

## Understanding Chemical Pollution at Sea – A New Website

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### Abstract

Today, the internet has become a key method of communication. Young generations, as well as the wider public, now use smartphones and tablets on a daily basis to find information and gain understanding in different fields.

With this as a backdrop, *Cedre* and Transport Canada naturally decided to pursue their collaboration by developing a website devoted to the issue of chemical pollution at sea. In 2012, a learning guide was released on chemical pollution at sea composed of 2 posters and a booklet. This learning package is intended for 12 to 18-year-olds and their teachers, but also for journalists, those potentially involved in spill response and the general public.

The associated website [www.chemical-pollution.com](http://www.chemical-pollution.com) is divided into six major sections: an introduction to chemistry and a few examples of its uses, different aspects of shipping – such as the types of ships used and regulations, the main sources of chemical pollution at sea, spill prevention and preparedness, the different response techniques – systematically illustrated with examples of past incidents, the impact on human health – the environment and the economy.

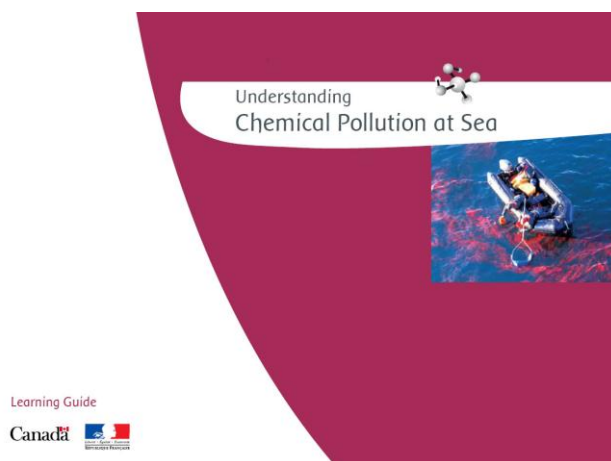
This interactive website features a series of original animations. Users can, for instance, discover the organisation of a port terminal, view the behaviour of different chemicals, understand techniques used to respond to a spill of bulk cargo... A quiz, with different levels of difficulty, offers users the chance to test their knowledge on this issue. A character named Phosphacola also accompanies younger users on a journey to follow a chemical from its extraction to its end use, presenting its transport across the world's oceans and the spill risks to which it may be exposed.

### 1. Objectives

The chemical industry is today at the hub of the global economy and must often overcome vast distances between production and consumption areas. These geographical constraints require large volumes of hazardous substances to be transported, often by sea. Shipping generates risks which are steadily rising, due to the ever-increasing size of vessels, together with the pressure of world markets. In the event of an incident, these risks lead to different problems to those encountered in the case of oil spills. The threat of a chemical spill

is a concern for many stakeholders (industry leaders, politicians, environmentalists and citizens).

It is therefore essential to have concise, comprehensive, educational information on this issue. Transport Canada and *Cedre* decided to produce a learning package entitled “Understanding Chemical Pollution at Sea” (Fig.1) (Cedre, 2012). This learning package follows on from that on oil spills produced by *Cedre* in 2008 entitled “Understanding Black Tides” (Cedre, 2007). This learning package about chemical pollution at sea consists of a learning guide of more than 90 pages and two posters. It is intended for 12 to 18-year-olds and their teachers, but also for journalists, those potentially involved in spill response and the general public.



**Figure 1: Front cover of the learning guide: “Understanding Chemical Pollution at Sea”**

These printed documents have been widely distributed at international conferences and meetings (in particular Interspill 2012, Clean Pacific 2012, Bonn Agreement meeting, EMSA, OMI, OPRC-HNS group, EPPR - Arctic Council, EU-funded Safemed II, AMOP 2012...).

