Terra et Aqua is a quarterly publication of the International Association of Dredging Companies, emphasising “maritime solutions for a changing world”. It covers the fields of civil, hydraulic and mechanical engineering including the technical, economic and environmental aspects of dredging. Developments in the state of the art of industry and other topics from the dredging industry or professions, which are associated with dredging, are also included.

As Terra et Aqua is an English language journal, articles must be submitted in English.

Contributions will be considered primarily from authors who represent the various disciplines of the dredging industry or professions, which are associated with dredging.

Students and young professionals are encouraged to submit articles based on their research.

Articles should be approximately 10-12 A4s. Photographs, graphics and illustrations are encouraged. Original photographs should be submitted, as these provide the best quality. Digital photographs should be of the highest resolution.

Articles should be original and should not have appeared in other magazines or publications. An exception is made for the proceedings of conferences which have a limited reading public.

In the case of articles that have previously appeared in conference proceedings, permission to reprint in Terra et Aqua will be requested.

Authors are requested to provide in the “Introduction” an insight into the drivers (the why) behind the dredging project.

By submitting an article, authors grant IADC permission to publish said article in both the printed and digital version of Terra et Aqua without limitations and remunerations.

All articles will be reviewed by the Editorial Advisory Committee (EAC). Publication of an article is subject to approval by the EAC and no article will be published without approval of the EAC.
EDITORIAL

THE TAPARURA PROJECT: SUSTAINABLE COASTAL REMEDIATION AND DEVELOPMENT AT SFAX, TUNISIA
BART CALLAERT AND JAN VAN DEN BOGAERT
The rehabilitation of a heavily polluted industrial area to create a clean urban centre demanded continual cooperation amongst financiers, managers, engineers, environmentalists, contractors and government authorities.

CONSIDERING COPENHAGEN’S COP15 SUMMIT IN RELATION TO MARINE AND DREDGING PERSPECTIVES
KARSTEN MANGOR
The dredging and maritime industries have long been aware of the challenges of climate change. And they already are providing innovative solutions.

MEET RENÉ KOLMAN: AN INTERVIEW WITH IADC’S NEW SECRETARY GENERAL
IADC’s new SG describes his perceptions of the dredging industry, of IADC’s role and his plans for the future.

DREDGING ROCK WITH A HOPPER DREDGER: THE ROAD TO THE RIPPER DRAGHEAD
ROELAND NEELISSEN, ARJAN TANIS AND VINCENT VAN GOOL
Research, investigations into pickpoints and cutting geometries, predictive models and trials were essential in constructing a ripper draghead that could be placed on a TSHD.

THE ROAD SHOW SHE-Q BUS: “SAFETY IS AS IMPORTANT AS OPERATIONS”
WILKO BARDELMEIJER
Updating the safety system was only the first step. Communicating the new procedures one-on-one to all personnel was just as important.

BOOKS/PERIODICALS REVIEWED
A review of Practical Channel Hydraulics: Roughness, Conveyance and Afflux; and a new FACTS ABOUT Confined Disposal Facilities is available.

SEMINARS/CONFERENCES/EVENTS
Time to register for the IADC Seminar in Singapore and answer Calls for Papers at conferences in 2010.
Before looking ahead to this new decade, let us take a quick look back to 2009. One of the last events of the old year was the United Nations Climate Conference held in Copenhagen in December. Many meetings and reports preceded this event, and at one of them, BusinessEurope Conference on Climate Change in Brussels in October, President of the European Commission José Manuel Durão Barroso emphasised that, “…climate change is a moral and an ethical issue: firstly in a development context, as developing countries are bearing the brunt of climate change, despite having contributed to it the least, and lacking the means to tackle it…. [and] climate change is a moral issue in an inter-generational context as well. We simply have no right to impose the pain and cost of climate change on future generations…. because we know it will cost more to sort out the problem, the longer we leave it unsolved”.

For those of us in the dredging industry, the Copenhagen COP15 Summit and the meetings leading up to it made concrete many facts of which we are well aware: The urgency of addressing the consequences of climate change, as well as “going green” as an economic opportunity and a stimulus for future growth and prosperity. Predictions that adapting to climate change will lead to innovations and investments in clean technologies and products have already been proven true in the dredging industry. Innovation, seeking sustainable solutions have long been our goals. The private dredging and maritime construction companies have supported and implemented sustainable remedies for coastal protection throughout the world. The leadership of the private dredging industry is already evident when it comes to developing technologies in land reclamation and flood prevention which are part of the challenges inherent in climate change. And the industry seeks cooperation with organisations such as the World Nature Fund and has launched EcoShape, a research group dedicated to finding maritime solutions through “working and building with nature”.

Since the value of waterborne transportation is recognised as by far the cleanest and most fuel-efficient means of moving goods around the globe, it follows that the dredging industry itself is essential to the success of the shipping industry and port activities. In fact, the private dredging industry has been a reliable partner in planning, financing and implementing port development, expansion and improvement, to ensure that seaports are navigable and safe and at the same time environmentally sustainable. The private dredging companies are also actively participating in deliberations about how to lessen the carbon footprint through emissions control and improved energy efficiency.

The eyewitness report from the Copenhagen COP15 Summit found in this issue of Terra et Aqua reflects this consciousness and concern. Also articles about dredging projects in Taparura, Tunisia (coastal remediation) and in Melbourne, Australia (port deepening and widening) have benefited from the dredging industry’s commitment to finding environmentally sound and sustainable solutions to the world’s maritime challenges, of which climate change is at the top of the list.

Koos van Oord
President, IADC

Koos van Oord
President, IADC
THE TAPARURA PROJECT: SUSTAINABLE COASTAL REMEDIATION AND DEVELOPMENT AT SFAX, TUNISIA

ABSTRACT

The Taparura project, part of an action programme designed by Tunisian government authorities and supported by the European Investment Bank, is an effort to rehabilitate a port area which had been heavily polluted by industrial development. The Taparura project focuses on the sustainable socio-economic remediation of the coastal area around the city and harbour of Sfax, Tunisia’s second most populous city. Since the 1960s commercial and industrial development at Sfax in the southern part of Tunisia had been emphasised and the coastal area had been neglected. Especially the processing of phosphates to produce fertilizers had left stockpiles of phosphogypsum which are 6 metres above the sea level and cover 50 hectares. The objective of the rehabilitation is to construct a mixture of public and private spaces, including residential areas and to restore several kilometres of the coastline and create new beaches, reconnecting the city of Sfax to its beaches and encouraging the development of tourism.

The Taparura project is divided into two phases: 1) decontamination of the area and development of land in the sea (420 hectare); and 2) development of the area and construction a new urban centre. The first stage of the project, which entailed the decontamination and the rehabilitation of the entire site, is now completed. This was a complex multidisciplinary project and as such provided a challenge for everyone involved including the financiers, managers, engineers, environmentalists, contractors, consultants and government authorities.

INTRODUCTION

The Taparura project is a typical example of the challenges for sustainable development and ecological aspects of port cities and their surroundings. It is part of a wider action programme put together by the Tunisian authorities to tackle the primary sources of pollution in the region. The site is located along the northern coastal area of Sfax city near the harbour and includes the rehabilitation of a former industrial site complex, the clean-up of beaches and complete restoration and development of the area.

LOCATION AND HISTORY OF THE POLLUTION

Located 270 km southeast of Tunis, the city of Sfax was founded in AD 849 on the ruins of Taparura and is the capital of the Sfax governorate. It is a Mediterranean port on the Gulf of Gabes, a gulf on Tunisia’s east coast in the Mediterranean Sea (Figure 1). The gulf is 600 kilometres long, with the Kerkena...
Islands on the northeast and Djerba Island on the southeast. It has a large tidal range, 2.0 metres at spring tides. Sfax municipality, often described as Tunisia’s second city, has a population of 260,000 inhabitants and is an industrial centre for processing phosphates. The port is the largest in Tunisia and specialises in the export of phosphates from big mining complexes in the region. The coastal area, some 150 hectares, is adjacent to the harbour and has suffered pollution from various types of solid and liquid wastes for years. Especially phosphorgypsum, the residue from phosphate treatment, has been stored in an unregulated manner along the coastline, covering a surface area of 50 hectare piled 6 metres high. The pervasive pollution from this site was threatening the beaches and coastal waters of Sfax, hampering further development and economic growth, such as tourism, as well as presenting a health problem.

THE TAPARURA PROJECT

The Taparura project forms part of a global action programme developed by the Tunisian authorities to tackle the sources of pollution and to improve the overall environment of the Sfax region. The project promoter is the Tunisian Ministry for Equipment, Housing and Land Use Planning and the actual client is “Société d’Etude et d’Aménagement des Côtes Nord de la Ville de Sfax”, an autonomous government company under supervision of the Ministry for Equipment, Housing and Land Use Planning. This company is responsible for continuing the policy of pollution abatement and development of public and private industrial parks. The beach and landfill restoration will create a mixed space for new public and private activities, such as recreational complexes of beaches, parks and sports grounds, and educational, health and museum infrastructures, as well as the implementation of social housing programme.
A detailed site investigation both on- and offshore.

- The excavation of approximately 1.7 million m³ on land, including 1.25 million m³ of phosphogypsum plate around the toe of the landfill (Figure 4).

- Dredging of approximate 450,000 m³ contaminated sediments below sea level, with a water depth of approximate 0.5 to 1.5 metres. All wet polluted material was stockpiled and dewatered in a specially designated area on top of the existing landfill (Figure 5).

- The rehabilitation of this pyramidal phosphate dome comprises the reshaping of the slopes, the installation of a vertical bentonite-HDPE (high-density polyethylene) screen along the perimeter in order to create a confined area, including the installation of a cover layer with land-based material and a new topsoil layer. The remediated area was reclaimed with 6.75 million m³ of sand, dredged by means of trailer suction hopper dredgers with material sourced at a distance of approximately 18 km (Figure 6).

The entire contract period was set at 2.5 years with an approximate project value of 73.5 million euros. The European Investment Bank (EIB) contributed approximately 50 percent of the financing with the other 50 percent coming through export credit facilities sourced from Belgium and France. These included a concession and a direct commercial loan.

