

Cleaning, Disinfection and Sterilization of Parts in Makrolon®

- Influencing factors
- Limits

General

Molded parts in Makrolon® can be cleaned, disinfected and sterilized by almost any of the well-known methods employed in practice.

The smooth surface of the parts is seen to be a particular advantage here.

Under certain conditions, however, contact with cleaning, disinfecting and sterilizing media may cause some damage, which manifests itself in the form of stress cracking.

This generally leads to a great reduction in mechanical strength, but there are also other effects, which are not always visible, such as swelling or chemical decomposition of the polymer, which can similarly impair the mechanical strength.

This Technical Information Sheet contains no specific recommendations as to suitable cleaning agents and disinfectants for Makrolon® parts, because the composition of such products can change and BMS has no influence on these formulation changes.

Besides the nature and concentration of the contact medium, the appearance of stress-cracking effects is influenced by the following factors:

- inherent stress state in the molded part
- mechanical load during contact
- temperature during contact
- viscosity of the Makrolon® grade

As regards the first three points, experience has shown that the lower the degree of stress, the mechanical load and the temperature, the lower the tendency towards stress cracking.

In order to avoid mechanical stresses or to reduce them to a minimum, it is advisable not to clamp the

molded parts and not to stack them – or at least not too high – during cleaning, disinfection or sterilization.

It should also be noted that medium- and high-viscosity Makrolon® grades have slightly better resistance to cleaning agents and disinfectants than low-viscosity Makrolon® grades.

Care should also be taken about the effect of hot water, as well as hot aqueous solutions of cleaning, disinfecting and sterilizing media.

Although Makrolon® can be treated repeatedly with boiling water or steam at 120 to 125 °C, permanent contact with water at above 60 °C or with steam will lead to damage.

Both media cause gradual hydrolytic decomposition of the polymer, which will manifest itself in a reduction in a number of mechanical properties.

The best resistance against the stresses mentioned is found in the types of Makrolon® with greater resistance to hydrolysis.

These are the grades with the final digits . . 06 / . . 56 and . . 08 / . . 58 and Makrolon® WB1239.

Cleaning

In many cases it is sufficient to clean with warm or hot water to which some weakly acidic, neutral or weakly alkaline cleaning agent has been added.

Standard cleaning

When cleaning tableware or chocolate molds in dishwashers or washing lines to remove remains of food, care should be taken to ensure that the manufacturer's recommended concentration of the normally strongly alkaline pre-rinsing solution is not exceeded and that the temperature is precisely maintained.

The temperature of the rinsing solution is generally about 60 °C.

The subsequent rinsing cycle, which generally involves weakly acidic or neutral active substances being added to the water, can be carried out as usual at 80 to 85 °C on account of the very short contact time (less than two minutes).

Here again, the manufacturer's instructions with respect to the concentration of clear rinsing agent employed should be carefully followed.

Standard cleaning with subsequent sterilization

When cleaning animal-breeding cages made of Makrolon[®], it is important that the litter be carefully removed.

If this is followed by treatment with an alkaline cleaning agent, this must be rinsed off completely, otherwise the subsequent conventional sterilization operation will leave dull marks on the surface of the Makrolon[®] part.

Practical experience has shown that if a clear-rinsing agent is used, the film that remains on the article surface can also lead to surface defects in the form of microcracks during subsequent hot steam sterilization.

Cleaning of returnable bottles

See for this our Technical Information Sheet "Makrolon[®] WB1239 - Water in Good Shape".

This Technical Information can be found on the INTERNET at <http://plastics.bayer.com/plastics/emea/en/home.jsp>
(Markets / Packaging)

Disinfection

Depending on their composition, disinfectants can damage Makrolon[®].

Care must be exercised with some products containing aldehydes, phenols or amines as the active ingredient.

Otherwise, tests have shown that Makrolon[®] is compatible with a large percentage of commercially available disinfectants.

Sterilization

Any molded articles to be sterilized should previously have been cleaned.

Otherwise, there is the danger that constituents of the contamination will cause severe turbidity, cracks, etc. during sterilization.

Sterilization by steam (saturated steam)

To prevent deformation of the molded parts, the sterilization temperature should not exceed 125 °C.

Care must also be taken to ensure that Makrolon[®] parts are not damaged by substances added to the boiler feed water, such as alkaline corrosion inhibitors, and that the article is positioned in such a way that no condensation can accumulate inside it.

As a rule, it is possible to sterilize molded parts made of Makrolon[®] many times before gradual chemical decomposition reduces the mechanical strength to a level where it is no longer adequate for certain applications.

Sterilization tests on test specimens have shown that even after 100 cycles of 30 minutes each at 120 to 125 °C, the part still retains comparatively good impact strength.

This also generally applies even if the material exhibits hairline cracks and the molded part appears slightly milky as a result of the high stresses imposed on the material by repeated sterilization.

In view of these gradually occurring changes, articles made of Makrolon[®] that are intended only for single use should not be repeatedly sterilized.

Sterilization with ethylene oxide (ETO)

Suitable sterilization processes are those which use ethylene oxide, either undiluted or mixed with carbon dioxide or inert gases in the ratio 10 to 20 % ethylene oxide / 90 to 80 % remainder.

The temperature during sterilization should not exceed 65 °C.

Tests have shown that repeated sterilization can cause slight brittleness combined with crack formation.

The impact strength of test specimens treated with pure ethylene oxide at 55 °C for 50 cycles of 6 hours each is unchanged in comparison with the starting level despite slight crack formation.

Sterilization with high-energy radiation (γ-radiation)

Makrolon[®] has a high resistance to the effects of high-energy radiation.



Its resistance depends on the ambient conditions and the radiation dosage applied.

Assuming that 28 kGy (2.8 Mrad) of energy is required to sterilize Makrolon[®], the resin can be sterilized 10 to 20 times before any appreciable reduction in mechanical strength occurs.

Polycarbonate does, however, become progressively more yellow with each sterilization.

Makrolon[®] grades Rx2430, Rx2530 and Rx1805 contain a special stabilizer which makes them less susceptible to color changes caused by high-energy radiation than standard Makrolon[®] grades.

Sterilization with peracetic acid

Makrolon[®] can be sterilized with 2 % concentration peracetic acid without suffering damage. (Appropriate safety precautions must be observed when handling peracetic acid!)

Sterilization with hot air

Sterilization with hot air plays only a minor role for molded parts in Makrolon[®], since temperatures of 180 to 200 °C are generally used to save time.

No problems are to be expected with molded parts in Makrolon[®] up to a hot air temperature of 135 °C.





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