AUGUST 2021 #41

Information Bulletin

Centre of Documentation, Research and Experimentation on Accidental Water Pollution

FEATURE: Containers

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RESPONSE

Grounding of bulk carrier *MV Wakashio* in Mauritius

FEATURE

Containers

Cedre NEWS

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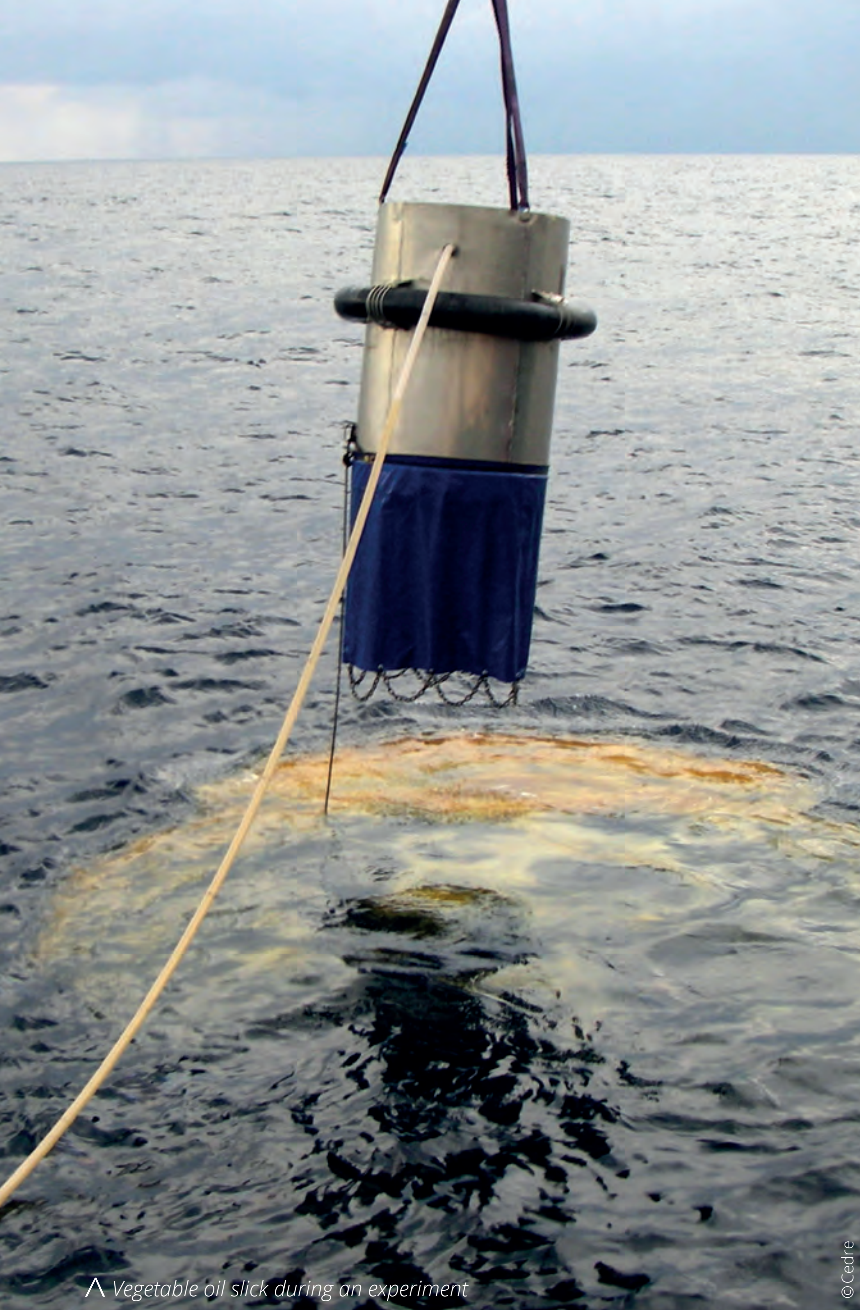

Vegetable oil slick during an experiment

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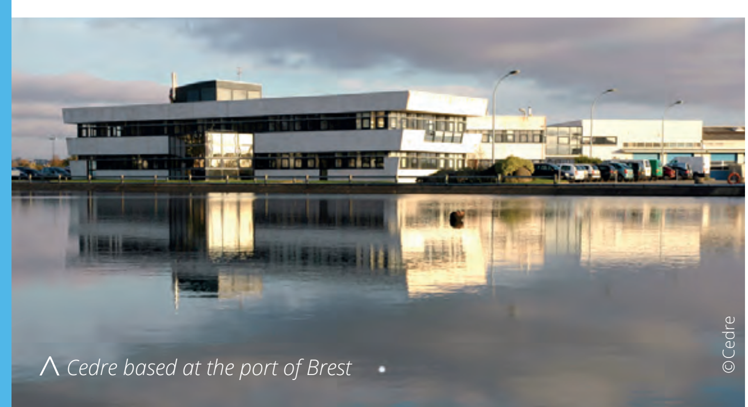

Cedre based at the port of Brest

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EDITORIAL

Maritime container shipping offers a concrete illustration of the sharp rise in worldwide maritime trade. The figures are striking: the capacity of container ships is constantly growing, jumping from 2,500 Twenty-foot Equivalent Units in 1971 to over 23,000 today. This evolution brings extraordinary opportunities but also means new challenges. The risk of containers being lost overboard is escalating in parallel to this development, generating disparate pollution with major consequences for maritime and environmental safety. Plastics and flammable, toxic and explosive chemicals are transported side-by-side in these stacks of thousands of containers, whose contents are recorded in a simple declaration and are very difficult to verify.

The maritime industry estimates that over 1300 containers have been lost overboard annually over the past decade. The release of their contents, depending on the degree of degradation of the container, is unpredictable and can occur several years after falling into the sea. Containers can also cause major incidents onboard ships, sometimes resulting in the loss of lives.

MSC Flaminia, Svendborg Mærsk, Mærsk Honam, MSC Zoe, Yantian Express, Grande America… The list of container ship incidents continues to grow, without forgetting suspected incidents (the sinking of the *Avel Vor* probably caused by a container). Today, rapidly obtaining accurate information on the goods transported is therefore a major priority in the event of an incident and I commend Cedre on their initiative to devote this Bulletin to the issues raised by the expansion of maritime container shipping.

Denis Robin,
Secretary-General for the Sea

Containers for dummies

Container ship in dock

By Nicolas Tamic, Operations Manager at Cedre.

On 3rd May 1966, Rotterdam: the container ship the *Fairland* completed the first ever transatlantic crossing to deliver some 220 containers to Europe from America. In 2019, according to the latest UNCTAD (United Nations Conference on Trade and Development) report, some 2 billion tonnes of goods were shipped in containers. This staggering growth is spearheaded by the TEU – Twenty-foot Equivalent Unit – the standard shipping container measuring 6.096 m in length. Join us on a journey of discovery as we explore this emblematic unit of measurement.

Why transport goods in containers?

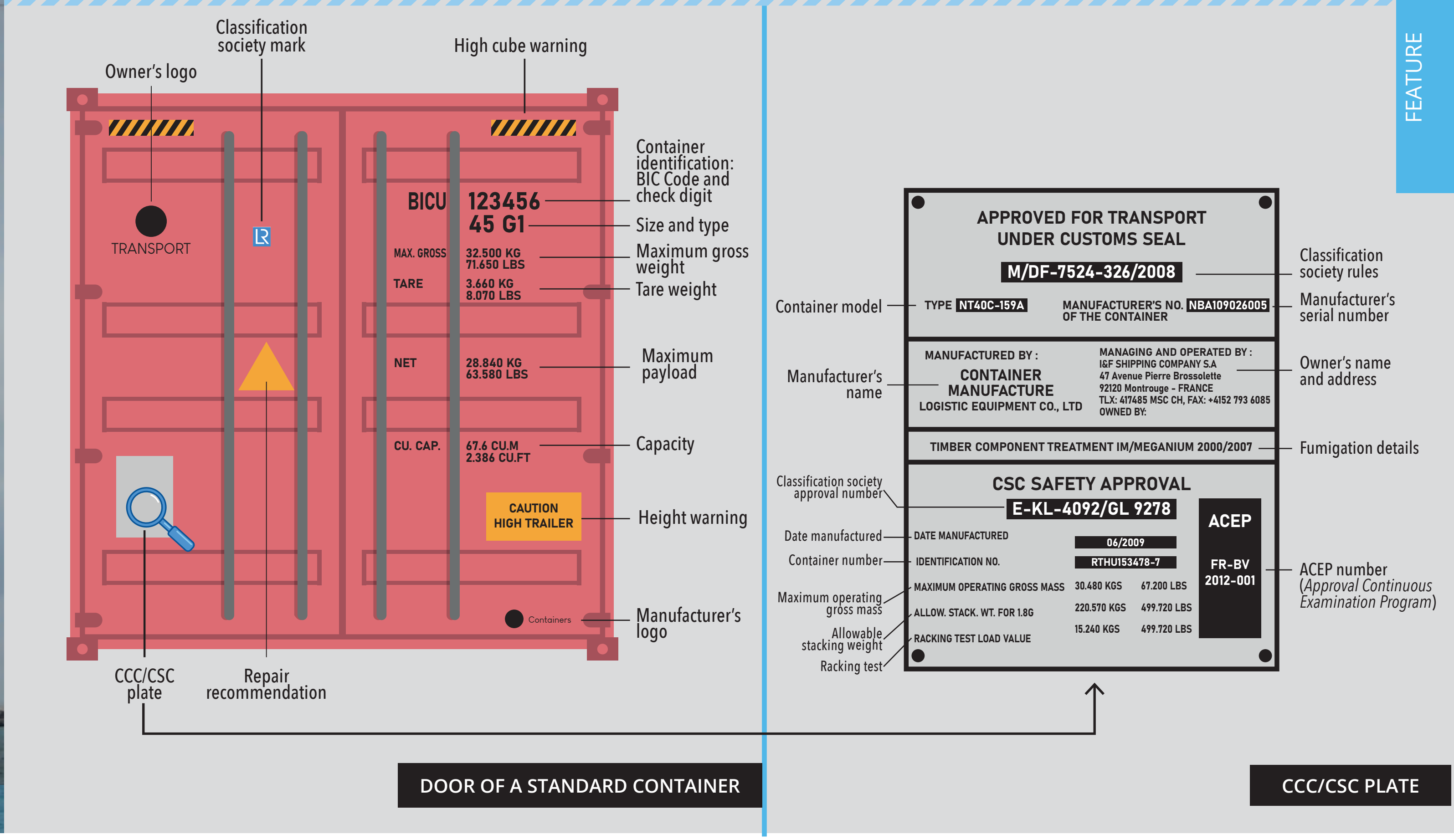
Maritime shipping entails myriad risks (storms, lashing failure, water damage, soiling, ship sweat, breakage, handling failure, theft and loss overboard) liable to affect the transported goods and other vessels. Shipping containers are the best way to protect these goods. They are watertight, robust, secure, very easy to handle and reusable. Their considerable advantages in terms of intermodal transport, combined with the minimisation of load breaks, explain the growth of containerised maritime transport, which has today led to vessels with impressive capacities of 24,000 TEU. In total, according to the Alphaliner database, over 23 million TEUs are currently in circulation.

The TEU: the "unstandardised" standard

Container typology is complex. While the standardised TEU was intended to facilitate shipping, it led to the development of complex containers that make loading operations onboard ships more difficult.

The specifications for freight containers are set out in ISO standards 1496-1 and 668, which state that a TEU must be 20 foot long, 8 foot wide and 8.5 foot high. The volume and payload capacity of a dry cargo container (designed to carry bulk cargoes) range from 33 m^3 and 23 tonnes (20 foot) to 67 m^3 and 25 tonnes (40 foot). Forty-foot equivalent units (2 TEUs) were soon to appear, followed by containers with specific heights and lengths. These include high cube containers (9 feet high, 76 m^3 and 25 tonnes payload capacity), half height containers (4.25 feet high), babytainers (less than 20 feet long) and pallet-wide containers (45 feet long with a payload capacity of 42 tonnes).

Over and above these size and capacity criteria, containers can also be specifically designed for the type of cargo transported. Examples include reefers (refrigerated transport), open-top (simply covered with a tarpaulin), open-side/full-access (allowing side loading), tanks, ventilated (livestock transport), flat-rack (with removable side walls) or more anecdotal examples such as CMA-CGM's Aquaviva (equipped with a filtration and oxygenation system for the transport of live lobsters).



DOOR OF A STANDARD CONTAINER

CCC/CSC PLATE

Container numbering

Every container features information that can be used to identify it.

Identification number:
This number, attributed by the Bureau International des Containers (BIC), is composed of a 3-letter prefix identifying the owner and an additional letter representing the equipment identifier (U for freight containers; J for detachable freight container-related equipment, and Z for container-related trailers and chassis). The following 6 numerals are chosen by the owner and the final boxed number is the check digit that provides a means of validating the consistency between the prefix and the 6-digit serial number.

Size and type code:
Composed of 4 numbers and letter, it comprises a letter or a number indicating the container length (2 for 20 feet, 4 for 40 feet, L for 45 feet and M for 48 feet). The second digit specifies the container height (2 for a normal height of 8 feet, 5 for a high cube). Finally, a combination of a letter and a number identifies the container type (G1: dry; R1: reefer, U1: open-top, P1: platform; T1: tank).

CCC/CSC plate:
This plate, visible at the bottom of the left door, is its "seaworthiness certificate". It is valid for 5 years from the date of manufacture, then is renewed every 30 months. The Combined Data Plate specifies that the container is in compliance with the provisions of the International Convention for Safe Containers (CSC) which aims to ensure the safety of human life and property when handling containers and to facilitate the international transport of containers by providing uniform international safety regulations. The plate also indicates that the container complies with the Customs Convention on Containers (CCC).

Additional information may be displayed on the container according to the goods transported. This is the case for dangerous goods which must comply with the IMDG code and the specific markings set out in this code, in particular if the product is environmentally hazardous (see p.11).

Container tracking

The tracking of containers throughout the supply chain is ensured by associating the container number with its 6-digit customs seal number at the port of departure. This guarantees integrity during transport. The shipowner continuously tracks every container from loading port to unloading port using internal systems implemented by the ship planner. The ship planner is responsible for drawing up the container ship's stowage plan taking into account several parameters: the vessel's technical, operational and commercial constraints, the container's position according to the goods it contains (reefers, dangerous goods, etc.), its weight, size, handling equipment available at ports of departure and arrival, etc.

Real-time container tracking is gradually being introduced. With the advent of the Internet of Things (or IoT), containers can now benefit from connectivity meaning that they can be tracked in real time. This could be beneficial for maritime security in the event of a container being lost overboard.

