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Modelling Dishwashers' Resource Consumption in Domestic Usage in European Households and its Relationship to a Reference Dishwasher

The "Recommendations for the Quality Assessment of the Cleaning Performance of Dishwasher Detergents" provide detailed procedures to assess the performance of a household dishwasher detergent using a standard test programme of a standard dishwasher. As such, they are a *de facto* standard for a whole industry. Consequently, it is relevant to ensure that the conditions under which the tests are carried out represent the relevant market: the automatic dishwashing machines installed and used in households in Europe. But no data are available by now describing the situation in the households. The task here is to model the distribution of total energy, water consumption and programme duration of the automatic dishwashing machines installed and used in private households in Europe when used by the consumer. Those data are then compared to the data of the reference dishwasher and, thus, the relevance of the reference system to the dishwashers installed in private households is assessed.

Key words: Consumer, water, energy, dishwasher, model

Modellierung des Ressourcenverbrauchs von Geschirrspülern im häuslichen Gebrauch in europäischen Haushalten und seine Beziehung zu einem Referenz-Geschirrspüler. Die „Empfehlungen für die Qualitätsbewertung der Reinigungsleistung von Geschirrspülmitteln“ enthalten detaillierte Verfahren zur Bewertung der Leistung eines Haushaltsgeschirrspülmittels unter Verwendung eines Standardtestprogramms für einen handelsüblichen Geschirrspüler. Als solche stellen sie *de facto* eine Norm für eine ganze Branche dar. Folglich muss sichergestellt werden, dass die Bedingungen, unter denen die Tests durchgeführt werden, den relevanten Markt repräsentieren: die in den Haushalten in Europa installierten und verwendeten Geschirrspülautomaten. Bislang liegen jedoch keine Daten vor, die die Situation in den Haushalten beschreiben. Hier geht es darum, die Verteilung der Gesamtenergie, des Wasserverbrauchs und der Programmdauer der in Privathaushalten in Europa installierten und genutzten Geschirrspülautomaten bei der Nutzung durch den Verbraucher zu modellieren. Diese Daten werden dann mit den Daten des Referenz-Geschirrspülers verglichen und so die Relevanz des Referenzsystems für die in den Privathaushalten installierten Geschirrspüler bewertet.

Stichwörter: Verbraucher, Wasser, Energie, Geschirrspüler, Modell

1 Introduction

The Miele G1223 SC (GSL 2) dishwasher is recommended as a reference dishwasher in the "Recommendations for the Quality Assessment of the Cleaning Performance of Dishwasher Detergents" (called "IKW methodology for dishwasher detergent") [1], because this dishwasher cannot be influenced by automatic control. This is important to avoid unidentified machine parameters influencing comparative testing. The machine offers various programmes (see Table 1), whereof a standard testing programme with no pre-wash, a cleaning temperature of 45 °C and a holding time of 8 min is taken as the standard test programme ("bold" in Table 1). Other parameters of this standard test programme are that the filling level of the machine is at about 5 L, the total energy and water consumptions are at 0.83 kWh and 14.25 L, respectively, and the total time is 82 min (Fig. 1). Worth to note that programmes with a longer holding time are available, too.

The "Recommendations for the Quality Assessment of the Cleaning Performance of Dishwasher Detergents" [1] provide detailed procedures to assess the performance of a household dishwasher detergent using this standard test programme. They are widely used, not only in Germany but at least throughout Europe, to assess and compare the performance of household dishwashing detergents. As such, they are a *de facto* standard for a whole industry. Consequently, it is relevant to ensure that the conditions under which the tests are carried out represent the relevant market: the automatic dishwashing machines installed and used in households in Europe.

Comparisons to dishwashers from the market show, firstly, that there is a broad variety of programmes offered by each dishwasher (examples for Bosch: Fig. 2, Beko: Figure 3 and Miele: Figure 4). These examples show, secondly, that the main cleaning programme duration (visible at the first rapid drop of the temperature when the cold water of the rinsing cycle goes into the dishwasher) is much later for all other programmes than it is for the GSL 2 (Fig. 1), where it begins about 24 min after the start. Some of the machines (e.g. Bosch in the Eco programme) wash for about 2 h before the rinsing starts.

