METHODS FOR SAMPLING THE WATER COLUMN

INTRODUCTION

In selecting a method for sampling the water column, the first consideration is whether to sample for whole oil or dissolved phase oil or both. The determination should be based on the oil properties and characteristics, degree of weathering, and potential routes of exposure to target fish species.

Whole Oil Sampling

When spilled oil remains in whole oil form, a variety of sampling methods may be applied, depending upon the location of the oil within the water column. Whole oil sampling within the water column will typically use some sort of mesh net or oleophilic snare to filter water and entrap tar balls.

Oil that is weathered into tar balls may float on the water surface, subsurface, or at virtually any depth in the water column. The depth at which tar balls float may depend upon the oil characteristics, sediment entrapment, weathering, sea state, and environmental conditions, and may change over time. Depending upon the stratification of tar ball fields in the water column, their movement will be impacted by wind, waves, currents, and tides. A tar ball sampling program may seek to verify assumptions about tar ball movement, and as such may involve targeted sampling based on trajectory data. Or, a tar ball sampling program may seek to build a data set that can be analyzed over time. This will typically involve repeated surveys in designated locations or stations over time.

Methods to sample for tar balls in the water column are either active or passive. Active methods usually involve actively towing a net, curtain, or oleophilic snare through the water. Passive methods involve placing oleophilic materials in a given location for a set period of time and then checking them for signs of contamination.

Oil that remains on the water surface, either as slicks or floating tar patties, may be tracked through visual observation or remote sensing. This information would generally be collected as part of the overall spill response, rather than as a discrete fisheries water quality sampling program. Coordination with spill managers may yield important data regarding the movement and location of the slick. Trajectory modeling may also be useful in predicting spill movement and identifying at-risk fisheries.

A final method for indirectly assessing the presence and abundance of whole oil in the water column is through the use of beach surveys.

Beach survey data provides a gross measurement regarding the presence or absence of oil spatially and/or temporally. Beach survey data may be extrapolated to draw conclusions regarding the relative abundance and distribution of whole oil in coastal waters. Beach surveys can be used to track changes in the presence of oil in the water through time, by surveying areas known to "collect" oil and monitoring changes in the quantity of oil found on the shore over time. Surveys can also be used to monitor for the presence of oil in new locations—by surveying critical beach areas adjacent to processor intakes, for example.

DETECTION LIMITS OF WHOLE OIL SAMPLING METHODS

The sensitivity of whole oil water quality sampling methods is limited by several factors, including the relative volume of water sampled, the affinity of the tar balls or whole oil for the sampling devices used, and the location of sampling stations relative to whole oil distribution. For example, tow net sampling that occurs in a tar ball field may suggest a high concentration of oil in the water, but this may not be constant throughout areas of concern. Similarly, if tow nets are used at the wrong water depth, or are towed at too high a speed, they may not detect whole oil that is present in the water column. Passive sampling devices may be more or less sensitive depending upon the chemical composition and degree of weathering of the oil in the water column. Certain oils may adhere more readily to sorbent materials.

A major limitation to the beach survey tactic is that there is not necessarily a clear correlation between the presence of tar balls on shore and the presence of oil in the water column. The presence of tar balls on shore may fluctuate depending on weather conditions without necessarily indicating a corresponding fluctuation of the quantity of oil in the water. There is also a time lag between the time at which oil is observed on the beach and the time when that same oil was actually in the water column.

Finally, with all whole oil sampling methods, it is possible that the oil detected may not necessarily be attributed to the spill source of concern. Background tar ball levels vary in different water bodies. In areas with high vessel traffic, nearby oil and gas exploration, or adjacent to ports or marinas, background tar ball levels may be relatively high.

Dissolved Phase Oil Sampling

When spilled oil dissolves into the water column, sampling methods that measure the concentration of dissolved hydrocarbons must be used. A common methodology for assessing dissolved oil involves taking water samples from various stations and then conducting laboratory analyses on the samples to determine the concentration of dissolved hydrocarbons. This is commonly referred to as whole water sampling or grab sampling.

