logo - "That ruins it." It's stuck partly with sticky tape, so it's not smooth.
The uneven surface is nothing compared to all the other technical problems the TU Delft team is about to face, however. Completing eight laps proves to be extremely difficult.
During the second attempt something goes wrong with the on- board electronics and the car fails to respond properly to the speed commands. The team hopes to compensate for this by setting a much higher speed (60 km/h). To no avail.
To make matters even worse, Kok goes the wrong way. She follows a car in the so-called 'urban concept' class. The cars in this class are less futuristic, have four wheels, doors and a seat, and their track has many more bends.
"It's amazing she managed those bends," says mechanical engineering student, Wicher Sol, glossing over her mistake. "The car has a 30-metre turning circle."
The students have all night to solve the problem and hope to be one of the first in line for the measuring stations next morning, where fuel marshals check all the meters and fuel gauges. It is always very hectic there so important to get there early.

Stress

Next morning, however, it turns out there's a leak in the compressor supplying oxygen to the fuel cell. The students did not discover this until the morning because, like all the other hydrogen teams, they had had to hand in their hydrogen tank the previous evening. They are at the end of their tether, having barely slept for three days. They try to seal the leak with superglue and sealant. "We need stronger stuff," Harikumaran shouts as the fuel marshals' clock ticks away. They have another two hours before the track closes.
While the leak is being sealed, the students gradually realise that an even bigger underlying problem is lurking in the electronics.
The stress caused by the Discovery Channel camera crews following the team is pushing them to breaking point. "Could you please stop filming for a moment?" asks aerospace engineering student, Jac van Egmond.
Prior to the race, Bouquet had warned there could be disappointments. They were unable to test drive the vehicle due to a problem with the suspension. A Shell PR worker also tried to do some damage control. Just before the start of the event, she pointed out that there were other interesting Dutch teams participating besides the hot favourite from TU Delft, including the Hydro Cruisers from The Hague University of Applied Sciences (which eventually won in the 'hydrogen urban concept' class).

The rocket shaped Ecorunner uses up the same amount of energy as a lightbulb.

Frenchman Mickael Ducamp, of the Polyjoule team from Nantes Polytech, is not at all surprised that things have gone far from smoothly for the TU Delft team. He dropped by the Delft team's tent and, together with a colleague, offers some advice.
"We also encountered all sorts of problems in the first years that we participated," explains Ducamp, whose car is also hydrogen-powered. "Just like the TU Delft team, we bought our electronics from manufacturers. But then it's hard to find the cause of any problems. Now we make everything ourselves."
Polyjoule is the undisputed champion in the hydrogen

Completing eight laps proves to be extremely difficult

class. This year their vehicle achieved the equivalent of 5136 kilometres a litre, breaking their own 2010 record of 4896 kilometres.
"Their result is quite bizarre," Bouquet says of the French. "They beat 80 percent of the plug-ins." Mechanical engineering student, Philip Rabe, explains what is so unusual about that. "Hydrogen cars have to convert hydrogen to electricity. We can achieve an efficiency of 60 percent. Battery-powered cars have an efficiency of a 100 percent, which they get for nothing."
By now, the marshals' clock has reached zero. The students sit with reddened eyes, some of them with their heads between their knees.
Bouquet and some of his colleagues plan to take part again next year. "If we can spend a year tuning, it could be so much better." (TvD)

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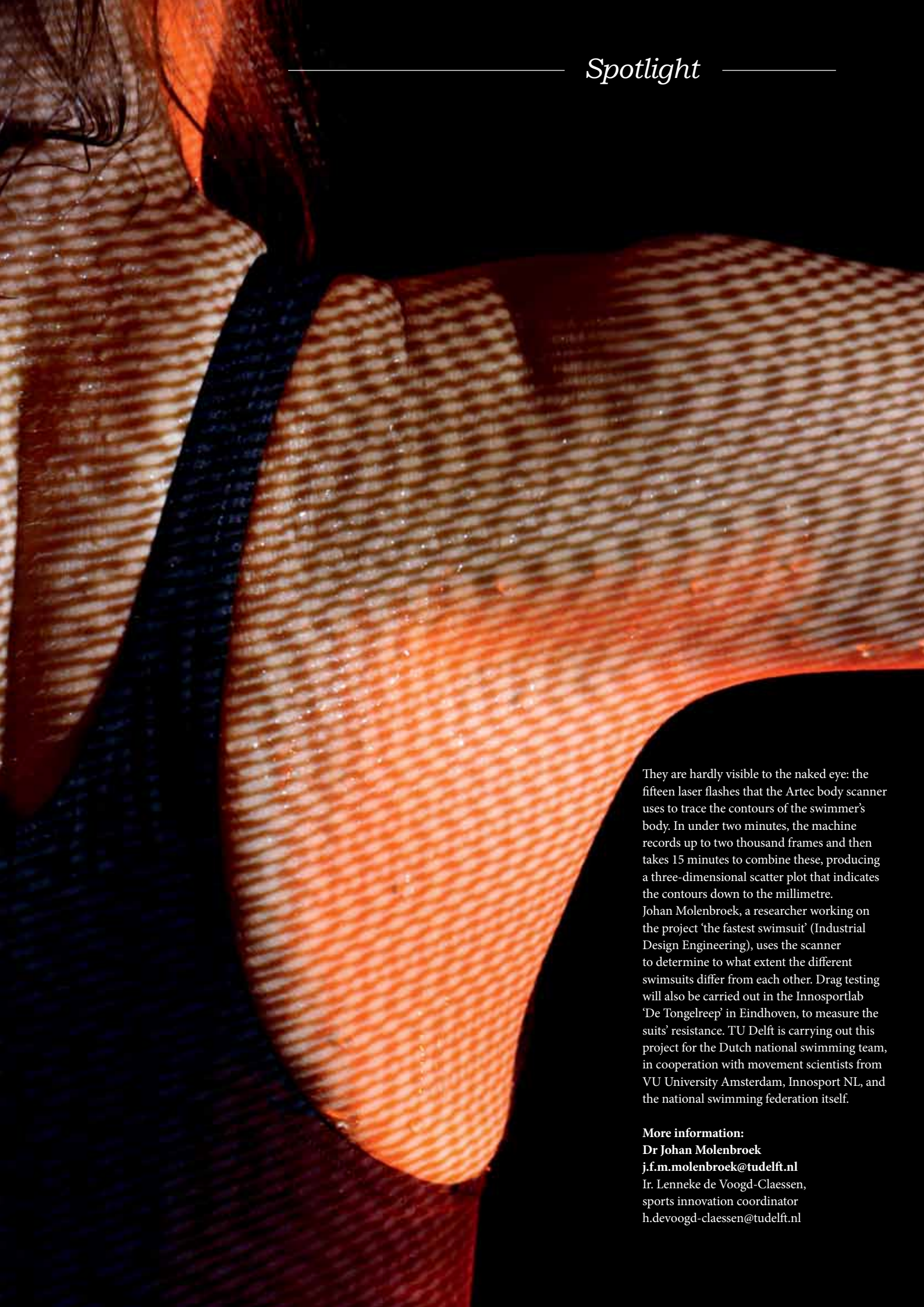
Photo: Sam Rentmeester/FMAX