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## 2. Methods

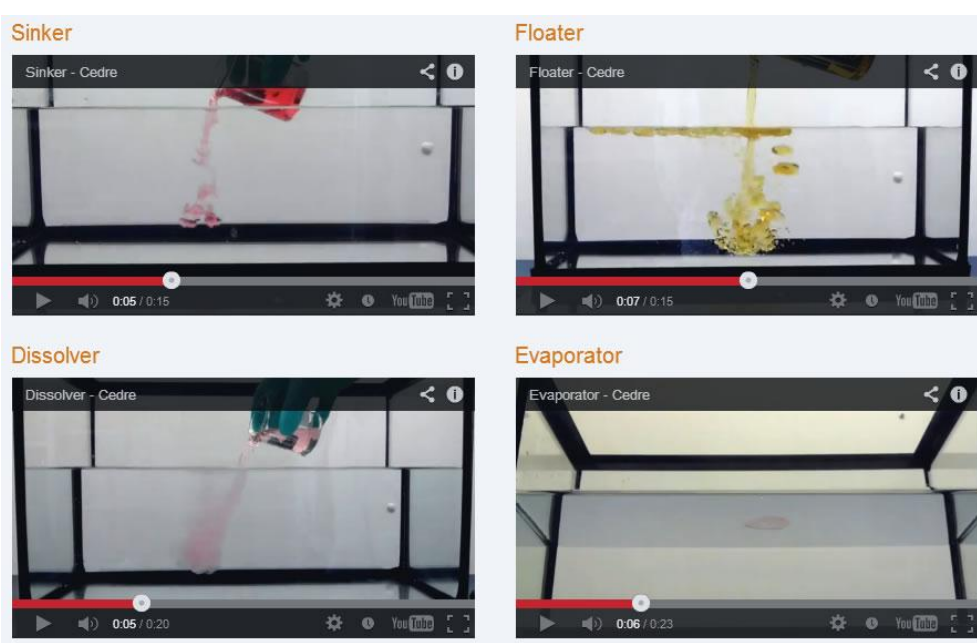
The content produced for the printed version of this guide was then adapted to be integrated into the web-based version of “Understanding Chemical Pollution at Sea”. The website is divided into six major sections: Chemicals, Shipping, Sources of pollution, Prevention and preparedness, Spill response and Impact. A toolbar provides access to the bibliography, the glossary, the index of main uses for the substances referred to in the content of the site, a page to download PDF files, a links page, a webpage on how to order the book, the legal references and the site map.

This interactive website features a series of 7 original animations:

- The animation on “Where can chemicals be found in our everyday lives?” shows that chemicals products are found everywhere in our homes (Fig. 7).
- “Main operating terminals within a port” allows users to discover the organisation of a port terminal (Fig. 8).

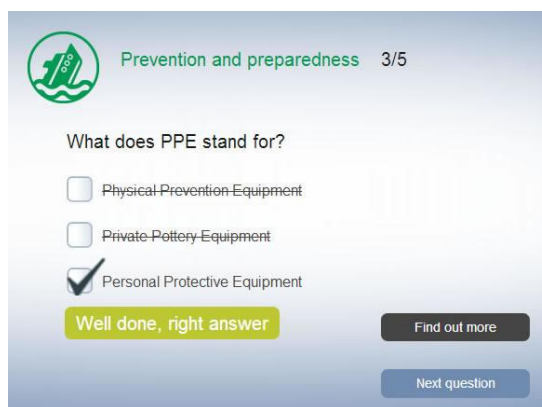
- “Causes of ship-source accidents involving chemicals worldwide” shows the distribution of causes via an interactive pie chart.
- “How does a substance behave when spilt in water?” presents the behaviour of a substance spilt at sea based on the Standard European Behaviour Classification (SEBC).
- The animation “Response to spills of bulk HNS cargoes” shows techniques used to respond according to the accident area.
- The “Fate of chemicals in the environment” animation is designed to show that the behaviour of a chemical in the water heavily influences its fate in the marine environment over the days, months and years following its release (Fig. 9).
- The environmental impact is illustrated by the animation on “Animal communities affected according to the chemical's behaviour” (Fig. 10).