Another way to sample for dissolved phase oil involves the use of a specialized instrument that may be placed into a water body to provide a real-time measurement of dissolved hydrocarbons. These instruments – fluorometers – may be set in one location or towed through the water.

DETECTION LIMITS OF DISSOLVED PHASE OIL SAMPLING METHODS

Regardless of the dissolved phase oil sampling method, caution must be applied in interpreting results. Many coastal areas in Alaska have background levels of hydrocarbons that may complicate analysis of sampling data. When conducting dissolved phase oil sampling, it is recommended that control samples be taken to identify background hydrocarbon contaminant levels, if feasible.

When using fluorometry, it is important to consider that compounds other than oil may also fluoresce and send out a signal that may be interpreted as hydrocarbon contamination but in fact may be from another source.

As with whole oil sampling, the selection of sampling stations and the sampling design may also determine whether the sampling method is effective in detecting the target contaminant levels.

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TOW NET SAMPLING

OBJECTIVE & STRATEGY

The objective of Tow Net Sampling is to collect data regarding the presence and distribution of whole oil as tar balls, tar patties, mousse, or other whole oil form, in the water column. Tow nets may be deployed at different locations and depths within the water column, depending upon the oil type and information needs driving the sampling program. Data collected by tow net sampling may be extrapolated to draw conclusions regarding the relative abundance of whole oil both spatially and temporally. The sampling scheme should be designed based on the real time question posed for the incident. Different sampling schemes are required to determine the answer to the following questions:

- What is the oil distribution at the surface?
- How dense is the oil in the water column?
- Is this section of water oil-free?
- Is the amount of oil in this area increasing or decreasing?
- Is there sub-surface oil?
- Is there oil present near a seawater intake?

Care must be taken to choose a sampling design that is appropriate to the questions being asked.

TACTIC DESCRIPTION

Operating Environments

Tow Net Sampling may be deployed in any water body where tow vessels can operate. Applicable operating environments include: nearshore and offshore marine waters, harbors, bays, rivers, and lakes. Tow vessels and sampling gear must be sufficiently seaworthy to suit the worst conditions expected in the operating area.

Deployment Configurations

TOW NET CONSTRUCTION

The tow net is constructed of a conical-shaped mesh fastened around a metal hoop. The size of the tow net mouth and length of the net may vary depending upon the data needs and sampling environment. A standard-sized tow net that has been used effectively in past spills had a 3-foot diameter metal hoop with a 10-foot long net (See Figure TNS-1). The mesh size should be appropriate to the type and quantity

of oil spilled and expected state of weathering. A bridle, attached to tow rings on the metal hoop, is used to tow the net. The tow net may or may not have a collection cup at the end.

Tow nets may be constructed at the time of the spill using locally available material, or may be constructed and tested ahead of time. Mesh should be sufficiently strong to withstand the towing pressure and frequent cleaning. A plastic-coated mesh should be more oleophilic. PVC pipe with an end cap may be used for the collection cup.

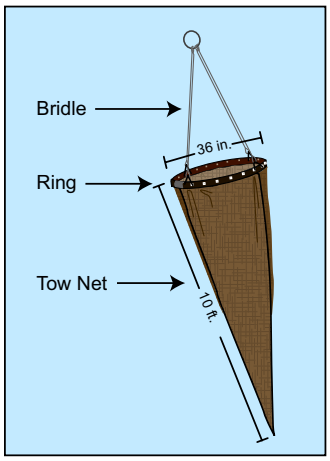

Figure TNS-1. Tow net without collection cup.

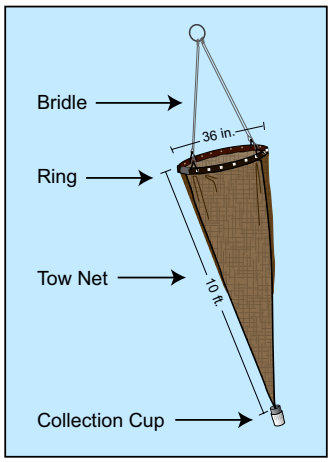

Figure TNS-2. Tow net with collection cup.

