Guidance on the Carriage of Refuse Derived Fuel (RDF)

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Definition

RDF stands for Refuse Derived Fuel. It is produced from commercial, industrial and household waste and is sold as a fuel for incineration in, for example, power generation facilities. Incineration of this product can offer clear environmental and economic benefits compared with landfill, where recycling is impractical.

There is no strict definition for the composition of RDF, but in an attempt to harmonise the products being shipped and stored under the name, the UK Government has proposed the following:

"Refuse derived fuel (RDF) consists of residual waste that is subject to a contract with an end-user for use as a fuel in an energy from waste facility. The contract must include the end-user's technical specifications relating as a minimum to the calorific value, the moisture content, the form and quantity of the RDF".

Composition and Production

Unlike the similar product, Solid Recovered Fuel (SRF), which is produced in compliance with European Standard EN 15359, RDF is not tested against a standard specification and can vary in calorific value, content and composition.

RDF is principally composed of plastic, paper, cardboard, composites, textiles and organic materials but may also include some glass and metal.

Preparation may include screening for recyclable material and high water content bio-degradable waste, followed by shredding and baling in plastic wrap. It is commonly packed as 1 ton bales.

Shipping Restrictions

RDF is classed as a waste product and has been named, in the European Waste Catalogue as "Combustible Waste – RDF" categorised as EWC 19 12 10 and rated "AN (Absolute Non-hazardous)".

It is not named in the IMSBC or IMDG codes, but as a waste, its movement is governed by the terms of the European Regulation 1013/2006 on the shipment of waste within the EU, and by the Basel Convention internationally.

Any shipment must be declared using the forms annexed to the EU Regulations. These set out the Exporter and Importer, description of the waste and the method of disposal or recovery to be used – incineration for energy recovery in the case of RDF.

Hazards Associated with RDF

There have been a number of reports of problems with the storage and shipment of RDF. It is not a "stable" material. It is subject to reactions and degradation at a rate that may be unpredictable due to its non-uniform composition and preparation.

Some of the problems that occur during storage are due to incomplete or ineffective wrapping. Unpleasant smelling liquid may escape into the surrounding area causing potentially harmful incidents and increasing the likelihood of problems with rats and flies.

However, the primary concerns to the shipping industry are likely to be the result of chemical reactions taking place within the cargo.

While the screening process is intended to remove the majority of the waste that is prone to biodegradation, this is not always achieved. Household waste, including food and garden waste for example is likely to contain high levels of moisture and create conditions conducive to the growth of bacteria.

In the first instance these bacteria break down the organic matter: consuming oxygen and releasing carbon dioxide. In the hold of a cargo vessel this creates a potentially hazardous low-oxygen atmosphere and crews must observe safety procedures when entering confined spaces. As the biodegradation proceeds and the oxygen is exhausted, different strains of

bacteria that thrive in anaerobic conditions may begin to grow and start to release hydrogen sulphide, hydrogen and methane as well as carbon dioxide.

The release of flammable gas and the creation of a potentially explosive atmosphere in cargo holds clearly present a potential risk to the operation of the vessel and her crew. This risk is increased by the possibility of self-heating in the RDF, which can be due to heat generated through microbiological activity or exothermic chemical reactions. In general, the nature of the product and the high moisture levels mean that self heating is unlikely to be sufficient to lead to ignition of the cargo or flammable gases unless there is a significant contamination by foreign matter within the RDF.

The nature of the product and its uncertain composition means that there is a possibility that a consignment or part thereof could contain dangerous contaminants such as oil or solvents. These may have been disposed of in the municipal waste and not been effectively removed or they may be illegally hidden within the bulk of the RDF in order to avoid more expensive special waste treatment. The presence of dangerous foreign matter could aggravate a situation where flammable gas and/or heat was being generated.

Measures to Mitigate the Risks

Above, we have identified the primary risk associated with the shipment of RDF to be the generation of flammable gases.

