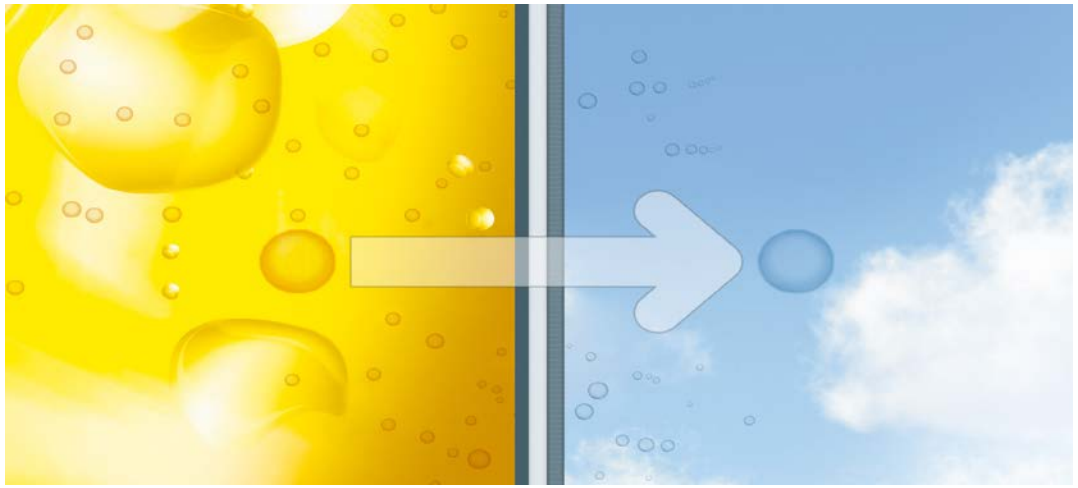
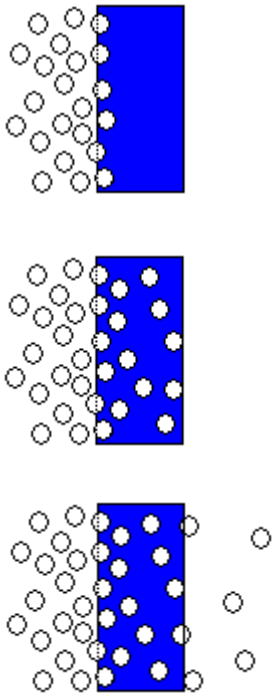
Basics on permeation and EVOH

- What is permeation?
  - **Permeation is the movement from gases, vapours and liquids through a solid material**
- When does permeation occur?
  - **In case the partial pressure of the permeant between both sides is different**



Basics on permeation and EVOH

- Permeation proceeds mainly in three steps:



Absorption

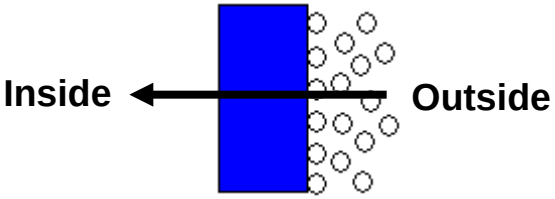
Diffusion

Desorption

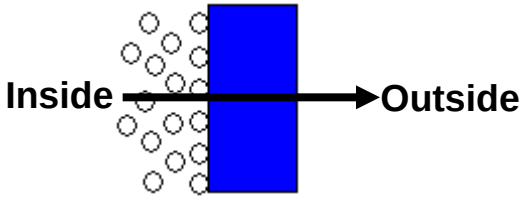
$P_1 > P_2$

Basics on permeation and EVOH

Permeation consequences



- Permeation of water vapour
  - Chemical reaction
    - e.g.: Isocyanate
- Permeation of oxygen
  - Oxidation (e.g. edible oil)
  - Vitamin deterioration
  - Growth of micro organisms

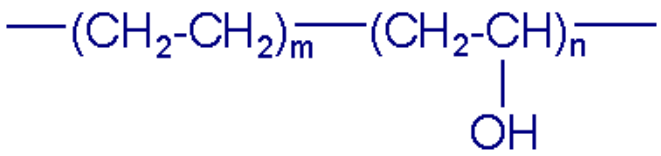


- Permeation of solvents
  - Changing composition / quality
  - Creating Ex-Zones
    - e.g.: Inks, Resins
- Permeation of nitrogen
- Permeation of aroma and fragrances

Basics on permeation and EVOH

EVOH permeation barrier

- EVOH is a co-polymer of ethylene and vinyl alcohol



An **excellent barrier** against:

- Solvents
- Gasoline, oil
- Aroma
- Gases

Where is EVOH **commonly used**?