SINGLE VS. MULTIPLE TOW NETS

Tow nets may be deployed singly or in groups. The use of multiple tow nets deployed simultaneously at different depths will provide comparative data regarding the vertical distribution of whole oil in the water column.

Figure TNS-3. Single tow net.

Figure TNS-4. Multiple tow nets.

Vessel configuration

Tow nets may be deployed from the vessel in any number of configurations, based upon the vessel particulars. Fishing vessels, spill response vessels, or other vessels-of-opportunity may be utilized if available. It is recommended that the vessel platform have a boom or hydraulic arm that can be suspended over the side of the vessel to facilitate deployment of the tow net alongside the vessel. The tow net should be deployed at an appropriate distance from the vessel to avoid entanglement.

The vessel must be capable of slowing to tow speeds of 1 kt.

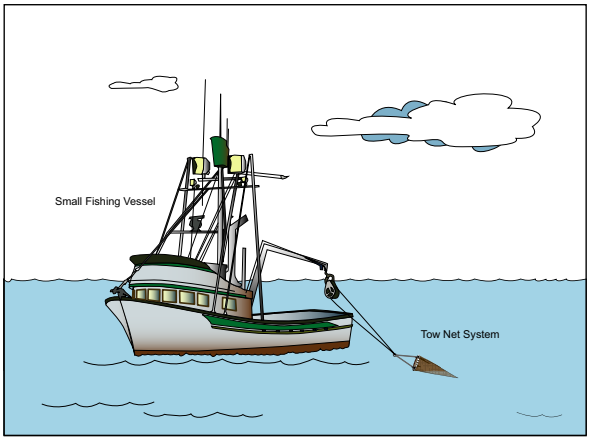

Figure TNS-5. Tow net deployment from small fishing vessel boom.

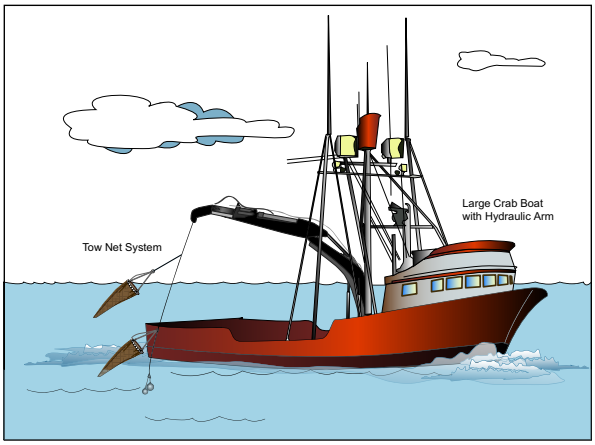

Figure TNS-6. Tow net deployment from crab boat with hydraulic arm.

Weighting the Tow Net

In order for the tow net to remain at the desired water depth for the duration of the tow, it must be appropriately weighted. The amount of weight required may vary depending upon the construction and size of the net, the desired water depth, and the environmental conditions. "Sinkers" used for fishing on the seafloor may be suspended from the tow net opening or from the line. Lengths of chain may also be used as sinking weights.

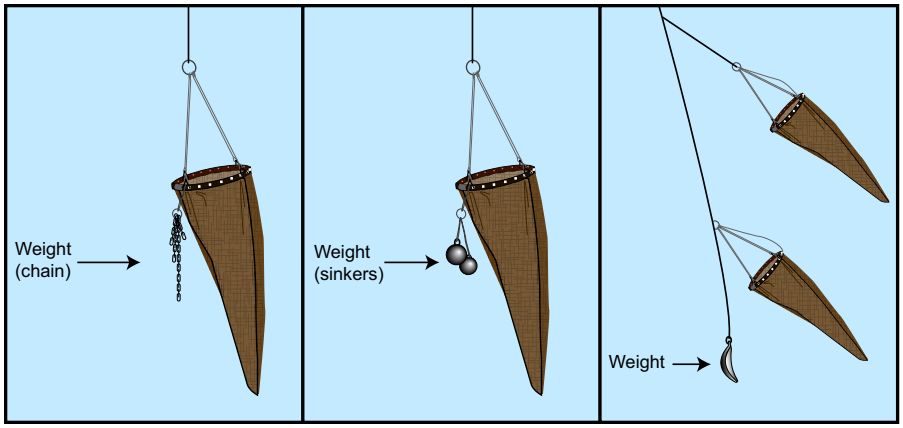

Figure TNS-7. Possible configurations for weighting a tow net.

