

Preface

When I told my friends and colleagues that I was writing a book about Helium I was met primarily with wrinkled eyebrows and comments like, “Why would you write a book about Helium?” I pondered the question for quite some time before deciding to sit down and start typing. I mean, why *is* helium interesting? I would speculate that a vast majority of the population only thinks that helium is used in toy balloons and blimps. Thus, to them, it *would* be quite boring I assume. That’s when it hit me. There needs to be some education about the element that is fundamentally critical to an abundance of high-technology applications in order to help prevent its wastage. You see, helium is the second most abundant element in the Universe but it is actually quite rare here on Earth. I will explain this supply polarity in the subsequent chapters but the point is we currently have a global shortage of the stuff and without it, many facets of industry and scientific research would screech to a halt. There are arguments that toy balloons, which normally sell for a dollar or so should actually sell for higher than US\$50 each to essentially prevent its wastage in the balloon industry. All of that helium inside the latex or foil balloons found in countless birthday parties ultimately finds its way out of the balloon and into the atmosphere where it is lost forever. That helium formerly in the balloon will find a home in our atmosphere for a year or two, mixing with air currents, before it ultimately leaves our atmosphere and enters space.

This book is about the most common isotope of helium, Helium-4 (^4He). When you hear anything about helium, they are more than likely talking about this common isotope which has two protons and two neutrons in its nucleus and orbited by two electrons. Every balloon you see, for instance, contains Helium-4. The same goes for any other helium used in its abundant array of commercial and scientific uses. Helium does, however, have a lighter and stable isotope called Helium-3 (^3He). Although any detailed explanation about Helium-3 is beyond the scope of this book, it is important to note that it is also a very valuable and exceedingly rare commodity that is very important for use in neutron detectors, for example, which are able to detect radioactive materials crossing country borders. In addition, if you Google “Helium-3”, you will find an abundance of information about mining the moon for

Helium-3 for use as a clean nuclear fuel. Whether Helium-3 lunar mining becomes a reality or not is also beyond the scope of this book so it will not be discussed.

The chances are that if you bought this book, you are aware that there is a helium (Helium-4 which I will simply call “helium” from now on) shortage. Hold on, if helium is the second most abundant element in the Universe, how could there be a shortage of it? That’s a great question and one that I am frequently asked. Although the explanation will be discussed in greater detail in subsequent chapters, the short answer is that the Earthly inventory of helium has a different origin than the cosmic inventory. All of the helium found in the Universe was created in the Big Bang, or the birth of our universe, whereas the helium we use here on Earth is a product of the radioactive decay of the two heaviest natural elements, uranium and thorium. Indeed if Earth had no supply of these heavy radioactive elements, we would have no helium to harvest. In fact, if there were no uranium and thorium, life on Earth would be very different than it is today, if life existed at all.

As I go back to my balloon example, every helium atom in that balloon was a product of the radioactive decay of the elements mentioned above. This radioactive decay occurs in both the Earth’s crust and mantle and in rare cases, helium can migrate up through the crust and collect to form commercial deposits. This process will be discussed in great detail in Chap. 4. Interestingly, if I were to look at any balloon at any party in any state in the United States, all of that helium was produced in the United States. You see, the United States has been the primary source of helium worldwide since the industry began after World War I. As I am writing this, however, the paradigm is shifting and the United States will soon be a net importer of helium unless new reserves are discovered. In fact, Qatar has just replaced the United States as the largest exporter of helium in the world.

This book is about Helium and its industry. Although many important aspects and properties are mentioned, helium is a very complex atom with some very amazing properties. However, due to the somewhat macro scope of this book, more micro information such as transition phases between Helium I and II, for example, will not be discussed. In addition, there are other property terms like “polarizability” and “diamagnetic susceptibility”, while important when studying the nature of the helium atom, will not be discussed here. The main objective of this book is to provide the reader with a general, albeit thorough, text of the primary industrial aspects of helium without delving too deeply into the heavy details of the element.

I hope this book satisfies your curiosity about this fascinating element. Although I tend to use “balloons” as examples, it is merely because they are the most visible use of helium and something that most can relate to. In the subsequent chapters we will discuss what helium is and why it is so important across various industrial and scientific applications. Next we will learn about the cosmic abundances of helium and from there move into the history of helium’s discovery. Lastly, we will delve into how it is formed and produced here on Earth, discuss its industry, and visit briefly the future of the helium industry. There is simply no other element like it.

This book was written to provide a full and comprehensive piece on all aspects of helium from its cosmic and terrestrial abundance all the way to its end usage. This text was designed to allow readers to choose what is of interest. Some portions are highly scientific and thus can be skipped if the reader simply wants to better understand a specific chapter of the text.

Helium

The Disappearing Element

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2015, XIII, 138 p. 37 illus., 9 illus. in color., Softcover

ISBN: 978-3-319-15122-9