# Product Permeation

## Permeation

Permeation is the penetration of a permeant (liquid or vapor) through a solid surface[1]. It is directly proportional to the concentration gradient of the permeant, the surface's intrinsic permeability, and the material's mass diffusivity. Permeation is modeled by equations such as Fick's laws of diffusion, where the diffusion coefficient is proportional to the square of the velocity of the diffusing particles which in turn is dependent on the temperature, viscosity of the permeant and the size of the particles[2].

Hence, chemical products can permeate through the walls of the container or the bottle. The rate of permeation depends on the properties of the chemical, the container properties (type of material), the container thickness, temperature and length of time the product is stored in the container. A more thorough summary on permeation is available from Joel Fischer's presentation on Permeation and Measurement Techniques[3].

## Affected Products

SEASTAR CHEMICALS ULC's Instrument Quality (IQ) products stored in HDPE bottles (specifically IQ Hydrochloric Acid, S010401 and IQ Nitric Acid, S010101) permeate when exposed to elevated temperature for periods of time. Elevated temperature is defined as temperatures above the recommended maximum storage or transport temperature 15°C (59°F) – 25°C (77°F).

To avoid product permeation ensure the recommended maximum storage or transport temperature is not exceeded. In the event liquid is detected in product packaging, it is recommended to use SEASTAR CHEMICALS ULC's Safe Handling Guidelines[4].

## Product performance

As permeation is the diffusion of product gas or vapour through the wall of the material, the performance of the product is NOT affected by permeation. The amount of diffusion is very small, typically less than 0.1% of the product volume and is characterized by droplets or micro droplets.

Addendum

[1]Permeation, Wikipedia

[2]Fick's laws of diffusion, Wikipedia

[3]Permeation and Measurement Techniques, Joel Fischer, Lab Manager and Scientist, Mocon Inc., 2007 Place Conference, September 16 – 20, St. Louis, MO. http://www.tappi.org/content/events/07place/papers/fischer.pdf

# [4]Safe Handling Guidelines

## Detection of product vapor or condensate

Acid bottles are placed in polyethylene protective bags to provide extra safety during transportation.

Product vapor (fumes/gas) or condensate (mist/droplets) may be present in the polyethylene protective bags due to elevated temperatures during transportation or storage. Vapor or condensate may cause the bag and/or closure (cap) to discolor.

Note: the presence of product vapor, condensate or discoloration of the packaging has no impact on product performance.

**Material Safety Data Sheet must be read prior to opening this package and should be fully understood prior to use of the product.** Follow the recommendations outlined in the (M)SDS. Wear recommended personal protective equipment (PPE) prior to handling these products. Ensure recommended engineering controls are in place and operating. Also ensure hazard statements, precautionary statements, and first aid measures have been read and fully understood prior to opening the product. People working with hazardous materials must be properly trained regarding the hazards and safe use.

For **Hydrofluoric Acid** products: DANGER! This product may be fatal if inhaled, absorbed through the skin, or swallowed. Important! Do not open the package, use or handle this product until the Hydrofluoric Acid product (M)SDS has been read and fully understood. Make sure there is a hydrofluoric acid treatment gel or solution and a hydrofluoric acid treatment plan available prior to opening the product.

To avoid the presence of product vapor or condensate in the polyethylene protective bags it is recommended to store and transport the product at temperatures between 15°C (59°F) and 25°C (77°F).

**If product condensate (mist/droplets) is detected:**

1) Place bottle in the recommended engineering control (ventilation hood / laminar flow cabinet).
2) Carefully remove and thoroughly rinse the bag and bottle with high purity water.
    a. The action should be slow and deliberate as to not disperse any droplets on the bag or bottle.
3) After rinsing, test the pH of any residual liquid inside the bag and on the bottle.
    a. The pH should be greater than 5. If the pH is less than 5, repeat rinsing and recheck the pH.
    b. Continue until the pH is greater than 5.
4) Allow the bottle to dry or wipe with a particle-free laboratory cloth prior to use.
5) Ensure the cloth and any water used during rinsing are disposed of according to product disposal guidelines found in the (M)SDS.

**Abbreviation(s):**

(M)SDS: Material Safety Data Sheet or Safety Data Sheet

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