Towing Transects

The areas in which a tow net will be deployed should be identified in the sampling plan. Towing transects may be pre-identified or they may be random. If the sampling design necessitates a data set that can be compared over time, the tow nets may be deployed along the same transect multiple times.

Use of a GPS track when conducting random tows will accurately record the actual tow pattern and distance.

Tow Speed & Direction

The tow vessel should operate at speeds of 1 to 3 kts, depending on the mesh size of the tow net. Towing a net too fast builds a head wave in front of the net, which may deflect tar balls around the net. It is important to tow at a consistent speed throughout the tow period. Tow speed must be consistent for all tows if encounter rate (e.g., catch per unit effort) is to be calculated.

Tows should be conducted in a straight line along a given heading if possible to simplify data analysis. However, topography and navigational hazards may require the vessel operator to vary course. In this case, a GPS track line should be acquired for the tow.

Current Tides, and Rips

Tides and currents must be considered when planning and conducting tows. If tow data is to be analyzed for encounter rate or catch per unit effort, tows should be standardized with respect to currents; either within the current, against the current, or cross-current.

Tide rips are collection points for floating oil. Tide rips may be targeted if the sampling plan calls for seeking out areas where the oil is likely to be. When towing for encounter rate data, known tide rips should be avoided as they may skew data in favor of higher tar ball concentrations.

PROCEDURE

Tow net sampling may utilize one or more tow nets deployed from a vessel platform.

1. ***Inspect equipment to make sure it is in working order and free from contamination.***
2. ***Start Tow.***
   a. Deploy tow net at pre-designated depth(s).
   b. Maintain constant vessel speed and heading, if possible.
3. ***Monitor and document vessel course and speed.***
   a. Document visual observations.
      i. Convergence zones, tide rips.
      ii. Impacted wildlife.

iii. Sonar/fish finder information.

iv. Vessel traffic.

4. Inspect tow net and collection cup at regular intervals (e.g., every half hour or hour).

a. Consider need to check net more frequently in convergence areas.

5. Record tow data and findings.

a. Latitude/longitude of tow (beginning and end points).

b. Tow duration (start and end times).

c. Vessel speed and heading.

d. Type/quantity of oil observed.

e. GPS track line if the tow is not in a straight line.

f. Location of net in water column (depth).

g. Take representative photographs.

h. Photograph of nets where oil observed.

6. Attempt to obtain sample of collected oil if sufficient quantity available.

a. Use proper handling and storage procedures.

b. Maintain proper documentation and chain of custody.

7. Decontaminate oiled tow net and collection cup

a. If tow net and collection cup are not contaminated, proceed directly to step #8.

b. Set oiled net and collection cup on sorbent pad on sampling table.

i. Do not allow contaminated equipment to come into contact with vessel.

c. Use proper personal protective equipment.

i. Review material safety data sheet for cleaning solution.

ii. Use eye protection.

iii. Use rubber gloves.

iv. Use splash suit/rain gear.

v. Have available first aid kit and eye flush kit.

d. Place appropriate cleaning solution in cleaning tub.

i. Soak net/collection cup in cleaning solution for 5 minutes.

ii. Scrub net or collection cup with brush if needed.

iii. Rinse with clean water.

iv. Repeat cleaning process until net and cup are clean.

v. Observe proper disposal methods for dirty cleaning solution and water.

vi. To spot clean small areas (<1 mm), use the scrub brush and cleaning solution.

8. Redeploy tow net.

a. Repeat steps #1 through #7.