They are hardly visible to the naked eye: the fifteen laser flashes that the Artec body scanner uses to trace the contours of the swimmer's body. In under two minutes, the machine records up to two thousand frames and then takes 15 minutes to combine these, producing a three-dimensional scatter plot that indicates the contours down to the millimetre.
Johan Molenbroek, a researcher working on the project 'the fastest swimsuit' (Industrial Design Engineering), uses the scanner to determine to what extent the different swimsuits differ from each other. Drag testing will also be carried out in the Innosportlab 'De Tongelreep' in Eindhoven, to measure the suits' resistance. TU Delft is carrying out this project for the Dutch national swimming team, in cooperation with movement scientists from VU University Amsterdam, Innosport NL, and the national swimming federation itself.

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‘A building kissed back to life’

Karin Laglas has been Dean of the Architecture Faculty since January 2011. She sees the wide-ranging nature of the faculty as a strength, but would also like to reduce ‘fragmentation’.

‘The honeymoon is over’, was the title you gave to your column in the faculty newspaper B-nieuws. How are you finding things after your first months as Dean of Architecture?

“I really like it here. It’s a great group of people to work with. Everyone is really enthusiastic about their subject; they simply radiate positive energy and have a certain drive. There is an excellent atmosphere within Architecture, partly thanks to the people, but also because of the building. There’s always something going on. It’s a very pleasant place to work and to be in.”

What is it that makes the building so great?

“It’s called BK City and it actually does function like a real city. The street is the place where you bump into people and the espresso bar is a key meeting point.”

That is where the important things happen.

“Yes, an amazing number of things are organised: lectures, exhibitions... things with a real focus on architecture. At the same time, the building is an example of one of the most important architectural tasks we are presently facing: making existing construction ready for a new future. BK City is an excellent example of that. When I was a student here, it was the main building and I can still recall having maths lessons here. When I think of what it used to be like, it’s simply amazing what has been achieved. I think it’s an extremely communicative building. There are lots of students in the building, because we encourage them to work here. The result is a place with real dynamism and movement.”

In your column, you also wrote: ‘Let’s build on what we already have: cherish those areas in which we excel, such as critical self-reflection, with some added focus here and there: streamlining, eradicating duplication, reducing fragmentation, tidying up disorder and maybe stopping something if necessary.’ In what areas does Architecture excel?

“What really impresses me is that Architecture spans the whole of the practical world of the built environment. I come from this practical world rather than from academia and if you look at how you work together to shape the built environment, it’s all about designing buildings, designing the city and the construction techniques needed to achieve this. And it’s also about the process: how do you get all the processes in order and ensure that the design is actually realised? These four elements are clearly and effectively catered for in our faculty, both in the study programmes and the research. I see that as a major strength: the fact that we can offer the whole package. This also means it’s possible to switch between the main elements; to teach students that various different roles are involved in the built environment and show them how these work together. It’s important to remember that although we may be an academic programme, we are also one of the programmes that the law designates as a vocational programme, in the same way as medicine or a pharmacy degree course.”

The faculty struggles a little with this, the fact that architecture is a vocational programme - and therefore not academic – and yet is still expected to conduct academic research.

“Exactly, and according to the research visitation, we don’t do at all badly at academic research. The general assessment is good. We also prepare people for a profession, but of course in an academic way. And as I always say: it’s not just about people learning something and how to apply it, but also that they advance it and develop it further. Ultimately, it’s about teaching students critical reflection. You see it in the graduation project designs and in practice in buildings about which you can clearly say: that building goes beyond the application of existing knowledge, it actually adds new knowledge as well.”

The OTB Research Institute for the Built Environment is being merged with Architecture. I believe that this was because OTB focuses more on research and less on teaching. Architecture, on the other hand, does a lot of teaching and less research.

“We do conduct research and it is rated highly. We are also the faculty with the most students, which could explain the particular focus on teaching. This is almost inevitable. And it’s true - OTB does hardly any teaching and conducts a lot of research. All of this makes the merger an attractive prospect. It would be good to link the academic aspect to our more vocational focus. I don’t think there is any contradiction there. Some people believe there is, but it’s not actually the case. The two areas complement each other. And, of course, the main reason we’re merging is because of the overlap in terms of content.”

In your column, you wrote that Architecture needs to focus more.

“I don’t have any precise plan outlining the areas on which we need to focus, but when you see the wide variety of activities here, I do sometimes think that we could be more selective. In some ways, it’s an attractive prospect adopting a wide approach to everything and offering lots of choice, but it is also good to focus on a few specific areas. Take our activity programme, for example. We offer a wide range of lectures and symposia. Some of these things could be merged, making them attractive to a slightly wider public. Or you could focus on a particular theme. The same is true for the minors. Couldn’t we offer slightly less choice? Engaging in a wide range of activities is

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'Architecture spans ***the whole of the practical world*** *of the built environment'*

always a strength, as well as being enriching. But on the other hand, if you do too many things, the range can become too wide. Within Architecture, I've noticed a tendency to actively seek out breadth. I think that the breadth of the faculty is a strength; it's not that I'm going in there saying that we should stop doing any one thing in particular. I have no new grand design – I just want to focus within what we're already doing. And so we come to reducing fragmentation: we do offer a huge number of subjects."

Hence the need to eradicate duplication and tidy up disorder?

