Effects of the environment

Introduction

This chapter presents information on the behaviour of DELRIN® in various conditions of exposure to chemicals at ambient temperature.

Evaluation of the chemical resistance and weatherability of DELRIN® was accomplished in a series of laboratory tests where unstressed specimen were exposed in the selected environment for periods up to one year; the final appreciation was based on visual observation, the changes of weight and dimension, and measurement of mechanical properties.
The chemical composition of the environment, exposure time, and temperature were confirmed as the main factors influencing the behaviour. These results can be used to estimate the suitability of DELRIN® under comparable exposure conditions. It must be recognized however that there are always limitations to the prediction of actual performance from laboratory data obtained using unstressed specimen in continuous exposure to a certain environment. Intermittent exposure and service stresses can strongly modify the behaviour of the part.
Therefore the information in this chapter should be considered as a starting point. It is not meant to substitute for any testing that may be required to determine the suitability of DELRIN® under expected service conditions.

Table 7.1 – Behaviour of DELRIN® exposed to various chemicals. Unless a concentration is specified, samples were immersed in the pure liquids at room temperature for periods up to one year. The final appreciation is based on the visual appearance, the changes of weight and dimension, and the retention of mechanical properties. The ratings range from "resistant" (no visible chemical attack, tensile strength changed by less than 20%) to "unsatisfactory" (severe chemical attack and/or changes of mechanical properties).

Chemical	Behaviour	Chemical	Behaviour
Acetic acid (5%)	resistant	Hydrofluoric acid (10%)	unsatisfactory
Acetic acid (20%)	limited resistance	Hydrogen peroxide (1%)	resistant
Acetic acid (50%)	unsatisfactory	Hydrogen peroxide (30%)	unsatisfactory
Acetone	resistant	Hydrogen sulphide	unsatisfactory
Air (all pressures)	resistant	Insecticides	resistant
Alcohol (all types)	resistant	Iso-octane	resistant
Ammonia (10%)	unsatisfactory	Jet Fuel / kerosene	resistant
Aniline	limited resistance	Lubricating oil	resistant
Benzene	resistant	Methyl chloride	limited resistance
Bleaching fluid (10% chlorine)	unsatisfactory	Methylene chloride	limited resistance
Brake fluid	resistant	Methyl ethyl ketone	limited resistance
Butane	resistant	Mineral oil	resistant
Calcium chloride (10%)	resistant	Motor oil	resistant
Carbon dioxide	resistant	Nitric acid (10%)	unsatisfactory
Carbon monoxide	resistant	Nitrous acid	unsatisfactory
Chloracetic acid (10%)	unsatisfactory	Nitrous oxide (dry)	unsatisfactory
Chlorine gas	unsatisfactory	Oils (food)	resistant
Chlorinated water	limited resistance	Oils (mineral)	resistant
Chloroform	limited resistance	Oleic acid	resistant
Chromic acid (10%)	unsatisfactory	Palmitic acid	resistant
Citric acid	limited resistance	Paraffins	resistant
Cyclohexane	resistant	Perchloric acid (10%)	unsatisfactory
Detergents	resistant	Phosphoric acid (30%)	unsatisfactory
Diesel fuel	resistant	Potassium hydroxide (10%)	unsatisfactory
Ethanol	resistant	Propane (liquified gas)	resistant
Ethyl acetate	resistant	Sodium chloride (10%)	resistant
Ethyl ether	resistant	Sodium hydroxide (10%)	unsatisfactory
Ethylene glycol	resistant	Sodium hypochlorite (5%)	unsatisfactory
Formaldehyde (37%)	resistant	Sulfur dioxide	unsatisfactory
Formic acid	unsatisfactory	Sulphuric acid (30%)	unsatisfactory
Fuel oil	resistant	Tetrahydrofuran	resistant
Fruit juice	resistant	Toluene	resistant
Gasoline	resistant	Trichloroacetic acid	unsatisfactory
Glucose (sat. sol.)	resistant	Trichloroethane (1,1,1-)	resistant
Heptane	resistant	Turpentine / white spirit	resistant
Hexane	resistant	Urea (5%)	resistant
Hydrochloric acid (10%)	unsatisfactory	Vinegar	resistant

Resistance to chemicals

One of the outstanding properties of DELRIN® acetal homopolymer is high resistance to a variety of organic compounds that cause rapid failure of other plastic materials. DELRIN® resins have good load-carrying ability in many neutral organic and inorganic materials, even at elevated temperatures. Typical chemicals to which they are resistant include alcohols, aldehydes, esters, ethers, hydrocarbons, agricultural chemicals, and many weak acids and bases; DELRIN® has a good dimensional stability in most of these substances.