9. When towing is complete, store tow net.

a. Clean net of all contamination prior to storage (see #7).

b. Store in a manner that prevents contamination from other sources, such as hydraulic oil or fuel oil from the tow vessel. Heavy polyethylene bags (e.g., oily waste bags) are a good storage option.

CONSIDERATIONS AND LIMITATIONS

+ Detection limits may be affected by vessel speed, sampling sites, duration and depth of tows, affinity of spilled oils for tow net materials, background tar ball levels, sea state, currents, tide rips, sensitivity of laboratory analyses, and human error.
+ Daily weather evaluations are recommended, and should include distance to safe harbor, transit times and exposure of vessels.
+ Vessel masters should have experience in the appropriate operating environment and local knowledge is preferred.
+ Select tow depth and configuration of tow net(s) based on information needs as identified in sampling plan.
+ Avoid deploying tow net directly off vessel's stern end because of the potential interference of propeller wash and entanglement potential.

REFERENCES TO OTHER TACTICS

Other methods associated with Tow Net Sampling include:

- Aerial Surveillance
- Handling and Storing Samples
- Waste Management
- Data Collection and Management
- Safety

EQUIPMENT AND PERSONNEL RESOURCES

Resources for this tactic include tow nets, towing bridle, weights, collection cups, chain or line, vessels, decontamination equipment, log books, GPS, digital cameras, and sampling technician(s). Configuration and specific resources required will be determined by site conditions, spilled oil type and volume, area of coverage, as well as resource availability. Resource sets may need to be refined as site-specific requirements dictate.

Tow Net Sampling

Equipment	Function	Quantity	Notes
Tow nets Recommended net specifications: 36" diameter ring with 10' conical net. Net material: Phifertex vinyl-coated polyester yarn woven into an 11 x 17 strands/inch mesh, 34% open, 11 oz./yd. Collection cup: 4" PVC pipe and fittings	Collect whole oil in water column.	1 primary, with 1-2 backup/ alternate nets	If multiple tow nets are to be deployed simultaneously, should have 1 primary and at least 1 alternate tow net for each planned depth.
Bridle (6" ring or link, 4-part steel line with eyes at both ends, 6 shackles)	Connect tow net to line.	1 primary, 1 backup	If multiple tow nets are to be deployed simultaneously, should have 1 bridle for each planned depth, with at least 1 backup.
Line (typically polypropylene)	Suspend tow net.	Sufficient length to accommodate planned sampling depth, accounting for horizontal drag	
Weights or sinkers (typically lead)	Sink net to desired tow depth.	Varies	May be necessary to adjust amount and configuration of weights based on on-scene conditions and desired tow depth.
Sorbent pads	Line sorting/sampling table to examine tow nets.	2-3 pads per planned tow; recommend maintaining large stock on vessel	
Detergent (e.g. de-greaser)	Decontaminate/clean tow net and collection cup.	1 bottle	Consult bottle regarding recommended dilution. Refer to MSDS for safety. Use only products registered on the National Contingency Plan product schedule.
Wash basins	Soak tow net/collection cup for decontamination.	At least 2 basins – one to wash and one to rinse	
Oily waste storage	Store contaminated water from washing tow nets and soiled sorbent pads.		Refer to Waste Management Procedure.
GPS	Record position/location data (latitude/longitude) for each tow.	2 (1 primary, 1 backup)	Recommend using combination of handheld GPS and vessel's GPS system.
Sampling materials	Collect and store samples of encountered oil for possible laboratory analysis.	Varies	Refer to Sample Handling Procedure.
Log books and data collection supplies	Record data regarding oil observations, conditions, etc.	Varies	Refer to Data Keeping Procedure.
Measuring tape or ruler/scale	Measure size of tarball or oil observation.	One per sampling technician	Photographs of tar balls or oil encounters should include ruler or scale to demonstrate size.
Digital camera	Record images of sampling process and observations.	One per sampling technician	Ensure sufficient batteries, charger, and memory stick storage for length of sampling survey.
Vessel	**Function**	**Quantity**	**Notes**
Vessel with hydraulic arm or boom and capability to travel as slow as 1 kt	Sampling platform	1 per sampling trip	Vessel should be inspected prior to use for safety equipment, communications capabilities. Tow vessels must be sufficiently seaworthy to suit the worse conditions expected in the operating area.
Personnel	**Function**	**Quantity**	**Notes**
Sampling technician(s)	Deploy tow nets, collect data.	2-3	Recommend at least 2 technicians per trip for safety. More than 2 may be required if towing multiple nets. Technicians must have sufficient Hazmat certification and basic vessel safety training.

