

Dryflex[®] WS

Hydrophilic Thermoplastic Elastomers



MOVIE TIME



BE CURIOUS...If the video doesn't play automatically, please go to <https://vimeo.com/292721220> → to watch the magic

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INTRODUCTION

With the Dryflex WS range we have turned the usual water-resistant properties of thermoplastic elastomers (TPE) on their head to create materials that swell up to ten times their volume when immersed in water. These materials were developed to expand after contact with aqueous solutions to form a positive seal and prevent the ingress or exit of water.

A range of formulations have been developed which offer different swell levels when immersed in water. When there is no longer water present the compound shrinks back to its original size, a process of expansion and contraction that can be repeated. The compounds have solid structural integrity; unlike many of the equivalent clay based products which can erode and shatter over time. Compounded in any colour, the water swellable TPE is 100% recyclable and can be processed using conventional fabricating methods, including extrusion and injection moulding.

Please use this guide as an introduction to our Dryflex WS range and [contact us](#) to discuss your specific requirements.

HOW DOES IT WORK?

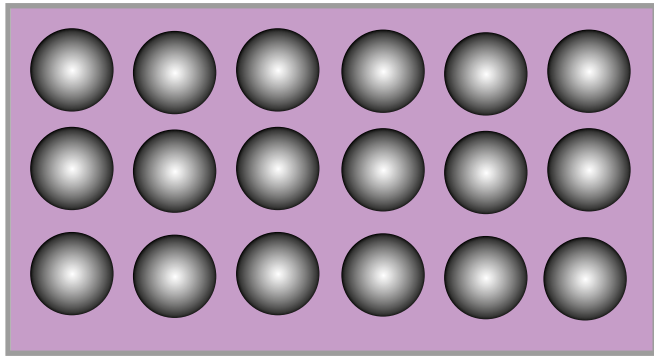


Fig 1 : The hydrophilic additive is added to the TPE compound at the time of manufacture

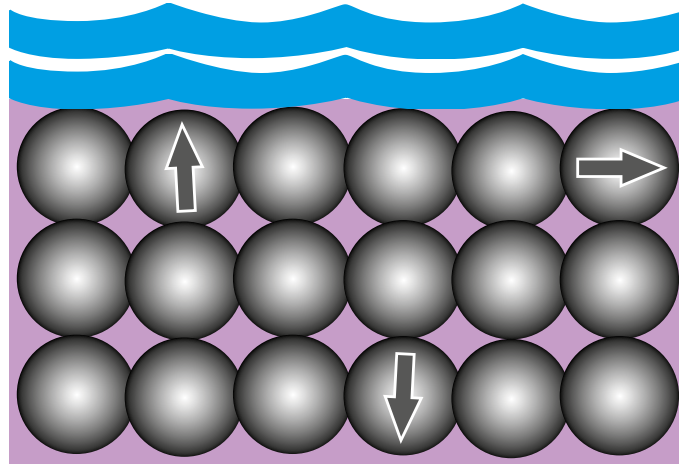


Fig 2 : After immersion in water, the TPE compound will expand uniformly, at a controlled rate and volume percentage

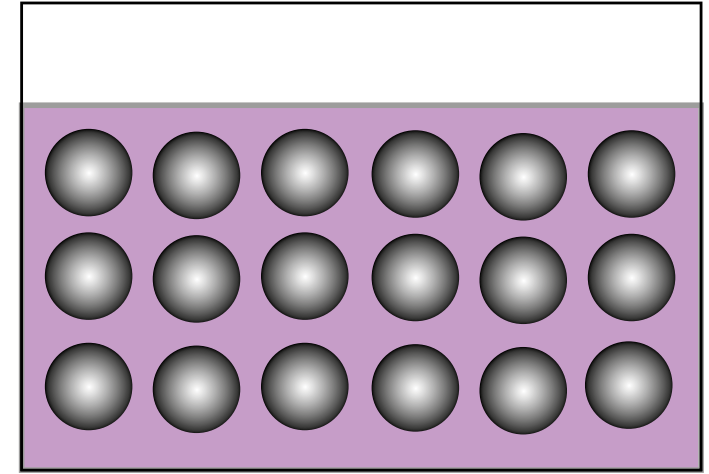


Fig 3 : When there is no longer water present the TPE compound shrinks back to its original size

