

## **Geographical Survey of Chlorine Gas Leakage at the Chlorination Station of Abfa Company Using Aloha Software (Case Study: Lar Station)**

**Afshin Jafarnia<sup>1</sup>, Ahmadali Khorrambakh<sup>2\*</sup>, Abdorasoul Ghanbari<sup>3</sup>**

1. Ph.D. Student of Geography, Larestan Unit, Islamic Azad University, Larestan, Iran
2. Assistant Professor, Department of Geography, Larestan Branch, Islamic Azad University, Larestan, Iran
3. Assistant Professor, Department of Geography, Larestan Branch, Islamic Azad University, Larestan, Iran

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### **Abstract**

Chlorine is a toxic gas and oxidant that is used in Iran to treat drinking water. Failure to investigate the effects of gas leakage or reservoir explosion can cause irreparable damage to employees and residents around the station. So far, no research has been done on this issue in Lar. The present study studies the release of chlorine gas from a one-ton reservoir at Lar chlorine station. In this paper, using Aloha software, we examine the nature, extent, rate of propagation, and various risk areas and vulnerable populations. Investigations show that the gas release in the event of damage to a one-inch valve can result in a deadly radius of 1.5 kilometers, effective 5 kilometers' radius and Can be felt up to 10 kilometers. It was also found that in the warm season in the first minute about 400 kg, and in the cold season 330 kg of gas can be removed from a hole in the diameter of one inch. Due to the possibility of occurrence of the incident and the location of the station in the direction of the prevailing wind, there is the possibility of harming a large number of citizens located at a radius of 5 kilometers from the station. Therefore, taking effective steps, such as: informing the residents, increasing awareness of the staff and the relief forces, installing proper scrubbers and increasing the level of safety of the station are necessary.

### **Introduction**

A chemical leak is a serious threat to the air quality and occupational safety of residents near its leakage site. Despite the large efforts of factories and industries to manage chemicals safely, there is always the possibility of devastating and fatal accidents. In many cases incidents are not understood, predicted or avoided. Getting ready to respond to these crises at the time and place of occurrence requires the identification and assessment of high-risk

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\* Corresponding Author, Email:ahmadali.kho@gmail.com

locations. The incidence of accidents in densely populated areas has a wider impact on society. The extent of the damage caused by these incidents depends on the extent of expansion, the first reaction to the incident, the incident and the surrounding area. An appropriate response to these conditions requires an appropriate coordination between individuals and local institutions. This occurs when the level of awareness in society increases the risk and the need for mutual preparedness to deal with it.

In our country, despite the importance of the hazards of exposure to chemicals, are generally programmed to respond to emergencies, taking into account the nature of the various materials and their respective risks, the level of risk and their range of exposure in a manner that is as effective as possible in the shortest time possible, There is not.

One of the most potentially damaging materials that is widely used today in the industry is chlorine gas. A large number of major industrial incidents in the last century have been related to the release of this toxic gas in the environment. Chlorine is used in the manufacture of plastic materials or other materials for the treatment of water and sewage, as well as the manufacture of refrigerants, glues, insecticides, drugs, disinfectants, bleachers and other consumer products. One of the sources of chlorine emissions from a water treatment plant in Iran is August 14, 2017 in Dezful, which left one dead and 509 injured, so it is best if possible to replace the chlorination system with a purification system with Ozone is a more modern, safe and effective way.

Ozone is one of the compounds that, according to its specific properties, has been used by European countries for nearly a century as a disinfection in drinking water. The first application of ozone was made in 1893 in the Netherlands and was fed to a refinery that fed the Rhine River. Today, more than 1,000 water treatment station use ozone as part of a chemical treatment, most of which are in the western countries, especially France, Switzerland and Canada. The largest ozone depletion facility has been used in the regions of Paris and Montreal.

Software modeling is a quick and accurate way to predict the extent of material release and simulate its consequences. Because the available mathematical models for sequencing modeling involve complex and time-consuming computations, the use of simulation software at this stage is important and because the evaluation of the consequences of hazards such as the release of high-risk chemicals in the environment, one of the most important and essential steps to increase the level of safety in existing or developing units is the importance of using more software with more capabilities. The purpose of the assessment is to determine the extent of the potential hazards and incidents of fire, explosion and distribution of toxic substances.

After modeling the probable events that can occur in a process, it is time to assess the effects and consequences of the incidents, which can be classified into

the two categories of consequences of the toxicity of released materials in the environment and the consequences of the explosion of abandoned materials in the environment. One of the information's necessary to assess the outcome of process events is vulnerability criteria, which, after using the scenario modeling stage, to analyze the extent of possible damage, should compare each outcome with standards that indicate the degree of damage.

