

Analysis of consumer behavior in usage of dishwashers with a focus on sustainability

Astrid Klingshirn, Julia Haid und Benjamin Eilts

Abstract

Even though resource efficiency in automatic dishwashing has been in strong focus since the release of the eco-design directive, this 4-week ethnographic research study in 26 German households reveals, that real-life behavior in pre-cleaning, detergent use, program choice and appliance maintenance is still far from best practice: Manual pre-cleaning, mostly under running water, is a standard procedure. The ECO-program is still not within the top 3 programs used, even though cycle-time constraints prove not to be the limiting factor. Basic maintenance measures are frequently neglected and overdosing of special salt for regeneration and rinse aid is observed in ~50 % of the households using multi-function detergents. However, dishwasher load capacity is almost always fully used.

Keywords: Dishwasher, consumer behavior, program choice, cleaning performance, pre-cleaning

Analyse des Verbraucherverhaltens bei der Nutzung von Geschirrspülmaschinen mit Fokus auf Nachhaltigkeitsaspekte

Kurzfassung

Obgleich die Ressourceneffizienz bei Geschirrspülmaschinen seit der Veröffentlichung der Ökodesign-Richtlinie stark im Fokus steht, zeigt die vorliegende vierwöchige ethnografische Studien in 26 deutschen Haushalten, dass das reale Verhalten bei der Vorreinigung des Geschirrs, beim Reinigungschemieeinsatz, der Programmwahl und der Gerätewartung noch immer nicht der Best Practice entspricht: Eine manuelle Vorreinigung, meist unter fließendem Wasser, ist Standard. Das ECO-Programm gehört noch immer nicht zu den Top 3 der verwendeten Programme, auch wenn sich die Laufzeit nicht als limitierender Faktor erweist. Die Gerätewartung wird häufig vernachlässigt und eine Überdosierung von Regeneriersalz und Klarspüler liegt in ca. 50 % der Haushalte vor, die Mehrphasenreiniger verwenden. Jedoch zeigt sich, dass die Kapazität des Geschirrspülers fast immer voll genutzt wird.

Schlagworte: Geschirrspülmaschine, Verbraucherverhalten, Programmwahl, Reinigungsleistung, Vorbehandlung

Analysis of consumer behavior in usage of dishwashers with a focus on sustainability

Astrid Klingshirn, Julia Haid und Benjamin Eilts

Introduction and background: Sustainability, the consumer, and the dishwasher

Sustainability aspects have steadily moved to the forefront. Not only have companies been focusing on sustainability, providing sustainable products in layout, design, and resource usage, also consumers are including sustainability aspects into their purchase decisions (Bangemann 2021). For example, there is a noticeable trend towards less or recyclable packaging and a focus on regional sourcing of products of daily usage as well as a steady trend toward a more sustainable diet (Lehmann et al. 2022). The necessity of saving resources, such as electricity and water has reached everyday life, also in the private home (Rüdenauer & Fischer 2021).

Yet pushing customer awareness and guidance is still decisive: Policy as well as companies need to guide and inform consumers so that they take the step from the intention to consume sustainably to the act of buying and using products sustainably (White 2019, Bhutto et al. 2021).

In the segment of home appliances, market-driven innovations, along with push strategy of the Eco-Design directive and the pull strategy of the energy label, have been pushing consumers towards efficient home appliances, especially in large home appliances such as dishwashers. When applying the most efficient ECO program in state-of-the art dishwashers, relevant water and energy savings are accomplished: Comparing real usage scenarios with best practice scenarios, consumers can save up to 27 % energy and up to 25 % water by choosing the ECO program instead of high temperature or quick programs. Yet still appliance usage patterns counteract efficient usage: Next to program choice the major issues causing inefficient usage in real-life are related to pre-cleaning behavior of dishware and filling grade (Brunzell & Renström 2019, Schencking & Stamminger 2022).

To this end, this 2021 ethnographic customer research study examines the usage of dishwashers in private homes in Germany. The main objective is to further understand consumer usage patterns and motivations, also in comparison with past studies, which have shown that there is still room for improvement in dishwasher usage patterns, and to derive which aspects have to be further promoted in consumer education, training, and guidance.

Methodology: Multi-level mobile ethnographic research approach

For the study of the usage of automatic dishwashers, 26 households, made up of an existing consumer panel of Albstadt-Sigmaringen University, owning a dishwasher that is no older than five years are recruited, without further quota definitions.

The data for the dishwasher-usage analysis are collected in a multi-stage process (Fig. 1). All answers provided are transmitted by the respective household manager. In stage 1, the participants are asked about their sociodemographic data and the key information on dishware cleaning, including all data on their dishwasher, the typical pre-cleaning procedure, the detergents used, the dishwasher programs used, the cleaning and drying performance evaluation, as well as all underlying motivations for the typical usage patterns via an online survey. The online questionnaire is set up using UmfrageOnline (umfrageonline.com).

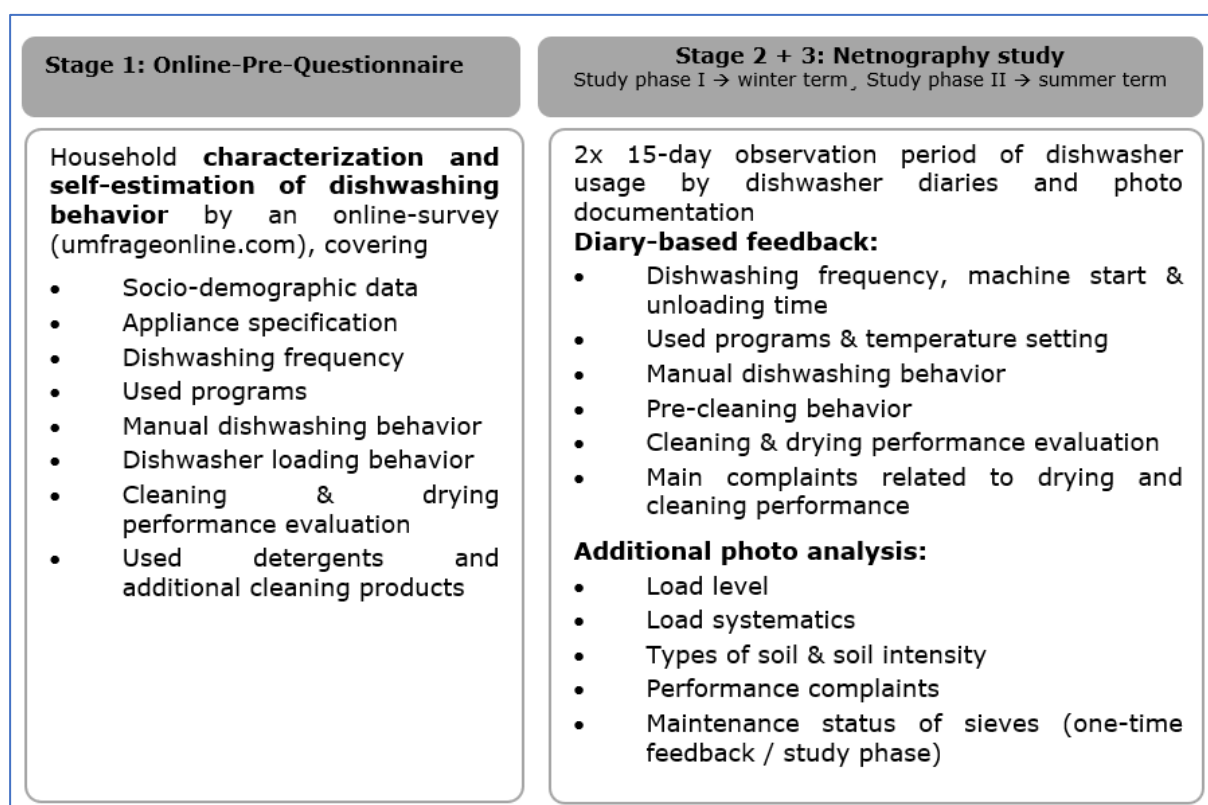


Fig. 1: Multi-stage netnography research approach on dishwashing behavior

The follow-up observation periods cover a 15-day period in winter term (Study Phase 1 (SP 1), January 2021) and summer term (Study Phase 2 (SP 2), July 2021), to account for seasonal differences, thus 390 total observation days per study phase are accomplished. The panel is provided with a dishwasher diary. The diary is filed on a daily basis and submitted via the messenger service WhatsApp to the research team along with pictures, providing additional detail insights.