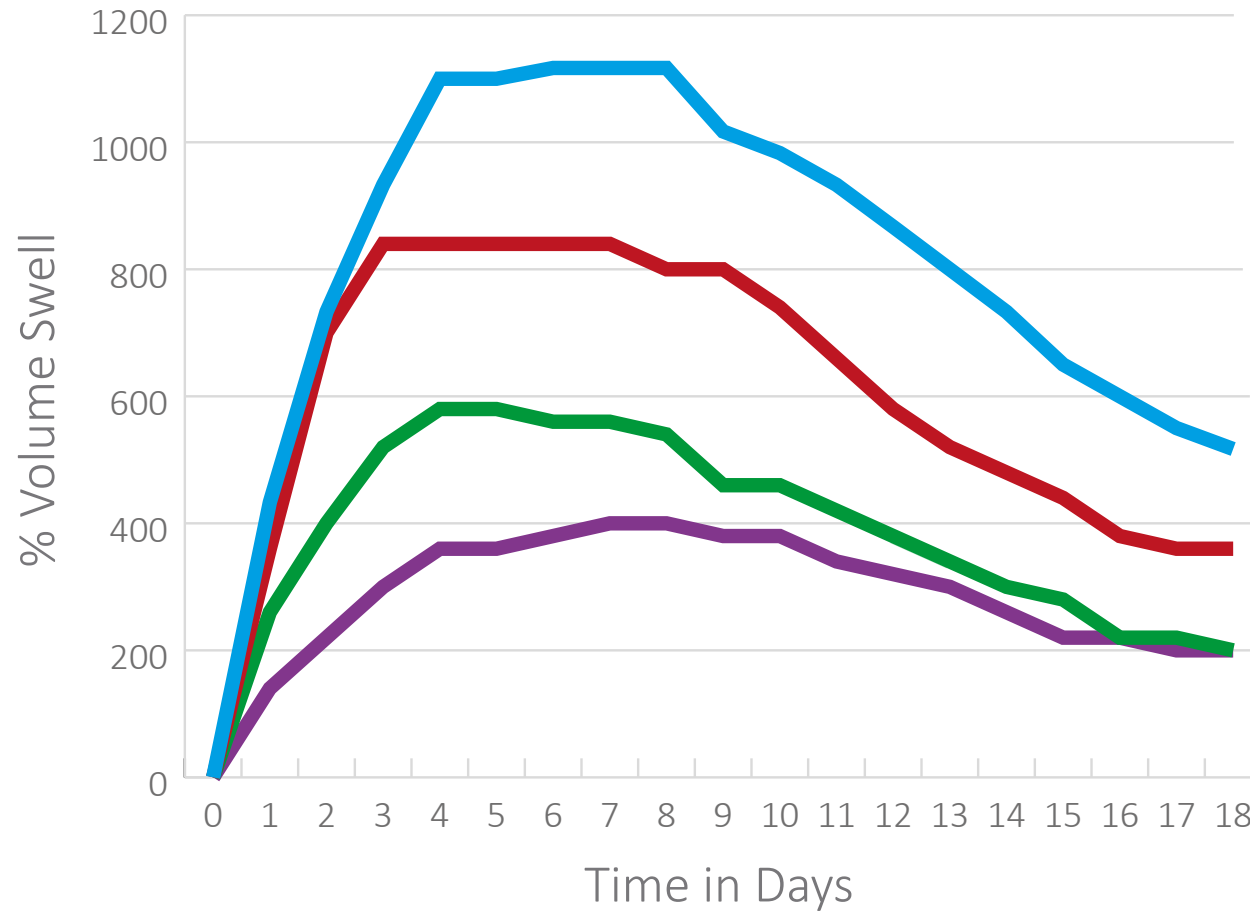
HOW MUCH DOES IT SWELL & HOW QUICKLY?





