



## ANTHROPOGENIC DISASTERS ON BULGARIAN TERRITORY: CHEMICAL ACCIDENTS ON LAND AND AT SEA

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### ABSTRACT

Natural and anthropogenic disasters become more frequent worldwide. As technology advances, the risk of major industrial accidents increases. Often accidents in the chemical and oil industry, in agriculture, or during transportation, lead to mass poisoning and extensive environmental pollution. The particularities of the medical support in case of such chemical incidents are challenging the healthcare system.

The article aims to analyze the chemical accidents and the measures taken to reduce their effect in Bulgaria and in the Black sea aquatory.

Historical and documentary methods have been used to gather information on disasters and accidents in Bulgaria, where toxic chemicals have been released into the environment, causing material damage and human casualties. We have researched and analyzed various articles and publications in Bulgarian and foreign scientific journals on the subject.

Major industrial and transport accidents in the last 50-60 years on land and water had been selected from the literature sources. Both the reasons that led to them and the measures which were taken to eliminate the consequences were discussed.

The major industrial accidents with a release of industrial toxic substances into the environment are relatively common and result in contaminating large areas and many casualties. Chemical accidents at sea are indicative of the need for joint action by different organizations to quickly overcome and avoid environmental impact. The risk of industrial poisonous substances entering the environment is significant and measures to avoid such accidents have to be taken, as well as training of a wide range of health professionals and the general public on the proper behaviour in case of a chemical disaster.

**Keywords:** anthropogenic disasters, industrial toxic substances, chemical accidents, environment,

### BACKGROUND

There has been an increase of the natural and anthropogenic disasters and catastrophes worldwide in the last few years. They are an inevitable part of our daily lives – being present in the news and social media, on radio and television. As technology advances, the risk of major industrial accidents increases. There is a growing trend, especially in chemical plants' breakdown. Many accidents involving toxic chemicals have also been reported in Bulgaria. [1] Every year, over 100 industrial accidents are registered on the country's territory, with an increasing tendency. Many of the compounds used in the various industries are explosive or easily flammable, and almost all are toxic to a certain degree. Many toxic chemicals are produced or stored in many different locations in the country, posing a risk to the environment and the population in the region. Often, accidents in the chemical, petroleum and agricultural enterprises cause poisoning of large numbers of people. [2] Have to be noted that the medical support to the intoxicated casualties has to be provided within an extremely limited timeframe in order to be efficient. Medical support includes wide range activities that are fully dependent on the type and quantity of the toxic chemical released, the place of the accident and the weather conditions at the moment of the accident. [3, 4] Therefore, specific training for chemical incidents medical response, as a part of the major incident medical support educational program, [5] is required for the medical teams involved into the accident management. Availability of specific drugs and medical consumables for treatment of chemically injured people into the admitting hospital is another prerequisite for the adequacy and efficiency of the chemical major incident medical management and support.

### AIM

The article aims to research and analyze anthropogenic disasters, connected with industrial toxic substances' spills and their environmental impact. Wherever available information, analysis of the measures taken to reduce the effect of chemical accidents in Bulgaria and in the Black sea aquatory is done.

## MATERIALS AND METHODS

Historical and documentary methods have been used to gather information on anthropogenic disasters and accidents in Bulgaria with release of toxic chemicals into the environment. Of particular importance are the ones, causing material damage and human casualties. We have studied and analyzed various articles and publications on the subject in Bulgarian and English languages, which have been published in different scientific journals. We have also researched the daily press from the time period of interest.

## REVIEW RESULTS

### 1. Chemical Accidents on Land

#### 1.1. The Zgorigrad (Sgurigrad) Tailings Dam Accident - 1966

Tailings dams pose a great risk of accidents, the most common reason being the collapse of the dam's wall. The worst case in Bulgaria was on May 1, 1966, in Vratsa county. At the beginning of the 20th century near the town of Vratsa, there were two mines - "Plakalnitsa" and "Sedmochislenitsi". In 1957, the "Mir" lead-zinc mine took up work. Two years later, a flotation plant was opened.

The mines were known for their nugget lead which reached over 90% of the ore content. During the year prior to the accident, the dam wall was inspected several times by specialists and the presence of cracks in it as well as overloading of the tailings dam itself was found. Design errors had also been reported, including the fact that the water towers did not work. At the end of April 1966 torrential rains flooded the area for several days. The tailings dam was overflowing, and on May 1 at 11 o'clock the dam wall collapsed, providing a loud thunder and causing an earthquake.