The three stages during the implementation were: Site investigation, remediation works and rehabilitation and civil works.
During this time, all land and offshore equipment was mobilised. These included dumpers, excavators, pontoons and other auxiliary equipment. Also prior to the start of the dry excavation and the dredging activities, the necessary infrastructure and road access was built. Once all this had taken place, remediation of the area began.

Dredging was performed in shallow water (water depth 0.5 to 1.5 metres). With storage space for contaminated sediment at a premium, over-dredging was held to a minimum by high accuracy dredging and close attention to the environment. A high precision backhoe fitted with an environmental bucket was used. The dredged sediments are temporarily stored on top of the existing landfill, where they are dewatered. Then the dry sediment is used to re-shape the confined disposal facility (CDF). During the remediation
The Taparura Project: Sustainable Coastal Remediation and Development at Sfax, Tunisia

Stage, some civil works were performed including the creation of embankments, a drainage canal and a vertical screen surrounding the CDF. The screen was constructed from cement-bentonite slurrywall with a high-density polyethylene (HDPE) foil. The remediated area onshore was reclaimed with sand pumped from the Kerkennah Channel using two TSHDs, the James Cook and the Alexander Van Humboldt (Figure 7).

The remediation of the area by removal of the phosphogypsum offered immediate health and safety improvements as the sediment contained arsenic, lead, cadmium, chromium, fluoride, zinc, antimony and copper at levels dangerous to human health (Figure 8).

Figure 9 shows the site at the beginning of the works. With the completion of the remediation, the next phase is ready to start: the development of the urban centre Taparura (Figure 10).

CONCLUSIONS

After years of studies in the 1990s to determine the feasibility of a clean-up project in the city of Sfax, the conclusion was reached in 1997 that the so-called Taparura project would be cost-effective and technically possible and that the benefits to the community in the southern Tunisian city of Sfax would be significant and long-lasting. The aim of the Taparura project is to transform the North coasts of the town of Sfax, affected by the industrial wastes, into an urban quarter where life could be pleasant and in which all sources of pollution have been eliminated or made neutral. Moreover, the project will ensure that the town of Sfax will be reconnected with its coastline through the creation of new beaches.

The ecological aspects of such a project in and around port cities is always a major challenge to all those involved: planners, financiers, engineers, environmentalists, contractors, consultants, authorities and many others. The execution of the remediation project took 2.5 years from mid-2006 to 2008 and laid the groundwork for the following phase to begin. The development phase for the Taparura urban centre, 420 hectares of reclaimed land with parks, a 5-kilometre-long beach and a residential area with housing for more than 20,000 people is now underway. The socio-economic benefits for the community and the city of Sfax are clear and will provide a significant improvement in the quality of life for its citizens as well as an economic boost through increased tourism.
The Copenhagen Summit on Climate Change provided some challenges to the world leaders who attended. Still significant progress was made. The Accord that resulted will provide challenges and opportunities for the dredging industry to support the efforts to combat climate change and provide solutions for flooding, erosion and the needs of coastal development and protection. This work is supported by CoMIBBS Joint Research Activity, which is part of the HYDRALAB project, funded by the EU Infrastructure Programme, EU project code 022441.

INTRODUCTION

World leaders had some busy and difficult days during the United Nations COP15 (15th Conference of the Parties) Summit in Copenhagen in December 2009. The results were not as ambitious and binding as expected but the expectations were perhaps set too high compared to the many difficulties that were encountered during the negotiations. At the end of the conference the Copenhagen Accord was agreed upon and the United Nations urges all countries to sign this climate accord.

THE ACCORD

The Copenhagen Accord includes amongst other items that the Heads of State, Heads of Government and Ministers have agreed as follows [extract]:
- "We underline that climate change is one of the greatest challenges of our time. We emphasize our strong political will to urgently combat climate change. To achieve the ultimate objective of the Convention to stabilize greenhouse gas concentration in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system, we shall, -enhance our long-term cooperative action to combat climate change. We recognize the critical impacts of climate change and the potential impacts of response measures on countries particularly vulnerable to its adverse effects and stress the need to establish a comprehensive adaptation programme including international support.
- We agree that deep cuts in global emissions are required according to science, and - to reduce global emissions so as to hold the increase in global temperature below 2 degrees Celsius.
- Adaptation to the adverse effects of climate change and the potential impacts of response measures is a challenge faced by all countries. Enhanced action and international cooperation on adaptation is urgently required to ensure the implementation of the Convention by enabling and supporting the implementation of adaptation actions aimed at reducing vulnerability and building resilience in developing countries, especially in those that are particularly vulnerable, especially least developed countries, small island developing States and Africa. We agree that developed countries shall provide adequate, predictable and sustainable financial resources, technology and capacity-building to support the implementation of adaptation action in developing countries.
- The collective commitment by developed countries is to provide new and additional resources, approaching US$ 30 billion for the period 2010 – 2012 with balanced allocation between adaptation and mitigation (i.e. to deal with drought, floods and other impacts of climate change, and to..."
Considering Copenhagen’s COP15 Summit in Relation to Marine and Dredging Perspectives

develop clean energy). In the context of meaningful mitigation actions and transparency on implementation, developed countries commit to a goal of mobilizing jointly USD 100 billion dollars a year by 2020 to address the needs of developing countries. A significant portion of such funding should flow through the Copenhagen Green Climate Fund”.

Taking advantage of the close proximity of DHI’s main office to the venue of the summit, DHI and COWI jointly organised a seminar: Solutions to the Challenges – after COP15. The seminar focused on marine and water resources issues and their relation to Climate Changes and possible solutions to the new risks. The seminar was visited by COP15 participants from more than 25 countries as well as representatives from local authorities and NGOs.

The Copenhagen Accord is a political agreement rather than a legally binding agreement. It is evident that there is a strong political drive towards gaining control of climate change. This was expressed in terms of reducing greenhouse gas emissions, thereby controlling the rise in global temperatures to max. 2° Celsius, and also controlling other climate parameters.

CLIMATE CHANGE RESULTS
Climate changes of special relevance for the marine perspective are rise in temperature and (associated) sea level rise as well as changes in storm frequencies and intensities, and precipitation. These changes will cause increased risk of flooding, coastal erosion and salt intrusion and such. The most severe impact is probably the increased risk of flooding, especially in the world’s major deltas and low-lying island communities, such as atoll islands (Figure 1). It is also evident that the increasing emphasis on controlling the climate changes puts more weight on sustainability in all kinds of planning, development and protection activities in coastal zone. Many coastal development projects as well as sea defense and coastal protection projects, involve dredging and reclamation activities and are therefore of great interest for the dredging industry.

A binding agreement would have meant a great incentive to invest in green sustainable technologies. These necessary investments will now come at a slower rate. Several industry leaders have expressed disappointment over the political system in connection with COP15 and they propose that the dredging industry must now take initiatives towards green and sustainable development.

Such sustainable awareness and method developments are already ongoing within the dredging industry both in relation to developing dredging technologies towards higher efficiency and less environmental impact and in respect of securing that the dredging/reclamation projects are designed to account for climate changes.

The above-mentioned impacts of climate changes indicate that it is necessary to think in more sustainable and flexible solutions in relation to coastal protection and sea/river defense techniques as traditional solutions (revetments, seawalls and dikes) are very inflexible and often counteract natural mechanisms, such as gradual retreat of the coastline and associated shoreward movement of the dune system in the case of coastal erosion, and flooding of the river plains in the case of river dikes. Furthermore, traditional protection solutions have often been introduced as remedial measures to compensate for negative impacts of other interventions, which is a reactive approach.

PROACTIVE APPROACH
Now, however, with the increasing impact of climate changes in the coastal zone, there is...
good reason for shifting to a more proactive approach by implementing a sustainable development by taking into account all the needs and requirements in the coastal zone in integrated projects.

An example of an integrated coastal project could be a scheme which rehabilitates a coastal section by removing hard protection measures, providing new beaches for recreation and fishing activities, providing protection against erosion and flooding and providing new space for development. Such a scheme will typically be soft and flexible and will require comprehensive dredging, filling and reclamation activities.

Although many may be familiar with the recently completed Amager Beach Park project (see *Terra et Aqua*, No. 111, June 2008), an even earlier example of such a project that proved to work very well is the Koge Bay Beach Park located south of Copenhagen, which was built in the 1980s. The dredging and reclamation contractor was the German company Wabau GmbH, which was a daughter company of Broekhoven, with Broekhoven (Dutch) and Rohde Nielsen (Danish) as subcontractors. Before the implementation of the project this site was characterised by a shallow shoreface with some barrier islands and a low-lying hinterland, which suffered from frequent flooding. The shallow coast was not suitable for recreation for which there was a huge demand as the hinterland is heavily populated.

An integrated scheme was developed, combining construction of artificial beaches on top of the barrier islands for recreation, construction of four new marinas, excavation of new lagoons between the beach islands and the coast and introduction of a dike throughout the entire stretch, which secured the low lying backland against flooding. The project is shown in Figures 2, 3 and 4.

Other examples of integrated projects are the coastal rehabilitation and protection projects in Sri Lanka (Negombo and Vennapuwa) developed by NIRAS, Lanka Hydraulic Institute and DHI.

Negombo had a wide beach which was an important asset for its many beach hotels. Furthermore, these waters were used by the local fishermen. However, in the 1980s, the beach was seriously eroding mainly as a result of sand mining in the rivers. The project consisted of four coastal breakwaters about 175 m long, supporting 800 m long beach sections, providing coastal protection as well as recreational beaches and beaches for
fishing activities. Initial sand filling of 400,000 m³ was part of the project (Figure 5).

The Vennepawa site is a fishing village 15 km north of Negombo which suffered from severe coastal erosion and which had been protected by emergency revetments along its entire beach frontage. However, this prevented the fishermen from using the beach as a boat landing. The rehabilitation project consisted of rebuilding of the revetments and introducing some beach sections, the so-called cove concept (Figure 6), in order to provide landing possibilities for the local fishermen. One of the coves is presented in Figure 7 and it is evident that the cove is heavily used by the fishermen.

