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ACCIDENTAL WATER POLLUTION**

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**Inland Waters Technical Newsletter n°25**

**LTEI 2015 - 2**

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- **Main oil spills worldwide**

**Collision of a tanker barge and a spill of heavy oil (Apex 3508, Kentucky, US)**

On 2nd September 2015, a collision occurred between two tugs on the Mississippi near Paducah (Kentucky, US), causing a breach in one of the cargo tanks of a barge (Apex 3508, belonging to Inland Marine Services) and resulting in the release of approximately 450 m<sup>3</sup> of slurry oil. Due to its high viscosity (160,000 cSt) and density (specific gravity of 1.14), the substance was expected to sink as a single compact mass. Indeed, no slicks were observed at the surface or on the banks of the river along the 16-km stretch surveyed downstream of the incident, and sheen was only detected locally. Through the use of a high frequency (450 kHz) side scan sonar and a multibeam sounder from a light boat, together with visual inspection by divers and trawling with ballasted sorbents, the bathymetry and areas of sunken oil could be accurately mapped. The endpoint criteria established for clean-up of the contaminated riverbed (less than 10% coverage) were reached 3 weeks after the incident, with the removal – using mechanical dredgers – of over 1,700 m<sup>3</sup> of contaminated sediment.

- **Main spills of other substances worldwide**

**Tow boat accident: non-persistent spill of caustic soda (Vacherie, Louisiana, US)**

On 2nd July 2015, on the Mississippi, near Vacherie (Louisiana, US), a barge overturned following a collision between two tow boats. The barge was carrying approximately 750 tonnes of sodium hydroxide, which immediately began to leak out into the environment. The US Coast Guard, in charge of managing the incident, requested scientific support from the National Oceanic and Atmospheric Administration (NOAA) to model the substance's fate and the subsequent risks. The sodium hydroxide was expected to rapidly dissolve and be diluted, without posing any major risks for the environment. No spill response actions were necessary, other than monitoring to determine when the water quality had returned to normal.

**Mines: major mine waste water spills due to retention pond ruptures**

In August 2015, near Silverton, Colorado (US), the wall of a retention pond at a gold mine (Gold King Mine), abandoned since 1923, where work was being carried out to clean and drain the site, fractured causing over 11,300 m<sup>3</sup>, according to USEPA, of waste water (laced with zinc, iron, copper, arsenic, mercury, lead and various heavy metals) to be released into the Animas River. The breach occurred unexpectedly during soil contamination analysis work. On-site the EPA diverted the flow of waste water towards 2 retention ponds and attempted to neutralise the acidity of the effluent and to filter out particles. Thanks to rapid dilution, the levels of contaminants in the water (which was already subject to chronic pollution) had returned to pre-spill values by mid-August. Until then, water intakes at the facilities located downstream were shut off and recreational activities temporarily banned by the authorities.

Then, in early November 2015, the Rio Doce and rivers in the Brazilian states of Minas Gerais and Espirito Santo were contaminated by tens of thousands of cubic metres (estimated at around 60,000 m<sup>3</sup> according to several sources) of extraction waters when a dam burst at a Samarco silver mine. The incident caused several villages and hamlets to be flooded by a flow of water and mud, killing 19 people and injuring 50. The spill reached the Atlantic Ocean, some 650 km from the mine, affecting the river mouth, a sensitive area, notably in terms of its ecology (it is for instance a breeding zone for a species of giant sea turtle) and its tourism. While little detail is provided on the circumstances and consequences of the spill, we know that it caused fish mortality and contaminated drinking water (affecting the supply to 280,000 people).

**Spill of a soluble substance due to train derailment (BNSF Railway, Wisconsin, US)**

On 7th November 2015, a convoy of 115 cars operated by Burlington Northern and Santa Fe (BNSF) Railway derailed a few kilometres north of Alma in Buffalo County, Wisconsin. Twelve of the 25 derailed tank cars overturned, releasing approximately 70 tonnes of ethanol into the Mississippi from the 6 leaking tanks damaged during the accident.

