Gas mask introduce

A gas mask is a device designed to protect the wearer from noxious vapors, dust, and other pollutants. Masks may be designed to carry their own internal supply of fresh air, or they may be outfitted with a filter to screen out harmful contaminants. The latter type, known as an Air Purifying Respirator (APR), consists of a tight-fitting face piece that contains one or more filter cartridges, an exhalation valve, and transparent eye pieces. The first APR was patented in 1914 by Garret Morgan of Cleveland, Ohio, an African American inventor also credited with major improvements in the traffic signal. When the Cleveland Waterworks exploded in 1916, Morgan showed the value of his invention by entering the gas-filled tunnel under Lake Erie to rescue workers. Morgan's device later evolved into the gas mask, used in World War I to protect soldiers against chemicals used in warfare.

A gas mask is a mask put on over the face to protect the wearer from inhaling "airborne pollutants" and toxic gases. The mask forms a sealed cover over the nose and mouth, but may also cover the eyes and other vulnerable soft tissues of the face. Some gas masks are also respirators, though the word gas mask is often used to refer to military equipment (e.g. Field Protective Mask, etc.) (The user of the gas mask is not protected from gas that the skin can absorb.)

Airborne toxic materials may be gaseous (for example the chlorine gas used in World War I) or particulate (such as many biological agents developed for weapons such as bacteria, viruses and toxins). Many gas masks include protection from both types. During riots where tear gas or CS-gas is employed by riot police, gas masks are commonly used by police and rioters alike.

Aside from serving their functional purposes, gas masks are also used as emblems in industrial music, by graffiti taggers because the mask protects them from the graffiti canister's toxic fumes, and by Urban Explorers venturing into environments where materials such as asbestos is present.

The traditional gas mask style with two small circular eye windows originated when the only suitable material for these eye windows was glass or perspex; as glass is notoriously brittle, glass eye windows had to be kept small and thick. Later, discovery of polycarbonate allowed gas masks with a big full-face window. Some have one or two filters attached to the face piece. Some have a large filter connected to the face piece by a hose.

Principles of construction

Absorption is the process of being drawn into a (usually larger) body, or substrate, and adsorption is the process of deposition upon a surface. This can be used to remove both particulate and gaseous hazards. Although some form of reaction may take place, it is not necessary; the method may work by attractive charges, for example, if the target particles are positively charged, use a negatively

charged substrate. Examples of substrates include activated carbon, and zeolites. This effect can be very simple and highly effective, for example using a damp cloth to cover the mouth and nose whilst escaping a fire. While this method can be effective at trapping particulates produced by combustion, it does not filter out harmful gases which may be toxic or which displace the oxygen required for survival.

MCU-2/P Protective Mask on a U.S. Navy member. The filter cartridge is on the left side of the mouth, which makes it easier to aim a rifle right-handedly.

Gas mask used by the French military. The filter cartridge is connected via a flexible hose.
Greek Infantry with gas masks
Image of gasmask with eyeholes and 4 connections

Safety of old gas masks

Gas masks have a limited useful lifespan that is related to the absorbent capacity of the filter. Once the filter has been saturated with hazardous chemicals, it ceases to provide protection and the user may be injured. Most gas masks use sealing caps over the air intake to prevent the filter from degrading before use, but the protective abilities also degrade as the filter ages or if it is exposed to moisture and heat. Very old unused gas mask filters from World War II may not be effective at all in protecting the user, and can potentially cause harm to the user due to long-term changes in the filter chemical composition.

World War II gas masks contained blue asbestos in their filters, and this material continued to be used until at least 1956. Breathing blue asbestos in the factories resulted in death from mesothelioma of 10% of workers, and between 2.5 and 3.2 times the normal incidence of lung or respiratory cancers. Some of the gas masks known to contain asbestos are the British MK4 and MK5 respirators which were issued to the majority of the British army during World War II. Current advice is never to wear any gas mask of uncertain military origin.

Many scare stories have originated from various Russian gas masks and their filters that are now common in surplus stores; the GP-5 was often considered to have an asbestos filter, however like most cold-war masks it only contains activated charcoal.

