

Surveyor's Notebook

DANGER OF HOT WORK NEAR CONTAINERS

A Container was loaded with approximately 16 tonnes of non-ferrous aluminium scrap metal bound for Pakistan. The container was stuffed in Northern Europe and subsequently loaded onto a container ship soon after. The scrap cargo had a high value and was understood to be a by-product from a computer recycling process. The scrap cargo was a mixture of loose aluminium foil in strips and small reels of compressed aluminium tape, some of which were loosely wound.

During the voyage, the fitter was required to carry out some hot work repairs on the hold platforms. The following procedures were carried out:

- identification of any International Maritime Dangerous Goods (IMDG) containers nearby
- risk assessment
- permit to work that required atmospheric testing to confirm oxygen, toxic gas and flammable gas concentrations
- tool box meeting; two personnel working as a team
- full protective equipment worn

As the fitter was cutting steel plate with an oxyacetylene torch close to the door of this particular container, there was an explosion, which killed the fitter instantly.

– THE INVESTIGATION

An investigation was carried out by an expert firm of consultants, which found the following:

- the container was a standard 20ft unit, with a plywood floor in satisfactory condition, fitted with small ventilation openings on the side walls with perforated plastic covers.
- the container was approximately 70-80% full
- the floor edge was detached at the rear of the container, the walls of which appeared to have 'bulged' out; the doors also showed damage as a result of the explosion. The container had been damaged as a result of an internal explosion
- there was no evidence of oily substances, solvents or extraneous material within the cargo

- there was a significant thin oxide film on aluminium strips within the container and on samples removed from the container
- samples of cargo were recovered and placed in airtight drums. These were shipped to a laboratory and the air space above the metal samples was tested. Analysis showed that hydrogen gas was present in all the air spaces that were tested at a concentration of up to 1.37% by volume. This corresponded to 34% of the lower explosive limit (LEL) for hydrogen. This provided evidence that the cargo was susceptible to evolve hydrogen and could potentially produce levels of hydrogen sufficient to form an explosive mixture in air
- it is possible that flame-cutting sparks were propelled to the edges of the container doors through which a flammable hydrogen-air mixture was present

– HYDROGEN

Hydrogen is a colourless, odourless gas, normally present in air at concentrations of about 5ppm. When mixed in the correct proportions in air and ignited in a confined space, hydrogen burns rapidly, generating high rates of pressure rise. The minimum concentration of hydrogen in air to form a flammable mixture (the LEL) is 4% by volume.

Hydrogen is a much lighter gas than air and would initially tend to rise and accumulate near the top of a sealed or enclosed space such as a container. The relatively high permeability of hydrogen allows good mixing to the extent that homogeneous mixtures can form and also leak from, say, a container. The ventilation grills on the container may have been taped over, preventing the hydrogen from escaping. In any event, forced ventilation within the hold is unlikely to have any material diluting effect on a localised volume of a flammable gas at the container walls and doors that is accessible to flying sparks from hot cutting or welding operations. The generation of hydrogen from the cargo could have been caused by one of a number of mechanisms, including chemical contamination, reaction with moisture, an effect of the manufacturing process and/or the subsequent storage of the material. It is unlikely on this occasion that a galvanic reaction between the aluminium and steel caused the build-up of hydrogen.

In any event, the relatively high specific surface area of the aluminium tape may have been the overriding factor that facilitated the generation of sufficient hydrogen to form a flammable atmosphere in the container.

It was noted that according to the ship's container stowage plan, this container was in fact not stowed in the correct bay.

– LESSONS LEARNT

Ship's masters should be aware that scrap aluminium metal and also other scrap metals may produce hydrogen gas, particularly if they become wet or moist. It is not usual for ships to have gas meters onboard to specifically detect hydrogen gas. However, conventional explosimeters are usually carried onboard and these will determine whether there is a potentially flammable gas mixture present, although they will not identify the nature of the gas.

(Article extracted from The Standard Club's publication - Standard Safety)

Next quarter: Seaview begins a new column, "AA Talk" covering marine insurance related topics, consisting of articles, note-worthy news, case briefs and answers to questions on claims. "AA" has been a popular slang in Hong Kong which is becoming commonly known in the mainland and Taiwan, meaning "going Dutch" - dividing the cost. The Institute member designated to edit this column is a practicing average adjuster.
