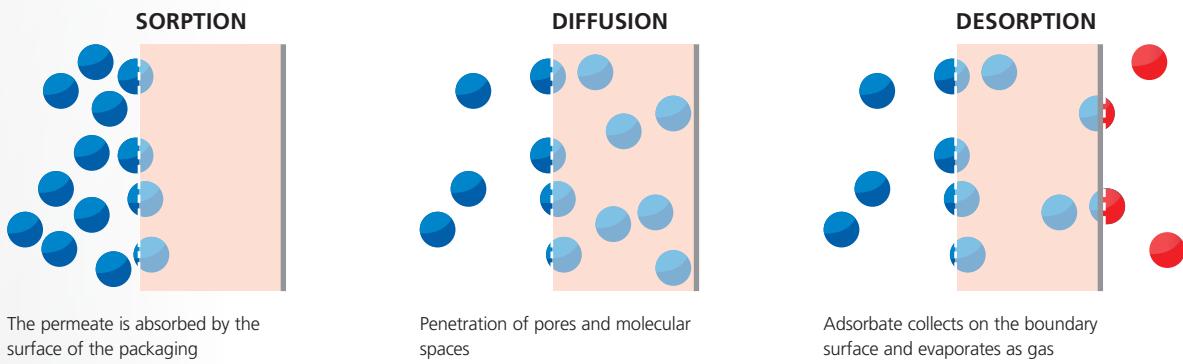




**EVOH PERMEATION BARRIER
PROTECTION AGAINST HAZARDS AND
RISKS IN PACKAGING APPLICATIONS**

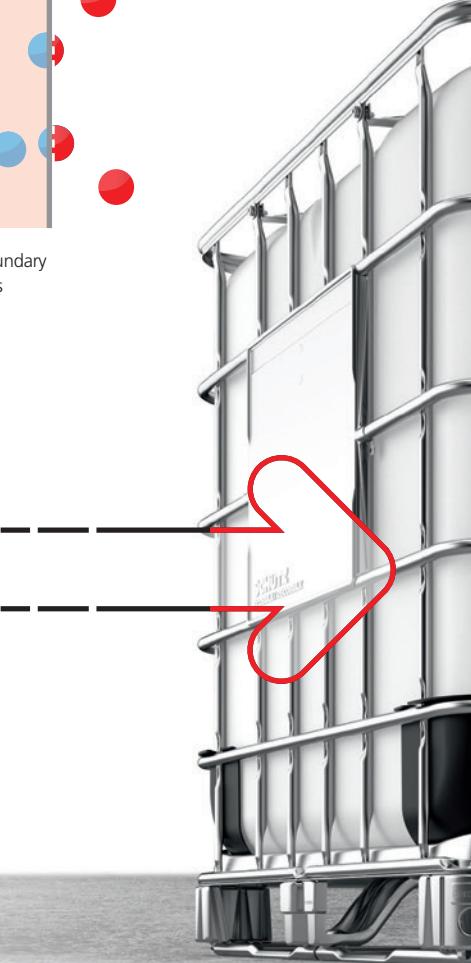
Permeation and its effects.