Modern gas masks are quite safe and do not use asbestos, but it is still important to be careful when using a modern gas mask. Typically masks using 40mm connections are more recent design. Rubber also degrades with time so new in box "Modern type" masks can be cracked and leak.

Use of a mask

A modern mask typically is constructed of an elastic polymer in various sizes. It is fitted with various adjustable straps which may be tightened to secure a good fit. Crucially, it is connected to a filter cartridge near the mouth either directly, or via a flexible hose. Some models contain drinking tubes which may be connected to a water bottle. Corrective lens inserts are also available for users who require them.

Masks are typically tested for fit prior to actual use. After a mask is fitted, it is often tested via various challenge agents. Isoamyl acetate, a synthetic banana flavorant, and camphor are often used as innocuous challenge agents. In the military, the use of tear gases such as CN, CS, and stannic chloride in a chamber may be used to give the users confidence in the efficacy of the mask.

When the mask is used in a real scenario, or as part of a drill, users are to quickly hold their breaths, don their masks, and exhale hard to purge any contaminants from the interior of the masks. They also check the edges of the mask for good contact with the skin to detect potential leaks. Further protective clothing may be worn after the mask is donned.

Further information: MOPP and NBC suit

Reaction and exchange

This principle relies upon the fact that substances that can do harm to humans are usually more reactive than air. This method of separation will use some form of generally reactive substance (for example an acid) coating or supported by some solid material. An example is resins. These can be created with different groups of atoms (usually called functional groups) that exhibit different properties. Thus a resin can be tailored to a particular toxic group. When the reactive substance comes in contact with the resin, it will bond to it, removing it from the air stream. It may also exchange with a less harmful substance at this site.

Though it was crude, the hypo helmet was a stopgap measure for British troops in the trenches that offered at least some protection during a gas attack. As the months passed and the use of poison gas occurred more frequently, more sophisticated masks were developed and introduced. There are two main difficulties with gas mask design:

The user may be exposed to many different types of toxic material. Military personnel are especially prone to being exposed to a diverse range of toxic gases. However if the mask is for a particular use (such as the protection from a specific toxic material in a factory), then the design can be much simpler and the cost lower.

The protection will wear off over time. Filters will clog up, substrates for absorption will fill up, and reactive filters will run out of reactive substance. This means that the user only has protection for a limited time, and then they must either replace the filter device in the mask, or use a new mask.

A primitive respirator was designed by A. von Humboldt in 1799 for underground mining

Various gas masks employed on the Western Front and Eastern Front during World War I

Finnish civilian gas mask from 1939. These masks were distributed to the male head of families during World War II

1939 baby's gas mask at Herne Bay Museum

History and development of the gas mask

The common sponge was used in ancient Greece as a gas mask. An early type of rudimentary gas

mask was invented in the 9th century by the Banu Musa brothers in Baghdad, Iraq. They described it in their Book of Ingenious Devices, [verification needed] mainly for protecting workers in polluted wells.

Primitive respirator examples were used by miners and introduced by Alexander von Humboldt already in 1799, when he worked as a mining engineer in Prussia, as well as a Plague Doctor's bird beak shaped mask/face piece.

The gas mask was patented on June 12, 1849, by the American, Lewis Haslett, in Louisville, Kentucky. It was an "Inhaler or Lung Protector," issued for an air purifying respirator. Haslett's device filtered dust from the air.

Early versions were constructed by the Scottish chemist John Stenhouse in 1854 and the physicist John Tyndall in the 1870s.

Another early design was the "Safety Hood and Smoke Protector" invented by Garrett Morgan in 1912, and patented in 1914. It was a simple device consisting of a cotton hood with two hoses which hung down to the floor, allowing the wearer to breathe the safer air found there. In addition, moist sponges were inserted at the end of the hoses in order to better filter the air. Morgan won acclaim for his device when in 1916 he, his brother, and two other volunteers used his device to rescue numerous men from the gas and smoke-filled tunnels beneath Lake Erie in the Cleveland Waterworks.

