Dealing with HNS from the Napoli

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Introduction

This paper briefly describes how the containers and tank containers were dealt with by Braemar Howells Ltd. in Portland Port after their arrival from the MSC Napoli. It covers in general terms how they were managed on site and then presents three case studies as to how certain of the more hazardous products (both in tanks and containers) were dealt with in order to make them safe for disposal or onward delivery.

Background

The MSC Napoli, capable of carrying over 4400 'Twenty-foot equivalent units' (TEU's), developed a split in the side and was beached in Branscombe Bay 20th January 2007.

Fig.1 MSC Napoli in Branscombe Bay

The vessel was actually carrying almost 3000 containers and tank containers. Every conceivable item was on board from nappies to the infamous BMW motorbikes, cars, paper, furniture, alcohol, precious metals, food items and of course Hazardous and Noxious Substances (HNS) both in tanks and containers.

Fig. 2 Containers being loaded to a barge

All of the tanks and containers were offloaded from the Napoli to barges by the salvage company and brought back to Portland Port. After being craned from the barges to the Occasional Coaling Pier (OCP) in Portland the contents of each container were assessed by the loss adjusters. They were then assigned various categories such as re-sale, waste, return/send to consigner/consignee etc. and marked up accordingly. Many of the containers then had to be taken to the washdown facility before being processed or stored in various locations prior to being transported out to their destinations.

Area set aside for dealing with the HNS containers

Fig. 3 Area set aside for dealing with HNS containers

The area designated for dealing with the HNS containers (not the tank containers) was known as the burning ground; an area of rough ground well away from the rest of the operation in the port. It was unfortunately difficult to access with large cranes and other transport and impossible to use fork-lifts. An all terrain telescopic un-loader had to be used for emptying the contents of the containers.

Fig. 4 Bunded areas especially created by Braemar Howells Ltd. for dealing with the HNS from the containers

Several bunded areas were made up for the containers from railway sleepers and heavy duty plastic, in order to contain any potential spills from leaking drums, IBC's and other packages that may be inside. A control area with small office, changing and equipment storage area was set up so that the HNS operation could be largely independent of the rest of the container operations. Containers would be called up, offloaded and dealt with in batches to minimise vehicle and cranes movements to the area.

Area for dealing with HNS tank containers
The tank containers were dealt with in a different manner. These could only be worked on in the location where they were landed from the barge (OPC). The reason for this was that OPC was bunded and had under jetty storage tanks which would contain the larger amounts of liquid should catastrophic failure occur during storage of the tanks or whilst response activities we being carried out on them.

General Procedures

HNS containers
Once a container was on site, a risk assessment was carried out (including PPE and RPE assessments) based on the manifest. An opening procedure using chains to control and restrict the doors in case the load had shifted in transit was used. The contents of the containers were checked against what was expected from the manifest and a plan for dealing with the contents was drawn up and put into action.

HNS tank containers

In order not to disrupt container recovery operations it was decided to leave dealing with the tank containers until the rest of the operations involving OCP were finished. One or two exceptions had to be made in order to add inhibitors to some of the tanks (that contained polymers) in order to prevent uncontrolled polymerisation events. To allow this operation to take place safely it was necessary occasionally to evacuate OCP for a short time. As above, risk assessments including PPE and RPE assessments were carried out and a plan of how to deal with each situation was drawn up.

General Response to HNS incidents

Before any response to an HNS incident there needs to be an information gathering phase. This can generally be split into 3 related areas

- Information regarding the hazards of the chemicals
- Information regarding the protection of the response team
- Information regarding how the hazards may affect the vessel / environment

Chemical Hazards

In all cases in dealing with HNS incidents it is necessary to get accurate product information regarding the hazards. This can be obtained from a variety of sources such as:

- The manufacturer's emergency response advice line a.k.a. Level 1 response
- Safety Data Sheet
- Chemical Databases e.g. Chemdata, TROCS, Wiser, Hazmaster, Croner, Sax EH40, Gesamp...
- Vessel manifest etc.

Most of these sources of information (with a couple of exceptions) are not designed for dealing with large scale emergencies or incidents.

PPE/RPE

Once the hazards are established then it is necessary to look at how the response team may be protected from them. In a lab situation PPE is the last resort in and mechanical means such as fume hoods and remote working are employed. In a response situation PPE is usually has to be relied upon more heavily.

