Extract from European Directive 2009/18

(26) Since the aim of the technical safety investigation is the prevention of marine casualties and incidents, the conclusions and the safety recommendations should in no circumstances determine liability or apportion blame.

In view of the COVID-19 pandemic in 2020, and local rules and regulations to prevent the further spread of the virus, the investigators of the Federal Bureau for the Investigation of Maritime Accidents adhered to all legislation in vigour, which might have hampered certain investigative acts. Nevertheless, no efforts were spared to conduct the investigation, into the cause of the marine accident mentioned in this report, to the largest possible extent and conclusions were only drawn after very large consideration.

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4. GLOSSARY OF ABBREVIATIONS AND ACRONYMS

"	Inches
%	Percent
AB	Able Bodied Seaman
BV	Bureau Veritas
C/O	Chief Officer
COT	Cargo Only Tank
IMO	International Maritime Organization
kW	Kilo Watt
m	Metre
m³	Cubic Metres
MSDS	Material Safety Data Sheet
mt	Metric Tons
Mts	Motor Tank Ship
N°	Number
PPE	Personal Protection Equipment
PS	Port Side
SB	Starboard
UTC	Universal Time Co-ordinated

5. MARINE CASUALTY INFORMATION

5.1 RESUME

Throughout this report all times are in Central European Time, UTC+2, unless specified.

On June 3rd 2021 around 06:30 hours, mts CENTRAL PARK had completed the loading of a cargo of sulphuric acid at the Sea Tank terminal, berth 322, in the port of Antwerp.
A cargo surveyor of Bureau Veritas boarded the vessel to take samples of the cargo. An AB escorted the cargo surveyor to the sampling points of the cargo tanks.
The surveyor was wearing a hazmat suit. The AB was wearing a coverall, a helmet, safety shoes, a face shield, goggles and chemical resistant gloves.

Around 09:00 hours, the surveyor was taking samples of cargo tanks N° 2, when the air blowing operation of the used cargo lines into cargo only tanks N°1 commenced.
After the Pump Man opened the gate valve at the manifold to release the pressurized air in the cargo lines, a hammering noise was heard and a mist of sulphuric acid was created at the master valve of cargo line N°1P.

At that moment, the AB that was assisting the cargo surveyor, was standing near the ship's side, at a safe distance form cargo only tank N°2 and about 10 m downwind from the master valve of cargo line N°1P.
The mist of sulphuric acid came into contact with the AB. The AB immediately ran to the emergency shower on deck to wash off the chemical product.

The AB suffered second degree burns on his back, on the back of his neck, on his arms and his face. He was transported to the hospital for medical treatment.

5.2 CLASSIFICATION OF ACCIDENT

According to Resolution A.849(20) of the IMO Assembly of 27 November 1997, Code for the investigation of Marine Casualties and Incidents, a marine casualty means an event that has resulted in any of the following:

- the death of, or serious injury to, a person that is caused by, or in connection with, the operations of a ship; or
- the loss of a person from a ship that is caused by, or in connection with, the operations of a ship; or
- the loss, presumed loss or abandonment of a ship; or
- material damage to a ship; or
- the stranding or disabling of a ship, or the involvement of a ship in a collision; or
- material damage being caused by, or in connection with, the operation of a ship; or
- damage to the environment brought about by the damage of a ship or ships being caused by, or in connection with, the operations of a ship or ships.

A serious injury means an injury which is sustained by a person in a casualty resulting in incapacitation for more than 72 hours commencing within seven days from the date of injury. Consequentially, the incident was classified as a

MARINE CASUALTY - SERIOUS INJURY

5.3 ACCIDENT DETAILS

Time and date	June 3rd 2021, 09:10 hours, UTC+2
Location	Port of Antwerp, Berth 322, Sea Tank terminal
Persons on board	23
Injured persons	1

6. SYNOPSYS

6.1 NARRATIVE

On May 31st, 2021, mts CENTRAL PARK was on her way to the port of Antwerp to load a cargo of sulphuric acid, a corrosive product, as shown in Figure 1.

Physical form	Liquid
Odour	Odourless
Colour	Colourless
Density	1.8361; 20^0 C; 98%
Melting point	-1.11^0 C – 3.0^0 C; 98%
Boiling point	310-335^0 C; 98%
Solubility	Water, miscible, exothermic
Vapor pressure	0.06 hPa; 20^0 C; 90%;
Viscosity	0.0225 Pa.s; 20^0 C; 95%
IMO Class	8, Corrosive

Figure 1 - Chemical properties of sulphuric acid

The entire Material Safety Data Sheet, MSDS, of sulphuric acid can be consulted in Annex 1.

Around 10:00 hours, a cargo operations meeting was held in the cargo control room. The meeting was organised by the Chief Officer and attended by all crew involved in cargo operations.

Later that day, around 14:00 hours, the vessel arrived at the Westhinder anchorage. The following day, June 1st, 2021, around 18:30 hours, a pilot boarded the vessel and mts CENTRAL PARK continued her voyage towards the port of Antwerp.
In the meantime, the cargo operations had been prepared. All checks as per company's "*VTC 03 Prior to Cargo Operation Check List*" were carried out. No deficiencies were reported.
A toolbox meeting was held by the Chief officer and the Master. The toolbox meeting emphasized the risks of the corrosive cargo. Further, the compliance with company procedures and the use of the required PPE were discussed.
On June 2nd at 04:40 hours, mts CENTRAL PARK safely moored at the Sea Tank terminal, berth 322, in the port of Antwerp.

Mts CENTRAL PARK was scheduled to load a cargo of approximately 18000mt of sulphuric acid, destined for the port of Jorf Lasfar, Morocco.

The cargo was to be loaded in 12 cargo only tanks, COT, N° 1, 2, 4, 5, 7 and 8. Each tank consisted out of a starboard side tank, S, and a port side tank, P, as indicated in Figure 2.

A more detailed stowage plan is consultable in Annex 2.

Tank No		Capacity (m3)	Coating
1P	X	600	STAINLESS STEEL
1S	X	602	STAINLESS STEEL
2P	X	575	STAINLESS STEEL
2S	X	564	STAINLESS STEEL
3P		1.222	STAINLESS STEEL
3S		1.233	STAINLESS STEEL
4P	X	2.453	STAINLESS STEEL
4S	X	2.439	STAINLESS STEEL
5P	X	1.012	STAINLESS STEEL
5S	X	1.023	STAINLESS STEEL
6P		2.549	STAINLESS STEEL
6S		2.548	STAINLESS STEEL
7P	X	2.010	STAINLESS STEEL
7S	X	1.998	STAINLESS STEEL
8P	X	561	STAINLESS STEEL
8S	X	562	STAINLESS STEEL

Figure 2 - Tank capacity table

At the terminal, a Loading Master oversaw the loading of the cargo. A ship/shore safety checklist was complied with by the terminal and mts CENTRAL PARK.

To load the cargo, 2 x 6” cargo hoses, supplied by the shore, were to be connected. One hose was connected to the 6” PS manifold of tank No. 4P and the other, by means of a reducer, to the PS manifold of the 12” common line, as indicated in the manifold arrangements in Figure 3. The terminal Loading Master was in radio contact with the cargo control room on board and with the Pump man on deck of mts CENTRAL PARK.

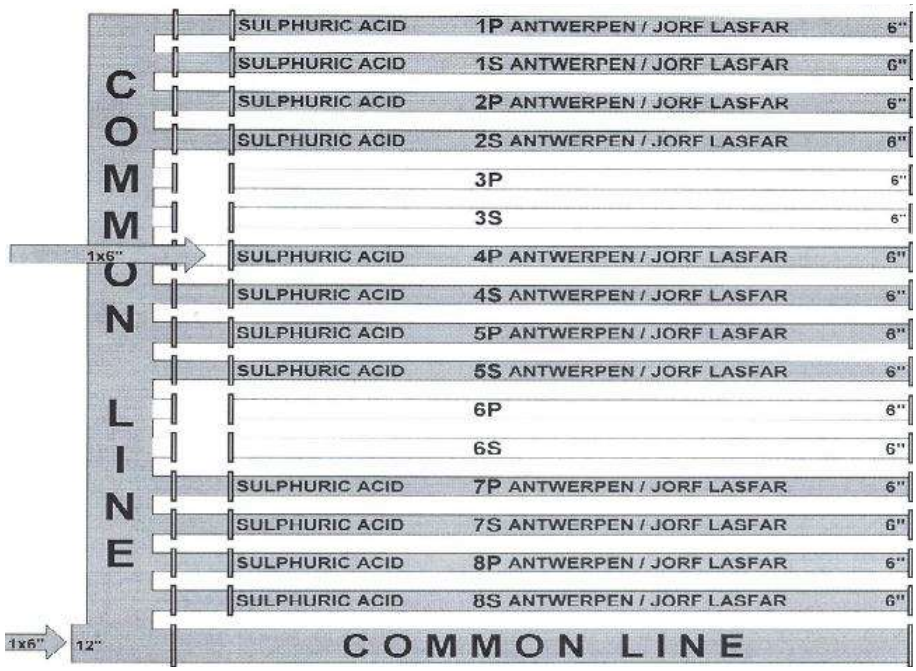


Figure 3 - Manifold arrangements

On June 2nd, around 07:40 hours, three hours after arrival, the vessel was ready to load the cargo.

On June 3rd, at 06:30 hours, the loading of the cargo was finished. A cargo surveyor of Bureau Veritas boarded the vessel to take running samples[1] of the received cargo, from each cargo only tank separately.

The running samples had to be taken through the tank's main hatch by lowering a cage with a sample bottle into the cargo and pulling it up again afterwards.

An AB was appointed to escort the cargo surveyor to the cargo only tanks. The AB was wearing a coverall, a helmet, safety shoes, a face shield, goggles and chemical resistant gloves. He was not wearing a hazmat suit, since he did not have to take the samples himself. His task was to escort the surveyor and to hand over an empty sampling bottle when asked for.

The surveyor was wearing a hazmat suit, as he had to take samples of the corrosive cargo.

At 08:30 hours, the surveyor started taking samples. At 08:50 hours, the sampling of cargo only tanks N°1S and 1P was completed, and the AB escorted the surveyor to cargo only tanks N°2 where the sampling continued. Whilst the surveyor was taking the samples from cargo only tank N°2P, the AB stayed at a safe distance from the surveyor, near the PS railing of the vessel.

[1] A running sample is obtained with an apparatus which accumulates the sample while passing in both directions through the total liquid height, excluding any free water – source: ISO 3170:2004

During the sampling of the cargo, the Chief Officer and the Officer of the Watch were inside the cargo control room, occupied with the ship's administration.

