Recommendation for the Quality Assessment of Hand Dishwashing Detergents

Part C: Cleaning Performance through Soak and Rinse

The German Cosmetic, Toiletry, Perfumery and Detergent Association
Home Care Department, Frankfurt am Main, Germany

1. Preamble

The companies active in the German Cosmetic, Toiletry, Perfumery and Detergent Association (IKW e. V.) provide their expertise on the products they manufacture in the form of recommendations for quality assessments to the public.

These recommendations for quality assessments are developed in working groups and are intended to enable qualified assessments of the relevant products carried out by manufacturers and testing institutes. They describe quality characteristics that the respective products achieve the effects expected by consumers and manufacturers.

1.1 Mandate and Objectives

Both consumers and manufacturers of hand dishwashing detergents are interested in reliable and practical testing methods for quality assessment, particularly regarding cleaning performance. In 1998, an IKW working group was first commissioned to develop a "Recommendation for the Quality Assessment of the Cleaning Performance of Hand Dishwashing Detergents"[1].

In 2018, IKW established another working group of experts from detergent manufacturers, raw material suppliers, and testing institutes to revise the testing method originally published in 2002. The updated recommendation now represents a collection of three testing methods, which in their non-binding form are intended to enable a qualified examination of hand dishwashing detergents by the companies themselves and by testing institutes. It may also serve as a contribution to the discussion on testing methods for hand dishwashing detergents at the European level and is divided into the following testing methods:

- **Part A:** Mileage through Plate Test [2],
- **Part B:** Cleaning Performance through soak and wipe (scrub tester) [3],
- **Part C:** Cleaning Performance through soak and rinse.

Each of the three testing methods for the quality assessment of cleaning performance of hand dishwashing detergents must meet the following criteria:

- Consumer relevance,
- Reproducibility,
- Differentiation and
- A test execution that is as straightforward as possible.

To meet these criteria, each test should be conducted with an internal control. This internal control should be selected by the persons performing the test based on its suitability for verifying the reproducibility and validation of the test method. **Neither the internal control nor the individual chemicals or other devices mentioned here can be obtained from the IKW office.**

1.2 Sustainability

The companies active in IKW are committed to achieving optimal quality standards for their products. They aim to ensure their future viability in a constantly changing world by consistently aligning with the concept of sustainability. Sustainability is understood as the balanced integration of economic, social, and environmental aspects to meet today's needs while preserving all possibilities for future generations.

This commitment to the model of sustainability is based on experiences that are manifested in numerous exemplary initiatives. The member companies of IKW have been engaged in the field of sustainability for a long time under the umbrella of the association and sister associations. These commitments have led to a series of distinguished industry-specific initiatives, including the dialogue platform FORUM WASCHEN, the IKW report on sustainability in the laundry, care and cleaning product industry, the sustainability initiative "Sustainable Washing and Cleaning" (Charter 2020+) of the International Association for Soaps, Detergents, and Maintenance Products (A.I.S.E., Brussels), as well as voluntary commitments. In addition, members are also involved in initiatives of the raw material and supplier industry, such as the "Responsible Care" initiative of the chemical-pharmaceutical industry and chemical trade in Germany.

The societal benefit of laundry and homecare products in terms of hygiene and value-retention is undisputed. The products contribute significantly to today's standard of living and health and to resource conservation, for example, by extending the lifespan of items such as dishes and cutlery. In this sense, the recommendations for quality assessment serve to encourage company employees to act responsibly towards people and the environment when developing and manufacturing products. They also serve consumers who can expect effective, health-compatible, and environmentally friendly products.

The recommendations for the quality assessment must not hinder such developments and therefore must be updated as needed.

It can only be determined for a product whether it offers good cleaning performance in terms of recommendations for the quality assessment. Highlighting isolated test criteria is not permitted and may be misleading.

1.3 Evaluation of Results

The recommendations describe which test criteria are relevant for a certain product and how they should be measured. It should be noted that every finished product has an intended spectrum of effects, which is primarily based on consumers' expectations about each individual quality characteristic, resulting in some quality characteristics being more emphasized and other characteristics being less important for each product. The desired combination of the individual properties is also subject to constant change and dependent on new technical capabilities and consumer habits.

1.4 Legal Requirements

Regarding formulation, packaging, and labelling, the following regulations (among others) must be followed, if applicable:

- German Food, Commodities and Feed Code (LFGB),
- German Dangerous Substances Ordinance (GefStoffV),
- German Detergents and Cleaning Products Act (WRMG),
- German Product Safety Act (ProdSG),
- German Prepackaged Products Ordinance (FPV),
- Dangerous Goods Ordinance on Roads, Railways and Inland Waterways (GGVSEB).