We have developed a range of compounds that offer swell levels from 350% to 1000%. We can also customise the swell level to meet the requirements of a specific application. The swelling is not instant, under recommended conditions most Dryflex WS grades will swell to optimum levels within 7 days. All Dryflex WS grades will reach quoted swell levels within 21 days under recommended conditions and testing procedures (please see grade specific information for recommendations). After reaching optimum swell levels, the system will relax and establish equilibrium.

Grades across the Dryflex WS range swell at various rates, dependent on the following factors:

- Hardness
- The formulated level of swell additive
- Environmental conditions (for example temperature and water conditions)
- Profile geometry
- Compression of material at the die
- Surface finish and potential sealing of the material bulk from water penetration

DRYFLEX WS % VOLUME SWELL



-  Dryflex WS 25E950
-  Dryflex WS 40E850
-  Dryflex WS 35E550
-  Dryflex WS 40E350

The swell level is calculated on a percentage volume basis. In order to standardise the testing process, samples are evaluated in de-ionised water at 23°C.

DOES IT RETURN TO ITS ORIGINAL SIZE WHEN THERE IS NO LONGER WATER PRESENT?

Yes, in fact this is one of the strengths of Dryflex WS TPE compounds. Their structural integrity means they can withstand long-term cycling from wet to dry.

Profiles produced from Dryflex WS exhibit excellent retention of properties during repeated cycling.

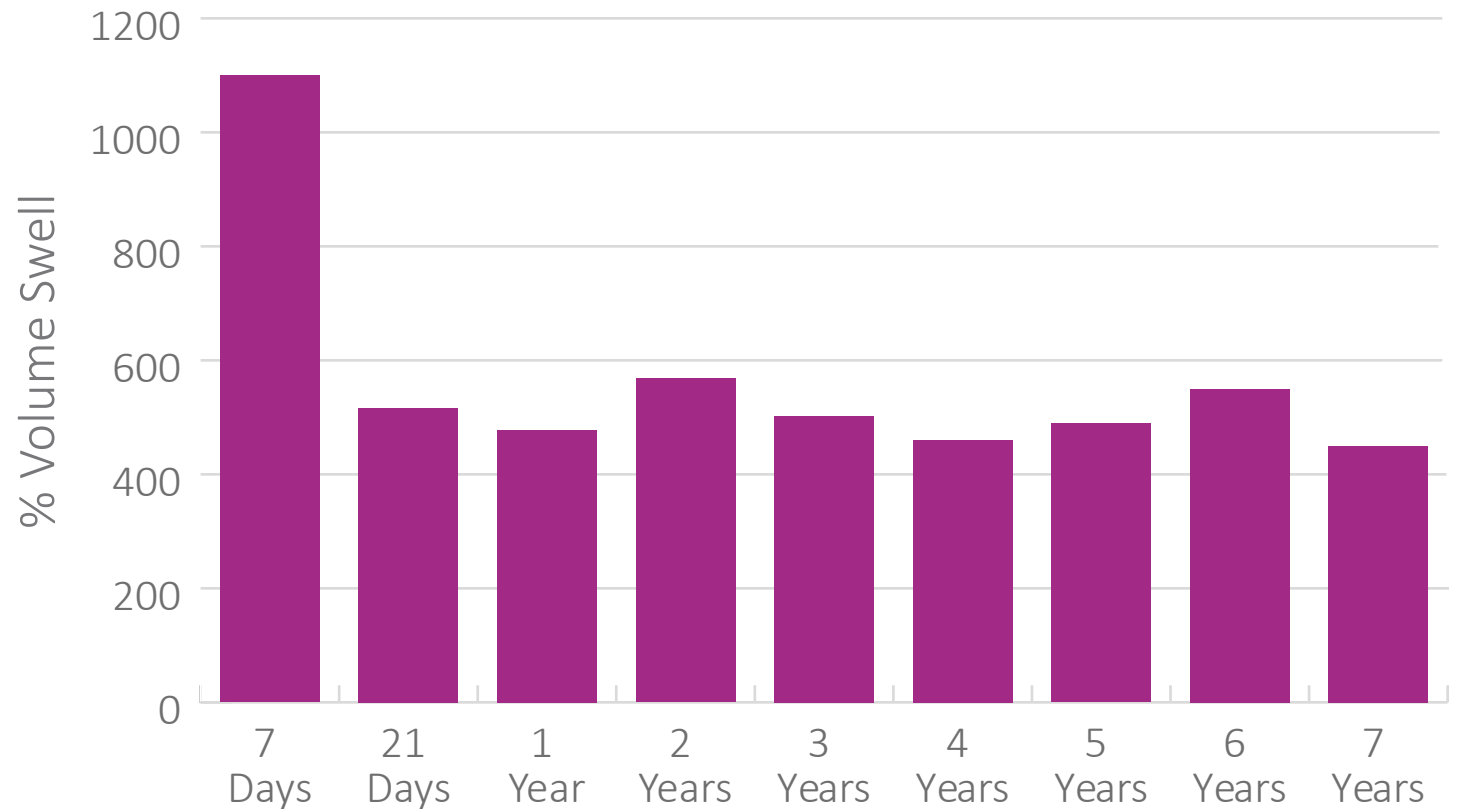
On the following page you can see results from long term cycling.