Over 100 local inhabitants were temporarily evacuated as a preventative measure, while a section of highway adjoining the site was closed to traffic. Details of the response are not provided in our information sources, except for mentioning the BNSF personnel and equipment mobilised for leak

control operations, prior to the removal of ethanol and righting of the overturned tank cars, as well as for the containment<sup>1</sup> of the spill under the supervision of State and federal agencies, led by the Environmental Protection Agency, with scientific support from NOAA, in particular in terms of forecasting (modelling) of the behaviour and potential effects of the ethanol on the aquatic environment. No visible signs of environmental impact were reported, probably due to the rapid dissolution of this highly miscible product in the river.

#### **Rail accident and sulphuric acid spill in watercourse (Incitec Pivot Limited, Australia)**

On 27th December 2015, the 26 wagons which made up a freight train travelling through a rural part of Queensland (Australia) derailed<sup>2</sup> then overturned, some 20 km east of Julia Creek. The train included tanks from the fertiliser company Incitec Pivot Ltd, carrying a total of 200 m<sup>3</sup> of sulphuric acid. One of these wagons was damaged and leaking, and released an estimated 80 m<sup>3</sup> of its cargo into a nearby watercourse.

No technical details of the response are available in our information sources, however we are told that it was hampered by site access difficulties, as this remote site was located in an area where recent flooding meant that roads had been temporarily closed. In addition to assessing the situation and determining the measures required to respond to the spill and right the wagons, the authorities preventively made health protection a priority, declaring a state of emergency in accordance with the Public Safety Preservation Act and setting up a 2-km exclusion zone around the accident site.

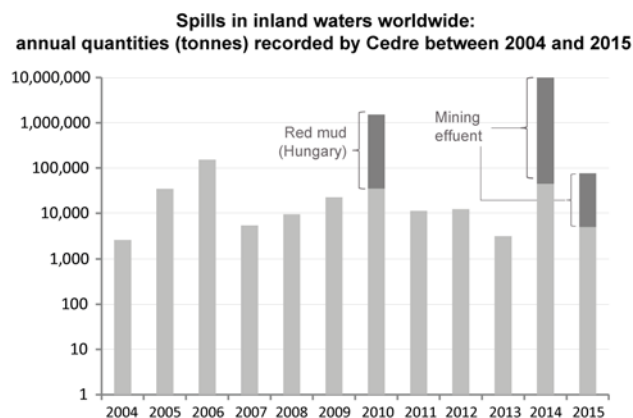
### • **Review of significant spills having occurred worldwide in 2015**

This analysis is based on an inventory of incidents in 2015 recorded by Cedre having led to a spill of over an estimated 10 tonnes, for which sufficient information was available. We remind readers that, for a certain number of incidents, the volumes spilt are not known or were not available in our sources of information, although they clearly exceed the ten-tonne mark; these missing data and inaccuracies indubitably penalise the accuracy of the results presented below.

#### **Spill sources**

In 2015, 36 incidents followed by significant spills ( $\geq 10$  t.) were identified in inland waters, a value slightly below the median (39) for the period 2004-2014 (calculated based on annual data estimated in a similar way). This year therefore deviates only very slightly from the norm in terms of the number of significant incidents known to us.

These incidents however represent a total quantity of oil and other hazardous substances of almost 76,500 tonnes (Fig. 1).<sup>3</sup> This estimation is far higher than the annual median expressed for the period 2004-2014 (around 12,400 tonnes), and is the 4<sup>th</sup> highest since 2004.



As in 2014, the vast majority of the total volume (almost 95%) can be accounted for by 2 spills of contaminated water from mining effluent retention ponds. These incidents occurred in August and November 2015, in the United States<sup>4</sup> and Brazil<sup>5</sup> respectively, and represented over 71,000 tonnes of contaminated water. Hence, the volume of transported products (oil, HNS...) spilt in 2015 is therefore relatively modest and is in fact one of the lowest recorded by Cedre since 2004.