Over 500,000 cubic meters mud mass, containing a high concentration of cyanide and heavy metals, ran along the Leva River, sweeping houses on both banks. The wave washed away about one-third of the Zgorigrad village, passed through the Vratsata pass and reached the central square of Vratsa minutes after the festive manifestation was over. Official statistics counted 118 dead, many injured, requiring emergent medical support provision on the site and in all available hospitals nearby, more than 150 destroyed houses and more than 1,000 people without a roof. Apart from the drowned, over the next few days, some of the wounded and those who had swallowed mud and water with a high concentration of cyanide and other poisonous chemicals also died. [6, 7] The final number of victims has been estimated to be about 500. Such serious disruption of everyday life due to disaster led the health system to work under pressure. [8] In order to respond to the demands of the medical situation, the National Disaster Medical Support Plan was activated, thus allowing mobilization of the medical capabilities of the neighboring districts for fast triage, medical evacuation and hospital admittance of all injured in accordance to the required medical treatment in several towns. Health system challenge was related not only to the emergency support and treatment to the casualties. [9] There was an imminent danger of an epidemic in the region, so all doctors in the Vratsa district have been

mobilized in the cleanup. The local Hygiene and Epidemiology Inspection's capacities were enhanced by teams sent from the capital for assuring the full control over the sanitary treatment of the affected area.

#### 1.2. Explosion and Fire in a Chemical Complex in Devnya - 1986

Vinyl-chlorine (VC) – gas cloud explosion on the territory of the Plant for Chlorine and PVC Production No. 2 in Devnya Chemical Complex in 1986 turned out to be one of the deadliest accidents in Bulgaria. The facility was one of the most modern for its time. 15 minutes before the morning shift workers arrived, a blast shook the plant. Material damage and the number of victims were unprecedented for the time. The Vinyl Chloride Plant was completely destroyed, the laboratories housed in a four-story building were flattened to the ground. A crater remained in the place of the blast. An earthquake Magnitude 3, according to the Richter scale was registered in Varna, 30 km away. 18 people were killed, another 19 were seriously injured and admitted for treatment in Varna's hospitals, and hundreds were exposed to the gas and have sought medical assistance. The organization of medical assistance for the affected population was done into accordance to the municipal disaster medical support plan and has granted swift and smooth mobilization of the required medical means and capabilities. If the released polyvinylchloride gas had not ignited, the tragedy would have been much greater, as the fire prevented the formation of large toxic cloud that could have reached Varna.

At the moment the plant is in liquidation. Due to low security control, new accidents happened on its territory. In 2005, as a result of a thunderstorm, poisonous chlorine gas was released; a reservoir of toxic substances was damaged in 2012 and flaw detectors were stolen in September 2012 for scrap metal, exposing the perpetrators, their relatives, as well as police officers and emergency medical teams to ionizing radiation from the radioactive substance in the container. [10]

#### 1.3. The Debelets Toxic Substance Release

One of the more recent cases was a transport incident with the release of toxic substances into the environment near the town of Debelets.

In the early hours of July 11, 2011, a Turkish chemical tanker truck turned and blocked the Kilifarevo - Veliko Turnovo road. The tanker truck's content was 20 tons styrene. This is a volatile, colorless liquid that penetrates the human body through the respiratory system and, to a lesser extent, through the skin, mainly accumulating in the fat tissue. It is also a carcinogenic chemical - classified as a group 3 carcinogen by the International Agency for Research on Cancer. It is very easily flammable. About 5 tonnes of it were poured onto the road and into the grasslands and finally got into the Belitsa River (the District Eco-Inspection confirmed that styrene contamination was a cause of the mass extinction of fish in the river). A toxic cloud was formed that headed towards near-by town of Debelets. Due to the high toxicity of the substance, a

decision was made to evacuate the local population. The disaster management plan was activated and strict organization and coordination was established for execution of joint disaster relief operations. These coordinated activities facilitated the evacuation of between 2200 and 2300 people at risk. Eight buses were provided for their transportation, first evacuating the children from the kindergarten (51 in total, among them - 20 babies). Part of the population was evacuated by ambulances as there were some people with disabilities and some locals used private transport. Five rescue crews (three fire crews, one rescue vehicle and one chemical protection vehicle) were dispatched to the scene and the duty-free staff of the Regional Police "Fire Safety and Population Protection" Department-Veliko Tarnovo was ready to join if needed. Seventeen of their members were already on the site as well as 10 cars with 42 policemen of Regional Police Department - Veliko Tarnovo. Access to the accident site was restricted within a radius of 200 m, and ambient air monitoring was carried out several times. [3]

Pollution was neutralized by foaming, which prevented its evaporation. Increased levels of harmful emissions into the air had been observed, with values beginning to decline after the passing of the cloud. Only two residents of Debelets sought medical help at the Emergency Department of Veliko Turnovo's Regional Hospital. Recommendations were given to the population when symptoms (irritation of the skin, mucous membranes of the eyes, nose or throat) occur as a result of gassing, to seek medical assistance and to use wet towels to protect the respiratory tract. This is the only case in Bulgaria where, after court cases and an out-of-court agreement, 2778 residents of Debelets received compensation for the caused damages.