The construction and reclamation works for the two projects were performed by a consortium between Monberg & Thorsen and Hoffmann & Sons.

Also other marine problems require a new “work with nature” approach, such as management of tidal inlets by artificial bypass (dredging) instead of building inlet jetties.

The increasing impact of the climate changes on the marine environment indicates that there will be a strong focus on environmentally optimised and sustainable adaptation schemes in the future, which focuses on mitigation of the climate change in combination with solving all the already existing problems experienced by coastal societies. The demand for integrated, optimised and sustainable solutions is especially required in developing countries, where resources are scarce but where international funding may become available through the Copenhagen Green Climate Fund.

CONCLUSIONS

The Copenhagen Climate conference may not have achieved everything it hoped for, but many steps have been taken in rekindling interest for measures to address the increasing impacts of climate change on the marine environment. In the future full attention will be placed on environmentally optimised and sustainable adaptation schemes, which focus on mitigation of climate change in combination with solving all the already existing problems experienced by coastal societies.

The demand for integrated, optimised and sustainable solutions is especially required in developing countries, where resources are scarce but where international funding may become available through the Copenhagen Green Climate Fund. Work in the natural marine environment with major dredging and reclamation projects is normally regulated by local environmental legislation, however the environmental legislation in certain countries is either insufficient or insufficiently enforced. International consultants and dredging companies working under such conditions have a special obligation to follow internationally accepted environmental standards and to promote solutions that are environmentally sound.
As of January 1 2010, René Kolman has assumed the reins as Secretary General at the International Association of Dredging Companies. He is still “learning the ropes” as he says, but according to him, the importance of dredging and maritime construction in the world clearly is underestimated.

“About a year and a half ago I found myself short-listed and heading to The Hague for an interview at the IADC, the International Association of Dredging Companies. Coming from a background of working with a Dutch branch organisation, I was already aware of the important Public Relations function that such groups have toward spreading positive information and image-building for their members and industry.

“But I was not prepared for the incredible excitement that the dredging and maritime construction industry offers. To begin with, IADC member companies work worldwide. That means the Secretary General is expected to be at meetings worldwide. My first experience was travelling to Abu Dhabi, to attend our own IADC Seminar on Dredging and Reclamation in order to learn the basics of dredging.

“Then in May, I helped organise, with the London School of Economics, the IADC Young Management Days 2009 in Athens, Greece. We examined the subject, ‘Dredging in Uncertain Economic Times’. As an economist, I of course found the discussions extremely interesting and useful. Through a method of working with scenarios, the group was able to have a meaningful give-and-take about the future of dredging. After that it was off to Phoenix, Arizona for the WEDA (Western Dredging Association) meeting. There I had the honour of presenting an IADC Award for the Best Paper by a Young Author. Rewarding young professionals, attracting them and keeping them in our industry, is especially important for maintaining a vital, active business.

“This was followed by our own Annual General Membership meeting in Oman, and a month later the IADC International Seminar in Singapore, where I presented an award for the best team project. Once again, these awards, seminars and IADC-sponsored events aim to heighten awareness about dredging overall, amongst young people relatively new to our industry, but also amongst stakeholders and decision-makers.

“My background as economist influences what I do and how I tackle problems. Just as IADC dredging companies are always exploring new means of technology and have to enter cost effective tenders and are constantly busy with research and development, we as a branch organisation also have to be cost effective with our communication tools. Our target groups remain ports and harbour authorities, government agencies, energy exploration companies, real estate developers, and of course students both at university and on other vocational levels”.

IADC’S ROLE AS EDUCATOR

“The viewpoint of the contractors is that if they can work with informed clients, they can do a better job. That’s why we try to reach a wide variety of groups through our seminars and our publications, like the series Facts About various dredging issues – Surveying, Contracts, Site Investigations, Contaminated Disposal Facilities, our books, Dredging for Development and Environmental Aspects of Dredging, and Terra et Aqua, our quarterly journal on dredging and maritime...
In that framework, we also seek out and appreciate cooperation with other dredging-related organisations, such as IAPH, PIANC, EuDA, the various groups under the WODA umbrella, FIDIC and numerous others. Each has its own area of expertise and I can see how important it is to share our resources and complement each other’s efforts.

“Still there are areas that definitely need continuing attention and present quite a challenge. Despite globalisation, dredging in many countries is a closed market. We need to assemble more statistical information about dredging in these markets and we need to reach out to a broader public. Luckily I inherited a competent staff that has been working at IADC for quite a number of years and they are very able to guide me in these efforts – and point me in the right direction if I am drifting off-course into dangerous waters”.

DREDGING IS AN UNKNOWN INDUSTRY

“If you ask me what has struck me the most in the last year working myself into the atmosphere of IADC and its members, it is how little the general public knows about the importance of dredging. Most people don’t think about how our ports work, what the importance of global trade is, how that great sandy beach you are lying on during your vacation came to be or maybe almost came not to be because of hurricanes, tsunamis and even ordinary natural erosion. And that’s not to mention the offshore aspect of dredging. Bringing gas and oil from the North Sea, from Sakhalin in Russia would not be possible without the pipelines laid on the ocean bed by dredging companies. Without these energy supplies Northern Europe would be very cold indeed.

“Recently I had the privilege of being onboard one of our trailing suction hopper dredgers for a 24 hour period. Traversing the North Sea on a TSHD is a real eye-opener. The enormity of the ship itself, the high tech facilities on the bridge where the captain tried to explain to me the intricacies of the computer programmes, the functions of the draghead, how to optimise the loading and unloading. Also the deafening sound of the engine room, the expertise and experience of the crewmembers, serious, motivated people doing their job with calm and attention to every detail of trailing and sailing.

“When I was offered the position at IADC, a bit of my dream to live near water and be involved in a water industry was on the verge of fulfillment. But I had no idea how challenging the industry actually is. It’s a wide open, pioneering business, filled with so many surprises, continually re-inventing itself. On the other hand, because dredging is a specialised niche, and because many of our participating members started out, and some still are, family businesses, the level of familiarity is striking. I don’t know if there is another industry that is so high tech and yet still has maintained that feeling of personal closeness. Simply said, I’m excited and ready for action.

“One of my goals for this coming year is to make sure that others get as excited as I am, especially that more young people decide to choose a career in the dredging industry. I may not be a student any more, but I understand the difficulties of making career choices. Taking on the job of Secretary General at IADC is certainly one of the most satisfying decisions I’ve made. I’m definitely glad to be ‘onboard’ as they say around here.”
ABSTRACT

After an extensive selection process in 2004 Boskalis Australia Pty Ltd was selected by the Port of Melbourne Corporation to execute the Melbourne Channel Deepening Project. The aim of the project was to make the Port of Melbourne accessible for 14-metre draught vessels at all tidal conditions. One of the most challenging parts of the project was the deepening of the Entrance to Port Phillip Bay, which is located in an environment characterised by a rock bottom, strong tidal currents, a persistent and long swell, regular shipping traffic and a National Marine Park abundant in deep reef fauna nearby. The metocean conditions prohibited the deployment of a cutter suction dredger and the use of drilling and blasting. The latter method was also not preferred for social and environmental reasons. Seeing the metocean constraints, a trailing suction hopper dredger remained the preferred equipment for the project. However, the layered, cemented limestone was too strong to be dredged with conventional dragheads. This article describes the development of a ripper draghead, capable of dredging rock.

Several parts of the dredging process were objects of research. Literature and former tests were analysed to derive the forces required for cutting the rock. A model was made to predict the cutting capabilities of ripper dragheads. Several types of pickpoints and cutting geometries were investigated during cutting tests with a test-cart equipped with measuring and logging instruments in a quarry. The ripper draghead was engineered and constructed after having determined the optimal teeth configuration with respect to forces and dimensions of the cut rock. In addition, vessel motion and vessel maneuvering studies were undertaken to investigate the operational limits of the dredger. The vessel crew was trained on a dredging vessel simulator whereby the actual currents and the predicted cutting forces were used as inputs.

A full-scale trial dredging campaign was undertaken with a trailing suction hopper dredger, the Queen of the Netherlands in 2005. The trial demonstrated that the rock at the Entrance could be dredged with the ripper draghead. Extensive video monitoring showed that the dredging process had to be optimised with respect to the loose material left behind after dredging. Additional laboratory tests with a scale model of the ripper draghead were performed at the Delft Hydraulics Laboratory. The tests focused on the optimisation of the suction process by investigating the effectiveness of the draghead’s water jets and the influence of different draghead geometries. Based on the laboratory results, the existing ripper dragheads were modified and the work method was amended. This article originally was presented at CEDA Dredging Days 2009 and is published here in a slightly revised version with permission.

INTRODUCTION

The size of trailing suction hopper dredgers (TSHD) has been significantly enlarged over the last decennia. Starting with the first jumbo dredger Pearl River, built in 1994, the hopper volumes have increased from 17,000 m³ up to 35,500 m³ nowadays, such as the Queen of the Netherlands. Currently, TSHDs are being built with a hopper volume of approximately 46,000 m³. Obviously, the total installed power, the propulsion power, the dimensions
ROELAND NEELISSEN
graduated in 1993 from the Delft University of Technology with a degree in Physics. In 1994 he joined the Research & Development department of Royal Boskalis Westminster. Many projects he was involved with comprised the excavation of rock with several types of dredging equipment. When the preparations for the Melbourne Channel Deepening project commenced, he was assigned to the project team, especially responsible for the development of the ripper dragheads for the TSHD Queen of the Netherlands.

ARJAN TANIS
studied at the Technical College in Dordrecht, and has worked Boskalis since 1998. He is currently senior project engineer on the central technical department and specialist in dredging installations on suction hopper dredgers. He was involved with the Melbourne project from the outset, particularly for the design and mechanical engineering of the test facilities and the ripper draghead.

VINCENT VAN GOOL
(MSc) graduated in Mechanical Engineering from the Delft University of Technology (the Netherlands). As Production and Planning Engineer of the Melbourne Channel Deepening Project, he was responsible for the project schedule, for monitoring the vessel performance and for proposing improvements to maximise production outputs. As R&D Engineer he was involved in the development of the ripper dragheads.