The achieved feedback rate is $\geq 90\%$ in both study phases (90 % response rate in SP 1, 95 % response rate in SP 2).

The dishwasher diary includes feedback on the pre-cleaning behavior, the chosen program and temperature as well as additional program options, the dishwasher starting time and emptying time. Satisfaction with the cleaning and drying performance of the dishwasher is also reported back, as well as performance complaints, which have to be fortified by pictures. Detail pictures of the loaded dishwasher racks prior to the start are provided by each participant in addition, to evaluate load level and the share of different dishware materials. Pictures of the dishwasher screens are provided by the panelists once per observation period, to get an insight in the maintenance status and consumer knowledge of machine handling.

All photos are categorized with a list of keywords for further analysis, using Adobe Lightroom. All extracted data are analyzed using Excel Professional 2021 and Minitab Statistical Software 2021.

The reporting participants and thus household managers are mainly female (85 %, Tab. 1). The majority of participating households are family households with three or four people (58 %) and couple households (28 %). The average dishwasher age reported is 2.6 years (MIN: 0.5 years, MAX: 5 years).

Tab. 1: Overview of the sociodemographic data of the consumer panel

Socio-demographic data		n (%)
Gender	female	22 (85 %)
	male	4 (15 %)
Age group	25-34 years	3 (11 %)
	35-44years	9 (35 %)
	45-54 years	2 (8 %)
	55-64 years	9 (35 %)
	≥ 65 years	3 (11 %)
Household type	Family-household (3 people / 4 people / >4people)	15 (58 %) (6 (23 %) / 6 (23 %) / 3 (12 %))
	Couple-household	10 (38 %)
	Single household	1 (4 %)
Children (< 18 y)	none	17 (66 %)
	1 child	4 (15 %)
	2 children	5 (19 %)

Results and discussion: Insight in consumer dishwashing behavior

Manual dishware cleaning

In 55 % of the households additional manual cleaning is performed as a standard routine. The reported manual cleaning frequency is 3.5 cleaning cycles per week, with a slight decrease in the summer period (-12 %). 60 % of manual cleaning is performed in parallel to the dishwasher usage. The total number of reported manually cleaned dishware categories is comparable in SP 1 & 2, with a mean part variety of 1.4 in SP 1 and 1.1 in SP 2. The main reason for manual cleaning is that the items are too large for the dishwasher (~ 38 / 31 %), e. g. large pots, baking trays (Fig. 2). Around 26 % state that the parts are used several times a day (knives, children teats, etc.), 23 % fear that the parts could be damaged (especially pans and knives) and around 10 % state that the dishes are not properly cleaned in the dishwasher. The reasons for manual cleaning are largely comparable in SP 1 and 2, with large items showing a higher proportion in SP 1 and sensitive items, and items used several times a day dominating in SP 2 (+12 %).

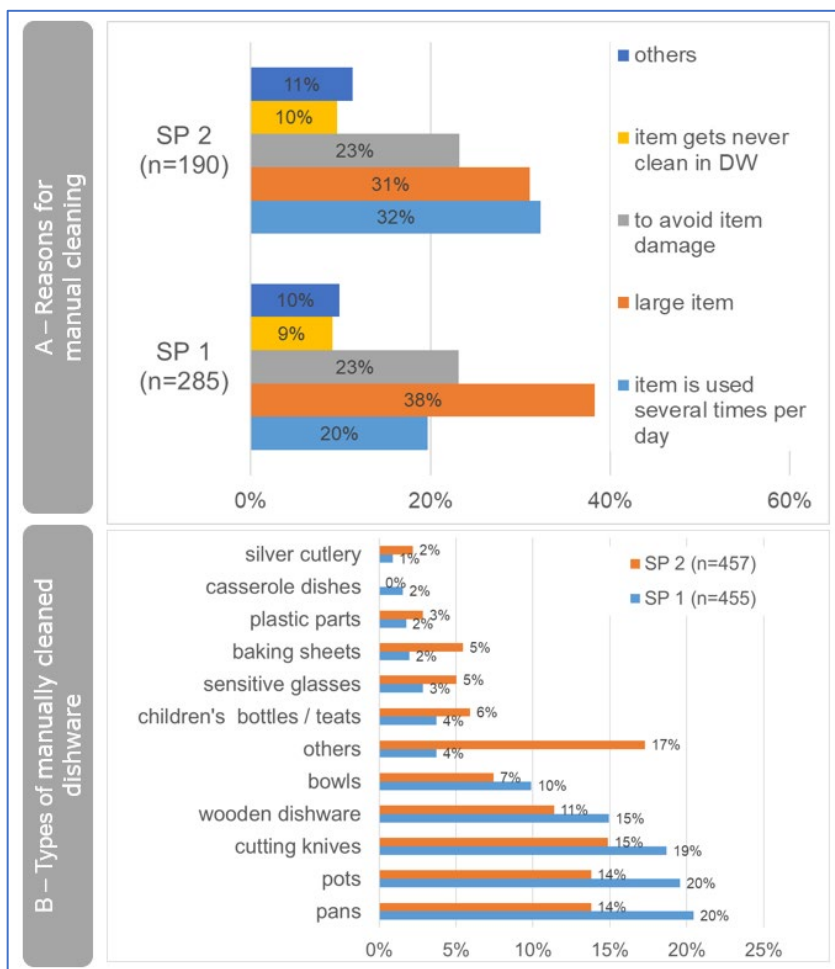


Fig. 2: Reasons for manual cleaning (A) and reported manually cleaned dishware (B) by SP (multiple answers)

As compared to prior studies, in which a manual cleaning frequency of 7.2 cycles per week is reported (Stamminger & Streichardt 2009), a strong decrease is observed. The decrease may be related to a stronger awareness for resource efficiency in daily life (Lehmann et al. 2022). At the same time, the opportunity cost of time may also be a key driver - the perceived actual cost for manual cleaning is preliminary the time consumed in washing-up (Stratton 2012, Venkatesh 2022, Schencking & Stamminger 2022). The results also stress, that some manual cleaning activities are unavoidable, either related to assure a proper workflow, to avoid dishware damage or due to limitations in dishwasher dimension.

However, the methodical approach of documentation of each manual cleaning cycle via the diary may have resulted in a smaller number of manual cleaning cycles being reported as actually being conducted - routine actions can easily be forgotten in the standard daily procedure.