"Yes, I think there can be strength in combining things. That this prevents students hearing the same thing twice. That's not always a bad thing, but you should try to prevent repeating things so much that they just become dead weight. You can reduce fragmentation by merging things, by creating greater wholes that unite a number of the smaller subjects and bring them together. This is the kind of thing that we're currently working on. We're starting with the Bachelor programme. As a new population of students arrives, let's aim to offer them a good basic programme. But we're not trying to do everything at once. So we'll take a closer look at the Master phase a little later on."

Is this your way of approaching the review?

"The things that I've mentioned are lenses - perspectives - that we've applied in approaching the review."

Is there anything in the faculty you feel should be radically cut?

"The four elements mentioned - designing the building, designing the city, the technological aspect and the process aspect - is there anything there that we feel we should no longer do?"

Your answer is probably no.

"That's right. We have also discussed this with our management team. I actually think that the breadth is a strength. That is the starting point for the review. Then we can start to consider what is still appropriate today? Or better: what is appropriate for the future and what may not be? Can we combine things more effectively? Merge things? We need to be aiming to survive on more modest funding. The decision has to be content-based. We should end up with a faculty in which we are doing good things together. In my view, you should never make cuts purely for the sake of it."

It can't be easy becoming dean in the middle of a cost-cutting programme. You have to deal with lots of people who are losing out.

"Of course that makes it more difficult. But I would like to qualify that on two counts. Firstly, we have quite a lot of people on the verge of retirement. So there is scope to implement changes without making any direct redundancies. That gives you room for manoeuvre in terms of policy. It doesn't mean that everyone who is retiring won't be replaced. On the contrary, but it does give you more choices. Secondly, the enrolment quota means that we will have fewer students. In 2014, we expect to have around 2,500 students instead of 3,300. Of course, that has an impact on the teaching load. Our design teaching is very focused on the individual. We work with small groups and we intend to maintain the group size. That means there'll be fewer groups and fewer teaching hours. That can be useful for the review. But it will still be a considerable operation."

And what about the € 25 million for Architecture that the ministry would like back?

"The original intention was for us to move into this building temporarily. Now we're staying permanently - there is quite a lot of work to be done, on the insulation and the acoustics. In my opinion the € 25 million was intended to create an icon, and that is what we did. If anything is an iconic building, this is. It's regarded as such by the professional world and we're about to be awarded a major international prize: the Europa Nostra. Right now, building conversion is a hot issue. This is something that we've achieved here extraordinarily well and – I feel free to say as I wasn't personally involved – truly iconically. So I would say: how more iconic do you want it to be? I do believe that as far as building conversion is concerned, this building has been kissed back to life."

You are a great lover of literature. What do you enjoy reading?

"I read a lot of specialist literature and am a real fan of Jeannette Winterson. She's an English writer: beautiful use of language and lovely stories in the 19th-century narrative tradition, but written in a really contemporary way. It's almost poetry. Yes, I love to read. At the weekend, I live in Friesland, where I have my vegetable garden. I spend my weekends reading, gardening and sailing on the Frisian lakes. We have a Frisian yacht: it's an oak ship dating from 1895 with leeboards. It's superb!"

Who is Karin Laglas?

Professor Karin Laglas (1959, Rotterdam) studied Civil Engineering at TU Delft and later held management positions with property development companies MAB and OVG and property investment company Rodamco Europe. Last year, she was acting director of BNA (Federation of Dutch Architects). She is also a member of the Supervisory Board of the WestFriesGasthuis hospital; a member of the supervisory board at Twynstra Gudde; a commissioner at the Netherlands Forum for Urban Renewal; and a member of the Amsterdam City Forum.

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A battery charger with feelings

Many of Crijn Bouman's friends were sceptical when he launched his company, Epyon, which develops fast battery-charging systems. 'Electric cars are for hippies,' they claimed.

Photo: Sam Rentmeester/FMAX

"The thing accelerates like you wouldn't believe," warns Crijn Bouman, a second before he hits the start pedal. In around five seconds, the speedometer is already notching up 100 km/hr. "But the real magic is that it can charge the battery for just 4 or 5 euros. I recently drove 260 km with just a single quick charge in-between."

The battery: that is what Bouman is interested in. Epyon, the company he founded in 2005, produces the fast chargers it requires. Currently there are just a few of them, spread across the entire country. But that number is set to grow quickly, expects Bouman, who graduated in IDE in 2006. "It was announced at the AutoRai that there will soon be a network of 25 of our fast chargers," he explains. The companies involved are BP, Nissan, Taxi Prestige, Liander and Van der Valk.

"People used to tell me that electric cars are for hippies," recalls Bouman. "But electric driving is not something of the distant future. It's already the subject of some major investment."

At the Epyon company building in Rijswijk, the second fast charger in the series of 25 has just been secured to a truck, on its way to a BP petrol station in Delfgauw. Drivers of electric vehicles will soon be able to charge their batteries there up to 80% in just 30 minutes, massively increasing their potential range.

These are exciting times for a business that has developed into a company with dozens of staff and millions of euros in turnover. Last year saw a number of Japanese car manufacturers agree on a standard for the charging process, and this has resulted in a steady increase in demand. This week, Epyon will put the final touches on three systems intended for the Dutch and German markets. "Our aim," says Bouman, "is to be installing five chargers per day in five different countries by the end of this year. If we do well this year, we are set to become the market leader. Except in Japan, of course, where they are much further ahead. But Japanese companies manufacture exclusively for the Japanese market."

Until 2007, Bouman and his colleagues were still trying in vain to conquer the market with fast-charging systems for mobile telephones. "We spent six long years of research and have numerous patents that we can use." This research is still continuing. In a specially set-up room, dozens of batteries from different manufacturers are being charged under different conditions.

"The secret of the fast charger is not really the hardware," Bouman explains. "Our patents relate mainly to the software. This is because the charger and the vehicle have to communicate continuously with each other, if the battery is to be charged efficiently. Every millisecond, the fast charger asks the battery: how are you feeling now?" (TvD)

New gas, new opportunities?

Reports regularly appear in the news about shale gas: gas extracted by a process known as fracking. This could more than triple the global supplies of available natural gas. In the Netherlands, the first test drilling was viewed with suspicion.

"In the US, the extraction of shale gas has really taken off in recent years," reports De Volkskrant (28 February 2011). "Drilling rigs to force the gas out of the ground are sprouting up all over the country."