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PASSIVE SAMPLING

OBJECTIVE & STRATEGY

The objective of Passive Sampling is to collect data regarding the distribution of whole oil as tar balls, tar patties, mousse, or other whole oil form, in the water column. Passive sampling devices may be deployed at different depths within the water column, on fishing gear, or in specific geographic locations, depending upon the oil type and information needs driving the sampling program. Data collected through passive sampling provides a gross measurement regarding the presence and absence of oil spatially and/or temporally.

Passive sampling data may be used to monitor areas adjacent to seawater intakes and to assess the risk of oil to fishing gear. The sampling scheme should be designed based on the real time question posed for the incident. Different sampling schemes are required to determine the answer to the following types of questions:

- Is oil present at the surface?
- Is there sub-surface oil?
- At what depths in the water column is floating oil encountered?
- Is this section of water oil-free?
- Is the amount of oil in this area increasing or decreasing?
- Is there oil present near a seawater intake?

Care must be taken to choose a sampling design that is appropriate to the questions being asked.

TACTIC DESCRIPTION

Operating Environments

Passive Sampling may be deployed in any water body where vessels can operate or where access exists from docks, shoreline, or other marine structures. Applicable operating environments include: nearshore and offshore marine waters, harbors, bays, rivers, and lakes.

Passive sampling devices may be deployed from vessels, docks or other marine structures, or by divers. Vessels and sampling gear must be sufficiently seaworthy to suit the worst conditions expected in the operating area.

Deployment Configurations

Passive sampling devices may be configured in a number of different ways, depending upon the information needs driving the sampling program. The basic components of a passive sampling device are:

- ***Sorbent material:*** A sorbent or oleophilic material will enhance the likelihood that floating oil will adhere to the sampling device upon encounter. Sorbent snares or oleophilic netting, mesh, or line may be used. Polyethylene is the most common oleophilic material used for passive sampling.
- ***Positioning device:*** A positioning device such as a length of line or a piece of fishing gear is often used to position the sorbent material(s) at the desired location and water depth.
- ***Anchor and float:*** An anchor or anchoring device and float or buoy are usually needed to secure the sampling device in place. Traditional anchors may be used, or available structures such as buoy lines, docks, or water intake pipes may be used to anchor the sampling device.

Passive sampling devices can be designed and assembled ad hoc with locally available materials. Fishing gear for species-of-concern is often a good starting point for developing a passive sampling device. For example, if a crab fishery is underway, an unbaited crab pot may be used to anchor the device, with sorbent snare attached to the float line at fixed intervals.

VERTICAL LINE PASSIVE SAMPLING DEVICES

Passive sampling devices for water column sampling may be oriented vertically by anchoring the device to the bottom and attaching a float. Sorbent snare or other sorbent materials may be affixed to a float line continuously or at fixed intervals to collect information regarding the vertical distribution of oil in the water column.

Depending upon the information needs, a vertical passive sampling device may focus on a specific zone within the water column. The line need not stretch all the way from the surface to the bottom; passive sampling devices can be configured so that they only extend down a certain distance from the surface or up a certain distance from the bottom. Figure PSWC-1 shows a variety of potential configurations.