Severe metocean conditions (strong currents and high swell) excluded dredging by a CSD. In addition to metocean constraints, also environmental and social constraints prohibited the use of drilling and blasting of the rock. However, vessel motion and vessel maneuvering studies showed that the workability for a jumbo trailing suction hopper dredger was good.

For the Melbourne Channel Deepening project, workability and shipping traffic were the drivers to explore the dredging of rock with a TSHD further.

PLANNING THE PROJECT
For deepening the Entrance to Port Phillip Bay to -17.3 metre, a thickness of approximately 3 metre of rock had to be dredged at Nepean Bank and Rip Bank. The Entrance is a channel of 235 m wide with regular shipping traffic.

Unconfined Compressive Strength

of the suction tubes, and the size and weight of the dragheads have also increased. As a result of these developments harder soils and even rock, which are normally dredged with a cutter suction dredger (CSD), can now also be dredged with a TSHD.

But why deploy a TSHD in harder materials if CSDs are already capable of dredging rock? A significant difference between the TSHD and the CSD is the workability. Large CSDs cannot work in wave heights exceeding 1 m, but TSHDs are capable of dredging in waves up to 3 m. For a CSD, strong currents prevent the use of a floating discharge line, whereas the maneuvering of a TSHD will be slightly affected only. In addition, jumbo trailing suction hopper dredgers can dredge significantly deeper than CSDs and they are much more flexible in relation to shipping traffic. In general the costs of mobilising a CSD are higher than for a TSHD.

For the Melbourne Channel Deepening project, workability and shipping traffic were the drivers to explore the dredging of rock with a TSHD further.

The Port of Melbourne Corporation conducted a soil investigation with a jack-up platform in the Entrance in 2003. This investigation took 8 weeks to complete and comprised 10 boreholes (see Figure 1), showing that the seabed is underlain by a layered sequence of “dune calcarenites”; siliceous calcarenite, calcareous sandstone and sand belonging to the Bridge-water Formation. Strength tests and seismic investigation indicate that for this type of rock a CSD would normally be deployed.

Figure 1. Overview of Port Phillip Bay (left) and the Entrance, showing the Nepean Bank (upper area), the Rip Bank, the area to be dredged (yellow) and the locations of boreholes (right).

Figure 2. Example of calculated cutting production depending on rock strength.
As a TSHD was the preferred dredger to be used, the focus was on the development of a draghead, capable of dredging the rock in the Entrance. This project was incorporated in the R&D programme of Boskalis and a project group was formed by the R&D Department, Technical Department and Dredging Department to integrate knowledge regarding the cutting process, production levels, soil characteristics and construction details.

The development process started with a desktop study. This study comprised an inventory of rock cutting theories, analysis of laboratory cutting tests and collecting knowledge on ripping by bulldozers in various rock types.

The desktop study led to relations between properties of the rock and the force levels required for cutting the rock. A model was set up for the cutting of rock with a TSHD equipped with a ripper draghead. This model predicts the maximum strength of rock that can be dredged, depending on characteristics like propulsion power, trailing speed, draghead weight and draghead layout. The cutting production, depending on the strength of the rock, is also predicted.

Figure 2 shows a generic result of the model for a particular TSHD equipped with a ripper draghead with different numbers of teeth. The figure indicates that the teeth will not penetrate if the rock strength exceeds a certain limit. As a consequence, the production will be zero unless the number of teeth is reduced.

**CUTTING TRIALS IN THE QUARRY**

For the optimisation of the design of the draghead an experimental test programme in an Australian quarry was proposed. The general set up comprised a bulldozer pulling a test cart equipped with ripper teeth or pickpoints. The aim of the tests was to gain insight in the cutting forces, penetration forces and the size of the cut rock. The size of the cut rock is important because large rock lumps might block the draghead or even worse, block the dredging pump.

Several quarries in the vicinity of Melbourne were visited, and the geological setting and mechanical properties of the present rock were investigated. The quarry for the test programme was selected based on the good similarity with the rock properties in the Entrance. Seismic velocities measured in the quarry were approximately the same as those measured in the Entrance.

The conclusion from the study was that the rock in the quarry was representative of the rock in the Entrance, with respect to strength, layering and cementation. A test cart with ripping teeth was built, to be pulled by a bulldozer (Figure 3).

At the quarry two sites were selected for testing. The first site consisted of weakly cemented sands with densely cemented rock concretions and extensive rock ridges, representing the areas at the Entrance where caprock is present. The second pit consisted of layered aeolianite rock that compared well with the rock encountered in the boreholes at the Entrance. During each test the cutting forces and penetration forces on the ripper
teeth were derived from load pins. After removal of the cut rock in the track, the groove patterns were mapped. From these measurements the cutting production and the specific energy of the rock could be derived. The dimensions of the cut rock were measured after each test. Samples of the cut rock were collected for strength analysis.

The cart was constructed in such a way that the number of teeth, the type of teeth and the space in between the teeth could be varied. In addition, the cutting depth and cutting angle of each tooth could also be varied.

Although the cutting processes above and under water show many similarities, there are some differences: Cutting in dry rock is a drained process, while cutting under water in saturated rock might be an undrained process. To quantify the differences between the cutting process above and under water, a separate study was conducted by Delft Hydraulics in the Netherlands.

The results of this desktop study were used to translate the measured forces, breakout patterns and production levels in the quarry to the underwater situation.

Fifty tests were conducted to achieve an optimal layout of the cutting geometry with acceptable force levels and production levels. The size of the cut rock was sufficiently small to pass the suction mouth of the draghead and the pump, minimising the risk of blocking (Figure 4). Based on the quarry tests the basic design criteria for the ripper draghead were established, like the weight of the draghead and number and type of the pickpoints. Also the optimal cutting depth and the spacing between the pickpoints were derived from the quarry tests.

**DESIGN OF THE RIPPER DRAGHEAD**

The data of the cutting tests in the quarry and the results of the desk studies on the cutting and the breaking of rock were used as inputs for the design phase of the ripper draghead.

The first issue was to define the design criteria and the risks. The forces which could be expected during normal operation were known from the quarry tests. However, besides these normal cutting forces, the expected harsh operational conditions will cause external forces affecting the construction. The ripper draghead or suction pipe may hit the edge of the Rip Bank and additional vertical forces will be generated when the draghead lands on the rock bottom while the ship is rolling in 3-metre waves. The draghead may be subject to sideward movements when the motions of the ship and the suction pipe are influenced by the long waves and strong currents in the Entrance. All teeth may simultaneously hit a hard rock edge and cause extreme force levels.

The greatest risk is damage to the suction pipe and to the connection of the suction pipe with the ship’s hull. Several measures were designed to protect the construction against these peak loads and to avoid damage of the construction.

To determine the force levels for the design of these safety measures vessel motions, vessel maneuverability and the structural integrity of the suction pipe and the vessel were analysed in great detail. An extensive study was started.
to find out which limit should be observed to minimise the risk of incurred delays caused by damage.

Based on the results of the quarry tests and risk analysis the design criteria could be translated into the design of the ripper draghead and the protection of the pipe construction. The draghead consists of a helmet and a visor. The helmet is the base construction, including the suction mouth, which has to collect the ripped rock. The function of the visor is to cut the rock with its teeth. A safety break pin construction was designed in the connection of the visor with the helmet. This construction was based on a pre-stressed pin, which should break before the construction is overstressed. If an overload occurs because forces on the teeth are too high, the pin will break and the visor can swing away to the back and the teeth will lose contact with the rock.

The sensitivity for fatigue is a weak point of a normal break pin construction, and because of that, the lifetime of the pin material is affected. If this were to cause a break, instead of an overload, it would result in an unnecessary delay of the ship.

The lower part of the suction pipe is exposed to bending by its own weight and the forces generated by the ripper draghead. Besides that, a typical risk at the Melbourne project concerns the collision of the pipe with the sharp edges of protruding rock ridges and with the edge of the canyon, a geological erosion feature in the Entrance. This will cause buckling and bending of the pipe, followed by breaking. To guarantee the integrity, a protection unit was constructed and installed at the lower side of the suction pipe. Impact by collisions is damped in this way. During the project this has proven to be effective.

For picking up the rock, a minimum speed of the water flow is required. Proper matching of the dredge pump capacity and the suction inlet of the helmet is very important to avoid blockage and spillage behind the draghead. The photos and films which were made of the quarry tests were very helpful to examine how the rock was cut by the teeth and what would be the best design in which the water flow would pick up as much rock as possible.

Another point of attention was the wear of the draghead. The dragging of the heavy draghead on the rock bottom and the hydraulic transport of the stones with high suction speed causes enormous wear of the construction. To combat the wear, wear-resistant material was added on several critical locations in the design.

The design of the draghead was optimised by means of FEM calculations. All expected load cases were considered in these calculations.

During the final design phase a selection procedure for a manufacturer of the dragheads was started. Criteria for the selection were:
- quality of steelwork and welding,
- references of similar jobs,
- organisation of the orders,
- capacity,
- price and
- delivery time.

After the selection three ripper dragheads were built in Australia according to high quality standards. The construction was observed and checked by a superintendent every day.

**FULL-SCALE TRIAL AT ENTRANCE OF PORT PHILLIP BAY**

To determine the environmental effects of dredging in general and to see whether the TSHD was able to dredge the rock at the Entrance of Port Phillip Bay, a full-scale dredging trial was conducted in 2005. Part of the Entrance to Port Phillip Bay was designated as trial area. In August, the TSHD *Queen of the Netherlands* dredged for two weeks to demonstrate that the ripper draghead technology (Figure 5) was capable of dredging the rock at the Entrance.

An extensive follow-up programme of the trial was set up. Amongst other attention points it comprised the measurement of production, vessel motions and stresses and loads in the suction tubes. Also the properties of the dredged material were analysed in detail.

A wave buoy located nearby was used for real time monitoring the wave height and direction. Also two ADCP profilers were installed on the bottom near the trial area to obtain current and wave spectrum information. Every day the survey vessel performed a survey at the trial area to gain insight in the progress and in the development of the bottom roughness.