Around 09:00 hours, the terminal reported to the cargo control room that everything was in place to commence the blowing through of the 6" cargo line N°1. Because the vessel was stern trimmed upon completion of the loading of the cargo, this cargo line could not be drained by gravity.[2]

The Pump Man and one AB were sent on deck. Their task was to open the manifold valves of tank N°1, valves 1P and 1S, when the air pressure in the 12" common line was built up to 5,5 bar and to monitor tank N°1 where the cargo remnants was led into.

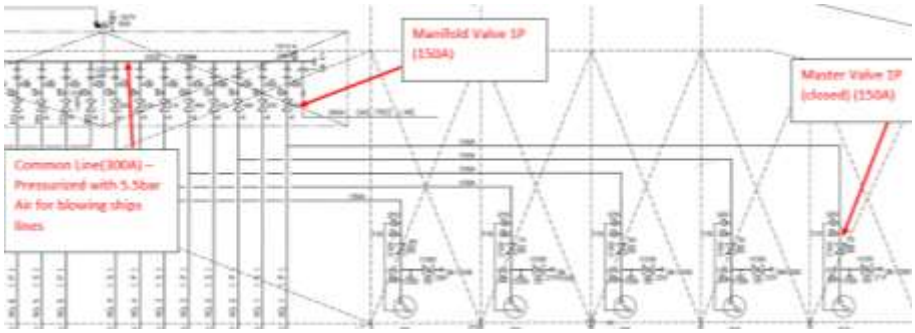


Figure 4 - Scheme with lines and valves during line blowing

It was agreed with the terminal that the air pressure should not exceed 6 bars.

Inside the cargo control room, the Officer of the Watch remotely operated the master and drop valves of cargo only tank N°1.
He informed the Chief Officer, who was present in the cargo control room, and the Pump Man on deck that the valves were put in open position.

Subsequently, the terminal started blowing compressed air into the common line. When the pressure at the manifold was built up and reached 5 bars, the Pump Man informed the cargo control room and after confirmation of the Chief Officer, the manifold valves of tank N°1 were opened by the Pump Man and the pressurized air was led into the 6" cargo line.

[2] After loading, cargo residues can be left in the cargo lines. To remove these residues, compressed air is blown through the cargo lines by the terminal. The cargo residues are blown into one of the cargo only tanks on board by means of master and drop valves that are put in the right position.

The opening of the valves was followed by a hammering noise. The Pump Man immediately opened the manifold valve of tank N°4P to release the pressure from the cargo line and informed the terminal Loading Master to stop the line blowing operation.

The Pump Man then witnessed that the AB, that was escorting the BV cargo surveyor, was running to the emergency shower station on deck. The AB was exposed to sulphuric acid.

The Pump Man alarmed the officers in the cargo control room. It was 09:10 hours when they received the emergency call from the Pump Man.

The Chief Officer contacted the terminal Loading Master to suspend the line blowing and to inform him about the emergency on deck.
Subsequently, the Chief officer went to the emergency shower to assist the injured AB.

The Officer of the Watch informed the Master.

The injured AB had taken off his contaminated coverall and water was pouring over his body when the Chief Officer arrived at the emergency station.

Figure 5 shows how the sulphuric acid degraded the tissue of the coverall.



Figure 5 - Contaminated coverall

The injured AB told the Chief Officer that he was caught in a mist of sulphuric acid while he was waiting until the cargo surveyor had taken the samples of cargo only tank N°2P.

The Chief Officer noticed that the injured AB had small burns on his back, the back of his neck, on his arms and in his face. The sight of the injured AB seemed to be ok at that moment.

The terminal Loading Master also arrived on board carrying an antidote spray. He informed the Chief Officer that an ambulance was on its way in order to transport the injured AB to a hospital.

The antidote spray was applied onto the chemically burnt skin of the AB.

The ambulance arrived at 09:30 hours. The medical team boarded the vessel and picked up the injured AB. The ambulance departed to the hospital at 10:10 hours.

After the AB was transported to the hospital, the area where the cargo had been spilled was inspected to detect the origin of the mist of sulphuric acid.

Traces of sulphuric acid were found in a wide area behind cargo only tanks N°1, as shown in Figure 6.



Figure 6 - Affected deck area

It was noted that the upper Teflon[3] gasket of the master valve of cargo only tank N°1P was damaged. The master valve of cargo only tank N°1P was found in closed position and should have been in open position during line blowing.

[3] A gasket made of polytertfluorethyleen. Teflon is a brand name, but the name “Teflon” is commonly used to describe gaskets made of polytertfluorethyleen.



Figure 7 - Master valve of cargo only tank N°1P



Figure 8 - Detail of damaged gasket

The Chief Officer pointed out the master valve of cargo only tank N°1P as the source of the spill. The WNW wind blew the particles of sulphuric acid in the direction of the vessel's stern, towards the location where the AB was standing. This location was approximately 10 m away from the master valve of cargo only tank N°1P where the spill occurred.

The crew washed away the spilled sulphuric acid with water. The contaminated water was collected on board in a separate tank. No pollution occurred.

The Teflon gasket was replaced by a new one. The damaged gasket is shown in Figure 9.

The remote operation of the valves was checked after the incident, but no anomalies were found.



Figure 9 - Damaged gasket after disassembly

At 10:30 hours, the cargo surveyor had finished the sampling of the tanks and line blowing could be re-initiated.

At 11:00 hours, line blowing was finished without further incidents and the cargo hoses were disconnected at 11:20 hours.

The vessel left the berth on June 4th 2021, at 00:33 hours, destined for Jorf Lasfar, Morocco.

7. FACTUAL INFORMATION

7.1 VESSEL'S PARTICULARS – MTS CENTRAL PARK



Figure 10 - Mts CENTRAL PARK

Picture: vesselfinder.com

Type	Chemical tanker
Flag	Liberia
Port of Registry	Monrovia
Call Sign	D5IM4
IMO N°	9725823
Keel Laid	10/2015
Shipyard	Kitanihon shipbuilding -Hachinohe, Japan
Manager	Zodiac Maritime
Gross Tonnage	12 145
Net Tonnage	6 203
Summer Deadweight	19 997 mt
Summer Draught	9,74 m
Capacity	21 960 m³
LOA	145,0 m
Beam	24.2 m
N° of Main Engines	1
Max. Engine Power	4 900 kW
Main Engine Type	AKA SAKA Diesels, 5 cylinders
Max. speed	15,3 knots

8. INJURIES

The AB had received a nebula of sulphuric acid over his back, over the back of his neck, over his arms and over his face.
The coverall that the AB was wearing is shown in Figure 11. The tissue had become wasted by the spilt sulphuric acid.

The sulphuric acid caused second degree chemical burns on 9% of the total body surface of the AB.
There were some minor burns in the face.
The medical staff in the hospital identified a small minority of the total amount of injuries as potentially resulting in scarring, however, those burns were small and did not require surgical treatment.

Ophthalmological examination on June 4th, 2021, was reassuring and normal.