Videos (Fig. 2) to present the behaviour of substances spilt at sea were specially produced in *Cedre*'s laboratory.



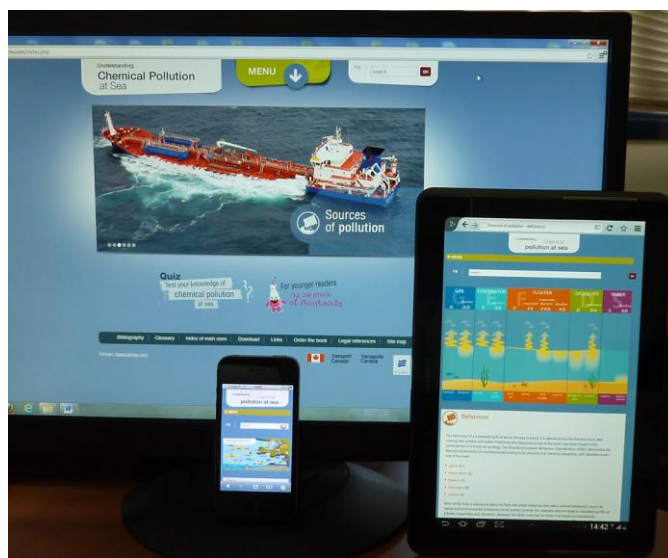
**Figure 2: Videos to show the behaviour of a substance spilt**

A quiz (Fig. 3), with different levels of difficulty, offers users the chance to test their knowledge on this issue. A character named Phosphacola also accompanies younger users on a journey to follow a chemical from its extraction to its end use, presenting its transport across the world's oceans and the spill risks to which it may be exposed.



**Figure 3: The quiz**

A particular effort has been made to make these two sites “responsive” (Cashmore, 2012; Marcotte, 2011, Marcotte, 2010), i.e. they automatically adapt to suit smartphones and tablets (Fig. 4 and 5). Responsive web design (RWD) is a web design approach aimed at crafting sites to provide an optimal viewing experience - easy reading and navigation with a minimum of resizing, panning and scrolling - across a wide range of devices (from desktop computer monitors to mobile phones). The content presented (texts, photographs, diagrams, animations, video clips) automatically adapts according to the device used.



**Figure 4: Responsive web design: interface that adapts to different types of devices (desktop computer monitor, smartphone and tablet)**

The launch of these two new websites was announced on social networks (Facebook, Twitter), *Cedre*'s website ([www.cedre.fr](http://www.cedre.fr)), in *Cedre*'s monthly newsletter and through the distribution of flyers at international conferences (AMOP 2013, SPILLCON 2013...) and meetings.

### 3. Results

The websites went live in March 2013. The English version is available at [www.chemical-pollution.com](http://www.chemical-pollution.com) (Fig. 6) and the French version at [www.pollution-chimique.com](http://www.pollution-chimique.com).



Figure 5: QR Code to connect to the website



Figure 6: www.chemical-pollution.com home page

The first section of the website, entitled “Chemicals”, provides an overview of the chemical industry, and the roles of chemicals in everyday life (Fig. 7). It also covers the basics of chemistry, such as atoms and molecules. A section is devoted to the sourcing and manufacture of chemical goods, including refining and synthesis methods used in the industry. Different classes of chemicals are presented, along with examples of representative products. Information is provided on how to properly read the labels and material safety data sheets of hazardous materials.

