H2S complications

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Hydrogen Sulphide is a very toxic, corrosive and flammable gas. It has a very low odour threshold and a distinctive odour of rotten eggs. H2S is colourless, is heavier than air, has a relative vapour density of 1.189, and is soluble in water. ISGOTT (International Safety Guide for Oil Tankers and Terminals, 5th edt.,ICS, OCIMF, IAPH), section 2.3.6

Danger of H2S gas is well known and recognized within industry. Exposure to 700ppm in air rapidly induces unconsciousness (few minutes) and death, when more than 700ppm – immediately fatal (ISGOTT, para 2.3.6.4).

1. High Sulphur Fuel Oil cargo handling

1.1 SAFETY REQUIREMENTS

ISGOTT, at sections 2.3.6.1 - 7 describes exposure limits, typical effects of exposure to H2S and enumerate safety procedures for handling cargoes and bunkers with H2S. In section 2.3.6.5 underlined additional measures applicable in cases of Very High Concentration of H2S (100ppm in the vapour space is considered to be a reasonable threshold). Among other things it requests:

i. Vapour monitoring on deck
ii. Bridge, CCR and accommodation atmosphere monitoring
iii. Use of personal H2S gas monitoring equipment
iv. Risk assessment
v. Use of EEBD and SCBA if and when necessary
vi. Specific safety procedures and instructions to be available to ship's crew

And section 2.3.6.7 says:

General Nuisances

> In addition to being a health hazard, the H2S odour is also considered a public nuisance. Most local environmental regulations limit or ban the release of H2S concentrations to the atmosphere and this is, in any case, good practise. It is therefore necessary to maintain cargo tank pressures within acceptably low limits.

Further practical guidance, which is given in section 11.1.9 of ISGOTT relates to operational measures necessarily to be taken to minimise the risks associated with loading of H2S rich cargoes. The guidance provides the following requirements:

i. Closed loading procedures described in Section 11.1.6.6 should be used.
ii. Venting to the atmosphere at a relatively low tank pressure should be avoided, particularly in calm wind conditions.
iii. Cargo loading should be stopped if there is no wind to disperse the vapours or if the wind direction takes cargo vapours towards the accommodation.

iv. Only personnel actively engaged in ship security and cargo handling should be permitted on open decks. Regular maintenance on deck should be limited or postponed until after the end of cargo operations. Visitors should be escorted to and from the accommodation spaces and briefed on the hazards of the cargo and emergency procedures.

It shall be stressed that guidance enumerates measures concerned ***loading operation only*** (emphasis mine) of cargoes containing H2S. Discharging is being considered as activity which does not require any special guidance apart of general safety measures described in sections 2.3.6.1 – 7. Naturally, risk of H2S poisoning is much less during discharging because no vapour emission goes out from ship's tanks, i.e. while volumes of cargo diminish in the course of discharging, Inert Gas produced by ship's IG plant replaces empty volumes and keeps constant positive pressure in tanks and lines.

1.2 DISCHARGING TERMINAL / CHARTERERS' REQUIREMENTS

Nowadays, many (if not all) ports and terminal impose certain restrictions on H2S content in vapours emission from tankers. Maximum permitted levels may vary significantly and in some ports be 100ppm and in some only 10ppm. Apparently these local regulations put some pressure on the charterers when cargo in question is of higher H2S content than permitted. Therefore on a loaded leg they are to solve two (in case of HSFO) mutually exclusive problems:

a. To keep cargo heated
b. To bring H2S content within limits imposed by terminal or local administration

Section 2.3.6.7 of ISGOTT says:

> The tank vapour pressure will rapidly increase if the vapour space is exposed to heat or the product is agitated.

Therefore there is a tendency to bring heating of HSFO cargoes to an absolutely necessary minimum, sufficient only to keep it at contracted temperature.

But if little or no heating may serve to some purpose when dealing with vapour pressure there is still a problem of high H2S content. The truth is that there is no any means within technical abilities of normal tanker to reduce H2S content in vapour emission. Vessel can only ventilate tanks with Inert Gas and temporarily displace rich H2S vapours into atmosphere via tanks ventilation system. Key words in previous sentence are: ***ventilate into atmosphere*** and ***temporarily*** (emphasis mine). These key words speak for themselves – firstly, this operation cannot be done in port nor at sea "if the wind direction takes cargo vapours towards the accommodation" (ISGOTT 11.1.9) and, secondly, achieved results very and very doubtful, see 1.3 PURGING below for details.

However, as far as my personal experience shows, lack of understanding of this simple physics described above, ignorance of basic safety rules and insufficient technical background of staff in some shipping offices give rise to same erroneous decisions made again and again irrespective of personalities in each given case. These decisions usually direct the master and the crew of the vessel to start "purging" of cargo tanks with IG day or two before arrival into port of discharging. Let us see if this operation has anything to do with purging.

1.3 PURGING

I'm not going to enlighten the reader with some ideas of great novelty or inventions of my own. All my conclusions based on immense experience concentrated in definitions, requirements and instructions combined in ISGOTT. Therefore for those who use word purging very often in connection with H2S vapours I shall borrow from ISGOTT another quotation:

> Definitions.
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> Purging. The introduction of inert gas into a tank already in the inert condition with the object of further reducing the existing oxygen content and/or reducing the existing hydrocarbon gas content to a level below which combustion cannot be supported if air is subsequently introduced into the tank.

It should be noted that a whole philosophy of introduction of Inert into ship's tanks built on the principle of strict avoidance of any such composition of a mixture of hydrocarbon gas and air in ship's tanks which will be capable of ignition. This can be achieved when hydrocarbon content is either too small (below 1% by volume) and not sufficient for combustion or when hydrocarbon content is too high (above 10% by volume) in which case there is no oxygen enough to support and propagate combustion. Technically the ship's staff can influence only oxygen content and not hydrocarbon, therefore to ensure a non-flammable atmosphere in all ship's tanks oxygen level of 8% and less is being achieved by introduction of Inert Gas with oxygen content of less than 5% (see IG composition). That would be an end of story but for the fact that periodically cargo compartments of tanker vessel shall be inspected and sometimes repaired. To carry out such inspections/repairs tanks must undergo gas-freeing procedure, i.e. the introduction of fresh air into a tank with the object of removing toxic, flammable and inert gases and increasing the oxygen content to 21% by volume. Evidently, that if at the beginning of gas-freeing hydrocarbon content is above 1% by volume (i.e. enough to initiate combustion), which is usually so when vessel carries crudes or petroleum products, introduction of fresh air will very soon develop into situation when hydrocarbon and air mixture will be capable of ignition. And under these circumstances the purging has to take place.

> ISGOTT, 7.1.6.10 Purging
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> When it is required to gas free a tank after washing, the tank should first be purged with inert gas to reduce the hydrocarbon content to 2% or less by volume. This is to ensure that, during the subsequent gas freeing operation, no portion of the tank atmosphere is brought within the flammable range.

Thus, purging is just an operation of replacement of gas in cargo tanks by either displacement (which is a layering process) or dilution (which is a mixing process) method.

What usually the charterers propose or 'order' to do is not a purging as it defined and described in ISGOTT but a kind of ventilation to bring H2S content down, which is not only time-dependable or little effective but also prohibited "if the wind direction takes cargo vapours towards the accommodation".

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