The forces in the suction tubes were measured by load pins in the hinges. No stress limits were exceeded, the theoretical models were confirmed and the integrity of the suction pipe and hull connection could be guaranteed. The cutting forces were roughly comparable with the forces measured during the tests at the quarry. Minor damage to the draghead was encountered, probably caused by collisions with seabed ridges. To reduce the bottom roughness, the dredging method...
Initially aimed at high spots in order to flatten the sea bottom. The survey after the trial showed a significantly smoother sea bottom than before starting the operations (Figure 6).

During the two-week trial in the Entrance about 30,000 m³ were dredged, which was well in agreement with the production levels estimated from the quarry tests. At hard spots the production was lower, sometimes significantly, but the trial showed that all rock could be dredged.

Rock samples were collected from the draghead and from the hopper. Geotechnical analysis by the University of Melbourne showed that UCS values generally varied between 1-30 MPa. The strength of two very dense samples was respectively 71 and 112 MPa.

During the trial the work method was evaluated and optimised. At the time the crew got used to the complex currents, the sailing patterns were adjusted. The setting of the swell compensator, determining the effective weight of the draghead, was optimised and two pickpoint types were tested. Eventually an optimal balance was derived between effective draghead weight, forces in the pipe and production.

Several photo and video inspections were made by divers and a comparison was made between the actual dredging test and the ripping tests in the quarry. Both situations are shown in Figure 7.

However, the inspections also showed that the amount of stones remaining on the seabed after dredging should be reduced. These stones were not stable under the present currents and waves and could potentially be relocated to other areas, which was not acceptable.

LABORATORY RESEARCH

The full-scale trial showed that the cutting process of the ripper draghead was well in line with the expectations, but additional research was necessary to improve the suction characteristics of the draghead, aiming at minimisation of the amount of stones left behind on the sea bottom. Experiments with a scale model draghead appeared the best way to visualise and analyse the suction process. Because of their experience and their suitable laboratory facilities Delft Hydraulics was engaged for the test programme. A scale model of the ripper draghead was constructed and the sea bottom was simulated by preparing a layer of cemented gravel in the dredging flume. A test comprised a passage of the draghead through the prepared bed over several metres. The passage was monitored through a glass wall. Underwater video cameras were used for registration and sensors were installed for measuring operational parameters.

The test programme focused on the variation of relevant parameters like suction flow, jet flow, geometry of the draghead and suction mouth. Operational parameters were scaled in accordance with Froude’s law. Because a flat sea bottom does not represent reality, also the influence of the topography of the sea bottom was investigated.

The material left behind after passage of the draghead was measured by a laser survey system (Figure 8) and checked by simple weight measurements of the loose material. The test programme was arranged into resemblance tests, insight tests and optimisation tests.

The resemblance tests, in which the model draghead and operational parameters were equal to the draghead used at the full-scale trials in Melbourne, showed that not all cut material was removed. Then the influence of the jet flow, suction flow, geometry of the draghead and suction mouth was investigated and adjusted during insight tests. The final layout of the draghead was established in the optimisation tests. Compared with the original layout, a significant improvement in suction characteristics was achieved, as can be seen in Figure 9.

In accordance with the results of the laboratory tests the ripper dragheads in Australia were modified and tested further on the Salalah project in Oman where approximately 1,000,000 m³ were dredged. The dredging of the Entrance of the Melbourne Channel Deepening project could start with fully developed and well-tested ripper dragheads in the beginning of April 2008.

Figure 8. Measuring bottom topography with laser (left) and result of laser measurement before and after the passage of the draghead (right).
A total of 140,000 m³ of rock had to be dredged at the Nepean Bank and 135,000 m³ at the Rip Bank. The borehole data suggests that a Holocene aged layer of gravelly sand and blocks of cemented carbonate overlies in patches a Bridgewater Formation siliceous calcarenite, calcareous sandstone and sand (Figures 10 and 11). Petrological analysis (Holdgate and Wallace, 2004) indicates that in some cases, additional cementation has taken place near the seabed surface, probably adding to the strength near the seabed surface. This additional cementation is of marine origin (i.e. calcite precipitated directly from sea water). Marine cements are also present in the gravel fragments overlying the Bridgewater Formation. This is contrary to the older calcite cement of the rock, which is of fresh water origin (cement precipitated from meteoric water when the dune deposits were above sea level).

Based on the available soil information, an estimate was made that a small amount of the total volume could not be dredged directly by the ripper dragheads. As contingency, a dedicated hydraulic hammer system was designed which could be positioned using a dynamically positioned vessel and swell compensated arm, to pre-treat this harder rock.

With 80% of the time waves having a significant height (Hs) larger than 1.0 metre (Figure 12) and currents up to 3.5 m/s, and approximately every hour a vessel passing by, conditions were more suitable for a jumbo trailer suction hopper dredger than any other type of dredger.

To protect the Port Phillip Heads Marine National Park close to Nepean Bank, a ridge of at least 5 m wide along the north-west edge of the Nepean Bank had to be left in place, until the remaining area was dredged.
to the required design depth. Strict environmentally enforced control was set to prevent loose material falling into the adjacent deep, locally known as the canyon.

In addition, dredging of the canyon edges (North edge of the Rip Bank and all edges of the Nepean Bank) was conducted from the canyon towards the plateau. When dredging towards the canyon, the dragheads were lifted so that no rock was removed within 5 m of the edge (Figure 13).

Regular clean up of the dredged area was required to avoid accumulation of loose material on the sea bottom. Special teeth were fitted on the ripper dragheads and the swell compensator pressure was set on a high level to avoid that new material was cut during clean up. A dedicated software application was used to register the area covered during the clean up operation.

During the dredging works, dragheads were inspected on a regular basis. During these inspections, rock samples were collected. All samples were selected on having only fresh cut sides, so it can be assumed they were ripped from the bed by the dragheads and not already present as loose stones beforehand. Only larger rock lumps with a certain minimum strength got stuck in the draghead (Figure 14). In the hopper the very weakly cemented part of the volume was found as sand or as coin-sized fragments.

With all available soil information, together with production figures and survey progress, it could be confirmed that the initial estimated amount of hard rock (UCS=15-30 MPa for a few percent of the total volume), was approximately correct. It was possible to remove all material with the ripper dragheads. Mobilisation of the contingency equipment such as the under water hammer system was not necessary.

The mechanical, operational and monitoring measures that were taken to manage and control damage to the pipes and the dragheads, were effective. The mechanical measures included a fender attached to the lower suction pipe, a breaking bolt between helmet and visor as described before. In addition, special care was taken for the “streamlining” of the dragheads.
At the start of the works, dredging focused on the shallowest parts first. This reduced the bottom roughness and thus the risk of rock ridges impacting the dredge pipe. Figure 15 shows a distribution of the measured sea bottom depth before and after the dredging.

Software was developed to help the operator to lift the pipe in time. In addition to the standard instrumentation load pins were installed in the cardan between upper and lower suction pipe to monitor the level and fluctuations of forces in the suction pipes.

A semi-quantitative approach was chosen to investigate and classify the rock spill. Towed video surveys were conducted 4 weeks after technical completion. A total of 35 km of video transects were sailed resulting in 33 hours of video footage. Then, from the video footage, 1280 pictures were captured and selected, which evenly covered both the Nepean and Rip Bank dredged areas. All pictures were independently reviewed by 5 persons and visually divided into 5 classes, based on a percentage of the area covered by loose material (4 classes are shown in Figure 16).

Based on this classification procedure it could be derived that about 12% of Nepean Bank and about 20% of Rip Bank was covered with rock spill. This was well within the predictions of the Supplementary Environmental Effects Statement (SEES).

**REFERENCES**


**CONCLUSIONS**

This article describes the successful development of a ripper draghead, capable of dredging rock with a Trailing Suction Hopper Dredger. The cutting forces were determined by cutting tests in a quarry and the suction characteristics were optimised by scale model tests in the laboratory. This research resulted in the construction of a ripper draghead that has proven to be very effective at the Channel Deepening Project in Melbourne. The ripper draghead was sufficiently strong to withstand all occurring forces and the protection measures of the suction pipe were appropriate. The dredging of the Entrance of Port Phillip Bay was executed well within time from April to September 2008. As a result of the optimised draghead design and the well-prepared work method, the amount of spill was minimal.

The realised productions accorded with the estimated productions and video surveys proved that the quantity of loose material left behind was well within expectations. The work benefited from the continuous interest and support of our Alliance partner, the Port of Melbourne. Besides the authors the following persons have made significant contributions to the project in their specific field of knowledge: G.J. Grundlehner who supervised the workability studies, R.J.M. van Maastrigt who conducted the production calculations, W.F. Rosenbrand as manager of the R&D department of Boskalis, F. Uelman as the engineering manager of the Channel Deepening Project, P.N.W. Verhoef who did the engineering geological investigation and last but not least the crew of the *Queen of the Netherlands*. 
ABSTRACT

After thorough evaluation the decision was made at the home market office of Boskalis that their SHE-Q system was ready for an update. With the full support of Management, the updating and implementation of the system was undertaken using the Deming Cycle. With the goal of reaching zero personal accidents, the new system went on the road and the so-called Road Show with a specially outfitted bus visited over forty sites in the Netherlands carrying the new SHE-Q message to all employees.

INTRODUCTION

In October 2007, a management review at the home market office of Boskalis bv, in Rotterdam, the Netherlands, revealed that its SHE-Q system was up for a proper revision – more directive, less paper.

The kick-off was held a few months later in February 2008, and in April 2009 the company was finished updating and implementing the SHEQ Management System (Figure 1). During this period of time Management showed full commitment to the updating process in monthly sessions where the policy documents and the primary processes, from “prospecting” through to the “evaluating” of projects, were reviewed.

During the review of the policy documents it was clear that in line with the Group policy, the ultimate objective – zero personal accidents – was clearly accepted by all and that for this reason following up on Health and Safety issues was considered to be of paramount importance for the execution of operations safely and under healthy conditions. For this the “Deming Cycle”, an iterative four-step problem-solving process was adopted in which instruments of SHE-Q system were defined to ensure the proper functioning of the system.

