Helium Shortage 4.0: What caused it and when will it end?

Phil Kornbluth, President of Kornbluth Helium Consulting, discusses the major events that have led to a global helium shortage and outlines projections for the future of the helium market

ANYONE who uses helium in their business will be well aware that the global helium market has been experiencing 'Helium Shortage 4.0' since the beginning of 2022. From January 2022 onwards, most helium users have been dealing with supply allocations from their suppliers and sharply higher prices for the helium that they require. This article will explore the causes of Helium Shortage 4.0, the developments that could bring it to an end, and the potential impact of the war in Ukraine and sanctions on helium market developments.

Unprecedented helium shortages

Helium markets have experienced a series of extended periods of short supply since 2006. In fact, 2022 was the eighth year of supply deficits during the 17-year period between 2006-2022. But 2022 was not supposed to be another year of shortages. The giant state-owned Russian energy company Gazprom was supposed to start up a huge natural gas processing plant to process the gas flowing to China through the 3,000km Power of Siberia pipeline in the Amur Region of Siberia in late 2021. The waste gas from the Amur gas processing plant is rich in helium and is an ideal feed gas for a helium purification and liquefaction plant. Gazprom plans to produce helium from three separate helium plants, each of which will have annual nameplate capacity of about 28.2 million litres (750 million standard cubic feet or SCF). At full capacity, which was not expected to be reached until 2025, the Amur Plant has the potential to produce 84.5 million litres (2.25 BCF) per year of bulk liquid helium, equivalent to roughly one-third of current worldwide capacity. Gazprom had been planning to start up the first helium plant in 2021, with the second plant starting up in 2022 and the third plant starting up in 2024 or 2025. With two plants running in 2022, adding up to 56.3 million litres (1.5 BCF) to world supply, 2022 was expected to be the year when the era of recurring helium shortages finally came to an end. Unfortunately, this has not come to pass. After briefly starting up the first helium plant at Amur in September 2021 and producing helium for a few weeks, the plant was taken down to complete punch list construction items. While the plant was offline, there was a fire in the natural gas processing plants feeding the first helium plant on 8 October 2021 and then, on 5 January 2022, there was a major explosion/fire in the natural gas processing plants providing helium feed

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gas. These fires and explosion were major setbacks for helium production from Amur and, combined with the impact of the war in Ukraine and sanctions, have delayed helium production from Amur until at least the second quarter of 2023.

While helium markets were disappointed by the delayed impact of new Russian supply, there were a handful of other contributing factors to Helium Shortage 4.0. Foremost among them, there was an extended outage of the U.S. Bureau of Land Management's (BLM) purifier, commonly referred to as the Crude Helium Enrichment Unit (CHEU), that upgrades the purity of crude helium removed from the Cliffside Field storage reservoir before delivering it to four privately owned helium purification/ liquefaction plants connected to the BLM Pipeline & Storage System. The CHEU went down around 10 January 2022 and did not resume operations until 10 June, removing more than 10% of global capacity from the market. Other factors contributing to the severity of Helium Shortage 4.0 included planned maintenance at two of the three helium plants in Qatar during February and March, reduced production from Algeria caused by the need to replace the loss of Russian gas resulting from the war in Ukraine, reduced production from the Darwin, Australia, plant due to depletion of the Bayu-Undan offshore natural gas field and a fire at a natural gas processing plant in Haven, Kansas, that produces crude helium. Suffice to say, a lot of things went wrong with the world's helium supply in 2022 and we ended up with a severe helium shortage.

User impacts of Helium Shortage 4.0

How did Helium Shortage 4.0 impact helium users? Four of the world's five major helium suppliers, including Air Liquide, Linde, Matheson and Messer, declared force majeure and implemented supply allocations (i.e. rationing) for their contract customers. Among the helium majors, Air Products and Chemicals was the sole exception. With supply allocations, customers receive a fixed percentage (i.e. usually less than 100%) of their helium requirements based on their share of a prior period's historical deliveries. Allocation percentages typically vary depending on the criticality of the application for which helium is utilised. For example, a medical application, such as MRI, might not be subject to allocation, or might receive a very high allocation

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percentage, while a customer who uses helium to fill party balloons might be subject to a low allocation percentage. Allocations can cause a great deal of inconvenience and frustration, and they may result in constraints on the helium users' business or activity. Besides allocations, the other major impact is on price. The helium business, with only five major global suppliers, is an oligopoly and the major gas companies are adept at managing price. During shortage periods, prices can increase quickly and dramatically. That has been the case during Helium Shortage 4.0, with price increase activity receiving an added boost by the need to pass through significant increases in the cost of helium produced by ExxonMobil and Qatar Petroleum. While there is no publicly available information on the price of helium, helium price levels have increased by 50-100% for most helium users since the start of Helium Shortage 4.0.