The interaction of four parameters is necessary for a complete washing process, as was first described by Sinner [3]: temperature of the wash, chemicals used, mechanical agitation and washing duration. The washing result is satisfactory only if they are available in the right amount (forming the so-called *Sinner circle*). However, the *Sinner circle* also postulates that it is possible to exchange the activity of one of the parameters for another one without the overall result deteriorating. This option is widely used today when creat-

Pre-wash	Cleaning temperature (in °C)	Holding time after reaching the cleaning temperature (in min)	Rinse temperature (in °C)	Example of
No	40	8/20/55	55	Low-temperature programmes
No	45	3/8/55	55	Standard test programme
No	50	3/8/55	55	Normal programme
No	50	3/8/55	65	Normal programme
Yes	50	3/8/55	65	Normal programme
No	65	10/30/55	65	Intensive programme

Table 1 Table from the "IKW methodology for dishwasher detergent". Programme characteristics of the programme P2 of GSL 2 used for tests following the "IKW methodology" are shown in bold (source [1])

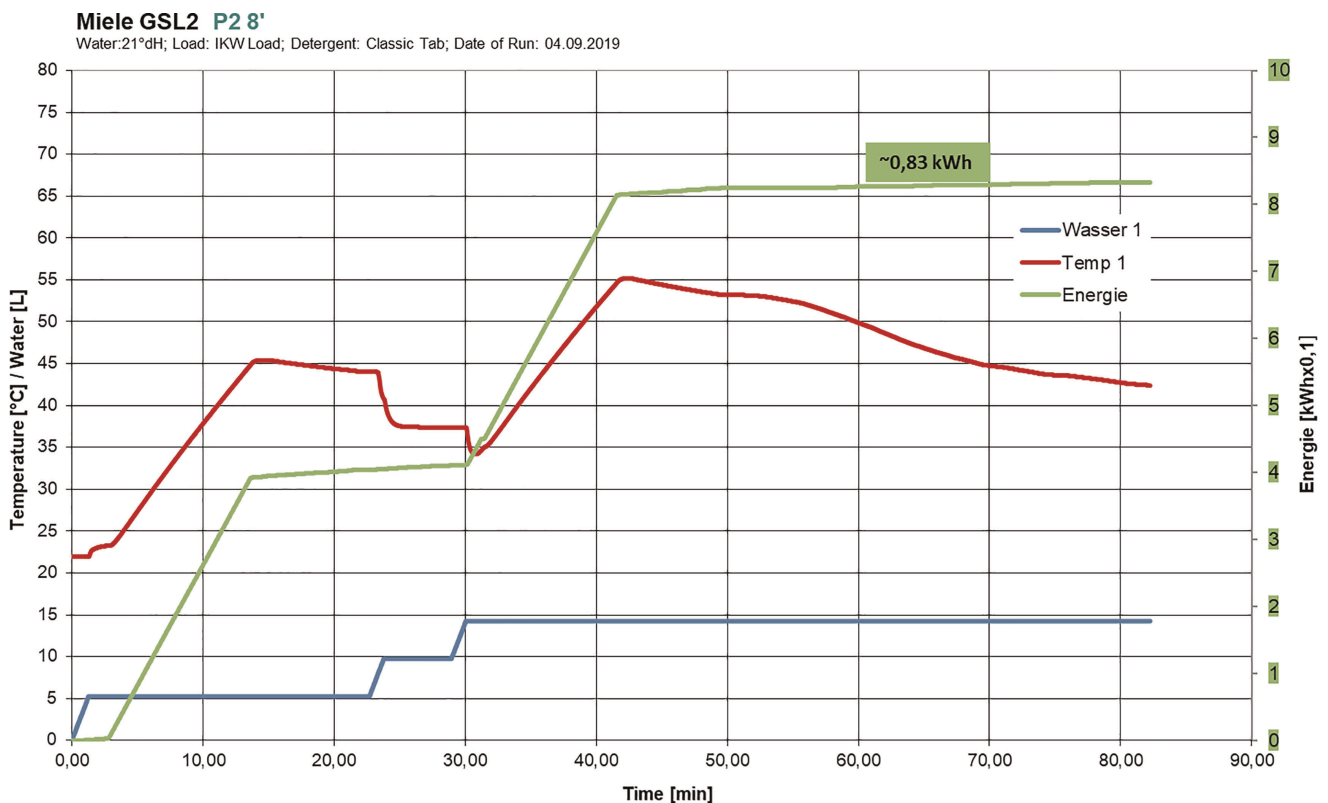


Figure 1 Course of temperature, water intake and energy consumption of the programme P2 of GSL 2 in tests used following the 'IKW methodology' (source: [2])

