- Procedures are being streamlined to access personnel from other regions.
- Escalation: Level I, II, and III spills were defined and ICS charts developed (see Figure 3).

Conclusions

The development of the SOSC course promoted the rethinking of ADEC's response program. It prompted the developers to examine the intent of the statutes and structure the course, and ultimately the program, to conform with these mandates.

Author

Harry Young is an environmental specialist with the Alaska Department of Environmental Conservation. He has also served as a spill response coordinator for ARCO, and program coordinator of the Texas A&M Oil Spill School, as well as with Texas A&M's Environmental Engineering Division, and as a Coast Guard officer.

EVALUATION OF VARIOUS SURFACE OIL DETECTORS APPLIED TO HAZARDOUS ZONES

François Cabioc'h, Jean-Pierre Polard, Catherine Stéphan
CEDRE
B.P.72—29280 Plouzané
France

ABSTRACT: *Handling hydrocarbons at terminals or refineries leads to many opportunities for oil spills. In a search of the quickest response to this type of spill, the French Direction of Civil Protection funded a study aimed at achieving state of the art detection of oil spills at terminals. CEDRE evaluated four types of oil detectors: ultraviolet, infrared, visible, and a membrane one. The evaluation consisted of measuring the response to various thicknesses and several oils.*

The successive operations undergone by crude oil, from the producing areas to the consumers, constitute as many pollution hazards. More than the risks due to tanker traffic, which involve spectacular and dramatic incidents, tanker loading or unloading operations lead to probabilities of oil spills that are not negligible.

Audits carried out by CEDRE on refineries, oil fields, and harbors showed that the earlier the spill is detected the better chance there is to control it and to limit its consequences.

Although the volumes involved in spills originating from the handling of oil are generally not on the scale of oil spilled in tanker incidents, the consequences can be disastrous for the reputation of the company—for instance, those with refineries located close to sensitive areas (rivers).

Conscious of the lack of information about this type of oil spill, the French Direction of Civil Protection funded a study aimed at evaluating, from a response and operational point of view, various means of spill detection now on the market.

The study plan

We first established an exhaustive list of the equipment available on the market and classified them according to their principle of action. Contacts were then made with the manufacturers to get equipment for testing purposes.

Types of equipment tested. Four devices were evaluated: a mechanical one and three optical (visible, ultraviolet, infrared) methods. Table 1 summarizes the characteristics of the devices.

Oils tested. The hydrocarbons tested were crudes (Fulmar and Kitti-

Table 1. Characteristics of the detectors tested

	Laser ODL-12	Membrane SAPHIR	Infrared Slickwatch	Ultraviolet FLUCOmat
Parameter	Thickness	Thickness	Thickness	Surface covered by the oil
Dimension (mm)	530 × 357 × 935	L: 250 ø: 63	311 × 292 × 241 same for receiver	600 × 600 × 400
Weight (kg)	47	0.6	15.4 and 17.7 (receiver)	12 and 13
Use	Equipment placed between 0.3 and 0.6 m from water. Ponctual beam	Detector floating	Equipment placed between 1.5 to 9 m from the surface (area covered: 40 to 1590 cm^2)	0.5 m above water Area covered: 0.3 m^2
	Low agitation		Low agitation	Low agitation

Table 2. Detectors tested: response time related to hydrocarbon type

	ODL-12	SAPHIR	Slickwatch
Gasoline	1 s to 3 s for 1 μm	100 μm: 6 s to 8 is 12.5 μm: more than 30 min	Alarm for 0.5 μm to 1 μm
FOD	4 to 6 min for 1 μm	25 μm: 4 min 100 μm: 2 min 30 s	Alarm at 0.1 to 0.3 μm 0.1 μm: 4 min
Crude (medium)	7 min for 1 μm	25 μm: more than 45 min	0.1 μm: 10 s to 1 min
Kerosene	No detection at 0.1 μm 0.8 μm are detected after 2 min 30 s	100 μm: 55 s 55 μm: 1 min 40 s	0.5 μm: 1 min 40 s to 2 min 50 s
Marine fuel	2 to 3 min for 0.1 μm	Not tested	Not tested
No. 2 fuel oil	No detection due to impossibility to obtain a 0.1 μm layer	Not detected	Detected

way) and refined products. These last products range from volatiles (gasolines) to medium (fuel oil, diesel, marine fuel, kerosene) and heavy (No. 2 fuel oil).

Operating conditions. A pit of about 2 m^2 was filled with water (clean and dirty). A current was produced (with and without small waves) and a certain volume of hydrocarbon was poured on the surface to obtain various oil thicknesses (ranging from 0.03 to 1.5 μm). The parameters measured were the response time (if any) and the intensity of response (for the UV detector).

