Toxicity Alert: Hydrogen Sulfide

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Abstract
Recent cases of casualty of workers in rubber latex factories due to hydrogen sulfide call for urgent attention to better understanding, prevention of damages in working and living in risky environments, and promotion of public and labor awareness. Specific responsible organization here is the subcontractor of latex factories. H₂S characteristics, sources and symptoms from exposure are emphasized. Proper practice should be followed strictly along with better cooperation among experts for the main objective in saving lives and greater safety in living and working.

Keyword: Industrial pollutants; Casualty from toxic gases; Toxicity awareness; Cooperations and practice for gas safety; Environmental pollutants

Introduction
The way that there are greater and greater number of industrial factories especially petroleum and rubber together with greater amount of wastewater, garbage and pollution causes casualty loss as well as health problems repeatedly. Lately in southern Thailand, there is the case that workers did their jobs in wastewater treatment areas, causing loss of consciousness, serious harm and death due to hydrogen sulfide [1]. Therefore, greater recognition and awareness of this gas are essential which can lead to the prevention as well as careful plan for the operation to make it safer for life in the future.

H₂S properties
Hydrogen sulfide is the compound of hydrogen and sulfur with the chemical formula of H₂S, similar to water (H₂O) so it can dissolve in water very well. It is colorless with the odor of rotten eggs and greater density than air. After contact, the olfactory reception is paralyzed and cannot sense the gas any more, intensifying its toxicity [2]. The gas can be found everywhere in this whole wide world. It is toxic, corrosive, flammable and acidic when dissolving in water. For reading convenience, H₂S is used instead of hydrogen sulfide from this point on.

H₂S sources
In nature, hydrogen sulfide is found in great percentage in natural gas. It is obtained from volcano eruption and deserted wells. By chemical reactions, it can be formed by the reaction of hydrogen and sulfur at high pressure and temperature, the reactions of sulfide compounds with acids and the decomposition of certain sulfur compounds such as thioacetamide (CH₃CSNH₂). For the waste from communities or factories, it arises from the digestion by anaerobic bacteria which are normally bacteria consuming sulfate to get energy.

Existence in environment
For natural environment, due to the fact that the process of becoming fuel source involves sulfur; H₂S can be found in various areas. Not large amount is found in petroleum and petroleum products. In contrast, it can be found at high concentration up to 90% in natural gas. It can also move from underground to the surface via volcano and hot or cold spring. And because of bacteria, deserted wells can also be filled with H₂S. Finally, smaller amount of hydrogen sulfide can be formed in specific organs of human and animal bodies, mainly mouth and intestine, by the decomposition of proteins by bacteria.

In the case of industrial environment, H₂S can be found in petroleum distillation from the reactions to remove sulfur. A number of industries that give away H₂S to the environment include coal burning, paper mills, tanning, sewerage and mining among others. The way that sulfur is left to react with organic matters at high temperature can also lead to the formation of H₂S by bacterial decomposition. Finally, oil drilling can cause the releasing of this gas to the
Brain damage and the loss of control by the brain $S$ had special mechanism and symptoms especially to our $S$. However, there are specific items to be $S$ in wastewater systems of $S$. Due to the fact that $H$ immediate unconsciousness $S$ is urgently, seriously and extremely required. Impact on eye membranes, eye irritation, and red eyes with lots of tears $S$ affects the metabolism $S$ is approximately.

<table>
<thead>
<tr>
<th>Concentration</th>
<th>Period (Approximately)</th>
<th>Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Short 1-5min</td>
<td>Impact on eye membranes, eye irritation, and red eyes with lots of tears</td>
</tr>
<tr>
<td></td>
<td>Moderate 30min</td>
<td>Cough from the irritation of the membranes of alimentary canal and gastrointestinal mucosa</td>
</tr>
<tr>
<td></td>
<td>Long 1h</td>
<td>Irritation of respiratory organs and difficulties in breathing</td>
</tr>
<tr>
<td>High</td>
<td>Short 1-5min</td>
<td>Brain damage and the loss of control by the brain</td>
</tr>
<tr>
<td></td>
<td>Moderate 30min in</td>
<td>Immediate unconsciousness</td>
</tr>
<tr>
<td></td>
<td>Long 1h</td>
<td>Breathing stop and death</td>
</tr>
</tbody>
</table>

Table 1: Symptoms for $H_2S$ exposure at different concentrations and time periods (Adapted from [5-8]).
Things to be done in factories

To help the situation of \( \text{H}_2\text{S} \) in factories, there are five top priority measures to be implemented. First is the ventilation; the factories need to have good facilitation for air flow. The workers also need to wear the clothes that are not too tight and well-ventilated. Secondly, the oxygen masks are required together with the equipment to prevent the chemicals and goggles. Thirdly, the workers need to be well educated and trained with the certificates to let others know that they are well qualified. Fourth, there must be the sensors for hydrogen sulfide and the equipment to signal the warning in case the concentration exceeds the limit as well as security tools are necessary to be installed. If the case is worse than the aforementioned, then the air needs to be sampled and measured continuously by flow-based sensors to make sure about the amount of toxic gases.

Determination of \( \text{H}_2\text{S} \)

\( \text{H}_2\text{S} \) can be determined by a number of methods recently including gas chromatography (GC) [9], optical probes [10], emission spectrometry [11], cyclic voltammetry [12] and fluorescent probes [13, 14]. The most used on site is electrochemical methods [5]. As a matter of fact, this is one of the research topics proposed by the student at the author’s electrochemical research lab due to the fact that wastewater from rubber sheet cleaning was found to have certain harmful effects plants of citrus family, especially lime. so it deserves separate review articles for those who specifically focus on recent \( \text{H}_2\text{S} \) analytical methods and their characteristics.

Lessons from the case of casualty

There are a number of lessons to be learned from the case of the damage from \( \text{H}_2\text{S} \) to workers. Above all, the phrase “Safety First” is to be strictly held on to, which means carefulness in operation as well as common sense and awareness. In Thailand in particular, the way that people take it easy is normally a basic way of living, but it has to be emphasized that this is not the case because it concerns life and death. Even in other cases such as welding, the way that the welders do not use the masks can be easily seen. And due to the fact that Thai people normally follow local wisdom, at least they can think of the way that traditional well diggers use the candle to check the availability of oxygen. If the light goes out, it means the air is not safe for them anymore. The second thing is that the weak point especially in Thailand is maintenance. Everything needs to be well equipped according to the rules and regulations. Money has to be invested and things must be well planned on the security.

Thirdly, educating and training workers are required to allow them to be able to take care of themselves and others. Knowledge transfer to provide awareness to both workers and the public is necessary, which also reflects the importance of science subjects in school, particularly sulfur cycle in the environment. Next, the news warns us to take really good care of the environment. More often than not, widespread rubber latex companies especially in southern Thailand release the smell from time to time, particularly in the morning. It is surely irritating at least to a certain extent in particular to those who exercise and wake up early in the morning to go to work. No one knows about the accumulating effects that the smell might have and not to mention the rotten smell of wastewater. This is the perfect example to ask whether it is about time to take care of air, water or soil. The fifth to be well implemented is the integrated cooperation from all experts involved including engineers, chemists, environment personnel, medical doctors, industrialists, experts for rubber and polymer, public relations personnel, labor and administrators. Finally, everyone needs to be aware of significance of life and living. Our lives are of great value to families, society and the nation hence they should be well taken care of and highly valued. Real actions need to be taken and make the situations better right in time, before more harm and greater risks to become the next casualty cases.

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References

1. http://www.youtube.com/watch?v=tn4Zv9NMb9s