In addition, the following legal acts of the European Union apply, which form the basis of the German regulations or to which they refer to:

- Detergents Regulation (EC) No. 648/2004,
- Regulation on the Registration, Evaluation, Authorization and Restriction of Chemicals (EC) No. 1907/2006 („REACH Regulation"),
- Regulation on Classification, Labelling and Packaging (EC) No. 1272/2008 („CLP Regulation"),
- Biocidal Products Regulation (EU) No. 528/2012 and
- Regulation (EU) 2019/1148 on explosives precursors.

2. Introduction

Hand dishwashing detergents still have a high importance on the market and are used daily by consumers. The products are aqueous solutions of different surfactant mixtures; some hand dishwashing detergents contain additives such as fragrances, colorants, and ingredients to adjust viscosity. Hand dishwashing detergents are specifically developed for cleaning dishes and cutlery in households to remove a variety of food residues containing fats, starches, or proteins. Consumers have a wide range of products with different profiles to choose from, including special formulations with unique claims (e.g., "suitable for sensitive skin").

Ecological aspects of hand dishwashing detergents, as with other detergent, care, and cleaning products, are driven by the continuous (further) development of concentrated and innovative formulations. Performance has been further improved by innovative surfactant combinations and, in certain circumstances, enzymes. The products are classified as detergents as stated in Article 2 of the Detergents Regulation (EC) No. 648/2004 and must be labelled in accordance with Annex VII of this regulation. In addition, a list of ingredients must be made available on the Internet. Surfactants used in detergents must be completely biodegradable as per the Detergents Regulation. Environmental compatibility depends mostly on the type of concentrate (e.g., ultra-concentrate) in which the product is purchased and the dosage applied by the end user.

To evaluate the quality of these products, a test procedure that is as simple, reproducible, and consumer relevant as possible is desired, both for external comparative tests and during product development. This should be based on consumer behaviour and common types of soil. The development of the quality assessment of hand dishwashing detergents (including test methods) is based on the work of the IKW working group, consisting of experts from hand dishwashing detergent manufacturers and raw material suppliers, as well as testing institutes.

3. Working Group's Approach

The main focus of the working group is the mileage and cleaning performance of hand dishwashing detergents for private consumers. To achieve state-of-the-art, consumer and practice-relevant conditions, the existing recommendation for the quality assessment of hand dishwashing detergents is used as the basis. Certain aspects, such as the changed consumer behaviour due to the increased use of dishwashing sponges and the significantly more powerful product formulations now available on the market, are addressed through the update and expansion of the method.

Consumer-relevant cleaning habits include soaking soiled items in diluted hand dishwashing detergent followed by scrubbing with a sponge ("soak and wipe") [4], soaking in diluted hand dishwashing detergent followed by simple rinsing ("soak and rinse") as pre-treatment, and immediate scrubbing with a sponge and detergent ("instant cleaning"). These practices are reflected in the three parts of the recommendation for quality assessment for hand dishwashing detergents.

4. Method Description

This method is used to determine the cleaning performance of hand dishwashing detergents via soak and rinse. Either soiled

Fig. 1 **Left:** Required items for the test method using tinted glass plates (individual application). The starch-based test soil on the plate has been coloured blue in this image for better visibility. **Right:** Required items for the test method using glass tiles (collective bath).

glass plates or glass tiles are soaked in a hand dishwashing detergent solution and then rinsed by hand. This test method allows for the evaluation of a hand dishwashing detergent's ability to clean three different types of soil **without** mechanical action. Therefore, the products are dosed according to the manufacturer's recommendations. The three types of test soil include an amylase-/protease-/surfactant-sensitive soil (oat flake-based test soil), a protease-/surfactant-sensitive soil (cheese sauce test soil), and an amylase-sensitive soil (starch-based test soil).

4.1 Scope of this Test Method

This test method involves evaluating the cleaning performance of hand dishwashing detergents on oat flake-based, cheese sauce, and starch-based test soils, which are applied to glass plates or tiles and subsequently dried. The test method simulates the removal of cooked, baked-on, or dried household food residues, particularly on dishes. For this purpose, three different types of test soils are each applied to glass plates or tiles, then dried and aged prior to cleaning. After soaking, glass plates are rinsed individually and glass tiles are rinsed collectively either under running water or by immersion in a collective bath. This is intended to show how the hand dishwashing detergent alone can reduce the wiping effort.

