



Safety Backpack for the Gas Industry and Mining Industry Workers

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Safety backpack for the gas industry and mining industry workers

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Abstract - Industrial sector contributes to the majority of the economical growth as it has been revolutionizing along with the developing technology. Safety is a crucial factor of every industry and it is very pathetic to address the fact that industrial accidents are a recurring drawback to the sector. It has been reported that on average, 1,109 deaths and more than 4,000 injuries in registered factories were reported each year, in four years to 2020, according to DGFASLI data. Considering the Delhi Factory incident we can understand that most the people died due to the gas leakage rather than burns and other injuries. In order to reduce the impact of the circumstance, we are designing a backpack with an oxygen supplying and health condition monitoring system for workers that can use utilized during the emergency situations. This paper explains about the overall designing ,working and usage of the system designed for labors to ensure safety in working environment.

Keywords – Respirator

**Mask¹ ;Sensor² ;Fatality³ ;Gas⁴
;Backpack⁵**

I .INTRODUCTION

Industrial sector is an important factor for urbanization , with an increase in productivity and production of the Gross Domestic Product measure (GDP) also increasing intensively . Human capital is a major investment by the industries to increase productivity as well as economic growth. The nature of industrial work involves manufacturing, processing, and production operations, ranging from heavy industries such as mining and construction to lighter industries such as electronics and textile. Creating a culture of safety where employees feel empowered to report hazards and near-misses is essential in maintaining a safe and healthy industrial environment. Industrial Accidents are a major drawback for in the growth of the industrial sector. According to data collated by IndustriALL, in the first half of 2022, at least 78 industrial and mine accidents have been reported, killing at least 199 workers and injuring more than 348 . It's very pathetic that though we are being revolutionized with a lot of technologies, still we lag on to resolve the basic and in need problem that needs to be resolved. The Delhi factory incident that happened in December 2019 created a huge impact on industrial accidents. In fact to add on to the incident ,most the people died due to the gas leakage rather than burns and other injuries. Here we are utilizing the existing

technology into a compact and affordable product that tries to reduce the industrial fatality rate caused due to harmful gas leakage to the most by designing a survival safety backpack which is fitted with cylinders that supply oxygen along with mask to the worker for sustaining until the rescue team arises to the spot. Also we incorporated an alert system that produces a signal about the person in critical condition so that the rescue team gets an alert to help the person in emergency .Several other basic monitoring tools has also been incorporated in the backpack itself and also these backpacks will be easily carried along with the PPE(Personal Protective Equipment) kits that the workers use. The backpack design is also included along the way and the material consideration is done in such a way that it is of fire resistant and lightweight and also chemically less reactive and will be on the affordable range as well .This idea proposed will help to reduce the fatality rate and also ensure a safe and secure environment to work .

II.SOLUTION

Chemical emissions have forced the closure of the vast majority of India's industrial fatalities. This affects both the individual's life as well as the economy. In order to avoid such circumstances and reduce the fatality rate, we hereby propose a solution, which is a safety kit for handling such situations. This safety kit is a backpack that includes compact oxygen cylinders as well as a MSA respirator mask with a heart rate sensor, which is used to monitor the heartbeat at regular intervals. In comparison to the existing products, this kit will be lightweight and made of fire resistant material **NOMEX**.

When an emergency occurs at work, this device assists the staff momentarily while the rescue team is en route. The heart rate sensor measures the worker's heart rate as soon as the device is turned on. A danger light that is used to warn the rescue team for those who have special needs is included with the backpack so that they may prioritize these workers and provide them emergency assistance for those in need.

III. TECHNOLOGY INCORPORATED

List of the technology utilized in building the kit are listed below as follow:

- Heart Rate Sensor - Which is used to monitor the workers heart rate and would provide emergency assistance in need and rescue them as soon as possible.
- Pneumatic System -For systematic supply of the gas supply throughout the process.
- Gas Monitoring System - System has sensors for the gas level monitoring in the cylinders, so that they can be replaced for further use.
- Alert System - That provides a signal to the rescue team to rescue the worker who is in need of emergency assistance.

IV.COMPONENTS USED

- Supplied-OXYGEN
Respirator (mask):

Supplied-air respirators, also known as supplied-oxygen respirators, are masks that provide breathing air from an external source. They are commonly used in industrial and medical settings where workers may be exposed to hazardous materials or where the air quality is poor.

The oxygen source is connected to the mask via a hose, which provides the user with a constant flow of clean, breathable air. This type of respirator is typically used in environments where the concentration of harmful substances is too high for a filtering facepiece respirator (such as an N95 mask) to provide adequate protection.

- Heart rate sensor (WH-873)
- Modified Backpack
- Refillable oxygen cylinders:

Refillable oxygen cylinders are containers used to store and transport oxygen gas. Refillable oxygen cylinders come in a range of sizes, from small portable units to larger cylinders used in stationary oxygen delivery systems. The oxygen is stored in the cylinder under pressure, and can be released and used as needed by opening a valve. The material used for producing the cylinder is low carbon steel since it doesn't react much with the air.

- Gas sensor:

A gas sensor is a device that detects and measures the concentration of specific gasses in the air. The accuracy of a gas sensor can be affected by various factors such as temperature, humidity, and the presence of other gasses that can interfere with the measurement. Gas sensors play a critical role in many industries and applications, helping to monitor air quality, detect hazardous gasses, and ensure the safety of people and the environment.