THE DEMING CYCLE

The Deming Cycle, named for Dr. W. Edwards Deming, a statistician, professor and business consultant, is typically used in organisations for business process improvement. As a repetitive process to determine the next

Figure 1. The kick off to the Road Show where the first SHE-Q booklet was presented by Managing Director P. van der Linde.
In the sessions, during which the primary processes were discussed, the group was first asked to clearly define the purpose of each process. Furthermore in smaller groups they were to redefine which process steps they found important, in order to control that particular process. This was done on blank sheets of paper so as not to fall back on the existing procedures. For each defined process step, the group was then asked to state critical success factors for that step and to list the main activities under these steps. Finally, responsible functions were added to the process steps.

Parallel to the management work group sessions, five sub-workgroups consisting of various project and staff members of the organisation also met on a monthly basis, reviewing the adjacent supporting processes, such as “Purchasing”, “Engineering”, “Surveying” and “Rental of Equipment” giving their views and input from the work floor.

All this was done with one objective, namely, to adjust the system in such a way that it increasingly forms part of the daily work routine, to make the work procedures lean and mean, and furthermore, to have a full adaptation to the standards set forth by the International Boskalis group.

Having accomplished this analysis, the question eventually arose of how to implement this revised system in a decentralised organisation and how to further explain the management commitment towards “safety”.

**THE ROAD SHOW**

Hence, a purposely outfitted SHEQ-layout bus was rented to go out on the road, and bring the message to each and every employee, in a one-on-one setting, explaining what Boskalis as a company stands for (Figure 2).

Over a three-week period, the so-called “Road Show” visited three offices and over forty projects in the Netherlands, reaching more than two hundred and forty people.

During the Road Show, led by the Boskalis Netherlands SHE-Q department, members of the Management team – Directors, the Operational Managers and the Staff department heads – also participated in each session to show their commitment to the system.

For the issues “zero incidents” and “working in the most efficient manner”, the answers ranged from “will first have to have some proper checks before we start working again” and “further increasing awareness” till “not much more than by making sure the project (safety) plans and planning are adhered to”.

**The Portal**

Once in the bus employees gathered around a table and were given a general overview of the things to come (Figures 3 and 4). They were informed about the latest “tool” being implemented for SHE-Q: The newly installed web-based “Boskalis Portal” on which the SHE-Q department installed a so-called “department site” where all documents for the SHE-Q system are found and can be downloaded, in combination with a new soil registration programme.

After all this was explained, the session continued at the back of the bus. This second phase of the session started off with an in-depth discussion of the SHE-Q Policies and Principles. Amongst others points, an essential question was put on the table: What kinds of additional SHE-Q actions would the participants take different or in addition to those that they would have taken before they went into the bus, at the moment they would step out the bus after this session, in order to adhere to the outlined policies?

During the sessions other issues of the SHE-Q system were discussed such as managing risks and changes to operations and planning. Also
WILKO BARDELMEIJER
(left) with his righthand man Jeroen van der Klooster in Vlissingen, at the last session in the series of Road Show presentations. Bardelmeijer joined Boskalis bv in 1986 and has worked on a variety of projects throughout the world for Boskalis and Westminster from Algeria to Norway to South Africa, in a variety of roles as a Project Engineer, Offshore Engineer and ultimately as QA/HSE Engineer. Since 2005 to the present he is SHE-Q Manager Boskalis Netherlands, headquartered in Rotterdam and is responsible for the implementation of Safety policy and the daily operations of the department.

determine the extent of the risks by means of assessing the possible hazards to the project.

FROM THEORY TO PRACTICE
After the session in the bus, a Management Safety inspection was conducted. Hence, theory was directly put into practice. The Road Show approach of coming directly to the project, having a one-on-one session and a safety walkabout on the project was clearly appreciated by the employees and directly supports implementation of SHE-Q policies and awareness (Figures 5 and 6).

ROAD SHOW REGISTER
During the one-on-one session, the employees raised various issues and had remarks and questions about the SHE-Q system and organisation. These issues were noted as action points on the participants’ lists. As a follow-up all noted points were gathered together in the “Road Show Register” and discussed during the next following Management Meeting one month later. The outcomes of these issues were added to the Register and sent back as feedback to each employee. Furthermore, the Road Show Register was centrally placed on the SHE-Q department website of the Boskalis Portal. Based on several messages sent to the department by mail, this was highly appreciated.

Several months later in November 2009 a follow-up session of the SHE-Q Road Show was initiated. This was done to get feedback and to determine where support is needed and to see how the SHE-Q system is being used in practice. Even now members of the SHE-Q department continue to visit all operational projects in the Netherlands.

CORPORATE SAFETY PROGRAMME
This Road Show by bus illustrates how SHE-Q is approached by Boskalis locally in the Netherlands. At a corporate level, Boskalis will roll out a company-wide safety programme in 2010 setting out the Boskalis Safety Standard with a focus on safety behaviour.

CONCLUSIONS
The outcome of these follow-up sessions is still to be seen, but results so far are promising. It may obvious that just being out there with a Road Show to discuss safety and other SHE-Q issues gives in itself an enormous boost in awareness and in shaping employees’ mindset toward the concept of Safety. Other lessons learned? Do not rent a bus, buy one.
Practical Channel Hydraulics – Roughness, Conveyance and Afflux

By Donald W. Knight, Caroline McGahey, Rob Lamb and Paul G. Samuels


Practical Channel Hydraulics is a good reference guide for the practicing or research hydrologist or hydraulic engineer. The authors represent a number of well-respected institutions: Donald W. Knight, University of Birmingham, UK; Caroline McGahey, HR Wallingford Ltd, Oxfordshire, UK; Rob Lamb, JBA Consulting, UK; and Paul Samuels, Water Management, HR Wallingford, UK.

With the recent emphasis of flood plain management in countries such as United Kingdom, United States and elsewhere in Europe and other parts of the World, the book provides a thorough discussion of useful methodologies and tools that could be applied to study open channel hydraulics around the globe. Considering the recurrent experience of Mississippi River flooding in the United States, it has become increasingly apparent that Governments and river management authorities should be able to study and predict accurately the flood stages and water levels associated with anticipated storm or flood events across a variety of systems. In this rapid age of development, such studies could be targeted towards better management of flood plain areas, or refinements or optimisations of in-river structures such as bridges, culverts or others that might constrict flow during a higher frequency flood event. The authors have developed this book with a good discussion of the hydraulic properties and influences of such systems so that it lends itself naturally to such analysis to determine the nature and extent of flooding.

The book does a wonderful job of introducing simple channel hydraulics principles in the initial chapters, followed by detailed discussions of specific topics later on. Chapter 1 introduces the accompanying numerical model, CES-AES (Conveyance and Afflux Estimation System), while Chapter 2 deals with some basic concepts in open channel flow and introduces the reader to the complexities of modelling rivers and channels, and the uniqueness of the various features such as vegetation and hydraulic structures and controls.

Chapter 3 provides a good discussion of the scientific principles and issues related to flow structures, including theoretical formulations and underlying assumptions. It also provides a good discussion of uncertainties and how it can be best assessed and represented.

Chapter 4 serves as a good reference for the application of the accompanying model, CES-AES, introducing its many aspects such as estimating stage-discharge relationships, spatial distribution patterns of velocity and shear stress, effects of vegetation, and afflux at culverts and bridges.

Finally, Chapter 5 discusses application of the CES-AES tool in addressing ecological aspects, including habitat sensitivity, sediment geomorphology, and flow variations, and discusses model applications and associated issues.

Chapter 6 discusses the author’s remarks on future developments in the model and in the field of open channel hydraulics. The book also provides a summary of the associated finite element approximations (used in the CES) and the hydraulic equations (used in the AES) as Appendices.

One of the highlights of the book is that it provides a link (www.river-conveyance.net) from which the computer model, CES-AES can be downloaded free-of-charge, thanks to the funding provided to the authors by the host of environmental agencies in the United Kingdom and elsewhere, most notably the UK Environment Agency and the Engineering and Physical Sciences Research Council.

At its core, the CES-AES is composed of five modules:
1. the Roughness Advisor, which contains a vast library of potential bottom conditions one might encounter in river systems and their associated influence on river bottom roughness;
2. the Conveyance Generator, which uses the channel cross section and the bottom roughness to derive the channel conveyance;
3. the Uncertainty Estimator, which estimates the “upper” and “lower” bounds of “potentially credible solutions”, considering the possible variations in the input parameters and accounting for potential uncertainty surrounding each variable for each predicted water level;
4. the Backwater Module, which calculates the “backwater profile”
Books / Periodicals Reviewed

(i.e., the profile at a point of known river flow and stage height) upstream of a control; and
5. the Afflux Estimator, which evaluates the influence bridges and culverts on resulting final water surface profiles.

The CES-AES computer programme, available at the website referred to above, appears to be adequately well developed and is very user-friendly. Supporting technical documentation is also available for the technically savvy and intrigued reader. However, this book itself provides a good overview of the model application and thus is a handy tool for its execution. While the book may appear a bit too theoretical to some folks, it is intended for the academically oriented and the practitioner most interested in modelling such complex systems.

With its universal approach and the application of metric units, both book and software serve an international audience of consultants and engineers dealing with river modelling, flood risk assessment, maintenance of watercourses and the design of drainage systems. Suited as course material for training graduate Masters students in civil and environmental engineering or geomorphology who focus on river and flood engineering, as well as for professional training in flood risk management issues, open channel flow hydraulics and modelling.

This book can be ordered from CRC Press at http://www.crcpress.com/product/isbn/9780415549745

DR. RAM MOHAN
Anchor QEA, LLC

FACTS ABOUT
CONFINED DISPOSAL FACILITIES
INTERNATIONAL ASSOCIATION OF DREDGING COMPANIES
March 2010. 4 pp. Available free of charge online and in print.

This is the latest in the IADC series of concise, easy-to-read “management summaries”, which give overviews of essential information on specific dredging and maritime construction subjects.

