Zemdrain®

improving concrete durability

technologies for the construction industry

FRANK®

Zemdrain® | table of contents

Max Frank GmbH & Co. KG I Technologies for the construction industry
Mitterweg 1
94339 Leiblfing · Germany
Phone +49 (0) 94 27 / 1 89-0
Fax +49 (0) 94 27 / 15 88
info@maxfrank.com
www.maxfrank.com

Concrete degradation

Environmental influences are the most frequent cause of degradation of concrete structures. After only a few years the level of deterioration can become so severe that replacement of the entire structure or refurbishment of the surface becomes unavoidable. The problem is magnified by the poor quality of the concrete in the outer cover zone which increases the risk of premature damage.

Problems arising from these two causes result in deterioration of the concrete in the cover zone:

- Blowholes, increased porosity and the use of a release agents result in increased adhesion of floating particles and growth of micro-organisms
- Frost and abrasion cause surface degradation
- Chemical attack causes surface erosion
- Chloride ingress leads to reinforcement corrosion and surface spalling
- CO_2 leads to carbonation and to the loss of concrete's protective alkalinity

Results of abrasion and acid attack in a sewage treatment plant

Micro-biological growth is aided by the use of release agents

Results of salt crystallisation in a marine environment

Concrete surfaces in aggressive environments

Concrete surfaces in aggressive environments such as sewage treatment plants, are constantly subjected to attack by abrasive forces, freeze/thaw action and from acidic waste water. The first sings of damage can become visible within a few years and degradation of the structure can accelerate very quickly. This photograph was taken in a sewage treatment plant after 10 years of operation and shows the transverse wall of an activation basin (without Zemdrain®) in comparison with a longitudinal wall (with Zemdrain®).

A comparison of both surfaces demonstrates very clearly that the use of Zemdrain® will delay the need for refurbishment by many years or may even make repairs completely unnecessary.

without Zemdrain® ***with Zemdrain®***

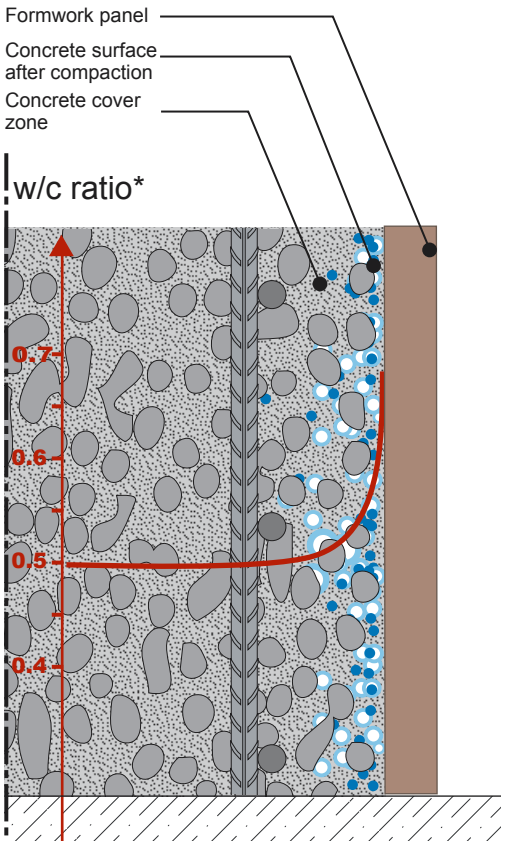
Causes of concrete degradation

For correct placement all concrete requires a higher w/c ratio than that required for the concrete's hydration process. The result of this will be that a concrete with a water-cement ratio of 0.45 – 0.5 will contain a water surplus of 40 – 60 litres/m³.

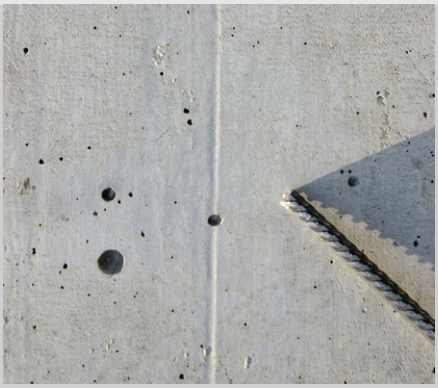
During compaction excess air and water are transported to the concrete/formwork interface. As the formwork face is mostly impermeable or only slightly absorbent, this excess air and water accumulate and cause the w/c ratio to increase (~ 0.7) and result in a simultaneous increase in blowholes and other surface blemishes.

Thus, even in the short term, the durability requirements with regard to the surface concrete, such as long-term reinforcement protection and low-maintenance surfaces are no longer fulfilled.