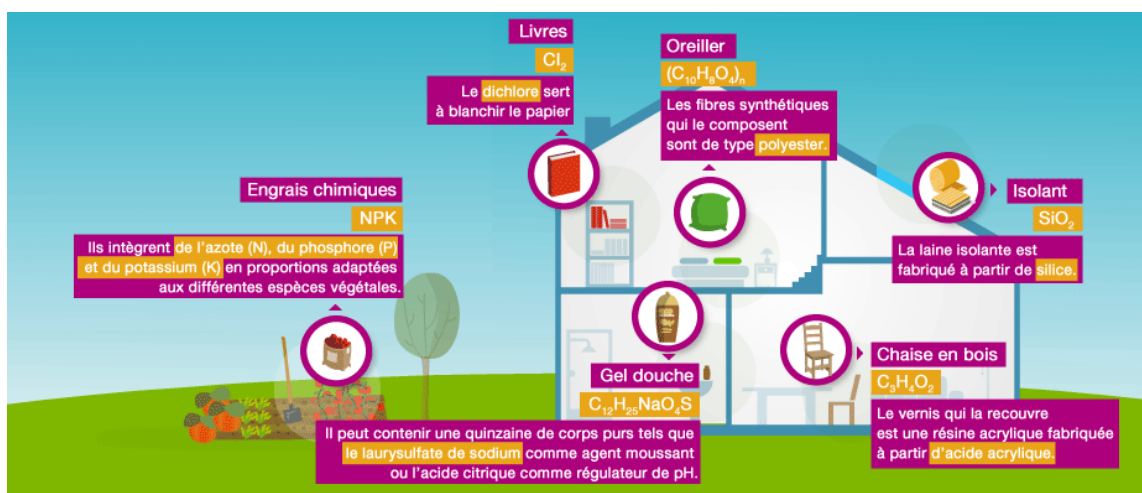


Figure 7: Where can chemicals be found in our everyday lives?

The “Shipping” section introduces the concept of hazardous and noxious substances (HNS) and presents major shipping routes for bulk chemical transportation. Detailed information is provided on the logistics of marine transportation, such as port terminals (Fig. 8), types of vessels according to the chemicals transported and different forms of packaging. Sections on transporting gases, bulk liquids, bulk solids and containers explain the different challenges and technologies involved in their transport. A global picture of the most commonly transported chemicals is also provided to clearly define the major risks involved in

transportation, based on past incidents and volumes transported (Rousseau and Gaillard, 2010). Emphasis is also placed on the safe transportation of dangerous goods through strictly enforced codes and regulations.

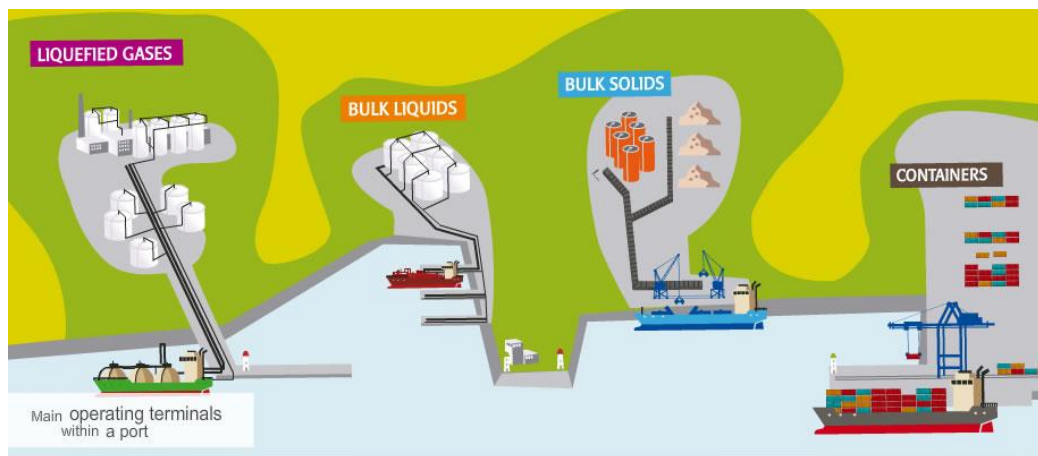


Figure 8: Main operating terminals within a port

The third section, “Sources of pollution”, describes the various sources of chemical pollution, whether chronic or accidental. The part on chronic pollution raises awareness of the effects of low dose, on-going pollution by chemicals on both human health and the marine environment. The causes of marine incidents resulting in the accidental release of chemicals are listed, with their contribution to the overall frequency of incidents. A map of notable incidents involving chemicals provides a valuable picture of the location of these events in relation to shipping routes and economic centres. The fate of spilled substances is explored to clearly explain the wide range of behaviours (Fig. 9) that can be encountered with chemicals in contact with water (LeFloch, 2006). Historically significant incidents and the associated response efforts are summarized and analysed to provide insight into the challenges associated with chemical spills, as well as the lessons learned from these incidents.

