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Water Resources Law (WRL): Secure anchoring in concrete sealing surfaces

Whitepaper for planners & users

Contents.

Whitepaper
“WRL: Secure anchoring in concrete sealing surfaces”

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Water Resources Law (WRL)
Facts & figures.

Two barriers

Plants with liquid substances hazardous to water must always be fitted with a primary and secondary sealing barrier.

Plant systems usually consist of a container and a drip pan.

LI concrete is a per se liquid-tight concrete. **LIP concrete** is LI concrete after a penetration test and can therefore differ from the technical rules of LI concrete.

For **coated concrete** the coating alone guarantees the impermeability of a building component.

WRL

The principle of concern requires that potential water body contamination must be avoided at all times.

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The WRL defines the sustainable management of water bodies with the aim of protecting water as a resource. The terminology WRL can be found in the German legislation and technical literature as WHG (Wasserhaushaltsgesetz). Among other things, it defines requirements for industrial plants for the safe handling of substances hazardous to water.

70 %	of the earth is covered with about 1.4 billion cubic kilometres of water.
97.4 %	of the total amount of water consists of non-potable salt water.
2.6 %	of the global water volume is fresh water bound in ice and snow.
0.3 %	of the world's water resources constitute liquid, drinkable fresh water.

1960

on 1st March, the Water Resources Law in the Federal Republic of Germany officially came into force.

The abbreviation HBV (**H**erstellen, **B**ehandeln, **V**erwenden) stands for plants for the manufacturing, treatment and use of substances hazardous to water. HBV plants must observe the principle of concern.

LAU plant →

← **HBV plant**

LAU plants (**L**agern, **A**bfüllen, **U**mschlagen) are plants for storing, filling and handling substances hazardous to water. The WRL explicitly requires a "suitability determination" for LAU plants.

Significance of WRL sealing surfaces
A brief introduction.

Water bodies are an elementary component of the natural balance and serve both as the basis of human life and as a habitat for animals and plants. Germany's Water Resources Law (WRL) has been in place since 1960, the primary objective of which is to **protect water resources** as a usable commodity through sustainable water management. For companies and everyone involved in the installation of hazardous substance plants, this entails a multitude of challenges. After all, every plant operator has to ensure in accordance with the WRL that no water-hazardous substances enter the environment. According to the Federal Ministry of the Environment, one litre of waste oil is enough to render one million litres of drinking water unusable. The WRL therefore contains strict requirements as a **precaution against water and soil damage.**

The principle of concern

The principle of concern in the Water Resources Law (WRL) requires that potential contamination of water bodies (surface waters and groundwater) must be avoided as a matter of principle. In this whitepaper, we only refer to plant-related water protection. The regulation on facilities for handling substances that are hazardous to water (AwSV) provides concrete specifications for plants handling substances hazardous to water. Summarised briefly, plants such as these must always be designed as a redundant system with a primary and secondary protective barrier. The secondary barrier consists of either LI-/LIP-concrete according to the German Committee for Reinforced Concrete (DAfStB) guideline, normal concrete with an approved WRL coating or a secondary drip pan, e.g. made of steel. In addition, operators must comply with certain obligations such as continuous control measures.