**Figure 1**

The estimated median volume of spills for the year shows that the spills in 2015 were distributed around a median value of approximately 70 tonnes. Furthermore, with the exception of the two mining

<sup>1</sup> The operator reported that floating booms had been laid along the banks. This was apparently an attempt to restrict the spread of the ethanol into the watercourse. Its efficacy on this substance (miscible in water) is not reported.

<sup>2</sup> Probably, according to various information sources, due to recent episodes of major flooding in the area.

<sup>3</sup> Minimum estimation due to a lack of detailed data for several incidents.

<sup>4</sup> See above, section "Main spills of other substances worldwide"

<sup>5</sup> See above, section "Main spills of other substances worldwide"

effluent releases, only half a dozen of the spills reached the hundred-tonne mark, and one exceeded a thousand tonnes.

As in previous years, **pipelines** represented the most frequent source (25%) of significant inland water pollution incidents recorded in 2015, followed by overland transport in **tanks** (Fig. 2), representing a total of 22% of cases (divided between **tank cars** and **tanker trucks**, with respectively 14% and 8% of the number of spills).

**Onshore oil facilities** were the source of around 20% of spills, in particular oil **wells** (14%) and **refineries** (5%).

These were followed by various onshore industrial facilities, with **power plants** being responsible for 8% of spills and **mines** 5%.

The other types of sources identified in 2015 – vessels (**barges**) and various facilities (**factories**, various **SMEs**, etc.) – were involved in less than 5% of significant spills during the year.

In terms of quantities, we note the vast predominance (around 95 %) of **mines** in the 2015 total (Figure 3), relating to the 2 incidents outlined above. Aside from these mining-related spills, the largest quantities spilt were from **land pipelines** (50% of total, excluding mines), then vessels (**barges**, totalling 24%) and overland transport (**tanker trucks** and **tank cars**, giving a combined total of 20% of the overall total, excluding mines).

The other sources identified represented only a minor share (less than 3%) of the estimated total for 2015. Given the patchy nature of the data identified, no accurate indication of their relative shares of the overall total can be given, except from stating that they are most likely underestimated (Fig. 3).

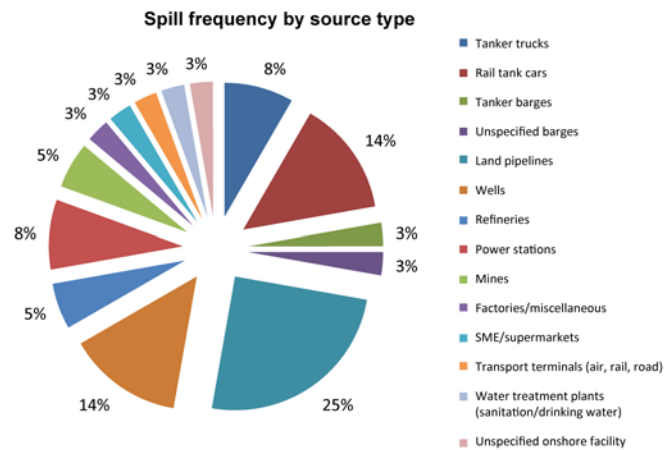


Figure 2

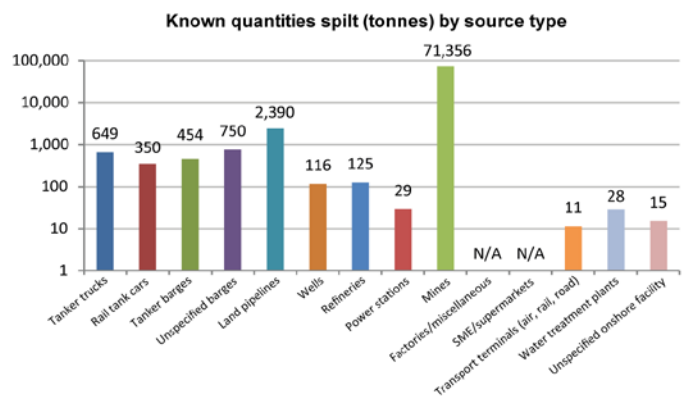


Figure 3

### Types of substances spilt

The 2015 total is very largely dominated (around 94%) by releases of **waste waters**, in particular containing **mineral matter** from mining activities (around 71,400 tonnes of waste water mainly containing heavy metals).