4.2 Equipment, Materials and Ingredients

4.2.1 Equipment and Materials used for Testing (Figure 1)

- Beakers (different volumes)
- Fine-bristle or silicone brush (e.g., pastry brush, width approx. 2.5 cm, Order-No.: 87001, wfk Testgewebe GmbH)
- Stainless-steel rack for glass tiles (custom-made by a metal workshop)
- Glass plates (required size: diameter approx. 23.5 cm, inner surface area approx. 177 cm^2, e.g., DURALEX „Lys“) **or**
- Glass tiles (required size: approx. 10 cm x 12 cm; thickness approx. 2 mm; smooth surface, area: approx. 110 cm^2, e.g., CFT, Order-No.: „DG H“)
- Rectangular cleaning basin (required dimensions: approx. 35 cm x 35 cm x 12 cm, e.g., 10 liters “Curver Viereckschüssel”) **or**
- Cylindrical cleaning basin (required dimensions: inner diameter approx. 29 cm, inner height approx. 19 cm, wall and bottom thickness approx. 4 to 5 mm, e.g., custom-made by a plastic-processing workshop) [5] **or**
- 2 plastic boxes (required dimension: approx. 40 cm x 30 cm x 19 cm, e.g., 14 liters “SmartStore Box”)
- Blender, 500 W (equivalent to medium household quality)
- Drying cabinet with circulating air function (e.g., company Memmert or company Binder)
- Scale for weighing of the glass plates / -tiles (required readability and accuracy: 1 milligram)
- Water bath (required temperature: min. 40°C, e.g., IKA HB digital)

Additionally required for the preparation of the starch-based test soil:

- Work surface or shelf for drying and storing the soiled glass plates or tiles, with the ability to keep them horizontally stored
- Dispenser (e.g., serial dispenser “Fortuna Optifix”, company Graf/Wertheim)
- Electric laboratory stirrer with paddle stirrer (e.g., IKA Laborrührwerk, IKA-Werke, Staufen)

Additionally required for the preparation of the starch-based and oat flake-based test soils:

- Timer

Additionally required for the preparation of cheese sauce and oat flake-based test soil:

- Magnetic stirrer with heating plate, incl. magnetic stirring bars (e.g., IKA Magnetrührer, IKA-Werke, Staufen)
- Temperature sensor (e.g., IKA Laborrührwerk, IKA-Werke, Staufen)

Note: Glass plates or tiles must be individually labelled for traceability, e.g., using a permanent marker. It is important to ensure that the labelling is waterproof to prevent smudging or removal during the test procedure.

4.2.2 Ingredients and Recipe for the Test Soil

4.2.2.1 Starch-based Test Soil

Ingredient	Specification	Source	Percentage by weight
Potato Starch	e.g., Superior, Emsland GmbH	local / supermarket	25%
Maize Starch	e.g., Standard, Roquette GmbH	e.g., GB Chemie	25%
Rice Starch	e.g., Remy DR, Beneo GmbH	e.g., Möller Chemie	25%
Wheat Starch	e.g., SP, Roquette GmbH	e.g., IMCD France	25%

Tab. 1 Recipe for the starch-based test soil of the test method.

4.2.2.2 Oat flake-based Test Soil

Ingredient	Specification	Source	Percentage by weight
Oat flakes	e.g., "blütenzarte Köllnflocken"	local / supermarket	4.8%
UHT milk	Fat content: 1.5%	local / supermarket	23.8%
Water	Water hardness: 16.8°dH (e.g., hardened tap water)		71.4%

Tab. 2 Recipe for the oat flake-based test soil of the test method.

4.2.2.3 Cheese Sauce Test Soil.

For the cheese sauce test soil, a commercially available cheese sauce is used, e.g., „Les Sauces Käse Sahne-Sauce" by Thomy (250 grams).

4.3 Test Soils

The three test soil formulations are used separately (for formulations, see section 4.2.2). The maximum shelf life of pre-purchased food products corresponds to the best-before date recommended by the manufacturer. The preparation and storage of the test soils for this test method are conducted in accordance with the following instructions.

4.3.1 Preparation of the Test Soils

Depending on the number of glass plates or tiles to be soiled, the corresponding amount of each test soil is prepared according to the preparation recommendations below. For this purpose, all components are weighed separately in accordance with the specifications in section 4.2.2.

4.3.1.1 Preparation of the Starch-based Test Soil (Example: 1,000 grams approach)

During the preparation and application of the starch-based test soil, a distinction is made between the use of glass plates and tiles, as described below.

- **Preparation for Glass Plates**

  In a 2-liter beaker, 988.00 grams of water with a water hardness of 16.8°dH are weighed in. **Tap water, hardened tap water, or synthetic water of the required hardness may be used.** The beaker is placed in the water bath **before** the water is heated, and the laboratory stirrer with paddle is positioned as close to the bottom as possible.

  In a second beaker, 3.00 grams of each starch type (potato, maize, rice, and wheat starch) are weighed in separately (total starch content: 12.00 grams). While stirring continuously, the starch mixture is added to the first beaker containing the unheated water. This beaker is then covered (e.g., with aluminum foil) and stirred in a boiling water bath until the water-starch mixture reaches a temperature of 95°C. At this temperature, stirring continues for 30 minutes. The beaker is then removed from the water bath and cooled to approximately 35°C while stirring.