Figure 11 - Coverall worn by the injured AB

9. ANALYSIS

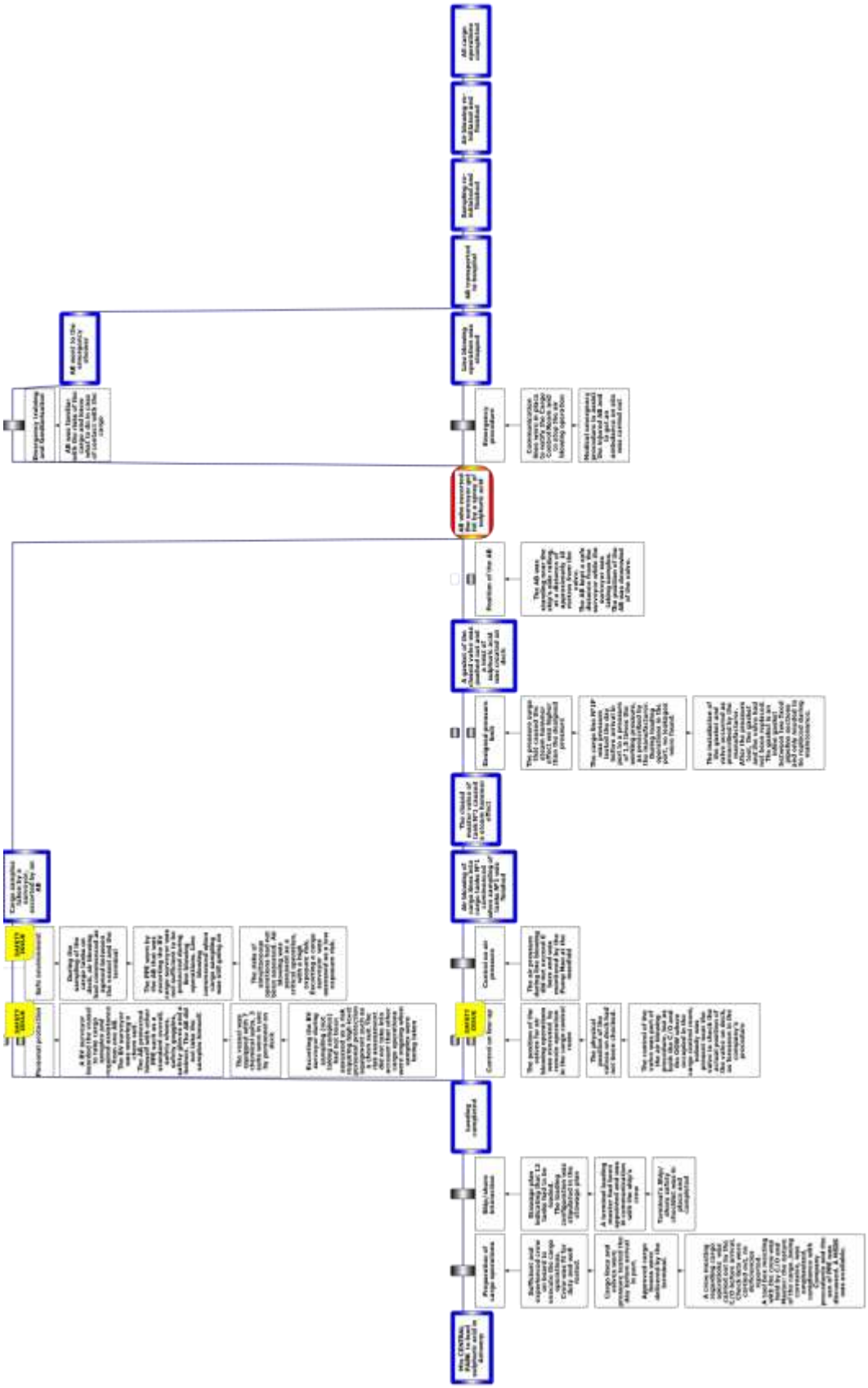
9.1 TIMELINE

Date and Time	Actor	Action
31/05/2021 10:00:00	Chief Officer	Cargo operations meeting with deck crew was carried out in Cargo Control Room
Before Arrival	mts CENTRAL PARK	All checks as per "VTC 03 Prior to Cargo Operation Check List " were carried out. No deficiencies were reported.
Before Arrival	mts CENTRAL PARK	Toolbox meeting was carried out by C/O and Master, and nature of cargo (corrosive) was emphasized, compliance with Company procedures and use of PPE was discussed
2/06/2021 4:40:00	mts CENTRAL PARK	All fast at Sea Tank terminal, Port of Antwerp
2/06/2021 7:40:00	mts CENTRAL PARK	Loading of Sulphuric Acid in 12 tanks commenced
3/06/2021 6:30:00	mts CENTRAL PARK	Loading of Sulphuric Acid completed
3/06/2021	BV Surveyor	Boarded the vessel to take final cargo samples
3/06/2021	BV Surveyor	Requested assistance to take samples
3/06/2021	AB	AB was appointed to assist the BV surveyor
3/06/2021 8:30:00	AB	AB was not wearing a hazmat suit, but was reported to be wearing overall, safety shoes, safety goggles, chemical gloves, face shield and helmet
3/06/2021 8:30:00	BV Surveyor	Started taking samples, was wearing a chem suit
3/06/2021 8:50:00	BV Surveyor	Finished sampling cargo only tanks 1W and started sampling cargo only tanks 2W
3/06/2021 8:50:00	AB	AB escorted the surveyor to cargo only tanks 2W, the AB was standing clear off the cargo sampling area
3/06/2021 9:00:00	Terminal	Requested to start line blowing operation
3/06/2021 9:00:00	Officer of watch	Present in the Cargo Control Room to assist in line blowing operation and to assist C/O with paperwork

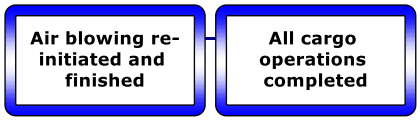
3/06/2021 9:00:00	Chief Officer	Present in the Cargo Control Room, involved in cargo documents
3/06/2021 9:00:00	Officer of watch	In radio contact with terminal and Pump man
3/06/2021 9:00:00	Pump Man	At the manifold to control the line pressure during line blowing operation and to operate valves
3/06/2021 9:00:00	Pump Man	Was wearing a hazmat suit
3/06/2021 9:00:00	Pump Man	In communication with terminal Loading Master
3/06/2021 9:00:00	2 AB assisting Pump Man	Involved in line blowing operation, wearing a chem suit
03-jun-2021	Officer of watch	Agreed with terminal to keep the maximum pressure during line blowing below 6 bars
03-jun-2021	Terminal	Agreed with OOW to keep pressure during line blowing operation below 6 bars
03-jun-2021	Chief Officer	Ordered OOW to open master and drop valves remotely
03-jun-2021	Officer of watch	Pushed the buttons to open the master and drop valves remotely and informed the C/O
03-jun-2021	Chief Officer	Asked OOW to inform Pump man about opened valves
03-jun-2021	Officer of watch	Called Pump man to inform that master and drop valves were opened
03-jun-2021	Pump Man	Confirmed that he received the message from the OOW with "OK, Noted"
03-jun-2021	Pump Man	Opened the manifold valve when the pressure at the manifold valve was 5 bar
03-jun-2021	Pump Man	Heard a "bang", a hammering noise. Opened 4P cargo only tank valve to release pressure from the common line.
03-jun-2021	Officer of watch	Continued paperwork inside Cargo Control Room
03-jun-2021	Pump Man	Ordered the terminal loading master to stop air blowing from the shore
3/06/2021 9:10:00	AB	Ran to emergency shower

3/06/2021 9:10:00	Pump Man	Saw the AB that escorted the BV surveyor running to the emergency shower and informed the cargo control room
3/06/2021 9:10:15	Chief Officer	Received a call from Pump man that AB was hit by a spray of sulphuric acid
3/06/2021 9:10:15	Chief Officer	Asked the OOW to call the Master
3/06/2021 9:10:15	Chief Officer	Informed terminal to stop line blowing operation
3/06/2021 9:10:15	Chief Officer	Requested the AB to continuously pour water on his body
3/06/2021 9:10:15	Officer of watch	Received a call from Pump man that AB was hit by a spray of sulphuric acid
3/06/2021 9:10:15	Officer of watch	Informed the Master
3/06/2021 9:10:30	Terminal	Loading master boarded with antidote spray
3/06/2021 9:10:30	Terminal	Informed the C/O that an ambulance was on the way
3/06/2021 9:10:30	Chief Officer	Went to emergency shower station for assistance and observed burns on the back and on the left arm of the injured AB
3/06/2021 9:10:30	Chief Officer	Held a conversation about the event and checked the condition of the AB
3/06/2021 9:30:00	Emergency services	Medical team arrived on board
3/06/2021 10:10:00	Chief Officer	Went to COT pump stack area to investigate what has happened and observed a damaged gasket
3/06/2021 10:10:00	Emergency services	Injured AB transported to hospital with an ambulance
3/06/2021 10:30:00	BV Surveyor	Completed sampling
3/06/2021 10:30:00	Chief Officer	Commenced blowing of cargo hose when sampling had finished
3/06/2021 11:00:00	Chief Officer	Finished blowing of cargo hose
3/06/2021 11:20:00	Pump Man	Disconnected cargo hose
4/06/2021 0:33:00	mts CENTRAL PARK	Vessel unmoored and departed to Jorf Lasfar, Morocco

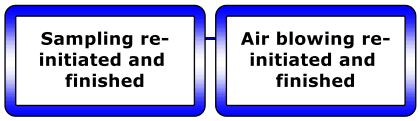
9.2 BARRIER FAILURE ANALYSES DIAGRAM (BFA) - OVERVIEW



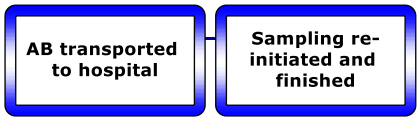
9.3 BARRIER FAILURE ANALYSIS DIAGRAM - DETAIL



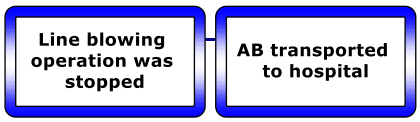
All cargo operations completed



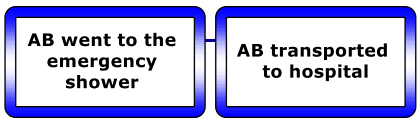
Air blowing re-initiated and finished



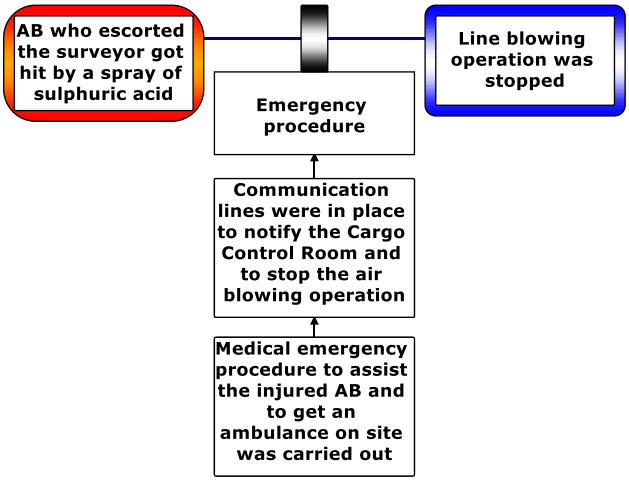
Sampling re-initiated and finished



AB transported to hospital

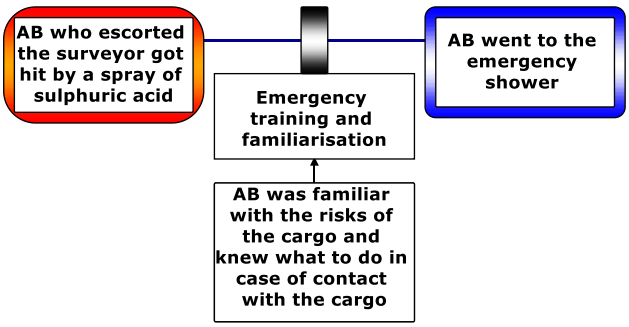


AB transported to hospital



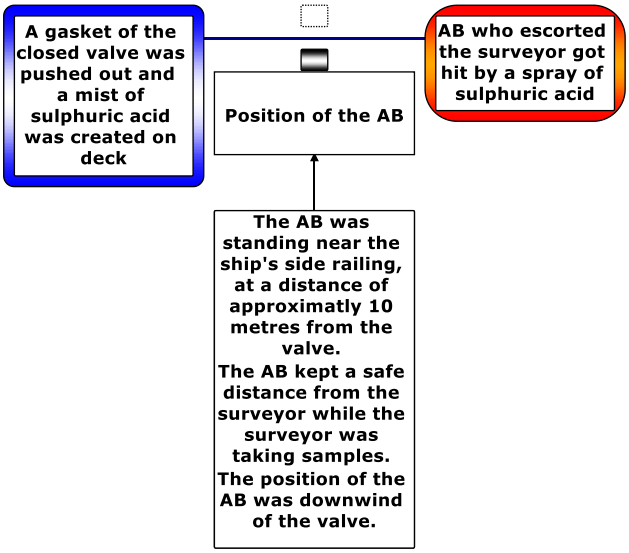
Line blowing operation was stopped

Incident Barrier	***Performance***	***Barrier Challenge***	***Remarks***
Effective	Terminal / Mts CENTRAL PARK	Intraship and ship / shore communication	Communication lines were in place to notify the Cargo Control Room and to stop the air blowing operation
Emergency Procedure	Terminal / Mts CENTRAL PARK	Medical assistance	Medical emergency procedure to assist the injured AB and to get an ambulance on site was carried out