Facts About Confined Disposal Facilities addresses a key environmental issue regarding dredging and the appropriate disposal of dredged material from navigation and maintenance projects. Indeed, safe disposal is almost always a critical deciding factor when determining the feasibility of a project. Contaminated dredged material can pose an unacceptable risk to the surrounding waters and land. Finding a suitable site for placing dredged materials is therefore essential in the planning and management of a dredging project and the decision should, if possible, be taken early on. Confined Disposal Facilities (CDFs) are areas specifically designed for the containment of contaminated dredged material that provides control of potential releases of contaminants to the environment. They offer a permanent and practical solution. Yet the lack of space for CDFs can often present a challenge and frequently arouses the NIMBY (Not In My Backyard) reaction. And their limited capacity makes it urgent to utilise them optimally. How to determine when and where a CDF should be placed and how to maximise the efficiency and lifetime of a CDF are the focus of this newest Facts About.

All Facts About are downloadable in PDF form at the IADC website: www.iadc-dredging.com. Printed copies can be ordered by contacting the IADC Secretariat: info@iadc-dredging.com.
6th Argentine Congress of Port Engineering & “Sustainable Development of River and Maritime Port Infrastructure in Latin America”
BUENOS AIRES, ARGENTINA
APRIL 5-7, 2010

The Argentine Congress and PIANC’s Latin American Seminar, “Sustainable Development of River and Maritime Port Infrastructure in Latin America,” will be held simultaneously next April as part of the PIANC 125th Anniversary Celebration in 2010. The event will be a meeting place and technical forum for professionals from the maritime and river port fields worldwide who are engaged in engineering, management, and port planning. The seminar will comprise managers, researchers, government representatives and private business coming from the most important Latin American countries.

Congress topics include: Development of LNG Terminals: project, construction, safety, and environmental aspects; renovation projects for urban port areas; upgrading waterways infrastructure; latest trends in barge river navigation; latest dredging technologies; breakwaters and shore protection; fluvial information systems for navigation safety; environmental aspects in river and maritime infrastructure.

For further information see: www.aadip.org.ar

34th International Seminar on Dredging and Reclamation
GRAND PARK CITY HALL HOTEL, SINGAPORE
APRIL 19-23, 2010

Regardless of the economic climate, the need for dredging and land reclamation continues. Maintaining and improving ports, the need to clean up past pollution in densely populated coastal areas and the urgency of coastal protection against rising sea levels in this time of climate change are all reasons why governments are investing in maritime infrastructure projects.

For this reason, International Seminar on Dredging and Reclamation, developed by the International Association of Dredging Companies (IADC), continues to be highly regarded and well attended. This 34th edition of the Seminar will be held in co-operation with the National University of Singapore.

The course is given by recognised experts from the world’s leading dredging companies and is aimed at (future) project managers, project staff and decision makers in governments, port and harbour authorities, offshore companies and other organisations that have to execute dredging projects. Over the last fifteen years, this intensive course has reached hundreds of professionals in maritime related fields thus laying the basis for many successful dredging projects around the globe. It has been presented in Delft, Singapore, Dubai, Buenos Aires, Bahrain, Tampico and Abu Dhabi.

The five-day course strives to provide an understanding of dredging through lectures by experts in the field and workshops. Some of the subjects covered are:
- land reclamation, the development of new ports and maintenance of existing ports;
- project phasing (identification, investigation, feasibility studies, design, construction, and maintenance);
- descriptions of types of dredging equipment and boundary conditions for their use;
- state-of-the-art dredging techniques as well as environmentally sound techniques;
- pre-dredging and soil investigations, designing and estimating from the contractor’s view;
- costing of projects and types of contracts such as charter, unit rates, lump sum and risk-sharing agreements.

Getting out of the classroom and into the field is an important feature of the seminar and so in each country a visit to a dredging project is planned, if possible combined with a trip on a working trailing suction hopper or cutter dredger.

The cost of the seminar will be € 2,950,-; this fee includes all tuition, seminar proceedings and workshops and a special participants dinner during the week. It is exclusive of travel costs and accommodation. If needed, IADC assists with finding accommodation in the conference hotel or at another facility. See page 32 for registration form.

For further information contact:
Frans-Herman Cammel, International Association of Dredging Companies (IADC)
Tel: +31 070 352 3334
• Email: cammel@iadc-dredging.com

Ports 2010: Respecting the Past, Building the Future
JACKSONVILLE, FLORIDA, USA
APRIL 25-28, 2010

The Ports and Harbors Committee of the American Society of Civil Engineer’s (ASCE) Coasts, Oceans, Ports, and Rivers Institute (COPRI) is pleased to announce the Ports 2010, the 12th in COPRI’s successful series devoted to port and harbor engineering. This continues ASCE’s partnership with the US Section of PIANC in the development of the ports engineering conference in the world. The conference will focus on current projects, practical issues, innovative engineering and construction, and state-of-the-art developments for port engineering. The 2010 conference will feature short courses, 36 technical sessions, keynote addresses, and social activities planned to facilitate ample professional interaction in an informal atmosphere.

The technical programme is enhanced by cooperation with the Jacksonville Port Authority (JAXPORT), a conference sponsor, which
will offer technical tours of its facilities. Ports 2010 also will feature expanded programs for young professionals and students.

For further information on the conference programme contact:
Conference Organizing Committee Chairman Dr. Stephen Dickenson,
• Email: stephen.dickenson@oregonstate.edu
Further updates are available at www.portsconference.org.

PIANC MMX
LIVERPOOL, UK
MAY 10-14 2010

The quadrennial PIANC International Navigation Congress is a leading technical forum for professionals engaged in navigation, ports and waterways. It is also a professional networking event. The 32nd Congress and 125th Anniversary celebration is to be held in the maritime city of Liverpool on the Mersey estuary in North West England. The Congress is open to all. Congress themes and topics are:
- Navigation for the future: Climate change, adaptation and mitigation and impact of ultra-large container ships, development of LNG terminals, in inland barge transport and in recreational navigation.
- Innovative design in ports and terminal infrastructures, inland waterways, locks and terminals and marinas and yacht harbours.
- Sustainable renovation: Upgrading old port areas, renovation of waterway infrastructure, ports and cities and life-cycle approach to maintenance.
- New major links and nodes: Inland waterways (incl. Seine-Scheldt), seaports and the Panama Canal.
- Working with nature: Dredging and sediments, breakwaters and shore protection and environmental management.
- Safety and security: Marine safety and risk analysis, modern mooring systems, information and communication technology and river information system.

For further information contact:
PIANC UK Section
• Email: info@piancmmx.org.uk
www.piancmmx.org.uk

35th IADC International Seminar on Dredging and Reclamation
JUNE 21-25 2010
UNESCO-IHE, DELFT, THE NETHERLANDS

Since 1993 the International Association of Dredging Companies (IADC) has regularly run week-long seminars especially developed for professionals in dredging-related industries to familiarise them better with the many aspects and challenges of dredging. Dredging experts from IADC member companies present the lectures and complement theory with their practical knowledge and experience. Amongst the subjects covered are the development of new ports and maintenance of existing ports; project phasing; descriptions of types of dredging equipment; costing of projects and types of dredging projects.

Events outside of the classroom are equally important and stimulating. A site visit to a local dredging project is conducted, where enthusiastic employees of an IADC company show participants dredging equipment in action and provide them with a deeper insight into the intricacies of the dredging operation. In addition, midweek a dinner is organised, where the participants, lecturers and other dredging employees can mingle and network.

The first IADC International Seminar on Dredging and Reclamation in 2010 will be organised in co-operation with UNESCO–IHE in Delft, The Netherlands from June 21-25. The Seminar is aimed at decision makers and their advisors in governments, port and harbour authorities, offshore companies and other organisations that have to execute dredging projects. The cost of the seminar will be € 1,950 (VAT inclusive). This fee includes all tuition, seminar proceedings, workshops and a special participants dinner, but is exclusive of all travel costs and accommodation.

For more information, please contact the IADC Secretariat:
Mr. Frans-Herman Cammel
• Email: camel@iadc-dredging.com

Sustainable Ocean Summit
BELFAST, UK
JUNE 15-17 2010

The Sustainable Ocean Summit (SOS) is the first international, cross-sectoral ocean sustainability conference for the private sector. The conference will bring together the wide range of industries that use marine space and resources around the theme of “Reducing Risk, Increasing Sustainability: Solutions through Collaboration”. The conference kicks off with the inaugural “Roundtable of Ocean Industry Association Leaders” (ROIAL) at the SOS opening plenary.

The main theme sessions will address: biosecurity and invasive species; sustainable ports; sound and ship strike impacts on marine mammals; marine debris; decommissioning ships and structures; offshore renewable energy interaction with other industries; the Arctic Ocean; climate change and ocean science; fisheries and aquaculture interaction with other industries; the role of finance, insurance and legal sectors in sustainability. “Marine Spatial Planning - What Ocean Industries Need to Know” will be the focus of a special half-day seminar on June 17 2010 to highlight this emerging approach to marine governance.

The World Ocean Council (WOC), an international business leadership alliance on ocean sustainability and stewardship, is generating significant attention from industries worldwide, including shipping,
oil and gas, fisheries, aquaculture, ports, dredging, mining, insurance, finance, renewable offshore energy, tourism, shipbuilding, dredging, marine technology and others.

For further information:
www.oceancouncil.org or
• Email: paul.holthus@oceancouncil.org,
Tel: +1 (808) 2779008

WODCON XIX
GRAND EPOCH CITY RESORT & EXHIBITION CENTRE,
BEIJING, CHINA
SEPTEMBER 8-12 2010

WODCON XIX Congress and Exhibition, with the theme, “Dredging makes the world a better place”, will be organised by EADA in association with CHIDA. Papers will cover the following topics:
- Relationship between dredging and sustainable development
- Dredging technology and research
- Beneficial uses of dredged material
- Environmental aspects of dredging
- Survey and positioning technology and equipment
- Physical and numerical modeling
- Sediment dewatering, treatment and disposal
- Dredging equipment
- Dredging project case studies.

Technical visits and tours will take place on September 13-14, after the Conference.