Major worldwide maritime shipping trends

By the French Directorate of Maritime Affairs, Commercial fleet unit.

Cosco Shipping Lotus *container ship passing through the Panama Canal*

The challenges of maritime shipping routes in different parts of the world are mainly related to the control of strategic areas, freedom of navigation, access to resources and the extension of zones of influence. Shipping traffic varies significantly according to the type of cargo.

For dry bulk cargoes (ores, grain) and liquid bulk cargoes (oil), South-North flows take place from raw material producing countries to consumer countries (industrialised countries). In the case of crude but also refined oil, the Middle East plays a key role, with strategic passages such as the Suez Canal and the Strait of Hormuz, through which 30% of all seaborne-traded crude oil passes.

East-West trade, consisting of three main routes (Transatlantic, Asia-Europe, Trans-Pacific) linking all the major economic regions, is the dominant containerised freight flow. These routes pass through two interoceanic canals (Panama, Suez) and three straits (Malacca, Bab-el-Mandeb and Gibraltar). Trans-Pacific containerised trade overtook Transatlantic trade in 1985, before almost drawing level with Europe-Asia trade in the mid-2000s. Today, the Trans-Pacific (27.8 million TEU) and Europe-Asia (24.8 million TEU) routes are dominant, well ahead of the Transatlantic route (8.1 million TEU).

Since the 2008 crisis, although the Asia-Europe and Transatlantic trade arteries remain dominant, a very rapid surge along interregional, North-South and South-South routes has boosted growth in global containerised trade. South-South and intraregional trade flows now account for 40% of the total volume of containerised freight. Of these non-mainlane routes, intra-Asian movements totalled over 30 million TEU per year.

The expansion of the Panama Canal in 2016 helped to meet the growing demand for the transport of dry bulk and containerised cargoes onboard very large vessels and to access new markets. The Panama Canal is the second busiest canal, after the Suez Canal. During the 2018/2019 period, more than 13,000 vessels passed through the Panama Canal carrying a total of 442.1 million tonnes of cargo, up 9.5% year-on-year. Thanks to economies of scale and reduced transit times, the canal's expansion has attracted cargo transiting from Asia to the east coast of the United States. It also contributes to the development of a major transhipment hub in the Caribbean region. Gas transport also benefits from the expansion of the canal, as much of the US gas is exported from Houston to Asia.

The new Suez Canal, which opened in 2015, was intended to ease the traffic flow by shortening transit time. It involved digging a new 35 km waterway, resulting in the elimination of a waiting area and more importantly allowing traffic to travel in both directions simultaneously. The canal is a key passage for container and oil shipping. However, the effects of the opening of the new canal remain limited for economic reasons: toll levels, low oil prices encouraging ships to sail around the tip of Africa, competition with other routes and the plateau in world trade. In 2019, 18,880 ships transited through the Suez Canal, up almost 4%.

With sea ice melting earlier each year, the prospect of a polar sea route linking the Pacific to the Atlantic emerged a few years ago. Despite these projections, the significant development of a polar route is not currently on the cards for various reasons. Firstly, maritime shipping remains difficult and risky in polar waters, and secondly, the commercial operation of ships is based on a model that is unsuited to polar navigation.

How will these trends evolve in the future? Will they not be disrupted by new environmental rules? It is clear that the integration of environmental costs in the price of maritime shipping could encourage regionalised trade. However, the possible effects of accelerated development in certain areas of the world (Africa, South Asia) on the continuous growth of major commercial shipping lines should not be overlooked.

Container ship behaviour

By François-Xavier Rubin de Cervens, Director of the French marine casualties investigation board, BEAmer.

The question of lost containers is a sensitive subject for France because of its geographical exposure to ship-related incidents. At International Maritime Organization level, although there have been developments through mandatory container weight verification prior to loading, there is still progress to be made. However, awareness is growing as a result of incidents that have affected other foreign shores.

While large-scale losses during major incidents are well identified and investigations conducted (*CMA-CGM Otello* (BEAmer report), *Svenborg Maersk*, *CMA-CGM G. Washington*, *MSC Zoe* etc.), small-scale losses are far less prominent, even although the undeclared loss of a few isolated containers also constitutes a non-negligible navigational hazard. The French marine casualties investigation board, BEAmer, is set to publish a report on a study it conducted which shows that, even at a low angle, a collision with a semi-submerged container can cause a breach liable to sink a 60-metre ship.

Post-incident technical investigation reports provide similar and complementary insight. The following few lines focus more specifically on lashings and twistlocks.

In principle, the subject is fairly straightforward: if containers are lost overboard during transit, it is simply because they are not sufficiently secured on board or because the container structure cannot withstand accelerations. Large-scale losses are connected to the ever-increasing size of container ships, jumping from 1500 TEU (Twenty-foot Equivalent Units) in 1968 to 24,000 TEU today, a sixteen-fold increase. However, the lashing system for containers, a multimodal (and not only shipborne) means of transport, remains relatively unchanged, while the constraints have greatly increased in maritime shipping. There has been a leap in ship widths and stack heights; containers can be stacked 8 to 11 tiers high above the main deck. This calls for the strictest of care in positioning containers, particularly in terms of their weight, however this may be overridden by commercial constraints.

Given their size, the behaviour of Ultra Large Container Ships (ULCS, 400 m long and 60 m wide) cannot be controlled "instinctively" by the master as was the case in the past, with the possible appearance of roll, sometimes parametric rolling, accentuated by the very high stability of these vessels. The master must therefore use specialised software capable of predicting the ship's behaviour to support his route-planning. Such software is not systematically installed on board and even when available it is not always used or mastered (*Svendborg Mærsk*).

The ship can be subject to rapid heavy rolling of up to thirty degrees, which, given the width of the ship, results in very severe container movements. The container stacks are exposed to accelerations beyond the scope of conventional calculations, making the usual references obsolete. In this case, even if no anomaly is detected and the containers are secured in compliance with the pre-established plan, the twistlocks as well as the containers themselves can no longer withstand the strain. In the case of a ULCS like the *MSC Zoe*, which had phenomenal stability combined with a length of 397 m, the report by the German Federal Bureau of Maritime Casualty Investigation (BSU) indicates that elements of the Code of Safe Practice for Cargo Stowage and Securing (CSS Code) become inapplicable. The provisions of the Cargo Securing Manual may also be inappropriate for very large container ships. Thus, aside from defects of certain automatic or semi-automatic twistlocks, as mentioned in the BEAmer report on the *Otello* incident, in certain sea conditions failure can occur on compliant parts with equally compliant securing.

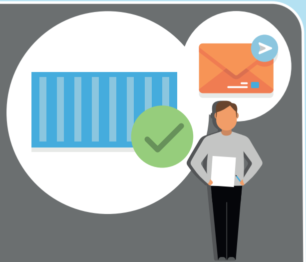
This leads to the conclusion that container securing and resistance standards should be reviewed to take into account increasing ship size.

© MSC Zoe report, Germany BSU – German Waterway Police

^ *Broken parts: deck fittings, twistlocks, turnbuckles*

A container's journey from Asia to Europe

Some 23 million containers are currently in the hands of shipping companies. In order to ensure their safe delivery, each container follows a precise logistical itinerary involving numerous parties. Here you will discover, in a simplified, stepwise approach, all the operations involved in transporting a shipment from Asia, where the goods were produced, to the buyer in Northern Europe.



Step 1: booking

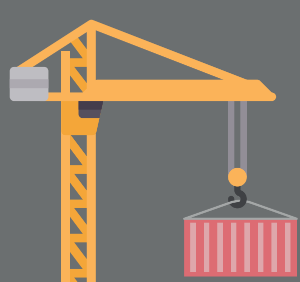
The booking is placed by a forwarder (freight forwarder and customs agent who manages the multimodal supply chain from shipper to consignee) with a shipping company. This step consists in reserving a "slot" to transport a container from a loading port to a destination port. The booking is confirmed by documents sent to the forwarder following which they commission a carrier to pick up a container from the shipping company's yard.

Step 2: packing or "stuffing"

Packing, also commonly referred to as "stuffing", is the process of loading and stowing cargo inside the container. The container may be packed as an FCL (Full Container Load) or LCL (Less than Container Load), a part load which is a more economical solution. This operation is conducted either by the producer or by a specialist handling company. The inventory of the goods contained, the name of the shipper and the consignee, the markings and numbers, the number and type of packages, the quantity and a description of the goods will be recorded on a cargo manifest. The container is then sealed.

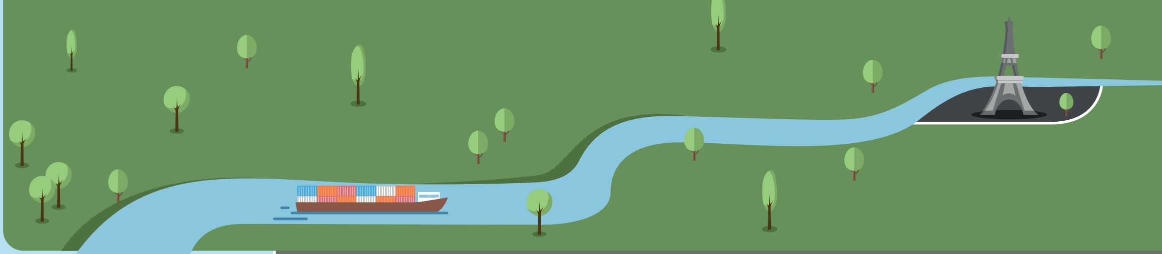
Step 3: arrival at container terminal

The carrier (road/rail) is granted access to the container terminal after declaring the container number and associated seal number to the port authority. They can then drop off the container in the terminal's onshore operations area. The container will then be transferred to the storage area and then to the port operations area in order to be loaded on board the shipping company's vessel using specialised lifting equipment. Meanwhile, the forwarder will have completed the export customs declaration.



Step 4: loading onto ship

The container is loaded on board in compliance with the ship planner's instructions. The ship planner designs a loading plan for the ship, organising the containers according to their final destination, size, cargo, container stack weight, stowage constraints and ship stability. Once the container has been loaded, the ship's master issues the bill of lading, which is the container's "transport ticket" so to speak, and includes the name of the shipper and the consignee of the goods, the shipping company that issued the bill of lading, the origin freight forwarder, the destination freight forwarder and the freight payer.



Step 8: returning the container to the shipping network

Once emptied, the container is dropped off at the shipping company's nearest container yard ready for its next journey. The container will be taken out of service after approximately 10 to 15 years. It can then be recycled, especially if it is a "dry freight" container, i.e. a general purpose container made of steel and wood. It may alternatively be given a new life as a storage structure, a modular housing element or even a swimming pool!

Step 7: delivery to final destination

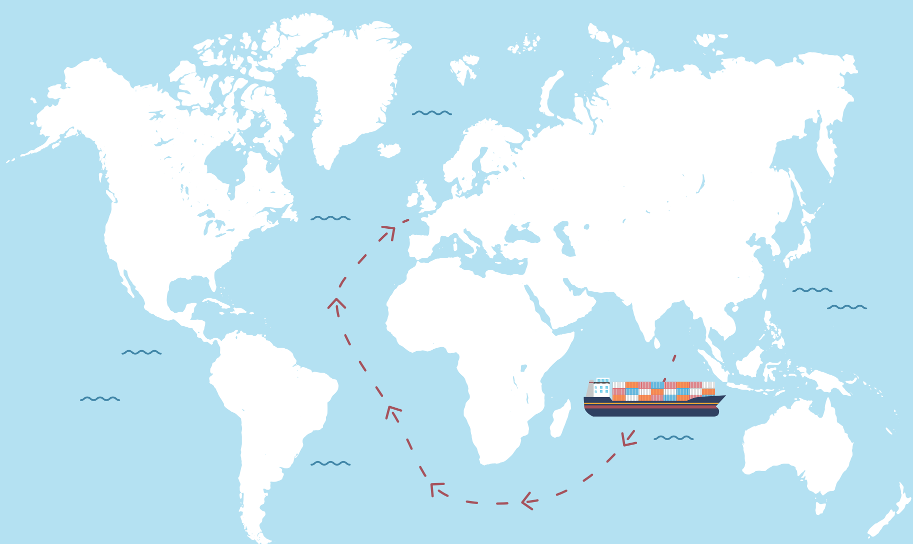
Depending on logistical requirements, the container will either be dropped off in a warehouse (in the case of consolidation/deconsolidation) for delivery to the end customer, or the container will be dropped off directly at the customer's premises by rail or road, the advantage of containers being that they allow multimodal transport. The container may even continue its journey by barge via inland waterways and be unloaded and customs cleared in a river terminal, as is the case in Paris-Gennevilliers.

Step 6: unloading

The unloading process is the reverse of the loading process, with the container passing through the port operations, storage and onshore operations areas. Meanwhile, the forwarder will deal with the formalities for customs clearance of the goods.

Step 5: shipping

The ship will take the most cost-effective and safest route. It may make stopovers before delivering the container. Depending on the loading plan and certain logistical constraints, the container may be unloaded at the port of call and then reloaded before sailing to its final destination port. Near the entrance to the English Channel, if the ship is powered by fuel oil and does not have a scrubber system, it will have to switch fuel in order to comply with the Sulphur Emission Control Area (SECA) regulations which require the use of fuel with a very low sulphur content (0.1 %) to reduce atmospheric emissions of sulphur oxides in the Channel, North Sea and Baltic Sea. As the ship approaches the port of destination, the shipper's freight forwarder and the shipping company inform the consignee's freight forwarder of the forthcoming arrival of the container.



Container risks

By William Giraud, engineer at Cedre.

What is the definition of a container and what does it carry?

The 1972 Convention for Safe Containers, adopted by the UN and IMO, defined the term container as a transport unit (frame, demountable tank or other similar unit) with an internal volume of at least one cubic metre, designed to carry goods and be readily handled, in particular when being transhipped from one mode of transport to another (maritime, inland waterway, rail or road). It goes without saying that a wide variety of products can be transported in containers. The risks are related to several aspects, in particular navigation risks and risks inherent to the type of cargo transported and the consequences in the event of rupture of cargo packages.

What are the risks related to navigation?

Containers can be transported on board container ships, but also on any type of vessel that meets the requirements of the SOLAS Convention*. This includes ferries, ro-ro vessels or even other types of ships that occasionally carry containers, such as inland waterway transport. Despite the existence of the IMO Code of Safe Practice for Cargo Stowage and Securing (CSS Code*), and the update of the SOLAS Convention which, since 2016, requires the shipper to declare the verified gross weight of the container, recent maritime incidents (see p. 12 and p. 15) show that the loss of containers overboard is still a problem today.

