Corrosion Protection of Containers for Radioactive Waste – Storage Requirements –

Dr. Axel J. Schmidt, Günter Hasemann, Friedel Vollmer
Phone: +49 511 986-1791/ -1813, Fax: +49 511 986-1848
axschmidt@tuev-nord.de, ghasemann@tuev-nord.de, fvollmer@tuev-nord.de

TÜV NORD EnSys Hannover GmbH & Co. KG
Am TÜV 1, D-30519 Hannover, Germany

Abstract

Radioactive waste must be handled and stored in a controlled manner. The cask/container is an important barrier for retaining the radionuclides. In Germany various types of casks/containers exist for the conditioning of radioactive waste. The type used for a specific application is selected according to the properties of the radioactive waste and the acceptance criteria of the chosen storage facility. The storage of casks/containers also must comply with the acceptance criteria of the existing interim storage facilities as well as the acceptance requirements of the planned repository Konrad.

German authorities require qualification of handling concepts, checking of documentations and inspection casks and containers for the safe long-term storage of radioactive waste on behalf of the safe storage of radioactive waste packages. These reviews have to be done by independent experts based on knowledge of all necessary elements of the containers, e.g. material, fabrication facilities including manufacturing, mechanical test results and corrosion protection systems and must be finished before beginning of the storage.

In order to achieve consistent standards for corrosion protection systems existing operating instructions and manuals (internal/external) or comparable supporting documents according to standards and regulations (DIN ISO / DIN EN) are of great importance.

Introduction

If nowadays the talk is about processing, packing and long-term storage of low and intermediate level radioactive waste (LILW), then the question of suitable waste casks/containers is immediately connected with this subject. Which one of the existing and future interim storage facilities in Germany is being examined more closely is only of secondary importance here.

Based upon the acceptance requirements of the planned repository Konrad and and Technical Acceptance Criteria (TA) of existing interim storage facilities, the container-specific needs are transferable to additional interim storage facilities as well.

Essential issues are being reinforced by the recommendation of the German "Reactor Safety Commission" (RSK) of December 2003 to long-term interim storage of LILW. In it, it is listed that by means of suitable laying of the waste containers (materials, corrosion protection, design layout, such as avoidance of unprotected crevices) long-term integrity must be ascertained.

Casks/Containers

As a basic principle, waste casks/containers can be categorized into three basic types. Aside from concrete (cylindrical) casks we have cast iron (cylindrical) casks and containers. Containers can be made of various materials (e.g. reinforced concrete, cast iron or sheet steel). Solely the main dimensions and the permissible maximum weight are fixed for the individual basic cask/container types. The sheet steel container in different versions (type I - VI) has been certificated for the most part.

