Chemical Oil Spill Treating Agents (COSTAs)

What a Responder Needs to Know to Consider Use of a COSTA

Except for specific circumstances (i.e. to prevent or substantially reduce a hazard to human life in accordance with 40 CFR 300.910 (c)) the use of chemical oil spill treating agents (COSTAs) will be considered on a case-by-case basis. Chemical oil spill treating agents include dispersants, herding agents, emulsion treating agents, solidifiers, elasticity modifiers, shoreline cleaning agents, shoreline pre-treatment agents, oxidation agents, and bioremediation agents.

In general, the use of dispersants is not promoted within the boundaries of the Region 5 or Region 7 Regional Response Teams (RRTs).

Regarding other non-dispersant COSTA, Region 7 has no pre-approvals in place. Region 5 has a pre-approval in place for the test use of the elasticity modifier product, ELASTOL. Additionally, the use of the NOCHAR A610 solidifier product contained in booms, sock, and pillows is also approved for use in Region 5. No approval is in place for use of uncontained solidifier products. Note that both ELASTOL and NOCHAR were removed from the National Product Schedule in 1996, and, therefore, neither may be used except as provided for in the National Contingency Plan (40 CFR 300.910 9 paragraph (c)).

Consistent with the National Contingency Plan (NCP), in situations when a human hazard is not present, the federal on-scene coordinator (FOSC) must receive the concurrence of the U.S. Environmental Protection Agency (USEPA) Regional Response Team (RRT) representative(s), and the RRT representative of the affected state(s) to use any chemical product. The FOSC must also consult with the Department of Interior (DOI) and Department of Commerce (DOC) natural resource trustees, where practicable, before authorizing the use of a chemical product. Any on-scene coordinator (OSC) or responder must comply with applicable local, state, and federal regulations.

Note that the FOSC is authorized to use any chemical product without requesting permission if he or she believes its use is necessary to prevent or substantially reduce a hazard to human life (40 CFR 300.910 (c)). If a chemical product is used under these circumstances, the FOSC must notify the USEPA RRT representative and the state(s) RRT representative of its use as soon as possible. This policy should be applicable to any OSC whether local, state, or federal.

General COSTA show stoppers:

- Is the product on the National Product Schedule? If not, then it should not be used except as noted in 40 CFR 300.910 (c).
- Are all players in agreement on its use? If not, then it should not be used. These players shall include the Local Incident Commander, FOSC, SOSC, and the State and Federal natural resource trustees.
- COSTAs require RRT approval.

COSTA Decision Tree

The following information is excerpted from the API/NOAA manual "Options for Minimizing Environmental Impacts of Freshwater Spill response, 1994.

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Dispersants

Objective:
To remove floating oil from the water surface and disperse it into the water column, to reduce impacts to sensitive shoreline habitats and animals that use the water surface.

Description:
Specially formulated products that contain surface-active agents are sprayed at concentrations of about 5 percent of the oil onto the slicks by aircraft or from boats. The products can be applied undiluted or mixed with water. The dispersants reduce the oil/water surficial tension and decrease the energy needed for the slick to break into small particles and mix into the water column. Some physical energy is needed to mix the dispersant into the oil and treated oil into the water.

Applicable Habitat Types:
Open water and large rivers with sufficient depth and volume for mixing.

When to Use:
When the impact of the floating oil has been determined to be greater than impacts resulting from mixing of oil into the water column.

Biological Constraints:
Not suitable in shallow water depths where the dispersed oil could affect benthic resources. The dispersed oil must not affect water intakes.

Environmental Effects:
May increase effects on water-column organisms, particularly plankton and larval fish. Dispersion will only be partially effective, so some water surface impacts will still occur.

Other Limitations:
Effective application needs enough wind, but not too much (generally less than 25 knots). Dispersants are not too effective after approximately 12 hours due to weathering of oil and increased viscosity. In general, lighter petroleum products are more dispersible than heavier products. Dispersants should not be used if water intakes are nearby. For aerial application of dispersants the visibility should be 3 miles or better, the ceiling should be 1000 feet or higher, and the wind speed should be 25 knots or lower.

Emulsion treating agents

Objective:
To break or destabilize emulsified oil into separate oil and water phases. Can also be used to prevent emulsion formation.