Cedre and the French Navy began working on this issue in 2008 through the Interreg LostCont project (see Cedre Information Bulletin n°25).

What are the risks relating to the cargo in the containers?

From a regulatory point of view, the risks associated with containerised transport are dependent on the type of cargo but also its packaging. The documents outlined below provide more detailed information.

The Globally Harmonized System of Classification and Labelling of Chemicals (GHS)

The objective of the GHS is to make information available to protect human health and the environment during the handling, transport and use of chemicals. The GHS is intended to raise the awareness of users who may be exposed to a chemical or mixture of chemicals. To do so, the GHS defines criteria for the classification, labelling and packaging of chemicals. In particular, it puts forward a standardised structure for safety data sheets, which is included in the European CLP and REACH regulations. It also defines the size requirements for the standardised labels that must be displayed on the container and on which the name of the substance(s) and the hazard pictogram(s) must appear.

The UN Recommendations on the Transport of Dangerous Goods (TDG)

This document calls for the standardisation of dangerous goods transport regulations around the world. This document, in which Volume II takes the form of model regulations, is followed by various modal regulations such as the IMO International Maritime Dangerous Goods Code (IMDG Code*), the European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways (ADN), the Regulations concerning the International Carriage of Dangerous Goods by Rail (RID) and the European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR). The TDG Model Regulations focus on hazards related to transport and storage such as physical hazards, flammability/explosion, immediate health hazards (acute toxicity, by inhalation or skin contact, and skin corrosion) and severe environmental hazards for water. Containers carrying dangerous articles or substances must be listed in the dangerous goods manifest and each container must be marked with placarding and hazard pictograms in accordance with the regulations for the relevant mode of transport.

These Recommendations were created prior to the GHS and were used as a reference for defining certain classification criteria that are common to both systems. Some articles, substances and mixtures may be classified as dangerous goods by the TDG Model Regulations (and therefore also by IMDG) but not by GHS. This is the case, for instance, of lithium batteries.

© www.unece.org

∧ *GHS pictograms*

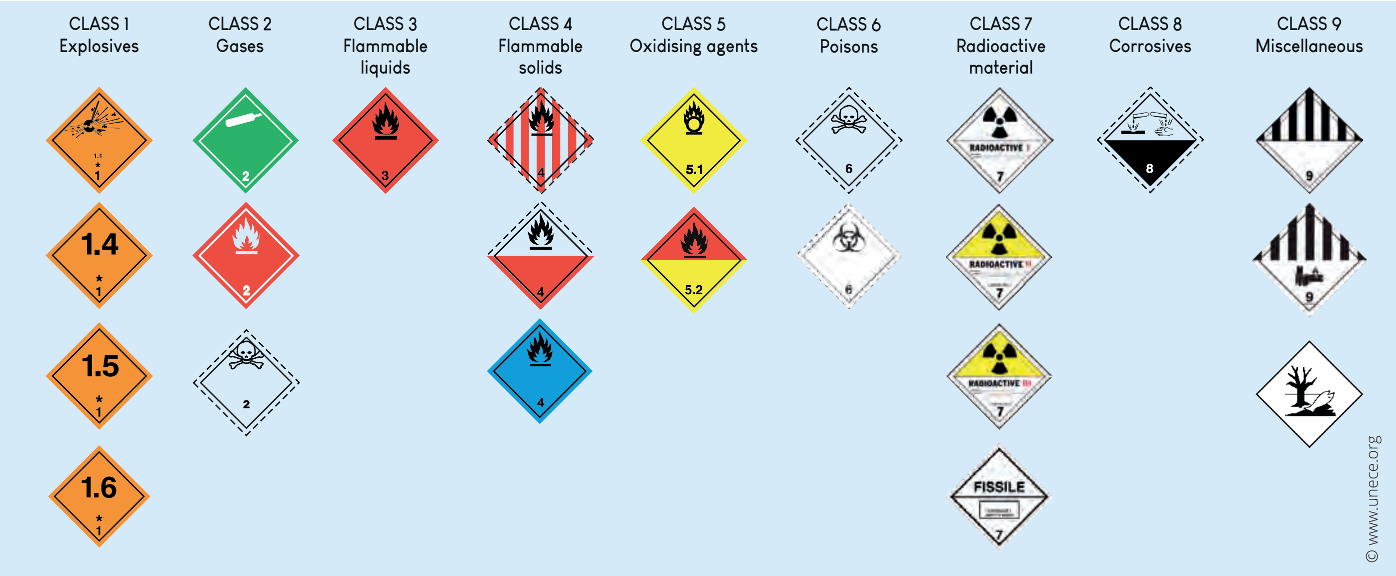
IMO/ILO/UNECE Code of Practice for Packing of Cargo Transport Units (CTU Code)

The CTU Code provides advice on the safe packing of cargo transport units for the relevant personnel and trainers. Even if the goods carried are not dangerous, certain risks are involved in containerisation. This is the case, for example, with fumigation, which can be implemented using phosphine, a substance that is toxic to humans. Furthermore, improper packing or securing of cargo in a container may raise risks for its integrity.

The various regulations are assumed to be complied with and containers carrying hazardous chemicals or dangerous articles are known on the basis of declarations made by the consignor or shipper, as checks cannot be systematically carried out. Undeclared or misdeclared goods may therefore present an additional risk for their transport, storage or in case of emergency intervention.

Emergency response to containers

On board a ship, the crew must be trained and have access to the IMDG Code Supplements which include the MFAG (Medical First Aid Guide) and the Emergency Response Procedures for Ships Carrying Dangerous Goods (EmS) Guide. When an incident occurs or is at risk of occurring during container storage or transport, Cedre's on-call team can be notified or alerted in various ways, in particular via the MAR-ICE, ICE and Transaid networks.



/\ *IMDG Code pictograms for labelling packages and containers carrying dangerous goods*

What expertise can Cedre offer in relation to container incidents?

The risk analysis will be closely linked to the conditions surrounding the incident. It will be different for containers lost overboard as a result of a collision or in case of a fire on board. Cedre's on-call team will be able to provide its expertise based on the information provided on the incident, within a timeframe of a few hours to several days. The risk analysis will take into account the cause of the incident, its location and all the information on the container(s) involved. The dangerous goods declaration documents, starting with the manifest, will provide access to essential information: the UN number, hazard class, packing group, container number, position on the ship or container type and weight of the goods. This information may be obtained quickly when the incident involves one or a few clearly identified containers. However, when the risks must be assessed for all or part of the vessel carrying containers, a lengthy classification process will have to be carried out, as far as possible by a team of experts present in the crisis unit (for instance LASEM*, naval firefighters at the incident management centre set up by the authorities) to extract and process information. Additional information may be requested from the shipowner or DPA (Designated Person Ashore), such as the packing certificate, to obtain more detailed information on the contents.

If the transport documents cannot be accessed, any information obtained from observations made at the scene of the incident, wherever possible, may be useful. This may include, for example, the container's position on the ship, its placarding and the pictogram(s) displayed.

The case of containers lost overboard

It is important to determine the risk for navigation. A general purpose container will sink unless its cargo gives it buoyancy, as was the case with bags of crisps in a container on board the *Grande America*. A refrigerated container will float and a tank container may float or sink depending on the product transported and its fill level. In order for Météo-France to refine the drift using the Mothy model, the immersion level of the container must be known.

SAY WHAT ?

*SOLAS Convention

International Convention for the Safety of Life at Sea, adopted in 1914, whose main objective is to specify minimum standards for the construction, equipment and operation of ships, compatible with their safety.

*IMDG Code

International Maritime Dangerous Goods Code, international guidelines for the carriage of dangerous goods in packaged form, intended for all those involved in the maritime transport of such goods.

*CSS Code

Code of Safe Practice for Cargo Stowage and Securing

*LASEM

French Navy laboratory (*Laboratoire d'Analyse, de Surveillance et d'Expertise de la Marine*)

Loss of containers overboard from the *MSC Zoe*

The MSC Zoe *in the North Sea*

ID card

Name: *MSC Zoe*
Incident date: 1st and 2nd January 2019
Incident location: North Sea, TSS Terschelling-German Bight
Spill area: Dutch and German waters
Cause of incident: containers breaking loose due to forces exerted on the vessel in a storm
Products transported: containers
Quantity transported: 13,465 TEU (2,659 twenty-foot containers, 5,403 forty-foot containers)
Ship type: container ship
Date built: 2015
Place built: South Korea
Length: 395 m
Draught: 14.5 m
Flag: Panama
Owner: Xiangxing International Ship Lease Co Ltd
Charterer: Mediterranean Shipping Co SA
P&I Club: West of England
Classification society: DNV-GL / China Classification Society

On the night of 1st to 2nd January 2019, the container ship *MSC Zoe*, in force 8 winds, lost containers overboard while travelling through the Terschelling - German Bight Traffic Separation Scheme between Germany and the Netherlands. The two countries carried out joint actions to attempt to locate and recover as many containers and goods as possible, both at sea and on shore. An ancient wreck was discovered during this search.

The incident

On 2nd January 2019, container debris and miscellaneous cargo washed up on the shores of the German and Dutch Wadden Islands. These objects and debris were from containers lost overboard on the night of 1st to 2nd January from the container ship *MSC Zoe*, en route from Sines (Portugal) to Bremerhaven (Germany), carrying 13,465 TEU (Twenty-foot Equivalent Units). The vessel is one of the world's largest container ships, operating a regular service between Asia and Europe.
The *MSC Zoe*, in the Terschelling - German Bight Traffic Separation Scheme (TSS) at the time, was caught in force 8 to 9 winds with waves approaching from abeam. The crew felt strong rolling movements. A round to inspect and check the container lashings (in particular 3 containing dangerous goods) was carried out in the afternoon of the 1st.

At around 11 pm, the roll increased to the point of waking the chief officer and causing various items on board (including a printer on the bridge) to fly through the air. The roll then appeared to subside.

At 1 am on the 2nd, a visual inspection with a signal lamp showed that a number of containers had fallen over. Others were hanging overboard. Further investigation was not possible due to the darkness and weather conditions..

At 1:30 am, the roll increased again and the master saw containers collapse and fall overboard. The authorities were alerted and the ship reduced speed and changed course to diminish the influence of the swell and wind. At this stage, the master announced that about thirty containers had fallen overboard.

At daybreak, a tour of inspection was carried out, in particular to locate the containers of hazardous substances. Two of them had fallen overboard, while the third was hanging over the side of the ship. Other containers had also fallen into the sea and the crew observed damage to the lashings, including the tensioners from the lashing rods, twistlocks, hooks and locking pins, etc. Loose parts of the lashings were found on deck. The number of lost containers was re-evaluated several times, finally reaching a total of 270 on the evening of the 2nd. At this stage, the authorities were in possession of the complete cargo manifest but did not know which containers had been

The MSC Zoe *in the North Sea*

lost. The Netherlands Coastguard deployed a guard vessel to redirect traffic towards the north of the TSS. An action plan to salvage what could be recovered was already being developed and discussed between the salvage company appointed by the ship's insurance company and the Dutch authorities.

At 1 am on the 3rd, the *MSC Zoe* moored in Bremerhaven. A new inspection was carried out on board by the crew and the German and Dutch authorities. It was still difficult at this stage to determine exactly what had been lost, as some containers still onboard had been completely crushed.

It was not until the final unloading in Gdansk, several days later, that the total number was established: over 1,000 containers were damaged and 342 had fallen overboard, containing 3,200 tonnes of goods according to the cargo manifest.
Only three of them contained hazardous substances. One of these had been carrying 280 boxes containing

bags filled with a mixture of dibenzoyl peroxide and dicyclohexyl phthalate, an irritating white powder, but more importantly a powerful oxidant that can undergo violent decomposition at high temperatures (class 5.2). Two full bags (25 kg each) were found on a beach in the Netherlands and were safely recovered. Several empty bags were found in Germany. The container itself was found empty.
The second contained 1,400 kg of lithium-ion batteries (class 9). To our knowledge, it was not found.
Finally, the third container was loaded with 22.5 tonnes of expandable polymeric beads (Industrial Plastic Pellets, IPP). These beads are considered hazardous (class 9) due to the fact that they are manufactured in such a way that they can release pentane (a few percent) during transport, which can generate a flammable atmosphere. This type of bead has already been identified as a cause of major explosions.

⋀ *Plastic particles found on Borkum beach*

These small beads (4 mm in diameter) were immediately found on beaches following the incident. They were then scattered by the wind, making their recovery particularly difficult.

Offshore and onshore operations

The possibility of temporarily closing the shipping lane was considered in the hours following the incident, but this option was quickly abandoned as initial investigations showed that there was no risk of ships hitting sunken stacks of containers.

Immediately after the containers fell overboard, cooperation began between the German and Dutch authorities and the shipowner (via its P&I club). MSC appointed the salvage company Ardent to carry out search and recovery operations at sea. The area to be surveyed was enormous, covering around 4,200 km^2. Both countries quickly agreed on the geographical areas where search and recovery actions should be carried out.

The first priority was to locate the containers and their debris (many of them had not withstood the force of the elements) as well as various objects that had been released from them.
German and Dutch maritime surveillance aircraft (*Dornier 228*) screened the area.

⋀ *German vessel* Neuwerk *conducting a search operation*

Searches were also carried out from vessels equipped with multibeam sounders. Initially, search operations focused on the southern lane of the TSS, then were extended to the area between the lane and the coast.

In total, more than 6,000 objects were identified on the seabed and were plotted for each km^2. Of course, not all of these objects were from the *MSC Zoe* and it would not have been conceivable to bring up everything found. Additional observations were made using a ROV equipped with a video camera to attempt to distinguish the debris from the *MSC Zoe* from other debris.

The objects and debris were then brought to the surface and loaded onto the decks of vessels equipped with cranes and grabs, then transported to a central collection point. A recovery report was drawn up for each identifiable object. On the basis of these reports, *Rijkswaterstaat* (the Dutch water management agency) was able to identify in which container each object had been carried and where it was placed on board, by cross-checking with the cargo manifest.

Fishermen were also involved in recovery operations through the "Fishing for Litter" programme (see Cedre Information Bulletin n°40). Debris floating at the surface and subsurface is a risk for navigation. Several trawlers struck floating debris.