This is due to two spills of 11,400 and 60,000 tonnes, respectively, which occurred in the United States and in Brazil following the rupture of the walls of waste water retention ponds<sup>6</sup>.

Aside from these mining effluents, oil represented the highest share (77%) of the total volume spilt, mainly composed of **unknown/unspecified oil** (around 42%) and **crude oil** (31%), which would appear to rank far higher than light refined products (whose share may be underestimated due to incomplete data) (Fig. 4).

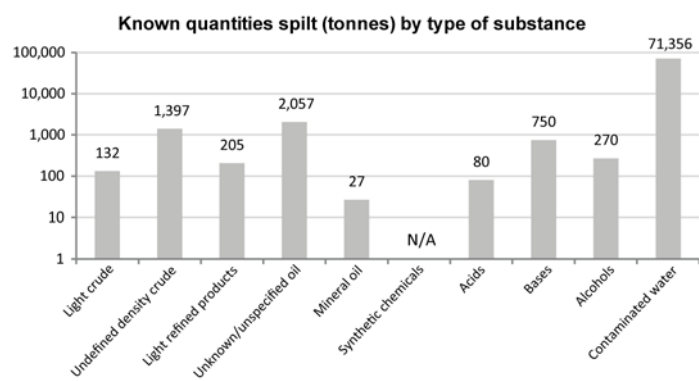


Figure 4

<sup>6</sup> See above

In 2015, the share of **chemicals** (around 22%) was lower than that of oil. This is however an underestimation, due to the lack of available data on a spill of a synthetic chemical at a paper mill in the US<sup>7</sup>. The major share of this category involved **bases** (15% of annual total), due to a single spill of around 750 tonnes of caustic soda (when a barge capsized in July 2015 in a waterway near Vacherie, Louisiana, US)<sup>8</sup>, ahead of **alcohols** (5%) and **acids** (2%).

## Events

The most frequently reported incidents in 2015 were **breaches or ruptures in structures** (approximately 78%, see Fig. 5):

- Most of the incidents in this category were due to a **loss of integrity** (36% of incidents), mostly of internal pipes within onshore industrial facilities (particularly oil facilities) and pipelines. In terms of the quantities spilt, these incidents however only represented a marginal share (less than 1%) of the recorded annual total (Fig. 6)<sup>9</sup>, as they generally resulted in only small spills in 2015. We note the spill of just under 100 m<sup>3</sup> of diesel from a pipeline between a refinery and a loading dock near the Mississippi (April 2015; see LTEI n°24).
- **Overtuning** incidents (mainly overturning/derailment of rail tank cars or road tankers) represented 22% of incidents (Fig. 5) but represented the second highest share of the annual total spilt in inland waters (Fig. 6), exceeding the thousand-tonne mark.
- **Structure ruptures** represented around 17% of cases and were hands down the greatest contribution to the annual total, due to the two above-mentioned tailings pond ruptures.