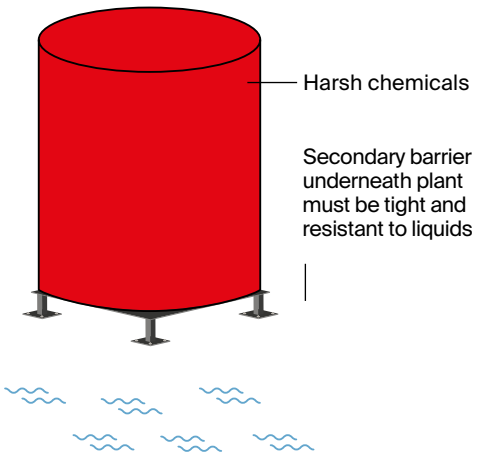
The challenge of WRL surfaces

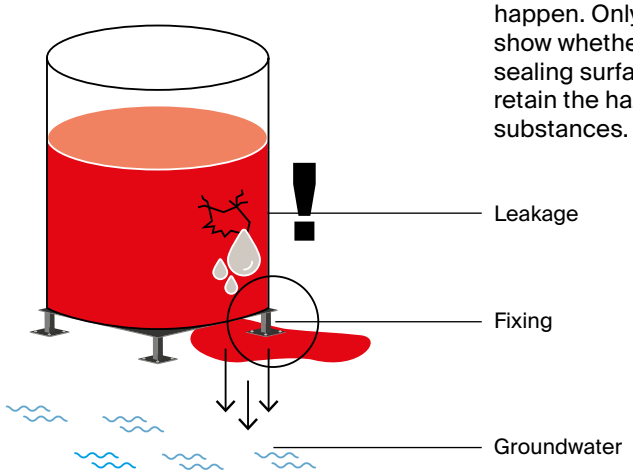
In practice, plant designers and especially plant constructors are often faced with the task of installing secondary barriers (sealing surfaces) on the ground surface below a plant. To do so, they create concrete surfaces impermeable to liquids, for instance, in accordance with the WRL. If anchors are also placed in the area of sealing surfaces, the **resistance and impermeability** of the fastening solution must be proven, as the sealing is potentially no longer guaranteed at this point (you can read more about this on page 8, among others).

What is the purpose of WRL sealing surfaces?
WRL sealing surfaces are intended to prevent substances hazardous to water from penetrating into surface and underground water.

fischer obtained the first general design approval (aBG) for WRL-compliant anchoring in LI-/LIP-concrete, issued by the DIBt (German technical authority and a service provider for the construction sector). Plant designers and constructors can thus rely on a safe and proven system that supports them in acting in an environmentally friendly manner. Find out more about WRL-compliant anchoring and the solutions fischer offers in this whitepaper.

Leakage with liquid





Accidents can always happen. Only then will it show whether the sealing surface can fully retain the hazardous substances.

Anchorings in WRL sealing surfaces. Systems per anchoring base.

The anchoring ground is a decisive factor with regard to the WRL-compliant usability of fixing systems, as not all anchor types can be safely and permanently installed on every anchoring base. With **regard to concrete sealing surfaces**, a floor slab used as a barrier layer (WRL sealing surface) can either be made of liquid-proof concrete (LI-/ LIP concrete) or with a sufficiently resistant coating applied to standard concrete.

Installation knowledge

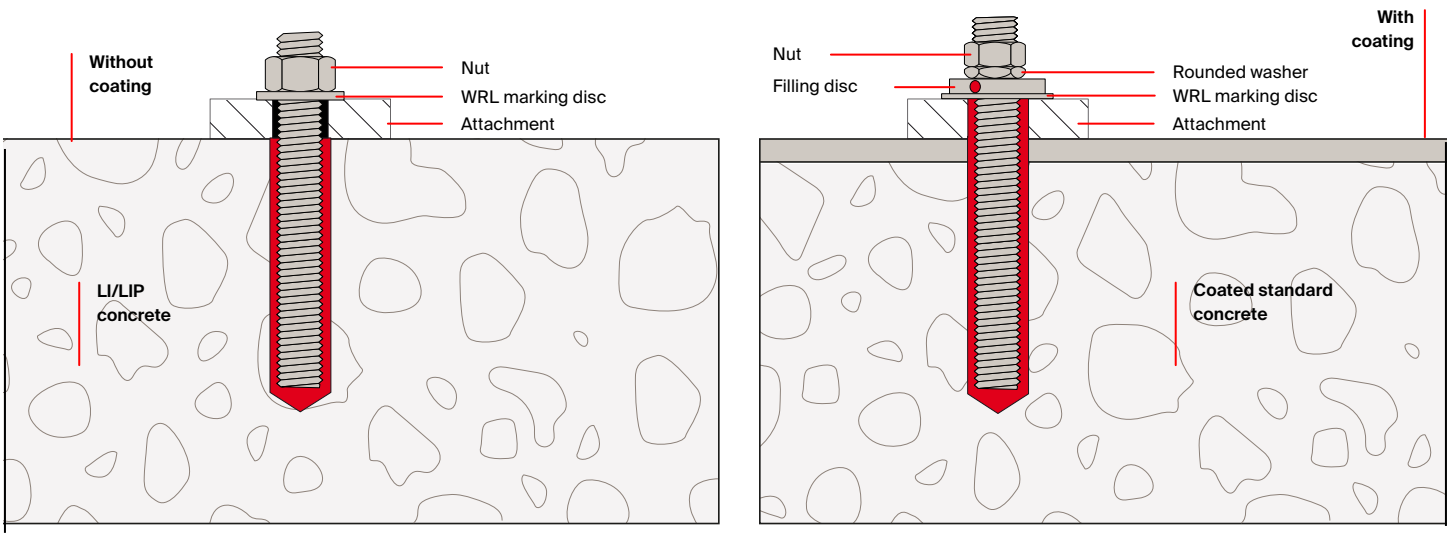
Irrespective of the existing anchoring base, the WRL places **high demands on the stability, serviceability as well as tightness and resistance** of fixing systems.