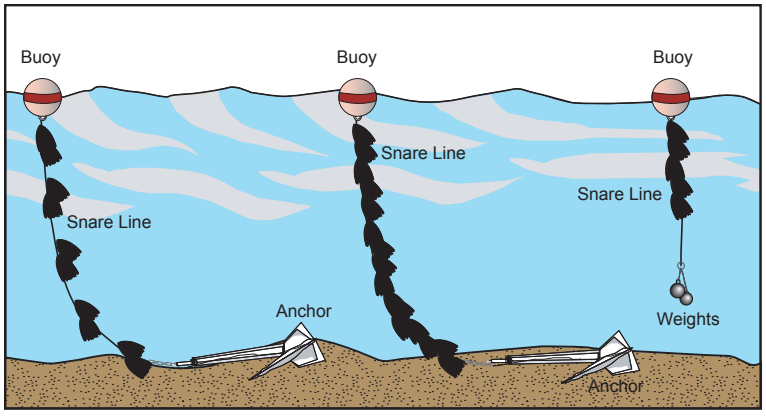

Figure PSWC-1. Vertical Line Passive Sampling Device Configurations.

MESH CURTAIN OR SCREEN PASSIVE SAMPLING DEVICES

Passive sampling devices may also be configured using a mesh screen or curtain, which may be deployed at nearly any angle. Curtain devices may consist of a single mesh curtain deployed at the desired angle in the water column, or of a series of curtains with graduated mesh sizes deployed at a specific location, such as in front of a water intake. A screen device uses a frame to affix and position the mesh. Screens are useful when deploying the passive sampler at depth, as the weight of the frame can sink and position the mesh screen.

Depending upon the deployment of the mesh curtain or screen passive sampling device, it may also be considered as a protective measure to prevent or reduce the amount of oil entering through a water intake. It is important to consider the potential for other debris and for pelagic organisms to become entrapped in the mesh or screen.

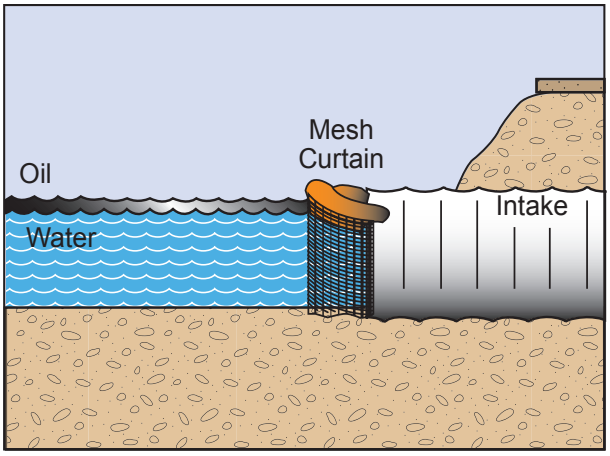

Figure PSWC-2. Mesh Curtain Passive Sampling Device positioned near seawater intake.

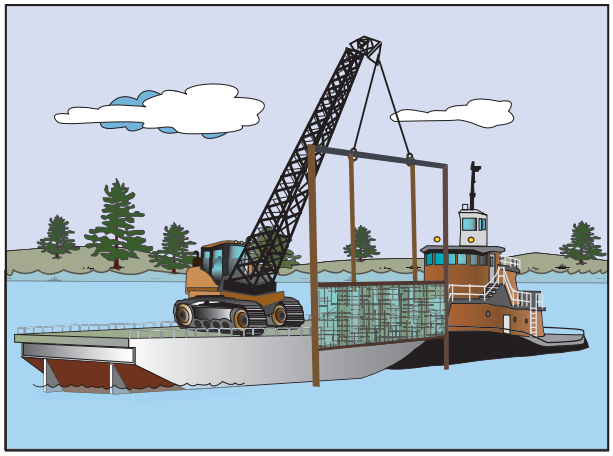

Figure PSWC-3. Mesh Screen Passive Sampling Device.

PROCEDURE

1. Prepare passive sampling device.

a. Affix sorbent snares or curtain to positioning device at desired intervals.

2. Set the passive sampling device at the desired location.

a. Mark the location using a buoy and a numbered tag.

b. Record latitude/longitude coordinates of device location along with the date and time and other relevant observations.