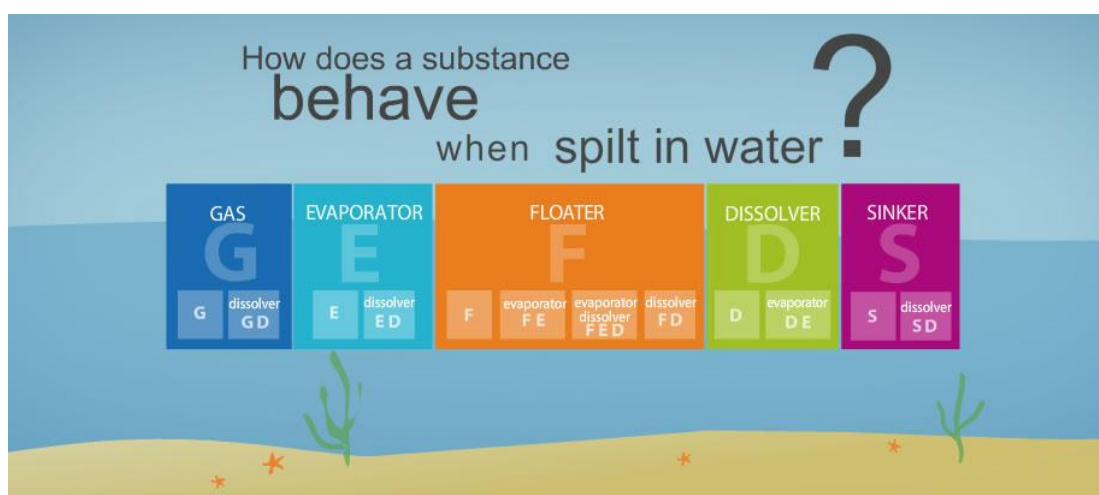


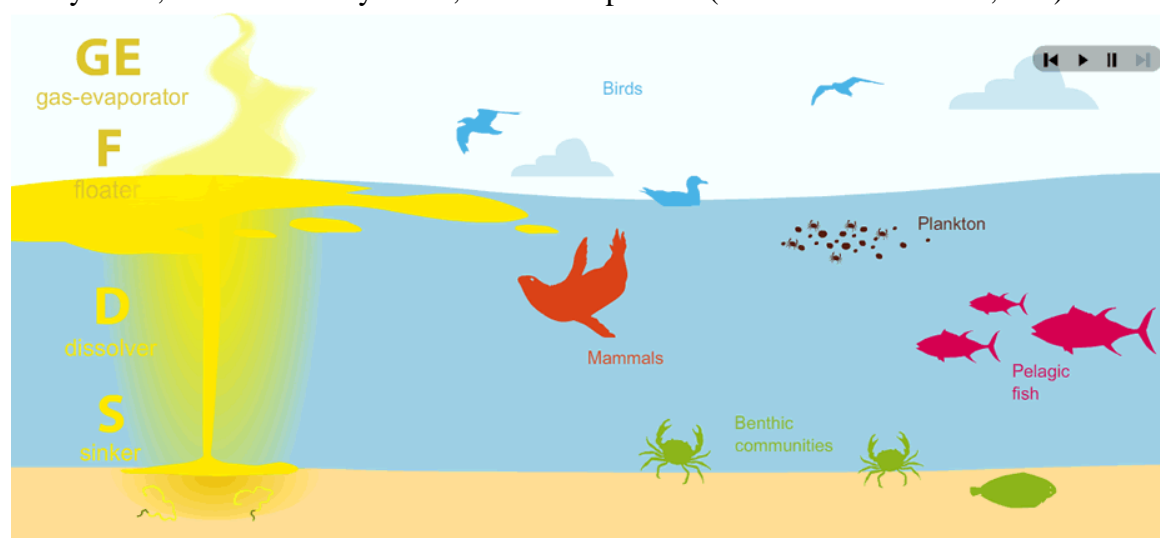
Figure 9: How does a substance behave when spilt in water?