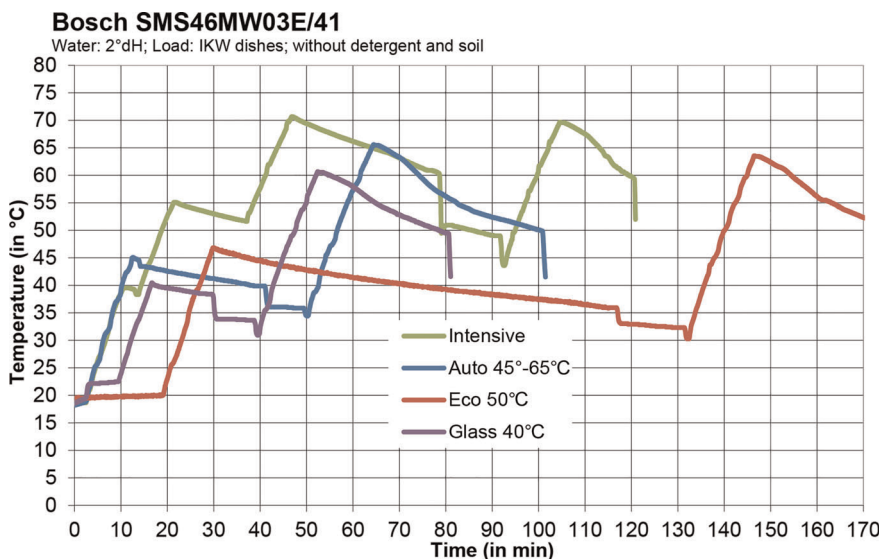


Figure 2 Programme course depicted by the temperature profile of various programmes of a Bosch dishwasher (source: [2])

ing programmes which are optimised, for example, for short programmes (by increasing the temperature and reducing the time) or for very ecological programmes (by increasing the programme duration and reducing the temperature).

Dishwashers in Germany have an average lifespan between 8.6 and 13.1 years [4], depending on the cost category of the purchase. Therefore, it is fair to assume that the market offer of dishwashing machines of the last 12 years defines the type of dishwashers in households today. The question is whether the standard test programme in the Miele GSL 2 is suitable to work as a reference for the relevant market: The programme characteristics of the standard test programme need to be compared with those parameters of the dishwashing machines offered to the market during the last 12 years. However, not all models and brands of dishwashers are equally well represented in households. Therefore, at least a weighting of the brands according to their market share is necessary. Additionally, not all programmes are used equally often. Therefore, a weighting is needed to reflect the different usage behaviour of the consumer regarding the programme of the dishwasher chosen. Another

question is which are the right parameters to compare. The total energy, water consumption and programme duration are clearly relevant quantities. The amount of water used during the main wash and the maximum temperature reached during the main cleaning process would also be of interest.

Although there are already models regarding how different consumer behaviour influences the resource consumption of dishwashing or laundry treatment in households [5], modelling the probability of a certain product and programme being used and a certain usage behaviour of the consumer is lacking.

The task here is to model the distribution of total energy, water consumption and programme duration of the automatic dishwashing machines installed and used in private households in Europe and to find evidence regarding the amount of water used during the main wash and the maximum temperature reached during the main cleaning process of those machines when used by the consumer. Those data may then be compared to the data of the reference dishwasher Miele GSL 2 and, thus, the relevance of the reference