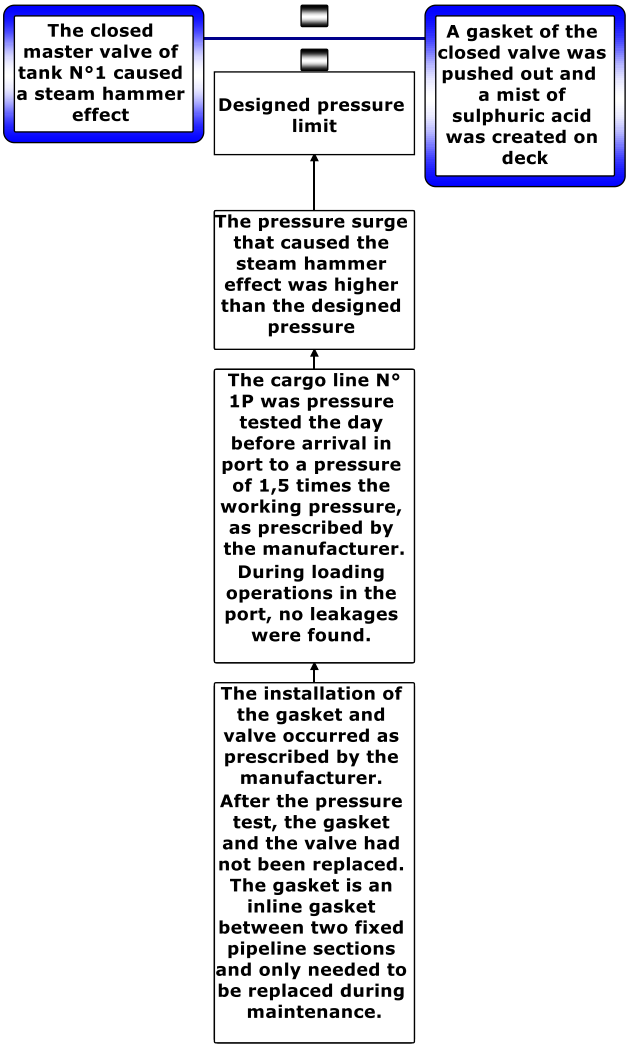
AB went to the emergency shower

Incident Barrier	***Performance***	***Barrier Challenge***	***Remarks***
Effective Emergency training and familiarisation	Crew mts CENTRAL PARK	First aid	AB was familiar with the risks of the cargo and knew what to do in case of contact with the cargo



AB who escorted the surveyor got hit by a spray of sulphuric acid

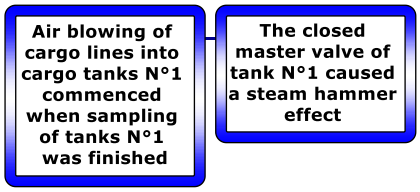
Incident Barrier	***Performance***	***Barrier Challenge***	***Remarks***
Inadequate Position of the AB	AB	Safe distance	The AB was standing near the ship's side railing, at approximately 10 metres from the valve. The AB kept a safe distance from the surveyor while the surveyor was taking samples. The position of the AB was downwind of the valve.



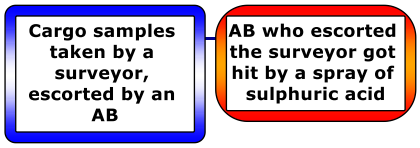
A gasket of the closed valve was pushed out and a mist of sulphuric acid was created on deck

Incident Barrier	***Performance***	***Barrier Challenge***	***Remarks***
Failed Designed pressure limits	Operational	Design	The pressure surge that caused the steam hammer effect was higher than the designed pressure
	Mts CENTRAL PARK	Test and inspection	The cargo line N°1P was pressure tested the day before arrival in port to a pressure of 1,5 times the working pressure, as prescribed by the manufacturer. During loading operations in the port, no leakages were found.
	Mts CENTRAL PARK	Installation and maintenance	The installation of the gasket and valve occurred as prescribed by the

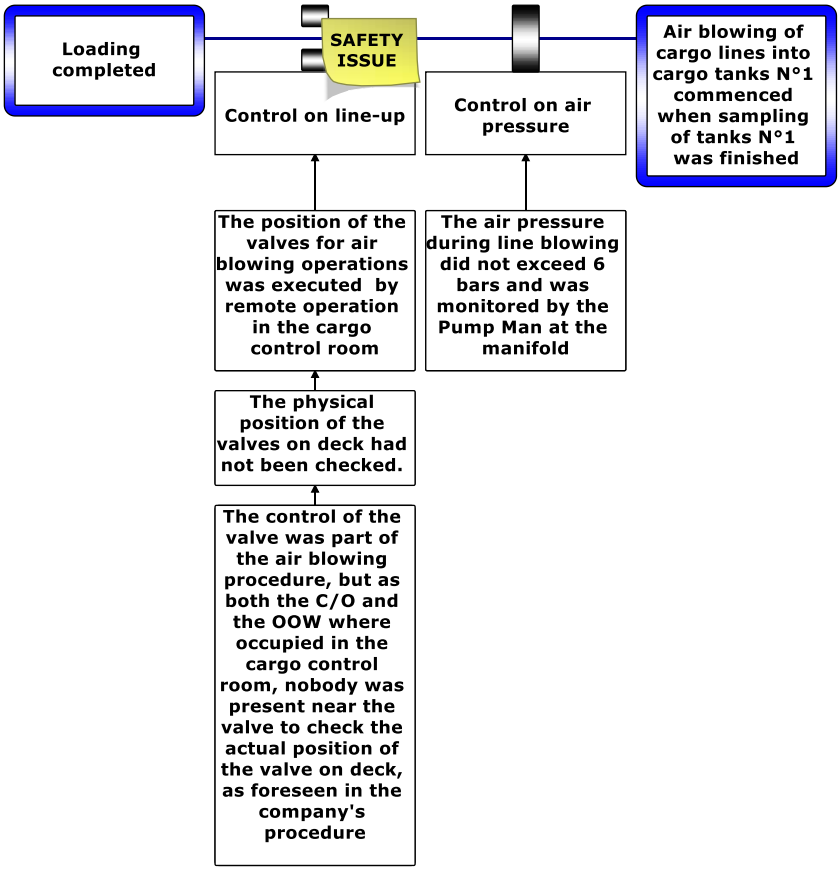
			manufacturer. After the pressure test, the gasket and the valve had not been replaced. The gasket is an inline gasket between two fixed pipeline sections and only needed to be replaced during maintenance.



The closed master valve of tank N°1 caused a steam hammer effect



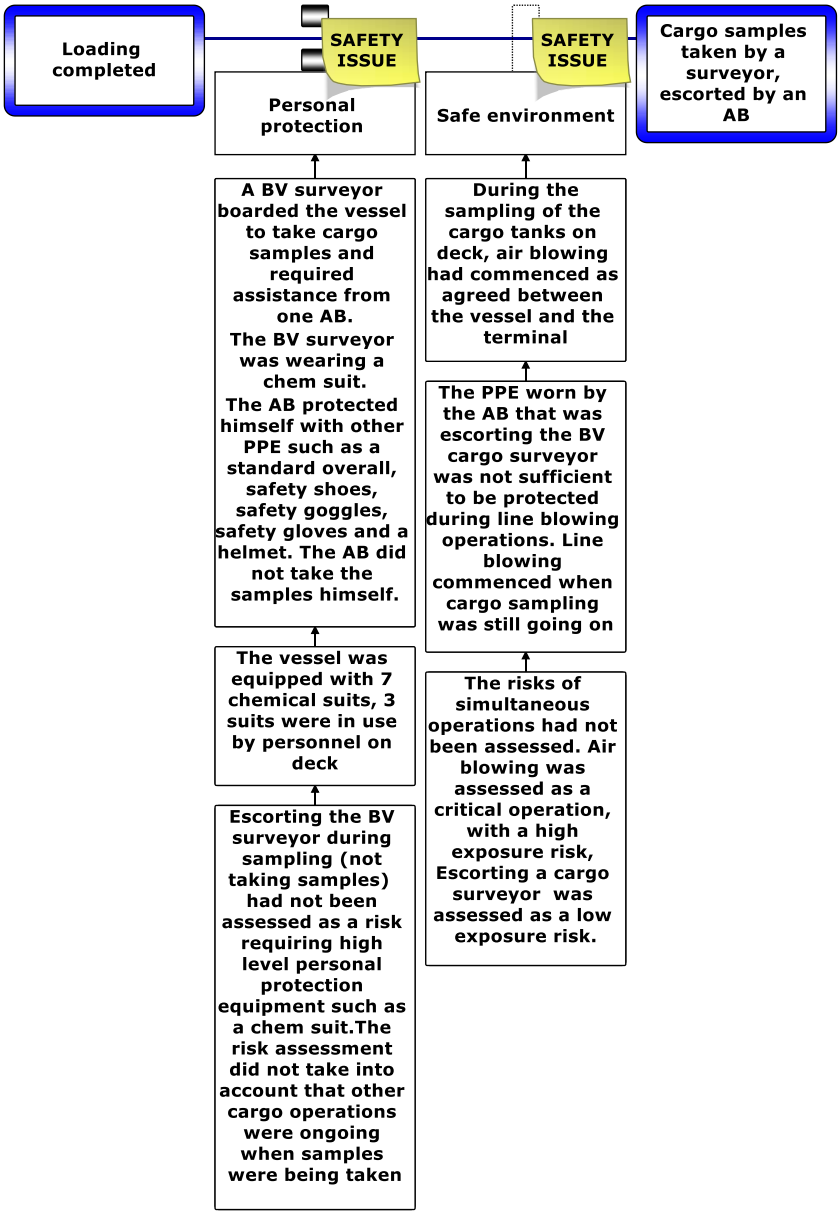
AB who escorted the surveyor got hit by a spray of sulphuric acid



Air blowing of cargo lines into cargo tanks N°1 commenced when sampling of tanks N°1 was finished

Incident Barrier **Failed**	***Performance***	***Barrier Challenge***	***Remarks***
Control on line-up	Mts CENTRAL PARK	Valve operation	The position of the valves for air blowing operations was executed by remote operation in the cargo control room
	Mts CENTRAL PARK	Control on valve position	The physical position of the valves on deck had not been checked
	Mts CENTRAL PARK	Planning of resources	The control of the valve was part of the air blowing procedure, but as both the C/O and the OOW were occupied in the cargo control room, nobody was present near the valve to check the actual position of the valve on deck, as foreseen in the company's procedure

Incident Barrier **Effective** Control on air pressure	***Performance***	***Barrier Challenge***	***Remarks***
	Mts CENTRAL PARK	Safe pressure	The air pressure during line blowing did not exceed 6 bars and was monitored by the Pump Man at the manifold

