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Investigations of aged metal seals for interim storage

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Abstract. The storage of spent fuel and high-level radioactive waste in Germany is performed in interim storage containers with double-lid systems. The lids are bolted and equipped with metal seals (e.g. Helicoflex®) to ensure the safe containment of the inventory. The used metal seals have a layered structure consisting of three components as can be seen schematically in the cross-sectional view in Fig. 1.

In the centre, a helical spring is positioned that is surrounded by two C-shaped jackets and is mainly responsible for generation of the required restoring force. The inner jacket is made of stainless steel and homogenises the restoring force of the helical spring. The outer jacket is made of silver or aluminium which are both soft metals in comparison to the contact partners (lid and container body). During bolting of the lid to the container body, the seal is compressed. The generated restoring force of the helical spring causes a plastic deformation of the outer jacket and adapts to the surfaces of the lid and the container body. Hence, leakage paths are closed, and the sealing function is generated.

Typical durations for existing interim storage licenses in Germany are 40 years, but it can be expected that they have to be extended to longer periods as a final repository will not be available before the end of the running licence periods. This extension of licence periods requires a solid understanding of the long-term behaviour of the seals under storage conditions. To meet this challenge, long-term investigations were started at the Bundesanstalt für Materialforschung und -prüfung (BAM) in 2009. These tests focus on seals assembled in test flanges which are stored at temperatures ranging from room temperature to 150 °C for accelerated ageing. The aged seals are tested repeatedly after certain ageing steps, and the leakage rate (as indicator for sealing performance), the remaining seal force, and the useable resilience upon decompression are determined.

An update on the performed investigations with respect to earlier publications (Grelle et al., 2019; Goral et al., 2023) will be given, and the implications of the results for resilient, long-term safety will be presented. Additionally, there will be a focus on the currently planned further investigations, and the following question will be addressed. What is additionally needed for evaluation of an interim storage period extension in regard to the used metal seals?

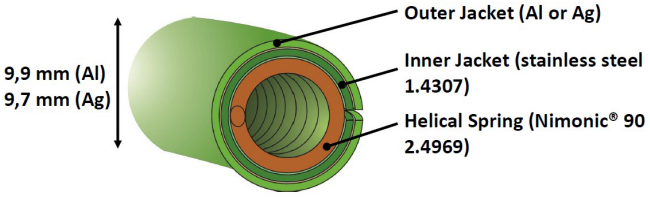

Figure 1. Cross-sectional view of Helicoflex® metal seal (based on Probst et al., 2014).

References

Goral, M., Kömmling, A., Probst, U., Wossidlo, P., Jaunich, M., Wolff, D., and Völzke, H.: Langzeitversuche über 10 Jahre an Federkern-Metalldichtungen mit Aluminium- bzw. Silberummantelungen, in: Jahrbuch Dichten, Kleben, Polymer, edited by: Berger, K. and Kiefer, S., ISGATEC, Germany, 43–63, ISBN 978-3-946260-08-0, 2023.

Grelle, T., Probst, U., Wolff, D., Jaunich, M., and Völzke, H.: Investigations on the long-term behavior of metal seals for dual purpose casks, 19th International Symposium on the Packaging and Transport of Radioactive Materials PATRAM 2019, 4–8 August

2019, New Orleans, LA, USA, INMM, https://resources.inmm.org/system/files/patram_proceedings/2019/a1251_1.pdf (last access: 18 July 2023), 2019.

Probst, U., Schulz, S., Jaunich, M., Wolff, D., and Voelzke, H.: Langzeituntersuchungen and Metalldichtungen für Transport- und Lagerbehälter für radioaktive Stoffe, in: Dichtungstechnik Jahrbuch 2014, edited by: Berger, K. and Kiefer, S., ISGATEC, Germany, 162–173, ISBN 978-3-9811509-7-1, 2014.