⋀ *Bicycle parts and plastics collected on Borkum beach*

Miscellaneous items washed up on the shores of several of the Wadden Islands: containers, container fragments, plastic beads, car parts (wheels, dashboards, etc.), shoes, cushions, clothes, toys, light bulbs, etc. The main islands affected were Vlieland, Terschelling, Schiermonnikoog (Netherlands) and Borkum (Germany). Debris also reached the mainland (Friesland and Groningen in the Netherlands, Lower Saxony in Germany).
In Germany, collection was managed by the municipalities, the Central Command for Maritime Emergencies (Havariekommando, whose role is to ensure coordinated and joint martime emergency management in the North Sea and the Baltic Sea, and was in charge of coordinating clean-up operations), the fire brigade, the sea rescuers and volunteers. Amphibious tracked vehicles were used on the island of Borkum.

⋀ *Onshore search operations*

In the Netherlands, the emergency services (including the army) were also assisted by many volunteers.

By 4th July 2019, 2,383 tonnes of the 3,200 lost had been recovered, either at sea or on shore. In February 2020, it was estimated that the majority of the goods lost overboard had been found and recovered.

Long-term monitoring of the impacts of the lost goods (especially plastic beads) on this fragile ecosystem (the Wadden Sea is classified as a UNESCO biosphere reserve) has been undertaken.
A specific study was carried out following recordings of excess mortality among guillemots observed in January and February 2019: an estimated 20,000 guillemots died, first in the north and then rapidly in the south of the Netherlands. Several research institutes joined forces with wildlife health centres to conduct a joint necropsy session on 123 guillemots and 12 razorbills. These birds are reported to have died of starvation without any proven link to the plastic beads or other debris from the *MSC Zoe*.

Incident causes and recommendations

In June 2020, an investigation report entitled "Loss of containers overboard from MSC ZOE, 1-2 January 2019" was published jointly by the Dutch Safety Board, the German Federal Bureau of Maritime Casualties Investigation (BSU) and the Panama Maritime Authority. It is partly based on the analyses and conclusions of the report entitled "Safe container transport north of the Wadden Islands – lessons learned following the loss of containers from MSC Zoe", also published in June by the Dutch Safety Board.

By comparing the places where the debris and miscellaneous objects were found with the survey carried out by *Rijkswaterstaat*and the ship's route, the investigators concluded that there had in fact been several episodes of container loss: at each location, the containers and goods found were consistent with groups of containers positioned next to each other on deck. Based on the recovery locations of the lost containers, the report identifies 6 instances of container loss, between 8 pm on 1st January and 1:30 am on 2nd January.

Damaged containers on board the MSC Zoe

As for the precise causes of these successive losses of containers, the investigators rule out the obsolescence of the vessel (commissioned in 2015, i.e. 4 years before the incident), a lack of qualification, skills and vigilance on the part of the crew, as well as errors at the time of loading or securing the containers. The weather conditions encountered were certainly unfavourable, but neither rare nor particularly extreme for this area.

The Dutch Safety Board called on two research institutes. One (Deltares) modelled the currents, water level, wind and waves encountered by the ship, the other (MARIN) applied these parameters to a model container ship in a test basin.

Meanwhile, BSU worked with the University of Hamburg. The tank tests showed that the ship had indeed been subjected to strong parametric rolling, and due to its intrinsic qualities, notably its very high stability, had quickly recovered its equilibrium position every time, thus subjecting its structures and its load to very strong accelerations and significant forces. This could be what caused the failure of the lashing rods and twistlocks. In the test tank, the ship model hit the bottom due to its own movements but also due to the high amplitude of the waves. Finally, under the test conditions, the waves not only affected the hull but also the rows of containers on deck. The roll period for this type of vessel is very close to the wave periods observed in this area of the North Sea. When the ship is in a beam seas, its movements are therefore amplified.

In the light of these results, the Dutch Safety Board issued a warning to seafarers informing them of these risks, and in particular of the risks of bottom contact (or near contact).

The choice of route (southern rather than northern lane) does not appear to have had a significant impact. The Port State Control (PSC) inspection carried out in Bremerhaven in January 2020 revealed that several handrails were broken or bent. Lashing bridges were also damaged, as well as fire valves, ventilation openings and several hatches. The hull had a series of minor dents above the waterline.
An underwater inspection was carried out by divers in Gdansk. The survey statement by DNV-GL states that the divers found no damage caused by grounding.

The final recommendations of the joint Dutch-German-Panamanian report focus on the following points:

- Concerning ships: revise existing regulations for container ships, regarding securing equipment but also on stability, especially when sailing in shallow waters; install on board instruments to measure and record in real time the amplitude of roll in order to be able to correct the ship's course but also to be able to investigate any incidents a posteriori; propose solutions to help the crew to detect container losses in real time;

- Concerning the German and Dutch authorities: examine the need to change the location of the existing lanes of the TSS taking into account risk factors and the fact that the Wadden Sea is classified by IMO as a Particularly Sensitive Sea Area (PSSA);

- Concerning MSC: seek a better design and instrumentation of future container ships;

- Concerning the World Shipping Council and the International Chamber of Shipping: communicate on the subject and promote innovation in terms of ship design and equipment.

Discovery of objects from previous incidents

The search operations conducted at sea led to the discovery of unrecorded wrecks, as well as explosives dating from the Second World War.

More surprisingly, copper plates and wooden beams were found in Dutch waters. The plates bore the mark of the Fugger family, German bankers and merchants.

An archaeological investigation revealed that these remains came from a 30-metre ship, built in around 1540 (the trees used for its construction were felled in 1536), making it the Netherland's oldest wreck to date.

By Anne Le Roux,
Emergency Response Coordinator at Cedre.

Container recovery

By Raphaël Fachinetti, Director of CEPPOL, the French Navy's Centre of Practical Expertise in Pollution Response.

Containers have become the norm for maritime transport of manufactured and retail products. By rationalising transport, containers have cut costs and have no doubt helped to reduce the risk of human accidents during handling in ports. Yet the reassuring, orderly image of neat rows of containers on the deck of a container ship does not mean there is no risk associated with this mode of transport. Every year, ships fall victim to cargo fires and an annual average of 1,400 containers are reported to be lost overboard by shipping companies. The most characteristic recent European incidents of this type are that of the *MSC Zoe* involving the loss of containers in the North Sea and the sinking of the *Grande America*. The first ship lost part of its cargo in bad weather and shallow waters, with containers of dangerous goods coming ashore; the second sank with the remainder of its cargo after a fire broke out onboard. A container floating at the sea surface constitutes an immediate collision hazard for sea users, especially fishing vessels. If these containers carry harmful products, they pose a short term hazard for the environment, humans and even the underwater environment if they sink.

When a cargo catches fire or falls overboard, the crew or shipper may be blamed for inadequate stowage, poor maintenance of gear and equipment, insufficient supervision or lack of response. In many cases, however, misdeclaration, whether deliberate or unintentional, of goods, weights and contents, as well as poor packaging, are the cause of the incident. If containers that are heavier than declared are placed in the highest rows, it is evident that the swaying force generated by the ship's movements in a storm could exceed the strength of its lashings. If the lashings fail, the container stacks may collapse, the contents spill out, often into the sea, and fires may break out on board. A misdeclared or misidentified container that requires to be protected against heat may be exposed to sunlight or heat and, as an additional risk, may be close to products that are incompatible with the products it contains. Overheating could then cause a fire or explosion, as was the case on board the *MSC Flaminia* in 2012.

IMO, States, NGOs and maritime operators do not stand idle in the face of these issues. The objectives of protecting human lives and the environment, as well as limiting costs and insurance premiums, converge to bring about changes in regulations, the organisation of transport and ship design. France supports various plans to revise regulations, such as the mandatory checking of container weights at the time of loading (gantry crane), electronic tagging and the mandatory reporting of containers lost at sea to the maritime authorities. Classification societies, insurers and salvage companies are considering new standards for lashing systems and fire-fighting equipment.

Recovering a container offshore

Although the legal status of containers is still somewhat vague, they can be assimilated with shipwrecks, for which liability falls on the owner for their management and the obligation to eliminate all hazards. In the event of an incident in Europe, shipowners and insurers are often quick to deal with containers at the surface. France has a range of resources at its disposal to respond to a shipping incident involving the loss of containers at sea. The Maritime Prefect has the necessary legal arsenal and can compel operators to take action. They can also rely on all the organisations that contribute to the State's action at sea and in particular on the expertise of Cedre and the resources of the French Navy. Maritime surveillance aircraft, whose crews are trained in search and rescue, are able to locate and mark drifting containers with GPS buoys. Assistance vessels chartered by the French Navy, such as the *Sapeur*, or belonging to the military fleet, such as the BSAM vessels, are capable of hoisting drifting containers. If necessary, they may be assisted by divers, naval firefighters, the Navy's analysis laboratories and experts from Cedre. Where appropriate, French Navy hydrographic ships or minehunters are capable of surveying the seabed and locating sunken containers. With its ROVs and other equipment, CEPHISMER (the French Navy's human diving and subsea intervention unit) is able to conduct operations to secure or recover some of the dangerous goods, illustrated recently by the plugging of the *Tanio*. Clearance divers in every port are capable of carrying out response and recovery operations at depths of up to 60 metres. In the event of a maritime incident, the Maritime Prefects have access to all the French Navy's knowledge and capabilities in order to safeguard human lives and protect the environment.

The loss of containers poses an immediate risk to shipping and the environment. Under the impetus of States, shipping operators and NGOs, international regulations are evolving, slowly some would say. France is able to take action in legal terms thanks to its organisation of State action at sea, but also in technical terms thanks to the expertise of Cedre and the know-how of the French Navy.

FEATURE

Container drift forecast with Mothy

Containers drifting at the surface

By Pierre Daniel, Météo-France.

The National Forecasting Centre run by Météo-France operates a sea drift forecasting system to assist the authorities responsible for marine spill response and search and rescue operations. This system, by the name of Mothy, is used on average around 20 times a week in relation to real oil spills or search and rescue operations.

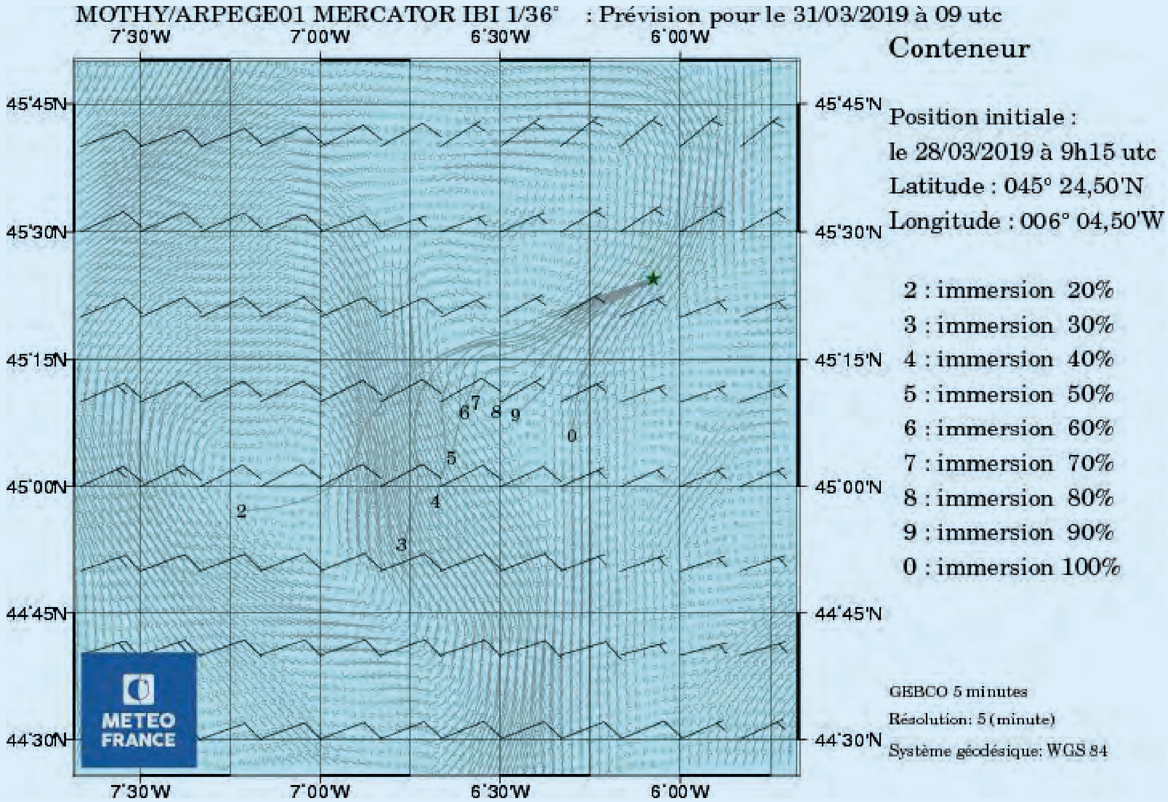
The Mothy system is composed of three modules: oil, SAR targets and containers. The "oil" module is used for any type of pollutant that drifts as a slick at the sea surface. This includes oil slicks but also vegetable oil spills and even Sargassum seaweed. The "SAR targets" module concerns search and rescue operations and includes 73 targets: man overboard, life rafts, beach gear, different types of vessels, etc. Finally, the "containers" module applies to the drift of a container or any other floating cuboid-shaped object.

Freight containers comply with international standards; there are two main sizes of containers: 20-foot (6.058 x 2.438 x 2.438 m) and 40-foot. Their buoyancy depends on the container type and its contents. General purpose containers are not watertight. They only float if the density of their contents is low. Tank containers, designed to transport liquids and gases, can generally float for longer periods depending on the cargo carried.

The Mothy system's "container" module was developed based on experiments on the drift of an instrumented container at sea. These experiments, carried out in 1991 and 1992 off the coast of Brittany, were led by Cedre, with the participation of Ifremer and the French Navy.

A 20-foot container was equipped with a wind recorder and a GPS positioning system. The degree of immersion of the container proved to be an essential parameter in evaluating the combined effects of wind and current. As the degree of immersion is generally unknown, the module was configured to process 9 different immersion levels so as to cover the full possible immersion range. This module was then successfully tested on two container drift incidents. In December 1993, during a storm in the English Channel, the container ship *Sherbro* lost 88 containers, 10 of which contained dangerous goods. One of these containers was tracked and recovered. In February 1996, the ship *Churruca* lost a container at the entrance to the English Channel. It was found on the shoreline near Perros-Guirec five days later.

Mothy's "containers" module has been operational since March 1998 and can be activated on demand 24/7 by a marine forecaster at Météo-France's National Forecasting Centre. It has since been activated many times and has led to the



Mothy forecast at +72 hours for a drifting container lost from the Grande America*, Bay of Biscay, March 2019. The numbers on the map indicate different possible immersion level hypotheses.*

successful recovery of containers lost overboard. Its accuracy has been enhanced over time as the accuracy of environmental data (winds and currents) has improved. A recent example of a major incident for which the model was used is the *Grande America*, which lost containers in the Bay of Biscay in March 2019, several of which were recovered at sea.