The activities related to prevention and preparedness for chemical spills are described in the fourth section of the website. A section on the organizational framework explains the role and importance of various international initiatives and co-operation agreements aimed at supporting preparedness efforts. The logic behind the creation and implementation of

contingency plans is clearly explained and illustrated to make this concept more tangible for those not directly involved in such activities. Valuable information is provided on the specialized response associated with chemical incidents, covering topics such as personal protective equipment and response team training. A section on ship inspection highlights the importance of assessing the safety of sea-going vessels that transport dangerous goods in order to avoid incidents before they happen.

The fifth section, “Spill response”, covers both the logistical and technical aspects of chemical spill response. The general methodology of incident management is explained, including situation assessment, decision-making and emergency measures to be applied. In-depth information is provided on response to bulk cargoes as well as to containers and packages, with emphasis on the very different problems that each type of shipment can exhibit. (Kremer, 2011) A breakdown of response techniques based on the location of the spill and the type of incident helps readers to better understand the appropriate actions to be taken according to the specific situation encountered (Struski and Kremer, 2003). Monitoring and clean-up technologies and methods are explored, as well as waste management options.

The sixth section, “Impact”, deals with the economic, environmental and health effects caused by the release of a chemical. Practical information on the routes of entry of chemicals into the human body and basic toxicology concepts are explained in the first section. This information should enable readers to better understand the concepts of toxic doses, a subject little known to many individuals, which often leads to unjustified or misplaced fears and concerns. The fate and impact of chemicals on the environment is explained through the fate of spilt chemicals (where they ultimately will end up in the environment), bioaccumulation as well as the levels of harm observed in marine organisms (Fig. 10) following a pollution incident. Economic impacts and the measures in place to remedy them, such as liability funds, are also explained (Environment Canada, n.d.).



**Figure 10: Animal communities affected according to the chemical's behaviour**

To complete the learning experience, the quiz, which was created for the printed version, has been adapted and included to test users' knowledge of marine chemical pollution. Several questions are associated with each section of the website, with three increasing levels of difficulty.

To appeal to younger readers, the website features the story of an original character named Phosphacola, presented in a cartoon style. The narrative is based on the use of phosphoric acid in soda and is focused on three main steps in the production process: the extraction of rock phosphate, concentrated phosphoric acid and the finished product, a bottle

of cola. Each storyboard uses these three forms to explore the main themes of the website, such as types of vessels for transport, effects of spills, etc.

#### 4. Conclusions

It was felt by Transport Canada and *Cedre* an important and valuable task to explain to young generations the realities of HNS spills and their consequences objectively and not emotionally, as is too often the case with the media. It is important to present the facts of the matter clearly and simply.

The resulting websites present current knowledge of the behaviour of Hazardous and Noxious Substances (HNS) at sea, the organisation in place to respond to a spill, response methods and resources and the medium- and long-term consequences of an HNS spill for the environment as well as maritime and economic activities.

Today, the internet is a rapidly expanding medium, very well known to young people, which can be used to communicate important messages. One of the main challenges of this project was to create a responsive web design in order to adapt the content to the many devices that can be used to surf the web today.

In the wake of “Understanding Black Tides” and “Understanding Chemical Pollution at Sea”, a new document on Debris at Sea could be an interesting addition to this collection...

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