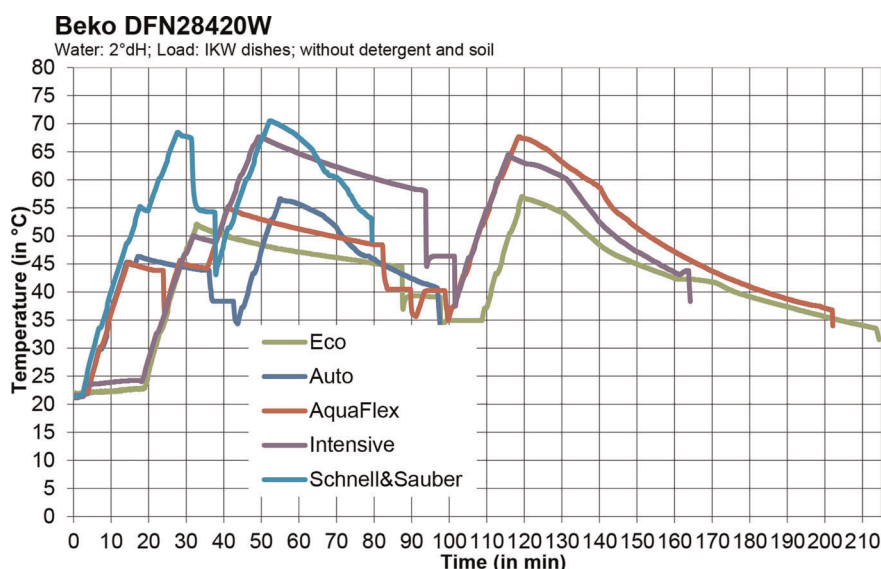


Figure 3 Programme course depicted by the temperature profile of various programmes of a Beko dishwasher (source: [2])

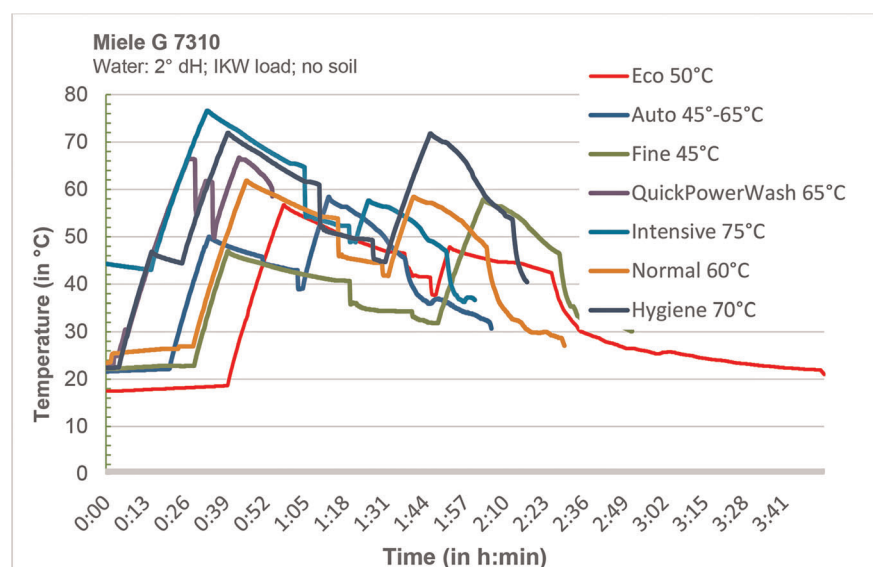


Figure 4 Programme course depicted by the temperature profile of various programmes of a Miele dishwasher (source: [2])

system to the dishwashers installed in private households may be assessed.

2 Methods and Model

It is not easy to find equivalent data for the machines on the market over the last 12 years. One source which could be used is the biannual report of the Industrieverband Körperpflege- und Waschmittel e. V. (IKW: Industrial Association for Personal Hygiene and Detergents), which describes the results of consumer behaviour collected by an "Online-Spül-Rechner" in Germany [6]. This internet tool asks the consumers about their dishwashing habits. *Inter alia*, the consumers' usage frequency of different programmes is gathered. Unfortunately, the programmes which could be selected have been changed over the years (Fig. 5). Nevertheless, the data collected show which programmes are selected most.

Another source may be a European-wide survey of consumer behaviour of household dishwashers conducted in the context of the revision of the Ecodesign and Energy Labelling Directive in 2015 [7, 8]. Even more programmes could be selected here, which spread the results further (Fig. 6). Moreover, there is a good coincidence regarding the usage of the Eco/energy saving, 45/50/55 °C (normal), Automatic, 60/

65 °C (normal), 70/75 °C (intensive) programmes considering only the last few years with the data gathered by the "Online-Spül-Rechner" (Figure 5). As those data represent 82 % of the European households, it may be concluded that there are not so many significant differences in the use of an automatic dishwasher between Germany and European consumers.