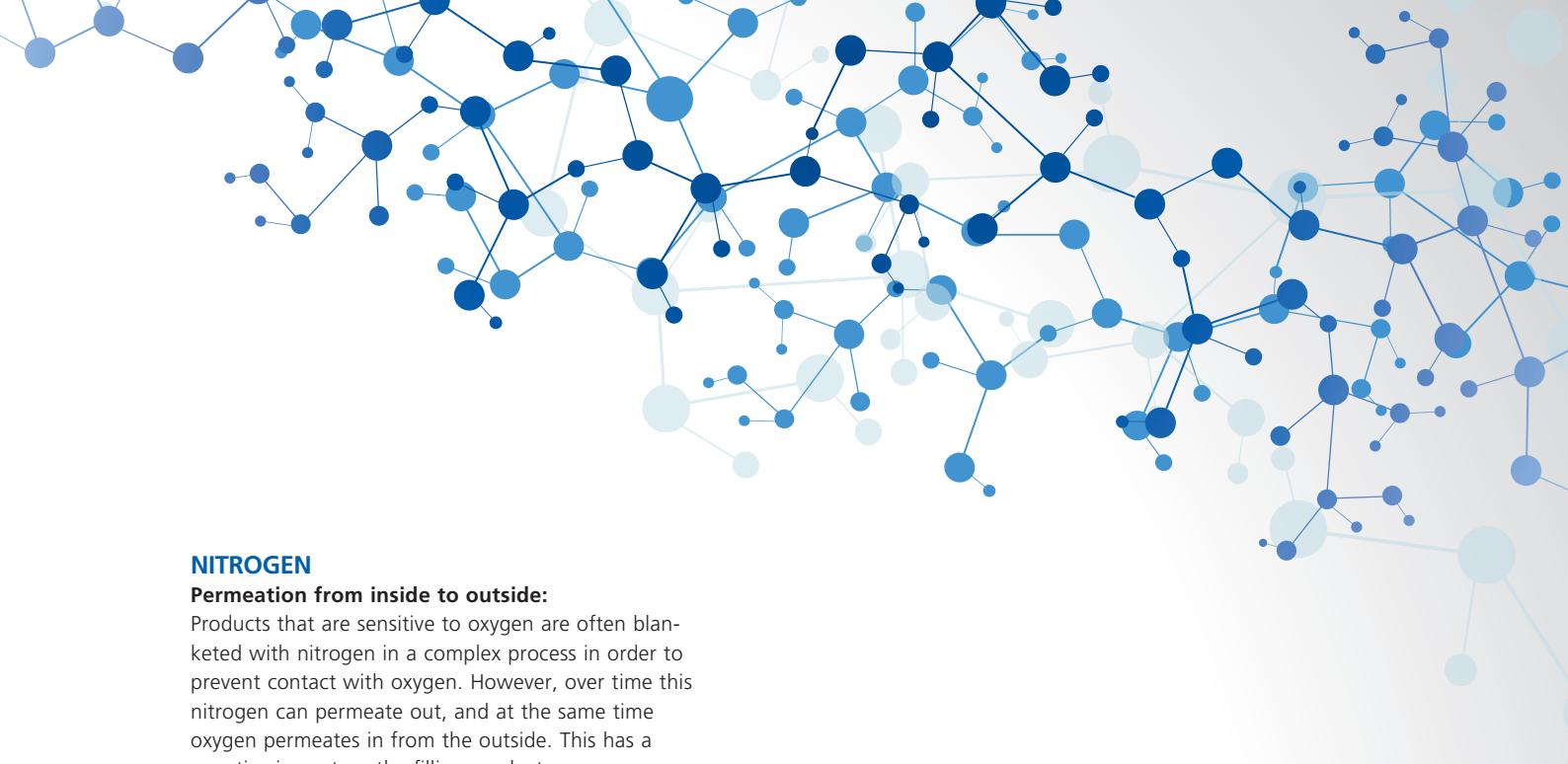
Gases, vapours and liquids can gradually diffuse through the walls of a plastic container. If there is a difference between the partial pressure inside the container and the ambient pressure outside, substances can permeate towards the lower pressure. This can result in an unnoticed loss of quality and volume of the filling product.



Examples of permeation and the results

OXYGEN
Permeation from outside to inside:
Oxygen permeation can cause changes in products that are sensitive to oxygen (e.g., oxidation, vitamin deterioration, microorganism growth). In sensitive food, pharmaceutical and cosmetic products in particular this can compromise the product quality, shelf life and hence also the flexibility of your supply chain.





NITROGEN

Permeation from inside to outside:

Products that are sensitive to oxygen are often blanketed with nitrogen in a complex process in order to prevent contact with oxygen. However, over time this nitrogen can permeate out, and at the same time oxygen permeates in from the outside. This has a negative impact on the filling product.



AROMAS & FRAGRANCES

Permeation from inside to outside:

Many aromas and fragrances have very strong permeation behaviour. This can often result in containers that are so deformed that they can no longer be transported and the formation of a strong odour outside of the IBC. Good examples of these two effects are terpenes, which often found in the form of citrus and orange oils.

NONPOLAR SOLVENTS & AROMATIC HYDROCARBONS

Permeation from inside to outside:

The permeation of substances such as styrene, benzene, toluene, xylene or solvent naphtha is the most dangerous form of permeation. The concentration in product mixtures has no impact on the permeation behaviour. The proportion that is present will start permeating, thus releasing vapours that are flammable and hazardous to health into the ambient surroundings. A product loss of between 5 and 10 % in four weeks is not uncommon. This process has a negative impact on the composition, quality and shelf life of the filling product. As a result, you compromise on flexibility in your supply chain.