  The mixture should be stirred slowly and continuously to prevent starch from settling and to avoid the formation of air bubbles, which could interfere with the dosing device (e.g., by drawing in air). Any loss due to evaporation must be compensated for by reweighing and adding the corresponding amount of water.

- **Preparation for the Glass Tiles**

  In a 2-liter beaker, 983.8 grams of water with a water hardness of 16.8°dH are weighed in. **Tap water, hardened tap water, or synthetic water of the required hardness may be used.** The beaker is placed in the water bath **before** the water is heated, and the laboratory stirrer with paddle is positioned as close to the bottom as possible.

  In a second beaker, 4.06 grams of each starch type (potato, maize, rice, and wheat starch) are weighed separately (total starch content: 16.24 grams). While stirring continuously, the starch mixture is added to the first beaker containing the unheated water. This beaker is then covered (e.g., with aluminum foil) and stirred in a boiling water bath until the water-starch mixture reaches a temperature of 95°C. At this temperature, stirring continues for 30 minutes. The beaker is then removed from the water bath and cooled to approximately 35°C while stirring.

The mixture should be stirred slowly and continuously to prevent starch from settling and to avoid the formation of air bubbles, which could interfere with the dosing device (e.g., by drawing in air). Any loss due to evaporation must be compensated for by reweighing and adding the corresponding amount of water.

4.3.1.2 Preparation of the Oat flake-based Test Soil (Example: 1,050 grams approach)

The preparation instructions are applicable for both glass plates and tiles.

In a 2-liter beaker, 250 grams of UHT milk (fat content: 1.5%) and 750 grams of water with a water hardness of 16.8°dH are weighed in. **Tap water, hardened tap water, or synthetic water of the required hardness may be used.**

The beaker, containing a magnetic stirring bar, is placed on the magnetic stirrer before the milk-water is heated. In the second beaker, 50 grams of oat flakes are weighed in. While stirring continuously, the oat flakes are added to the first beaker containing the unheated milk-water mixture.

Next, the beaker is covered (e.g., with aluminum foil) and heated to a gentle boil. Once the temperature reaches at least 95°C and no more than 97°C, stirring is continued for 10 minutes. The mixture is then cooled to approximately 40°C while stirring and subsequently blended at maximum speed for 2 minutes using a blender (500 Watt). Any evaporation loss must be compensated for by reweighing and adding the corresponding amount of water.

4.3.1.3 Preparation of the Cheese Sauce Test Soil (Example: 250 grams approach)

The preparation instructions are applicable for both glass plates and tiles.

In a 500-milliliter beaker, 250 grams of cheese sauce are weighed in and then heated to 50°C ± 2°C while stirring using a magnetic stirrer. To facilitate easier application, the cheese sauce is kept at a temperature of 50°C ± 2°C in a water bath.

4.3.2 Storage of the Test Soils

The storage of the test soils and all weighing procedures must be carried out under **climate-controlled conditions at a temperature of 20°C to a maximum of 25°C and a relative humidity of 40 to 60 percent**. Otherwise, due to the varying water content of the test soils on the dish surfaces, weighing errors may occur in gravimetrically evaluated test soils.

Under the specified environmental conditions, storage stability is seven days.

4.4 Preparation of the Cleaning Solution and Cleaning Utensils

4.4.1 Preparation of the Cleaning Utensils

The test procedure can be carried out either in a cleaning basin or a plastic box. For this purpose, the main criteria are whether the glass plates or tiles are to be soaked individually or collectively (e.g., in a shared bath using a suitable rack for the tiles).

Before starting the test, the cleaning utensils must be checked for possible contamination. **After each test run**, the cleaning utensils must be thoroughly cleaned with a hand dishwashing detergent, then rinsed well with tap water and dried.

4.4.2 Preparation of the Cleaning Solution

- **Cleaning Basin**
  The volume used for the test with a cleaning basin is 1.5 liters of cleaning solution. The hand dishwashing detergent is added to the center of the basin according to the manufacturer's instructions or – if no instructions are provided – at a dosage of 5 milliliters per liter. By adding 1.5 liters of water with a water hardness of 16°dH ± 2°dH and a temperature of 45°C ± 1°C, the hand dishwashing detergent is dissolved with gentle stirring, avoiding unnecessary foam formation (see **Figure 2**).