Other information needed to fulfil the task is to know about the energy and water consumption of the dishwashers in European households. Data collected in the context of the Preparatory Study [6] (Figure 7) show that the average energy consumption of dishwashing machines brought onto the market between 2006 and 2014 has been reduced from 1.024 to 0.942 kWh. However, this energy consumption is only for the programme used to declare details for the energy label (since 2011: unanimously called the ECO programme; before 2011: different programmes used depending on the manufacturer and brand).

A similar development is visible for the average water consumption, reducing from 14.96 L in 2006 to 10.34 L in 2014 in the ECO programme (Fig. 8).

Other programmes may have significantly different consumption values, as has been shown in the context of the Preparatory Study [7] by analysing a sample of machines from the market (Fig. 9). It turns out that rapid and normal

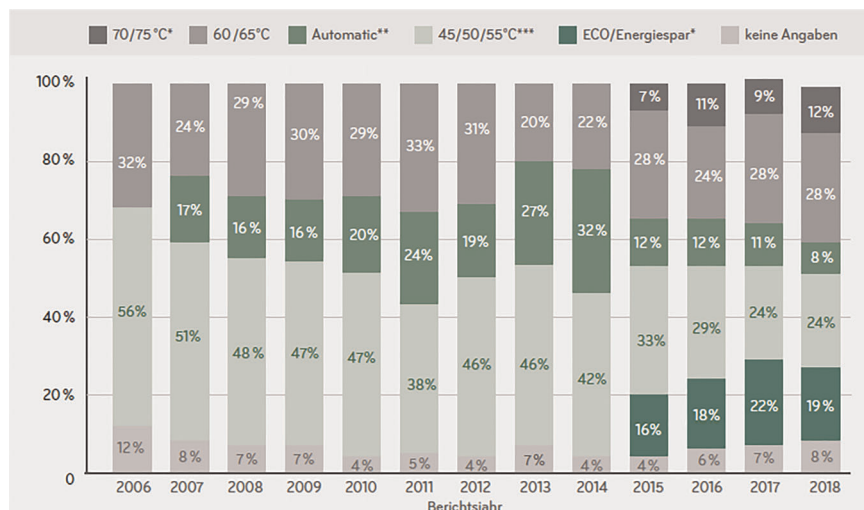


Figure 5 Table of distribution of programmes used in dishwashers in German homes (*first asked in 2015; **first asked 2007; ***supplemented "45 °C Programme" first time in 2015) (source [9])

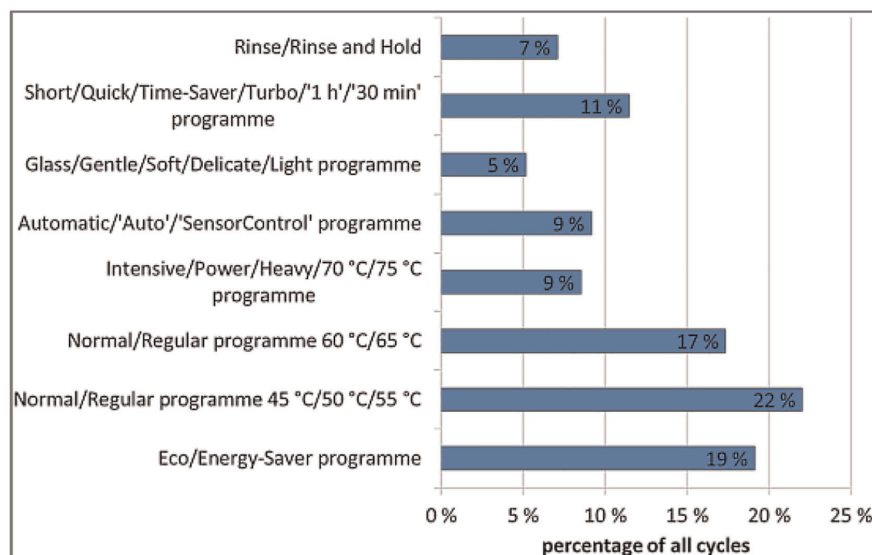


Figure 6 Dishwasher programmes used in European households in 2015. Weighted average covering 82 % of the European population (source: [7])

