



THE IEVOLI SUN SHIPWRECK : STYRENE TOXICITY AND OLFACTORY THRESHOLD IN MARINE ORGANISMS

Mr Stephane le Floch

Cedre – Rue Alain Colas – BP 20413 – 29604 Brest Cedex

Tel : 02 98 33 10 10 /Fax : 02 98 44 91 38 - stephane.le.floch@le-cedre.fr

Secondary authors : Messrs Romain Suaudeau and François Merlin

ABSTRACT

On 30 October 2000, at 4:30 a.m., the MRCC (Marine Rescue Co-ordination Centre) CROSS Corsen received a distress call from the *levoli Sun*, a chemical tanker flying the Italian flag. The vessel, en route from Fawley (UK) to Barcelona with 14 crew members and 6,000 tonnes of chemicals (styrene, methyl ethyl ketone and isopropyl alcohol), was 45 nautical miles north of the île de Batz. The master reported a leak in the bow section double bottom. After studying the possible options, a salvage team was winched on board the *levoli Sun* and passed a tow to the ocean-going tug Abeille Flandre. Towing began at 5:15 p.m. and on 31 October, at 9:00 a.m., at two thirds of the way down to shelter in the Cotentin peninsula, the *Ievoli Sun* sank at a depth of 70 m, 9 nautical miles north of the Casquets, 12 nautical miles from Alderney and 20 nautical miles from the Cap de la Hague.

Few days after the accident, crabs contaminated by styrene were fished in the vicinity of the wreck. Consequently, the French Ministry for Land Planning and Environment entrusted Cedre with carrying out experimental work to determine whether marine organisms exposed to styrene emit a typical smell, and if so, above which threshold. Experimental studies were performed on 130 crabs (*Cancer pagurus*), 800 mussels (*Mytilus edulis*) and 24 oysters (*Crassostrea gigas*).

Experiments were carried out in two steps: the first one consisted in a exposure stage to styrene followed by the second one which consisted in a decontamination stage. For this purpose, we used an 3 m³ tank of sea water contaminated by styrene and two others with fresh water dedicated to the decontamination study and as a reference tank. The evolution of styrene content in water was surveyed by GC-FID (Gas Chromatography and



Flame-ionization detector) and by Purge and Trap and GC-SM (Gas Chromatography and Mass Spectrometry) as to biological tissues contamination. Olfactory analysis were also performed.

The exposure stage shown that the styrene concentration was higher in tissues of studied organisms than in the sea water (2 mg/L), suggesting a bio accumulation process. After 100 hours of exposure, a saturation plate was observed, very clearly for crabs (24 000 µg/kg), less for mussels (~ 3 500 µg/kg). However, the bio concentration factor remains relatively low: around 12 for crab tissues, and slightly more for gill.

Decontamination process in biological tissues appears to be divided in three steps: a rapid evolution during the first 24 hours, followed by a standstill and one last purification step, much slower, after 76 hours in fresh water. Purification process appear to be much faster for mussels, with no apparent standstill phase.

The presence of styrene in tissues appears difficult to identify by smell. For instance, olfactory tests results show a large variability. However, the olfactory detection threshold can be established at 5000 µg/kg for raw and cooked crabs. The identification for raw mussels is more representative. The Olfactory detection threshold can be established at 1000µg/kg.





The *levoli Sun* wreck: Toxicity and Olfactory Threshold of Styrene in Marine Organisms

Stéphane LE FLOCH

Romain SUAUDEAU & François MERLIN

Technical lessons learned from the Erika casualty and other oil spills



Scenario of Incident

30th - 31st October 2001: the towing trip...



Products

Cargo:

4000 T. STYRENE (little soluble, potential for toxic cloud, for explosion, for tainting)

1030 T. MEK (moderately soluble, potential for explosion/fire)

1000 T. IPA (highly soluble, danger limited to recovery operations)

Propulsion:

150 T IFO 180

60 T GASOIL



Food Security (Seafood Contamination)

Questionable:

No detectable styrene in the seawater

BUT :

- 1) contaminated crustaceans were fished 1700 m deep in the North of the wreck
crabs 230 µg/kg (flesh)
 340 µg/kg (gill)
- 2) crabs without smell even if the olfactory threshold is estimated at 30-170 µg/kg

•Is it possible to detect all polluted crustacean?
•Is it necessary to establish a network for controlling the quality of seafood products?