For example, the “Concrete construction for the handling of water-polluting substances” **(BUmwS)** guideline by the German Committee for Reinforced Concrete (DAfStb) stipulates that only anchors approved by the building authorities in combination with proof of usability regarding the substance in use may be used for fastenings in concrete sealing surfaces. This is ideally fulfilled by a general design approval (aBG). Mechanical anchors are not permitted in this case, even if care is taken that the anchor is grouted in some way with mortar, because the tightness of the anchoring solution cannot be fully guaranteed, especially with mechanical anchors.

First installation steps in the context of the WRL

After checking the anchoring base (LI/LIP concrete or coated concrete), users can refer to the general design approval (aBG) or the expert report to determine whether an anchor can be used for the respective application, taking into account the medium found in the plant. **See page 10** of this white paper for more information.

The various systems



Sealing in LI/LIP concrete

A fixing in LI/LIP concrete must be designed so that no liquid can pass through the anchor installed in the concrete. This can be achieved by using suitable bonded anchors. A drill hole can usually be drilled with a hammer drill or a hollow drill. The drilling methods are defined and described in the respective assessment of the injection system (ETA). In addition, the drill hole depth must always be at least 50 mm less than the existing thickness of the fixing component.

The **European Technical Assessments (ETA)** associated with the product are mandatory and cover all requirements in terms of stability and serviceability. They regulate planning, verification and construction procedures. With WRL-compliant anchorings for applications in LI/LIP concrete, for which a general design approval (aBG) is available, users are on the safe side. Alternatively, expert reports or manufacturer's declarations may serve as supplementary proof of the tightness and resistance of a sealing system.

Sealing with coating

If the WRL sealing surface is realised by a coating applied to the concrete, this coating is solely responsible for sealing against water-polluting substances. After being anchored in coated concrete, the tightness of the coating must be completely restored despite any drilling. This applies equally to joints, floor drains and upstands.

When using injection systems, anchor rods are mounted into the mortar-filled drill hole by hand with a slight rotary movement.

Prof. Jörg Reymendt has been an expert on plants for the handling of substances hazardous to water according to the Water Resources Law (WRL) and facilities regulation (AwSV) since 1998.

» The increased protection of soil and water must continue to be one of our main objectives in the coming decades. Every small improvement, when applied many times, helps us to get closer to this. «

Prof. Dr. Jörg Reymendt

Professor at the Frankfurt University of Applied Sciences and partner at the ISG engineering firm and the IPQ Institute for Testing and Quality Assurance

WRL-compliant anchoring
Requirements for fixing systems.

In addition to the required proof of load-bearing capacity and serviceability, the German Committee for Reinforced Concrete (DAfStb) lists **two main criteria for an overall system** in the "Concrete construction for the handling of water-polluting substances" (BUmwS) guideline. These are impermeability and durability. Bonded anchors are stipulated for anchoring systems, and their suitability for the substance to which they are exposed has to be confirmed. As already mentioned, a **general design approval (aBG)** ensures this.

Role of the DIBt in approvals

European Technical Assessments (ETA) are universally valid throughout Europe. In the special context of the WRL, however, additional requirements are placed on the tightness and resistance of systems. These are regulated by the general design approval (aBG) referring to the ETA. The general design approval (aBG) is issued by the German Institute for Structural Engineering (DIBt - Deutsche Institut für Bautechnik). This confirms compliance with both building and water law requirements, meaning that the products and types of construction are considered suitable according to the **WRL**.

The DIBt (German technical authority and a service provider for the construction sector) draws up detailed **approval principles** based on such guidelines as well as technical rules. The test criteria contained therein in turn form the basis for the DIBt's (German technical authority and a service provider for the construction sector) general design approval, especially for anchoring systems for LI/LIP concrete.

Anchoring systems have to be tested in elaborate test series. Here you can see test cylinders being sampled from a coated concrete surface.

Reliable WRL compliant anchoring with fischer: sealed, tested, and officially approved.

Find out all about the **FIS EM Plus** and matching system components.

Go to the **WRL sets.**

Where to anchor according to the WRL

Chemical production tanks and pipelines, machines with more than 220 litres of hydraulic oil, rack and pallet storage or tank facilities: these and other facilities must be anchored in conformity with the WRL in order to protect water bodies from harmful alterations.

