

# Argon Gas - An Insulator

## Introduction

A firefighter dies during a flood rescue mission in March in West Virginia when the boat he is in overturns. Two other men who are also thrown into the frigid water live. What made the difference according to the National Institute for Occupational Safety and Health? Wearing the right type of clothing that provided insulation for the conditions.

In the beginning, when humans wanted to escape extremely cold temperatures, they would slaughter a furry creature and clothe themselves in the pelt. This worked fairly well, except for the smell, and the risk of getting paint thrown on their fur by someone from PETA. Over the ages, humans continued to look to animals for ways to stay warm. Wool was a good source as was down – but the result was either scratchy or so expensive that only the very wealthy could enjoy it.

Then we advanced and created down-like materials – from which we created beautiful puffy coats that looked like we were wearing a quilt – stylish, but not very useful for an active lifestyle.

Through it all, we came to realize that it is really the pockets of air that are warmed by our body heat that keep us warm. This brings us to the next generation of insulation: Argon gas

## What is Argon?

Argon was initially discovered by English scientists when they realized that there was something other than nitrogen, oxygen, carbon dioxide, and water in the air. Lord Rayleigh and Sir William Ramsay were finally able to isolate this mysterious substance in 1894 – discovering the first noble gas which they named “argon” (Greek for “lazy” or “slow”) in reference to its inactivity.

It is a naturally occurring gas that makes up 0.934% of the earth’s atmosphere by volume. It is heavier than air with a density of 1.784 grams per liter compared to the density of air of 1.29 grams/liter. It is not flammable and will not burn or explode as a gas.

Its thermal conductivity – how much heat that it transmits under the specified conditions – is 0.016. This compares to air (which is a mixture of argon, nitrogen, carbon dioxide, oxygen, and water) of 0.022.

## Safety of Argon

Argon is colorless, odorless, and tasteless and since it occurs naturally in the atmosphere is not a threat to the environment. No threshold limit value, permissible exposure limit, or maximum acceptable level has been established for normal exposure to the gas. It is also noncorrosive. As with any gas, however, releases of the gas in small spaces should be minimized since it can displace oxygen resulting in light headedness.

## Uses of Argon

Argon is used in industry in situations where a substance would be changed or impacted by contact with oxygen or nitrogen. It is commonly used as a “shielding gas” in arc welding; is used in incandescent light bulbs to help the wire filament burn longer and brighter, and in “neon” signs. Argon is also used in medical lasers to treat skin conditions. An argon-dye laser is used for eye surgeries for certain retina conditions or to heal damaged blood vessels.

Argon is commonly used in double paned windows instead of regular “air” because of its lower thermal conductivity (meaning that it does not conduct heat or cold as readily as air). Because it is readily available in the atmosphere and is easily recovered, it is also a more cost effective insulator than other inert gases.

For those who are more adventurous, argon is used for dry dive suits. Nuckols et al determined that using argon versus air in a dry suit increased the total suit insulation by 20% - an important difference when you are diving hundreds of feet under water – or participating in ice dives.

## Argon Compared to Other Insulators

Argon, down and synthetic down and other synthetic insulating materials all work by trapping body heat. For both down and synthetic down, the insulating properties are directly impacted by the quality of the material used and the thickness of the insulating material. Down allows body moisture to evaporate, retains its shape, and is lightweight and compressible. Synthetic down is less expensive, holds its insulating properties when wet, is easier to care for than down and is hypoallergenic.

Down loses its insulating properties when wet, it can be expensive to care for down-filled garments, some people are allergic to down, and the higher quality products are expensive. Synthetic down breaks down over time, is heavier than down, and tend to be bulkier than down. The newer synthetic materials also wick moisture and tend to be washable and dryable.

All of the materials, however, are trapping body heat. From a thermal conductivity standpoint, argon’s thermal conductivity is 0.016. Down has a thermal conductivity of 0.025 and some of the more recent synthetic materials have thermal conductivity ratings of 0.03478 – more than double the rate of argon. This means that there is greater heat loss with these products than there is with argon – making it the better insulator.

## Summary

Staying warm under a variety of conditions has long been a goal of the human race – having the right insulator for conditions is critical to survival. Argon is a safe, naturally occurring gas that naturally has excellent insulating properties. It has been recognized as an insulator in windows as well as in the extreme environment of diving. As a gas, it is flexible, ultra lightweight, and adaptable to a variety of insulating scenarios. Welcome to the 21<sup>st</sup> century!

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