Geotechnology professor, Stefan Luthi (Civil Engineering and Geosciences), explains the process, which involves drilling into deep layers of rock containing hydrocarbons. A small portion of these has remained sealed between layers of rock in the form of natural gas. Prof. Luthi: "We already know about Slochteren, but there is likely to be much more gas contained in the underlying rock."

To extract it, a hole is first drilled vertically to the right depth, followed by a series of horizontal drillings in the source rock. Special trucks then pump the rocks with water, sand and chemicals at such high pressure that the rock fractures, releasing gas that spontaneously flows upwards. This can take anything from a few days to a few years.

In the US, the waste water is often disposed of in wastewater treatment plants and then ends up in the rivers. This is where the problems start, because radioactivity levels in the rivers have recently increased significantly.

This is caused by radium, which Prof. Luthi says, is very common in certain parts of the granite rock in the US. Radium is a decay product of uranium or thorium. When radium itself decays, the radioactive gas radon is released.

Prof. Luthi believes that the claim in de Volkskrant that radioactivity could be released during test drilling is "scaremongering". The ground in the US is completely different to that in the Netherlands, and on the subject of radon, he says: "In rocky ground, there is always some gas that emerges through fissures in the rocks. It also happens in Switzerland, but you don't hear hikers complaining about it."

If radium does find its way into the wastewater, Professor Bert Wolterbeek from the Reactor Institute (Applied Sciences) believes that it can be easily filtered out. "Chemically, radium is similar to calcium. If it is possible to decalcify, you can also remove radium."

Prof. Luthi does not envisage large-scale shale gas extraction in Europe. It is an expensive method and environmental legislation will place limits on fracking because it uses too much water and involves pollution. (JW)

Life after Delft

Realist

Joris Thijssen (37) is campaign director at Greenpeace, where he started as a volunteer during his aerospace engineering studies.

Photo: Sam Rentmeester/FMAX

After two years of aerospace engineering, Joris Thijssen had had enough of the TU Delft techies. His passion has always been space travel, but he decided to take a gap year and travel to Australia, Hong Kong and Canada. This was to prove decisive for his future career.
What he saw and experienced on his travels got him thinking about mankind and the planet. "I asked myself if what we were doing was really sustainable."
Back in Delft, Thijssen decided to do something useful with his spare time. He became a Greenpeace volunteer, working as a campaigner and spokesman in The Hague. Back then, he didn't know that much about the organisation. "But from the start I liked the fact that Greenpeace does its homework first, then talks, and, if that doesn't help, starts campaigning."
He was personally involved in numerous campaigns, against fossil fuels at the Shell AGM, against nuclear fuel reprocessing and radioactive waste dumping at sea and against oil spills in Russia.
After volunteering for some time, Thijssen went on to become a paid Greenpeace campaign leader, a position he held for nearly nine years. "This meant a change in roles for me. Instead of chaining myself to things, I became a media spokesman and contact for the media and industry. I went to any legal proceedings that were initiated. The decision of whether to leave or to continue was in my hands. These negotiations were usually pretty tough."
After his time as campaign leader, Thijssen spent a year in China advising the local Greenpeace branch on how to expose such abuses as the use of dangerous pesticides. "They taught me about China, and I taught them how to campaign." Via Greenpeace International, where he spent two years supporting the 40 local offices, Thijssen returned to the Netherlands in 2009 to become head of the campaign department.
Would Thijssen call himself an idealist? "Knowing that 90 percent of North Sea fish populations are overfished, I can carry on eating fish, but that means my child won't be able to. I can also wait until the fish stocks have recovered. Does that make me an idealist? I'd say that makes me a realist." (SB)

The View

A factory at home

Professor of process intensification, Andrzej Stankiewicz (3mE), believes that by 2050 we may have small-scale food, chemical or energy factories at home.

A thick chunk of pasta disappears into a mould. Weird electronic noises and the sound of moving presses resonate from all directions. And… kerplunk: a freshly-plucked chicken emerges from the mould. Chickens, trout, cauliflower: this is how all food is created in the 1976 Louis de Funès movie, 'L'aile ou la cuisse'.
Is this how Professor Stankiewicz envisages the future? The professor cannot help but laugh, as he knows the movie. "That food is terrible."
Prof. Stankiewicz believes that it may be possible in the future for all of us to have a machine at home, like a small factory, for making our own food. "You'll load it with a type of flour, vegetable oil and flavourings and a type of meat will emerge. We'll also be able to have another small factory at home to convert household waste into energy."
But his vision goes much further than that. "In the future," he says, "we'll also have personalised medicine. Your genes will be analysed to determine the type of food and medicines that are best for you. And after a detailed blood analysis, it will also be possible to choose to add specific substances to your food. If your magnesium levels are particularly low today, then you can simply add a little magnesium to your food."
He explains that his ideas are also shared by his colleagues in process technology. Last year, the Delft professor brought together 30 leading scientists to pool their ideas on long-term developments in process intensification. The discussions (dubbed the Delft Skyline Debates) resulted in 14 technological milestones for 2050, including the examples above.
The researchers also believe that we will be able to recycle scarce elements from waste in 2050 by growing plants (known as hyperaccumulators) on waste sites.
The scientists have outlined their visions and the necessary stages of research leading up to them in their report entitled, 'Research Agenda for Process Intensification'. The report is being used to secure research grants.
In this framework, Prof. Stankiewicz's research aims to improve the efficiency of chemical reactions. At the end of last year, he received an ERC Advanced Investigators Grant worth €2.3 million from the European Research Council to fund his work.
"The chemical reactors used today do not give you enough control over the molecules," he explains. "I aim to create a 'perfect' reaction environment in which we can control the geometry of the collisions between molecules by using electromagnetic energy fields and laser beams."
The scientist is also involved in research into the production of synthetic meat in alliance with Wageningen University. "There's no need to worry," he says, referring to the Luis de Funès movie, "in Wageningen, there is already a company that produces synthetic meat and fish products using vegetable materials. You really can't tell the difference." (TvD)

Column

Superbike

Tonie Mudde (1978) studied Aerospace Engineering and is a science journalist and writer. His work has been published in Quest, nrc.next, Het Parool and de Volkskrant newspapers and elsewhere. In 2009 he was awarded a Tegel, the annual prize for journalism. Last year saw the publication of his debut novel, Spaghetti Spoetnik.