Additionally, there is the danger of an explosive atmosphere forming immediately around the container and the container contracting due to severe product loss. This can result in containers that are no longer suitable for transport and present a significant safety hazard.



Legal provisions and permeation studies.

Due to the potential effect of permeation during the transport of hazardous goods, legislators have defined very precise regulations for the containers that may be used.



Chapter 4.1.1.2 of the existing Transport Act (see the international IMDG Code and regional rules and standards, such as ADR) stipulates:

Those parts of the packaging, including bulk packaging (IBC) and large packaging units, which come into immediate contact with dangerous goods:

(c) must prevent the permeation of dangerous goods which could present a hazard under normal transport conditions.

If necessary these containers must be equipped with a suitable inner layer or treatment.

Tests conducted by the German Federal Institute for Materials Research and Testing (BAM)

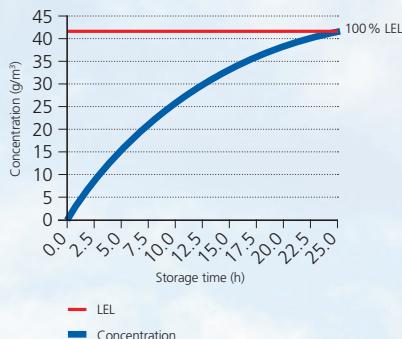
In specific tests with strongly permeating toluene, BAM stored 16 standard IBCs filled with 1,000 litres at 40°C (104°F) and the same number of IBCs with an EVOH permeation barrier at 50°C (122°F) in a 20" ISO box container with 32 ventilation units.



Without a permeation barrier, the lower explosion limit (LEL) was reached in only a few hours, creating an acute explosion risk inside the container.

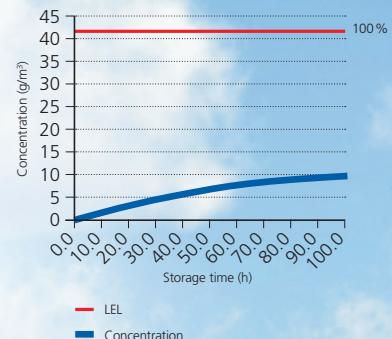
With an EVOH permeation barrier, the concentration of explosive gases remained below the critical limit, despite the more rigorous test conditions with a temperature that was 10°C higher. Under normal transport conditions the risk of an explosion can be practically ruled out!

Without a permeation barrier



Setting A: Rate of permeation 0.96 $\text{g}/(\text{m}^2 \times \text{h})$, 40°C/104°F,
Container material: HDPE

With an EVOH permeation barrier



Setting B: Rate of permeation 0.2 $\text{g}/(\text{m}^2 \times \text{h})$, 50°C/122°F,
Container material: HDPE with EVOH permeation barrier

Additionally, further storage tests yielded the following results:

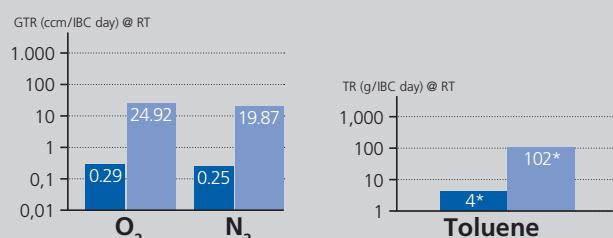


FILLING PRODUCT STYRENE

Standard IBCs filled with styrene which were stored for two months at a maximum temperature of 35°C (95°F) impressively displayed the permeation and polymerisation of the product outside the IBC. The loss of filling product through permeation in this case was more than 90 kg.

COMPARATIVE IBC MEASUREMENTS WITH OXYGEN, NITROGEN AND TOLUENE

Even at room temperature an EVOH barrier can significantly reduce the permeation rate of IBC inner bottles.