Next to that, a manual pre-cleaning of dishes that are placed in the dishwasher is observed as a standard routine by 50 % of participants, with no differences shown in SP 1 and 2. The pre-cleaning share is 20 % higher than estimated by the participants in the pre-online questionnaire. 45 % of the participants remove some or all residues before placing the dishware into the dishwasher, following best - practice advice. Pre-rinsing dishware under running water is the pre-dominantly applied pre-cleaning procedure (~48 %), while more time-consuming activities like pre-soaking in the sink are rarely followed procedures (~8 %). Even though pre-rinsing and soaking have been identified as unnecessary steps, adding additional resource consumption to the automatic dishwashing (Stamminger & Streichhart 2009, Belke et al. 2018), which has been in focus in consumer-oriented resource efficiency advice for some time (Forum Waschen 2019), these behavioral standard techniques are still maintained. This is also shown in a very recent cross-European study, which reports a pre-rinsing frequency of 36.5 % and pre-soaking frequency of ~9 % (Tewes et al. 2023).

Dishwasher usage: Number of cycles, program choice, capacity usage and load patterns

The reported **dishwasher usage rate**, based on the daily diaries and related picture documentation, is 5.1 cycles per household / week, with a decrease from 5.5 cycles in winter term (SP 1) to 4.6 cycles in summer term (SP 2). This decrease may be related to a changed food consumption pattern reported for SP 2 (summer period) in which a higher share of out-of-home food consumption is reported. In the SP 2 2021 this may also be strongly influenced by the pandemic, in which a re-opening of restaurants and bars is just again implemented.

Comparing the frequency of weekly cycles with previous studies an increase is shown: While the first EuP survey identifies average dishwashing frequencies of 4.1 cycles per week (Boyano et al. 2017), Richter's study from 2010 reports 3.2 runs, Bichler's study from 2015 reports 4.1 runs (Bichler et al. 2015) and Klingshirn's study from 2020 reports 4.5 runs (Klingshirn 2020). Whether this increase is related to the decrease shown in manual cleaning has to be further substantiated. A further analysis of the **share of dishwasher cycles per day** shows, that there is a maximum of 3 cycles/day. 88.5 % of the observed cycles are single cycles, 10.5 % are second cycles.

Based on the review of the reported dishwashers used and the available **cleaning programs** available, the programs are categorized into "Automatic", "ECO", "Intensive", "Normal", "Quick" and "Hygiene". Even though the program name "Normal" is no longer supported by the regulation, it is still found in the dishwashers used, and thus included (Fig. 3).

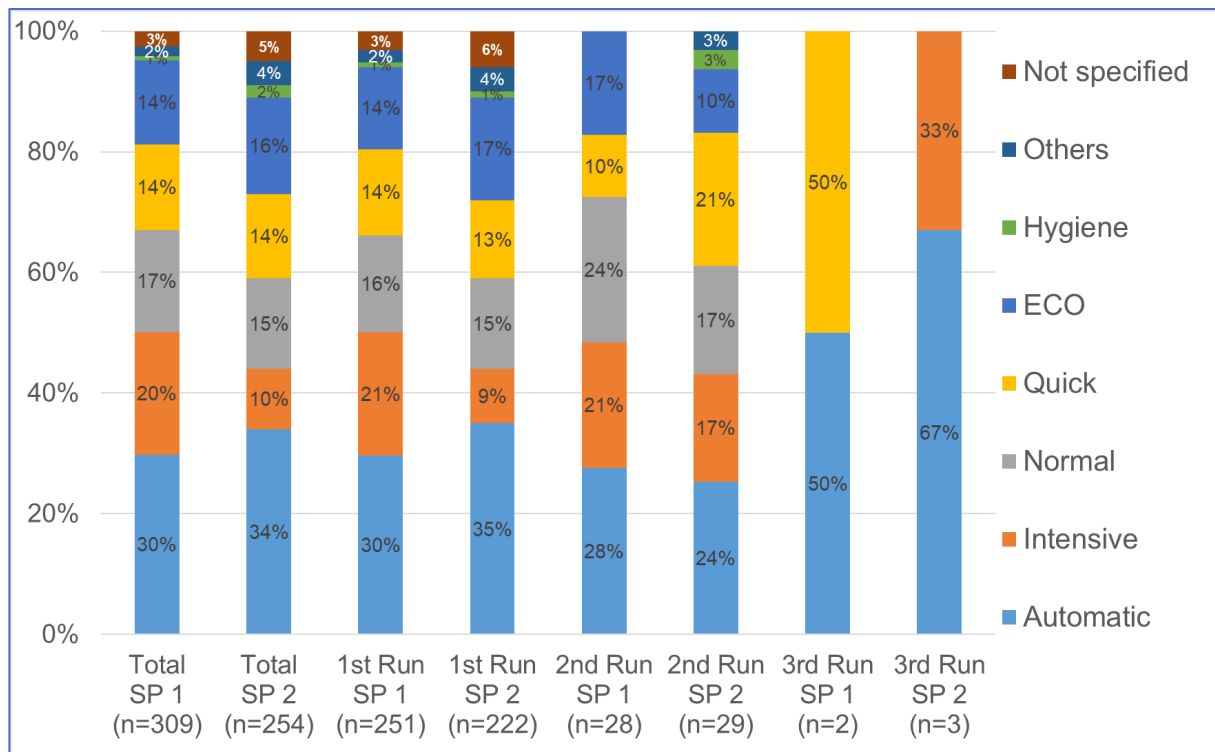


Fig. 3: Dishwasher programs used in first and second cycles by study phase

Approximately 1/3 of the households use the Automatic program. The share of usage of the Intensive program (20 % in SP 1) is reduced by 10 % in SP 2, probably due to a higher share of not specified program usages and the higher variety of further program usages. An equal share of runs (~15 %) is reported for the Normal, ECO and Quick program. As already outlined by Richter (2010), Stamminger & Streichhardt (2009) or Boyano et al. (2017), the ECO program is not the predominantly chosen program, with shares of ~18 %, even though it is the default program in all appliances used.

The current data even show a slight decrease of the previous reported 19 % ECO program usage (Boyano et al. 2017). The reasons stated for running the automatic and intensive program are mainly related to drying and cleaning performance, out of habit and run-time. Participants using the ECO program state to use it due to resource efficiency and as it is the pre-set program.

There is no strong deviation in the overall program choice for the 1st and 2nd cycles, suggesting that the basic usage pattern is applied for all cycles by the participants. In SP 2 a slight increase of the "quick program" usage (+8 %) is reported. About 45 % of the participants use the very same program throughout the two study periods, while 55 % use 2 to 3 different programs.

There is a share of 43 % (SP 1) and 52 % (SP 2) of reported dishwasher programs with temperatures ≥ 60 °C (Fig. 4). These data are in-line with the observations from Richter (Richter et al. 2010), showing 54.4 % programs with temperatures >65 °C. Thus, still the majority of dishwasher users choose the same type of program, frequently with high temperatures. 38 % of the participants select the additional "intensive" option in the program sub-menu, thus increasing the temperature of the program (reported for "Automatic" and "Normal" programs). The impact on the increased energy consumption related to the high temperature programs is either not relevant or participants are not aware of the impact.