This protection is guaranteed by both **LAU plants** as well as **HBV plants**. LAU plants (Lagern, Abfüllen, Umschlagen) are plants for storing, filling and handling substances hazardous to water. "HBV" (Herstellen, Behandeln, Verwenden) is an abbreviation for manufacturing, treatment and use. If the leak tightness of a plant has to be ensured by structural means, this is guaranteed by specially designed constructions. These secondary barriers collect liquids hazardous to water in the event of **primary barrier** leakage – for example in the event of an accident – and retain them for a limited period of time until the damage has been repaired.

The tightness of the **secondary barrier** is achieved, as already described, either by using LI/LIP concrete, by applying a coating to the concrete surfaces or by using an additional drip pan (e.g. made of steel). It is essential that the **overall construction can also be classified as liquid-tight.** With LI-/LIP concrete, the bonded anchor must therefore be as tight as the surrounding concrete. In the case of coated concrete, this applies to the sealing layer that - after having been "opened" by drilling – has to regain its original tightness after the drilling process.

No matter what type of plant is involved, drilling and anchoring through a coating system are always to be evaluated as defects and potential leaks.

i The **exposure levels of WRL plants** are differentiated between one-time and intermittent exposure. In the case of one-time exposure (e.g. in the event of an accident), the WRL plant is only exposed to a water-polluting substance or mixture for a certain period of time. In the case of intermittent loading, a certain drip loading frequency is assumed (e.g. in the case of regular filling processes).

A chemical production with tanks and pipelines is an example of an HBV plant.

A paint storage rack at the painter's shop is an example of an LAU plant.

Safety of LAU & HBV plants
Evaluation aids for users.

Plants that work with substances hazardous to water must collect the spilled substances in the event of leakage, defective pipelines and other accidents. This is the only way to prevent water pollution.

When anchoring in WRL sealing surfaces, the WRL surface must be drilled into, which potentially reduces the tightness against substances hazardous to water. However, the tightness and resistance must also be given and proven in the anchorage area in particular.

For planners and users, the important question is what **evaluation aids** are available to them to judge the **safety** of their LAU or HBV plant?

Evaluation of LAU systems

The DIBt (German technical authority and a service provider for the construction sector) has drawn up lists of media for obtaining a general design approval for use in LAU systems.

A total of **seven media lists** have been published so far, two of which are relevant for anchoring in WRL sealing surfaces. For coated concrete, media list 1 is relevant; for LI/LIP concrete, media list 4 is helpful. The DIBt (German technical authority and a service provider for the construction sector) constantly updates the media lists for waterproofing agents and sealing constructions in LAU systems.

Evaluation of HBV plants

Products and systems for the manufacture and repair of HBV plants must meet the same technical requirements for systems and products as LAU plants. In addition, the WRL and the facilities regulation (AwSV) require inspection of such plants by specialised companies or experts.

Water hazard classes

The facilities regulation (AwSV) obliges plant operators to handle sub-

Examples of relevant hazardous substances in LAU and HBV plants are heating oil, diesel, solvents, petrol, waste oil, acids, alkalis, chemical raw materials or other finished products.

LAU plants

- → **Storing (Lagern)**
  Fuel oil tanks, tanks, paint storage
- → **Filling (Abfüllen)**
  Gas stations, company gas stations, filling and unloading stations in production plants
- → **Handling (Umschlagen)**
  Handling areas in ports and logistics centres

HBV plants

- → **Manufacturing (Herstellen)**
  Industrial plants, chemical production
- → **Treatment (Behandeln)**
  Industrial plants, filter plants
- → **Use (Verwenden)**
  Refrigeration plants, hydraulic lifts, lathes, dip tanks, presses, transformers

The two major plant types in dealing with water-hazardous substances: LAU and HBV plants.

stances hazardous to water responsibly. The substances and mixtures they use must be assigned to a water hazard class (WGK) and water hazard level (WGS) listed in the facilities regulation (AwSV). For example, substances such as hydrochloric acid and caustic soda are considered "slightly hazardous to water" (WGK 1). Heating oil and diesel oil are classified as "clearly hazardous to water" (WGK 2) and petrol or waste oil as "very hazardous to water" (WGK 3).

The criteria according to which substances and mixtures hazardous to water are classified as **WGK 1, 2 or 3** or as not hazardous to water (unless they are considered generally hazardous to water) can be found in **Annex 1 of the facilities regulation (AwSV).** The classification is based on scientific tests on the respective used substance. This substance evaluation in turn determines who must inspect the plants and how often this must be carried out.