#### 1.4. The Ezerovo Railway Station Accident

On August 14 2013 a propane-butane tank exploded at the Ezerovo railway station near Varna. The blast was so powerful that it was felt in the city. The accident was the result of a problem during the transfer of propane-butane gas from two train tanks into a tanker truck belonging to Gaztrade Company. During the transfer the hose connecting one of the tanks and the tanker truck broke, its metal nozzle produced a spark that caused explosion and fire on the first tank. Firefighters fought to put down the flames, but still, a huge second explosion followed. Twelve people were injured, including seven of the firefighters. In addition to the exploded railway tank and the propane-butane tanker truck, a tank of gasoline exploded a little later. The fire spread on 50 acres. The fire brigades of Varna, Shumen and Devnya used besides their own fire trucks also specialized equipment from Varna airport. In Ezerovo windows of buildings were broken. The front of the gas cloud passed through agricultural land and did not affect the settlements in the region, and the air contamination was also below the permissible limits. The Regional Inspectorate of Environment and Water - Varna examined the air with a mobile automatic air quality control station and the analysis showed that there was pollution only in the ground air

layers of Ezerovo Power Plant and Izvorite district in Devnya. A week later the most severely injured 60-year-old employee of the company, with 95% burns, died. Many of the injured, including firefighters, were admitted for treatment at the Naval Hospital – Varna – clear example of a civil-military medical cooperation based on activities, described and trained into disaster medical support plan. The victims had a different burn rate - between 4% and 21% but no life threatening condition.

#### 1.5. The Hitrino Accident 2016

In early December 2016, a freight train accident at Hitrino Railway Station led to a declaration of a state of emergency in the area. The train composition transporting propylene and propane-butane tanks, according to initial data, derailed at a higher than the permitted speed, causing the drawbar of one of the tanks to break through another tank. This led to gas leakage, the formation of a poisonous cloud and the subsequent explosion, destruction and fires in the village. Due to the threat to the population and the environment, as well as the requirement for specific relief operations and a number of rescue teams, the National Disaster Management Plan was activated. The Centres for Emergency Medical Assistance (CEMA) of four provinces were mobilized along with the Centres for burning trauma on national level. The adequate actions taken by the authorities and rescue teams limited the casualties to only seven out of 37 severely injured. Adequate actions by the authorities and rescue teams limited the death toll to seven. Dozens were injured, and more than 30 people were admitted to medical establishments in Shumen and Varna. The population had been evacuated, and for 12 days, the disaster recovery teams, fire officials, Lukoil Company and others were working on the removal of the derailed tanks from the territory of Hitrino Railway Station. Their actions were hampered by leaking gas and the risk of new explosions. Controlled combustion of toxic chemicals leaking from the tanks was carried out to avoid gassing the area. At the same time, the tanks of the damaged composition were continuously cooled down to reduce the temperature of the structures and to avoid an explosion.

## 2. Chemical Accidents at Sea

### 2.1. The Motor Tanker Erma Case 1977

On June 23, 1977, in Varna Port, the motor tanker Erma, owned by the Bulgarian shipping company Navibulgar (Navigation Maritime Bulgare), just brought 17,721 tons of crude oil in from Libya to the Petrol base situated at the port. An explosion on board took place at 17.35 o'clock. A very big problem was that not far off the shore there were a dozen tanks of the Petrol company, and there was another tanker discharging gasoline just behind the stern of "Erma". Around 20:00, new explosions followed, breaking the deck over the boiler room, and discharging high metal all over the area. Nearly 20 hours the joint forces of the fire brigade, navy and port authorities tried to get under control the fire by using water and a specific fire-extinguishing substance. More than 90 explosions were registered before the fire was extinguished and the

tanker lied down on the seabed. [11]

The risk for the port and the city was enormous – explosion at the Petrol base presented a hazard that could endanger the population of the whole town. [12] All the preventive measures were ready to be implemented in case of explosion - all hospitals were alerted and had activated their disaster medical support plan mobilizing the available human and technical resources for admittance of a huge number of injured. The vehicles for medical and population evacuation were also prepared in case of need.