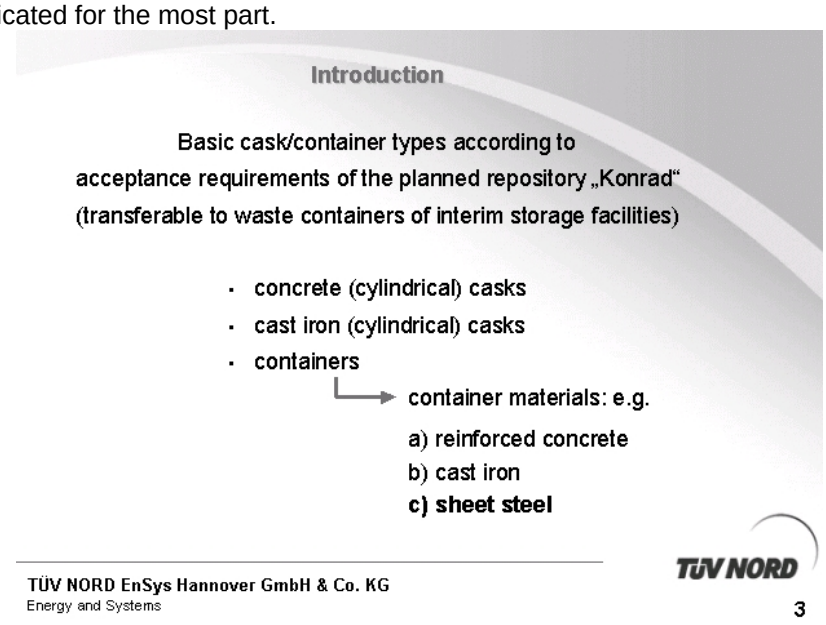

Figure 1: Basic casks/container types

Because of its material-conditioned version ("carbon steel") several essential issues resulting from the Technical Acceptance Criteria of interim storage facilities and repository will have to be considered for this type of waste container.

- Waste containers made of sheet steel must be manufactured in a corrosion protective manner on the interior and exterior. They must have a corresponding surface protection (e.g. priming and final painting).
- Waste containers must be resistant against corrosion from the exterior (atmospheric influence) and interior (waste products) in a manner that they will not sustain any attenuation which could result in container failure.
- During the waste packaging process care has to be taken in that the corrosion protection layer will not be damaged.
- Ease of decontamination of the exterior surface painting is a prerequisite.

Based on the above, the necessity of corrosion protection can be summarized as follows:

Whereas corrosion protection is generally used to avoid the deterioration of materials, it is necessary in the case of containers for radioactive waste specifically, to ensure the mechanical integrity of the container. This means, that for the entire duration of interim storage, which can extend over several decades, the waste container must be manageable in a safe manner. Under this aspect, the effect of unprotected container surfaces and unprotected open crevices must eminently be taken into consideration.

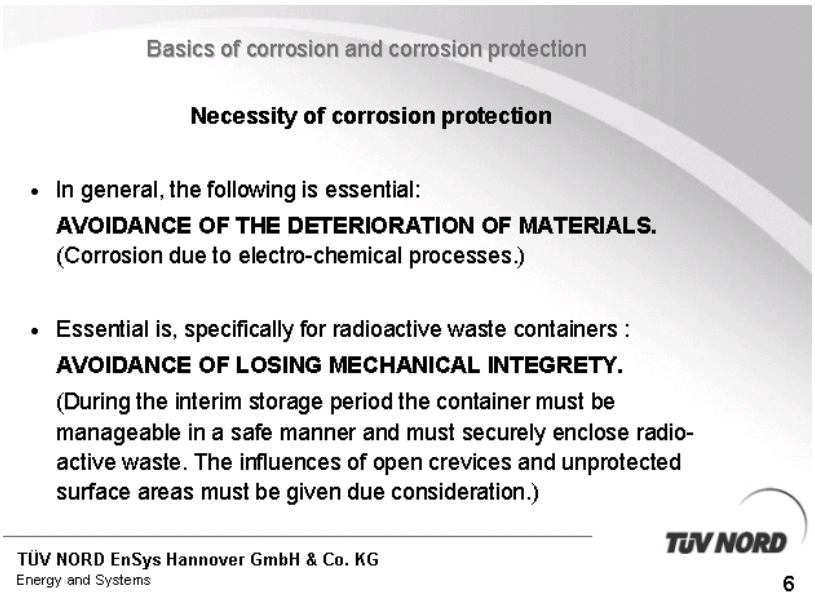

Figure 2: Necessity of corrosion protection

Here, too, current regulations have become very instrumental when it comes to questions concerning corrosion protection of sheet steel containers. To this respect, DIN EN ISO 12944 (ISO 12944) “Paints and Varnishes – Corrosion protection of steel structures by protective paint systems“ offers in 8 chapters essential information and, furthermore, corresponding reference to other standards and regulations.

It is common knowledge that statements concerning the effectiveness and corrosion protection depend on numerous factors.