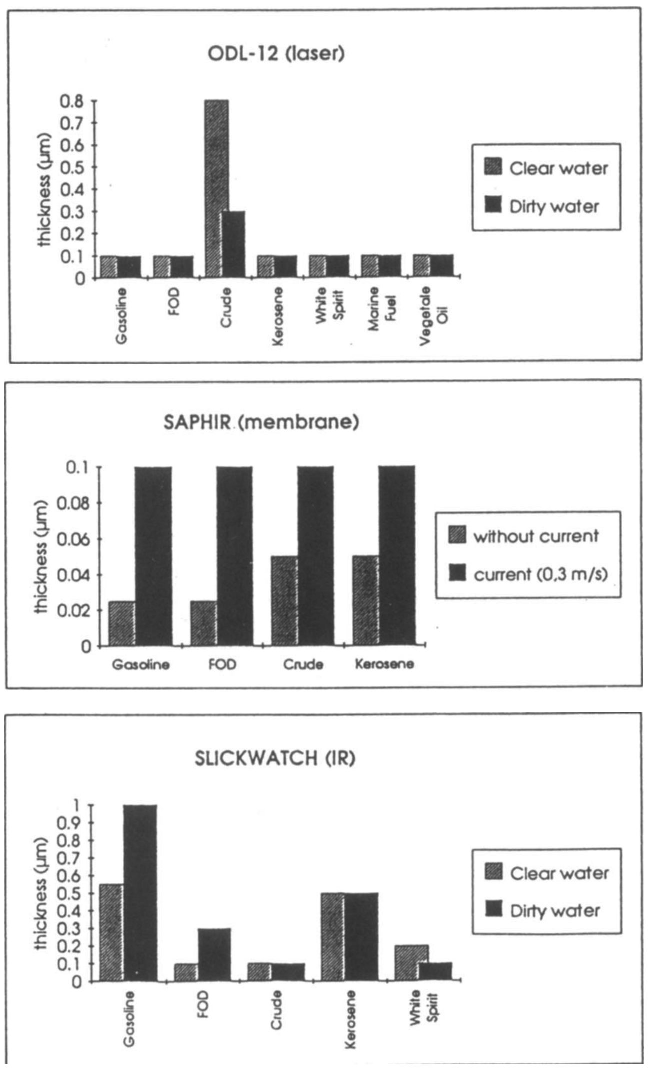

Figure 1. Minimum thickness of various oil products detected by three methods

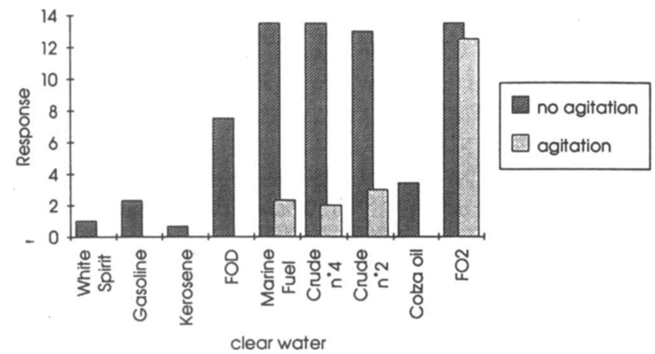

Figure 2. FLUCOMAT response to 33 μL of oil—performance is related to the ratio of surface covered by oil

Results

Thickness minima detected. The human eye is able to detect a layer of 0.1 μm of hydrocarbon floating on the water surface. Figure 1 shows the thickness minima for three detectors. In fact, only Slickwatch (IR) and ODL 12 (laser visible) can be directly compared, insofar as SAPHIR (membrane) is based on a response time criterion and the FLUCOmat (UV) performance is related to a ratio of surface covered by the oil (Figure 2). Table 2 summarizes the response time as related to the type of hydrocarbon.

Conclusion

It is difficult to compare, in the strictest sense, these four devices. Each of them has its own properties that answer one specific problem.

It still remains that, not considering price, the criteria for the choice of a detector will depend on the type of hydrocarbon most likely to be spilled, and also on the characteristics of the site. The buyer should define clearly the local conditions: water state (presence of waves or not), current variations, water level variations, and local infrastructure.

Author

François Cabioc'h, 42, is a chemical engineer who has been involved in the oil field industry for 11 years. He joined CEDRE in 1989 as a member of the research and development team. His main fields of activity include oil removal techniques at sea (burning and recovery) and contingency planning.