- **Plastic Box**
  For the test, 10 liters of cleaning solution are required. The hand dishwashing detergent is added to the center of the

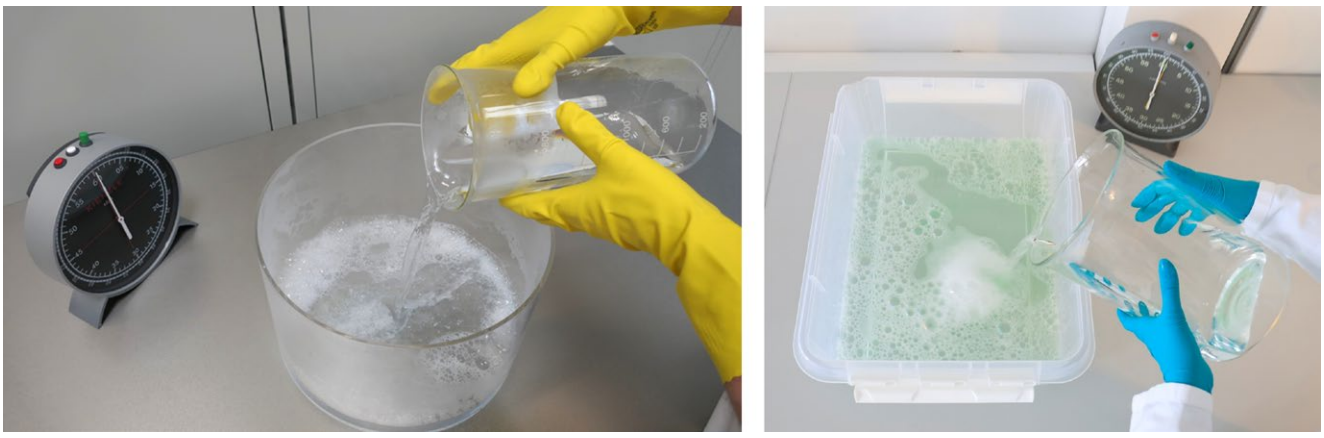

Fig. 2 **Left:** Preparation of the cleaning solution in a cleaning basin, **right:** Preparation of the cleaning solution in a sufficiently big plastic box.

plastic box according to the manufacturer's instructions or – if no instructions are provided – at a dosage of 5 milliliters per liter. By adding 10 liters of water with a water hardness of 16 ± 2°dH and a temperature of 45 ± 1°C, the hand dishwashing detergent is dissolved with gentle stirring, **avoiding unnecessary foam formation** (see **Figure 2**).

4.4.3 Dosage of the Hand Dishwashing Detergent

The hand dishwashing detergent is dosed according to the manufacturer's instructions and **added directly to the center** of the cleaning basin or plastic box with an accuracy of 0.1 grams. Dosing can be performed gravimetrically or volumetrically, considering the density of the hand dishwashing detergent.

If no manufacturer recommendation is provided on the packaging, a concentration of 5 milliliters per liter is recommended.

4.4.4 Water Temperature

The temperature of the prepared soaking solution should be 45 ± 1°C. **At the end of the test, the temperature of the solution should not be less than 40°C.** The temperature must be documented **before and after** the test.

4.4.5 Water Hardness

The water used to prepare the soaking solution must have **a hardness of 16 ±2°dH** at test start. For this purpose, suitable tap water, hardened tap water, or synthetic hard water may be used. **Before conducting the test**, the water hardness must be determined and documented.

4.5 Preparation of the Glass Plates and Tiles and Application of the Test Soils

4.5.1 Preparation of the Glass Plates and Tiles

When deciding whether to use glass plates or tiles for the test, the following **remark** should be considered: For individual soaking, glass plates are advantageous due to their angled rims. In contrast, glass tiles are more suitable for use in a collective soaking bath (plastic box).

In all cases, glass plates or tiles must undergo initial cleaning **prior to the test**.

Prior to their first use, new glass plates or tiles must undergo **three times** of initial cleaning.

Previously used plates or tiles require **one** time of initial cleaning. This cleaning step is essential to completely remove any residue from previous tests, especially those involving persistent soils.

In general, plates and tiles should be **regularly inspected for surface damage** and discarded if necessary. To prevent mechanical stress during storage, it is recommended to place a clean paper cloth between each plate or tile.

After initial cleaning and before first use, the glass plates or tiles should be left to stand for **at least 24 hours** before being weighed (using a scale with a minimum accuracy of 1 milligram). This ensures that no residual moisture is present.

> **Note:** After initial cleaning, glass plates and tiles **must only be handled with gloves** to avoid contamination.

4.5.1.1 Initial Cleaning of Glass Plates

In a laboratory dishwasher, the glass plates are cleaned using fully demineralized water at a cleaning temperature of 93°C, with a special, highly alkaline and active chlorine-containing dishwashing detergent intended for professional use (solid / liquid), e.g., Perclin by Ecolab. In the final rinse cycle with deionized water, approximately 20 grams of acid (e.g., citric acid) are added for neutralization. The initially cleaned glass plates are then **air-dried at room temperature for at least 24 hours** and subsequently weighed with an accuracy of 1 milligram.

4.5.1.2 Initial Cleaning of Glass Tiles

The initial cleaning of the glass tiles consists of the following two steps:

1. **Step – Soaking in an alkaline bath**: The glass tiles are soaked for 60 to 90 minutes at a temperature of 70°C with 3 percent Deconex 15 PFX (Borer Chemie AG-CH). After soaking, the glass tiles are rinsed with clear water.

