Response Considerations: SINKER
(applicable to all groups with "S" SEBC as behaviour)

SEBC CODE	S		SD	
STATE	LIQUID	SOLID	LIQUID	SOLID
Density @20°C	> dsw			
Vapour Pressure @20°C (kPa)	-			
Solubility @20°C (%)	≤ 0,1	≤ 10	0,1-5	>10

Attention: for SEBC subgroup "SD" see also → **Response Considerations: Dissolver**

Response strategies need to consider the factors affecting the behaviour and fate of the released substances as well as the short- and long-term processes when spilled at sea:

PROCESSES AND FACTORS AFFECTING BEHAVIOUR AND FATE OF FLOATERS IN MARINE ACCIDENT					
PHISIC STATE		S		SD	
SEBC CODE		LIQUIDS	SOLIDS	LIQUIDS	SOLIDS
BEHAVIOUR and FATE	**Environmental Factors influencing intensity of processes**	Water-column sea-bottom currents, water temperature; bottom morphology, bathymetry			
	Drift and spread of HNS	Drift, dispersion, floating in water column before deposition; drift on sea bottom			
		Accumulation on sea bottom / potential sediments penetration		While sinking: dissolution, dilution and dispersion in water column (potential submerged floating plume). Residuals accumulate on sea bottom	
	Other relevant HNS properties	Δd (density) (d_{sw} - d_{solid}): affect sinking speed			
		logKow / log Koc;		viscosity of the liquid or dissolved fraction	
		Reactivity, toxicity, persistency			
	Impact for marine environment	Impact to the marine environment is mainly related to benthic ecosystems; water column could be also affected. Microbial degradation of some sinker may be occur (e.g. decomposition of grain to form hydrogen sulfide). Some insoluble sinkers are persistent in marine environment.			
For hazard and risks see also → **Hazard** → **Chap. 3262 Hazardous to the environment**					

Considerations

- High cost for research and recovery activities
- In case of sinkers involved in an emergency on board a ship it should be considered to avoid dangerous situation related to hazard of the substances involved

SITUATION ASSESSMENT AND FIRST ACTIONS

Information gathering

- Immediately refer to SDS or chemical databases. In case of unknown substance act as in case of maximum risk → **Safety Data Sheet Content**
- Immediately refer to bathymetric and geomorphological data related to sea-bottom and to incident information
- Consider sea-weather conditions

→ **Incident Data Gathering**
→ **Incident Notification**
→ **Incident Resource**

Situation assessment

On the base of the information gathered on the incident and the contingency planning risk, consider to proceed to:

- hazard identification
  → **Response Consideration: Toxic Substances**
  → **Response Consideration: Hazard flammable and explosive substances**
  → **Response Consideration: Reactive Substances**
  → **Response Consideration: Corrosive Substances**
- estimation of risk and vulnerability
- evaluation of consequences
  → **Situation Assessment**

First actions

- Take into account the first actions to guarantee safe conditions for the responders identifying and reducing the hazards of explosion, fire, exposure to toxic clouds, etc. and then to stop or reduce the source of the HNS spill → **First actions (responders)** → **First actions (casualty)**
- Consider public safety
  → **Safety Zones**
- Equipment/Logistics
  → **PPE**
  → **Hazard: Portable gas detectors for first responders**

MONITORING

Modelling

- Modelling of spill: trajectories, drifting on seabed
- For sinker, to be considered: type of release, environmental conditions during the incident; evaluate prevailing weather and sea condition to determine way and distribution of chemical on sea bottom

  → **HNS Spill Modelling**

Monitoring through *in situ* measuring instruments and research technique

- Towing dredge (for solid substances) or absorbent material (for some liquid substances) along sea bottom
- Sonar systems: side scan sonar (solids) and multibeam (seafloor depression or accumulation, bottom pool of sinking liquids), R.O.V. investigations
  → **Remotely Operated Vehicles**
  → **Remote Sensing Technologies**

