European Maritime Safety Agency

Interspill 2022

Low sulphur and Alternative Fuels

Extended abstract by the European Maritime Safety Agency (EMSA)

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With the introduction of the global sulphur cap in January 2020, bunker fuels in the market are nowadays predominantly distillate marine fuels and very low and ultra-low sulphur fuel oils. On top of this, regulatory developments aiming at further reducing air emissions and the need to contribute to greenhouse gas (GHG) reductions have led to exploring the use of low or zero carbon fuels and other sustainable power technologies. Examples of these are the FuelEU Maritime proposal under the 'Fit for 55 package' and recent MARPOL Annex VI amendments requiring ships to improve their carbon intensity from 2023. Biofuels, methanol, hydrogen, ammonia and other synthetic fuels are emerging as possible alternatives to conventional fossil fuels. However, on top of addressing the technical challenges inherent to the use of these fuels, it is also relevant to understand the behaviour and environmental impact so as to define the appropriate response techniques when containment is lost. Against this context, EMSA is undertaking several studies on different alternative sources of power which cover the suitability of the different types, their production paths and market availability, a hazardous identification analysis, and knowledge about the different solutions to support Member States in responding to accidental pollution. In particular studies on biofuels and ammonia are to be completed during 2022.

Biofuels are fuels that are derived from feedstock resources such as oil and sugar crops, forest or agricultural residues or algae. These feedstocks undergo several processes before being converted into a biofuel. Of the various biofuels, biodiesel is what we call a drop-in fuel, that means that can be used as a direct substitute for MGOs, marine diesel oils or other marine fuel oils in low- to medium-speed diesel engines, which are normally installed in tugboats, small carriers or cargo ships. However, they are currently more commonly used as a fuel additive in conventional fuels to produce blended fuels with less carbon intensity. Second-generation biofuels, such as hydrotreated vegetable oils (HVOs), are growing in importance in the maritime fuel mix.

Ethyl and methyl alcohols are liquid fuels that can be used in existing internal combustion engines, subject to some modifications, and potentially in fuel cell applications. Methanol can be produced from many different feedstocks, such as fossil natural gas, coal, farmed wood, wood waste and even CO2 combined with electricity from renewables. The chemical composition remains the same, regardless of the source. Methanol is relatively easy to store and handle, and it is already being produced on a commercial scale from natural gas. Ethanol, on the other hand, is mainly produced through the fermentation and distillation of biomass containing sugar or starch, such as maize, sugar cane or wheat). Methanol and ethanol do not contain sulphur and are relatively pure substances that are expected to produce very low PM emissions during combustion.

Ammonia (NH3) has the potential to be used as an alternative fuel on ships, based on its physical and chemical properties. Its widespread use in industrial and agricultural processes may also facilitate its

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distribution using the existing infrastructure and supply chains. NH3 can be considered a zero-carbon fuel, with no carbon emitted when converted to electrical energy in fuel cells or mechanical energy in an internal combustion engine. As NH3 contains no carbon, its combustion does not produce any CO2. However, there is a risk of nitrous oxide formation that needs to be evaluated further, as nitrous oxide is a strong GHG. The main challenge however is the fact that NH3 is a toxic gas. Therefore, potential NH3 slips in the engine or from a containment loss is an important factor to considered to prevent harmful emissions.

The basic arrangement for an ammonia fuel supply system is similar to that for LPG. The key changes required being to accommodate the additional capacity required for the lower energy content, possible material differences and the recovery and treatment system designed to prevent venting. Question marks still remain on this latter aspect of the design since it may require significant storage volumes or scrubbing systems. Ammonia is extremely harmful to aquatic life, and land-based regulations provide strict water quality control criteria to limit the impacts of ammonia releases. It is anticipated that holding tanks may be required for discharge ashore – and therefore would require provision of adequate reception facilities – or the development of regulatory limits for water (and air) discharges.

Ammonia is a low flashpoint fuel, so the conventional ‘gas-safe’ or non-hazardous machinery spaces, which are currently applied for all the other low flashpoint fuels and gases, are anticipated to be suitable for ammonia with minor changes including provision of appropriate PPE and operational procedures. The fire and explosion risk is still in need of being properly assessed for ammonia, yet toxicity risk is the main driver for the gas detector type and the alarm levels. Typically, machinery space releases from the double barrier fuel piping are identified during HAZID risk studies, for example from dropped object or fatigue failures, but are considered to be at an acceptable risk level since they are low probability, high consequence events that are considered mitigated to ALARP levels by the existing safety concept and design requirements. Provisions for location of appropriate PPE such as Emergency Escape Breathing Devices (EEBD) in the machinery spaces may be a typical HAZID recommendation for ammonia as fuel.

In spaces where potential leak sources exist, such as fuel preparation rooms containing pumps, compressors, valves, single wall piping, etc. the likelihood of release is higher and will require additional safety features and operational safeguards. For many years there have been Rules from Classification Societies in place for the spaces where ammonia releases may occur from ammonia refrigeration equipment, such as on reefer ships or fishing vessels. These additional requirements, such as increased ventilation or water deluge systems, may be appropriate for such ammonia fuel supply system spaces and the emerging Guides and Rules by Classification Societies for ammonia are already starting to provide some prescriptive requirements for these spaces.