When Delft students set to work on a futuristic vehicle, it's always an interesting prospect. This time it's not a solar car or even a Superbus but rather a recumbent bicycle with an aerodynamic cover. This summer, on a plateau in America, the Human Power Team Delft will attempt to set a world speed record. Wind tunnel trials show that the superbike should be able to achieve speeds of 140 km/hr.

Suddenly I'm hit by a vision of the future… I see a green, congestion-free Netherlands, full of commuters in superfast superbikes, whose composite covers will keep our jackets and suits dry, obviating the need for raincoats. Amsterdam to Utrecht? Just 20 minutes pedalling from door to door.

I put in a quick call to project manager Hajo Pereboom from Human Power Team Delft. How much would the superbike cost if it was mass produced? 6,000 euros, is his estimate. Just try buying an electric car for that price. But the superbike does come with some important instructions. When moving from a stationary position, you need someone to push you or you'll topple over. It's also forbidden to cycle when there is a strong side wind.

Photo: Sam Rentmeester/FMAX

But where there is a superbike, there is a way. With a few minor adaptations to the design, it will be possible to create a city version, with a third wheel for additional stability and a child's seat under the cover. Although these extras may reduce the speed, but 80 km per hour on the cycle lane is still not to be sneezed at.

I do wonder, though, why the recumbent bicycle has never taken off in the past, as such bikes have been breaking speed records from as early as 1934. On my route to work, all the seated cyclists have to give way to the one 50-year-old man in his bright yellow recumbent bicycle. Why does no one follow his example? "I think the recumbent bicycle may be suffering from an image problem," Pereboom says.

Could that be it? I decided to take a look the next time I saw the recumbent cyclist on my way to work. Yesterday, he appeared behind me again. From high on my saddle I looked down upon him as he passed. With his legs pedalling at the front and his head against the handle bars…you may be the fastest on the cycle lane but you still look like a toddler on a go-cart.

But surely there is something you can do about this? Pereboom: "It's a case of waiting for a good designer to integrate an iPad under the recumbent bicycle."

In other words, the real mission is to create a superbike that looks irresistible to the general public. If someone smart at TU Delft put their mind to it, the recumbent bicycle could easily take over the country. Even more quickly than the solar car and Superbus, perhaps….

Under construction

Foto: Sam Rentmeester/FMAX

The Aula building will be undergoing renovations in the June-August period. The spaces to be renovated include the Senate Hall, the Van Hasselt Hall, the Robing Room, and the Committee Rooms. The glass in the north facade will be replaced and painting work carried out. During the renovations PhD defence ceremonies will take place at the Science Centre on Mijnbouwstraat, as it offers all the necessary facilities: a defence hall, robing room, committee room and a reception area.

Living in a lab

Once a place where thousands of trainee physicists studied, the Technical Physics Laboratory is now home to 95 students. "It's like living in a castle."

Around 45 years ago, Professor Emeritus of physics, Professor Tuinstra, was one of the last students to be found working towards his graduation in the monumental Applied Physics Laboratory of the Technische Hogeschool Delft. "The new Applied Physics building at Mekelweg was already in use at the time, but the equipment I needed to conduct X-ray diffraction experiments was still in the old laboratory. It was also where I gave my very first nerve-wracking lectures."
The characteristic building with its high tower used to make a deep impression. "The students were particularly impressed by the tower. My fondest memory of the building is of when they attached a Foucault pendulum right at the top, which then swung back and forth just above a beautiful compass rose on the floor."
To the very end, the building was full to bursting with large numbers of students. "Several research groups shared facilities," Professor Tuinstra recalls. "For example, one of the labs was split in two with a dividing line marked out on the floor. If you didn't keep to your own half you would hear about it."
Generally, Prof. Tuinstra found it a "remarkable building", with a "church-like appearance." The ceilings of the lab were 5 metres high or more. "In later years, spaces were subdivided, creating two separate floors. Fellow students told me it was perfect for eavesdropping. For an oral exam, you had to wait downstairs with the secretary. There you could hear the answers the student before you was giving to the professor quite distinctly. Many students were able to take advantage of that."
Initially, these high ceilings caused student accommodation provider Duwo some headaches, too. The question was how to divide up a building with such high ceilings. Duwo, and architects firm KBNG, decided to make full use of this height. "The solutions were dictated by the existing dimensions and structure of the building," says Joost Mulder, a Duwo spokesman. The construction costs were approximately 8,750,000 euros.
Each classroom was turned into two to three student flats. This means the apartments have ceilings that are 5 metres high, so there is room for a mezzanine that serves as a bedroom. "Some of the rooms retain the original furnishings. If you rent a room in the former prep room, you still have the original cupboards," says Mulder. "The windows at the rear of the building are different from the front. Generally speaking, each window corresponds to one apartment, which means that some are narrower than others." The smallest unit is 24 square metres, and the largest almost 70. The monthly rents vary between € 285 and € 550, excluding service charges of €170.
The building's age also caused major issues for Duwo and the architecture firm. The lab was built between 1917 and 1930. "There are structural issues, including cracks. It was one of the first buildings with a concrete structure. The technique of creating expansion joints had not yet been mastered. Concrete expands when it heats up and the architects were not yet able to accommodate this effect in the design. It doesn't pose a danger though, and the cracks have been repaired."
The building was also adapted to modern living and construction requirements in other ways: the external window frames were partly replaced and special new glass was installed. "This single-glaze glass provide a better degree of insulation than the old single-glaze panes. As it is a listed building, we have preserved the original detailing."
Some of the spaces have not been converted to flats, including the large lecture room. Its ceiling is no less than 8 metres high. "Building student flats there would have been too expensive, so it has been left as a large open space. We intend to lease it as business accommodation, and there has already been >>

Photo: Peter Odijk / Archive collection

The Technical Physics Laboratory in 1930.

Photo: Sam Rentmeester/FMAX

Student Albert Mulder lives in appartment 13 of Mijnbouwplein 11.

some interest." The library has been left in its original state, to emphasise the building's former use.
The entrance remains the most imposing part of this stately building: a monumental staircase with banisters made of natural stone. Standing at its base and looking upwards will give one a crick in the neck. "I always show visitors the staircase first. It's amazing," says first-year student in mechanical engineering, Albert Mulder (22, no relation to the Duwo spokesman), the occupant of apartment number 13. "It's like living in a castle."

