Volatile HNS risk assessment

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Shipping incidents involving Hazardous and Noxious Substances (HNS) that behave as gases or evaporators can pose significant risks to both the environment and public health, particularly when located in coastal waters or ports. Such incidents can indeed lead to the formation of toxic, flammable or explosive gas plumes that can travel large distances and pose risks over a wide area in relatively short timescales. In addition, with the increasing effort of the maritime transport industry to reduce its emissions, alternative fuels such as ammonia, methanol and LNG, are increasingly being considered and transported, either by bulk carrier or pipeline, thus introducing new potential accident scenarios. Therefore, it is crucial to provide accurate information on these new propulsion energies to help define effective response techniques and guidance, as well as their potential impact on coastal populations.

An efficient response to pollution can only be possible if the chemical released is known (e.g. physical and chemical properties, volume spilled, behaviour in the environment, etc.). Hence, as part of the MANIFESTS *Genius* EU project, we present new experimental data on HNS pertaining to 2 incident scenarios: a **leakage at the seawater surface near the shoreline** (e.g. from a coastal industry or a grounded vessel) and an **underwater leak from a pipeline**. Both scenarios can lead to the formation of a hazardous gas cloud.

For the seawater surface scenario, the evaporation kinetics of several HNS (cyclohexane, butyl acetate, methanol, …) were assessed using Cedre's wind tunnel. The air and liquid temperatures, along with the wind velocity, were monitored above the pool. The evaporation of each liquid was tracked following the weight loss fraction over time, which allowed to calculate the mass flow rate at the sea-air interface. Data were collected for both pure chemicals and the same chemicals when released on the surface of seawater. Hence, promising results were collected, offering valuable insights into the evaporation process and the influence of seawater on it. These findings will help refining the evaporation module developed in the previous project (based on the evaporation of pure chemicals, without seawater) and included in the DSS

Results showed that increasing wind velocities involve higher evaporation rates of chemicals, i.e. a faster evaporation of the slick. The evaporation process also transiently leads to a drop in liquid temperature. This temperature variation should not be so important in real environmental conditions due to external thermal exchange. When released at the surface of seawater, the same chemicals exhibited slightly lower evaporation rates, which were influenced by their vapour pressure and solubility in water.

For the underwater leak scenario, Cedre's experimentation column was used to assess both the rising speed and the percentage of solubilization of methane in seawater. The focus was then shifted to the characterisation of the gas cloud, by releasing methane underwater in Cedre's outdoor test tank. The objective was to detect any gas cloud at sea surface using a multispectral camera and to evaluate the effectiveness of a protective barrier (water curtain) against the gas cloud at different wind conditions.

These new data will contribute to the improvement of the prediction accuracy of existing evaporation models, including the OSERIT – evaporation module developed in the former MANIFESTS project, as well as the new underwater gas release modelling module developed in MANIFESTS *Genius*. This will offer crisis management stakeholders more precise information regarding the formation and behaviour of toxic gas clouds (Go/No Go decision).