Food Security (Contamination Test)

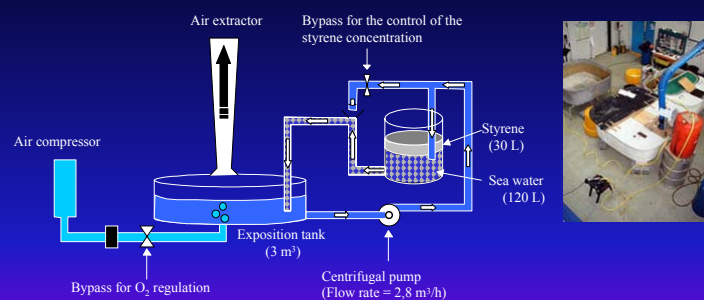
Objective : To determine the olfactory threshold of styrene in marine organisms

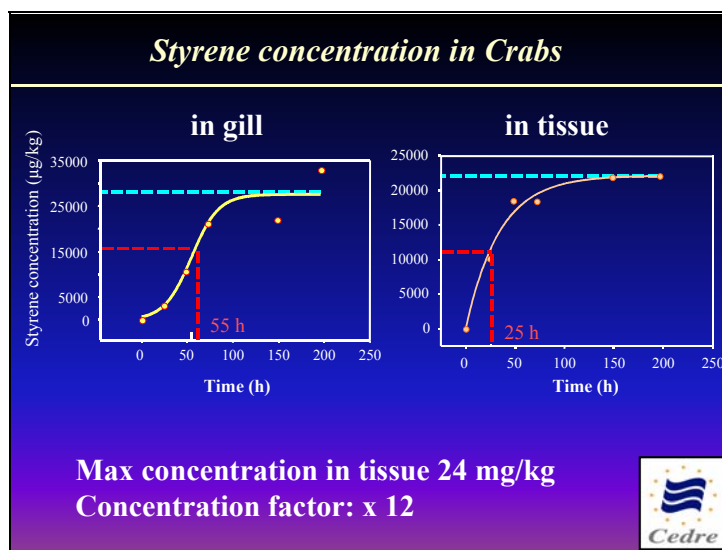
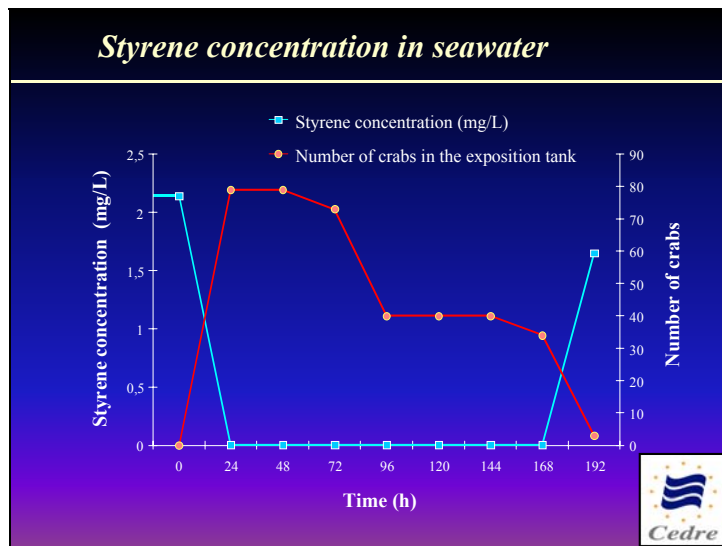
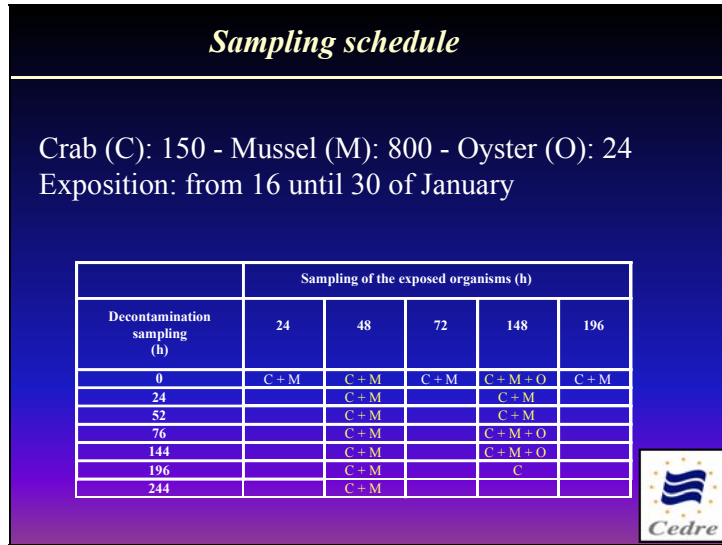
Selected species: Crabs, Mussels & Oysters

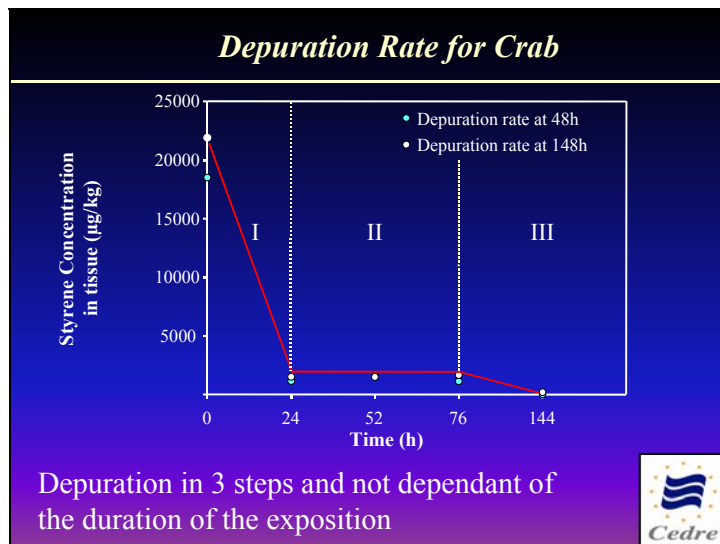
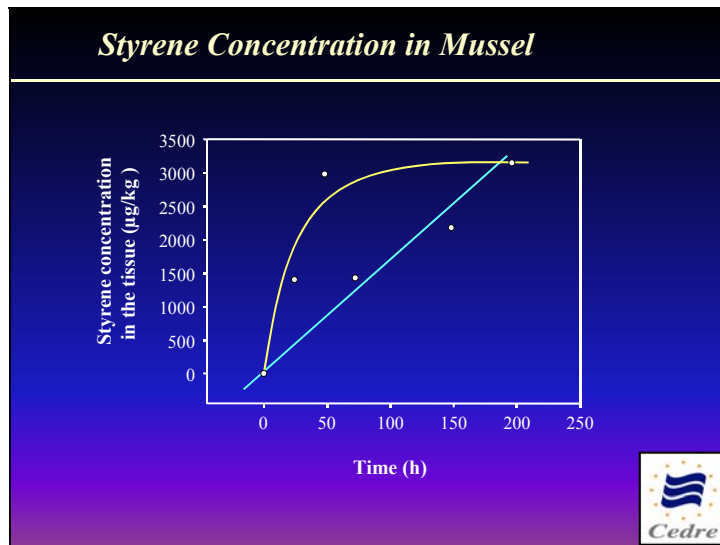
Procedure: To measure styrene concentration in the organism tissue and to carry out olfactory test on the same organism



Experimental Design






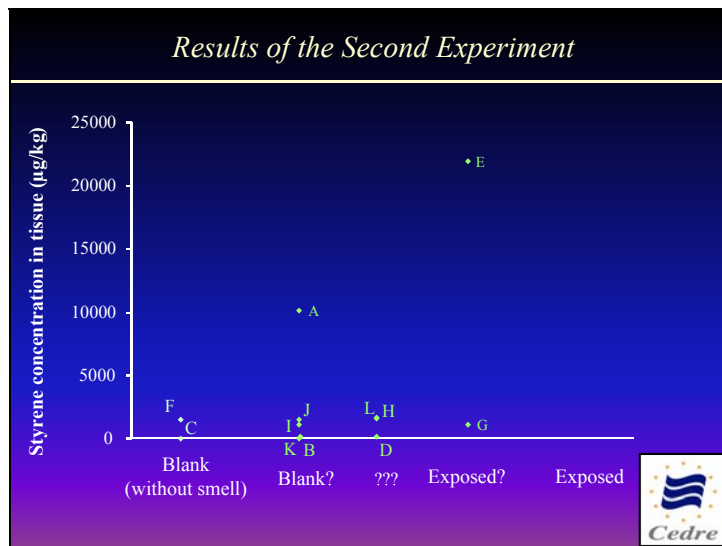
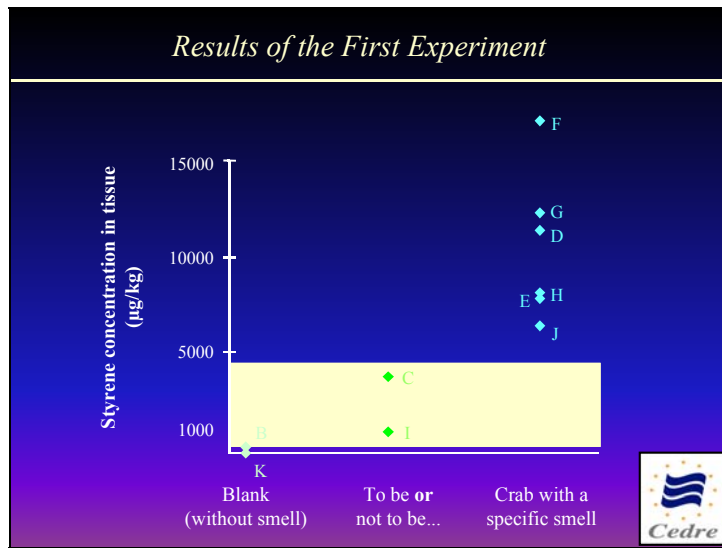


Olfactory Test

Jury = person with an average olfactory threshold (when it was too low or too high, people were excluded)

Procedure: to compare a reference smell (pyridine in water) to the organism smell





CONCLUSIONS

No mortality (styrene concentration = 2mg/L)

Contamination: max after 100-120h
Depuration rate in 3 steps

Max concentration in tissue: 24 mg/kg
Concentration factor: x 12

Olfactory threshold for crab = 5000 µg/kg