



Asiafreighter Arsine Incident

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Air Products shipment on the Asiafreighter to their facility in England in 1974. 2 pure arsine cylinders containing 35 lbs each, were strapped to an unsecured wooden pallet in a cargo container that had 12 drums of chemicals, 3 pallets of metal parts and one small strapped package. They were 44 liter in size and were filled by Precision Gas Products in Sept 1974. The cylinders were labelled liquid poison but there were no markings or labels on the shipping container. At New York Harbor on Nov 4, 1974 Seatrain loaded the container below deck. It then proceeded to Norfolk, Baltimore and Charleston finally leaving for Le Harve, France on Nov 9, 1974.¹ During 2 days of rough seas (Force 8, Nov 13 and 14) the 2 cylinders broke free of the wooden pallet. The cylinders then rolled back and forth violently and repeatedly in the cargo container as the ship rolled causing considerable damage to the container walls. Both cylinder valves torqued open, and one started to leak through a damaged valve outlet dust cap.



Fig. 1: Asiafreighter Container Ship

On Nov 13, a cadet was sent into Hold #2 to familiarize himself with the hold structure as part of his training and spent an hour there. On Nov 14 other officers joined him to do a detailed inspection of the Hold superstructure. The Captain, also joined the Chief Officer for a 10 minute inspection in the hold and noted that something was loose and banging as the ship rolled. The 4 crewmen that made the inspection became extremely ill at 16:00 with red urine, kidney pain and vomiting.

Since they were close to the English coast on Nov 15 a helicopter brought over a Medical Doctor who had the 4 flown to a hospital and a replacement crew brought over to the ship. On Nov 16, the 4 crewmen who assisted the 4 crewmen suffered from less severe exposure symptoms likely due to only contaminated clothing rather than entry to Hold #2. This included the Captain, cook and helper. They were also airlifted off the ship. By this time, the news media is providing major coverage and the public was alarmed.^{1,2,3}



They determined that the problem was in Hold #2 since that was where the 4 spent most of their time. On Nov 16, UK Government experts boarded the ship and conducted air monitoring in the holds. They however could not access Hold #2 while wearing SCBA as the manway was an 18" x 24" oval. Air samples were taken using evacuated cylinders and were analyzed by IR which determined that there was arsine present. Checking the manifests for all the cargo in Hold #2 they found that there was an Air Products shipment of arsine and concluded that this was the likely the problem. This was confirmed when colorimetric tubes (Draeger) for arsine were used to sample the Hold.

Air Products was contacted on Nov 17 and Dave Scott (AP Specialty Gas Manager) flew to England the next day in London and he was driven to Falmouth arriving the morning of Nov 19. There was considerable debate as to the best action encumbered with a lot of bureaucracy and uncertainty that was made worse by the news media. The Rotterdam Port officials stated that the ship would not be able to dock unless the arsine concentration was below 50 ppb. The UK MOD assigned a destroyer (Kent) as an escort.² Attempts were made to run the exhaust fans on all the holds periodically to dilute the arsine but the levels remained high. A canvas exhaust duct with a fan was then attached to a Hold #2 hatch to better exhaust it but it leaked causing another crewmen to test positive for arsenic. A wire reinforced plastic exhaust duct was then used.³ The ship then sailed from Falmouth to Rotterdam where the containers on deck were removed on Dec 1.

They went back out to sea and a floating crane was used to remove the containers in Hold #2 and place them on deck. A hole was made in the problem container and sodium hypochlorite was sprayed into the container to react the arsine. Dave was able to enter the container on Dec 3, stand the cylinders upright and close the valve stopping the leak on Cyl A. Dave reported that he could hear the leak and that the cylinder cap collars which are peened onto the cylinder neck were loose. Cyl A was close to empty while Cyl B was full. Both valves were open (3/4 turn). So if the leak started during the storm Nov 13-14 and lasted until Dec 3. Assuming a constant leak rate it was approx. 500 cc/min.

All 10 crewmen recovered without permanent injuries. The four that entered Hold #2 suffered severe renal failure. With proper medical treatment, all recovered their kidney function 6 months later.⁴

Arsine Toxicity Aboard the Asiafreighter

S. P. WILKINSON, P. MCHUGH, S. HORSLEY, H. TUBBS, M. LEWIS, A. THOULD,
M. WINTERTON, V. PARSONS, ROGER WILLIAMS

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Summary

Eight sailors on board the Asiafreighter were exposed to arsine that had escaped from a cylinder in the cargo hold. Four suffered severe toxicity and within a few hours had developed fever, weakness, nausea, vomiting, diarrhoea, abdominal pain, and haemoglobinuria. These patients had pronounced intravascular haemolysis, which in one patient was complete.