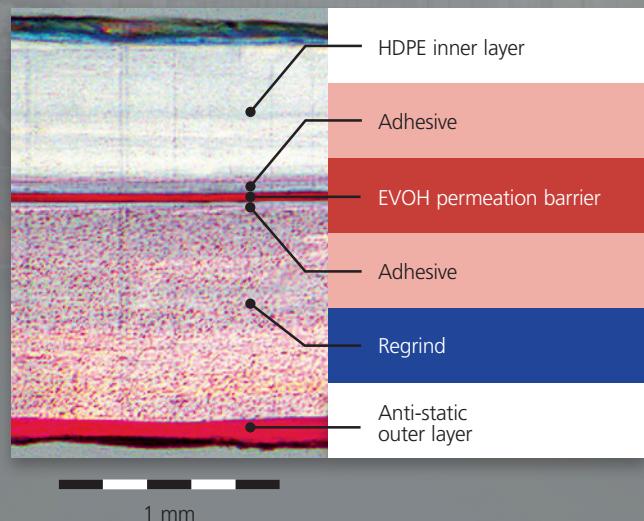
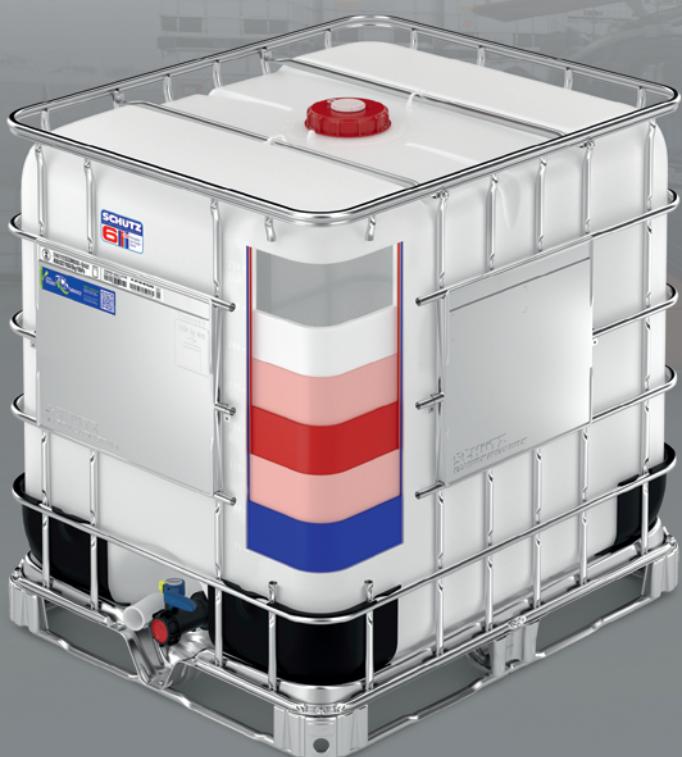
■ MX-EV 1000
(6-layer EVOH)

■ MX 1000
(without barrier)

* Computed values for a IBC including a screw cap DN 150 and outlet valve DN 50
GTR: gas transmission rate
TR: transmissivity rate
RT: Room temperature

Stop permeation.

Thanks to our innovative 6-layer technology for inner bottles, we are the first producer worldwide to offer IBCs with an integrated EVOH permeation barrier. Protect the quality of your filling products and prevent safety risks and environmental contamination. Enjoy greater flexibility and more economic efficiency in your supply chain.



HDPE + EVOH

CHEMICAL RESISTANCE
MECHANICAL PROPERTIES
WATER VAPOUR BARRIER

BARRIER AGAINST OXYGEN AND OTHER GASES
SOLVENT BARRIER
FLAVOUR BARRIER

Benefit from the many advantages of an EVOH permeation barrier.

Prevent product losses

Nonpolar solvents or aromatic hydrocarbons can no longer permeate the packaging, thanks to the barrier. The original composition of the product mixture and the overall mass practically remain unchanged.

Protection against the risk of explosion

IBCs with an EVOH permeation barrier comply with the legal specifications for permeating hazardous goods and prevent the formation of explosive atmospheres in standard storage and transport situations.

Longer product shelf life

Food, pharmaceutical and cosmetic raw materials have a longer shelf life as they are optimally protected against oxidation, vitamin deterioration and microbe infestation. Products that contain solvents, such as resins, adhesives and paints, stay at ideal processing quality for longer.

Securing product quality

An efficient barrier against the permeation of oxygen, nitrogen and other gases, as well as aromas and fragrances prevents the unnoticed loss of quality and unwanted changes to the characteristics of the packaged filling products.

Better environmental protection

Humans and the environment are protected against the permeation and diffusion of contaminants. In the packaging material the build-up of the filling product is reduced by up to 60 %, thus increasing the recycling rate of the plastics used.

New application options

The EVOH permeation barrier integrated in the ECOBULK allows the containers to be used in applications that were previously reserved exclusively for steel containers.



We would be very happy to provide further information about permeation and packaging.
Contact us on +49 2626 77 0. We look forward to your call!