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Cable knowledge
Chemical resistance

Technical Information 2019 – Englisch

R&M

Introduction

The term «chemical resistance» generally refers to the «non-interaction» of the workpiece to be assessed, or its shell, with chemical substances occurring in the environment.

As a rule, chemical resistance is only asked for in heavily loaded or potentially endangered environments.

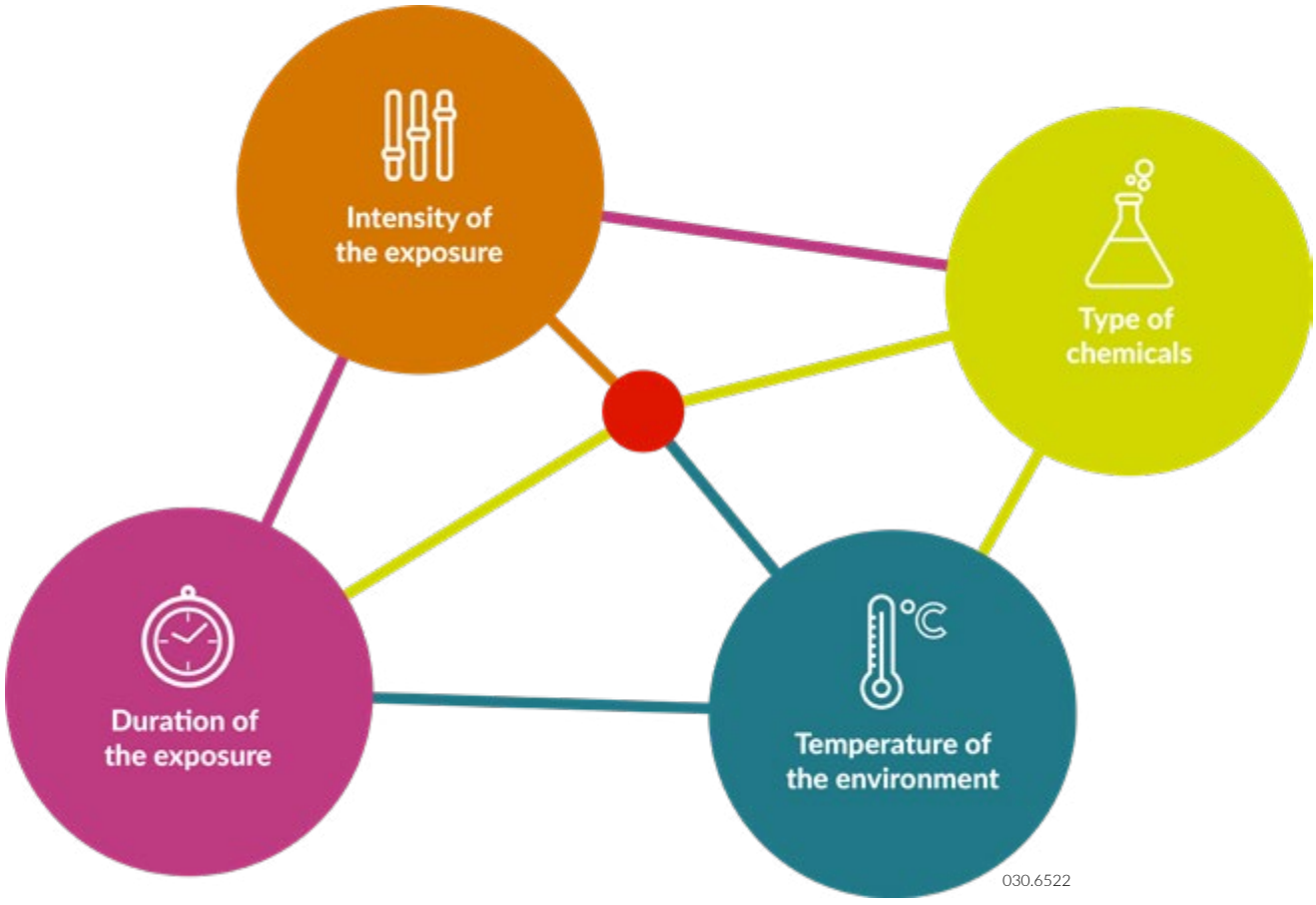
A product recommendation for highly exposed cabling components, such as a distribution box or the installation cable, must be made in coordination with the chemicals involved.

Common sense and knowledge of the effects of chemical exposure on the cabling component are of paramount importance in assessing the appropriate product. In any case, a cost-benefit analysis and a worst-case impact assessment should be carried out.

Chemical resistance

Unfortunately, the chemical resistance cannot be defined by a number, since different parameters act simultaneously on the test specimen. The ratio of these parameters to each other cannot be completely covered in the test.

Corresponding parameters for chemical loads



Type of chemical substance

Not only the chemical substance is decisive, but also its concentration in a solution or a gaseous mixture.