If you rent a room in the former prep room, you still have the original cupboards

It makes quite a change for someone used to living in grubby old student accommodation in Arnhem and Amsterdam. "It's a huge building. I have explored all of it. What do I think about the large lecture room? I didn't know there was one. That shows you the size of the place: I'd thought I'd seen everything, but apparently not", he laughs.
Mulder was allowed to decorate his room according to his own taste. The walls are turquoise. "I needed a long ladder to paint the walls." The walls are hung with black-and-white photographs of three generations of his family and pictures of old motorbikes. Prominent features are a massive flat screen TV and an IKEA bookcase. He is well aware that Delft desperately needs these new student rooms. "There is a real shortage of student accommodation. Before I heard of this place, I had been looking for six months. I replied to countless ads, but no luck. I would rather be here than in a student hostel. I have my own bathroom and kitchen. I hope that having my own facilities will help me to study more. Apart from my neighbours, I don't know many of the other occupants." The student is full of praise for the location. "I live right between the city centre and the campus: perfect."
One of the highlights of the building is its lookout tower, with a view over the canal city. "It was one of the first places I visited. Sadly it's closed off now, a real shame."
Tuinstra is pleased to see students living in the cherished building where he once studied and gave his first lessons. "It could have been demolished. I think it's great that students are living in it: it's a building that represents an important part of TU history, which is now being preserved." (RV) <<

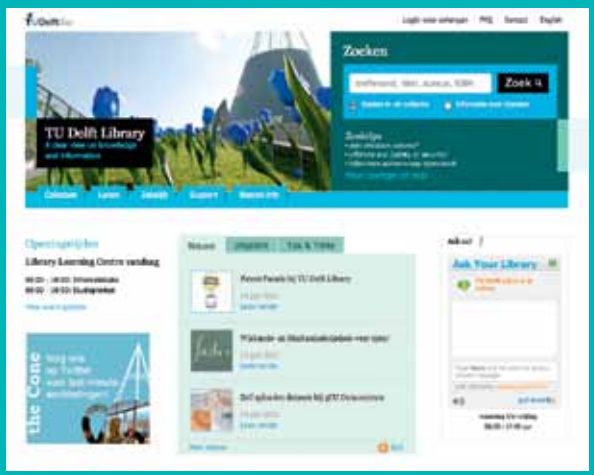
Coach Café

On 13 April, the Coach Café was held in Theater de Veste in Delft for young alumni and PhD students. TU Delft organised the evening with fellow universities Eindhoven and Twente, and with Blik-opener, a specialist career coaching organisation. The more than 50 participants were divided into groups of two or three. The groups then had a series of 3, 15-minute discussions with the coach. In these three sessions they shared their ideas on their talent, dreams and next career step. This was followed by a two-hour networking drinks reception to meet the coaches and other participants. The first Coach Café was held in Eindhoven in late 2010. The plan is for each of the three technical universities to organise a Coach Café every year. The Coach Café combines a fun evening with useful career discussions. Alumni and PhD students are challenged to be dynamic, in terms of their thoughts and actions. By sharing ideas, mirroring and reflecting, they can increase their awareness of their own talents and give their careers better direction. The evening is also an excellent way of building up a network of professionals that can prove useful in their future careers. An evaluation revealed that participants see the Coach Café as a good initiative that responds to the needs of young alumni. However, they would have liked to have more time for one-to-one discussions with the coaches. This will be borne in mind for the next Coach Café, planned for early 2012. Some of the participants have remained in contact with the coaches they met at the Coach Café. A LinkedIn group has now been set up and e-mail addresses exchanged, in order to enable participants and coaches to stay in touch.

Photo: Kevin Thomassen

New website TU Delft Library

TU Delft Library has a new website, which is easier to navigate and clearer, with a focus on searching the collection. A group of users was involved in designing the new website in order to help optimise the search functions.
See www.library.tudelft.nl.



Best advisor

A fantastic party at Ocean Diva in Amsterdam on 26 May was the setting for the presentation of the Young Professional of the Year 2011 award. This annual national award targets young professionals working in Dutch ministries or businesses. This year saw entries from 22 companies in three categories: managers, specialists and advisors. SEPAM alumna Hilde van Duijn from Royal Haskoning won the advisors category. The jury praised her nerve and role awareness, which enabled her to subvert traditional hierarchical relationships. In her young coaching initiative – in which young professionals coach the management - she took the lead in bringing about changes at Royal Haskoning. The overall winner from all three categories was IBM's Babouschka van Bilsen.

Marina van Damme grant

The next Marina Van Damme grant will not be awarded in January as usual, but rather during the Alumni Symposium on 7 October. This means that the deadline for nominations has been brought forward to Monday 5 September.
The grant was initiated by Marina van Damme, a student in Delft in the 1950s and is awarded to talented young female graduates of TU Delft. The winner must spend the grant within two years, broadening her university education and/or gaining wider international experience.
Further information is available from the University Fund, ufonds@tudelft.nl.

Gaming

Designers, policymakers, academic teaching staff and other professionals are increasingly realising that games are not only fun, but can also be useful. Games are now being developed to teach students, remind patients to take their medicine, recruit army personnel and collect data in order to improve search engines. Despite this, little is known about the way in which these games are designed. This is now set to change, thanks to the new book 'Triadic Game Design' by TPM alumnus Casper Harteveld. He presents a design philosophy in which all games are related to the three worlds of reality, meaning and play. His philosophy is based on the assumption that a balance must be struck between these different worlds.


Photo: Sam Rentmeester/FMAX

UfD-E.ON Team Work Award 2011

On 25 May, the UfD-E.ON Team Work Award was presented to the iGEM team, consisting of nine students of Life Science and Technology and Bioinformatics. The award targets TU Delft students and staff who have achieved an outstanding and special performance in a team context. Of the 13 teams that took part, four were invited to give presentations. The iGEM team designed a bacterium that can be used to combat dissolved oil molecules in water. In its assessment, the jury said: 'The four shortlisted projects are innovative, responsible and a good example of team work. The winning team successfully performed a highly difficult task, which attracted national and international media coverage. The project is particularly innovative and must be praised for effectively raising TU Delft's profile. The top prize was € 10,000 and a certificate. The other teams were awarded a consolation prize of € 2,000.