Entries in manufacturers safety data sheets (MSDS) often refer either to PPE for lab use or suggest that 'appropriate impervious' PPE is worn. It is usually left to the response organisation to specify the PPE and equipment that is suitable for the task. This means consulting databases and cross referencing all PPE and equipment to be used against the listed chemicals. Potentially this is a time consuming task where several chemicals are involved in the response.

Respiratory Protective Equipment (RPE) is dealt with in a similar manner by MSDS's. Generally in well ventilated areas respirators may be worn (where appropriate and suitable) and in confined spaces, breathing apparatus (BA) is used. Where appropriate and in all cases involving BA, a rescue team was on standby in case of any unforeseen incidents that may occur whilst carrying out the planned responses to the various products.

Vessel
In this case the Napoli was aground however there have been cases where a spill of chemicals on board has adversely affected the vessel. For example a spill of nitric acid on board the Syrian vessel Dalhia-S, caused it to sink due to rapid and severe corrosion.
In the case of the Sunna, the process of removal of the bulk (hazardous) cargo from on top of the forward bilge well caused rapid ingress of water due to damage caused by grounding. Without ship stability and salvage expertise the ship would have sunk during the final phase of the response.

HNS response is a wide ranging, variable and complex field. It demands specialist skills and knowledge of many different areas. Response teams need to be comprised of highly trained, skilled motivated and adaptable members and they need to be able to cover a wide range of skill sets. More importantly HNS response demands the ability to know when and where to seek extra information and expertise.

Three case studies

The three case studies presented are:
- a tank container requiring a product transfer
- a packaged goods container
- a tank container requiring addition of inhibitor to make the contents safe for continued storage

Case Study 1
Two tank containers filled with Epichlorohydrin came ashore from the Napoli. At some stage the tanks had become damaged and although not thought to be leaking they were designated unsafe for onward transport. A product transfer had to be carried out to fresh clean tanks that were provided by the product manufacturer / shipper.

Hazards of Epichlorohydrin include:

Thermal Decomposition in the presence of water, even at moderate temperatures, it may undergo thermal decomposition by hydrolysis, especially if the medium is acidic or basic. Epichlorohydrin burns to form water, carbon oxides and hydrogen chloride (HCl: an irritant gas).

Chemical Reactivity
Epichlorohydrin may react violently in the presence of certain substances. May polymerize exothermically if heated or **contaminated**. Exothermic polymerization on contact with strong acids or bases, zinc, aluminium, aluminium chloride, iron, ferric chloride [Sax, 9th ed., 1996, p. 1469]. (NOAA REACTIVITY, 2007)

Flammability
In mixtures with air, the vapour phase can produce a flammable or moderately explosive mixture when the concentration of epichlorohydrin is between 3.8% and 21% (by volume). In view of the significant risk due to its flammability, it is recommended to handle and store epichlorohydrin under nitrogen. Epichlorohydrin should be kept away from sources of heat, flames and sparks. In addition, when handling epichlorohydrin (pumping, etc.), electrostatic charges may be produced. These may cause sparks, which are a source of ignition. To avoid this risk, it is essential to ensure that all equipment is properly grounded and bonded.

Acute Toxicity
Epichlorohydrin (liquid or gas) is an irritant to the eyes, skin and mucous membranes of the respiratory and digestive tracts. It is absorbed through intact skin and, in some cases, induces allergic reactions. In addition, it may cause burns which appear a few hours after exposure. Epichlorohydrin may affect both respiratory and nervous systems, and may cause abdominal cramps and convulsions.
Because of the effects observed in animals, the European Union (EU) has classed epichlorohydrin as "possibly carcinogenic in humans"

Previous Incidents with Epichlorohydrin
Two previous major incidents with epichlorohydrin have occurred. One in Bristol at Albright and Wilson plant in October 1996 where there was a large explosion and the other was in July 1989 when drums of the product were being carried aboard the Dutch vessel Oostzee. This incident reportedly resulted in 44 responders and ship's crew being hospitalised due to the effects of Epichlorohydrin. (HELCOM Response Manual, Volume 2 *A3-19)*

PPE for Protection from hazards associated with Epichloroydrin

	(breakthrough times)
Tychem F suit	=204 minutes
PVA Glove	=300 minutes
Full face mask with Respirator filter	type A

Response
Once the PPE and RPE requirements are established and the plan and risk assessments completed, the team can then carry out the necessary work. In this case because of the large volume and particularly hazardous nature of the chemical involved, the plan was reviewed and approved first by both a team of chemists from the product manufacturer and the UK's National Chemical Emergency Centre (NCEC).
New clean hoses and fittings compatible with the product were specified in the plan. Certified clean tank containers purged with nitrogen were provided by the product manufacturer, the tanks and hoses were all earthed and continuity was checked. A gravity transfer of the two tanks was undertaken at night after evacuating the OPC area.

