



# Compendium of practice for Commercial Dishwashing

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Section 09

**Glass wash items**



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## 1. Glass: its use and properties

Glass is a molten product made of quartz sand (silicon dioxide). The additives lime, soda, potash and other natural materials such as feldspar make it easier to melt the raw material (1200 °C to 1500 °C), to dye or bleach, and to obtain specific properties (e.g. refinements).

The following main components are used in glass manufacturing:

- 65 – 75 % quartz sand** = glass-forming substance
- 10 – 20 % alkali** = liquid to make it easier to melt quartz sand
- 12 – 20 % lime** = gives glass hardness, shine and durability

Physically glass is a solidified melt without a defined crystalline structure.

A distinction is made between the following glass qualities:

- Soda-lime glass
- Crystal
- Lead glass
- Borosilicate glass
- Glass ceramic (vitroceramic)

**Soda-lime glass** is a standard consumer glass and is used predominantly for manufacturing bottles, simple drinking glasses or window panes.

**Crystal glass** is a transparent, ultra-pure glass without bubbles and striations and is used to manufacture valuable glass tableware and consumer goods.



**Lead glass** can contain up to 24 % lead salts and are characterised by its brilliance and high specific weight. Due to food legislation, the use of this glass is on the decline.

**Borosilicate glass** is a very chemical-resistant and temperature-resistant glass that is used predominantly for glass laboratory equipment and cooking / baking utensils.

The good chemical resistance is attributed to the boron content of the glass.

An important technical difference between these various glass qualities is different thermal expansion coefficients (dilation coefficients). The insensitivity to sudden temperature fluctuations is based on a low thermal expansion coefficient, such as that required for glasses for hot beverages.

Hardened glass is the product of special manufacturing technology: similar to that used in steel manufacturing, the finished product is reheated to just below the melting point and is then cooled down abruptly (tempering). This production process changes the ionic structure, and drinking glass and dishes (plates, bowls, cups, etc.) are particularly resistant to damage and breakage, as well as thermal stress.

Hardened glass is two to three times more resistant to chips than conventional glassware and other types of dishes. The breakage behaviour is considerably improved via reduced shattering.

**Glass ceramic (vitroceramic)** items and / or opal glass items have particular characteristics.

Glass ceramic is used for cookware due to the high thermal shock resistance (- 90 °C to + 800 °C).

Opal glass is the name for hardened glass dishes in the colours white or ivory. In addition to the basic substances, a fluorine bond is used for the manufacture.

Opal glass and its variants are used in the commercial sector, such as in large company canteens, by catering companies, and in hotels and restaurants.



The glass is especially easy-to-clean and hygienic due to the amorphous and non-porous surface. The physical-chemical properties of glass are determined predominantly by its composition, processing, design, post-production and surface finish.

Decoration is applied to the glass (drinking glass) afterwards.

There are two different methods:

Burning-in during the production process and subsequent individual decoration.

According to the state-of-the-art, coloured decoration applied subsequently is not particularly resistant to the physical and chemical stresses of machine washing.

In opal glass, the decoration is burned-in during the production process and is therefore very resistant.

## 2. Glass washing

Glasses should be cleaned in a glass washer and not in a dishwasher.

Special washing conditions such as shorter cycle times, adapted detergent and rinse aid, as well as lower temperatures in a glass washer have a positive impact on the service life of glasses, and on the cleaning and drying result.

Higher temperatures and higher doses of detergent as used to wash dishes and kitchen utensils will place more strain on glass surfaces, which considerably reduces the service life.

The requirements for the treatment of glasses (see *Compendium of practice for Commercial Dishwashing, Section 11 "Hygiene"*) are:

- visibly clean,
- dry



- shiny
- hygienically clean

According to the relevant recommendations, a drying time of up to 2 minutes outside the dishwasher is standard for tank dishwashers. Drops remaining on the point of contact and residual moisture inside glasses can be tolerated.

### 3. Recommendations for washing glassware

Drinking vessels should always be positioned at a slight angle in the dish and / or glass rack of the dishwasher to ensure that no water residues remain in the bases. Even correctly designed wash items and correct loading in the dishwasher cannot completely exclude small water residues, which results in a poor rinse result.

To avoid recontamination during the cleaning process, it is advisable to change the water regularly depending on the filter system in place.