3. Proceed to next location and repeat process until all passive sampling devices are positioned.

4. After the desired interval of time, return to each passive sampling device and inspect.

a. Recommended minimum "soak" time is 24 hours.

b. Shorter "soak" times may be appropriate for passive samplers deployed near water intakes.

5. Remove device from its station and inspect.

a. Place each snare or mesh net on sorting table, lined with sorbent pad, for inspection.

b. Check each snare or mesh for signs of oil contamination using sight, smell, feel, and UV light if appropriate.

c. Log all results (date, time, sampling device number, presence/absence of oil). Photograph any evidence of oil.

d. Place used sorbent or mesh in appropriate waste bag (refer to Waste Management Procedure).

i. Tag and label.

ii. Oil-free snare or mesh may be re-used to reduce waste.

CONSIDERATIONS AND LIMITATIONS

+ Detection limits may be affected by location of sampling transects, length of sampling intervals, affinity of spilled oils for passive sampling materials, background tar ball levels, sea state and currents, sensitivity of laboratory analyses, and human error.
+ Daily weather evaluations are recommended, and should include distance to safe harbor, transit times and exposure of vessels.
+ Vessel masters should have experience in the appropriate operating environment and local knowledge is preferred.
+ Select passive sampling locations and water depths based on information needs as identified in sampling plan.
+ Use buoys, floats, or other obvious markers to identify passive sampling devices that may pose a navigational hazard.
+ Take into consideration the influence of tide and currents when deploying passive sampling devices.
+ Take into consideration the potential for organisms or debris to become entrapped in passive sampling devices, and take steps to minimize this potential.

REFERENCES TO OTHER TACTICS

Other methods associated with Passive Sampling include:

- Processor Seawater Intakes
- Handling and Storing Samples
- Waste Management
- Data Collection and Management
- Safety

EQUIPMENT AND PERSONNEL RESOURCES

Resources for this tactic may include sorbent snare or mesh, a frame for mesh screens, chain or line, anchors, vessels, divers, decontamination equipment, log books, and sampling technician(s). Configuration and specific resources required will be determined by site conditions, spilled oil type and volume, area of coverage, as well as resource availability. Resource sets may need to be refined as site-specific requirements dictate.

Passive Sampling

Equipment	Function	Quantity	Notes
Sorbent snare	Collect whole oil in water column.	Varies	
Mesh curtain	Collect whole oil in water column.	Varies	Consider possibility of entrapping other organisms or debris when selecting mesh size.
Line	Suspend/position sorbent snare or curtain.	Varies	
Anchor or sinker weights	Hold passive sampling device in desired position/location.	Varies	
Sorbent pads	Line sorting/sampling table to examine snare or curtain.	Varies	
Oily waste storage	Store soiled sorbent materials.		Refer to Waste Management Procedure.
GPS	Locate sampling devices and Record position/location data (latitude/longitude) .	2 (1 primary, 1 backup)	Recommend using combination of handheld GPS and vessel's GPS system.
Sampling materials	Collect and store samples of encountered oil for possible laboratory analysis.	Varies	Refer to Sample Handling Procedure.
Log books and data collection supplies	Record data regarding oil observations, conditions, etc.	Varies	Refer to Data Keeping Procedure.
Measuring tape or ruler/scale	Measure size of tarball or oil observation.	One per sampling technician	Photographs of tar balls or oil encounters should include ruler or scale to demonstrate size.
Digital camera	Record images of sampling process and observations.	One per sampling technician	Ensure sufficient batteries, charger, and memory stick storage for length of sampling survey.
Vessel	**Function**	**Quantity**	**Notes**
Vessel with appropriate capability to deploy passive sampling device (e.g. with pot launcher if using crab pots)	Deployment platform	1 per sampling trip	Vessel should be inspected prior to use for safety equipment and communications capabilities.
Personnel	**Function**	**Quantity**	**Notes**
Sampling technician(s)	Deploy equipment, collect data.	2-3	Recommend at least 2 technicians per trip for safety. Technicians must have sufficient Hazmat certification and basic vessel safety training.
Divers	Deploy equipment, monitor and check equipment.	Varies	Divers should only be used when safe to do so.

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