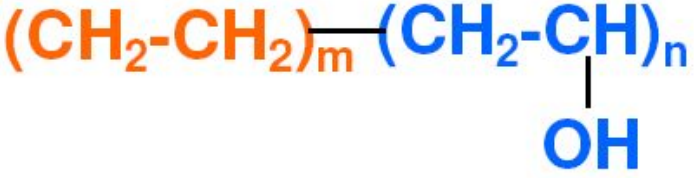
- Packaging of foodstuffs
- Packaging of cosmetics
- Plastic fuel tanks
- Bottles for crop protection products

Basics on permeation and EVOH

EVOH material composition

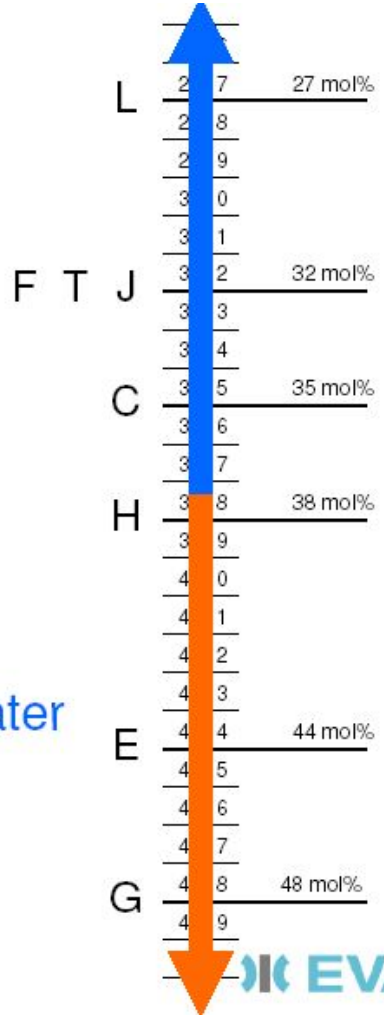
a compolymer of

Ethylene and **V**inyl **AL**cohol



- thermoplastic
- hydrophobic
- flexible

- barrier
- soluble in water



kuraray

EVAL EUROPE

SCHÜTZ

Basics on permeation and EVOH

EVOH application market

Automotive
3000T

Emission standards, ISO TS16494 qualified.

Pipe/Tube
4600T

Copper replacement, sanitary and floor heating.

Coating
1600T

Aluminium replacement, sterilisation.

Bottle
3400T

Barrier PET, IBCs, juice, value-added milk

Form
3400T

PVDC replacement, deep-draw, glass replacement

Flexible
15000T

Shrink film, stand-up pouch, MAP, Al replacement
Deep/Clear forming, Medical, Sterilisation

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EVAL EUROPE

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Basics on permeation and EVOH

Permeation comparison: EVOH vs. HDPE

Material	Permeation of d-Limonene at 20 °C (g x mm/m² x day)
HDPE	24.39
EVOH	0.0008

* Source: Kuraray Company Ltd

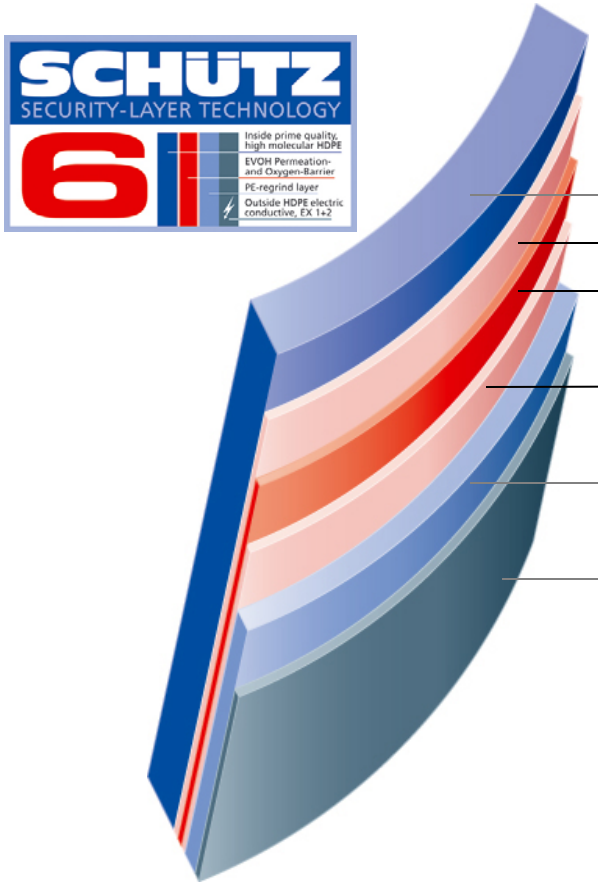
Wall thickness: 1 µm (equivalent 10000 µm = 10 mm)