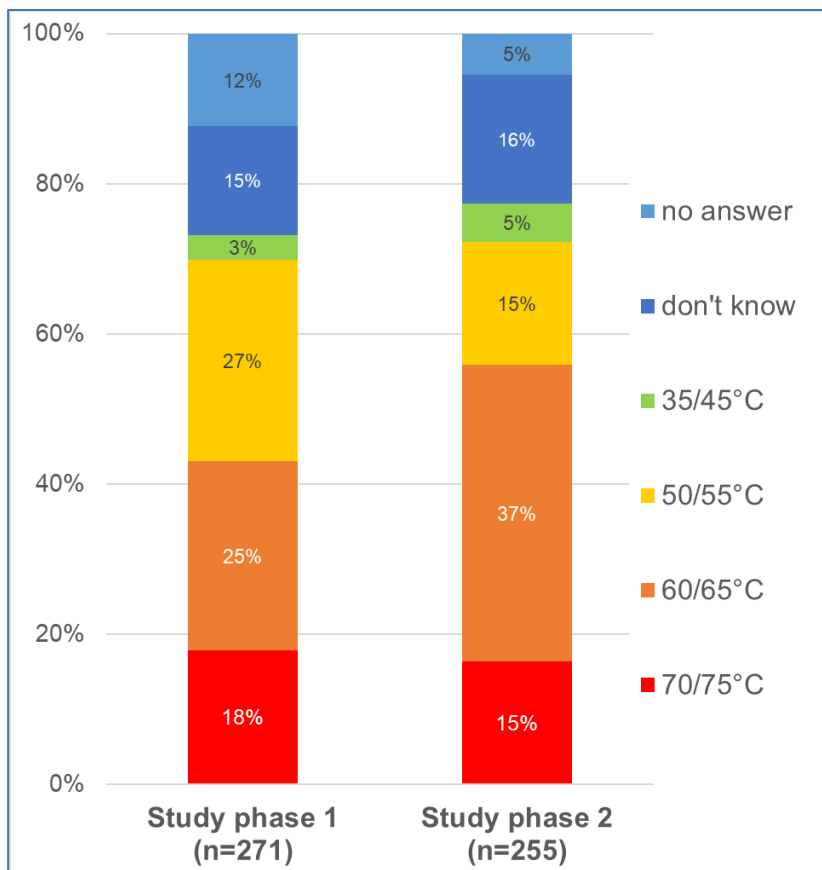


Fig. 4: Reported program temperatures by SP

A detail analysis of the **usage patterns** shows that the dishwasher is **mainly started in the evening hours**, with a peak time at 08:00 pm and a higher share of late start times (after 9 pm) in SP 2 (Fig. 5). The emptying time shows no strong variation, just a slight peak in the morning hours. The reported time span between start and emptying of the appliance is seven hours. Based on these facts, dishwasher run-time is actually not the limiting factor for program choice, even though this has been reported as the limiting factor from consumer perspective (Bichler 2014, Hook 2018). Yet still the perceived reduction in flexibility may still be the key driver in the underlying motivation for shorter cycle times.

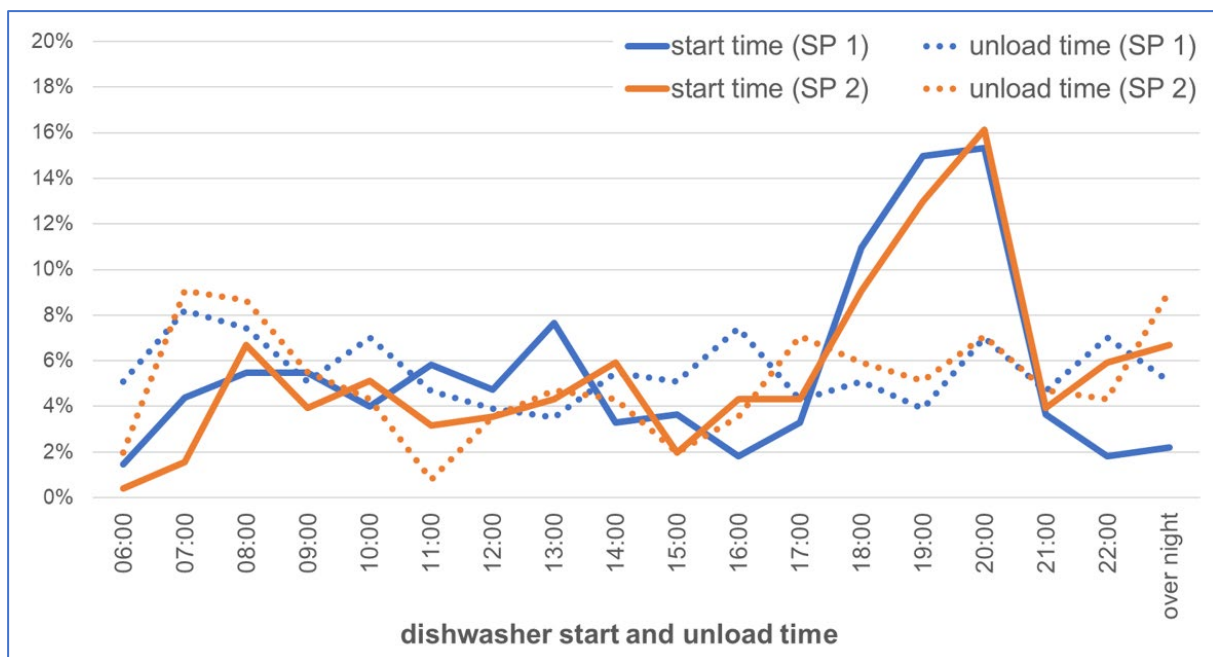


Fig. 5: Dishwashers start and unload times in SP 1 & SP 2

When it comes to the **capacity use** of the dishwashers (Fig. 6-A), a full capacity use is observed in 74 % of the runs for the upper and the lower rack. For the cutlery drawer a mid-capacity use is most frequently observed. These values, derived from the pictures provided by the participants, is much higher as reported in Richter's observation study in 2010 (~50 %, Richter 2010). Load capacity restrictions are observed, caused by a highly diverse types and shapes of dishware items placed in the dishwasher, thus limiting the optimum capacity use of predefined rack places (Fig. 7).

Approximately 50 % of the participants apply a partly systematic **load pattern**, 30 % follow a thoroughly systematic load pattern of the racks (Fig. 6-B). In 50 % of the cycles, an overlapping of the dishware is observed, regardless of the loading quantity and systematics. This procedure is either followed to be able to also clean bulky items in the dishwasher or to fully use the load capacity options of the racks.