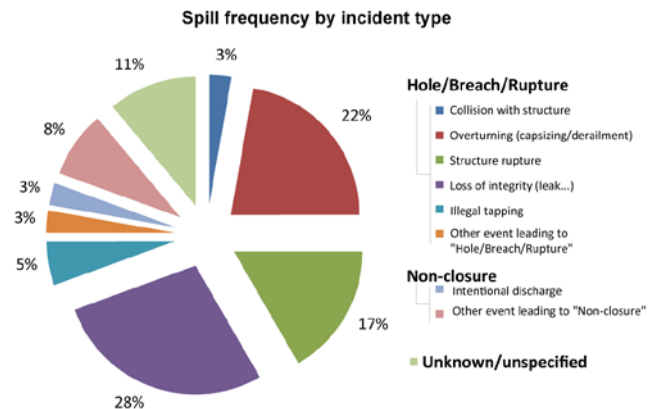


Figure 5

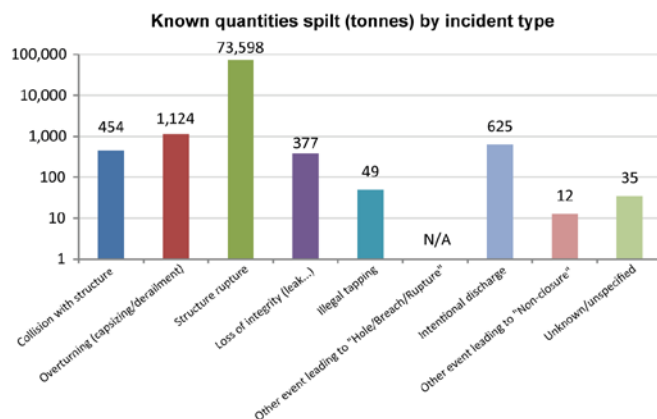


Figure 6

- Cases of loss of integrity due to **collisions** were relatively few (around 3% of cases) (Fig. 5) and represented a volume of over 450 tonnes, mainly due to the collision involving a tanker barge on the Mississippi in the state of Kentucky in September (US, see above).

Aside from **unspecified events**, responsible for 11% of the cases recorded, the other categories of incidents each represented less than 5% of cases (Fig. 5), with the exception of **non-closure events** (also 11%) representing a supplementary 600 tonnes of **deliberate releases**<sup>10</sup>.

## Causes

Analysis of the frequencies of each cause shows that the cause was **unknown or unspecified** in the vast majority (around 65%) of cases listed (Fig. 7). This category also represented the largest share in quantitative terms, with 80% of the total volume spilt (Fig. 8), the majority of which is attributed to the rupture of tailings ponds in December, which occurred for an unspecified reason at a silver mine in Brazil and led to the release of over 60,000 tonnes of contaminated water into several rivers in the

<sup>7</sup> This spill, which occurred in September 2015 (near Luke, Allegany County, state of New York), nevertheless appears to have been moderate: around 40 m<sup>3</sup> spilt, with part of the spill being contained within the industrial site, preventing it from spreading to the Potomac River.

<sup>8</sup> The barge overturned after breaking loose, following a collision between two tow boats (the reason for this collision is not specified).

<sup>9</sup> It is important to note that the patchy, or even missing, information relating to the quantities spilt in various seemingly significant pipeline incidents means that this share is probably underestimated.

<sup>10</sup> Due to the opening of valves on tanker trucks in early June 2015, during an attack on a convoy in the Columbian department of Putumayo. This deliberate release contaminated the soil and watercourses in the Amazon Basin, near the border with Ecuador with 500 to 750 m<sup>3</sup> of crude oil).

states of Minas Gerais and Espirito Santo in November 2015.

Among the causes identified, we note the prevalence of **external interference** (22%):

- half of these incidents were due to acts of **sabotage/terrorism/piracy/war**, mostly committed on land pipelines with, in 2015, cases in Colombia<sup>11</sup> and Nigeria<sup>12</sup> (Fig. 7). This cause ranks second in terms of the share of the overall total (with around 2,900 tonnes, see Fig. 8).
- Despite their relatively low occurrence (3%), **maintenance/repair work** was the number one cause in terms of the share of the total volume spilt (with over 11,300 tonnes), mainly due to the rupture of the embankments of a tailings pond at an abandoned gold mine in Colorado (US).<sup>13</sup>