This patient was also stuporose and anoxic, a condition attributed to failure of oxygen transport and sludging of red cell debris in the cerebral and pulmonary circulations, but he regained a normal level of consciousness after exchange transfusion. Evidence of marrow depression was present: the reticulocyte response to the haemolysis was poor and there was a thrombocytopenia. All four patients developed renal failure, one being totally anuric for five weeks. Two patients developed peripheral neuropathy, and one was still severely disabled six months after the incident. The other four patients had a similar, though less severe, illness.

Introduction

Arsine (arsenous hydride), a colourless gas, is an important environmental hazard in those industries concerned with refining and processing metals such as steel,¹ gold,² and tin,³ where it is formed by the action of acids or nascent hydrogen on arsenite impurities. In sewage plants arsine may also be liberated from fungi.⁴ The use of arsine in the transistor industry to stabilize selenium is not well known, and it was leakage of gas destined for this purpose, from a cylinder aboard a container ship, that led to the poisoning of the eight sailors described in this paper.

The Incident and Initial Symptoms

The Asiafreighter was transporting a mixed cargo from the U.S.A. to Europe in November 1974. After three days of heavy seas three of the crew and the first mate (cases 1-4) entered cargo hold no. 2 to gain access to the double bottom tanks of the hull and check for possible damage. The total time spent in the hold or the hull tanks ranged from 1 hour 5 minutes to 3 hours 45 minutes. The cargo in the hold was arranged in seven layers of containers, the two cylinders of arsine being in the second from bottom level. Though there was no external evidence of damage to that container one of the cylinders had leaked the whole of its contents through the cylinder valve, which had presumably opened as a result of repeated buffeting within the container during the storm.



Both cylinders were dropped off at the UK National Engineering Laboratory for testing.⁵

Numerous tests were conducted which determined that the cylinder and valves were leakfree and functional. The valves opened during the violent storm (Cyl A) had a dust cap with a damaged seal while the Cyl B dust cap was able to seal even installed only finger tight.

Test 4

A similar size cylinder was filled with 35 lbs of water and 210 psig of N₂ was pushed by foot to roll and impact a stationary cylinder 4' away that was lying against a wooden brace

Valve opened after

Valve closed lightly – 4 impacts

Valve closed medium force – 6 impacts

Valve closed maximum force – 14 impacts

Cyl A

Valve closed medium force – 15 impacts

Valve closed maximum force – 25 impacts

Cyl B

Valve closed maximum force – 21 impacts

Lessons Learned:

1. During rough handle or transportation, cylinder valves could torque open. This was not the only incident in which this has happened.

As a Best Practice companies started wire tying the valve handle shut for shipment to prevent it from vibrating open. Plastic shrink wrap around the valve provides additional physical securement of the handle.



Fig. 2: Cylinder Valve Wire Tied

2. Dust caps are not designed to be vaportight. The regulations now require a vaportight outlet cap to provide secondary seal for all highly toxic or pyrophoric gas cylinder valves. The nipple in the



center seals against the valve outlet connection while a dust cap may have a fiberboard or PTFE gasket.

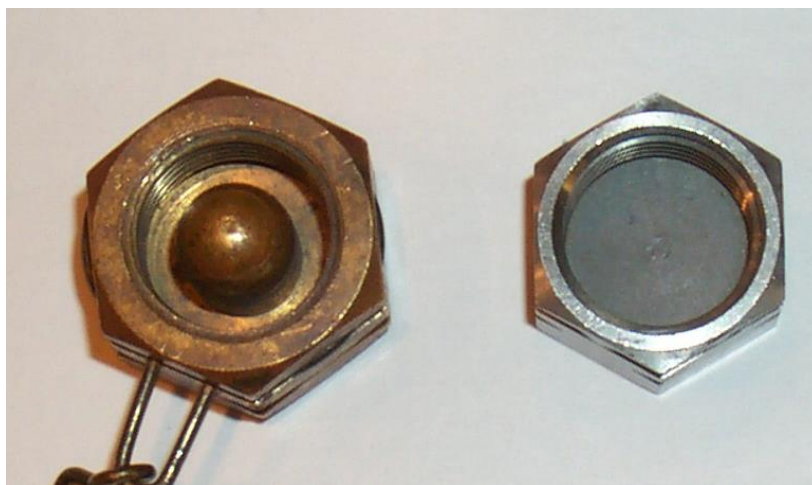


Fig. 3: Vaportight and Dust Caps

3. Toxic gases are not to be loaded below deck. The label used was incorrect.

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Chemically Speaking LLC
Eugene Ngai

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