Fig. 5. Tank container of Epichlorohydrin being transferred under gravity

Case Study 2
A container filled with drums of Ethylenediamine (EDA). Originally all of the drums were stored neatly on pallets in a double layer in the 20ft ISO container.

Whilst underwater two things occurred, the drums were compressed due to the water pressure from being submerged. In becoming compressed the drums all became dented and this damaged the protective linings inside the drums. This resulted in the chemical attacking the steel and causing almost every drum to leak. The second problem was whilst under water, the pallets and drums started to float around independently inside the container. When the container drained and settled they became wedged and making them difficult to remove.

Fig. 6 Pressure damaged drums of EDA

Hazards of EDA include corrosivity and flammability and for transport it is classified as a packing group 2 material. (Other perhaps better known examples of packing group 2 flammables are Petrol and Acetone and examples of packing group 2 corrosives are, up to 70% Nitric acid and, up to 51% Sulphuric acid.)

PPE for Protection from the hazards associated with EDA

	(breakthrough times)
Tychem F suit	>480 minutes
Butyl Rubber Gloves	>240minutes
Full face mask with Respirator filter	type A

Response

Once the PPE and RPE requirements are established and the plan and risk assessments completed, the team can then carry out the necessary work. In this case in order to access the drums the container roof had to be removed.

Fig. 7 Lid of the container being removed to access the damaged drums

The drums could then be taken out of the container using the tele-handler and placed in the working bund. Teams were then able to package the leaking drums in salvage drums ready for disposal.

Case Study 3

A tank container of methyl metacrylate had been damaged and had a significant split in the top next to the man-lid.

Fig. 8. Damage to Tank Container of Methyl Methacrylate

This would have allowed the inhibitor to have evaporated during storage on OCP. The product was also contaminated with sea water and it was necessary to add a final 'killer' inhibitor to render the product harmless and unable to polymerise.

Hazards of Methyl Methacrylate Include

Flammability
Highly Flammable

Reactivity
May polymerise if contaminated or subjected to heat. Container may be subject to violent rupture. Oxidizes readily in air to form unstable peroxides that may explode spontaneously [Bretherick 1979. p.151-154, 164]. Peroxides may also initiate exothermic polymerisation of the bulk material [Bretherick 1979. p. 160]. (NOAA REACTIVITY, 2007)

Health Hazard
Irritation of eyes, nose, and throat. Nausea and vomiting. Liquid may cause skin irritation. (USCG, 1999)

PPE for Protection from hazards associated with Methyl Methacrylate

	(breakthrough times)
Tychem F Suit	=25mins
PVA Glove	>300 minutes
Full face mask with Respirator filter	type A

Response
Once the PPE and RPE requirements are established and the plan and risk assessments completed, the team can then carry out the necessary work. In this case the tank and hoses were connected up and earthed. Several hundred litres were then drained off from the bottom valve into a suitable container and inhibitor added trough the man-lid to render the product harmless.

Fig. 9 Preparing to Add Inhibitor to a Tank Container of Methyl Methacrylate by Bleeding off some of the contents to an IBC.

Conclusions
Safety is always of paramount importance and all aspects of the situation must be taken into account when risk assessing and planning an HNS response. However in dealing with container and tank containers on shore it is primarily the chemical hazards and PPE/RPE aspects that need most careful consideration

HNS response is a wide ranging, variable and complex field. It demands specialist skills and knowledge of many different areas but more importantly it demands the ability to know when and where to seek extra information and expertise.

Response teams need to be comprised of highly trained, skilled motivated and adaptable members and they need to be able to cover a wide range of skill sets including team work, mechanical and marine engineering, chemical awareness, PPE/RPE training and familiarity, plant and equipment operations, communications equipment emergency procedures...

Responses sometimes have to be carried out in other than ideal locations, conditions and times, because of this both the training and equipment need to be of the highest quality and maintained to the highest levels.