Future projections for the helium market

As of March 2023, the key questions on the minds of helium users include:

- How long is Helium Shortage 4.0 going to last?
- What development will cause Helium Shortage 4.0 to end?
- How will the war in Ukraine and sanctions factor into all of this?

The remainder of this article will attempt to answer these questions.

The short answer to the first two questions is that Helium Shortage 4.0 will probably come to an end when the Amur plant restarts and is able to sustain production and deliver helium to the market at an annualised rate of approximately 37.6 million litres (1 BCF) per year. This would add around 15% to current supply and should be enough to restore a healthy balance between supply and demand. This quantity of new supply would require two of Amur's three plants to be in operation, with production equal to about 1 1/3 of one plant's nameplate capacity. When might this happen? As of late in the fourth quarter of 2022, Gazprom had been telling its customers that it would restart the first helium plant no later than April 2023, with the second helium plant starting up a couple of months later, sometime in late Q2 or Q3. In a 15 December press release, Gazprom stated that "the status of project execution has reached 87.52%. In particular, pre-commissioning continues on the third process train of the (gas processing) plant and the second unit of helium treatment, liquefaction and packaging." Based on these statements, it seems plausible that Gazprom could be producing enough helium from two helium plants to end Helium Shortage 4.0 by the end of 2023. However, it should be noted that, even though Gazprom has stated that they plan to produce helium by a certain date, there

is no guarantee that it will be able to do so, as there have been a number of missed deadlines associated with the Amur Project.

Even if Gazprom is able to start up helium production from two helium plants during 2023, there is significant uncertainty, due to the potential impact of existing and possible future sanctions. As of the time that this article is being written, there are no sanctions by Western countries or Russia that would prevent the export of Russian helium. While that could change at any time, there are sanctions-related obstacles that will make it challenging to get Amur production to market. Western ocean carriers are not allowed to call on Russian ports, reducing the number of ships that are calling on Vladivostok – the primary port for exporting helium from Russia. That greatly diminishes the number of slots available on cargo ships for the transport of 11,000 gallon helium containers and will make it much more difficult to maintain the steady and reliable flow of containers to/from Amur required to deliver two helium plants' worth of production to the market. Similar factors come into play for ground transportation from Europe. It is clear that logistics to/from Amur will be very challenging.

Another possibility is that sanctions could be imposed on exports of Russian helium that would cause Gazprom's existing contracts with the major helium suppliers to unravel. Helium demand from non-sanctioning countries, including China, Korea, Taiwan, India, and Singapore, is more than sufficient to absorb the production from Gazprom's first two helium plants. So, at first glance, one might think that it would be relatively easy for Gazprom to secure new customers for its helium. But that might be a very incorrect conclusion, because it could take at least several years for Gazprom's new customers to acquire the specialised cryogenic containers required to transport bulk liquid helium. If we assume that one container can be utilised to make 4-5 shipments per year, a total of 300-375 containers would be required to transport the full capacity of Gazprom's first two helium plants. At this time, there are only two established manufacturers of helium containers in the world – the Gardner Cryogenics subsidiary of Air Products and Linde Engineering. Both of these companies have recently been quoting lead times in excess of 18 months to prospective customers. For that reason, obtaining 300-375 tanks would not be a quick and easy task to accomplish. While some number of containers would be immediately available for delivery of helium from Amur, it would be far less than required for the full capacity of two helium plants and the shortage of tanks could greatly reduce the flow of Amur production into the market. If that were to happen, Helium Shortage 4.0 could be extended for up to several more years.

Even if there are no direct sanctions on Russian helium exports and the existing helium sales agreements remain intact, there are other potential indirect impacts of the war in Ukraine and sanctions that could impede the flow of helium from Amur into the market.

Let's revisit the three key questions from earlier after considering the above discussion. In the most optimistic scenario, which includes flawless execution by Gazprom to restart Amur, no sanctions on helium exports from Russia, existing sales contracts remaining in place and the ability to overcome logistics challenges, Helium Shortage 4.0 could begin to wind down during the second half of 2023 and come to an end by 2023 year-end. In worst-case scenarios, where sanctions cause the existing sales contracts to unravel and it takes Gazprom's replacement customers from non-sanctioning countries several years to procure the containers required to move Gazprom's helium to market, Helium Shortage 4.0 could continue throughout 2024 and into 2025. There are many different scenarios that can be considered that are somewhere between the optimistic and pessimistic cases. With so many variables to consider, it is very difficult to make a credible prediction as to how the situation will play out.

As Qatargas is planning to bring on its fourth helium plant (Helium 4), with 56.3 million litres (1.5 BCF) of new capacity in 2027 and there are quite a few other projects under development, it seems that helium supply should be plentiful towards the end of the decade. But for the next couple of years, at least, it looks like companies who are impacted by the balance between helium supply and demand will be dealing with tremendous uncertainty.

About the author

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