Water hazard levels (WGS)

The specific installation requirements are derived from the water hazard classes. In Section 4, the facilities regulation (AwSV) divides the installation requirements into hazard levels. The water hazard class, in conjunction with the plant's container size, determines the hazard levels A to D - where D stands for the highest hazard level on the scale. For liquid hazardous substances, the volume is used for classification purposes, while the mass is used for gaseous or solid substances.

Exposure of plants

The **exposure levels** for LAU and HBV plants (L1 to L3) are classified on a scale from "low - L1" through "medium - L2" to "high - L3", taking into consideration the water hazard class (WGK I to WGK III) and the duration of exposure.

i When classifying the **exposure level of an LAU or HBV plant,** storing (L), manufacturing (H), treating (B) and using (V) are one-time exposures, filling (A) and handling (U) are intermittent exposures.

One-time exposure: storing, manufacturing, handling, using

Level of exposure	Description	Duration of exposure
Low	L1	8 hours
Middle	L2	72 hours
High	L3	2,200 hours

Intermittent exposure: filling

Level of exposure	Description	Duration of exposure
Low	A1	Max. 4 filling operations per year (8 hours one-time)
Middle	A2	Max. 250 filling operations per year (28 days of 5 hours each or 144 hours one-time)
High	A3	Virtually no restriction on the filling frequency For LI/LIP concrete, this corresponds to 40 days of 5 hours each or 200 hours one-time For coated concrete: 450 hours resp. 45 days of 5 hours each

Intermittent exposure: storage

Low	U1	Packaging in accordance with the requirements of dangerous goods legislation (8 hours (one-time))
Middle	U2	Packaging without dangerous goods requirements (28 days of 5 hours each or 144 hours one-time)

According to worksheet DWA-A 786, Technical Rules for water-hazardous substances (TRwS) "Execution of sealing surfaces", October 2020, German Association for Water Management, Wastewater and Waste e. V., Hennef and DAfStb-Guideline "Concrete construction for the handling of handling water-polluting substances" (BUmwS), March 2011 edition, German Committee for Reinforced Concrete, Berlin.

Safe solutions with fischer
Anchoring in compliance with the WRL.

Anyone who places anchorings in the area of WRL surfaces is obliged to prove the resistance and tightness of the fixing solution, e.g. during an accident. Requirements refer to the entire system consisting of a fixing element, bonded anchor and anchoring base. This is precisely where **fischer** comes in and offers **solutions** with which anchorings in WRL sealing surfaces can be carried out safely in accordance with the WRL and facilities regulation (AwSV).

The high-performance **injection mortar FIS EM Plus** in conjunction with the fischer system components offers the perfect solution for WRL sealing surfaces, both in LP/LPP concrete and in coated WRL surfaces. Planners, contractors and plant operators can thus meet all typical requirements for anchoring components in WRL sealing surfaces. The fixing system is suitable for common media groups, types of exposure, plant types and anchoring bases.

Industrial plants such as these must be anchored according to the standards of the facilities regulation (AwSV).

Installation protocol for correct anchoring
The general design approval (aBG) requires documentation of the correctly performed anchoring.
fischer provides an installation protocol for this purpose containing all the necessary information in a legally watertight manner.

fischer FiXperience
WRL-compliant anchoring with the design software.

It is now possible to also verify anchorings in WRL sealing surfaces with regard to stability and serviceability on the C-FIX calculation module of the FiXperience software. The user can choose between LI concrete, LIP concrete and coated concrete. Depending on the selected anchoring base, all products relevant for approval are automatically displayed and the corresponding system components are combined with each other. The calculation is based on **EN 1992-4:2018** and the **EOTA Technical Report TR055, version 02/2018.**

