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Solubility of hydrogen in liquid helium – measurement project

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Hydrogen contamination in liquid helium has been recognized as a problem for several years now. A number of industrial helium extraction plants in the Mediterranean region have been pinpointed by the authors as the possible source. Hydrogen contamination has now been found in a large number of local helium liquefaction plants. These impurities were brought in with the helium deliveries and continue to accumulate. This often results in significant operational disruptions at the universities or research institutes affected: For example, this can be seen as frequent blockages in helium flow cryostats or in throttle sections of pumped systems.

The solubility of hydrogen in liquid helium is very low, and the exact value remains unknown. It is reasonable to assume that other factors also play a role.

One of the aims of the *HyLiqHe* project is to investigate the issue in more detail. The project is funded by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation). Appropriate measurement setups and measurements are underway. In addition to reliably quantifying hydrogen in the parts per billion (ppb) range, it is particularly challenging to distinguish between dispersion and solution within the liquid.

This contribution presents the results of a preliminary orientation experiment. The objective of this study is to obtain an approximate value for the solubility limit. A standard laboratory dewar was intentionally contaminated with a comparatively large amount of hydrogen, then sampled at various points within the helium reservoir using gas chromatography. Agglomerates of precipitated, solid hydrogen were observed at the phase boundary, alongside high levels of contamination in the low temperature gas phase. Reproducible values slightly below 100 ppb were measured in the liquid. The results are discussed; they support existing hypotheses on contamination behaviour within cryogenic facilities.

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