A drift committee to improve slick and container tracking

The French slick drift monitoring and prediction committee studies how spills evolve in time and space, in order to support incident management decision-making by the maritime authorities. Led by Cedre, this committee is composed of representatives of Météo-France, Ifremer and SHOM (French Naval Hydrographic and Oceanographic Service). It can also include representatives of any other relevant national or foreign organisation. The lessons learned from the *Prestige* oil spill (2002) led to the creation of this committee (French Instruction of 11th January 2006). It was recently activated during the *Grande America* spill (March 2019) and called upon during the *MV Wakashio* spill in Mauritius (August 2020).

By Vincent Gouriou, GIS specialist at Cedre.

Analysis of container ship incidents

Interesting report by EMSA

By Nicolas Tamic, Operations Manager at Cedre.

In October 2020, the European Maritime Safety Agency (EMSA) published an Analysis of Marine Casualties and Incidents involving Container Vessels. This report, which gives a detail review of the main causes of damage, is of particular interest.

This analysis is based on EMSA's specialised European Marine Casualty Information Platform (EMCIP) and Directive 2009/18/EC (one of six directives in the Erika III package) on the harmonisation of marine casualty investigations in the European Union. This report analyses the type of casualty events faced by container ships.

Cargo manifests

EMSA flags up qualitative and quantitative shortcomings in certain documents. This can lead to improper loading of certain containers by operators. A heavy container may be placed on deck and at the top of the stack when it should have been loaded in the hold due to its weight. This can affect the stability of the vessel, particularly in the event of severe rolling, which can result in containers being tossed overboard as their lashing systems are not sufficient to counteract this enormous physical strain.

Regarding the nature of the cargo, the IMDG Code states that "the classification shall be made by the shipper/consignor". Sometimes goods are misdeclared, intentionally or otherwise, leading to their inappropriate positioning on board. Dangerous goods can behave very differently depending on where they are placed (explosion, self-ignition, hydro-reactivity). EMSA mentions the case of the *Caroline Maersk* in August 2015. A container onboard this vessel was declared to contain "tablet for water pipe". It in fact contained charcoal (class 4.2 – spontaneously combustible) and caused a major fire to break out on board.

Packing and handling

Goods must be packaged correctly and in accordance with regulations. The IMDG Code sets down rules for the segregation, stowage and handling of dangerous goods, however its provisions are sometimes incomplete. One example of this is the case of lithium-ion batteries which can cause major fires that are difficult for crews to control. EMSA cites the example of the *CMA CGM Rossini* in 2016. A fire broke out onboard from a container carrying 16 tonnes of used lithium-ion batteries (class 9). Following its investigation, the French marine casualties investigation board, BEAmer, reported that this type of cargo should have been transported on deck and not in the hold. They also recommend international regulatory clarification for this type of cargo to significantly improve maritime safety.

Firefighting capabilities

According to the International Union of Marine Insurance (IUMI), the carrying capacity of ships has tripled, their firefighting capabilities have doubled, while their crews have been reduced by 25% (27 crew members on average). EMSA specifies the need to redefine onboard firefighting strategies and techniques as well as to revise the content of crew training to prevent the recurrence of and increase in the number of onboard fires, of which 40 were reported for 2019 (up 27% compared to 2018). Maritime stakeholders are now fully aware of this issue and amendments to the SOLAS Convention have been submitted to IMO to improve safety on board.

Loss of containers overboard

The size and design of container ships are largely responsible for the loss of containers overboard. Container ships do not have the same rigidity as compartmentalised ships. They are subjected to strong torsional movements, particularly when sailing in rough seas and inclement weather (North Atlantic, Channel-North Sea-Baltic Sea). These different elements cause erratic ship movements, in particular the phenomenon of parametric roll which can result in an angle of up to 41°. In certain shallow sea conditions, the ship may even touch the seafloor due to its draught (16 metres for the largest ships) combined with the sea state, causing violent shocks to the cargo. The container stacks can thus be subjected to sharp 5G accelerations (5 times the earth's gravity), leading to a domino effect causing the containers to be crushed one on top of another or to break their lashings and be thrown overboard, particularly if they are overloaded. In this regard, EMSA mentions the loss of 520 containers from the *Svendborg Maersk* in February 2014. In response, various measures help to reduce this type of risk: ship behaviour prediction systems, specific training for ship's masters, reinforcement of lashing systems, and weather routing software. However, they do not eliminate it altogether (see our article on the *MSC Zoe* on page 12).

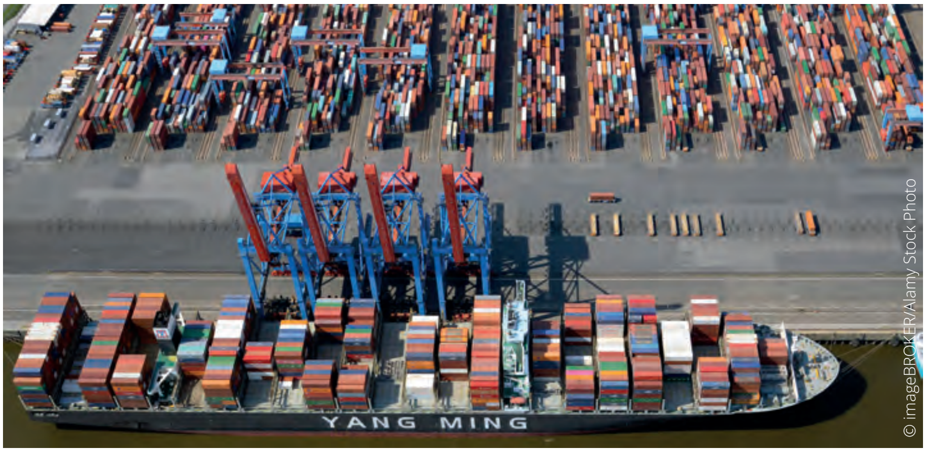
On 23rd April 2020, a naming ceremony was held for the *HMM Algeciras* (24,000 TEU, the largest container ship in circulation). Seven months later, on 2nd December 2020, the *ONE Apus* lost 1,900 containers at sea (of a total of 14,000). The contradiction between economic logic and maritime safety is thus sadly but perfectly illustrated. This underlines the need for the maritime community to be fully engaged towards inventiveness, proactivity and vigilance in order to reconcile the issues at stake.

more info

www emsa.europa.eu

Outlook for maritime container shipping

By the Directorate of Maritime Affairs, Sub-directorate for ship safety and ecological transition.



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Λ *Aerial view of a container ship, port of Hamburg, Germany*

Shipping containers were first invented in the 1950s and have since seen rapid, steady growth. The standardisation of containers (20- or 40-foot long) has profoundly transformed transport supply chains by establishing containers as the ultimate intermodal cargo transport unit. Packing goods in containers has many advantages (protection, efficient loading/unloading operations, reduced operating costs).

In response to the increase in container traffic, purpose-built container vessels emerged in the 1970s. Designed and equipped for this form of cargo, these ships were initially relatively modest in size (with a capacity of a few hundred containers) but have been continually growing ever since. Today, the largest ships carry more than 23,000 TEUs (Twenty-foot Equivalent Units) and are 400 metres long.

Container ships are usually operated on a liner system, on a predetermined route with scheduled calls to allow shippers to organise the shipment and receipt of their goods. Currently, the major shipping lines link Asia with Europe and North America. Containerisation has accompanied the growth of international trade since the 1960s and the acceleration of globalisation in the 1980s was made possible by container ships which boosted flows between exporting and importing countries thanks to this low-cost, long-distance mode of transport. Their share of the world fleet has been growing steadily. Between 2000 and 2008, container transport saw an increase of over 10% each year. Despite the 2008/2009 financial crisis, growth still continued at around 4% per year over the following decade. In 2016, 194 million TEUs were traded. According to the United Nations, growth is expected to continue and reach 4.5% per year between 2019 and 2024 (study conducted prior to the COVID-19 pandemic).

The development of container transport has gone hand-in-hand with profound changes to supply chains and port infrastructures, but also to safety regulations applicable to navigation and cargo. However, the emergence of larger, sometimes even giant, container ships now requires all the links in the chain to be reconsidered with the common objective of ensuring human safety and environmental sustainability. While incidents involving such giant vessels are fortunately rare, the consequences of a single incident can be considerable.

The advent of very large container ships affects the organisation of the transport sector. These post-Panamax or Malaccamax can only access a very small number of ports that are able to accommodate them from a nautical and logistical point of view. There are major constraints for ports, which are obliged to constantly review their maritime access and infrastructures to keep up with this race for ever-larger ships.

In terms of safety issues, there continue to be risks associated with towing operations. Given the volume and mass of fully laden ships, tugs are not always powerful enough to guide larger vessels. Furthermore, unlike oil tankers, chemical tankers and bulk carriers, container ships are not required to be equipped with an Emergency Towing Device (ETD), which can be problematic in certain situations.

The fire risk is also a major hazard for container ships, and increases with the number of containers carried. The fire that broke out onboard the *Yantian Express* in January 2019 from a container on deck is a good illustration.

There are also environmental risks if containers are lost overboard as well as due to the large quantities of fuel carried in their bunker tanks. Each year, it is estimated that between 550 and 2000 containers are lost at sea during incidents associated with adverse weather conditions causing ship instability. When containers fall overboard, it is extremely difficult to locate them and mitigate pollution risks.

All these issues give rise to discussions within the International Maritime Organization, and France actively contributes to the improvement of international regulations.

Finally, the range and power requirements of container ships are such that there is currently no credible alternative to fossil fuels for their propulsion. The switch from conventional heavy fuel oil to liquefied natural gas onboard some container ships is only the first step in the energy transition of these ships.

Filtration system effectiveness evaluation

⋀ *Filtration tests: filter cartridge filled with polypropylene sorbent strands in the test channel*

By Julien Guyomarch, Analysis and Resources Department Manager at Cedre.

Over recent years, several oil spills have occurred in inland waters due to pipeline ruptures, both involving light refined products (for instance a biodiesel spill in Sainte-Anne-sur-Brivet in April 2016) and crude oils (for example the Île-de-France pipeline rupture in February 2019).

These major incidents raised the question of the best response techniques to implement in watercourses, in particular the use of so-called "custom-made" filtration devices, i.e. systems built on site from readily available materials. In light of these incidents, Cedre conducted comparative tests of different absorbent materials, packed in the form of cartridges placed across a water channel into which various oils were released. In order to reflect the variety of potential spills, two refined products – one light, one heavy – and a medium crude were tested.

Test protocol

In order to assess the effectiveness of various filtration devices, a pilot-scale test device was designed and built. Different filtration configurations were considered, some combining two successive filters. The devices tested comprised both filter cartridges filled with loose materials (straw or polypropylene strands) and fabrics (one geotextile and two fabrics manufactured by Sonitec and Rai Tilliere).

The main challenge for this type of filtration is to maintain a good flow rate through the filtration system while ensuring good quality of the filtered water. The parameters monitored in order to validate the use of a material or device were as follows:
- filter clogging time;
- flow rate of fluid through the system;
- oil retention capacity in a water circuit.

These evaluations are conducted by taking quantitative and qualitative measurements.

Once the water level in the channel is stabilised, the flow rate is measured at the outfall from the wire mesh, as well as one metre along the channel. According to the cartridge tested, the pump generating the current is adjusted to avoid increasing the load, potentially causing overflow upstream of the cartridges. The water depth is measured upstream and downstream of the filter cartridges to determine the head loss.

The quantity of oil present at the water surface, at each level of the experimental system, is estimated following oil recovery using sorbents and weighing. This value is corrected for the water absorption of each material, determined in the laboratory based on a contact time of 30 minutes, similar to the filtration system tests.

The table below shows the different filtration conditions tested in this study. To simplify the test matrix, certain combinations that were assumed to have poor effectiveness were eliminated: insufficient filtration capacity for light products (straw for a diesel spill) or, on the contrary, excessive filtration capacity for heavy

Installing the filtration testing system

products (risk of clogging of the Sonitec fabric with heavy fuel oil).

Results

The water retention of the different materials, expressed as the mass of water per mass of sorbent, is significant, between 1 and 5, even for the most hydrophobic materials such as polypropylene strands.

For each set of tests, the head loss was estimated by measuring the difference in water level upstream and downstream of each cartridge. The results obtained, in decreasing order, were: Sonitec fabric > Rai Tillière fabric > geotextile > bulk sorbent (strands or straw).

The quantities of oil absorbed by the different filters and the location of free oil at the various points in the system were assessed.

In order to evaluate the filters or filter combinations that could be used in real conditions, the first criterion was to evaluate the quantity of oil passing through the whole device without being absorbed, without taking into account the quantity remaining upstream of one of the filters:

- less than 20% released into the water column: effective;
- between 20% and 50% released into the water column: acceptable;
- over 50 % released into the water column: ineffective.

	1 filter					2 filters		
	Strands	Straw	Rai Tillière fabric	Sonitec fabric	Geotextile	Straw/ Strands	Straw/ Geotextile	Geotextile / Strands
Light	X		X	X	X			X
Moderate crude	X		X		X		X	X
Heavy	X	X	X		X	X	X	X

Test matrix for sorbent materials

Conclusion

Following this series of tests, conclusions were drawn about which systems are most suitable for different types of oil. It would appear that, for each type of pollution, an optimal solution can be defined:

- For light refined oil: strand-filled filters. To avoid excessive head loss at a filter, fluff up the strands and use multiple devices positioned at the water surface.
- For crude oil: use of fabric together with a cartridge filled with loose sorbent material gives good results. Given the head loss however, filtration should be restricted to the upper part of the water column.
- On heavy fuel oil: all the systems tested appear to effectively absorb the oil, but the straw/strands and geotextile/strands combinations offer the best compromise between sorption and head loss.

Potential of sorbents for chemical spill response

By Pascale Le Guerroué, Head of the Laboratory at Cedre.

At the request of the French Navy, Cedre studied the potential of hydrophobic floating sorbents to absorb chemicals in the event of a spill at sea. Sorbents are known to be an effective solution for oil spill response and it appeared worthwhile to evaluate their potential for response to chemical spills.

This project was carried out over a two-year period and comprised the following successive stages:

- First, a literature review was conducted in order to select chemicals that float or have a high probability of being spilled, as well as the sorbents available in stockpiles or approved by Cedre.
- Following this research, four protocols were defined and consisted of characterising the physical resistance or compatibility of the sorbents with chemicals, their mechanical resistance to tensile stress, their sorption capacity as well as their capacity to mitigate evaporation.
- These protocols were then applied to the selected chemicals and sorbents.
- Finally, and in order to put the lessons learnt from these various tests into practice, two incident scenarios were defined, based on which we were able to address the conditions required for sorbents use.