Description:
Emulsion treating agents are water-soluble surfactants that are applied to emulsified oil at low concentrations (0.1-2 percent). They can be injected into skimmer reservoirs to break the emulsion so that excess water can be separated from recovered oil. They also can be sprayed (similar to dispersants) directly onto slicks to break or prevent emulsions.

Applicable Habitat Types:
On all water environments where emulsified oil is present.

When to Use:
For recovered oil, where storage capacities are very limited, to separate the oil and water so that the water can be treated and discharged. On floating slicks, when formation of emulsified oil has or could reduce skimmer efficiency.

Biological Constraints:
Unknown at this time.

Environmental Effects:
Because this is a new application approach, there are very little data available on which to evaluate environmental effects. Effective dosages are 1-2 orders of magnitude lower than dispersants. There are concerns about application to slicks on how treatment might change the physical or chemical properties of the oil, whether the oil will be more readily dispersed, and how the treated oil will behave upon contact with birds, mammals, and shorelines.

Elasticity Modifiers (visco-elastic agents, elastimers, viscosity modifying agents)

Objective:
To impart visco-elastic properties to treated oil and increase skimming rates.

Description:
Chemical agent is applied as a liquid spray or a slurry onto the oil in the proper dosage. Treated oil is rendered visco-elastic, but still fluid, gelatinous, or semisolid; there is no chemical change in the oil. The primary purpose is to increase the efficiency in removal rates by skimmers. Increases the recovery by drum skimmers, but can clog weir-type skimmers.

Applicable Habitat Types:
On all water environments where oil can be contained for recovery with skimmers. Not for use adjacent to wetlands or debris because of an increase in adhesive behavior of the treated oil.

When to Use:
When recovery efficiency of skimmers needs to be increased. Must be used in conjunction with booming or other physical containment. Not for use on heavy oils which are already highly viscous.

Biological Constraints:
Not suitable for vegetated shores or where there is extensive debris mixed in the oil. Should be avoided when birds or other wildlife that may be more adversely impacted by the treated oil can not be kept away from the treated oil.

Environmental Effects:
May enhance the smothering effect of oil on organisms. Thus, the treatment should be considered only where recovery of the treated oil is likely.

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Herding Agents

Objective:
To collect or herd oil into a smaller area and thicker slick, thus increasing recovery. Also can be used to herd oil away from sensitive areas.

Description:
Chemical agents which are insoluble surfactants and have a high spreading pressure are applied in small quantities (1-2 gallons per lineal mile) to the clean water surrounding the edge of a fresh oil slick. They contain the oil, prevent spreading, but do not hold the spill in place. Hand-held, vessel-mounted, or aircraft systems can be used. Must be applied early in spill, when oil is still fluid.

Applicable Habitat Types:
On all water environments.

When to Use:
Potential use for collection and protection. For collection, use to push slicks out from under docks and piers where it has become trapped, or in harbors, where the equipment is readily accessible for use early in the spill. For protection, in low-current areas, use to push slicks away from sensitive resources, such as wetlands. Not effective in fast currents, rough seas, or rainfall.

Biological Constraints:
Not suitable for use in very shallow water or fish spawning areas.

Environmental Effects:
Direct acute toxicity to surface layer organisms, though available products vary greatly in their aquatic toxicity.

Solidifiers

Objective:
To change the physical state of spilled oil from a liquid to a solid.

Description:
Chemical agents (polymers) are applied to oil at rates of 10-45 percent, solidifying the oil in minutes to hours. Various broadcast systems, such as leaf blowers, water cannons, or fire suppression systems, can be modified to apply the product over large areas. Can be applied to both floating and stranded oil.

Applicable Habitat Types:
All water environments, bedrock, sediments, and man-made structures.

When to Use:
When immobilization of the oil is desired, to prevent re-floating, penetration into the substrate, or further spreading. However, full solidification may not occur unless the product is mixed well with the oil, and may result in a mix of solid and untreated oil. Generally not used on spills of heavy oil because the product cannot be readily mixed into viscous oils.

Biological Constraints:
Must be able to recover all treated material.

Environmental Effects:
Available products are insoluble and have very low aquatic toxicity. Unrecovered solidified oil may have longer impacts because of slow weathering rates. Physical disturbance likely during application and recovery.

Chemical Shoreline Pre-Treatment

Objective:
To prevent oil from adhering to or penetrating the substrate.

Description:
Various types of chemicals, either solidifiers, surfactants, or film-forming agents, are applied to habitats in advance of the oil to prevent oil adhesion and penetration. Application must occur just prior to stranding of the oil, thus it is time-critical.