LONG TERM CYCLING

The chart outlines the optimum swell level of a typical Dryflex WS grade exposed to repeated cycling and measured on an annual basis.

The sample is fully immersed in de-ionised water for 7 days, then removed and allowed to fully dry for a further 7 days. This process is repeated, giving 26 wet / dry cycles per year.

Long Term Cycling Effects
Dryflex WS 25E950



WHY A HARDNESS RANGE?

Dryflex WS grades are typically available in a hardness range of between 25 and 40 Shore A.

A hardness range enables the production of profiles, or moulded components, with varying degrees of flexibility. The benefits of a softer, more flexible profile may be seen both in terms of the manufacturing process and installation techniques. For example the softer grades offer improved drapability, required for waterstop applications where the profiles may be coiled or need to be fitted around complex structures.

Softer versions of Dryflex WS also benefit from lower processing temperatures, which in turn allow for shorter cooling times. A process for which air cooling, rather than water, is recommended.

HOW ARE THEY AFFECTED BY ENVIRONMENTAL CONDITIONS?

The rate and swell level is affected by environmental conditions such as temperature, pH and salinity of the water, as shown in the graphs on the following pages.

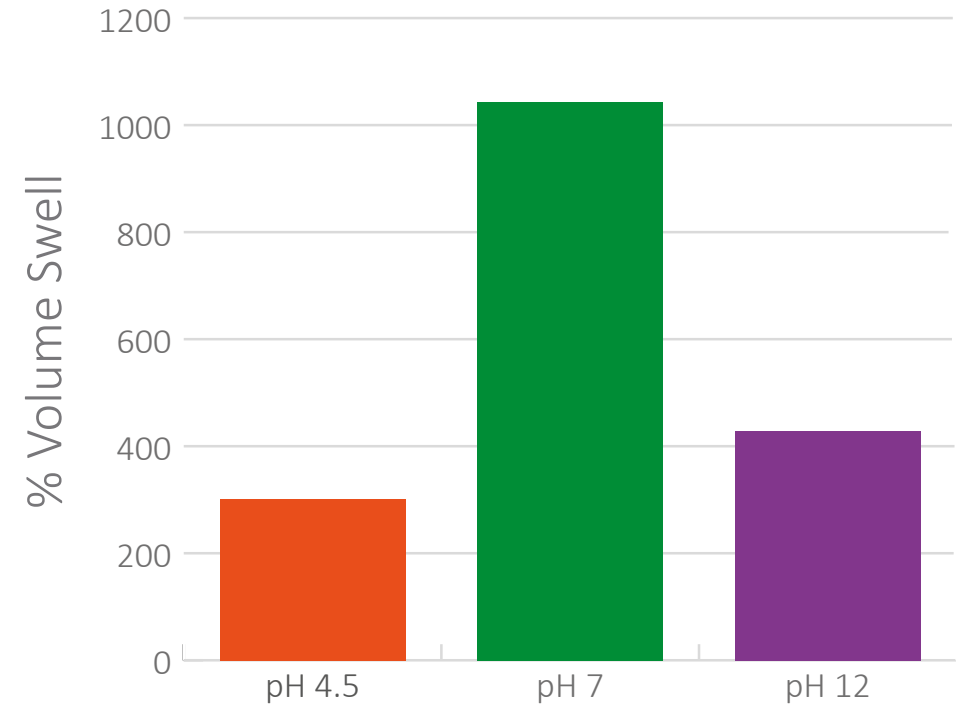
GRADE SELECTION:

Grades should be selected based on the hardness of the material and the environmental conditions to which the product will be exposed. In general, extremes of pH and salinity require WS grades with higher levels of optimum swell in de-ionised water. We recommend that products produced from Dryflex WS are fully evaluated under expected service environments. This also includes the impact of variations experienced during the moulding or extrusion process.

Effect of pH

Both acidic and alkaline conditions can affect the level and rate of swell.

Effect of pH
Dryflex WS 40E850
8 days at 23°C



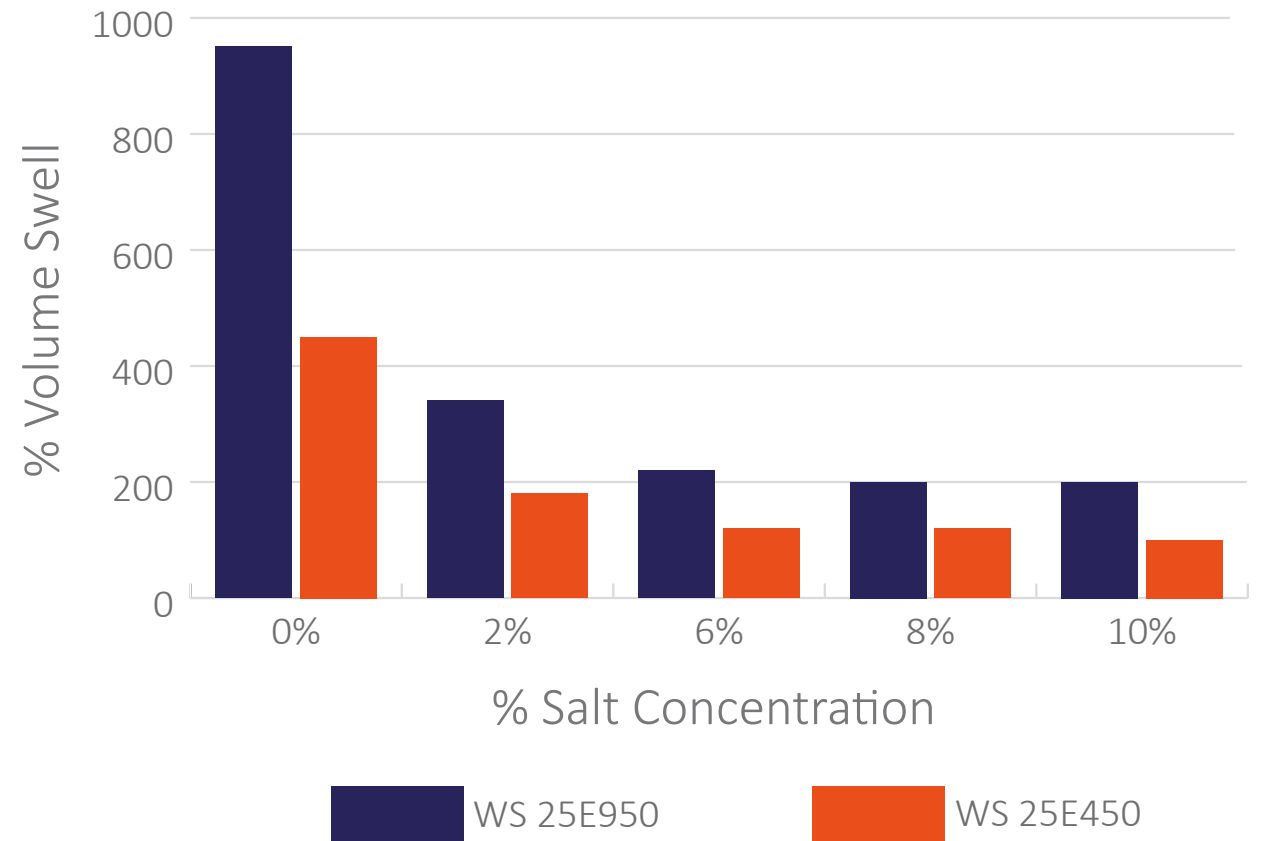
pH 4.5	H_2SO_4
pH 7	De-ionised Water
pH 12	$\text{Ca}(\text{OH})_2$