2. **Step – Rinsing**: In a laboratory dishwasher, a total of three rinse cycles follow using fully demineralized water at a temperature of 90°C. The first cycles use, for example, Neodisher Laboclean FT, followed by Neodisher Z (Dr. Weigert). In the final rinse cycle, approximately 100 grams of acid (e.g., citric acid) are added for neutralization at a temperature of 60°C using deionized water.

The cleaned glass tiles are then **air-dried** at room temperature for **at least 24 hours** and subsequently weighed with an accuracy of 1 milligram.

4.5.2 Application of the Test Soils

During the preparation and application of the test soils, a distinction is made between glass plates and tiles due to the different properties of the substrate material. For example, when using the starch-based test soil, a higher viscosity is required for application on glass tiles (see section 4.5.2.1).

> **Note:** After drying, the applied test soils **must not** flake off or crack. If this occurs, the affected glass plates or tiles must not be used.

4.5.2.1 Application of the Starch-based Test Soil

The starch-based test soil is applied using glass plates at approx. 35°C and glass tiles at room temperature.

All subsequent calculations refer to an area of 177 cm^2 when using glass plates, and to an area of 110 cm^2 when using glass tiles.

- **Glass Plates**
  Using a dispenser, 16.4 ± 0.1 grams of starch mass are dosed per plate. The plate rim remains free.

  By gently swiveling, the starch mass is evenly distributed over the inner surface of the glass plate. The prepared plates are then placed on a shelf with horizontally aligned surfaces. They remain there at room temperature until the soiling has dried, but in any case, for **at least 48 hours** (to be assessed visually only – do not touch). To ensure uniform drying conditions, the use of a fan or a circulating air-drying cabinet is recommended.

  After this drying step, the soiled glass plates are subsequently placed in a custom-made dish rack and dried for **four hours at 80 °C in a circulating air-drying cabinet** (e.g., from Memmert). Afterwards, the plates are left to cool for **at least one hour at room temperature** under **climate-controlled conditions** (20 °C to max. 25 °C, 40 to max. 60 percent relative humidity). They are then weighed.

  The dried application should amount to between 190 and 230 milligrams per plate. Plates with deviating application amounts must not be used.

- **Glass Tiles**
  Using a fine-hair or silicone brush, 2.25 ± 0.10 grams of starch mass are evenly applied and always distributed in the same way across the entire surface of each tile.

  The prepared glass tiles are subsequently **laid flat and dried for three days at room temperature** under **climate-controlled conditions** (20°C to max. 25°C, 40 to max. 60 percent relative humidity). After this drying step, the tiles are weighed.

  The application should amount to between 70 and 80 milligrams per tile. Tiles with deviating application amounts must not be used.

4.5.2.2 Application of the Oat flake-based Test Soil

The oat flake-based test soil is kept and applied using a water bath at a temperature of approx. 40°C.

All subsequent calculations refer to an area of 177 cm^2 when using glass plates, and to an area of 110 cm^2 when using glass tiles.

- **Glass Plates**
  Using a fine-hair or silicone brush, 2.0 ± 0.1 grams of oat flake-mass are evenly applied and always distributed in the same way to the inner surface of each plate. The plate rim remains free.

  The prepared glass plates are subsequently placed in a custom-made dish rack with horizontally aligned shelves. They are dried in a circulating air-drying cabinet with a **cold start for 2.5 hours at 100°C**. The oven must not be preheated. After drying, the soiled plates are left to cool for at least one hour at **room temperature** under **climate-controlled conditions** (20°C to max. 25°C, 40 to max. 60 percent relative humidity). They are then weighed.

  The application should amount to between 160 and 200 milligrams per plate. Plates with deviating application amounts must not be used.

- **Glass Tiles**
  Using a fine-hair or silicone brush, 1.25 ± 0.10 grams of oat flake-mass are evenly applied and always distributed in the same way across the entire surface of each tile.

  The prepared glass tiles are subsequently **laid flat and dried** with a **cold start for 2.25 hours in a circulating air-drying cabinet at 80°C**. The oven must not be preheated. After this drying step, the soiled glass tiles are weighed.

  The application should amount to between 100 and 130 milligrams per tile. Tiles with deviating application amounts must not be used.

4.5.2.3 Application of the Cheese Sauce Test Soil

The cheese sauce test soil is kept and applied using a water bath at a temperature of 50°C.

All subsequent calculations refer to an area of 177 cm^2 when using glass plates, and to an area of 110 cm^2 when using glass tiles.

- **Glass Plates**
  Using a fine-hair or silicone brush, 1.8 ± 0.1 grams of cheese sauce are evenly applied and always distributed in the same way to the inner surface of each plate. The rim of the plate remains free.