Due to the location of the Clare gas reservoir near the town of Lar and its location in the direction of the dominant winds of the region, as well as its location located at an altitude higher than the city, it is necessary to consider the possibility of leaking this gas heavily Poisonous and hazardous, for this purpose, the purposes of this study is to investigate the possible scenarios of chlorine gas release at the Abfa chlorine station. One of the scenarios with a high probability of occurrence is the possibility of failure and leakage of gas from the outlet tubes, which is one inch in diameter. This study examines the occurrence of this happening in the summer.

### **Materials and Methods**

In order to investigate the risk of chlorine emissions and to calculate the release method, the amount of dispersion and radius of damage, it is necessary to collect data including the physical and chemical properties of chlorine gas, the climate of the region, storage location and use of gas, storage tank type, shape, size And reservoir capacity. At first, the weather information of the area was extracted from the Meteorological Organization's Statistical Yearbook. Then, by referring to the station, information about the location of the reservoir and its type were collected.

Since the existing mathematical models for outcome modeling include complex calculations and very timely, the use of simulation software at this stage is important. In order to model the distribution, propagation speed, dispersion rate, and the radius of modeling impact by software, a quick and accurate method for Anticipating the extent of its material release and simulating its consequences has been exploited by ALOHA software, one of the free software for air pollutant release. The software is provided by the US Environmental Protection Agency (EPA) to model incidents caused by the release of toxic, explosive, or explosive fire or explosive substances. The software has a very rich database (more than 1,000 chemical materials) and a simple environment to prevent user mistakes.

### **Discus and Results**

As mentioned earlier, the most important criterion in the rate of diffusion and diffusion of gas is wind speed and air temperature. Therefore, considering the climatic conditions of the area, the calculations were carried out in two seasons (warm and cold). According to the climatic averages table for the warm season,

the average temperature is 34.4 ° C. Relative humidity is 35%, wind speed is 16 m/s and the wind direction for the western wind and for the cold season average temperature is 11.8 ° C, relative humidity 60% Wind speed is 9 m/s and the direction of the wind blowing is considered. Also, the cloud cover is 5% and the fracture in the tank's outlet valve, which has a diameter of one inch. According to the calculations made in the software, It was also found that more reservoir storage is evacuated in less than 5 minutes in almost all cold and hot seasons. The average discharge rate is 390 kg / min, but in the first minute it is about 400 kg in the warm season and about 330 kg in the cold season is discharged from the reservoir. Another output of the software is the radius of gas emission and its concentration for 60 minutes, which shows that in the warm season, 1.5 km of concentration to 20 ppm, in the range of 5 km concentration of 2 ppm, within 10 km of concentration to ppm 0.5. In the cold season, in the range of 1.4 km of concentration to 20 ppm, in the range of 4 km, the concentration of concentration in ppm 2, reaches 6.8 km to the concentration of 0.5 ppm.

### **Conclusion**

It can be concluded from the findings of this study that the release of chlorine gas in the event of damage to its outlet valve in the warm season will be broader than the cold season in general, but it covers the area of hazardous emissions in both seasons to a point in the city. Which includes important uses and high population densities such as the only city hospital, Azad University, Mehr housing Area, the largest city stadium and a large number of major city departments. Also, this area includes one of the most important links between the two cities of Larestan and Gharash (Dadman Highway), which always has high traffic. According to the location of the station in the direction of the wind direction of the region and the emission range up to 2 ppm, it is clear that the whole area of the new city of Lar is at risk of gas emissions, and it is possible to harm a large number of citizens located at a radius of 5 km from the station. Therefore, effective measures such as informing the residents, increasing the level of awareness of the staff and the relief forces, installing proper scrubbers and increasing the level of safety of the station are necessary. According to calculations, diagrams and maps, it is clear that in a radius of 1.5 km the emission is extremely dangerous and deadly, and up to a radius of 5 km, there is a possibility of serious and long-term complications for people and deprives them of the ability to escape. Considering the possibility of such a critical occurrence is very high, it is necessary to first install scrubbers for chlorination stations and the staff of the training station will be trained to deal with this situation. It should be noted that due to the speed of evacuation of materials, it is possible to arrive at the time of other relief forces. It is therefore necessary to have the equipment necessary for staff and guards in place so that they can be responded promptly and appropriately in case of occurrence, it seems that, if

possible, alert systems are available for hazardous areas and to People are taught how Faced with this situation.

**Keywords:** Chlorine gas, Crisis, Water treatment plants, Emergency response plan.

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