### 2.2. The “Moon Lake” Case 2002

Indicative of the need for joint action by all organizations at the local level was the 2002 incident with “Moon Lake” – a Turkish Bulk Ship that was thrown on the rocks south of Varna and posed a risk of fuel and oil leakage. In this case, for the first time, the measures envisaged in the Black Sea Emergency Plan were actually implemented. “Moon Lake” was not a very large vessel, but with quite a lot of oil products on board, including 53 tons of fuel and 3 tons of oil.

On September 29, 2002, the ship was on the raid waiting to enter the port of Varna. Strong wind emerged the next day and took her south of Cape Galata throwing her on the rocks in the Pasha Dere area near the Veteran hut. As the ship-owner abandoned the ship, in order to avoid environmental catastrophe, the Marine Rescue Co-ordination Centre started preparation of the Perun and Midzur Rescue Ships. Currently, however, weather conditions did not allow them to reach the devastated “Moon Lake”. The risk of leakage of fuel and oil increased when Moon Lake was damaged and tilted. The engine compartment flooded, endangering the ship’s integrity, and the crew was evacuated. One potential threat to Varna had been eliminated with the joint efforts of all the departments responsible for the Varna Marine Aquatory - Maritime Administration, Navy. The access of the vessels to the “Moon Lake” was provided by specialists from the Hydrographical Service using a hydrographic vessel to perform deepwater measurements for marking of safe passages in the underwater rocks aquatory. [5]

### 2.3. The Sozopol Oil Spill 2018

Sometimes the long term effects of disasters become obvious in decades as in the case of SS Mopang which sank near Sozopol in 1921.

In 1920 Mopang was built by the Submarine Boat Co shipyard in Newark, New Jersey as a part of a special program of the US Shipping Board to produce 150 ships to substitute the lost ones in the World War I. She was owned by Electric Boat Company (which was renamed later in General Dynamics).

SS Mopang was a Sub Boat type cargo steamship. The vessel was sailing from Bourgas to Istanbul when it hit a German mine near the port of Bourgas on July 1 1921, suffered large damage from the explosion to the bow section as a result of which sank within minutes. Almost a century the wreck lied on its starboard side at 30 m depth, be-

ing one of the most interesting and relatively easily accessible attractions for divers in the Bulgarian Black Sea aquatory. Still, in the last 15 years, small quantities of oil have been spotted incidentally in the area without any alert raised. In August 2018, after several days of severe weather, oil from the ship leaked out and reached some of the nearby beaches. Although authorities described the leak as “minimal and quite limited”, awareness has risen on the case. Research showed that the capacity of the ship’s tanks was 650 tons of crude oil with unknown quantity lying on the seabed at the moment.

The impending disaster needed decisive rescue measures. Strong winds combined with turbulent sea delayed the start of the rescue operation. Monitoring of the seawater was carried out, but it registered only slight pollution. Still, a decision to drain the crude oil from SS Mopang was taken, and special barriers were placed in the aquatory near Sozopol and St.Ivan island to prevent further pollution. As a rescue measure, a ship from the European Maritime Safety Agency was sent to collect the already leaked into the water crude oil. [13] Underwater technical inspection of the sunken SS Mopang was also done. Half of the tanks’ content was drained until November 2018 when the severe weather prevented further work. Plans were made to pump the remaining fuel out of the ship’s tanks in the spring of 2019 before the start of the summer tourist season. [14, 15]

## CONCLUSION

Performed analyses of the recent industrial accidents and the activities of the respective agencies and ministries are leading to the following conclusions:

1. The major industrial accidents with the release of industrial toxic substances into the environment are relatively common and result in contaminating large areas. They are threatening the population at the areas of damage and without preventive measures could cause great number of casualties - both irreversible and medical losses.
2. In the event of an accident with chemical substances spilled in the environment, there is a pressure applied to the health and rescue systems in Bulgaria. In order to respond adequately, efficiently and what is most important into the extremely limited by the intoxications and sustained injuries time frame for provision of life-saving medical aid, a joint, coordinated, pre-planned and trained activities are required. In order this requirement to be fulfilled, a joint planning and training process has to be implemented into the routine time schedule of the all entities responsible for the disaster relief.
3. Chemical incidents at sea are also indicative of the need for joint actions by many organizations to quickly address and avoid environmental impact. There is a significant risk of industrial toxic substances entering the environment, and measures to avoid such accidents have to be taken, as well as training of a wide range of health professionals and the general population on the proper behaviour in case of disaster.

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