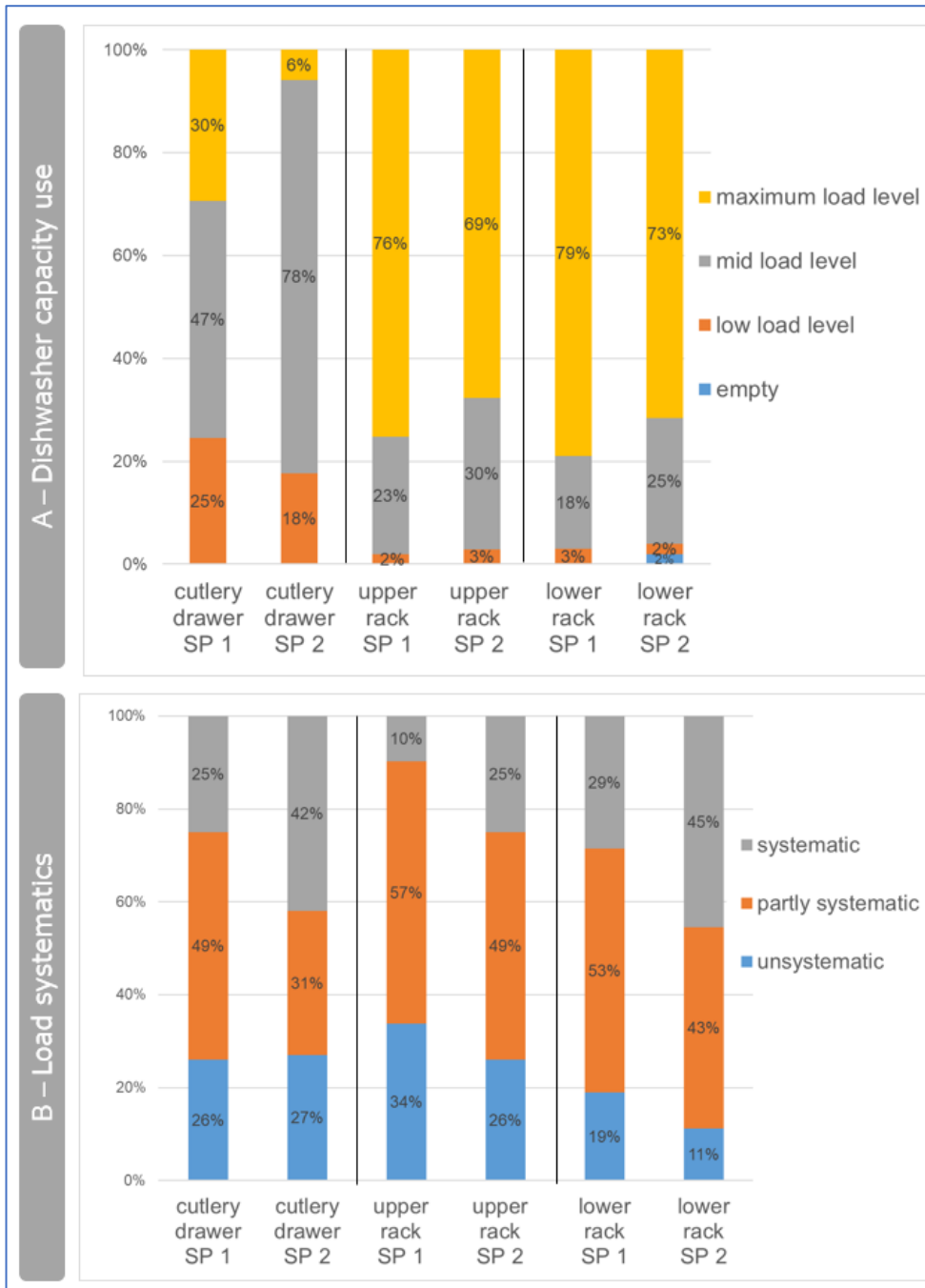


Fig. 6: Dishwasher capacity use (A) and load systematics (B) by rack and SP



Fig. 7: Examples of dishwasher capacity use and limitations caused by dishware shape and variety (© Klingshirn et al.)

Dishwasher performance evaluation

Consumer evaluation of the **cleaning and drying performance** is showing high satisfaction levels (Fig. 8 A, B). The overall aggregated satisfaction rating of "satisfied" and "very satisfied" reported in the diaries is 94 % for the cleaning performance and ~90 % for the drying performance. The reported satisfaction is 10 % higher for cleaning and 21 % higher for drying performance than started by the participants in the pre-online questionnaire. Just ~1 % of consumers report to be dissatisfied with the drying or cleaning performance.

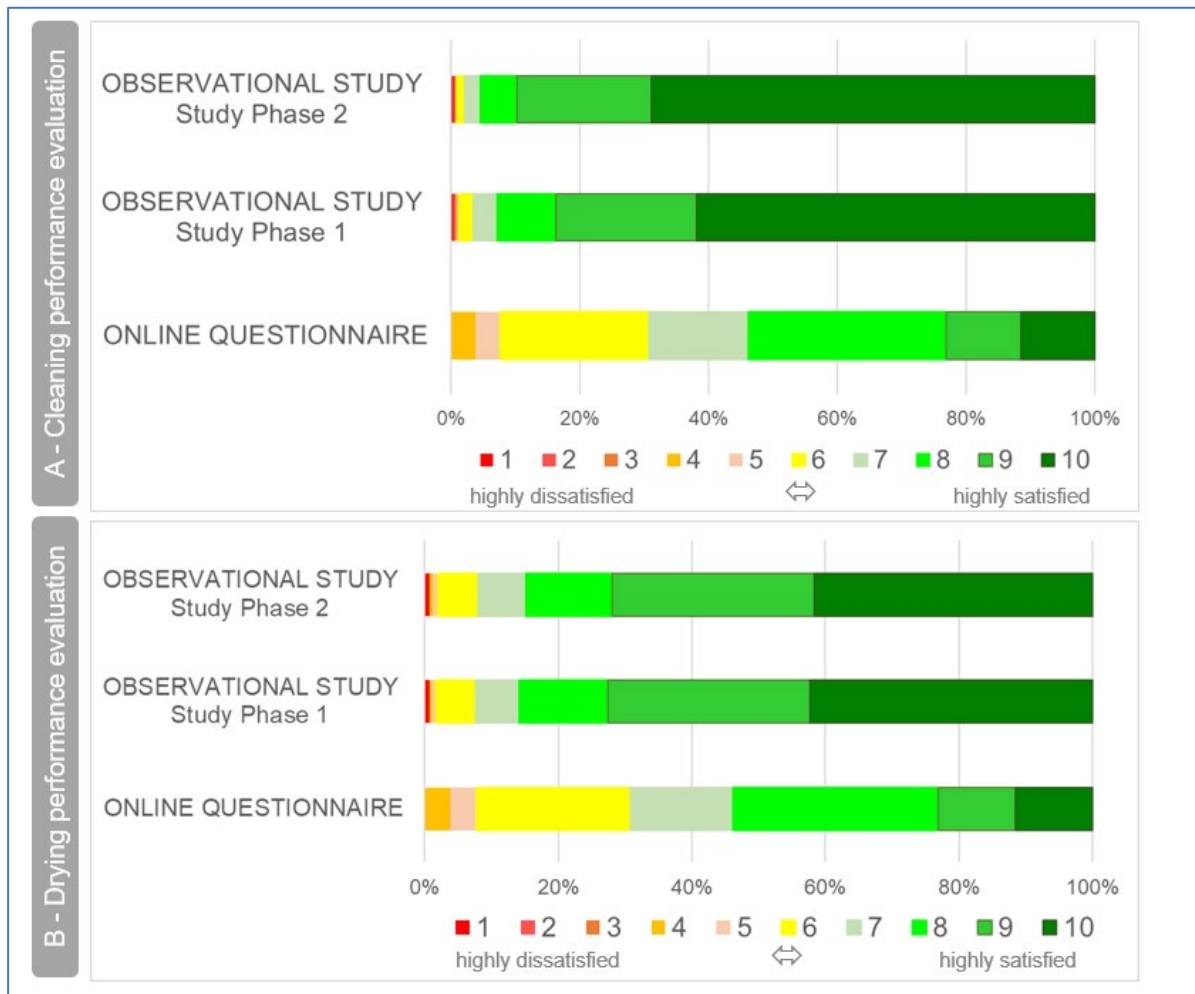


Fig. 8: Cleaning performance evaluation (A, left) and drying performance evaluation (B, right) as stated in the online pre-questionnaire and as stated in the dishwasher diaries

Despite the very high satisfaction, complaints related to cleaning performance are reported in ~36 % of all dishwasher cycles, mainly concerning cutlery (23 %), plates (15 %) and glasses (13 %). Major documented complaints refer to leftovers on dishware (~65 %) and dirt transfer (23 %). The reported complaints have been expected by the participants in ~82 % of all cases, due to heavily soiled parts that were placed in the dishwasher (50 %), because this very part gets never clean the first time (28 %) and other reasons (22 %), such as a typically observed soil transfer, incorrect dishware arrangement and lime residues.