For a fire to occur, broadly speaking there must be fuel, oxygen and an ignition source. The risks of a fire or explosion can be managed by addressing each of those factors in turn.

Firstly, the rate of generation of methane, the primary potential flammable fuel, can be reduced by considering the processing and storage of the RDF.

Prior to loading, it is important to ensure that the cargo has not been in storage for an excessive period. RDF producers have been known to build up stockpiles in anticipation of improving Euro exchange rates, but this practice can increase the risks in older bales that may well be more susceptible to gas generation. As a guideline, the UK Environment Agency position is that bales stored on the dockside for export should have been previously stored for no more than 4 weeks after processing.

Bales should be checked to make sure the wrapping is adequate and intact and that the cargo is not excessively wet. Drier cargo will support less microbiological activity. Furthermore, bales should be kept dry in storage, during loading and shipment, where possible.

During the voyage, Owners and Charterers should consider whether the holds should be ventilated en route. The more straightforward option is to allow ventilation. This would permit the dispersal of any flammable gases that have been generated and allow the oxygen in the hold to be replenished. Bacteria that are dominant in aerobic conditions tend to produce carbon dioxide rather than methane. Venting would also have a cooling effect on the cargo.

The main negative consequence of ventilating is that there may be a release of unpleasant smelling gases from the hold. In addition to this, if pockets of flammable gas were to build up – hydrogen sulphide is more dense than air and can collect in low parts of the hold - the presence of ~21% oxygen in the air means that there is potential for fire or explosion within the hold.

If the hold is sealed, and venting ceased, then the bacteria present will likely reduce the level of oxygen in the tank atmosphere to life threatening levels and possibly below oxygen levels that could sustain a fire or explosion. Methane and hydrogen sulphide may well be released however and the concentrations may rise to above the lower explosive limit, or LEL, thus making an explosive gas mixture. Without sufficient oxygen, there would be no immediate risk of fire, but if fresh air is allowed into the hold then an explosive atmosphere could be created.

If the cargo hold is sealed, it would be advisable to monitor regularly its atmosphere in order to understand the reactions that are taking place.

Owners should seek instruction from Charterers about whether to ventilate or not, but in the absence of such instruction, the best course of action would usually be to ventilate.

If high levels of flammable gas are present, then the course of action prior to discharge must be carefully considered. Steps such as notifying the discharge port authorities may be necessary along with preparing firefighting equipment and personnel. Prior to opening the hatches, measures to reduce possibility of ignition should be taken such as greasing or wetting moving metal parts and the use of nitrogen gas to render the hold atmosphere inert. Steps should be taken to ensure that crew and stevedores do not smoke.

It should also been noted that in the absence of sufficient oxygen, many commonly carried gas detectors will not produce accurate flammable gas readings (reported as % LEL). It is the responsibility of the crew to understand the operation of their equipment and its limitations. They might consider using a diluter device called a splitter that will provide more representative flammable gas readings in low oxygen environments in order to have a better understanding of the atmosphere in the hold and the potential explosion risk.

It would also be wise to monitor the temperature in the hold as this is an indirect measure of the chemical and biological activity that is going on and any significant increase in temperature may be an indication of a problem with the cargo.

At the time of discharge, if there is any liquid residue from the cargo in the hold, the Operator/Charterer should consider handling this in line with the restrictions set out in MARPOL Annex V. It would probably not be considered as Hazardous to the Marine Environment, with the caveat that the composition of the RDF is unpredictable and contamination with hazardous compounds cannot be ruled out.

Conclusions

In summary, RDF is a generic term used for cargoes of mixed waste whose composition, characteristics and properties are not fully known. There is no clear guidance from the IMO on the safe shipment of such cargoes, and while the “normal” constituents of the product are not classified as dangerous, there is potential for RDF to create hazardous conditions and hazardous situations have been known to occur. We would advise comprehensive risk assessments in line with good practice for loading, the voyage and discharge.

We are grateful to **Minton, Treharne and Davies Ltd** for producing this article and for their permission to publish this advisory notice.