EVOH

d-Limonene barrier: **+ 30,000 times**

Basics on permeation and EVOH

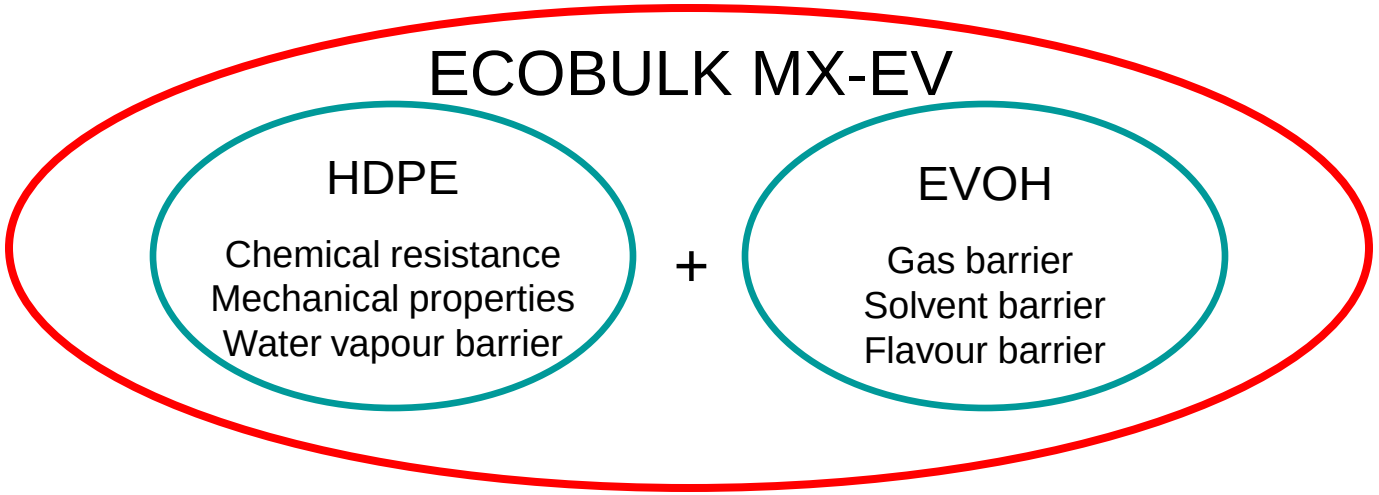
SCHÜTZ development: 6-layer technology



- Inner layer: HDPE, new material
- Adhesive
- **EVOH permeation barrier**
- Adhesive
- Intermediate layer: HDPE regrind
- Outer layer
  - conductive, anti-static, additional UV protection for filling good

Basics on permeation and EVOH

SCHÜTZ development: IBCs with EVOH



Basics on permeation and EVOH

ECOBULK MX-EV 1000 – UN approval

31HA1 /Y/.. ../D/BAM 11073-Schütz **/4380/2037

Standard fluid	Density (kg/liter)
Water	**1.9**
Hydrocarbon mixture (white spirit)	**1.4**
Detergent solution	**1.6**
n-Butyl Acetate with n-butyl acetate saturated detergent solution	**1.4**
Nitric acid 55%	**1.6**

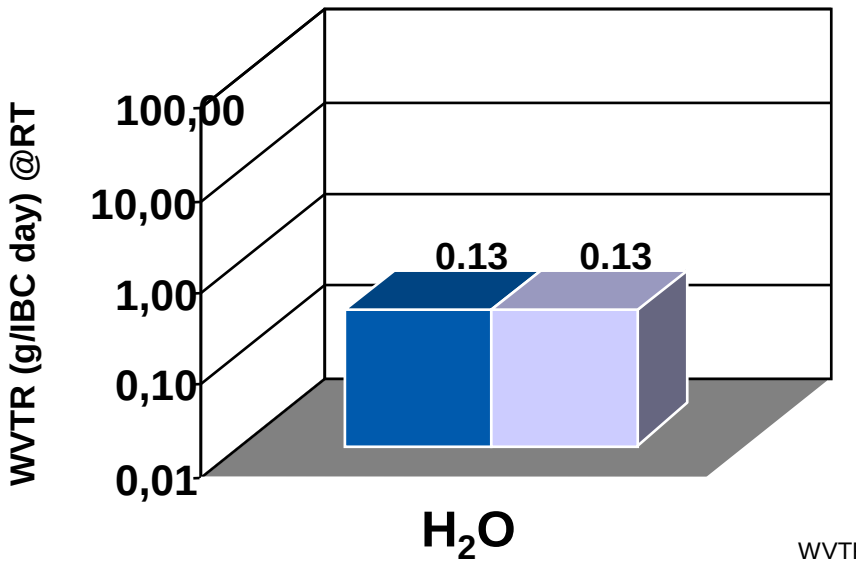
Pfl-Fr 2344 and Pfl-Fr 2323
Model fluids for crop protection products