Without Zemdrain®: the w/c ratio increases in the concrete surface area



**w/c ratio: water-cement-ratio*

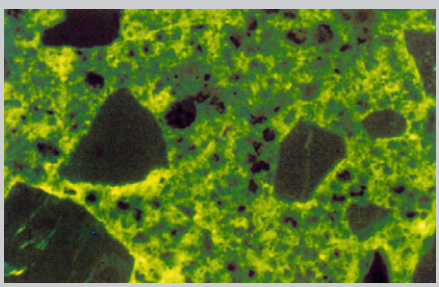


The following fundamental rule applies: concrete porosity and capillarity increase simultaneously with the increasing w/c ratio of the concrete. A concrete surface that is open to diffusion and with increased absorption presents the following disadvantages:

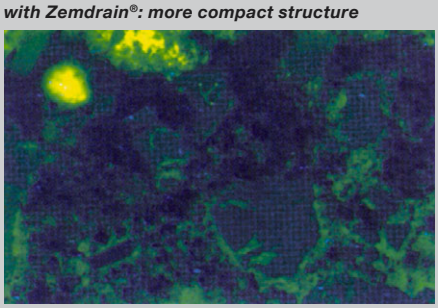
- Water transports aggressive substances, such as chlorides, towards the reinforcement.
- Air penetration accelerates various chemical processes, for example carbonation.
- Increased absorption behaviour of the concrete accumulates organic substances, such as release agents resulting in micro organism growth.

Petrographic images

Without Zemdrain®: porous structure

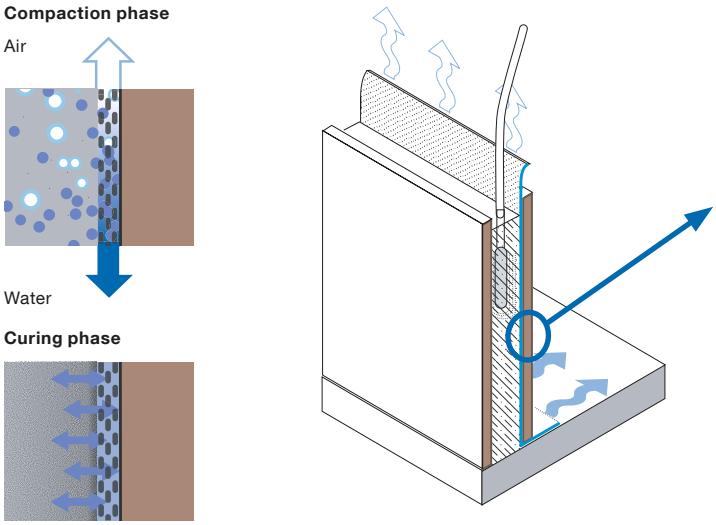


with Zemdrain®: more compact structure

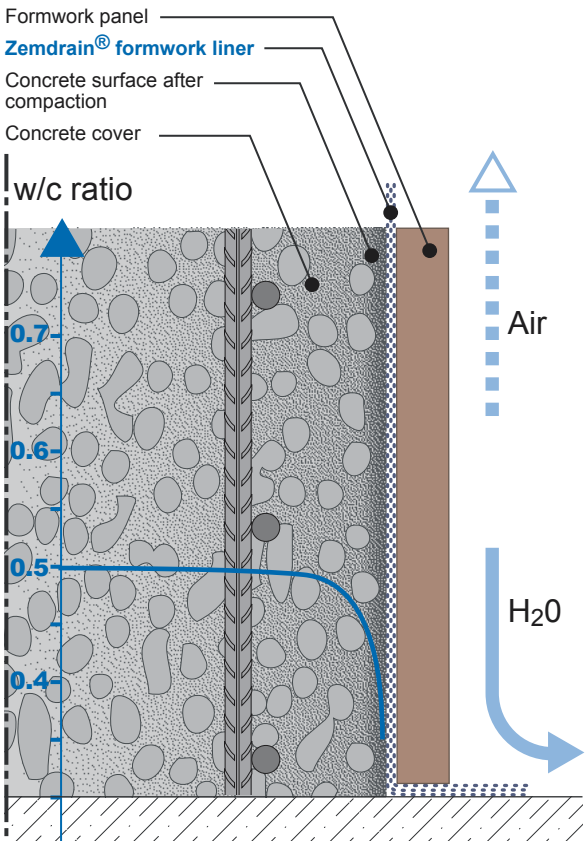


How Zemdrain® works

Zemdrain® is a formwork liner with a controlled pore size to allow the passage of excess water and air from the concrete/formwork interface, which is also designed to retain the majority of cement and other small fines. Compaction energy and concrete pressure lead to drainage of a major part of the excess water contained in the outer concrete surface (~ 20 mm) of approximately 2,5 litres per m^2. This not only optimises the w/c ratio and decreases concrete porosity, but at the same time concentrates the finest concrete particles to give a cement rich surface area. Additionally, water retained in the formwork side of the liner is given back to the concrete during the curing phase. (The stored water helps with early age curing).