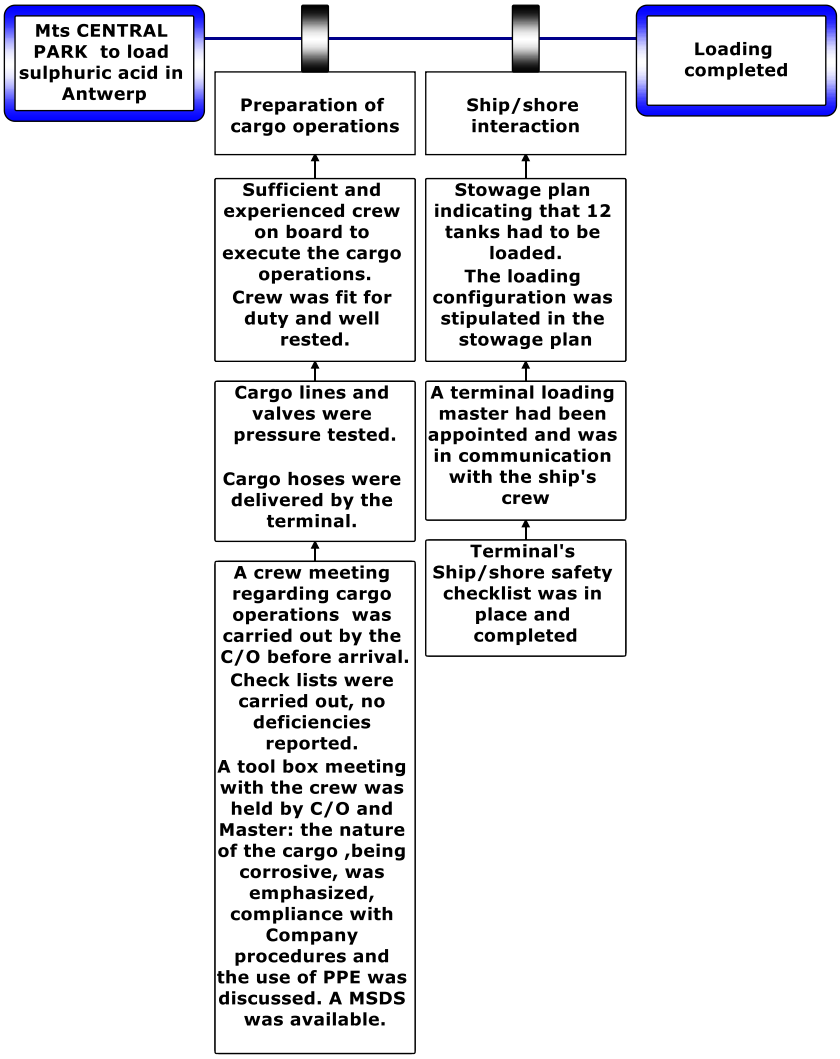


Cargo samples taken by a surveyor, escorted by an AB

Incident Barrier	***Performance***	***Barrier Challenge***	***Remarks***
Failed Personal protection	Mts CENTRAL PARK	PPE	A BV surveyor boarded the vessel to take cargo samples and required assistance from one AB. The BV surveyor was wearing a chem suit. The AB protected himself with other PPE such as a standard overall, safety shoes, safety goggles, safety gloves and a helmet. The AB did not take the samples himself.

	Mts CENTRAL PARK / Company	Availability of PPE	The vessel was equipped with 7 hazmat suits, 3 suits were in use by personnel on deck
	Company	Risk assessment	Escorting the BV surveyor during sampling (not taking samples) had not been assessed as a risk requiring high level personal protection equipment such as a chem suit. The risk assessment did not consider that other cargo operations were ongoing when samples were being taken

Incident Barrier	***Performance***	***Barrier Challenge***	***Remarks***
Missing	Mts CENTRAL PARK	Planning of operations	During the sampling of the cargo tanks on deck, air blowing had commenced as agreed between the vessel and the terminal
Safe Environment	Mts CENTRAL PARK	PPE	The PPE worn by the AB that was escorting the BV cargo surveyor was not sufficient to be protected during line blowing operations. Line blowing commenced when cargo sampling was still going on
	Company	Risk assessment	The risks of simultaneous operations had not been assessed. Air blowing was assessed as a critical operation, with a high exposure risk, escorting a cargo surveyor was assessed as a low exposure risk.



Loading completed

Incident Barrier	***Performance***	***Barrier Challenge***	***Remarks***
Effective Preparation of cargo operations	Mts CENTRAL PARK	Resources	Sufficient and experienced crew on board to execute the cargo operations. Crew was fit for duty and well rested.
	Mts CENTRAL PARK / Terminal	Material	Cargo lines and valves were pressure tested. Cargo hoses were delivered by the terminal.
	Mts CENTRAL PARK / Company	Information to crew	A crew meeting regarding cargo operations was carried out by the C/O before arrival. Check lists were carried out, no

			deficiencies reported. A toolbox meeting with the crew was held by C/O and Master: the nature of the cargo, being corrosive, was emphasized, compliance with Company procedures and the use of PPE was discussed. A MSDS was available.

Incident Barrier	***Performance***	***Barrier Challenge***	***Remarks***
Missing Ship / Shore interaction	Mts CENTRAL PARK	Planning	Stowage plan indicating that 12 tanks had to be loaded. The loading configuration was stipulated in the stowage plan
	Terminal	Communication	A terminal loading master had been appointed and was in communication with the ship's crew
	Mts CENTRAL PARK / Terminal	Agreements	Terminal's Ship/shore safety checklist was in place and completed

10. CAUSE OF THE ACCIDENT

1. The spill of sulphuric acid on board mts CENTRAL PARK occurred because the closed master valve of cargo line N°1P caused a steam hammer effect when pressurized air was released into the partly filled cargo line.
   The nuts of the bolts that tightened the gasket most probably slipped as a consequence of the steam hammer effect and this resulted in the Teflon gasket being pushed out during the line blowing operation.

2. The AB, that escorted the surveyor, was standing in the vicinity and downwind of the cargo line that had to be drained.
   The line blowing operation was carried out when the cargo sampling was still ongoing.
   The planning of the line blowing operation at the same time and in the vicinity of the location where samples were being taken, resulted in the exposure of the AB to the spilled cargo.

10.1 CONTRIBUTING FACTORS

1. During line blowing operations, the involved crew on deck was wearing a hazmat suit. The coverall worn by the AB that escorted the surveyor was not resistant against corrosives. The type of coverall contributed to the amount and severity of chemical burns.

2. The attention during the preparation of the line blowing operation was distracted by paperwork. This led to:
   - Insufficient personnel on deck to occupy all stations as prescribed in the company's procedures;
   - No delegation of tasks to overcome the tasks of the missing persons on deck;
   - No verification of the indicator of the position of the valve inside the cargo control room after remote operation of the valves.
     No technical failure regarding the remote control of the valve was detected before or after the incident.

   The result was the main valve of cargo line N°1P that remained in closed position when the pressurized air was released into the partly filled cargo line.

11. SAFETY ISSUES

1. A high exposure risk task, line blowing, and a low exposure risk task, escorting the cargo surveyor, were executed at the same time and in vicinity of each other. Both tasks required another level of PPE on board. No risk assessment or company procedure was in place to determine the conditions to simultaneously execute both operations.

2. Different levels of PPE for cargo related activities were defined on board, as shown in Figure 12. The use of the different PPE was explained in a PPE matrix that was available on board. As various types of cargoes could be transported by the chemical tanker, the required level of PPE was not always clear.
   A coverall could only be worn if no contact at all with corrosive cargo was possible.
   Escorting the cargo surveyor during sampling involved the carriage of sampling equipment and required a higher level of PPE than a coverall.



Figure 12 - Levels of PPE

3. The company procedure considered line blowing as a quick, but critical stage in the cargo operation. On board, the attention was distracted to cargo documentation during the planning and execution of line blowing. The company procedure regarding the critical line blowing operations was not fully implemented on board the vessel.

12. ACTIONS TAKEN

The company:

- ✓ Renewed and updated the PPE matrix to highlight the different levels of PPE for different cargoes and different operations;

- ✓ Carried out a briefing for the Master and the Chief Officer, organised by the QHSE manager and the QHSE superintendent. During the briefing following topics were highlighted:

    - Critical stages during cargo operations must be properly evaluated for the risks involved and required personnel must be in accordance with company cargo watch composition;
    - Planning of simultaneous operations, especially during a critical operation, must be properly evaluated, based on risk assessments and taking into consideration the personnel available;
    - During line blowing operations, one senior officer must be in charge and a deck officer should be on deck to supervise the operation. The operation must be conducted as per documented company guidelines for disposition of personnel.

- ✓ Carried out an extensive onboard cargo training during a sailing voyage for all crew involved in cargo operations.
  The training included, but was not limited to:
    - The discussion of the accident;
    - The effectiveness of manning levels and efficient supervision during cargo operations;
    - Training regarding line blowing and cargo sampling;
    - The introduction and explanation of the new PPE matrix.

- ✓ Circulated the accident report within the tanker fleet to avoid reoccurrence.

The terminal:

- ✓ Analysed the accident and evaluated the terminal risk analysis for loading operations. No adaptations were deemed necessary;
- ✓ Developed a toolbox to discuss with the crew of visiting vessels, stating that:
    - A hazmat suit is required during coupling, purging and sampling
    - Cargo operations and sampling must not to be carried out simultaneously
- ✓ Adapted the ship/shore safety checklist according to the information in the toolbox

13. ANNEXES

sulfuric acid, conc=93-99.5%

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Tessinerplatz 7
CH-8002 Zürich
☎ +41 44 745 81 00
🖷 +41 44 745 81 10
infoSDS@nyrstar.com

1.4. Emergency telephone number

24h/24h (Telephone advice: English, French, German, Dutch):
+32 14 58 45 45 (BIG)

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture

Classified as dangerous according to the criteria of Regulation (EC) No 1272/2008

Class	Category	Hazard statements
Skin Corr.	category 1A	H314: Causes severe skin burns and eye damage.

2.2. Label elements



Signal word Danger

H-statements

H314 Causes severe skin burns and eye damage.

P-statements

P280 Wear protective gloves, protective clothing and eye protection/face protection.

P260 Do not breathe vapours/mist.

P304 + P340 IF INHALED: Remove person to fresh air and keep comfortable for breathing.

P303 + P361 + P352 IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse simultaneously with neutralizing agent Diphoterine or equivalent neutralizing agent. Use complete bottle. Rinse under emergency shower for 1 to 2 minutes and continue rinsing under regular shower for 10 minutes with water at 35-36°C

P310 Immediately call a POISON CENTER/doctor.

P305 + P351 + P338 IF IN EYES: Rinse cautiously with neutralization agent Diphoterine or equivalent neutralizing agent for several minutes and continue rinsing with water for 10 minutes. Remove contact lenses, if present and easy to do. Continue rinsing.

P301 + P330 + P331 IF SWALLOWED: rinse mouth. Do NOT induce vomiting.