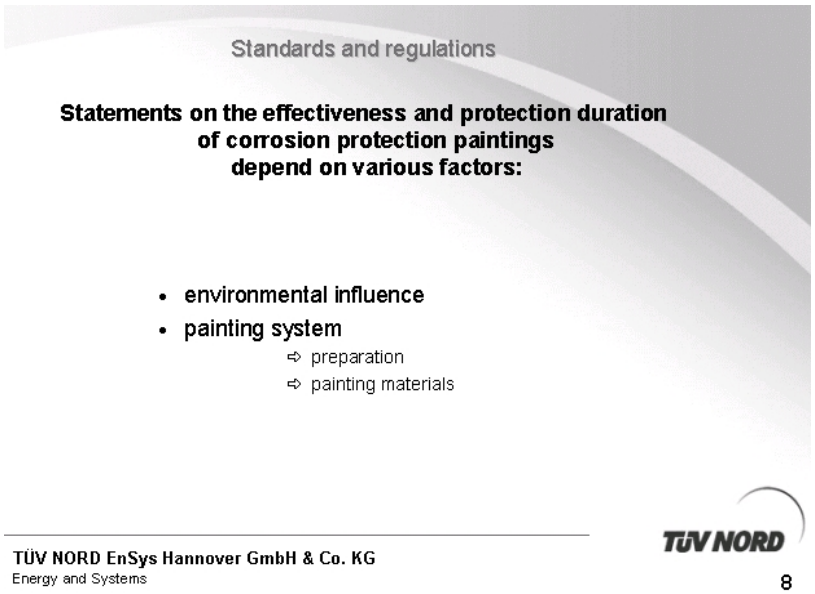

Figure 3: Factors of influence

For this reason, DIN EN ISO 12944 Chapter 2 takes the environmental influence into consideration and divides the environment (atmospheric conditions) into 6 corrosion categories. Data of the maximum assumed base material thickness decrease are being recorded after the first year of each category. Therefore, storage rooms with climate conditions that have been adapted to the waste packaging will be categorized C1 'insignificant' (thickness decrease max. 1.3 µm). Whereas buildings without heating, where condensation can occur can only be categorized as C2 'low', since a thickness decrease of alloyed steel can already be as high as 25 µm after one year. Aside from those corrosion categories there is no need to look at others on account of existing environmental conditions in interim storage facilities for radioactive waste.

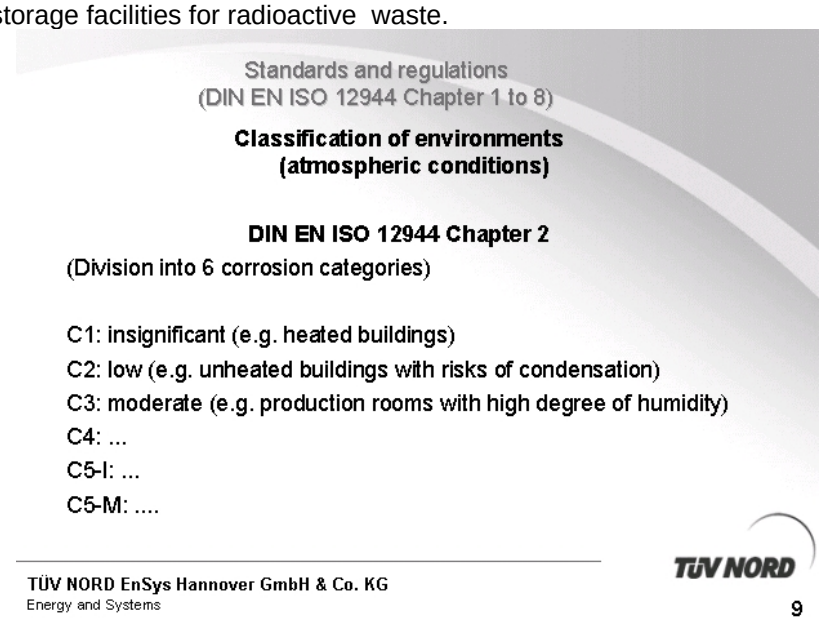

Figure 4: Standards and regulations

Whereas in Chapter 3 of DIN EN ISO 12944 basic rules for the design of construction elements are being pointed out, due to the fact that corrosion protection must already be taken into consideration at the 'drawing table', deals Chapter 4 with the different types of surfaces and surface preparation. Inadequate removal of rust, scales, grease, humidity or soluble salts, for example, will to a decisive degree have a negative effect on the adhesiveness of the painting.