Tested using the same criteria

Basics on permeation and EVOH

Permeation comparison: MX-EV 1000 vs. MX 1000

- Water vapour



- **MX-EV 1000** (6-layer technology)
- **MX 1000** (without barrier)

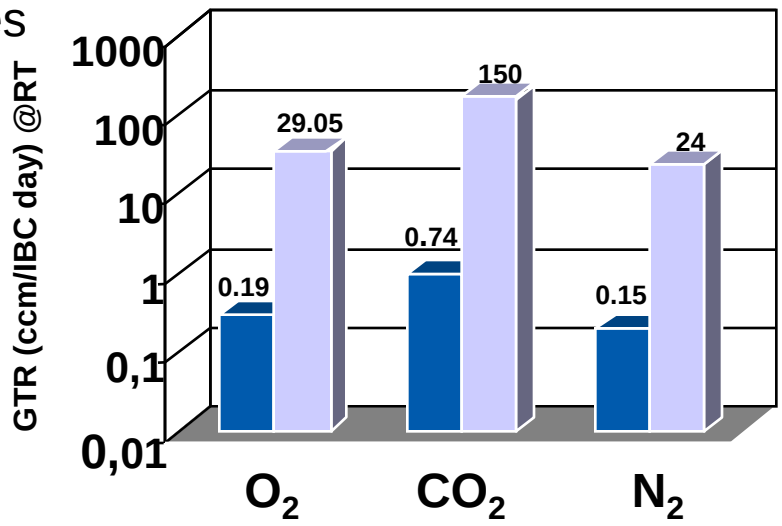
WVTR: water vapour transmission rate

MX-EV 1000	
Water barrier:	**comparable to the barrier of MX 1000**

Basics on permeation and EVOH

Permeation comparison: MX-EV 1000 vs. MX 1000

- Gases



MX- EV 1000 (6-layer technology)

MX 1000 (without barrier)

GTR: gas transmission rate

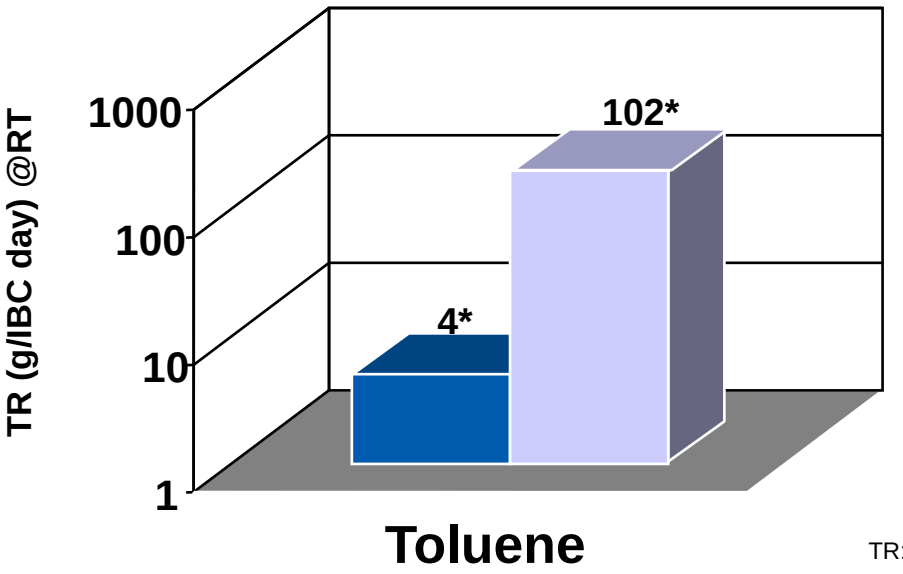
MX-EV 1000	
Oxygen barrier:	+ 150 times
CO_2 barrier:	+ 200 times
Nitrogen barrier:	+ 160 times

SCHÜTZ

Basics on permeation and EVOH

Permeation comparison: MX-EV 1000 vs. MX 1000

- Solvent



■ **MX- EV 1000** **(6-layer technology)**

■ **MX 1000** **(without barrier)**

TR: transmission rate

MX-EV 1000

Toluene barrier: **+ 25 times**

* Computed values for a IBC including a screw cap DN150 and outlet valve DN50

SCHÜTZ

Basics on permeation and EVOH

Permeation comparison

- Permeation of **b**enzene, **t**oluene, and **x**ylene starting form a mixture of these solvents*

*Test performed with 1l bottles