The first use of poison gas on the Western Front was on 22 April 1915, by the Germans at Ypres, against Canadian and French colonial troops. The initial response was to equip troops with cotton mouth pads for protection. Soon afterwards the British added a long cloth which was used to tie chemical-soaked mouth pads into place, and which was called the Black Veil Respirator. Dr. Cluny MacPherson of Royal Newfoundland Regiment brought the idea of a mask made of chemical absorbing fabric and which fitted over the entire head to England, and this was developed into the British Hypo Helmet of June 1915. This primitive type of mask went through several stages of development before being superseded in 1916 by the canister gas mask of 1916. This had a mask connected to a tin can containing the absorbent materials by a hose.

The British Royal Society of Chemistry claims that British scientist Edward Harrison developed the first practical gas mask for mass production, a claim supported by a thank-you note written by Winston Churchill.

American chemist and inventor James Bert Garner is credited by American sources with the invention of the gas mask in April 1915. Reading a newspaper article describing a gas attack on British forces which he hypothesized had employed chlorine gas, Garner remembered experiments he had performed while teaching at the University of Chicago, thus he set about creating the first gas mask which he tested on two of his associates in a gas filled chamber. Following the successful completion of the test, he provided the results to the British government. Garner's mask was of the first to be used on the Western front during World War I. Also in World War I, since dogs were frequently used on the front lines, a special type of gas mask was developed that dogs were trained

to wear.
In America thousands of gas masks were produced for American as well as Allied troops. Mine Safety Appliances was a chief producer. This mask was later used widely in industry.[11]

Gas masks development since has mirrored the development of chemical agents in warfare, filling the need to protect against ever more deadly threats, biological weapons, and radioactive dust in the nuclear era. However, where agents that cause harm through contact or penetration of the skin occurs, such as blister agent or nerve agent, a gas mask alone is not sufficient protection, and full protective clothing must be worn in addition, to protect from contact with the atmosphere. For reasons of civil defense and personal protection, individuals often purchase gas masks in the belief that they protect against the harmful effects of an attack with nuclear, biological, or chemical (NBC) agents; which is only partially true, as gas masks protect only against respiratory absorption. Whilst most military gas masks are designed to be capable of protection against spectrum of NBC agents, they can be coupled with filter canisters that are proof against those agents (heavier) or just against riot control agents and smoke (lighter, and often used for training purposes); likewise there are lightweight masks solely for use in riot control agents and not for NBC situations.

Although thorough training and the availability of gas masks and other protective equipment can render the casualty-causing effects of an attack by chemical agents nullified, troops who are forced to operate in full protective gear are less efficient in completing their given tasks, tire easily, and may be affected psychologically by the threat of attack by these weapons. During the Cold War era, it was seen as inevitable that there would be a constant NBC threat on the battlefield, and thus troops needed protection in which they could remain fully functional; thus protective gear, and especially gas masks have evolved to incorporate innovations in terms of increasing user-comfort, and in compatibility with other equipment (from drinking devices to artificial respiration tubes, to communications systems etc.). The gas mask has thus now arrived at a 'fourth generation' of development.

History of absorbents and neutralizers
Activated charcoal is a common component of gas masks. It is a carbon with an extremely high surface area and which attracts all manner of pollutants from air and water. Pollutants do not react with the carbon but are bonded to it in a process called adsorption. Over time the activated carbon becomes thoroughly coated and it ceases to remove pollutants. However, the charcoal can be reactivated and restored to its original state by baking the charcoal with high heat, which either evaporates or burns off the pollutants.

In the first gas masks of World War I, it was initially found that wood charcoal was a good absorbent of poison gases; it was found that urinating on the gas masks also enhanced the absorption of poisonous gases. In about 1918 it was found that charcoals made from the shells and seeds of various fruits and nuts such as coconuts, chestnuts, horse-chestnuts, and peach stones performed much better than wood charcoal. These waste materials were collected from the public in recycling programs to assist the war effort.