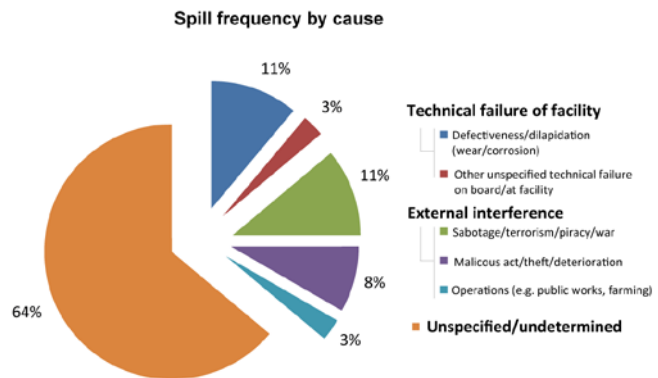


Figure 7

**Technical failures** were identified as the source of around 14% of events recorded (Fig. 7):

- The most frequent such incidents (11%) were due to defectiveness/dilapidation of various elements (internal pipes, storage tanks, etc.) at onshore facilities, although these incidents only represented a small share of the annual volume (Fig. 8). This type of incident most often involved only small volumes. The largest such incident was the rupture of a corroded pipe at an onshore oil facility (Seibou 2 Wellhead) in Nigeria, in January, followed by a spill of nearly 90 m<sup>3</sup> of crude oil in a river in the state of Bayelsa (see LTEI 24).

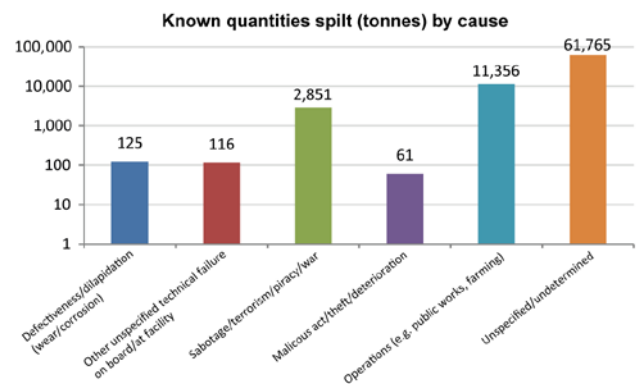


Figure 8

*In the absence of tests conducted or supervised by Cedre, we cannot guarantee the quality or performance of the response resources mentioned in the Technical Newsletter; the parties (companies, journalists, authors of articles and reports, etc.) providing the information bear sole responsibility.*

*Any mention by Cedre of a company, product or equipment does not constitute a recommendation and Cedre does not assume any liability with respect thereto.*

*The articles contained in the "Spills" section are based on information from various sources, in printed or digital form (specialised reviews and publications, specialised or general interest press, technical/scientific conferences, study reports, releases from press or institutional agencies, etc.). When a website or document containing a large amount of relevant information is identified, explicit reference is made thereto at the end of the article, under the heading "For further information".*

<sup>11</sup> On two occasions in June 2015, sabotage attacks on the Transandino pipeline, operated by the Colombian state-run company Ecopetrol, caused major spills (over 2,200 m<sup>3</sup> in total) of crude oil into various watercourses in the Department of Nariño (Colombia), on the Pacific side of the Andes, including the rivers Rosario and Mira. See LTEI n°24.

<sup>12</sup> On 16th August 2015, a leak of crude oil from a pipeline was detected at a metering station in Rivers State, Nigeria. The flow of oil was immediately stopped and surveys conducted by helicopter by the line operator confirmed and located the oil leak point, together with traces of excavations, leading to strong suspicions of sabotage. We have no information on the exact quantity spilt or the response actions.

<sup>13</sup> See above: in August, a breach unexpectedly opened up, during soil contamination analysis work at a former mining site undergoing decontamination work, leading to the release of over 11,000 m<sup>3</sup> of polluted water into the Animas River according to US EPA.