This study was performed on 15 sorbents, with various compositions and forms, and 18 chemicals. The (non-exhaustive) results obtained are presented below.

Compatibility test results

• Both synthetic and natural bulk sorbents react strongly with sulphuric acid and may be classified as incompatible with this product.

Compatibility test results

Tensile test results

• The oil sorption capacities can be correlated with those obtained for a viscous chemical and are significantly different from the results obtained with a low viscosity chemical.

• A loss of resistance of approximately 40% was measured for chemical-soaked sorbents.

Sorbent sample in the traction test bench

Evaporation attenuation test results

• The form of the sorbent plays a determining role.

Conclusion

The main information deduced from these tests has been summarised and provides an indication of the potential of the tested sorbents to absorb chemicals. It also points to significant differences between sorbents, depending on the chemical nature of the substance spilt.

This study thus expands the operational possibilities for using sorbents originally approved for oil recovery on chemical products.

These results clearly show that there is no single sorbent that meets all requirements and that the choice of sorbent must take into account the incident scenario: chemical nature of the substance spilt (compatibility), quantities to be recovered (mechanical strength, retention capacity) and the sorbent products available (bulk or pads).

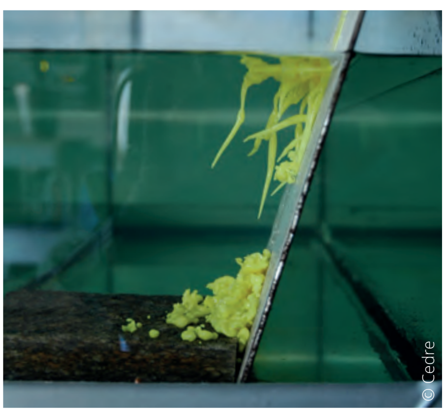
Behaviour of solid and molten sulphur

By Sophie Chataing-Pariaud, engineer at Cedre.

Sulphur, most of which comes from the oil industry, is widely used in the chemical industry, particularly for the production of sulphuric acid and the manufacture of fertilisers. Few incidents involving the accidental release of sulphur into the aquatic environment are reported in the literature, resulting in a lack of practical knowledge and feedback on its behaviour in water.

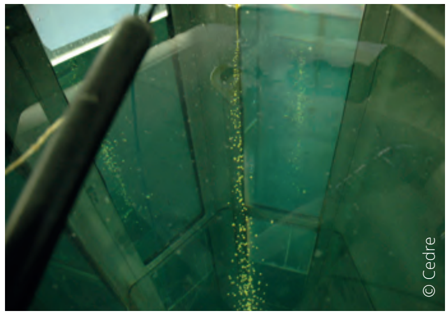
As an upshot of this observation, Cedre carried out experimentation to study the behaviour of solid and molten sulphur at laboratory scale and at pilot scale.

The laboratory characterisation showed that sulphur, whether solid or molten, tends to sink easily when released in water (fresh or sea water). No impact was recorded on pH values or hydrogen sulphide emissions during the release. The water temperature rose slightly when molten sulphur was released.



Release of molten sulphur on a piece of a ship's hull

The pilot-scale experiments confirmed that both solid and molten sulphur sank.



Release of molten sulphur into Cedre's Experimentation Column (CEC)

When solid sulphur is released in water, particles larger than 1.6 mm in diameter will immediately sink in static conditions. Smaller particles may sink if the water is agitated, which increases sulphur's tendency to sink in open water exposed to currents, tides or waves.

When molten sulphur is released into water, it solidifies rapidly and transforms into small granules, whose size depends on the flow rate of the spill. These sulphur granules bounce when they reach the bottom of the experimental set-up, increasing the spill's lateral spread. In open natural environments such as rivers or the open sea, currents promote the transport, and thus the spread, of spilled sulphur, increasing the area affected. The water temperature may increase locally and temporarily, however this phenomenon is reduced by a buffer effect in offshore environments (large quantity of water) and fast-flowing rivers. Sulphur may also be present at the water surface in the form of dust particles or even a solid slick in the case of a release on a partially submerged solid structure (e.g. ship's hull or quay). On the bottom, cooled molten sulphur is present in the form of different sizes of beads which may be discrete; these beads may be dispersed by the current or, on the contrary, merged together to form a crust.

Crust of sulphur following a release of molten sulphur into Cedre's deepwater test tank

This study provided experimental data on solid and molten sulphur released in water. The observations recorded are of particular interest in order to understand sulphur's behaviour, potential fate and impacts and thus identify appropriate response techniques.

	Solid sulphur	Molten sulphur
CAS n°	7704-34-9	
UN n°	1350	2448
Risks		
Shipping	- Harmless group C (in the form of granules, pellets)  - Hazard class 4.1 (large particles, crushed pieces)  	Marine pollution: Z (minor hazard to marine resources or human health) Safety hazard (S)

Different transport categories for sulphur

Characterisation of litter pollution on the Atlantic coast of Europe

Plastic litter on the shoreline

By Silvère André & Camille Lacroix, engineers at Cedre.

A study conducted as part of the CleanAtlantic project

The European project CleanAtlantic (2017-2021), which brings together 19 partners from 5 different countries, aims to protect biodiversity and ecosystem services in the Atlantic area by strengthening litter monitoring, prevention and removal capacities. In order to meet the objectives set out for the project, *in situ* characterisation of litter pollution appears to be an essential element. In order to reduce the presence of litter in the marine environment, the level and nature of this pollution must be determined to support the implementation of effective measures or actions.

Monitoring coastal litter in the North-East Atlantic

Marine litter has been monitored on the beaches of the North East Atlantic since 2001. As part of the OSPAR Convention's marine beach litter monitoring programme, regular monitoring is carried out at around 100 sites to obtain data on the abundance and composition of litter found on the shoreline. This monitoring is based on a common protocol for all the member countries of the Convention and provides the most comprehensive set of beach litter monitoring data for the North-East Atlantic.

The data used for the CleanAtlantic project come from this programme for the 2016-2019 period. They relate to 62 sites along the Atlantic coast of the five participating countries and represent a total of 922 surveys that have been analysed in order to characterise the pollution of the Atlantic coastline.

Shoreline pollution in the Atlantic area

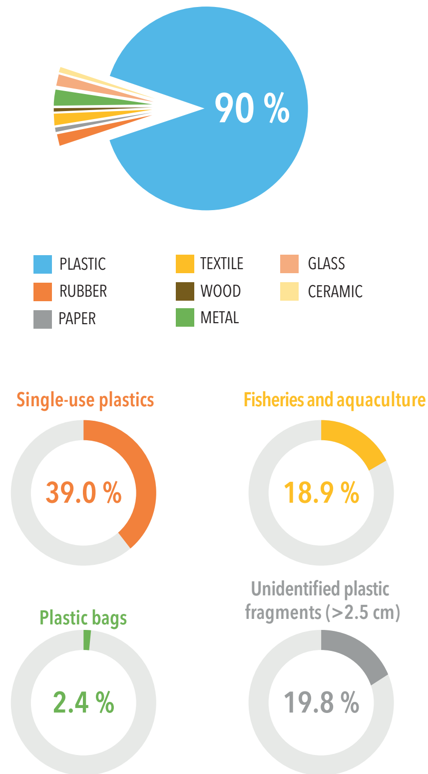
Abundant pollution that poses a risk to the marine environment

The analysis carried out across the 62 sites over the 2016-2019 period confirms the abundance of litter on the Atlantic coastline, with a median of 172 items of litter found per 100 m of beach. This value is far in excess of the threshold value of 20 litter items per 100 m adopted at European level by the Technical Group on Marine Litter set up under the Marine Strategy Framework Directive (MSFD). With 60 of the 62 sites showing median quantities above this value, the presence of litter on the coastline represents a potential risk for the marine environment and maritime activities in the Atlantic area.

A major share of plastic litter

Almost 90% of the litter found on the Atlantic coastline is plastic. Within this litter category, various types of plastic litter are found frequently and in high abundance. This is the case for example of single-use plastics, which represent 39% of Atlantic coastal litter. These include cotton buds (7.8%), bottle caps (7.7%) and cigarette butts (6%). Litter from fishing and aquaculture activities also plays a significant role (18.9%). These results highlight the high proportion of single-use plastics and fishing and aquaculture equipment in the Atlantic area, which together account for almost 60% of litter. Specific reduction measures have been introduced, including via the EU Directive 2019/904 on the reduction of the impact of certain plastic products on the environment, which came into force in 2019. Monitoring will later reveal whether these measures are effective and whether a decrease in the presence of

Atlantic area and OSPAR monitoring sites (in white) studied as part of the CleanAtlantic project



Composition of litter in the Atlantic area

these items is actually observed. Meanwhile, it is important to continue to study other types of litter, which represent more than 40% of the litter found on the Atlantic coastline.

Sorting litter collected at a monitoring site

Many fragmented and and unidentifiable litter items

While the majority of the waste observed on the Atlantic coastline can be clearly identified, the results of the study indicate that 19.8% of the litter found is in the form of unidentifiable fragments, ranging from 2.5 to 50 cm long, resulting from fragmentation processes during weathering. These figures confirm the extent to which plastics are broken down in the environment leading to the formation of numerous smaller fragments. In addition to the risk that this litter represents for the environment, the fragmentation process is also a barrier to litter characterisation and the identification of source activities, which are prerequisites for the implementation of effective reduction measures. It is therefore important to pursue research into these fragments in order to achieve a better understanding of their origins, fate and impacts.

Unidentifiable plastic fragments

The need for a common strategy and joint efforts

The results obtained reveal large quantities of litter on the Atlantic coastline, reflecting high levels of pollution in the marine area shared by the five countries (Ireland, United Kingdom, France, Spain and Portugal). This pollution appears to be ubiquitous and poses a risk for the marine environment and socio-economic maritime activities across the five countries. These results confirm the importance of implementing a common strategy, whether through collaborative projects such as CleanAtlantic or a harmonised approach to litter monitoring leading to the implementation of common measures or actions such as the OSPAR Regional Action Plan for Marine Litter.

Ground of the bulk carrier *MV Wakashio* in Mauritius

By Anne Le Roux, Emergency Response Coordinator at Cedre.

On 25th July, the bulk carrier *MV Wakashio* ran aground on a coral reef off the south-east of Mauritius. No leaks were reported during the first few days, however on 6th August oil began to leak from the vessel. The Mauritian authorities requested international assistance. France sent equipment and personnel on site as well as experts from Cedre and CEPPOL.

IN SHORT

25TH JULY 2020: GROUNDING OF THE *MV Wakashio* SOUTH OF MAURITIUS

FLAG: Panama

TYPE: Bulk carrier - **BUILT**: 2007

DIMENSIONS: 400 m long

DRAUGHT: 18 m

PRODUCTS TRANSPORTED: no cargo, approx. 3,800 t of VLSFO, 200 t of marine diesel, 90 t of lubricant oil

OWNER: Okyio Maritime Corporation

MANAGER: Nagashiki Kisen KK

CHARTERER: Mitsui OSK Lines

P&I CLUB: Japan P&I Club

The incident

On 25th July 2020, the Panamanian-flagged bulk carrier *MV Wakashio*, with a 20-strong crew, was sailing unladen from Singapore to Brazil when it ran aground on a coral reef 1.3 nautical miles off Esny Point in southern Mauritius. At the time of writing, the causes of the grounding have yet to be confirmed. The crew was safely evacuated; the ship however was stranded on its stern and could not free itself. As the *MV Wakashio* was unladen when it ran aground, the main risk for the marine environment was the vessel's bunkers: 3,800 tonnes of very low sulphur fuel oil (<0.5 %), as well as 200 tonnes of marine diesel and 90 tonnes of lubricant oil.

No leaks were observed in the immediate aftermath. As a precaution, the Mauritian authorities activated the national oil spill contingency plan and alerted a number of foreign countries, including France given the proximity with Reunion Island. They also worked to source tugs that were powerful enough to be able to refloat the vessel.

A few days after the vessel ran aground, the Mauritian coastguard detected small-scale oil leaks in the lagoon and laid spill response booms around the *MV Wakashio* as a protective measure. Personnel and equipment were dispatched and, by 3rd August, experts from SMIT (salvage), two tugs and one supply vessel sent by the shipowner as well as a tug (*VB Cartier*) provided by the French authorities were on site. Despite the resources deployed, it proved impossible to refloat the vessel.

Λ *Wreck of the* Wakashio, *photo taken on 21st August 2020*

Spill response

On 6th August, the situation began to deteriorate: the vessel was openly leaking oil and a slick could be seen at the surface. An estimated 400 tonnes of fuel oil were spilt. At this stage, the risks for Reunion Island appeared relatively low. However, the Commander of the Southern Indian Ocean Maritime Zone requested that Cedre put the drift committee into pre-alert mode.

At the same time, under the sub-regional oil spill contingency plan for the Western Indian Ocean Islands, the French authorities sent equipment to Mauritius by plane and ship (on board the French Navy overseas support and assistance vessel *Champlain*), including 800 m of manufactured boom, skimmers, sorbents and pumps.

Two-thirds of the POLMAR shoreline response equipment stockpile on Reunion Island was thus made available to the Mauritian authorities, while the POLMAR offshore response stockpile was retained in case the spill reached French waters.

On 9th August, the cracks that had appeared several days previously along the hull widened significantly, jeopardising the ship's integrity. The possibility of towing only part of the vessel began to emerge.

The next day, in addition to the equipment mobilised, 11 French experts were deployed to provide on-site spill response support. By this point the volume of oil spilt had been re-estimated at between 500 and 1,000 m^3.

Pumping operations to remove the oil remaining onboard began. The majority of the remaining fuel oil has been removed by 12th August. At the end of operations, the salvage company

announced that 3,200 tonnes of oil had been removed from the *MV Wakashio*, suggesting that the quantity spilled was somewhere in the region of 600 m^3. However doubts later emerged over this figure. Shoreline clean-up began, involving many local volunteers.

The Breton company Le Floch Dépollution was contracted by the shipowner.

On the 13th, an expert from Cedre joined the experts from CEPPOL who had arrived on Reunion Island the previous day. They joined the *MV Wakashio* command centre under the auspices

⋀ *Recovered oil stored in drums*

of the Prefect for the Southern Indian Ocean Maritime Zone.

The cracks in the wreck continued to worsen. On the 15th, the *MV Wakashio* broke in two during a towing attempt.

On the 17th, Cedre and CEPPOL arrived in Mauritius. They took part in the work of the national incident management unit, each focusing on their own field of expertise. The advisor from Cedre conducted shoreline surveys, in particular in the mangrove area, and provided the Mauritian authorities with a report together with clean-up recommendations.