2.3. Other hazards

Strong inorganic acid mists containing sulfuric acid are carcinogenic to humans

SECTION 3: Composition/information on ingredients

3.1. Substances

Name REACH Registration No	CAS No EC No	Conc. (C)	Classification according to CLP	Note	Remark
sulfuric acid, conc=93-99.5% 01-2119458838-20	7664-93-9 231-639-5	93%<=C <=99.5%	Skin Corr. 1A; H314	(1)(2)(10)	Mono-constituent

(1) For H-statements in full: see heading 16
(2) Substance with a Community workplace exposure limit
(10) Subject to restrictions of Annex XVII of Regulation (EC) No. 1907/2006

3.2. Mixtures

Not applicable

SECTION 4: First aid measures

4.1. Description of first aid measures

General:

Check the vital functions. Unconscious: maintain adequate airway and respiration. Respiratory arrest: artificial respiration or oxygen. Cardiac arrest: perform resuscitation. Victim conscious with laboured breathing: half-seated. Victim in shock: on his back with legs slightly raised. Vomiting: prevent asphyxia/aspiration pneumonia. Prevent cooling by covering the victim (no warming up). Keep watching the victim. Give psychological aid. Keep the victim calm, avoid physical strain. Depending on the victim's condition: doctor/hospital.

After inhalation:

Remove the victim into fresh air. Respiratory problems: consult a doctor/medical service.

After skin contact:

Take off immediately all contaminated clothing and simultaneously rinse with neutralizing agent (BUMB, Diphoterine or equivalent neutralizing agent). Use complete bottle. Continue rinsing under emergency shower for 1 to 2 minutes and continue rinsing under regular shower for 10 minutes with water at 35-36°C. Do not remove clothing if it sticks to the skin. Cover wounds with sterile bandage. Consult a doctor/medical service. If burned surface > 10%: take victim to hospital.

After eye contact:

Remove contact lenses, if present and easy to do. Continue rinsing. Rinse cautiously with neutralization agent (BUMB, Diphoterine or equivalent neutralizing agent) for several minutes and continue rinsing with plenty of water during 10 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Take victim to an ophthalmologist.

After ingestion:

Rinse mouth with water. Immediately after ingestion: give small amount of water to drink. Do not induce vomiting. Do not give activated charcoal. Do not give chemical antidote. Immediately consult a doctor/medical service.

4.2. Most important symptoms and effects, both acute and delayed

4.2.1 Acute symptoms

After inhalation:

Dry/sore throat. Coughing. Irritation of the respiratory tract. Irritation of the nasal mucous membranes. ON CONTINUOUS EXPOSURE/CONTACT: Corrosion of the upper respiratory tract. FOLLOWING SYMPTOMS MAY APPEAR LATER: Possible laryngeal spasm/oedema. Risk of pneumonia. Risk of lung oedema. Respiratory difficulties.

After skin contact:

Caustic burns/corrosion of the skin.

After eye contact:

Corrosion of the eye tissue. Permanent eye damage.

After ingestion:

Nausea. Abdominal pain. Blood in stool. Blood in vomit. Burns to the gastric/intestinal mucosa. AFTER INGESTION OF HIGH QUANTITIES: Shock.

4.2.2 Delayed symptoms

No effects known.

4.3. Indication of any immediate medical attention and special treatment needed

If applicable and available it will be listed below.

SECTION 5: Firefighting measures

5.1. Extinguishing media

5.1.1 Suitable extinguishing media:

Adapt extinguishing media to the environment.

5.1.2 Unsuitable extinguishing media:

Water.

5.2. Special hazards arising from the substance or mixture

On burning: release of toxic and corrosive gases/vapours (sulphur oxides). Violent exothermic reaction with water (moisture): release of corrosive gases/vapours.

5.3. Advice for firefighters

5.3.1 Instructions:

Cool tanks/drums with water spray/remove them into safety. When cooling/extinguishing: no water in the substance. Dilute toxic gases with water spray. Heat exposure: dilute toxic gas/vapour with water spray. Take account of toxic/corrosive precipitation water.

5.3.2 Special protective equipment for fire-fighters:

Gloves. Face-shield. Corrosion-proof suit. Large spills/in enclosed spaces: compressed air apparatus. Large spills/in enclosed spaces: gas-tight suit. Heat/fire exposure: compressed air/oxygen apparatus.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

No naked flames. Keep containers closed. Avoid ingress of water in the containers. Large spills/in confined spaces: consider evacuation.

6.1.1 Protective equipment for non-emergency personnel

See heading 8.2

6.1.2 Protective equipment for emergency responders

Gloves. Face-shield. Corrosion-proof suit. Large spills/in enclosed spaces: compressed air apparatus. Large spills/in enclosed spaces: gas-tight suit.

Suitable protective clothing

See heading 8.2

6.2. Environmental precautions

Contain released product, pump into suitable containers. Plug the leak, cut off the supply. Dam up the liquid spill. Prevent soil and water pollution. Prevent spreading in sewers.

6.3. Methods and material for containment and cleaning up

Neutralize spill with lime, sodium bicarbonate, soda (sodium carbonate) or soda ash. Neutralized substance: shovel into closing drums. Carefully collect the spill/leftovers. Damaged/cooled tanks must be emptied. Clean contaminated surfaces with an excess of water. Take collected spill to manufacturer/competent authority. Wash clothing and equipment after handling.

6.4. Reference to other sections

See heading 13.

SECTION 7: Handling and storage

The information in this section is a general description. If applicable and available, exposure scenarios are attached in annex. Always use the relevant exposure scenarios that correspond to your identified use.

7.1. Precautions for safe handling

Keep away from naked flames/heat. Gas/vapour heavier than air at 20°C. Observe very strict hygiene - avoid contact. Keep container tightly closed. Remove contaminated clothing immediately. Do not discharge the waste into the drain. Never add water to this product. Never dilute by pouring water to the acid. Always add the acid to the water.

7.2. Conditions for safe storage, including any incompatibilities

7.2.1 Safe storage requirements:

Store in a dry area. Ventilation at floor level. Keep locked up. Protect against frost. Store at ambient temperature. Provide for a tub to collect spills. Unauthorized persons are not admitted. Under a shelter/in the open. Aboveground. Keep only in the original container. Store only in a limited quantity. Meet the legal requirements.

7.2.2 Keep away from:

Heat sources, combustible materials, reducing agents, (strong) bases, metals, cellulosic materials, organic materials, oxidizing agents, alcohols, amines, water/moisture.

7.2.3 Suitable packaging material:

Carbon steel, polyethylene, polypropylene, glass, stoneware/porcelain.

7.2.4 Non suitable packaging material:

Monel steel, lead, aluminium, iron, copper, zinc, nickel, bronze.

7.3. Specific end use(s)

If applicable and available, exposure scenarios are attached in annex. See information supplied by the manufacturer.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

8.1.1 Occupational exposure

a) Occupational exposure limit values

If limit values are applicable and available these will be listed below.

EU

Sulphur dioxide	Short time value (Indicative occupational exposure limit value)	1 ppm
Sulphuric acid (mist)	Time-weighted average exposure limit 8 h (Indicative occupational exposure limit value)	0.05 mg/m³

Belgium

Acide sulfurique (brume)	Time-weighted average exposure limit 8 h	0.2 mg/m³
Soufre (dioxyde de)	Time-weighted average exposure limit 8 h	2 ppm
	Time-weighted average exposure limit 8 h	5.3 mg/m³
	Short time value	5 ppm
	Short time value	13 mg/m³

The Netherlands

Zwaveldioxide	Short time value (Public occupational exposure limit value)	0.26 ppm
	Short time value (Public occupational exposure limit value)	0.7 mg/m³
Zwavelzuur (nevel), gedefinieerd als de thoracale fractie	Time-weighted average exposure limit 8 h (Public occupational exposure limit value)	0.012 ppm
	Time-weighted average exposure limit 8 h (Public occupational exposure limit value)	0.05 mg/m³

France

Acide sulfurique, fraction thoracique	Time-weighted average exposure limit 8 h (VRI: Valeur réglementaire indicative)	0.05 mg/m³
	Short time value (VL: Valeur non réglementaire indicative)	3 mg/m³

Soufre (dioxyde de)	Time-weighted average exposure limit 8 h (VL: Valeur non réglementaire indicative)	2 ppm
	Time-weighted average exposure limit 8 h (VL: Valeur non réglementaire indicative)	5 mg/m³
	Short time value (VL: Valeur non réglementaire indicative)	5 ppm
	Short time value (VL: Valeur non réglementaire indicative)	10 mg/m³

Germany

Schwefeldioxid	Time-weighted average exposure limit 8 h (TRGS 900)	1 ppm
	Time-weighted average exposure limit 8 h (TRGS 900)	2.7 mg/m³
Schwefelsäure	Time-weighted average exposure limit 8 h (TRGS 900)	0.1 mg/m³

UK

Sulphuric acid (mist)	Time-weighted average exposure limit 8 h (Workplace exposure limit (EH40/2005))	0.05 mg/m³

USA (TLV-ACGIH)

Sulfur dioxide	Short time value (TLV - Adopted Value)	0.25 ppm
Sulfuric acid	Time-weighted average exposure limit 8 h (TLV - Adopted Value)	0.2 mg/m³ (T)

(T): Thoracic fraction

b) National biological limit values

If limit values are applicable and available these will be listed below.

8.1.2 Sampling methods

Product name	Test	Number
NON-VOLATILE ACIDS (Sulfuric Acid)	NIOSH	7908
Sulfur Dioxide (organic and inorganic gases by Extractive FTIR)	NIOSH	3800
Sulfur Dioxide	NIOSH	6004
Sulfur Dioxide	OSHA	1011
Sulfur Dioxide	OSHA	ID 104
Sulfur Dioxide	OSHA	ID 200
Sulfuric Acid	NIOSH	7903
Sulfuric Acid	OSHA	ID 113
Sulfuric Acid	OSHA	ID 165SG

8.1.3 Applicable limit values when using the substance or mixture as intended

If limit values are applicable and available these will be listed below.

8.1.4 DNEL/PNEC values

DNEL/DMEL - Workers

sulfuric acid, conc=93-99.5%

Effect level (DNEL/DMEL)	Type	Value	Remark
DNEL	Long-term local effects inhalation	0.05 mg/m³	
	Acute local effects inhalation	0.1 mg/m³	
	Acute local effects inhalation	2.7 mg/m³	SO2
	Long-term local effects inhalation	1.3 mg/m³	SO2

DNEL/DMEL - General population

sulfuric acid, conc=93-99.5%

Effect level (DNEL/DMEL)	Type	Value	Remark
DNEL	Long-term local effects inhalation	0.53 mg/m³	SO2

PNEC

sulfuric acid, conc=93-99.5%

Compartments	Value	Remark
Fresh water	0.003 mg/l	
Marine water	0.00025 mg/l	
STP	8.8 mg/l	
Fresh water sediment	0.002 mg/kg sediment dw	
Marine water sediment	0.002 mg/kg sediment dw	

8.1.5 Control banding

If applicable and available it will be listed below.