- Danger light:

Industrial danger lights are used to indicate hazardous or dangerous conditions. These lights are typically brightly colored (such as red or orange) and are equipped with features like flashing or continuous illumination to grab attention and alert workers and other individuals to stay away.

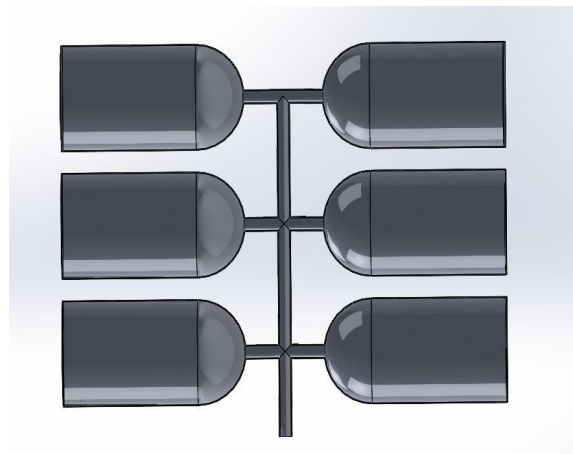
- Two AAA Battery
- Gas level monitoring sensor
- LED Display

V. DESIGN AND CALCULATION

We have improved our design so that the backpack safety kit is even lighter, easier, and more comfortable to use. First, as we can be seen in the image below, the oxygen cylinders were divided into eight smaller ones, and the oxygen is now packaged in an aluminum container rather than a steel one where weight can be reduced, and size made compact. Parallel connections are made between each of the eight oxygen cylinders.

According to equation, $P = F/A$
 where,
 P= Pressure exerted by the body
 F= Force acting on the body
 A= Area of the body

Since, Area is inversely proportional to the pressure exerted by the body. As area of the body decreases pressure exerted will



increase which makes the ease flow of air through the cylinder.

The above sketch is an 3D sketch of the prototype regarding the bag design and cylinder alignment

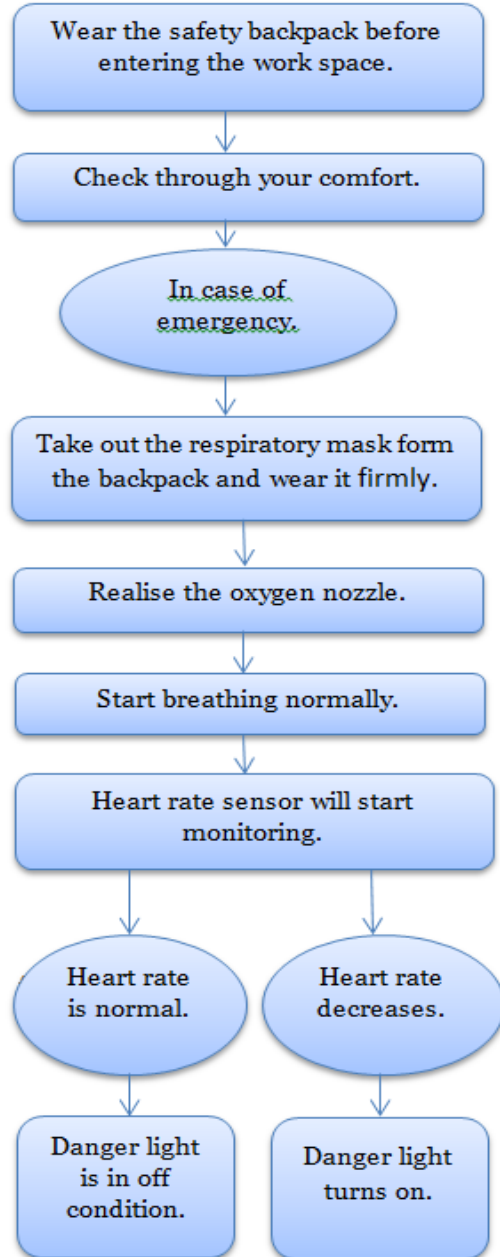
DIMENSIONS :

- Backpack - Width 180mm**
- Length 300mm**
- Cylinder - Diameter 50mm**
- Length 80mm**
- Weight 1.2 kg (overall)**

V.1 MATERIAL USED

The material used will be NOMEX^R 410, a Flame Resistant material metal aramid material which adds on to the uniqueness for the back . The other additional properties include high inherit dielectric strength , mechanical toughness ,thermal stability ,flexibility and resilience .The cost of one meter of the material is \$15.81 and is on the quite affordable side.

VI.WORKING FLOW CHART



VII. FUTURE OUTCOME

The implementation of this backpack in the gas industry can have numerous positive results, including:

- Increased safety:
The primary benefit of implementing this safety kit is to improve the safety of workers. This device can protect against accidents and injuries.
- Improved efficiency:
With a safety backpack in place, workers can operate more efficiently and without the fear of accidents.
- Cost saving:
Since this device is refillable the workers can refill once the oxygen is over. so no need to invest in a new safety device it may be ultimately leading to significant cost saving for the gas industry.
- Enhanced reputation:
By prioritizing safety, the gas industry can enhance its reputation and demonstrate its commitments to the well-being of its workers and the environment.
- Compliance with regulations:
Safety devices are often required by regulations and standards to ensure the safety of workers and the environment. Implementing such a device can help the gas industry comply with these regulations.

Overall, the implementation of a safety backpack in the gas industry can bring a range of benefits and is a necessary step towards ensuring a safer, more efficient, and more sustainable industry.

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