Again on the 17th, the stern section was towed out to sea. The Mauritian authorities were considering scuttling this part of the vessel, an option that was not recommended by the French authorities. Through its ambassador, France expressed its stance to the Mauritian authorities. The letter indicated however that if this solution were to be chosen, several conditions would need to be met. Drift forecasts, produced from various geographical positions by the drift committee led by Cedre, helped to fulfil some of these conditions. Salvage operations continued on the stern section, with the aim of removing all contaminants. Scuttling of the bow section began on 20th August. It was announced to have sunk on the 24th.

The stern section was still in place and showing a 10° list.

The experts from Cedre and CEPPOL returned to Reunion Island on the 25th, before heading back to Brest.

Actions by Cedre

In addition to the on-site mission, Cedre provided support to the French and Mauritian authorities from Brest in other ways:

- consultation between members of the drift committee. Given that there was no real risk of the oil reaching the coastline of Reunion Island, the drift committee was composed only of experts from Ifremer, Météo-France and SHOM. This committee generated drift forecasts from the wreck and worked on the potential scenarios for the scuttling of the bow section of the vessel.

- from September, the first laboratory analysis was conducted on samples of oil taken by the Mauritian authorities in order to characterise it and confirm that the samples of oil stranded on the shoreline matched the other samples and matched the oil from the *MV Wakashio*;

- a study was conducted on the sorption properties of hair. Cedre had received many enquiries concerning the possibility of using sorbent booms made from hair. This type of custom-boom has been used in Mauritius, generating a lot of interest, and media attention, and proposals to send stocks of hair to the island. Although this initiative is commendable, the results unfortunately showed that the sorption capacity of hair is limited, but above all that it is very hydrophilic and quickly becomes water-laden and sinks even before it had absorbed the oil.

Latest update...

No oil reached the shores of Reunion Island. On 5th November, the Chinese salvage company Lianyungang Dali Underwater Engineering was contracted by the shipowner to dismantle the stern section of the *MV Wakashio* which was still grounded. The work was scheduled to begin in December 2020 and end in spring 2021. Due to weather conditions, operations did not begin until mid-February and were interrupted shortly afterwards by the hurricane season. Wreck removal operations resumed on 1st June, at a pace dependent on sea conditions. Until dismantling is completed, while the risk of significant oil leaks is considered to be low, spill response equipment remains preventively on stand-by, as well as booms in the vicinity of the neighbouring Blue Bay Marine Park shoreline.

Cedre returned to the island in January 2021 to assist and advise the Mauritian authorities in assessing end-points for clean-up operations. Forty-seven sites were visited.

Chemical detection: hyperspectral imaging trials

By Stéphane Le Floch, Research Department Manager at Cedre.

Maritime shipping of chemicals is continually on the rise, both in frequency and tonnage, generating an increased risk of accidents, often involving the spillage of all or part of the cargo. One major hazard in such an event is the almost systematic toxicological and explosive risks inherent to the inevitable transfer of chemical pollution from the water surface to the atmosphere, with the formation of a dangerous gas cloud. In order to understand this risk, it is important to have tools to detect, and possibly characterise, a chemical slick at the water surface. Hyperspectral cameras appear to be able to play this role but are not yet operational due to a lack of calibration for chemicals under realistic conditions.

Based on these observations, Cedre, with the support of the French Aerospace Lab ONERA, conducted tests in an outdoor tank on behalf of Seoul National University's Department of Earth and Environmental Sciences, South Korea. The aim was to assess the performance of two cameras (VNIR-1600 and SWIR-1800) for the detection of slicks of 5 chemicals (toluene, xylene, styrene, acetone and vinyl acetate), chosen because they are very often transported by chemical tankers. The results obtained show that colourless slicks were accurately detected and that it was possible to observe differences in response between chemicals. This last point suggests the possibility of tracing the chemical nature of the product forming a slick on the water surface.

The tests conducted at Cedre confirm the potential of these hyperspectral cameras for the detection and characterisation of chemical slicks drifting at sea. These tests argue in favour of open sea trials under the responsibility of the French Navy and with the logistical support of CEPPOL to assess the performance of the cameras in real conditions, and in particular, to evaluate the effect of wave action on their performance.

⋀ *Tests in Cedre's outdoor tank*

Training for the OSRL response team

By Natalie Monvoisin, Training and Studies Department Manager at Cedre.

In April, then September 2019, Cedre ran two on-site bespoke training sessions each for a dozen members of the OSRL emergency response team. These 4-day practical courses, run annually since 2017, were held at Cedre's technical facilities. They provided the opportunity for OSRL's emergency response staff to test their assessment procedures and perfect their knowledge of response techniques on the water and the shoreline.

⋀ *Cleaning riprap*

During these courses, the trainees benefited from real-life conditions with the release of real oil; they practised implementing procedures and deploying equipment for containment and recovery on the water, on a section of road and at outfalls. They were also able to test different clean-up techniques on different oiled substrates: pebbles and cobbles, riprap and sandy beach.

The courses ended with a half-day exercise designed to give the trainees the chance to apply the knowledge acquired throughout the week based on an oil spill scenario. Like each year, these courses gave rise to productive technical discussions between trainers and trainees, and Cedre's team is keen to see this cooperation continue between our two organisations.

Renewal of the MTE/Cedre agreement

By Nicolas Tamic, Operations Manager at Cedre.

On 3rd September 2020, the multiannual agreement between Cedre and the French Ministry for Ecological Transition was renewed. This renewal, which extends the agreement between the Ministry and Cedre until 2022, was signed by Cedre's Director Stéphane Doll together with Olivier Thibault, Water and Biodiversity Director and Thierry Coquil, Director of Maritime Affairs, on behalf of the Minister of Ecological Transition and the Minister of the Sea. Under the agreement, Cedre is engaged in the five following focal areas:

National and international representation and cooperation, and spill response:

- Representation and cooperation take the form of Cedre's participation in actions to develop and maintain information networks relating to oil and chemical spill response and beach litter.
- The response aspect involves providing decision support 24/7 for the authorities in the form of notes and recommendations and, where necessary, on-site missions. It also involves the activation of the drift committee as and when required and the drafting of an annual report on illegal discharges.

Knowledge and expertise enhancement

- This focal area mainly comprises the behaviour and impact of oil and hazardous substances in the environment, the recording of spills in France and worldwide, technological intelligence, response equipment assessment and improvement programmes through standardised tests, technical foresight, and the updating of a response equipment and product database.

Response preparedness:

- Support provided to the authorities takes the form of advice on their contingency plans (ORSEC, POLMAR shoreline plan, inland waters, protected areas), participation in practical and crisis management exercises, theory and practical training for the authorities' personnel and recommendations on the choice of response equipment and products.

Information dissemination and documentation:

- Cedre's knowledge is disseminated via publications (newsletters, bulletins, technical guides) and by publishing documentation on its website. Its resource centre is also open to the public.

Support for public policies to reduce pollution of aquatic environments by macro-litter and micro-plastics:

- In addition to the technical support provided to the Ministry for the implementation of its litter response programme, Cedre acts as the focal point for scientific and technical support within the framework of the Marine Strategy Framework Directive (MSFD). Cedre is responsible for the related indicators and for the marine litter monitoring programme. It coordinates the national monitoring networks for plastic litter on the shoreline and from river networks. Finally, Cedre is involved in national, European and international bodies international bodies in this field.

Training, an international activity

By Natalie Monvoisin, Training and Studies Department Manager at Cedre.

For the third year running, Cedre played host to German trainees from the Central Command for Maritime Emergencies (CCME or Havariekommando), a joint institution of the German Federal Government and the Federal Coastal States, created to establish and maintain joint management of maritime emergencies in the North Sea and the Baltic Sea.

These mainly practical sessions organised by Cedre provided the trainees with the opportunity to train in the natural environment (on the banks of the Penfeld river) and focused training throughout the week on pollution surveys, clean-up site organisation and various containment, recovery and clean-up techniques.

These sessions were also the chance for the trainees to test equipment recently acquired by their institution.

Satisfied with these bespoke services for its personnel, CCME wishes to renew its confidence by signing a new contract with Cedre for 2021. This lasting Franco-German partnership continues to grow each year, on the basis of mutual knowledge and feedback.

Designing and building custom-made booms in the natural environment on the banks of the Penfeld river

more info
www havariekommando.de

The Bonn Agreement celebrates its 50th anniversary

By Agnese Diverrès, Information Department Manager at Cedre.

On 11th October 2019, 50 years of successful cooperation in protecting the marine and coastal environment against pollution of the Greater North Sea and its wider approaches by oil and other harmful substances were celebrated in Bonn.

The Ministers present recognised the common benefit of this cooperation between the Greater North Sea States (it should be recalled that Ireland joined the Agreement in 2001) and the European Union (the Contracting Parties to the Agreement) to prevent, prepare for and respond to accidental and illegal marine pollution from maritime activities and to tackle future challenges by renewing and expanding its Strategic Action Plan.

Two important recent decisions were highlighted: the extension of the Agreement's scope of application to include air pollution caused by shipping and its geographical extension through Spain's accession. Ministers welcomed a series of major new commitments to address new trends in shipping and other maritime activities such as offshore oil and gas exploitation and reaffirmed that, despite the decrease in the number of observed spills during recent years, risks will always remain.

Even after 50 years of effective and result-oriented work, the Bonn Agreement continues to provide guidance and inspiration, showing how effective collaboration can be in responding to marine pollution incidents with the ultimate goal of protecting the marine environment.

Cedre has been contributing to the work of the Bonn Agreement for many years, mainly via the Working Group on Operational, Technical and Scientific Questions Concerning Counter Pollution Activities (OTSOPA), for which it is one of the technical advisors for the French delegation.

Revision of the SGEPP Gabon Oil Spill Contingency Plan

To reinforce its preparedness to handle potential spills related to its oil storage activities, SGEPP (*Société Gabonaise Entreposage Produits Pétroliers du Gabon*) commissioned Cedre to revise its Oil Spill Contingency Plan for its Owendo storage facility as well as to provide consultancy services for the procurement of spill response equipment with a view to reinforcing its site's response capacities.

Two engineers from Cedre went to Libreville to launch this project. The aim of this field mission was to complete the collection of all the relevant documents required to analyse the site situation, to discuss on-site experience in terms of past incidents and the response implemented, to visit the storage facility and study its interfaces with the water body and surrounding environment, and to list the incident scenarios to be considered to jointly define the potential response strategies in the local context. This visit was also an opportunity, at the initiative of the SGEPP, to meet the key local and national oil spill response players (port authorities, New Owendo International Port (NOIP) infrastructure manager, fire brigade).

Throughout this project, Cedre benefited from the cooperation of SGEPP personnel at all levels (operators, HSE team and management), who were greatly involved, cooperative and aware of the issues involved in revising the plan. The final deliverables were submitted and validated in early 2020.

Cedre will strive to assist SGEPP in the implementation of this new plan and our respective teams are eager to pursue this fruitful collaboration initiated in 2007.

We would like to thank SGEPP for their renewed confidence.

By Natalie Monvoisin, Training and Studies Department Manager at Cedre.

SGEPP oil storage facility in Owendo, Libreville - Gabon

Norwegian delegation from MARINENVIRON at Cedre

By Nicolas Tamic, Operations Manager at Cedre.

On 10th and 11th March 2020, Cedre received a visit – initially scheduled in March 2019 and postponed following the sinking of the *Grande America* – from the Norwegian Centre for Oil Spill Preparedness and Marine Environment (MARINENVIRON). Cedre played host to representatives of this governmental organisation involved in spill response acting under the aegis of the Norwegian Ministry of Transport. Composed of the organisation's Director and a team of three engineers, the delegation visited Cedre's facilities, in particular those related to experimental tools as well as the technical facilities used for the practical training courses run by Cedre for trainees from the public authorities and the oil and gas industry. The deep-water tank and the man-made beach complete with riprap attracted the Norwegians' attention. The presentation of these facilities sparked discussions on two potential collaborative projects.

The first was to identify the possibilities for a partnership to support MARINENVIRON in its plans to set up a marine oil spill response centre. The second point of discussion related to collaboration opportunities for the response to microplastics and macrolitter on the shoreline. As a result of these exchanges, a Memorandum of Understanding is currently being drawn up.

HNS training course for the Thaioil group

By William Giraud, engineer at Cedre.

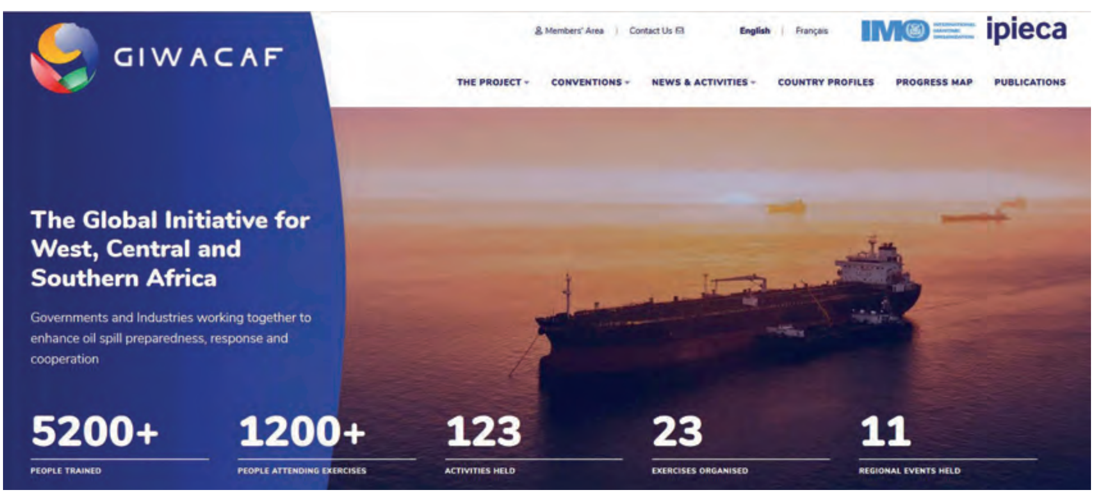
In order to respond effectively to a potential chemical spill from loading arms or at sea, a petrochemical industrial site belonging to the Thaioil group called upon Cedre's expertise to respond to their need for crisis management training on HNS (Hazardous and Noxious Substances). Two trainers from Cedre visited its Sriracha site in Thailand in May 2019 to provide bespoke training for a group of 19 trainees, ensuring that it addressed the specific issues posed by the chemicals manufactured or transported at the site. Among the products of concern for this petrochemical firm was solid sulphur, for which Cedre had conducted a study on the risks in the event of a spill. Based on this study, Cedre was able to propose training content that matched the expectations of Thaioil and its employees in charge of emergency response. Learning was facilitated by the interactive approach applied and practical exercises to ensure solid preparedness and an effective approach to HNS response. Alongside this training course, the Thaioil site's loading bay operations manager invited Cedre's trainers to visit the site facilities. These discussions helped to highlight the strong points and those that could be improved in order to respond effectively in the event of a spill. The visit also included a tour of Thaioil's incident management centre comprising innovative equipment.