  The prepared glass plates are subsequently placed in a custom-made dish rack with horizontally aligned shelves. They are dried in a circulating air-drying cabinet with a **cold start for 2.5 hours at 137°C**. The oven must not be preheated. After drying, the soiled plates are left to cool for **at least one hour at room temperature** under **climate-controlled conditions** (20°C to max. 25°C, 40 to max. 60 percent relative humidity). They are then weighed.

  The application should amount to between 250 and 300 milligrams per plate. Plates with deviating application amounts must not be used.

- **Glass Tiles**
  Using a fine-hair or silicone brush, 0.75 ± 0.10 grams of cheese sauce are evenly applied and always distributed in

Test soil	Type of dish	Application amount per 100 cm²	Application amount per plate / tile
Starch-based	Glass plate	9.3 ± 0.1 grams	16.4 grams / 177 cm²
	Glass tiles	1.9 ± 0.1 grams	2.25 grams / 110 cm²
Oat flake-based	Glass plate	1.1 ± 0.1 grams	2.0 grams / 177 cm²
	Glass tiles	1.1 ± 0.1 grams	1.25 grams / 110 cm²
Cheese sauce	Glass plate	1.0 ± 0.1 grams	1.8 grams / 177 cm²
	Glass tiles	0.7 ± 0.1 grams	0.75 grams / 110 cm²

Tab. 3 Application amounts of the different test soils per 100 cm² and per each dish surface (177 cm² respectively 110 cm²).

Fig. 3 Soaking of glass plates in a cleaning basin (individual application).

the same way across the entire surface of each tile.

The prepared glass tiles are subsequently laid flat and dried with a **cold start for 1.25 hours in a circulating air-drying cabinet at 120 °C.** The oven must not be preheated. After this drying step, the soiled glass tiles are weighed.

The application should amount to between 160 and 190 milligrams per tile. Tiles with deviating application amounts must not be used.

Fig. 4 **Left:** Rack with soiled glass tiles. The rack is a sufficiently large custom-made construction, ensuring that during both soaking and rinsing, each glass tile is adequately covered with soaking solution or water. **Right:** Soaking of glass tiles in a suitable rack placed in a sufficiently large plastic box (batch soaking).

4.5.2.4 Overview Application Amounts of the Test Soils

Table 3 provides an overview of the different application amounts, categorized by type of soiling and by type of glassware.

4.6 Cleaning Procedure

The tests must be carried out by trained personnel to ensure consistent positioning of the plates or tiles during the cleaning procedure. The personnel performing the tests should always wear dishwashing gloves.

4.6.1 **Step 1:** Soaking of Soiled Glass Plates and Tiles

- **Cleaning Basin (individual application)**
  One soiled glass plate is carefully lowered onto the bottom of the cleaning basin (see **Figure 3**). **The soaking time is 10 minutes.**

- **Plastic Box (batch application)**
  Several soiled glass tiles are placed in a suitable rack which is carefully lowered onto the bottom of the plastic box (see **Figure 4**). **The soaking time is 10 minutes**. The rack is then removed from the soaking bath with the same care.

4.6.2 **Step 2:** Rinsing of Soaked Glass Plates and Tiles

- **Cleaning Basin (individual application)**
  Immediately after soaking, the glass plate (see section 4.6.1) is rinsed in an almost vertical position for 10 seconds using 2.0 liters of cold tap water **directly from the faucet**, maintaining a **consistent distance from the faucet** (e.g., 10 cm). The required flow rate must be determined in advance.

  After the test, the glass plates are dried for one hour in a circulating air-drying cabinet at 80°C with a cold start, then left to cool at room temperature. The plates are then weighed again within a **maximum of 30 minutes**.

- **Plastic Box (batch application)**
  The second plastic box (see section 4.6.1) is filled with 12 liters of cold tap water immediately after soaking (see **Figure 5**). The rack with the soaked glass tiles is then **quickly**

dipped **five times** into and lifted out of the water bath. **This process should take no longer than five to seven seconds.** The time interval between removal from the soaking bath (Box 1) and rinsing (Box 2) should always be the same.

Alternatively, if constant water pressure is available in the laboratory, the soaked glass tiles can be rinsed individually. For this, 1 liter of tap water is poured over each tile from a container at a fixed angle.

Fig. 5 **Left:** Rinsing of soaked glass plates under running tap water. **Right**: Rinsing of soaked glass tiles by immersion in a batch bath. On the left is a plastic box used for soaking; on the right, the one used for rinsing by immersion.

After the test, the glass tiles are dried with a **cold start for 35 minutes in a circulating air-drying cabinet at 60°C**. The oven must not be preheated. They are then left to cool at **room temperature** under **climate-controlled conditions** (20°C to max. 25°C, 40 to max. 60 percent relative humidity) for at least one hour. The glass tiles are then weighed again within a **maximum of 30 minutes**.