WRL-compliant design with the C-FIX module

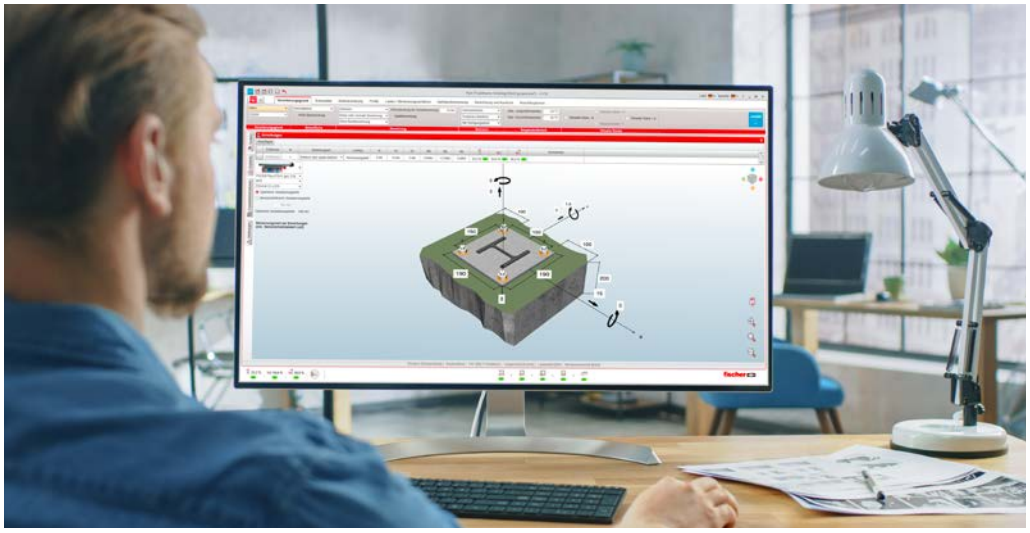
The calculated anchorage depths do not have to be additionally increased due to the WRL layer. Furthermore, the loads do not have to be additionally reduced and the utilisation factor determined in FiXperience can be accepted as less than or equal to 100 %. When selecting LI-/LIP-concrete, the applicable technical rules regarding the residual wall thickness of the drillhole are also checked. At the same time, the marking disc is added as a system component. In the case of coated concrete, the appropriate WRL set is added to the selected anchor rod and, if necessary, the anchor rod length is adjusted.

Secure and reproducible

The calculation printout generated in this way provides verifiable proof with regard to the stability and serviceability of the WRL sealing surface. In addition, it guarantees quality control because the installer can use the article numbers and installation details to once again compare all components and installation conditions with the articles on the construction site and the working drawings before starting to create the drill hole.

Try out fischer FiXperience free of charge now!

Click here for **FiXperience**



i With **C-FIX Online** fischer offers an innovative design program for steel and composite anchors in concrete as well as for injection systems.

Summary.

Summary Whitepaper
WRL compliant anchoring.

Requirements for plants in the context of the WRL
Special requirements regulated in the Water Resources Law (WRL) apply to plants that handle substances hazardous to water. In principle, these facilities must be planned and operated in such a way that there is no risk of "adverse changes to the water properties". Hazardous substances such as heating oil, diesel, solvents, petrol, waste oil, acids, alkalis, chemical raw materials, etc. must be collected in the event of leaks, defective pipelines or other accidents. In order to comply with the principle of concern in the WRL as well as the facilities regulation (AwSV), the plants must dispose of two safety barriers. In the context of anchorings, either **liquid-proof concrete (LP/LIP concrete**) or coated concrete can be used to retain substances hazardous to water (resistance and impermeability of installations).

What planners and users need to know
Whether chemical production silos and pipelines, shelf and pallet warehouses, oil tanks of ship ports or aircraft tank installations: These and many other facilities must be anchored according to German Committee for Reinforced Concrete's (DAfStb) guideline on "Concrete construction when handling substances hazardous to water" (BUmwS). For all these applications, bonded anchors are stipulated which are confirmed to be suitable for the respective medium to which they are exposed. This can be fulfilled by a general design approval (aBG) from an accredited testing institute such as the DIBt (German technical authority and a service provider for the construction sector).

Anchorages in WRL sealing surfaces
The conditions that must be fulfilled for the installation of WRL sealing surfaces are regulated in the facilities regulation (AwSV). It applies to stationary plants that handle at least 220 litres of one or more substances hazardous to water. Plants can be LAU plants (storage, filling and handling) or HBV plants (manufacturing, treatment and use). Plant constructors and operators are responsible for ensuring that, in the event of leaks in the primary barrier (in the event of an accident), specially designed structures are used to retain water-polluting liquids and gases for a limited period of time until the damage has been repaired.

The tightness of the secondary barrier is achieved either by using LI/LIP concrete or by applying a coating to the concrete surface. It is essential that the entire construction can also be classified as liquid-tight. With the injection mortar FIS EM Plus in combination with matching system components, fischer offers the right product solution for all these WRL sealing surfaces. This means that planners and users are well prepared for common substance groups and plant types.

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fischer's focus:

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