The Table 7.1 presents the results of tests for representative groups of chemicals. Injection-moulded bars were immersed in the chemical and maintained at room temperature. After exposure, the bars were examined for evidence of chemical attack, and measured to determine the changes in length, weight, and tensile properties; such changes may be reversible (absorption) or permanent (chemical attack, mechanical failure).

A change in length of the bar can result from stress relief due to exposure conditions, swelling, and/or chemical decomposition. In the majority of the tests, there was a length increase due to absorption. For this reason, dimensional variations in parts with close tolerance need to be verified under the proposed service conditions.

The Table 7.1 also shows cases where DELRIN® was unsatisfactory under the given test conditions. A change in service (intermittent contact, different concentration) may permit the use of DELRIN® with satisfactory performance and service life.

Fuel resistance

Gasolines and blends with alcohols

Standard DELRIN® grades have an excellent behaviour in the various gasolines or gasoline-alcohol blends available today. Blends with methanol are increasingly common and are known to cause more swell compared to regular gasolines and ethanol blends.

Standard specimen of DELRIN® 500 NC-10 and DELRIN® 500 P NC-10 were aged up to 1500 hours at 60 °C in a M-15 blend (regular gasoline +15% methanol). The Figure 7.01 illustrates the change in dimensions and properties as a function of exposure time. Only small changes can be noticed, explained by a slight plastification effect due to the fuel absorption.

Diesel, bio-Diesel, kerosene

Standard DELRIN® grades have an outstanding performance in these fuels. Almost no effect on dimensional and mechanical properties can be noticed after exposure at 60 °C up to 2000 hours.

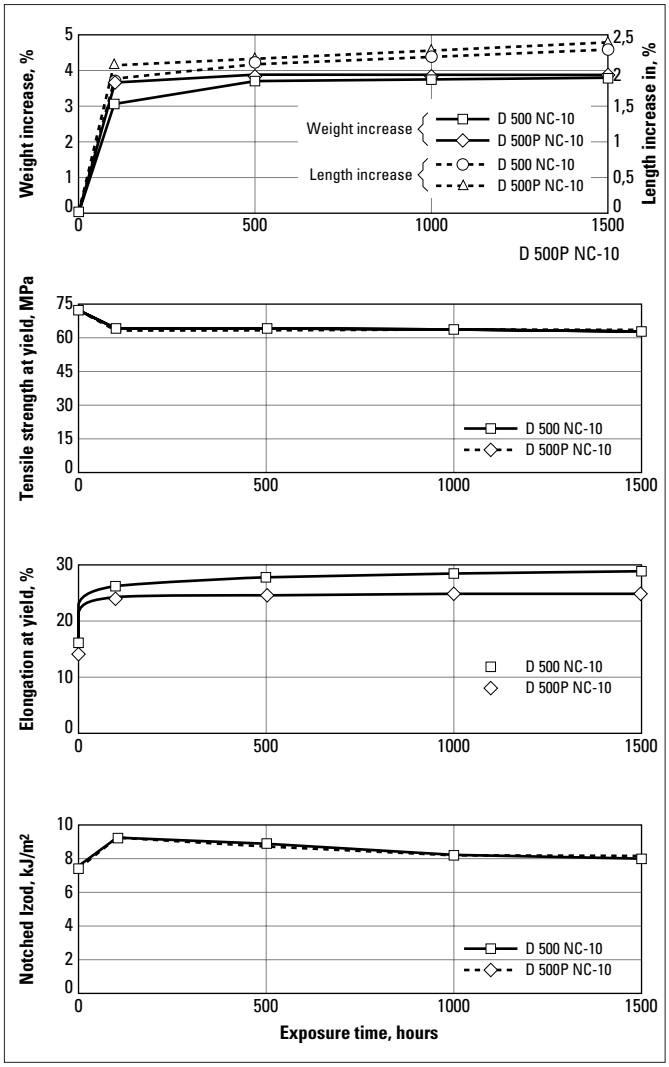

Figure 7.01 **Changes of weight, dimension and mechanical properties of DELRIN® 500 and 500 P immersed in fuel M-15 at 60°C**

Permeability

Due to its high crystallinity, DELRIN® is permeated only slowly by many substances including aliphatic, aromatic and halogenated hydrocarbons, alcohols and esters. Its permeability to small polar molecules such as water, methanol and acetone is higher, and these products induce changes of dimensions and/or mechanical properties (see the sections on effect of moisture, in Chapter 5, and on resistance to fuels, above).

Permeability characteristics and strength properties of DELRIN® make it a suitable material for containers, particularly of the aerosol type, and for parts in fuel reservoirs.