Effect of Salinity

The degree of salinity within the environment has a high impact on the ultimate level of swell.

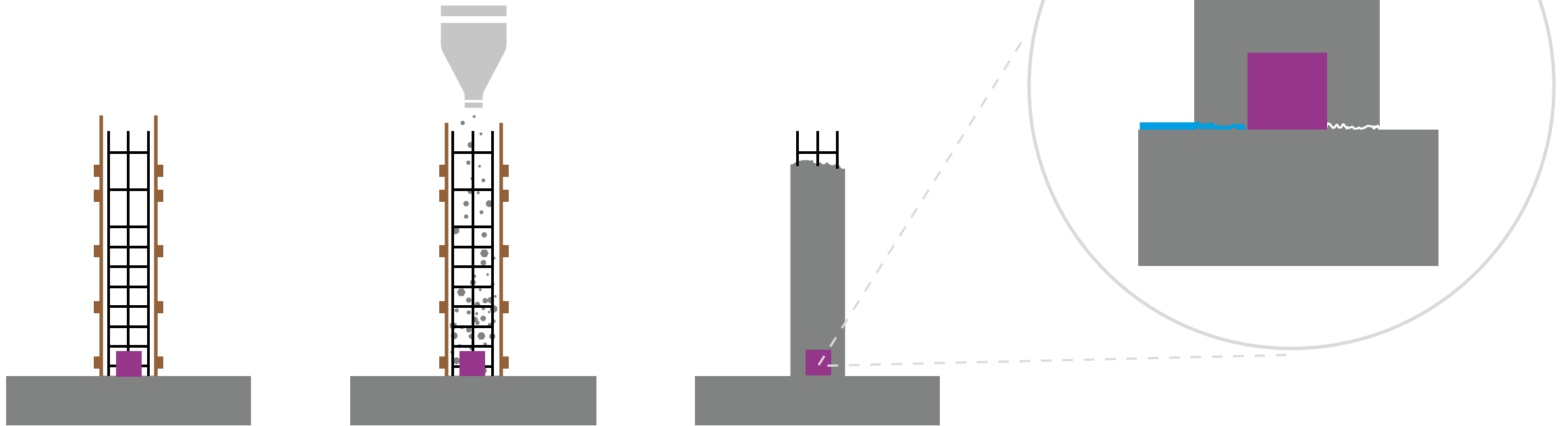
Swell rates are also reduced and can take up to 21 days to reach optimum levels.