8.2. Exposure controls

The information in this section is a general description. If applicable and available, exposure scenarios are attached in annex. Always use the relevant exposure scenarios that correspond to your identified use.

8.2.1 Appropriate engineering controls

Keep away from naked flames/heat. Measure the concentration in the air regularly. Carry operations in the open/under local exhaust/ventilation or with respiratory protection.

8.2.2 Individual protection measures, such as personal protective equipment

Observe very strict hygiene - avoid contact. Keep container tightly closed. Do not eat, drink or smoke during work.

a) Respiratory protection:

Gas mask with filter type E, at concentrations in air higher than the exposure limit for sulfur dioxide (SO2). Dust/aerosol mask with filter type P3 at concentrations in air higher than the exposure limit for sulfuric acid (H2SO4).

b) Hand protection:

Gloves.

Materials	Breakthrough time	Thickness
butyl rubber	> 120 minutes	0.5 mm
viton	> 480 minutes	0.4 mm

- materials (poor resistance)

Natural rubber, nitrile rubber, chloroprene rubber, leather.

c) Eye protection:

Face shield. Protective goggles.

d) Skin protection:

Corrosion-proof clothing.

8.2.3 Environmental exposure controls:

See headings 6.2, 6.3 and 13

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Physical form	Liquid
Odour	Odourless
Odour threshold	Not applicable
Colour	Colourless to brown
Particle size	Not applicable (liquid)
Explosion limits	Not applicable
Flammability	Non combustible
Log Kow	Not relevant
Dynamic viscosity	0.0225 Pa.s ; 20 °C ; 95 %
Kinematic viscosity	Not determined
Melting point	10.4 °C - 10.9 °C ; 100 %
	-1.11 °C - 3.0 °C ; 98 %
	-13.89 °C - -10 °C ; 96 %
	7.56 °C ; 83 %
Boiling point	290 °C ; 100 %
	310 °C - 335 °C ; 98 %
	330 °C ; 96 %
Flash point	Not applicable
Evaporation rate	No data available
Relative vapour density	3.4
Vapour pressure	0.06 hPa ; 20 °C ; 90 %
Solubility	Water ; miscible
Relative density	1.8305 ; 20 °C ; 100 %
	1.8361 ; 20 °C ; 98 %
	1.8355 ; 20 °C ; 96 %
	1.8144 ; 20 °C ; 90 %
Decomposition temperature	No data available
Auto-ignition temperature	Not applicable
Explosive properties	No chemical group associated with explosive properties
Oxidising properties	No chemical group associated with oxidising properties
pH	No data available

9.2. Other information

Absolute density	1830.5 kg/m³ ; 20 °C

SECTION 10: Stability and reactivity

10.1. Reactivity

Substance has acid reaction.

10.2. Chemical stability

Unstable on exposure to moisture.

10.3. Possibility of hazardous reactions

Violent exothermic reaction with water (moisture): release of corrosive gases/vapours. Reacts with many compounds: (increased) risk of fire/explosion. Reacts exothermically with organic material: risk of spontaneous ignition. Reacts violently with combustible materials: (increased) risk of fire/explosion. Reacts violently with (some) bases: heat release resulting in increased fire or explosion risk. Reacts with (strong) reducers: (increased) risk of fire/explosion.

10.4. Conditions to avoid

Keep away from naked flames/heat.

10.5. Incompatible materials

Combustible materials, reducing agents, (strong) bases, metals, cellulosic materials, organic materials, oxidizing agents, alcohols, amines, water/moisture.

10.6. Hazardous decomposition products

Aqueous solution reacts with (some) metals: release of highly flammable gases/vapours (hydrogen). On burning: release of toxic and corrosive gases/vapours (sulphur oxides).

SECTION 11: Toxicological information

11.1. Information on toxicological effects

11.1.1 Test results

- Toxicokinetics: summary

Basic toxicokinetics: The effects of sulphuric acid are essentially the result of the hydrogen ion (local deposition of H+, pH change) rather than an effect of the sulphate ion. Sulphuric acid (as such) is not expected to be absorbed or distributed throughout the body as the acid will rapidly dissociate; the hydrogen ion will form water. The sulphate anion will enter the body electrolyte pool, its kinetics will be governed by sulphate homeostatic mechanisms, and is therefore not predicted play a specific toxicological role. This supposition is supported by experiments which have studied the active component in inorganic acids on various endpoints, using different acids or salts. The results of these studies lead to the conclusion that the observed effects are due to the hydrogen ion, while the anion appeared to have no effect.

In a study of the clearance of radiolabeled sulphuric acid aerosol in different species, the authors observed that the sulphur from sulphuric acid was rapidly cleared (from 2 -9 minutes) from the lungs of animals into the blood following inhalation exposure (Dahl, 1983). Sulphate is a normal constituent of the blood (present at 0.8 -1.2 mg/dl) and is a normal metabolite of sulphur-containing amino acids. The body has efficient sulphate homeostatic mechanisms and excess sulphate is excreted in the urine (capacity-limited proximal tubular absorption); urinary sulphate concentrations of up to 500 umol/dl/kg bw have been reported. The body pool of this anion is large, and it is therefore unlikely that occupational exposure will significantly add to the normal body burden.

Systemic absorption of the hydrogen ion following dermal or inhalation exposure to sulphuric acid is not predicted to be significant, and the low level of hydrogen ions absorbed will be effectively controlled by the homeostatic mechanisms governing pH including the action of the enzyme carbonic anhydrase and NA+/H+ exchange in the proximal renal tubule. Although acidaemia and metabolic acidosis have been noted following cases of ingestion exposure, similar effects are not predicted following occupational inhalation exposure (which will be much lower and effectively limited by respiratory tract irritation) or following dermal exposure (due to low dermal absorption and local dermal irritation).

The deposition of sulphuric particles in the human lung has been studied extensively. Deposition is influenced by subject age, particle size and breathing rate. Sulphuric acid particles are hygroscopic and therefore will absorb moisture present in the airways, thereby increasing particle size and potentially increasing particle retention. Respiratory mucus has a limited buffering capacity and may reduce tissue contact.
The absence of systemic effects in the large number of toxicity studies performed with sulphuric acid is consistent with this assessment of its toxicokinetics.

The following information is taken into account for any hazard / risk assessment: Primary information is limited to a study of the absorption and kinetics of radiolabelled sulphate following the inhalation of sulphuric acid aerosols. Sulphuric acid immediately dissociates to the hydrogen and sulphate ions, with the hydrogen ion being responsible for the local toxicity (irritation and corrosivity) of sulphuric acid.

Dermal absorption: No dermal absorption is predicted under normal conditions of use, based on the physicochemical properties of the substance. However dermal absorption may occur when the integrity of the skin is lost (i. e. in accidental exposures resulting in burns).
The following information is taken into account for any hazard / risk assessment: No studies are proposed for scientific reasons and (given the corrosive nature of the substance), also reasons of animal welfare. No dermal absorption is predicted under normal conditions of use, based on the physicochemical properties of the substance.

Acute toxicity

sulfuric acid, conc=93-99.5%

Route of exposure	Parameter	Method	Value	Exposure time	Species	Value determination	Remark
Oral	LD50	Equivalent to OECD 401	2140 mg/kg		Rat (male/female)	Experimental value	
Dermal						Not relevant, expert judgement	

Inhalation (aerosol)	LC50	Equivalent to OECD 403	375 mg/m³ air		Rat (male/female)	Experimental value	

Conclusion

Not classified for acute toxicity

Corrosion/irritation

sulfuric acid, conc=93-99.5%

Route of exposure	Result	Method	Exposure time	Time point	Species	Value determination	Remark
Eye	Highly corrosive					Literature	
Skin	Highly corrosive					Literature	

Conclusion

Causes severe skin burns and eye damage.

Respiratory or skin sensitisation

sulfuric acid, conc=93-99.5%

No (test)data available

Conclusion

Not classified as sensitizing for skin

Not classified as sensitizing for inhalation

Specific target organ toxicity

sulfuric acid, conc=93-99.5%

Route of exposure	Parameter	Method	Value	Organ	Effect	Exposure time	Species	Value determination
Inhalation (aerosol)	LOAEC	OECD 412	0.3 mg/m³ air	Respiratory tract		4 weeks (6h/day, 5 days/week)	Rat (female)	Experimental value

Conclusion

Not classified for subchronic toxicity

Mutagenicity (in vitro)

sulfuric acid, conc=93-99.5%

Result	Method	Test substrate	Effect	Value determination
Negative	Equivalent to OECD 471	Bacteria (S.typhimurium)		Weight of evidence
Positive	Equivalent to OECD 473	Chinese hamster ovary (CHO)		Weight of evidence

Mutagenicity (in vivo)

sulfuric acid, conc=93-99.5%

No (test)data available

Conclusion

Not classified for mutagenic or genotoxic toxicity

Carcinogenicity

sulfuric acid, conc=93-99.5%

Route of exposure	Parameter	Method	Value	Exposure time	Species	Effect	Organ	Value determination
Inhalation (aerosol)	NOEC		100 mg/l air		Hamster (male)	No effect		Weight of evidence
Oral	NOAEL	Carcinogenic toxicity study			Mouse (male/female)			Weight of evidence

Conclusion

Not classified for carcinogenicity

Reproductive toxicity

sulfuric acid, conc=93-99.5%

	Parameter	Method	Value	Exposure time	Species	Effect	Organ	Value determination
Developmental toxicity	NOAEC	Equivalent to OECD 414	19.3 mg/m³ air	6 days (gestation, daily) - 15 days (gestation, daily)	Mouse (female)	No effect		Experimental value

Conclusion

Not classified for reprotoxic or developmental toxicity

Toxicity other effects

sulfuric acid, conc=93-99.5%

No (test)data available

Chronic effects from short and long-term exposure

sulfuric acid, conc=93-99.5%

ON CONTINUOUS/REPEATED EXPOSURE/CONTACT: Red skin. Dry skin. Itching. Skin rash/inflammation. Affection/discolouration of the teeth. Inflammation/damage of the eye tissue.