Complaints related to drying performance are reported in ~45 % of all dishwasher cycles, mainly concerning plastic parts (30 %), pots (22 %) and glasses (9 %). Major documented complaints refer to water droplets or water residues (≥ 90 %). The reported complaints are expected in 20 % of all cases. A poor drying performance is expected if dishware items have indentations (~50 %) or because the dishware never gets dry (~40 %).

These results show higher performances satisfaction values and lower dissatisfaction values as reported before (Emmel et al. 2003, Stamminger & Reichhardt 2009, Richter 2010).

There are also deviations in the dishware parts for which major problems are reported – former studies report major problems also for cups and cutlery in drying, whereas in cleaning less complaints were reported for glasses (Stamminger & Reichhardt 2009). The result of the present study may be related to the further improvements in appliance layout and design, also resulting in an improved dishwasher performance (Boyano 2017). At the same time, the complaints that are shown for more than 1/3 of all cycles do not have a negative impact on the appliance performance rating, also suggesting that consumers do not equate an impeccable cleaning result with a high cleaning performance for all dishware parts. The further statements on expected problems related to cleaning also show that the consumer sees himself as a relevant influencing factor of the cleaning performance.

Detergents used and appliance maintenance

In order to achieve a high level of sustainability also detergent use as well as appliance maintenance have to be considered. 50 % of all households use multifunctional tabs, while 20 % use powder and ~18 % use pouches (Fig. 9). Further on, the use of auto-dose systems and gels are reported. In total the usage of pre-dosed multi-dose products has even further increased as compared to former studies (Schneider & Stamminger 2011, Bichler 2014), probably mainly based on the further detergent evolution and innovations offered (Arendorf et al. 2014). 82 % of participants report to use of special salt for regeneration and rinse aid (with a decrease of usage of rinse aid in SP2 by 9 %) independent of the dishwasher detergent applied (Fig. 9). As in none of the households the water hardness is ≥ 3.75 mmol CaCO_3/l (= 21 °dH), 50 % of the participants overdose rinse aid and regenerating salt, either being unaware of the unnecessary double dosing or just sticking to standard procedures related to dishwasher usage. This double-dosing has also been well known from other studies (Bichler 2014, Statista 2017, Klingshirn 2020), yet obviously raising consumer awareness regarding a sustainable use of dishwasher detergents has not yet been accomplished.

Consumers have a high expectation when it comes to the lifetime of electrical products, mainly to avoid the expense and inconvenience of repair or replacement (WRAP 2013). For overall resource efficiency just durable products allow for an efficient use of resources over time, reducing consumption of raw materials and contributing to waste minimization (Bocken et al. 2016). For dishwashers 12.4 years is reported as the average first useful service-life of dishwashers (Prakash et al. 2016). Yet the actual lifetime of electrical products is often perceived as short by end-users (Hennies & Stamminger 2016). At the same time consumers have an impact on the lifetime – and also performance - by proper **maintenance** and usage (Tecchio et al. 2019).

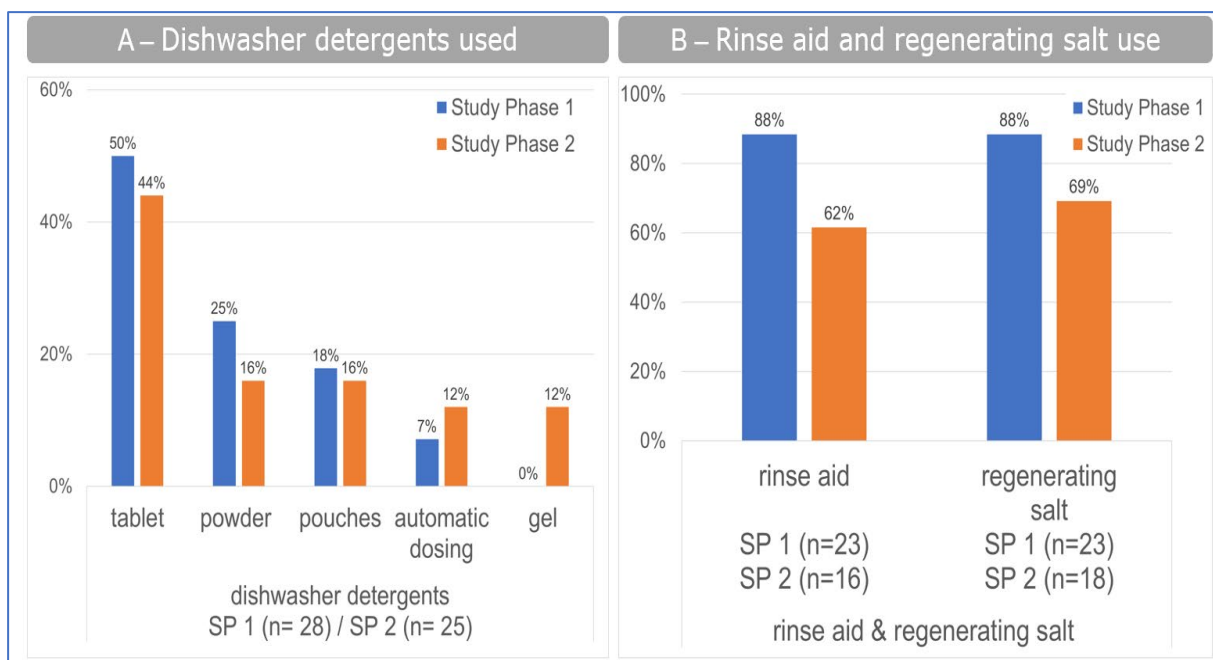


Fig. 9: Use of detergents (A), rinse aid and special salt for regeneration (B) by SP

Little is known about consumer maintenance behaviour in dishwashers and its impact on the proper functioning of the appliance. In the present study the maintenance behavior related to machine and sieve cleaning is reviewed. 11.5 % of the participants indicate to never clean the machine nor the sieves. A systematic cleaning is followed by ~1/3 of the households for the machine, yet by just 19 % for the sieves. The majority of participants state to do the cleaning upon need (31 % sieves / 46 % dishwasher). The review of the actual soiling status of the coarse, fine and microfilter, based on the pictures provided by the participants shows, that the soiling level covers the whole soiling range for all types of sieves. The highest soiling intensity is shown for the microfilter (Fig. 10). Consumers neither seem to be aware of the protective action of the sieves for the drain pump nor the impact on cleaning performance, i. e. reducing carry-over effects.