With Zemdrain®: the w/c ratio decreases in the concrete surface area



All benefits of Zemdrain® at a glance:

The use of Zemdrain® considerably increases the potential service life of all concrete structures. The benefits of replacing impermeable formwork coated in release agents with Zemdrain® are significant.

- **Reduced w/c ratio**
- **virtually blowhole free**
- **surface uncontaminated by release agents**
- **Increased surface hardness**
- **Increased abrasion resistance**
- **Increased freeze/thaw resistance**
- **Reduced micro-biological growth and improved hygiene**
- **Reduced carbonation**
- **Reduced water and chloride ingress**
- **Proven economic benefits and cost savings over the whole service life.** (studies carried out by STW institute, Hanover)

Zemdrain® | controlled permeability formwork liner

Zemdrain® is manufactured from polypropylene fibres and features a multi-pore surface with controlled pore dimensions, thus making the liner permeable to water and air whilst at the same time retaining the majority of cement and sand particles.
There is only a very slight bonding with the concrete surface, but the liner remains on the form during removal.

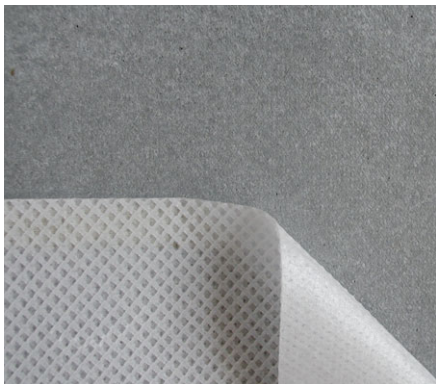
Application areas for Zemdrain®:

- Water retaining Structures
- Effective for vertical & sloping surfaces
- Bridges
- Marine Structures

There are two different styles of Zemdrain®:
Zemdrain® MD and Zemdrain® Classsic.
Both types of Zemdrain® produce concrete of equal quality and durability – however, the techniques required to apply the liners to the formwork are slightly different.

Zemdrain® MD

- The white material surface (concrete side) is smooth with a fine pore structure.
- The rear surface (formwork side) consists of a special drainage grid.
- One roll size of 2.5 m width and 35 m length.
- Highly economic due to multiple use (2 – 3 applications possible)
- simple and quick installation procedures.
- High water and air storage capacity makes MD very suitable for inclined and horizontal surface applications



Seawall Brighton (UK), 1992

Storage reservoir Jubach (DE), 1991

Flintshire Bridge, Wales (UK), 1995

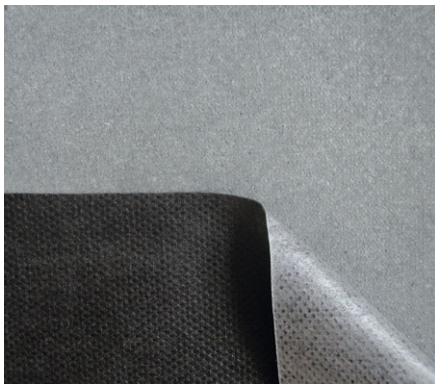
Wastewater treatment plant Munich (DE), 1990

Drinking water reservoir, Schlüsselfeld (DE), 1992

North Meadowvale Reservoir and Pump Station, Ontario (CA), 2006

Zemdrain® Classic

- The grey material surface (concrete side) is smooth with a fine pore structure
- The rear surface (formwork side) is black – with rhomb shaped impressions
- Various roll widths: 1.6 m and 5.2 m are available, the standard roll length is 50 m.
- Zemdrain® Classic is a single use liner
- Zemdrain® Classic is suitable for lining of large concrete surfaces inclusive of bridge soffits
- This liner is suitable for applications with special circular steel formwork in monolithic concrete construction



In addition to the present Zemdrain® information brochure we shall be pleased to provide you with the following documents on request:

- Test reports
- Technical application guidelines
- References
- Safety data sheets

Our technicians will be glad to advise you on the general application of Zemdrain® and also for special tailor-made solutions.

Just contact our direct extension number **+49 (0) 94 27 / 189-189** or alternatively visit our website at **www.maxframk.com** to get details of your local or regional Max Frank contact.

We are ready to face any challenge!

Sewage water reservoir Brisbane (AU), 2007

Bridge Gignac (FR), 2007

Al Garhound Bridge Dubai (UAE), 2007

Water reservoir Trin (CH), 2008

References

Max Frank GmbH & Co. KG | Technologies for the construction industry

Mitterweg 1
94339 Leiblfing · Germany

Sales Department

Phone +49 (0) 94 27 / 1 89-1 20
Fax +49 (0) 94 27 / 15 88

Technical Support

Phone +49 (0) 94 27 / 1 89-1 89
Fax +49 (0) 94 27 / 1 89-1 60

info@maxfrank.com
www.maxfrank.com

17072/1 – E – 05/08