Fully plastic racks or plastic-coated wire racks with stops that securely hold the glasses offer the best protection against chips and breakages as a result of mechanical stress. Glasses knocking into each other can cause significant mechanical damage (impact or abrasion points) to decorated and glass surfaces.

Improper arrangement of the glasses in the dishwasher and / or glass racks is the primary cause of glass damages.

The water quality has a considerable influence on a good drying and rinse aid result for glasses (see *Compendium of practice for Commercial Dishwashing, Section 05 "Water quality"*). Ideally, water with a maximum conductivity of 100  $\mu\text{S}/\text{cm}$  should be used for glass washing. This allows an excellent drying and rinse aid result when a suitable rinse aid is used in a dose configured to the water conditions.

#### 4. Possible visible glass changes through glass washing

Depending on the type of glass and the washing conditions, various changes can occur on the glass surface during machine washing:

- Stress cracks and / or chipped edges
- Scratch-like changes
- Flat abrasion points
- Glass clouding
- Coatings

**Stress cracks and chipped edges** can be caused by strong temperature fluctuations in the dishwasher, accompanied by incorrect loading (put under strain).

**Scratch-like changes** are caused by mechanical influences.

Over long periods of use, glasses can acquire **visible changes** (grey layer). This can be caused by two factors: reversible clouding caused by lime deposits, or irreversible glass corrosion.

Reversible lime deposits occur if no suitable water treatment required for operation of the dishwasher is used with correspondingly high untreated water hardness (>3 °dH see *Compendium of practice for Commercial Dishwashing 05 "Water quality"*). The calcifiers in the water can reach the glass and settle on the surface of the glass during the drying phase.

There are detergents that can set the water hardness, thus this clouding caused by lime can be avoided or at least reduced with an increased detergent dosage. Existing clouding caused by lime can be removed by thoroughly cleaning the glasses.

Clouding caused by lime can be completely removed with a little acid in low concentration.

**Glass corrosion** is visible clouding of the glass, which cannot be removed by polishing. This clouding constitutes irreparable damage to the glass surface, which can occur after frequent washing in a dishwasher. The clouding of the glass is caused by the release of glass particles or through various types of abrasion of the glass surface. What remains is an uneven surface with varying refractive index, which is perceived as clouding by the human eye. Glass corrosion does not occur spontaneously during an individual cleaning process, but

continuously across several wash cycles. The clouding is not always distributed evenly across the entire glass, but frequently occurs on subsequently thermally treated areas for manufacturing reasons (e.g. the rim).

Glass corrosion can occur in all types of glass. Certain glass types such as simple potash glass have a greater tendency towards glass corrosion. Crystal or borosilicate glass, however, are less sensitive. Even water alone can cause glass corrosion under the conditions of mechanical dishwashing. Using special glass cleaner delays glass clouding and damage to the decoration.

The instructions of the detergent manufacturer as regards the dosage of the detergent and rinse aid must be observed. Thus it is important to know that underdosage is generally less favourable for the durability of glasses and decorations than overdosage. Overdosage, however, does not improve the result. It is inefficient and adds to the waste water load.

#### Sample image of corrosion:



Figure 1: Local clouding on the rim  
Source: Glastechnische Tagung Leipzig 2003



**Figure 2: microscopic view of the glass corrosion**  
Source: Glastechnische Tagung Leipzig 2003

In Figure 2, lots of small pits are visible in the area of glass corrosion to the right of the image. On the left side, the glass clouding diminishes; there is less pitting.

In the following Figure 3, scratches, pinprick and lint-like changes caused by damages during manufacturing, i.e., stresses and irregularities during melting are visible.



**Figure 3: Linear corrosion**  
Source: Glastechnische Tagung Leipzig 2003



This compendium of practice, which has been drawn up by experts, should remind the reader that commercial machine washing cannot be successfully conducted on a superficial level or without the corresponding input of all persons involved in the cleaning process.

Only the understanding of technical processes, the resulting interrelations and the cooperation of all participants, particularly the dishwasher operator and staff, as well as having regular maintenance of the dishwasher, the dosing equipment and the water treatment system by the manufacturer, can produce the cleaning results expected by the user.

Consistent cooperation between the dishwasher, detergent and dosing equipment manufacturers, as well as the manufacturers of wash items, guarantees constant and optimal adaptation to practical requirements for the benefit of customers and the environment.

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