NEWS

The new GI WACAF website is live!

more info

www giwacaf.net



New standard training course

"Crisis management: water resource pollution"

By Arnaud Guéna, Production Manager at Cedre.

In recent years, several incidents in which drinking water production facilities have been affected or threatened by spills have been known to occur due to events on the water or on land: industrial accidents, transport of hazardous materials, shipwrecks, flooding, etc.

Sudden pollution of water resources at drinking water production facilities can generate a critical situation requiring the stakeholders involved to strive to limit the impact on the natural environment, to protect the population, but also to respond with appropriate crisis management to any disruption to drinking water production and distribution.

While training courses in operational crisis management exist, none focuses specifically on responding to water resource pollution.

Based on this observation, and in order to enhance the operational skills of the different players involved (operators, local authorities, administrations, safety and crisis management officers, firefighters...), Cedre, IMT Mines d'Alès – a prestigious engineering school with which Cedre shares longstanding collaboration in the field of research – together with (ES)²* and the AQUA SÛRETÉ* network, two of Cedre's more recent partners, joined forces to propose a three-day on-site training course focusing on crisis management relating to water resource pollution. The first edition took place from 1st to 3rd August 2021 at the IMT Mines d'Alès campus in Alès (Gard).

Based on feedback from incidents involving the pollution of water resources or distribution networks, the course included both theory and practical sessions run by personnel from Cedre, IMT Mines d'Alès, (ES)²*, the fire brigade, French government services and the media.

The course ended with a simulation exercise in which trainees put into practice the knowledge acquired and gained greater insight into their role within a crisis management unit.

SAY WHAT ?

***Environmental Emergency & Security Services - (ES)²**

An engineering consultancy that supports local authorities and critical infrastructure managers (water, sanitation, hydroelectricity) in anticipating and managing operational crises.

***AQUA SÛRETÉ**

A network created to provide a permanent framework for meetings, feedback and technical discussions between water sector operators, government services and solution providers.

AIMS

This training course is based on a series of past incidents affecting water resources (surface water, groundwater, or distribution). By the end of this course, trainees will be capable of:

- Identifying best practices and opportunities for improvement in operational crisis management
- Understanding how the different players involved in crisis management function (government services, local authorities, public and private operators...)
- Managing crisis communication more smoothly, including with regard to social media and live news media
- Effectively organising and managing an incident management unit

TOPICS COVERED

The programme is organised into various topics:

TOPIC I: Introduction and feedback

- Introduction to spills in inland waters
- Feedback from past spills
- Pollution detection sensors

TOPIC II: Stakeholders and their role in the event of an incident

- The role of the authorities (Prefect and Prefecture)
- Transporters and water network operators
- The role of DREAL (regional environment directorate)
- The role of the fire department (SDIS)

TOPIC III: Operational response and spill management methods

- Behaviour of substances spilt and response strategies
- Response techniques
- Response equipment
- Case studies

TOPIC IV: Crisis communication

TOPIC V: Crisis management

Theory approach:

- How can a crisis affect organisations?
- Examples of water pollution incidents affecting operators
- Crisis management best practices

Practical approach:

- How is an incident management unit set up?
- What are its components?
- What equipment is required?

Simulation:

Crisis simulation exercise in the IMT simulator: management of a spill affecting a water resource or distribution network.

Cedre speaks at parliamentary office hearing on plastic pollution

By Camille Lacroix, engineer and Loïc Kerambrun, Scientific Coordinator at Cedre.

On 27th April 2020, Cedre was heard by the Parliamentary Office for Scientific and Technological Assessment (OPECST), a joint organisation between the National Assembly and the Senate, in relation to its plastic pollution mission.

OPECST: French Parliamentary Office for Scientific and Technological Assessment

As it was not possible to meet in person and organise a visit of Cedre's facilities as initially planned, this meeting was held online in the presence of Mr Philippe Bolo, Member of Parliament for Maine-et-Loire, Ms Angèle Préville, Senator for Lot, as well as Ms Sandrine Von Campenhausen, advisor who assists the two parliamentarians in their mission.

The hearing was organised into three presentations followed by a discussion session. After giving a general overview of its activities, Cedre detailed its actions relating to aquatic litter, in particular its mission to support public policies conducted on behalf of the French Ministry of Ecological Transition, within the framework of the Marine Strategy Framework Directive (MSFD) and the Regional Seas Conventions.

This presentation highlighted the important role of national beach litter monitoring networks, led by Cedre, in the acquisition of plastic pollution data at national scale. Secondly, the knowledge acquired on the quantities, distribution and impacts of marine litter was presented, based in particular on the results through the CleanAtlantic, OceanWise and MICMAC projects in which Cedre is involved.

The conclusions of the mission were released on 14th December 2020 in a report entitled "*Pollutions plastiques : une bombe à retardement ?*" ('Plastic pollution: a time bomb?').

more info
www senat.fr

E-learning during the COVID-19 pandemic

By Emmanuelle Poupon and Romain Dietschi, engineers at Cedre.

Like other professional training organisations, Cedre has been affected by the COVID-19 global health crisis, with national lockdowns preventing us from hosting trainees or travelling to their sites. Having had to postpone or even cancel several training sessions, we were keen to adapt our services in order to offer those registered for the first session of the "Marine pollution crisis management" training course and the course on "Merchant ships and the role of shipping industry stakeholders in maritime incidents" the possibility of taking them remotely, from the comfort of their office or home.

Initially scheduled from 6th to 9th April, the first session of our "Marine pollution crisis management" training course had been postponed until early June. In early April, we began to consider possible alternatives according to how the pandemic might evolve. Given that we had an existing online training platform, developed in collaboration with the International Office for Water, and bolstered by encouragement from CEPPOL, our main partner for the organisation of this course, we opted to set up virtual classes.

From 2nd to 4th June, after the first lockdown measures had been lifted, around fifteen learners took the training modules provided by Cedre and several external contributors, either live or on demand, by logging in to our online training platform *elearning.cedre.fr*. Although the tabletop exercise that usually closes the course could not be run, the feedback from the trainees was generally very positive, with several of them underlining their satisfaction at having been able to take this course despite the challenging circumstances due to the pandemic.

A second virtual training course was organised from 3rd to 5th November, this time on "Merchant ships and the role of shipping industry stakeholders in maritime incidents".

More than 16 trainers ran all the virtual classes live. Thanks to the experience acquired during the previous online course, we were able to quickly transition from on-site to online training. Finally, trainees were offered the possibility of accessing the modules on demand, allowing some participants to take the course despite the circumstances being heavily impacted by the COVID-19 pandemic (on-call duty, personal circumstances, etc.). When trainees were invited to share their impressions at the end of the course, they highlighted the quality of the speakers, who willingly played their part, some taking advantage of the interactive possibilities offered via this approach (surveys, participatory work, etc).

The shoreline pollution crisis management training course held from 7th to 10th December was also run virtually and was attended by around 15 participants in mainland and overseas France.

2020, A PIVOTAL YEAR for Cedre in terms of ACCREDITATIONS

By Vanessa Lebriez, Studies and Training Department at Cedre.

In late 2019, Cedre began the certification process with the UK's Nautical Institute in order to become an NI-accredited training provider in compliance with IMO standards. This accreditation was granted in November 2020 for our IMO OPRC level 0, 1, 2 and 3 oil spill response training courses and our IMO OPRC-HNS level 1 and 2 chemical spill response courses. For IMO OPRC courses, level 0 consists in an introductory day on oil spill response, level 1 training is for operational staff, level 2 for supervisors and on-scene commanders and level 3 for senior management personnel. In the case of OPRC-HNS courses, level 1 courses are for first responders, supervisors and on-scene commanders, while level 2 courses are for administrators and senior managers.

ACCREDITED BY The Nautical Institute

In early 2020, Cedre decided to bolster its training activity by applying for Qualiopi certification (based on French regulations). The French law of 5th September 2018 states that all training providers working for the conventional market (public funding and/or pooled/joint funding) must be certified by 31/12/2020 (postponed to 31/12/2021 due to the COVID-19 pandemic). This certification, governed by the French National Quality Reference System (RNQ) Qualiopi, is based on 7 criteria composed of 32 indicators mainly focusing on the design and implementation of training. Having successfully passed the audit, Cedre is now Qualiopi-certified for the next 4 years. This certification demonstrates our regulatory compliance and ensures the funding of our training activity.

Qualiopi processus certifié

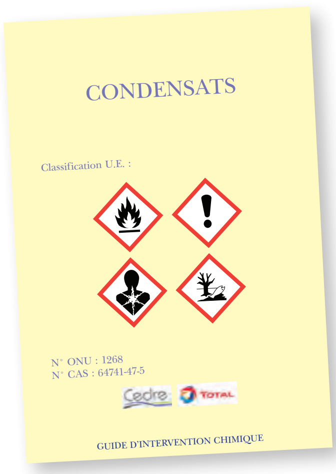
RÉPUBLIQUE FRANÇAISE

NEW PUBLICATIONS

ALL OUR PUBLICATIONS ARE AVAILABLE FOR DOWNLOAD from our website

www cedre.fr

Resources sections



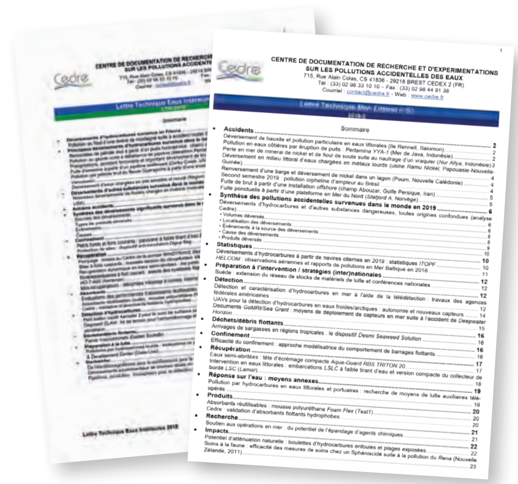
Chemical Response Guide on condensates

(56 pages)

Cedre recently published a new chemical response guide on condensates. The guide is intended for professionals who may be liable to face a condensate spill in an aquatic environment. Targeted towards both operational personnel and decision-makers, this practical guide provides useful information on spill response and contingency planning for such spills. It is designed to ensure rapid access to the necessary initial information, in addition to providing relevant bibliographical sources to obtain further information. It contains experimental data as well as the results of scenarios based on real incidents. The guide is available in digital format free of charge on Cedre's website ("Resources" section), while hard copies cost €25.

Cedre Technical Newsletters

Our biannual "Sea & Shoreline" and "Inland Waters" Technical Newsletters, available in both French and English, are a gold mine of information. They provide a summary of our technology intelligence activity on past and recent spills in marine and inland waters. They include data on past incidents, a review of spills around the world, statistics, information on response preparedness, oil recovery, response techniques, response products, compensation, environmental impacts, lessons learnt and slick drift, as well as details of recently published guidelines and recommendations. Latest publications: the Sea & Shoreline Technical Newsletters n° 49 and 50, and the Inland Waters Technical Newsletter n° 29. They are available online (Resources > Publications > Technical Newsletters).



New annual publication "Pollustats"

The latest addition to Cedre's collection, Pollustats, is an annual bilingual French/English publication. This document presents data obtained from an inventory of incidents around the world made known to Cedre and having resulted in an oil or HNS spill in surface waters. Our team of engineers with specialist knowledge of these data is at your disposal for further information. The Pollustats 2017, 2018 and 2019 reviews are available on our website (Resources > Spills > Statistics).

Cedre AT A GLANCE

Based in BREST for **40 years**

50 staff

€5 million budget

60 training courses annually

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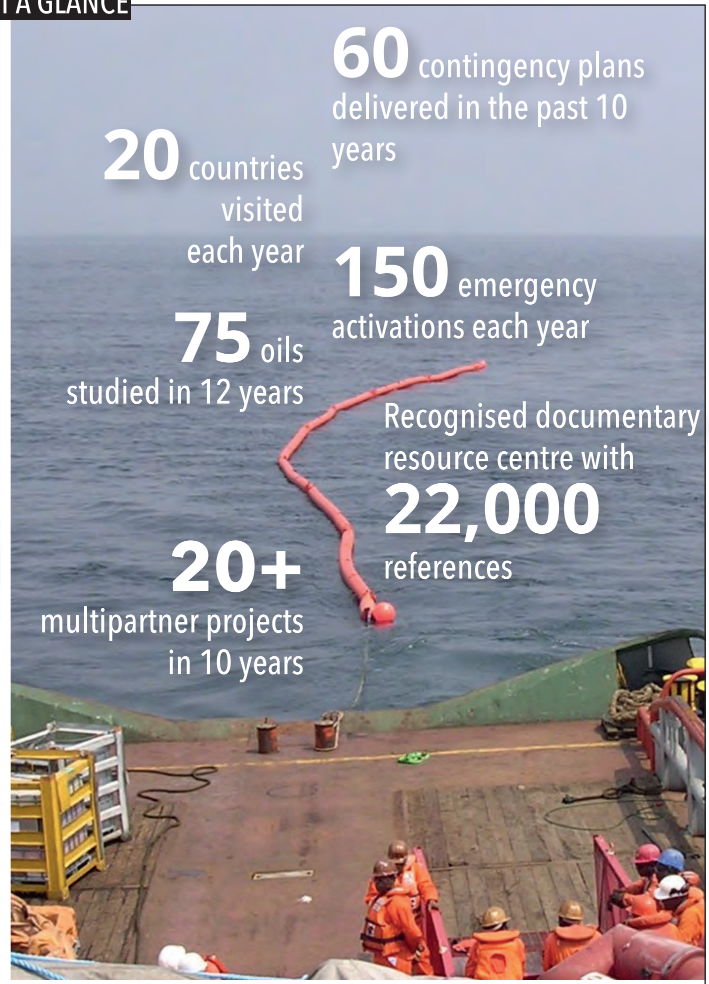

60 contingency plans delivered in the past 10 years

20 countries visited each year

150 emergency activations each year

75 oils studied in 12 years

Recognised documentary resource centre with **22,000** references

20+ multipartner projects in 10 years

INTERNATIONAL SCOPE

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