Effect of Saline Concentration
After 21 days at 23°C



APPLICATIONS

One of the main applications for Dryflex WS compounds are hydrophilic waterstops. These are typically used as part of a concrete structure and help to prevent the passage of fluids (e.g. water) when embedded in concrete joints. Other applications include tunnels, water treatment plants, drains, sewers, tanks, glazing and cable protection.



TYPICAL DRYFLEX WS GRADES

Grade selection should be based on the hardness of the material and the environmental conditions to which the product will be exposed. In general, extremes of pH and salinity require grades with higher levels of optimum swell in de-ionised water. We recommend that products produced from Dryflex WS are fully evaluated under processing conditions and expected service environments.

Material	Hardness ⁽¹⁾ Shore A	Density g/cm ³	Swell Level ⁽²⁾ %
Test Method	ISO 868	ISO 2781	Volume Swell
Dryflex WS 25E450	25	1.21	450
Dryflex WS 25E800	25	1.22	800
Dryflex WS 25E950	25	1.23	950
Dryflex WS 40E350	40	1.24	350
Dryflex WS 40E450	40	1.25	450
Dryflex WS 40E850	40	1.25	850

⁽¹⁾ After 15 seconds

⁽²⁾ Minimum swell level, up to 21 days immersion period in de-ionised water at 23°C

PROCESSING

Dryflex WS TPEs are primarily processed via extrusion processing techniques, but may also be injection moulded.

- In general these materials do not require pre-drying, however, after periods of prolonged storage pre-drying may be necessary.
- Venting of extrusion lines may be used as a method of preventing the build-up of volatiles during continuous processing.
- Cycle times for injection moulding will be governed by temperature and section thickness. Care must be taken to allow sufficient cooling of parts prior to demoulding in order to prevent permanent distortion of the article

Due to the nature of the swelling process, many factors can affect the overall level of swell and the rate at which swelling occurs, we have therefore created processing guides for each grade within the Dryflex WS range. These guides outline specific processing conditions that should be used. Deviation from recommended processing conditions can adversely affect the rate and ultimate level of swell.

Please contact us at WS@hexpolTPE.com for grade specific processing guides.

INCLUSIONS

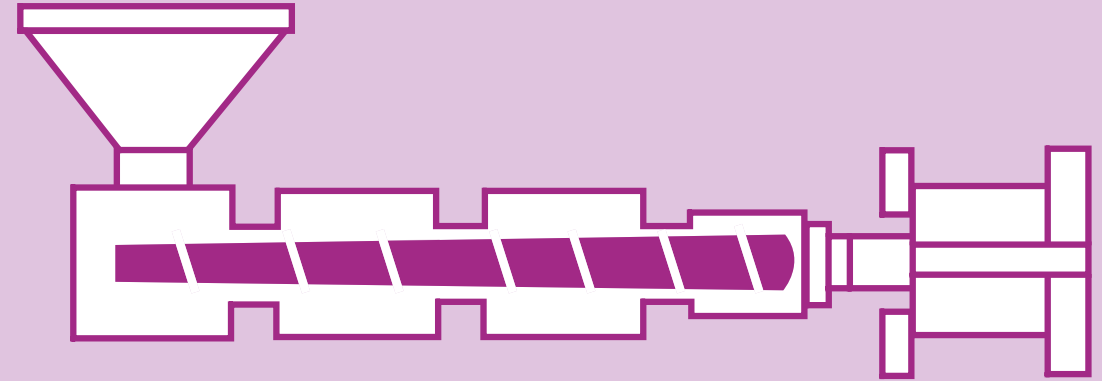
Dryflex WS is manufactured using swell additives based on acrylic salts. A characteristic of these products is that they can leave deposits within processing equipment which can cure to form hard particles. During processing, deposits can enter the polymer flow path and appear in moulded articles and extruded profiles as creamy coloured inclusions.

It is recommended to purge and clean processing equipment with suitable products on a regular basis in order to minimize the build-up of deposits on the screw and barrel. Ideally sieve packs should be used during extrusion to filter out any particles.