For further information contact:
Mr. Yang Zunwei, Chinese Dredging Association CHIDA
• Email: world.chida@yahoo.com.cn, www.chida.org

Capt. David Padman, EADA
• Email: david@pka.gov.my

John Dobson, EADA
• Email: dobsoncj@hotmail.com

Anna Csiti, CEDA Secretariat
• Email: ceda@dredging.org

Dr. Ram Mohan, WEDA
• Email: rmohan@anchorqea.com

Dr. Robert Randall, Director Dredging Studies
• Email: r-randall@tamu.edu

Panama Chapter 2010 Conference
EL PANAMA HOTEL, PANAMA CITY, PANAMA
APRIL 26-28, 2010

WEDA’s Panama Chapter, in conjunction with WEDA and Texas A & M University will host its Second Dredging Conference with the theme, “Dredging and the Panama Canal Expansion – An Update”. The conference will focus on dredging and environmental issues associated with new and innovative dredging projects in Panama. Topics of Interest are: Panama Canal expansion dredging projects, Pacific entrance dredging, fresh water dredging, Atlantic entrance dredging, Access Channels dry excavation & dredging, geotechnical & geological dredging aspects, environmental aspects, new technologies and equipment, special projects and techniques, regional projects of interest including Dique del Canal de Colombia, Rio Sixaola Dredging & Land Reclamation and Islas de Punta Pacifica in Panama.

Also included in this three-day conference are onsite visits to the following projects: Pacific Entrance Dredging, Access Channels Excavation and Dredging, Gaillard cut: dredging and Gatun Lake Fresh Water Dredging, and the Atlantic Entrance (Tentative). The conference will be a forum for discussions between North, Central and South American dredging contractors, Panama Canal Authority, other Government Agencies, environmentalists, consultants, academician, civil/ocean engineers who work in the fields of dredging, navigation, marine engineering and construction and the enhancement of the marine environment. Interested Authors should submit a one-page Abstract to one of the following Panama, WEDA & Texas A&M Technical Papers Committee Members:

Dr. Ram Mohan
Tel: +1 267 756 7165, Fax: +1 267 756 7166
• Email: rmohan@anchorqea.com

Dr. Robert E. Randall
Tel: +1 979 845 4568, Fax: +1 979 862 8162
• Email: r-randall@tamu.edu

Carlos A. Reyes
Tel: +1 507 276 6209, Fax: +1 507 276 0661
• Email: OPDV-OF1@pancanal.com

Western Dredging Association 30/
Texas A & M Dredging Seminar 41
RIO MAR WYNDHAM RESORT,
SAN JUAN, PUERTO RICO
JUNE 6-9, 2010

The theme of the 2010 Western Dredging Association (WEDA) and Texas A & M University will host its Annual Western Hemisphere Dredging Conference (WEDA 30 and TAMU 41) is “Dredging Works for the Economy and the Environment”. It will focus on dredging and
environmental issues associated with dredging programmes that create a strong economy and enhance the marine environment. This conference will be a forum for discussions between North, Central and South American dredging contractors, port authorities, other government agencies, environmentalists, consultants, academicians, civil/ocean Engineers throughout the Western Hemisphere.

The Technical Papers Committee will review all one-page Abstracts and notify authors of acceptance and final manuscript instruction for production of the proceeding on CD’s. One page abstracts must include: descriptive title, author names, author contact information (company name, address, phone, fax and email address) and abstract (<300 words). Submission of Abstract implies a firm commitment from the author to present the paper at the Conference. Interested Authors should send their one page abstract to one of the following:

Dr. Ram Mohan
Tel: +1 267 756 7165
Fax: +1 267 756 7166
• Email: rmohan@anchorqea.com

Dr. Robert E. Randall
Tel: +1 979 845 4568
Fax: +1 979 862 8162
• Email: r-randall@tamu.edu

Robert Wetta
Tel: +1 985 479 8050
Fax: +1 985 479 1367
• Email: rbwetta@dscdredg.com

For further information about registration for the conference contact:
Larry Patella, WEDA Executive Director
Tel: +1 360 750-0209, Fax: +1 360 750 1445
• Email: weda@comcast.net
http://www.westerndredging.org

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**Port & Terminal Technology 2010**
7TH INTERNATIONAL CONFERENCE & EXHIBITION
LONG BEACH, CALIFORNIA, USA
OCTOBER 5-6 2010

Now in its 7th year, Port & Terminal Technology has established itself as a “must-attend” key industry event. Because of the success in 2009 in the USA, the 2010 event will return to the USA delivering a diverse and in-depth conference programme complimented by an impressive line-up of industry experts and market leaders. Exploring the latest developments, issues, trends and technology affecting ports and terminals around the globe, the conference will provide delegates an invaluable learning opportunity as well as an excellent platform for discussion, debate and networking. The event will be complimented by an additional one-day workshop on Ports and the Environment.

The conference is especially designed for representatives from operations, maintenance and engineering.

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**Ports & The Environment 2010**
3RD INTERNATIONAL CONFERENCE
AMSTERDAM, THE NETHERLANDS
DECEMBER 1-2 2010

With the environment being a vital issue for ports and terminals worldwide the conference will return in December 2010 to examine key issues and topics such as noise, dust and exhaust emissions, environmental dredging, port expansion and development, ballast waste management, cold ironing, hazardous cargo, congestion, legal framework, terminal capacity and social-eco development issues affecting ports and terminals worldwide.

A call for papers is currently open for all thee above-mentioned Port events. For full details and to register to attend see www.millenniumconferences.com.

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**For further information, please contact:**
Claire Palmer – Event Manager
Tel: +44 (0)1628 820 046,
Fax: +44 (0)1628 822 938
• Email: claire@millenniumconferences.com
www.millenniumconferences.com

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**Port Finance & Investments 2010**
4TH INTERNATIONAL CONFERENCE
GRAND HOTEL, AMSTERDAM, THE NETHERLANDS
JUNE 1-2 2010

The conference will examine the challenges associated with developing, financing and managing port expansion plans and major investments. Revealing specific finance mechanisms being adopted for global port and terminal projects and covering key issues currently facing the port investment and finance market around the globe, the programme will highlight the latest economic trends and their impact on investment and financing opportunities, explore the necessary investment requirements and analytical assessments as well as explore specific finance mechanisms being adopted for global port and terminal projects.
Representatives of port authorities, companies, and individuals, with an education level equivalent to at least a B.Sc. or comparable work experience, interested in attending should register as soon as possible since the number of participants is limited. Final registration will only take place after IADC has received a non-refundable deposit of € 500 per participant.

**REGISTRATION FORM**

Male: O  Female: O

Initials: ................................................  Title: ....................................................

Surname: .............................................  First name: ...........................................

**Company address**

Company: ............................................  Phone: ..................................................

Address: .............................................  Mobile: .............................................

Postal code: ......................................  Fax: ...................................................

City: ..................................................  Email: ...............................................  

State: ..................................................  

Country: ............................................. 

**Private address** (only if you want to receive the information at your home address)

Address: .............................................  Postal code: ..........................................

City: ..................................................  State: ..................................................

Country: .............................................  Profession: ...........................................

O I would like to participate in this seminar. Please register me with above-mentioned details.

A copy of my passport and a business card is attached. I will pay a deposit for registration of € 500.

(Please note, seminar will only be held if sufficient participants register)

O I would like to book a room at the Grand Park City Hall Hotel from 19 - 23 April 2010 at SGD 230,- per night, excluding tax. Payment will be made directly to the hotel.

Signature: 

PO Box 80521, 2508 GM The Hague, The Netherlands
Fax: +31 70 351 2654
Email: info@iadc-dredging.com

**MORE INFORMATION**

For more information, please contact the IADC Secretariat, Mr. Frans-Herman Cammel,
Tel: +31 70 352 3334  Email: cammel@iadc-dredging.com.
Guidelines for Authors

Terra et Aqua is a quarterly publication of the International Association of Dredging Companies, emphasizing “maritime solutions for a changing world”. It covers the fields of civil, hydraulic and mechanical engineering including the technical, economic and environmental aspects of dredging. Developments in the state of the art of the industry and other topics from the industry with actual news value will be highlighted.

- As Terra et Aqua is an English language journal, articles must be submitted in English.
- Contributions will be considered primarily from authors who represent the various disciplines of the dredging industry or professions, which are associated with dredging.
- Students and young professionals are encouraged to submit articles based on their research.
- Articles should be approximately 10-12 A4s. Photographs, graphics and illustrations are encouraged. Original photographs should be submitted, as these provide the best quality.
- Digital photographs should be of the highest resolution.
- Articles should be original and should not have appeared in other magazines or publications.
- An exception is made for the proceedings of conferences which have a limited reading public.
- In the case of articles that have previously appeared in conference proceedings, permission to reprint in Terra et Aqua will be requested.
- Authors are requested to provide in the “Introduction” an insight into the drivers (the why) behind the dredging project.
- By submitting an article, authors grant IADC permission to publish said article in both the printed and digital version of Terra et Aqua without limitations and remunerations.
- All articles will be reviewed by the Editorial Advisory Committee (EAC). Publication of an article is subject to approval by the EAC and no article will be published without approval of the EAC.

Terra et Aqua is an English language journal, articles must be submitted in English. Contributions will be considered primarily from authors who represent the various disciplines of the dredging industry or professions, which are associated with dredging. Students and young professionals are encouraged to submit articles based on their research. Articles should be approximately 10-12 A4s. Photographs, graphics and illustrations are encouraged. Original photographs should be submitted, as these provide the best quality. Digital photographs should be of the highest resolution. Articles should be original and should not have appeared in other magazines or publications. An exception is made for the proceedings of conferences which have a limited reading public. In the case of articles that have previously appeared in conference proceedings, permission to reprint in Terra et Aqua will be requested. Authors are requested to provide in the “Introduction” an insight into the drivers (the why) behind the dredging project. By submitting an article, authors grant IADC permission to publish said article in both the printed and digital version of Terra et Aqua without limitations and remunerations. All articles will be reviewed by the Editorial Advisory Committee (EAC). Publication of an article is subject to approval by the EAC and no article will be published without approval of the EAC.