Sediment sampling

- Sampling: box corer, grabs / videos using ROV and/or professional divers

Water sampling

- Acquisition of chemical-physical parameters on (deep) water column by multi-parametric probe and analytical determinations using field instruments (e.g. GC-MS, GC-FID, GC-PD, IR, etc.). Only for SD or dissolved reaction products → **Chap. 325 Hazard: Reactivity**

Air sampling on boar

- Some sinkers as calcium carbide can react violently with water and can be ignited under almost all ambient temperature conditions, or as naphthalene that is reactive to air and flammable:
- Trace gas sensors: explosion or fire risks: explosimeter and gas detection
- Oxygen deficiency: electrochemical oxygen sensor

→ Hazard: Portable gas detectors for first responders
→ Sampling Techniques and Protocols
→ HNS Detection and Analysis Methods

RESPONSE OPTIONS

Action on vessel → Emergency Boarding

- Stop the release of substance from its source **→ Sealing and plugging**
- Transfer of cargo or tow the ship in place of refuge **→ Cargo Transfer → Emergency Towing → Place of Refuge**
- Retain all or part of the flow of the pollutant on board before it can reach marine environment

Action on pollutant → HNS Response on the Seabed

- Containment and Recovery: dredging (mechanical, pneumatic or hydraulic) for solids sinker; pumping systems for liquid sinker (also operated with R.O.V. or with underwater operator, depending on the dangerous of substance and the depth of the seabed).
- Wildlife response is focused on seafloor to minimize the impact on benthic ecosystem **→ Wildlife response**

Controlled release technique

- Controlled release of substance still stored on board (e.g. in case of loss of ship stability due to heavy weather phenomenon; not advisable -offshore only; Controlled release of substance still stored on board (not advisable – evaluate for offshore,only after a rigorous evaluation)

Option Zero

- Evaluate non-intervention strategy: recovery of sunken substance is often not possible

→ No intervention

POST SPILL

- Chemical and biological analysis (e.g. biomarkers) on pelagic and benthic organisms.
- Chemical analysis in sea bottom and water column (for persistent substances).

→ Environmental restoration and recovery
→ Post Spill Monitoring
→ HNS Detection and Analysis Methods

EXAMPLE OF SINKER CHEMICALS THAT POSE HEALTH AND/OR MARINE ENVIRONMENTAL HAZARD		
SEBC Group	**Main characteristics**	**GHS pictograms**
Benzyl chloride (S-liquid)	Flammable and moderately explosive when exposed to heat or flame. When heated to decomposition, it emits toxic and corrosive fumes. Harmful for humane health. Rapid reaction in water, Moderately acute aquatic toxicity. Interference and restriction on the legitimate use of the sea and the coastal structures (warning issued leading to the closure of amenities)	

Ethylene Dichloride (SD- liquid)	Highly flammable liquid and vapour (poison). On combustion, forms toxic and corrosive fumes Reacts with oxidizers. Slightly acutely toxicity for marine orgaisms. Effects on wildlife and bottom habitats (smothering of the seabed). Not readily biodegradable. *Incident: Alessandro I, 1991; 30 km from Molfetta, Adriatic Sea, Italy; Cargo: bulk (Ethylene Dichloride and acrylonitrile)*	
Calcium carbide (SD - solid)	React violently with water forming highly flammable and explosive gas(acetylene) and can be ignited under almost all ambient temperature conditions. Harmful for human. Low impact for marine environment. *Incident: Stanislaw Dubois, 1981; Off Island Texel, Netherlands. Cargo: package (857 tons of calcium carbide, 955 t of caustic soda (solid sodium hydroxide), 5.4 tons of a flammable organic peroxide and 5.6 t of explosives collided*	
Naphthalene (S- solid)	Harmful for human health. Present hazard and risks for marine environment: highly acutely toxicity, long lasting effects, moderate bioaccumulation and bioconcentration. Persistent in marine environment. Naphthalene molten is also flammable.	 for naphalene molten also: