

Boron Detectors - alternatives to ^3He tubes

Insights: The Helium-3 crisis

^3He in natural sciences-----

So far for the efficient detection of thermal neutrons Helium-3 based detectors are used, wherein ^3He serves as a neutron converter as well as a counting gas. These detectors are a core component of radiation monitors for security issues, but are as well widely used in neutron facilities to equip a manifold of instruments. Additionally, in cryogenics refrigerators utilize pure ^3He or mixtures with ^4He to achieve temperatures far below 1K. Nowadays research centres like J-PARC in Japan need amounts of 100,000 litres for operation.

The ^3He crisis -----

Until the present day it has not become feasible to extract ^3He from natural resources, although the abundance in the atmosphere is about 1 ppm and in some gas sources up to a few percent. So virtually all Helium-3 is of industrial origin, precisely stemming from the decay of Tritium, used as a booster for nuclear weapons. Driven by the arms race in the Cold War, mainly Russia and the USA produced and stored huge amounts of Tritium, which was decaying with a half-life of 12 years to Helium-3. In the beginning, due to the absence of a designated purpose, it was simply released into the environment until the potential of this resource as a neutron detector had been realized. The US then started to accumulate it reaching a peak amount of 235,000 litres in the late 90s. Up to the end of the last century it has not even been considered critical that the drop out of the Tritium production due to global disarmament lead consequently to a net stagnation of the contribution to the Helium-3 stockpile. But caused by the terrorist threats of 9/11 in 2001, the US government started to install Helium based radiation detectors all along their borders and in international ports to prevent radioactive material being brought into the country. This demand exceeded the

production so much, that the US

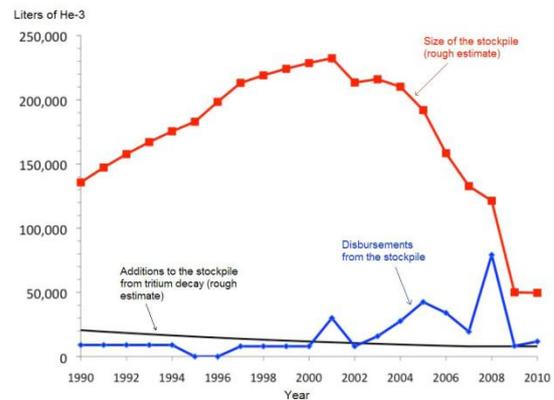


Fig. 1 Size of the Helium-3 stockpile 1990-2010 [1]

started to release almost all Helium-3 from their stockpile. In the year 2009 then a committee was set up to address the upcoming shortage leading to a policy of restricting the distribution of Helium considering the leftover volume. Caused by limiting the supply, the price of Helium-3 then raised exorbitantly from about 100 \$ to now 2000 \$ (UK) a litre. This pending shortage actually was not clearly noticed by the majority of scientist over a quite a long period of time as research centres not least could rely on their own reserves. Now research aims at the development of alternative technologies capable of substituting Helium based systems as far as possible. Meanwhile a number of concepts have been put on the table - some even exposing features extending the range of possibilities of measurement techniques.

References:

- [1] D. Morgan and D. Shea, "The Helium-3 Shortage: Supply, Demand, and Options for Congress", Congressional Research Service, 12/2010