Usually only a very limited number of possible chemicals are tested:

Chemical	Description	Occurrence
Gasoline, toluene and related (so-called olefins or olefinic solvents)	highly flammable, volatile organic substances chemically not very active, but there's a potential for material damage due to swelling/softening	airports, petrochemical industry, chemical industry
Oils, greases	hardly combustible organic substances chemically not very active, but there's a potential for material damage due to swelling/softening	everywhere where machines be operated oil production
Sulphuric acid	defined as 10 % solution in water chemically very active and aggressive acid	car batteries, electroplating
Detergents	surfactant solutions (soaps) up to 5 % chemically moderate active alkalis	detergents
Aggressive gases	mostly by-products of combustion reactions: • hydrochloric acid • SO2: sulphur dioxide (heavy oil combustion) • NO2: nitrous gases • Ozone: electrical discharges in the air the gases are particularly effective in combination with humidity very aggressive.	combustion processes
Alcohols, esters, acetone (so-called solvents)	organic liquids with moderate chemical activity, but potential for material damage by swelling/softening.	chemical industry, pharmaceutical industry

Intensity of action

Once it has been determined which chemicals can or will have an effect on the cabling component, it is necessary to determine the intensity or type of this contact in the case of liquid chemicals:

- Contact with splashes (e.g. oil droplets when the system is open)
- Contact with liquid jets (e.g. with a leaking pipe)
- All-round contact with the liquid (e.g. in an acid bath)

Duration of exposure

In determining chemical resistance, the exposure time is also a decisive factor in determining the influence of chemicals on the cabling component:

- short-term influence: a maximum five minutes, rarely occurring
- medium-term influence: up to 3 hours, rarely occurring
- long-term influence: over 3 hours, recurrent or continuous

Short-term or medium-term exposure means that the chemical exposure is only temporary for a limited period and is usually not planned.

Long-term influences are usually recurring stresses that are often part of a process (e.g. emptying a tank).

Duration → Intensity ↓	max. 5 min	max. 3 h	> 3 h
drops, splashes	low load	medium load	high load
Liquid jet, flooding	medium load	high load	high load
Immersed in the medium	high load	high load	high load

Temperature

In chemistry, the rule of thumb is that a temperature difference of +10° C leads to a doubling of the reaction rate.

Applied to the resistance of a material to a defined chemical, this means, for example, that at 30° C the influence of the chemical is twice as aggressive as at room temperature (20° C), and at 40° C even four times as aggressive.

The temperature, especially an elevated temperature, is therefore of drastically greater importance than, for example, the intensity or duration of the influence.

Interpretations

Simplified, the combination of intensity and duration of the chemical influence can be interpreted as a «chemical load».

Chemical load due to less aggressive chemicals

This group includes soaps, organic acids (acetic or formic acid), strongly diluted caustic or acid solutions, alcohols, silicones, oils, lubricants or greases.

This means that no specially resistant materials are required for droplet loading and short duration, but check the chemical resistance makes sense for medium loads.

Chemical loads due to aggressive chemicals

The influence of aggressive chemicals is primarily based on their chemical reactivity. They react with the surface of the cabling component and form new chemical compounds or destroy the original material.

Acids and strong bases are considered particularly aggressive.

When aggressive chemicals occur, the cabling component must always be resistant to them.

Exposure to swelling chemicals

Another group of chemicals are those that do not tread the cabling component by chemical attacks, but by penetrating the molecular structure, resulting in swelling and a corresponding weakening of the affected material.

This group includes olefinic solvents such as gasoline, toluene, benzene, brush cleaners, etc.

As a rule, this swelling is reversible, i.e. it returns to its original state once the chemical has disappeared.

However, if the swelling is too extreme or returns frequently, irreversible damage to the material may result.

All metals are naturally resistant to this group of chemicals. Plastics, on the other hand, exhibit the swelling mentioned above.

Resistance of the most commercially available materials

Chemical groups	PBT / PET (Polyesters)	PE (Polyethylen)	FRLSZH / LSZH (filled PE's)	PA (Polyamid)	PUR (Polyurethan)	PVC
oils	🟢	🟠	🟠	🟢	🟠	🟠
petrol , kerosene	🟢	🟠	🔴	🟠	🟠	🔴
salt water	🟢	🟢	🟢	🟢	🟢	🟢
Aqueous acids, aggressive	🟠	🟢	🟢	🟠	🟠	🟠
Aqueous acids, diluted	🟢	🟢	🟢	🟢	🟠	🟠
Aqueous alkalis, aggressive	🔴	🟢	🟢	🟠	🔴	🟠
Aqueous lyes, diluted	🟠	🟢	🟢	🟢	🟢	🟠
Organic acids, medium aggressive	🔴	🟢	🟢	🟠	🟠	🟢
Organic acids, aggressive	🔴	🟢	🟢	🟢	🟠	🟠
soaps	🟢	🟢	🟢	🟢	🔴	🟢
Solvent, Thinner	🔴	🟠	🟠	🔴	🟠	🔴

🟢 No problem / 🟠 Suitable for medium loads / 🔴 Not recommended

Summary and recommendations

R&M's standard products can withstand low and moderate loads without any problems. Experience has shown that chemical loads, even those of a coarser nature, can often be covered with a suitable standard product.

The following rule of thumb applies:

- Solvents: low hazard, recommended according to list «Resistance».
- Oils and fats: low hazard, recommend according to list «Resistance».
- Acids and alkalis: always consult with suppliers
- Aggressive gases: in any case consultation with suppliers
- Alcohols, acetone: low hazard, recommended according to list «Resistance».
- Aqueous solutions: low hazard, recommended according to list «Resistance».