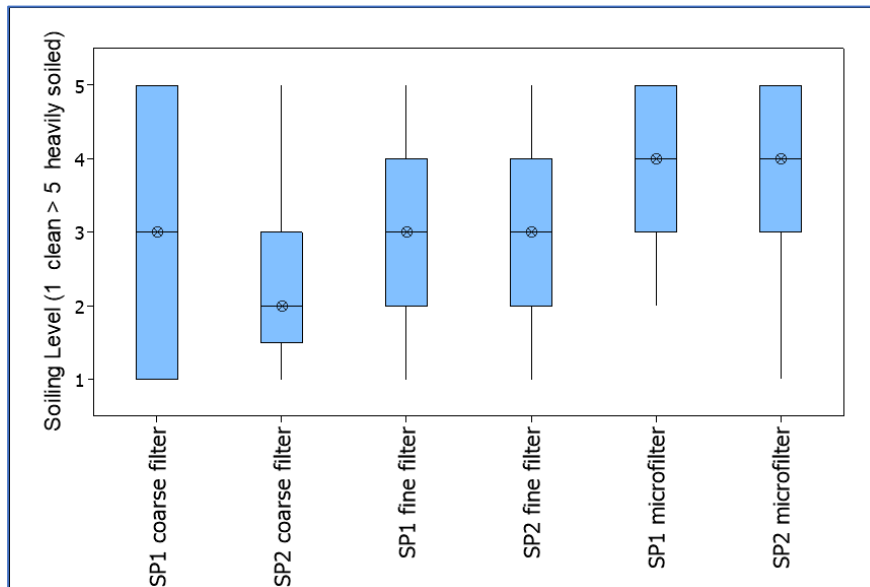


Fig. 10: Sieve soiling level as categorized by sieve filter picture analysis by SP

Conclusion: Resource efficient dishwasher usage: Still a long way to go

Despite the major activities related to consumer training and advice in efficient dishwasher usage (Forum Waschen 2016, Umweltbundesamt 2021), key aspects have still not been adopted as everyday standard procedures. The main problem areas are still **pre-rinsing** and **program choice** along with **detergent overdosage** and **appliance maintenance**, having not only an impact on immediate resource consumption, but also with respect to long-term resource efficiency, namely the first useful service-life of the dishwasher. The new eco-design measures contributing to circular economy objectives by improving the life span, maintenance, re-use, upgrade, recyclability, and waste handling of appliances do also require consumer action, namely in correct appliance use and handling to come up to the overall goal (European Commission 2019).

The present study shows that the use of the ECO program still remains well behind other programs. At the same time, however, it must be considered that, depending on the soiling intensity of the dishware, the Automatic program can show better or comparable consumption values. Based on the review of reported starting and unloading times of the dishwasher, time constraints are obviously not the limiting factor. Even though past (Hook 2018) and also very recently finished studies (Tewes 2023) highlight that for consumers long cycle-times are not acceptable, daily usage patterns show, that short cycle-times are rarely required. The perceived flexibility obtained is actually not required in most cases. Interestingly, also when multiple-cycles are applied per day, there is no trend towards a higher share of the quick program usage – standard program choice, mainly linked to satisfactory performance, seems to be the relevant parameter.

When it comes to overdosage of rinse aid and special salt for regeneration, most consumers do not seem to be aware of their wrongdoing. Further or more prominent references to the application of multi-function products – on the product itself or in the user-manual or appliance display - could help to reduce overdosing, also supported by highlighting the unnecessary additional costs that households incur each year in consumer education.

Raising customer awareness and a more active guidance in connected appliances and appliances with clear-text display is for sure one further option, next to currently used information channels, to promote best practice, even though these actions will just be able to be introduced in higher value appliances. Nudging sustainable program choice applying reward messages or icons or displaying resource savings (as already applied by some manufacturers) may be a further game changer when it comes to inducing behavioral changes.

Literature

- Arendorf J, Bojczuk K, Sims E, Menkveld R, Golsteijn L, Gaasbeek A, Boyano A, Medyna G, Kaps R (2014): Preliminary Report for Revision of European EU Ecolabel Criteria for Detergents for Dishwashers. DG JRC (IPTS). https://susproc.jrc.ec.europa.eu/product-bureau/sites/default/files/contentype/product_group_documents/1581681262/DD%20Preliminary%20Report.pdf (zuletzt abgerufen am 1.10.2023).
- Bangemann E (2021): Was sich Verbraucher von Unternehmen in puncto Nachhaltigkeit wünschen. Ernst & Young Global Limited (EYG). https://www.ey.com/de_de/consumer-products-retail/wie-stehen-verbraucher-zu-nachhaltigen-produkten (zuletzt abgerufen am 08.01.2023).
- Belke L, Maitra W, Stamminger R (2018): Global consumer study to identify the potential of water-saving in dishwashing. *Energy Efficiency* 11: 1887 ff, doi: 10.1007/s12053-018-9646-4.
- Bhutto MY, Liu X, Soomro YA, Ertz M, Baeshen Y (2021): Adoption of Energy-Efficient Home Appliances: Extending the Theory of Planned Behavior. *Sustainability*. 2021; 13(1): 250. doi:10.3390/su13010250.
- Bichler S (2014): Verbraucherakzeptanz von Energieeinsparpotentialen an automatischen Geschirrspülmaschinen. Schriftenreihe der Haushaltstechnik Bonn. Düren: Shaker: 72ff.
- Bichler S, Gorny S, Seifert M, Kessler A, Stamminger R (2015): How to Improve Sustainability and Environmentally Friendly Behaviour in Automatic Dishwashing? Example: Germany. *Tenside Surfactants Detergents*, 52(5): 340–350, doi: 10.3139/113.110384.
- Bocken N, de Pauw I, Bakker C, van der Grinten B (2016): Product design and business model strategies for a circular economy. *Journal of Industrial and Production Engineering* 33 (5), doi:10.1080/21681015.2016.1172124.
- Bosch (o. J.): So spart der Eco-Modus der Spülmaschine Energie <https://www.bosch-home.com/de/bosch-erleben/magazin/haushaltstipps/eco-modus> (zuletzt abgerufen am 11.03.2022).

- Boyano A, Moons H, Villanueva A, Graulich K, Rüdener I, Alborzi F, Hook I, Stamminger R (2017): Ecodesign and Energy Label for Household Dishwashers. JRC technical report. EUR 28645 EN, doi:10.2760/677372.
- Brunzell L, Renström R (2019): Recommendations for revising the energy label system for dishwashers: Supporting sustainable development and usage through the interaction of energy labels, technical improvements, and consumer behaviour. Energy Efficiency, doi:10.1007/s12053-019-09835-6.
- Emmel JA, Parrott K, Beamish J (2003): Dishwashing and Water Conservation: An Opportunity for Environmental Education. Extension Journal 41 (1), <https://tigerprints.clemson.edu/cgi/viewcontent.cgi?article=4947&context=joe> (zuletzt abgerufen am 29.09.2023).
- European Commission (2019): The new ecodesign measures explained https://ec.europa.eu/commission/presscorner/detail/en/qanda_19_5889 (zuletzt abgerufen am 1.10.2023).
- European Commission (o. J.): https://ec.europa.eu/info/energy-climate-change-environment/standards-tools-and-labels/products-labelling-rules-and-requirements/energy-label-and-ecodesign/energy-efficient-products/dishwashers_de (zuletzt abgerufen am 10.03.2022).
- Forum Waschen (2019): Wie Sie "richtig" Geschirrspülen und nachhaltig Abwaschen. Sechs goldene Regeln zum Spülen in der Geschirrspülmaschine. https://www.forum-waschen.de/files/content/Materialien/Bildkarten/2019_Bildkarte_MaschinenGeschirrspuelen.pdf (zuletzt abgerufen am 28.9.2023).
- Forum Waschen (2016): Sechs goldene Regeln zum Spülen in der Geschirrspülmaschine. <https://www.forum-waschen.de/geschirr-richtig-spuelen-abwaschen.html#richtiginspuelmaschinespuelen> (zuletzt abgerufen am 01.10.2023)
- Hennies L, Stamminger R (2016): An empirical survey on the obsolescence of appliances in German households. Resources, Conservation, and Recycling 112: 73 ff, doi: 10.1016/j.resconrec.2016.04.013.
- Klingshirn A et al. (2020): Nachhaltigkeit beim maschinellen Geschirrspülen: Analyse des Verbraucherverhaltens mittels mobiler Ethnographie. Hauswirtschaft und Wissenschaft 68 (2020), doi: 10.23782/HUW_09_2020.
- Klingshirn A, Burkart F, Eilts B, Fecht F, Gumbel L, Schillinger A, Strenger M, Weber S (2020): Nachhaltigkeit beim maschinellen Geschirrspülen: Analyse des Verbraucherverhaltens mittels mobiler Ethnographie. Hauswirtschaft und Wissenschaft Nr. 68 (2020): 145-168, doi: 10.23782/HUW_09_2020.
- Lehmann K, Renz D, Huber F (2022): Nun sag', wie hast du's mit der Nachhaltigkeit? EY-Parthenon GmbH. https://www.ey.com/de_de/consumer-products-retail/studie-nachhaltigkeit-deutscher-konsumentinnen (zuletzt abgerufen am 27.09.2023).
- Prakash S, Dehoust G, Gsell M, Schleicher T, Stamminger R (2016): Einfluss der Nutzungsdauer von Produkten auf ihre Umweltwirkung: Schaffung einer Informationsgrundlage und Entwicklung von Strategien gegen „Obsoleszenz“. Umweltforschungsplan des Bundesministeriums für Umwelt, Naturschutz, Bau und Reaktorsicherheit. Texte 11/2016. www.umweltbundesamt.de/publikationen/einfluss-der-nutzungsdauer-von-produkten-auf-ihre-1 (zuletzt abgerufen am 1.10.2023).