Applicable Habitat Types:
For solidifiers, bedrock, sand and gravel habitats, and man-made structures. For surfactant-type products and film-forming agents, sand to gravel habitats.

When to Use:
When oil is projected to impact an applicable shoreline, particularly those which have high recreational or aesthetic value. However, lack of information on the availability, effects, and effectiveness of most products greatly limits their use.

Biological Constraints:
The toxicity of currently available products vary over three orders of magnitude, thus each product should be evaluated prior to consideration for use. Solidifiers should not be applied where smothering of organisms is of concern.

Environmental Effects:
Product-specific. Solidified oil will have higher smothering effects. Products which disperse oil will affect nearshore resources. See discussion for dispersants and solidifiers.

Shoreline Cleaning Agents

Objective:
To increase the efficiency of oil removal from contaminated substrates.

Description:
Special formulations are applied to the substrate, as a presoak and/or flushing solution, to soften weathered or heavy oils to aid in the efficiency of flushing methods. The intent is to be able to lower the water temperature and pressure required to mobilize the oil from the substrate during flushing.

Applicable Habitat Types:
On any habitat where water flooding and flushing procedures are applicable.

When to Use:
When the oil has weathered to the point where it will not flow using warm to hot water. This approach may be most applicable where flushing decreases in effectiveness as the oil weathers.

Biological Constraints:
The released oil should be recoverable rather than dispersed into the water column. Use may be restricted where suspended sediment concentrations are high, adjacent to wetlands, and near sensitive nearshore resources.

Environmental Effects:
If more oil is dispersed into the water column, there could be more oil sorbed onto suspended sediments and transferred to nearshore habitats, particularly along sheltered shorelines.

Nutrient Enrichment

Objective:
To speed the rates of natural microbial degradation of oil by addition of nutrients (generally nitrogen and phosphorus).

Description:
Nutrients are applied to the habitat in one of several methods: soluble inorganic formulations which are dissolved in water and applied as a spray, requiring frequent applications; slow-release formulations which are applied as a solid and designed to slowly dissolve; and oleophilic formulations which adhere to the oil itself, thus they are sprayed directly on the oiled areas.

Applicable Habitat Types:
Could be used on any habitat type where safe access is allowed.

When to Use:
On moderately to heavily oiled substrates, after other techniques have been used to remove as much oil as possible; on lightly oiled shorelines where other techniques are destructive or not effective; and where nutrients are a limiting factor in natural degradation. Most effective on diesel-type and medium oils that do not have large amounts of high-molecular weight, slowly degrading components. Less effective where oil residues are thick. Not considered for gasoline spills which will be completely removed by evaporation at faster time frames than microbial degradation.

Biological Constraints:
Not suitable in shallow water or restricted waterbodies where nutrient overloading may lead to eutrophication, or where toxicity of nutrients, particularly ammonia, is of concern. Contact toxicity of oleophilic formulations may restrict areas of direct application. Toxicity tests should be evaluated carefully, as other chemicals in the product could be toxic to aquatic organisms.

Environmental Effects:
Very little information available on effects in freshwater.

Natural Microbe Seeding

Objective:
To speed the rates of microbial degradation of oil by addition of nutrients and microbial products.

Description:
Formulations containing hydrocarbon-degrading microbes and fertilizers are added to the oiled area. The argument is made that indigenous organisms will be killed by the oil or not able to degrade the oil, so new microbial species need to be added to speed the process of biodegradation.

Applicable Habitat Types:
Could be used on any habitat type where safe access is allowed.

Biological Constraints:
Not suitable in shallow water or restricted waterbodies where nutrient overloading may lead to eutrophication, or where toxicity of nutrients, particularly ammonia, is of concern. Toxicity tests should be evaluated carefully, as other chemicals in the product could be toxic to aquatic organisms.

Environmental Effects:
Very little information available on effects in freshwater.

When to Use:
On moderately to heavily oiled substrates, after other techniques have been used to remove as much oil as possible; on lightly oiled shorelines where other techniques are destructive or not effective; and where nutrients are a limiting factor in natural degradation. Most effective on diesel-type and medium oils that do not have large amounts of high-molecular weight, slowly degrading components. Less effective where oil residues are thick. Not considered for gasoline spills which will be completely removed by evaporation at faster time frames than degradation.