Photo: Ufonds

Best Graduate

TPM alumnus Jessica Sun has won the Best Graduates top 100 award. This contest for top talent is organised by Memory Events and 12 leading employers. Candidates must have an impressive CV to stand a chance of winning.
Sun works as a consultant at ING, completed two Master's degrees, was an active committee member and gained valuable experience abroad at the Winter Universiade in China in 2009. The top prize is an international MBA programme at Nyenrode University worth € 32,500.

Wanted: Alumnus of the Year

TU Delft is proud of its alumni and likes to communicate that fact. Alumni who have been a source of inspiration for others or made a special contribution to technology, innovation, science and entrepreneurship, could become the Alumnus of the Year. The winner will be announced at the Alumni Symposium on 7 October. In addition to a special memento, the winner will be awarded two prizes: a cash prize of € 2,500 for personal use and €7,500 to be spent on a TU Delft research project of their choice. The jury comprises the committee of the Friends of the TU Delft University Fund, under the auspices of the Rector Magnificus.
Do you know a suitable candidate for the award? Or perhaps you feel you qualify for the title of Alumnus of the Year?
Submit your nomination via the website www.universiteitsfonds.tudelft.nl or http://tudelft.nl/over-tu-delft/alumni.

Alumni Symposium 7 October

This year's TU Delft Alumni Symposium will be held on Friday 7 October and will focus on the theme of innovation and excellent research at TU Delft. Speakers from the world of science and academia, politics and the business community will be present and give their perspectives on a range of propositions relating to the theme of innovation. Further information will follow via LinkedIn, a newsletter, a personal invitation and the September edition of Delft Outlook.

Propositions

A good researcher can be compared with an excellent chef, who creates fine dishes (good results) even though the ingredients (data) are limited.
Tomohiro Suzuki, hydraulic engineer

Finally humans appreciate the benefits of micro and nanofluidics, nature has been doing this for millions of years.
Sharma Mokkapati, biotechnologist

The knowledge of public transport accessibility at the University of Delft and MIT is inversely proportional to the actual public transport accessibility of those locations.
Niels van Oort, civil engineer

According to the second law of thermodynamics, sustainability is an illusion.
Steven Weijs, civil engineer

It is called fate when the initial and boundary conditions of our life cannot be changed.
Chuangxin Zhao, engineer processtechnology

Excellent upbringing is worth ten times more than one PhD education.
Qing Ou, engineer transport

Patenting Page Up and Page Down functions by Microsoft clearly shows that the future design engineers should also be experienced lawyers.
Mojtaba Sabeghi, electrotechnical engineer

Proposition

A PhD student doing his/her research in finance is often blamed for the financial crisis.
Lech Aleksander Grzelak, mathematical engineer

Defense

That researchers in finance are being blamed for the financial crisis, is unfair, says Aleksander Grzelak, who developed models for pricing long-maturity financial derivatives. Grzelak thinks in the contrary that researchers can help mend 'the broken piggy bank'. On the cover of his dissertation, he put a picture of a broken piggy bank, held together by rope. "It's symbolic. The financial crisis was caused by greed and lack of regulations, not by failing models. But by improving the models, we, in academia, can help tie the economy back together."

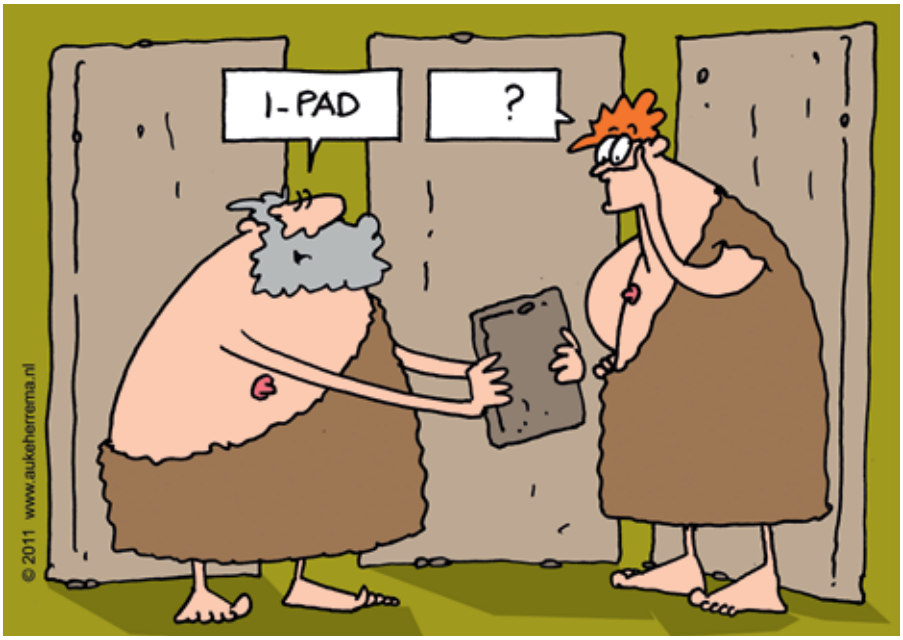
Sound bites

"Sometimes I'm accused of giving people carte blanche to consume indiscriminately by claiming that it all makes no difference in the long term. But I don't agree: I actually feel that we should do our utmost to use energy efficiently and to develop alternative sources of energy. We need to be smart, and to do smart things."
Emeritus Professor of Applied Geology, Professor Salomon Kroonenberg in de Volkskrant.

"It has long been known in psychology and economics that when people buy things they are in part driven by the question of whether they may later regret it. But until now there has never been a calculation model which companies can use to take advantage of this. This is what I have now designed: one key finding is that consumers do not simply compare one car with the others as a whole. Instead, they assess all the vehicles in terms of separate features. They look at the price, the engine capacity, the colour… you name it. They want to avoid their new car scoring relatively badly on any of these features as consumers may regret their purchase later. And that is just what companies don't want."
Associate Professor in Transport and Logistics, Dr Caspar Chorus in Algemeen Dagblad.