- Richter P (2010): Automatic dishwashers: Efficient machines or less efficient consumer habits? *Int. J. Consum. Stud.* 34: 228–234, doi:10.1111/j.1470-6431.2009.00839.x.
- Rüdenauer I, Fischer C (2021): Haushaltsgeräte: Marktentwicklung und freiwillige Instrumente zur besseren Marktdurchdringung. Fallstudie für das Umweltbundesamt im Rahmen des Vorhabens „Marktanalyse und Interventionen zur Förderung von grünen Produkten“. https://www.oeko.de/fileadmin/oekodoc/Fallstudie_Haushaltsgeraete.pdf (zuletzt abgerufen am 01.10.2023).
- Schencking L, Stamminger R (2022): What science knows about our daily dishwashing routine. *Tenside Surfact. Det.* 59 (3): 205–220, doi: 10.1515/tsd-2022-2423/html.
- Schneider M, Stamminger R (2011): Consumer behavior in dishwashing and cleanser consumption in German households. In SEPAWA - Congress & EDC Conference 2011, Fulda. <https://www.forum-waschen.de/files/content/Materialien/Artikel/SOeFW-%20Journal/Verbraucher verh Spuelen.pdf> (zuletzt abgerufen am 10.11.2023).
- Stamminger R, Streichardt C (2009): Selected Aspects of Consumer Behaviour in the Manual and Mechanical Dishwashing in Germany. *SOFW-Journal* 135, 11-2009: 50 ff. <https://www.forum-waschen.de/files/content/Materialien/Artikel/SOeFW-%20Journal/Verbraucher verh Spuelen.pdf> (zuletzt abgerufen am 10.11.2023).
- Statista-Umfrage (2019a): Welche Mittel nutzen Sie für Ihren Geschirrspüler?. <https://de.statista.com/prognosen/996245/umfrage-in-deutschland-zu-typen-von-geschirrspuelmitteln> (zuletzt abgerufen am 09.03.2022).
- Statista-Umfrage (2019b): Wie oft läuft bei Ihnen der Geschirrspüler? <https://de.statista.com/prognosen/996237/umfrage-in-deutschland-zur-nutzungshaeufigkeit-des-geschirrspuelers> (zuletzt abgerufen am 09.03.2022).
- Statista-Umfrage (2019c): Wie wird der Abwasch in Ihrem Haushalt erledigt?. <https://de.statista.com/prognosen/996212/umfrage-in-deutschland-zum-abwasch> (zuletzt abgerufen am 09.03.2022).
- Statistisches Bundesamt (2022): Anteil der privaten Haushalte in Deutschland mit einer Geschirrspülmaschine von 2000 bis 2021. <https://de.statista.com/statistik/daten/studie/516794/umfrage/private-haushalte-in-deutschland-mit-geschirrspuelmaschine/> (zuletzt abgerufen am 10.03.2022).
- Stratton L (2012): The Role of Preferences and Opportunity Costs in Determining the Time Allocated to Housework. *Forschungsinstitut zur Zukunft der Arbeit Institute for the Study of Labor, Discussion Paper No. 6436.* <https://docs.iza.org/dp6436.pdf> (zuletzt abgerufen am 27.09.2023).
- Tecchio P, Ardente F, Mathieux F (2019): Understanding lifetimes and failure modes of defective washing machines and dishwashers. *Journal of Cleaner Production* 215: 1112 ff, doi: 10.1016/j.jclepro.2019.01.044.
- Tewes T, Harcq L, Bockmühl D (2023): Use of Automatic Dishwashers and Their Programs in Europe with a Special Focus on Energy Consumption. *Clean Technol.* 2023 (5): 1067–ff, doi: 10.3390/cleantechnol5030054.
- Umweltbundesamt (2021): Geschirrspüler: Im ECO-Programm Wasser und Strom sparen. <https://www.umweltbundesamt.de/umwelttipps-fuer-den-alltag/elektrogeraete/geschirrspueler-spuelmaschine#wie-sie-bei-ihrer-spulmaschine-energie-sparen-> (zuletzt abgerufen am 1.10.2023).

Venkatesh G (2022): Dishwashers: Literature Review to Summarize the Multi-Dimensionality of Sustainable Production and Consumption. Sustainability 2022, 14, 10302, doi: 10.3390/su141610302.

White K, Habib R, Hardisty DJ (2019): How to Shift Consumer Behaviors to be More Sustainable: A Literature Review and Guiding Framework. Journal of Marketing, 83 (3): 22–49, doi: 10.1177/0022242919825649.

WRAP (2013): Electrical and electronic product design: product lifetime. <https://docplayer.net/21207357-Gb-report-electrical-and-electronic-product-design-product-lifetime.html> (zuletzt abgerufen am 1.10.2023).

Autorinnen und Autoren

Prof. Dr. Astrid Klingshirn (Korrespondenzautorin), Julia Haid BA BSc und Prof. Dr. Benjamin Eilts, Hochschule Albstadt-Sigmaringen University, Anton-Günther-Str. 51, 72488 Sigmaringen

Kontakt: klingshirn@hs-albstadt.de



© A. Klingshirn

Interessenkonflikt

Autorinnen und Autoren erklären, dass kein Interessenkonflikt besteht. Der Beitrag basiert auf der Studie „Consumer study on automatic dishwashing“, die in Kooperation mit folgenden Unternehmen im Jahr 2021 durchgeführt wurde: BSH Hausgeräte GmbH, Carl-Wery-Straße 34, 81739 München, Henkel AG & Co. KGaA, Henkelstraße 67, 40589 Düsseldorf, Midea Europe GmbH, Research Center, Liebknechtstr. 35, 70565 Stuttgart, Miele & Cie. KG, Mielestraße 2, 33611 Bielefeld und Reckitt Benckiser Global R&D GmbH, Robert-Koch-Straße 1, 69115 Heidelberg.

Zitation

Klingshirn A, Haid J & Eilts B (2024): Analysis of consumer behavior in usage of dishwashers with a focus on sustainability. Hauswirtschaft und Wissenschaft (72) 2024, ISSN online 2626-0913. <https://haushalt-wissenschaft.de> doi: 10.23782/HUW_18_2023