4.7 Evaluation, Validation and Documentation

For each type of soiling, **10 runs** must be carried out per test product either in individual application using glass plates, or in collective application using glass tiles, for example, one run with 10 glass tiles or 2 runs with 5 glass tiles each. The results are to be described for each test soil separately. Averaging across the three types of soiling as well as aggregating the values of glass tiles and plates is not permitted.

4.7.1 Evaluation

The cleaning performance of a hand dishwashing detergent is determined by weighing after application of the test soil before and after the cleaning test. The performance is expressed as a percentage and calculated using the following formula:

$$\text{Cleaning Performance } [\%] = \frac{\text{Soil}_{\text{removed}}\ [\text{mg}]}{\text{Soil}_{\text{applied}}\ [\text{mg}]} \text{ x } 100$$

4.7.2 Validation and Documentation

The total duration of each test (from the preparation of the test soils to the end of the cleaning process) must be recorded for every trial. The sequence of cleaning tests for the products within a study must be randomized. If many products are tested, it may be advisable to rotate the test personnel within a single cleaning test.

Members of the Working Group

Annette Ahr, Dr. Paula Barreleiro, Dr. Corinna Böhme, Svea Braak, Dr. Barbara Dücker, Rosa Escudero Moreno, Dr. Axel Freytag, Nadine Gerwing, Kyle Gethings, Dr. Eva Gierling, Dr. Bernd Glassl, Michael Gunzenhauser, Marzena Hallberg, Dr. Gerd Hüttmann, Dr. Thorsten Kessler, Sander Kluit, Daniel Lemcke, Zena Malocho, Mathieu Marino, Anthony Million, Dr. Stephanie Morris-Piou, Anja Müller, Isabel Müller, Dr. Stefan Müller, Anke Ophüls, Sandra Peter, Gesche Rauch, Thomas Rübener, Matthäus Ryl, Ángel Salgado, Tatiana Schymitzek, Gerrit Uhe, Dr. Sebastian Ullrich, Bart van de Putte, Silvia Vilchez, Sebastian Wagner, Dr. Sara Wagner-Leifhelm, Dr. Joachim Weißen, Dr. Hans Wendt, Jennifer Yates, Dilek Yilmaz

Supplier Directory for Used Chemicals

- Borer Chemie AG
  CH-4528 Zuchwil, Tel: +41 326 865 600
- Chemische Fabrik Dr. Weigert GmbH & Co. KG
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- GB-Chemie GmbH
  D-64409 Messel, Tel: +49 615 991 610
- IMCD Deutschland
  D-50668 Köln, Tel: +49 221 776 50

References:

The images shown in this publication were kindly provided by tensioconsult GmbH and Novonesis A/S Germany.

[1] This recommendation was published in SOFW-Journal Issue 5, 2002, Edition 128, pages 11 to 15.

[2] Part A of the amended recommendation was published in SOFW-Journal Issue 11, 2024, Edition 150, pages 44 to 54.

[3] Part B of the recommendation for the quality assessment of hand dishwashing detergents was published in SOFW-Journal Issue 9, 2025, Edition 151, pages 34 to 45.

[4] See Part B: Cleaning Performance through Soak and Wipe (Scrub Tester)

[5] See Part A: Mileage through Plate Test

Correspondence Address

The German Cosmetic, Toiletry, Perfumery and Detergent Association (IKW)
Section Home Care
Mainzer Landstraße 55 | 60329 Frankfurt am Main | **Germany**
www.haushaltspflege.org

Annex

Example of a significance test utilising analysis of variance and Tukey test on the example of starch-based test soil.

Measured values (dirt removal in %)

Test Soil: Starch-based			
	Result soil removal [%]		
Run	Product 1	Product 3	Product 9
1	7.2	49.3	44.8
2	8.7	43.1	41.3
3	4.4	40.5	39.6
4	8.7	47.2	42.3
5	1.0	49.5	40.5
6	4.6	49.5	64.7
7	0.5	63.2	53.1
8	0.5	60.6	53.7
9	4.3	56.8	55.4
10	0.5	56.5	38.5
Mean	4.0	51.6	47.4

Test Soil: Starch-based	Number of runs	Sum	Mean	Variance
Product 1	10	40.4	4.0	11.2
Product 3	10	516.2	51.6	55.06
Product 9	10	473.9	47.4	77.01

Overview of the adjustment:

r^2	0.914943
r^2 adjusted	0.908642
Square root of the mean square deviation	6.910564
Mean value of the target variable	34.35
Number of measurements	30

Tukey Test

Differences LSMean values Tukey HSD

$\alpha = 0.05$ $Q = 2.47942$

Level		Least Squares Mean	Std. Error
Product 3	A	51.620	2.1853
Product 9	A	47.390	2.1853
Product 1	B	4.040	2.1853

Levels not connected by the same letter are significantly different.