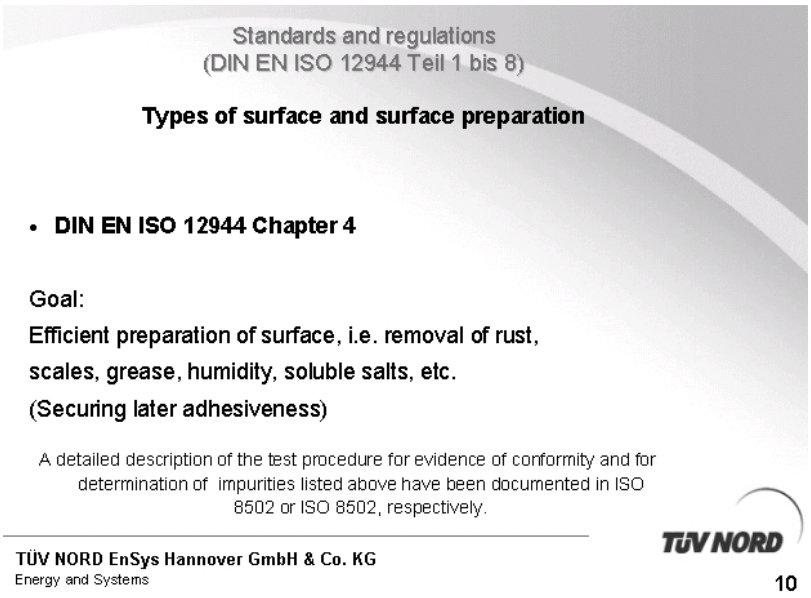

Figure 5: Standards and regulations

In this connection, in Chapter 5 of DIN EN ISO 12944 reference is made on the selection of a suitable painting system, which is dependable on the environmental conditions, the desired protection duration and the degree of surface preparation. As a matter of principle, when selecting the painting material, the technical bulletins of the painting material manufacturer should be consulted.

The evaluation of painting systems by means of laboratory tests are part of Chapter 6, whereby the test results obtained are to be regarded as an assistance for the selection of suitable painting systems.

Chapter 7 deals with the execution and monitoring of the painting operation in and outside of the plant. Chapter 8 finally contains the establishment of specifications for the initial painting as well as maintenance.

Summary

The results of knowing the requirements of the Technical Acceptance Criteria, the RSK recommendation and the standards and regulations, in particular those of DIN EN ISO 12944 Chapter 1-8 can be summarized as follows:

Statements and proof of corrosion protection of containers (sheet steel containers) for radioactive waste prior to the storage of waste packaging are a matter of principle in Germany. This includes proof of general suitability of the painting (e.g. pertaining to adhesiveness and ease of decontamination), proofs of painting processing (preparation, layer thickness, etc.) and proofs of adequate painting condition at the latest possible point in time, i.e. after conditioning, just prior to storage.

Statements on eventual repeated testing of the waste containers to be conducted during the storage period definitely are dependable on the proof to be rendered as listed above and on storage conditions. Here, DIN EN ISO 12944 (= ISO 12944) has emerged as a useful tool for the manufacturer, the deliverer as well as for the testing body. Waste product properties which possibly will only emerge during the course of radioactive waste processing, are to be given due consideration at all times, whereby the quintessential protection will be arrived at with dry waste.