

# Membrane Ageing

## Technical Bulletin

Air separation membranes are made from polymers. Solid plastic polymers are dissolved in a liquid solvent and produced in a special extrusion process. Dissolving the polymer in the solvent is like dissolving sugar in a cup of tea.

When a hollow fibre membrane is produced the molecules in the polymer are rearranged into a crystalline structure.

It is like we would keep on boiling the water in the cup of tea until all the water is evaporated and the sugar will be in the bottom of the cup again in its crystalline form.

During the production of the hollow fibre membrane, we take out the solvent (water in the cup of tea) so that the polymer becomes solid again in the hollow fibre form we want it to be.

### Process of ageing a hollow fibre membrane



Ageing of the fibre means that it will lose permeability or it will lose some of the ability to separate nitrogen from oxygen. In real life this means that after some time the same hollow fibre membrane will be able to make 20% to 30% less nitrogen compared to the day it was produced.

This reduction in productivity takes place because the wall of the hollow fibre membrane gets denser due to further evaporation of the solvents and molecular relaxation.

Although the membranes are dried after production there are always residues of solvents in the fibre that slowly evaporate in time. This evaporation makes the fibre wall denser and less open or permeable resulting in a less productive membrane.

The polymer molecules in the membrane attract each other. When a membrane is produced the molecules are not perfectly arranged and are randomly oriented. In time they will rearrange a bit and get closer to each other because they attract each other. This molecular relaxation also causes the membrane to be less productive.

### Ageing of the Parker membrane versus other membranes



Parker membranes are made of Poly Phenylene Oxide. This plastic polymer has the unique characteristic that molecular relaxation takes place in a very short period of 5 weeks. The Parker special production process also takes care of the evaporation of solvents so that after 5 weeks the ageing of the Parker Poly Phenylene Oxide membranes has stopped.

After 5 weeks the Parker membrane has completed 98% of the ageing and is considered stable and will no longer decrease in performance. As Parker only uses 5 weeks aged membranes in its products, the customer will always receive a stable product that does not suffer any loss in performance in time.

Conventional membranes are made of Polyimide, Polysulphone and Polycarbonate. These membranes have an ageing period that takes up to two years.

As it is impossible to have a 2 year fibre stock, other membrane manufacturers will supply un-aged membranes into the market that will suffer up to 20% performance loss during the first 2 years of operation.

This means that the compressed air supply system must be designed for both new and aged situation, which will result in higher investment costs.

## Post ageing

All membranes suffer from post ageing when exposed to higher temperatures. Parker competitors typically use compressed air temperatures higher than 45°C. These high temperatures cause post ageing that reduces the performance even further than the expected 20%.

Parker membranes are normally used up to or below 45°C and will therefore not suffer from post ageing due to high compressed air temperatures.