"The existing reactors are like pinball machines. Molecules collide at random and only a small proportion of these collisions produce the desired products. Our aim is to try to control molecules and make them like a snooker table instead. If you use laser light or microwaves as your snooker cue, you can significantly increase the effectiveness of these collisions."
Professor of Process Intensification, Andrzej Stankiewicz in Trouw.

"I won't really be living a student life, as I can't live on my own yet. I'll just be cycling to my lectures in Delft."
Thirteen-year-old Erik van den Boom, from Schiedam, about his future student life at TU Delft, in Algemeen Dagblad.



'It is imagination and not sheer knowledge that always has enriched human civilization'

Manjit Ghosh, materials engineer

In Person

Professor **Hester Bijl** (AE) has succeeded the Dean of Applied Sciences Professor Tim van der Hagen as Chair of the Delft Energy Initiative. The Delft Energy Initiative is one of the four Delft Research Initiatives aimed at improving public access to TU Delft research and making it better attuned to current social issues. Bijl holds an Antoni van Leeuwenhoek professorship in computational fluid dynamics.

Hans Krul, Secretary General of the TU Delft Executive Board, is leaving to take up a position at the Municipality of Delft. From 1 July he will take up the office of Town Clerk/ General Manager. Krul joined TU Delft in 1997 as Head of Legal Affairs. Three years later he was promoted to Secretary General of the Executive Board. The university is looking for a replacement for Krul.

Both Casper van Kalmthout (freestyle kayak) and **Robert Bouten** (canoe slalom) won the Dutch championship titles during the Kayak Festival at the Olympic-standard competition course in Zoetermeer. This was the fifth national title in a row for Van Kalmthout, who recently completed his Bachelor's studies at TPM. Canoe slalom racer Robert Bouten also won the national title. He was a five-time champion in the years 2005-2009.

From 1 July **Anka Mulder** will be the new Secretary General of the university. She succeeds Hans Krul. She will combine this task with her duties as Director of Education and Student Affairs, Head of the Review Task force, and President of the international OpenCourseWare Consortium.

Rudy Konings has been appointed professor (part time) at the Reactor Institute Delft. He will focus on improving the chemistry of the nuclear fuel cycle and the safe storage of nuclear waste. Konings combine his appointment at TU Delft with his position as head of the Materials Research Unit at the Institute for Transuranium Elements in Karlsruhe, Germany.

On 1 June, Professor **Nynke Dekker** of the Department of Bionanoscience (AS) joined the Executive Board of the Foundation for Fundamental Research on Matter (FOM). She succeeds Professor Carlo Beenakker (EEMCS). Dekker graduated cum laude at Yale and Leiden, obtained her PhD from Harvard in 2000, and set up her own research group in Delft in 2002, focusing on biophysics at the nanoscale.

TU Delft has been given a leading role in two new national research programmes subsidised by research funding foundation STW to the tune of more than 8 million euros. **Frans van der Helm**, professor of biomechatronics and robotics (3mE), will be in charge of a programme looking at improved control for robotic grippers. Han Vrijling, professor of hydraulic engineering (CEG), will be heading up a programme on multifunctional flood defences.

Jacco Hoekstra has been reappointed Dean of Aerospace Engineering from 15 August 2011. Instead of the usual four-year term, this appointment is for two years with the option of stopping after one year. Hoekstra says he misses "engaging with subjects in depth. Now other people are doing the work that I would like to do."

On 29 April no fewer than three TU Delft professors received a Royal Award. Professor **Mark van Loosdrecht** (AS) was knighted for his contribution to scientific breakthroughs in waste water treatment leading to significant energy savings. Professor **Hans Vrijling** (CEG) was made an Officer in the Order of Orange-Nassau. The professor of probabilistic design in hydraulic engineering is known for drawing attention to the safety of low-lying areas of the Netherlands and to dyke rings which are not sufficiently reliable. Professor emeritus **Salomon Kroonenberg** was also made an Officer in the Order of Orange-Nassau. In his role as scientist, writer, expert and advisor he succeeded in 'making people want to dig deeper in the field of geology', as the city of Delft put it so succinctly. And finally, MVRDV founder and Professor of Architecture **Winy Maas** received a French decoration on 9 May. He was appointed Chevalier de la Legion d'Honneur for his renovation of Les Halles in Paris and his contribution to the Grand Paris project.

Photo's: Sam Rentmeester/Hans Stakelbeek/FMAX

Who & where

Delft University of Technology has eight faculties, each of which is engaged in education and research in one or more disciplines. The University was founded in 1842 by King William II. With 13,000 students, 2,800 scientific staff members and 2,000 technical and administrative employees, it is the largest university of technology in The Netherlands.

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Multidisciplinary Centres

Adhesion Institute
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Telephone +31 15 278 5140/2342

Centre for International Co-operation and Appropriate Technology (cicat)
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Centre for Transportation Engineering
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Telephone +31 15 278 6634

Dutch Institute of Systems & Control (DISC)
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Koiter Institute Delft (Institute for Engineering Mechanics)
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Netherlands Institute for Metals Research (NIMR)
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OTB Research Institute for Housing, Urban and Mobility Studies
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Interduct Delft University Clean Technology Institute
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Advanced School for Computing & Imaging
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Trail Research School
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Central Library

Delft University of Technology Library (dutl) supplies information and provides services, particularly in the area of the technical sciences.
It comprises a central library and twelve sub-faculty libraries housed at the respective sub-faculties and institutes.
The dutl is intended for students and staff at the Delft University of Technology. However, as the task of the library is to provide scientific and technical information at a national level, its facilities are also available to the general public. As well as all areas of technology and natural sciences, the library also contains a general collection in the social sciences, economics etc.
This relates not only to books or periodicals, but also to standards, reports, reference works and congress proceedings.
Literature not in the collection or not on hand can be obtained through Delft University's Central Library from other libraries in the Netherlands or abroad.

For further information:
Delft University Central Library
Prometheusplein 1
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Delft University Press IOS Press
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Fax +31 20 620 34 19
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Information on facilities for foreign students:
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Liaison between business and research:
Liaison Office
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Information on research fellowships:
Mrs. M.Y.M. Spiekerman-Middelplaats
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General information on university education in the Netherlands:
Min. of Education, Science & Culture Central Information Dpt.
p.o. box 16375
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(Post Graduate) Courses

Delft TopTech
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www.delft-toptech.nl

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