SECTION 12: Ecological information

12.1. Toxicity

sulfuric acid, conc=93-99.5%

	Parameter	Method	Value	Duration	Species	Test design	Fresh/salt water	Value determination
Acute toxicity fishes	LC50		16 mg/l - 28 mg/l	96 h	Lepomis macrochirus	Static system	Fresh water	Experimental value; Nominal concentration
Acute toxicity crustacea	EC50	OECD 202	> 100 mg/l	48 h	Daphnia magna	Static system	Fresh water	Experimental value; GLP
Toxicity algae and other aquatic plants	ErC50	OECD 201	> 100 mg/l	72 h	Desmodesmus subspicatus	Static system	Fresh water	Experimental value; GLP
Long-term toxicity fish	NOEC		0.025 mg/l	65 day(s)	Jordanella floridae	Flow-through system	Fresh water	Experimental value; Nominal concentration
Toxicity aquatic micro-organisms	NOEC		26 g/l	37 day(s)	Activated sludge	Static system	Fresh water	Weight of evidence; Nominal concentration

Conclusion

Not classified as dangerous for the environment according to the criteria of Regulation (EC) No 1272/2008

12.2. Persistence and degradability

Biodegradability: not applicable

Hydrolysis in water

12.3. Bioaccumulative potential

sulfuric acid, conc=93-99.5%

Log Kow

Method	Remark	Value	Temperature	Value determination
				Not relevant

Conclusion

Bioaccumulation: not applicable

12.4. Mobility in soil

No (test)data on mobility of the substance available

12.5. Results of PBT and vPvB assessment

The criteria of PBT and vPvB as listed in Annex XIII of Regulation (EC) No 1907/2006 do not apply to inorganic substances.

12.6. Other adverse effects

sulfuric acid, conc=93-99.5%

Fluorinated greenhouse gases (Regulation (EU) No 517/2014)

Not included in the list of fluorinated greenhouse gases (Regulation (EU) No 517/2014)

Ozone-depleting potential (ODP)

Not classified as dangerous for the ozone layer (Regulation (EC) No 1005/2009)

Ground water

Ground water pollutant

sulfuric acid, conc=93-99.5%

SECTION 13: Disposal considerations

The information in this section is a general description. If applicable and available, exposure scenarios are attached in annex. Always use the relevant exposure scenarios that correspond to your identified use.

13.1. Waste treatment methods

13.1.1 Provisions relating to waste

European Union

Hazardous waste according to Directive 2008/98/EC, as amended by Regulation (EU) No 1357/2014 and Regulation (EU) No 2017/997.
Waste material code (Directive 2008/98/EC, Decision 2000/0532/EC).
06 01 01* (wastes from the manufacture, formulation, supply and use (MFSU) of acids: sulphuric acid and sulphurous acid). Depending on branch of industry and production process, also other waste codes may be applicable.

13.1.2 Disposal methods

Recycle/reuse. Remove for physico-chemical/biological treatment. Remove to an authorized dump (Class I). Remove waste in accordance with local and/or national regulations. Hazardous waste shall not be mixed together with other waste. Different types of hazardous waste shall not be mixed together if this may entail a risk of pollution or create problems for the further management of the waste. Hazardous waste shall be managed responsibly. All entities that store, transport or handle hazardous waste shall take the necessary measures to prevent risks of pollution or damage to people or animals. Do not discharge into drains or the environment.

13.1.3 Packaging/Container

European Union

Waste material code packaging (Directive 2008/98/EC).
15 01 10* (packaging containing residues of or contaminated by dangerous substances).

SECTION 14: Transport information

Road (ADR)

14.1. UN number

UN number	1830

14.2. UN proper shipping name

Proper shipping name	Sulphuric acid

14.3. Transport hazard class(es)

Hazard identification number	80
Class	8
Classification code	C1

14.4. Packing group

Packing group	II
Labels	8

14.5. Environmental hazards

Environmentally hazardous substance mark	no

14.6. Special precautions for user

Special provisions	
Limited quantities	Combination packagings: not more than 1 liter per inner packaging for liquids. A package shall not weigh more than 30 kg. (gross mass)

Rail (RID)

14.1. UN number

UN number	1830

14.2. UN proper shipping name

Proper shipping name	Sulphuric acid

14.3. Transport hazard class(es)

Hazard identification number	80
Class	8
Classification code	C1

14.4. Packing group

Packing group	II
Labels	8

14.5. Environmental hazards

Environmentally hazardous substance mark	no

14.6. Special precautions for user

Special provisions	
Limited quantities	Combination packagings: not more than 1 liter per inner packaging for liquids. A package shall not weigh more than 30 kg. (gross mass)

Inland waterways (ADN)

14.1. UN number

UN number	1830

14.2. UN proper shipping name

Proper shipping name	Sulphuric acid

14.3. Transport hazard class(es)

Class	8
Classification code	C1

14.4. Packing group

Packing group	II
Labels	8

14.5. Environmental hazards

Environmentally hazardous substance mark	no

14.6. Special precautions for user

Special provisions	
Limited quantities	Combination packagings: not more than 1 liter per inner packaging for liquids. A package shall not weigh more than 30 kg. (gross mass)

Sea (IMDG/IMSBC)

14.1. UN number

UN number	1830

14.2. UN proper shipping name

Proper shipping name	Sulphuric acid

14.3. Transport hazard class(es)

Class	8

14.4. Packing group

Packing group	II
Labels	8

14.5. Environmental hazards

Marine pollutant	-
Environmentally hazardous substance mark	no

14.6. Special precautions for user

Special provisions	
Limited quantities	Combination packagings: not more than 1 liter per inner packaging for liquids. A package shall not weigh more than 30 kg. (gross mass)

14.7. Transport in bulk according to Annex II of Marpol and the IBC Code

Annex II of MARPOL 73/78	Not applicable, based on available data

Air (ICAO-TI/IATA-DGR)

14.1. UN number

UN number	1830

14.2. UN proper shipping name

Proper shipping name	Sulphuric acid

14.3. Transport hazard class(es)

Class	8

14.4. Packing group

Packing group	II
Labels	8

14.5. Environmental hazards

Environmentally hazardous substance mark	no

14.6. Special precautions for user

Special provisions	
Limited quantities: maximum net quantity per packaging	0.5 L

SECTION 15: Regulatory information

15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture

European legislation:

VOC content Directive 2010/75/EU

VOC content	Remark
	Not applicable (inorganic)

European drinking water standards (Directive 98/83/EC)

sulfuric acid, conc=93-99.5%

Parameter	Parametric value	Note	Reference

Sulphate	250 mg/l		Listed in Annex I, Part C, of Directive 98/83/EC on the quality of water intended for human consumption.

REACH Annex XVII - Restriction

Subject to restrictions of Annex XVII of Regulation (EC) No. 1907/2006: restrictions on the manufacture, placing on the market and use of certain dangerous substances, mixtures and articles.

	Designation of the substance, of the group of substances or of the mixture	Conditions of restriction
sulfuric acid, conc=93-99.5%	Liquid substances or mixtures which are regarded as dangerous in accordance with Directive 1999/45/EC or are fulfilling the criteria for any of the following hazard classes or categories set out in Annex I to Regulation (EC) No 1272/2008: (a) hazard classes 2.1 to 2.4, 2.6 and 2.7, 2.8 types A and B, 2.9, 2.10, 2.12, 2.13 categories 1 and 2, 2.14 categories 1 and 2, 2.15 types A to F; (b) hazard classes 3.1 to 3.6, 3.7 adverse effects on sexual function and fertility or on development, 3.8 effects other than narcotic effects, 3.9 and 3.10; (c) hazard class 4.1; (d) hazard class 5.1.	1. Shall not be used in: — ornamental articles intended to produce light or colour effects by means of different phases, for example in ornamental lamps and ashtrays, — tricks and jokes, — games for one or more participants, or any article intended to be used as such, even with ornamental aspects,2. Articles not complying with paragraph 1 shall not be placed on the market.3. Shall not be placed on the market if they contain a colouring agent, unless required for fiscal reasons, or perfume, or both, if they: — can be used as fuel in decorative oil lamps for supply to the general public, and, — present an aspiration hazard and are labelled with R65 or H304;4. Decorative oil lamps for supply to the general public shall not be placed on the market unless they conform to the European Standard on Decorative oil lamps (EN 14059) adopted by the European Committee for Standardisation (CEN).5. Without prejudice to the implementation of other Community provisions relating to the classification, packaging and labelling of dangerous substances and mixtures, suppliers shall ensure, before the placing on the market, that the following requirements are met: a) lamp oils, labelled with R65 or H304, intended for supply to the general public are visibly, legibly and indelibly marked as follows: "Keep lamps filled with this liquid out of the reach of children"; and, by 1 December 2010, "Just a sip of lamp oil — or even sucking the wick of lamps — may lead to life- threatening lung damage"; b) grill lighter fluids, labelled with R65 or H304, intended for supply to the general public are legibly and indelibly marked by 1 December 2010 as follows: "Just a sip of grill lighter may lead to life threatening lung damage"; c) lamp oils and grill lighters, labelled with R65 or H304, intended for supply to the general public are packaged in black opaque containers not exceeding 1 litre by 1 December 2010.6. No later than 1 June 2014, the Commission shall request the European Chemicals Agency to prepare a dossier, in accordance with Article 69 of the present Regulation with a view to ban, if appropriate, grill lighter fluids and fuel for decorative lamps, labelled R65 or H304, intended for supply to the general public.7. Natural or legal persons placing on the market for the first time lamp oils and grill lighter fluids, labelled with R65 or H304, shall by 1 December 2011, and annually thereafter, provide data on alternatives to lamp oils and grill lighter fluids labelled R65 or H304 to the competent authority in the Member State concerned. Member States shall make those data available to the Commission.'

National legislation Belgium

Additional classification	Acide sulfurique (brume); C; La mention "C" signifie que l'agent en question relève du champ d'application de l'arrêté royal du 2 décembre 1993 concernant la protection des travailleurs contre les risques liés à l'exposition à des agents cancérigènes et mutagènes au travail.

National legislation The Netherlands

Waterbezwaarlijkheid	B (3)
SZW - Lijst van kankerverwekkende stoffen	zwaveltrioxyde; Listed in SZW-list of carcinogenic substances

National legislation France

No data available

National legislation Germany

WGK	1; Classification water polluting in compliance with Verwaltungsvorschrift wassergefährdender Stoffe (VwVwS) of 27 July 2005 (Anhang 2)
TRGS900 - Risiko der Fruchtschädigung	Schwefeldioxid; Y; Risiko der Fruchtschädigung braucht bei Einhaltung des Arbeitsplatzgrenzwertes und des biologischen Grenzwertes nicht befürchtet zu werden
	Schwefelsäure; Y; Risiko der Fruchtschädigung braucht bei Einhaltung des Arbeitsplatzgrenzwertes und des biologischen Grenzwertes nicht befürchtet zu werden

National legislation United Kingdom

No data available

Other relevant data

IARC - classification	1; Strong-inorganic-acid mists containing sulfuric acid
TLV - Carcinogen	Sulfuric acid; A2
IARC - classification	3; Sulfur dioxide and some sulfites, bisulfites and metabisulfites
TLV - Carcinogen	Sulfur dioxide; A4

15.2. Chemical safety assessment

A chemical safety assessment has been performed.

Annex 1 - MSDS Sulphuric Acid

Voyage : 03/21 Port: Antwerpen / Jorf Lasfar Date: 03-Jun-2021

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