Despite best working procedures, we cannot guarantee that Dryflex WS will be totally free of such inclusions. This must be fully evaluated when designing profile geometry, mould gates and process engineering.

PROCESSING : EXTRUSION

L/D Ratio: 20:1 - 25:1
Compression Ratio: 2.5 - 3.0
Breaker Plate/Screen: Both should be used
Draw Down: 5 - 10%
Cooling: Air cool only
(must not come into contact with water)

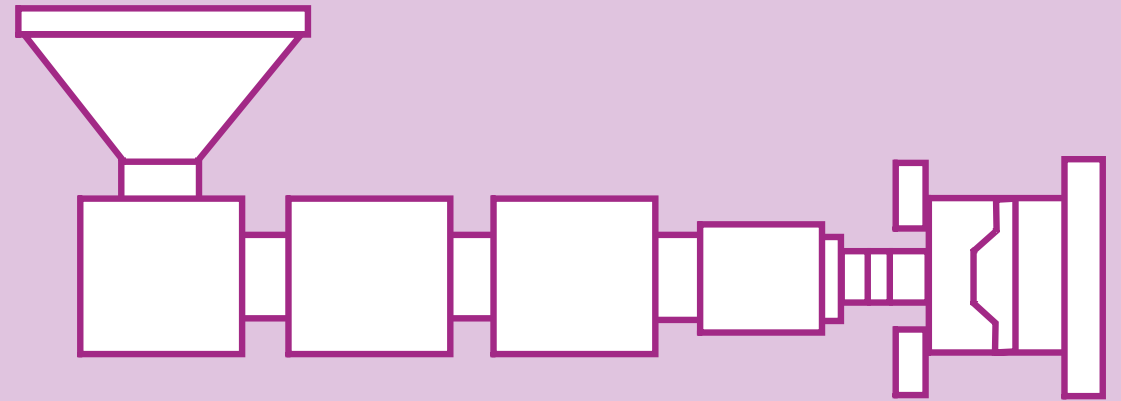


Temperatures °C	20 - 30 Shore A	80 - 90	80 - 90	90 - 100	90 - 100	110 - 120
	35 - 45 Shore A	110 - 110	110 - 110	110 - 120	110 - 120	120 - 130

→ These conditions are only for indicative purposes, please refer to the grade specific processing guide for precise details

PROCESSING : INJECTION MOULDING

Injection Speed:	Medium - Fast
Injection Pressure:	Medium - Fast
Back Pressure:	Low - Medium
Holding Pressure:	Sufficient to pack the mould
Cooling:	Can be demoulded when parts have cooled sufficiently



Temperatures °C

100 - 110

110 - 120

120 - 130

130 - 140

15 - 40

→ These conditions are only for indicative purposes, please refer to the grade specific processing guide for precise details

CONTACTS

To learn more about the opportunities with [Dryflex WS Hydrophilic TPEs](#), contact one of our colleagues:



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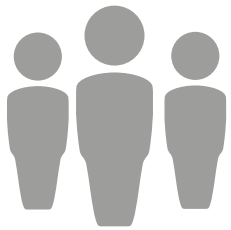


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ABOUT HEXPOL TPE

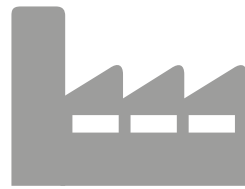
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300+ EMPLOYEES
WORLDWIDE



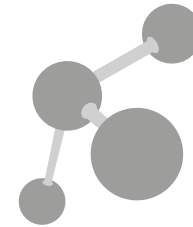
PRODUCTION PLANTS
Sweden, UK, Germany,
China, USA



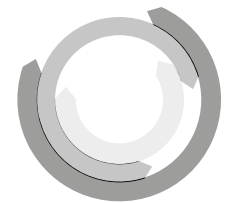
GLOBAL CAPACITY
> 80,000 tonnes p.a.



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HEADQUARTERS
Malmö, Sweden



34,796+
PROPRIETARY
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automotive, medical,
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