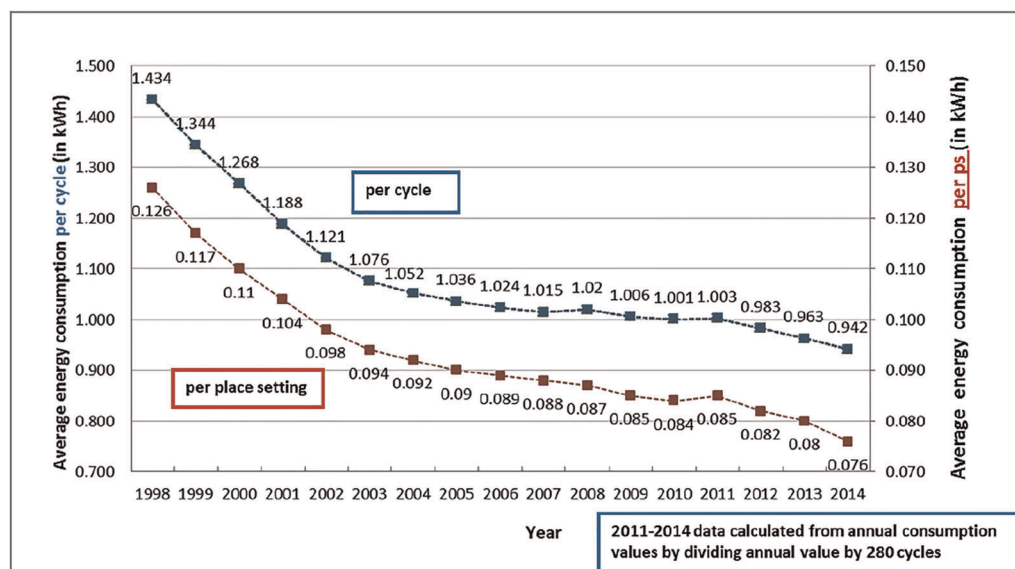


Figure 7 Average energy consumption of the officially declared dishwasher programmes in Europe [7]

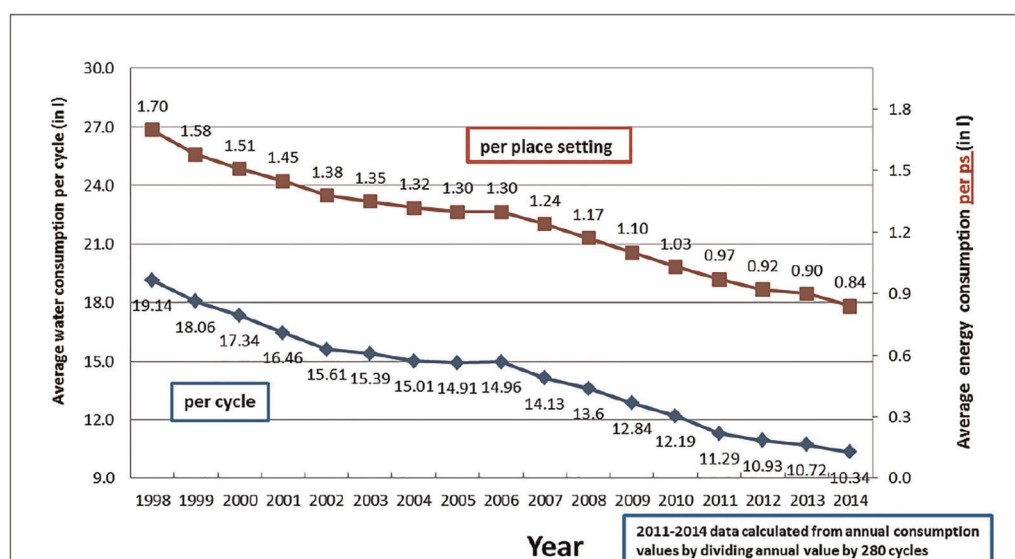


Figure 8 Average water consumption of the officially declared dishwasher programmes in Europe (source: [7])

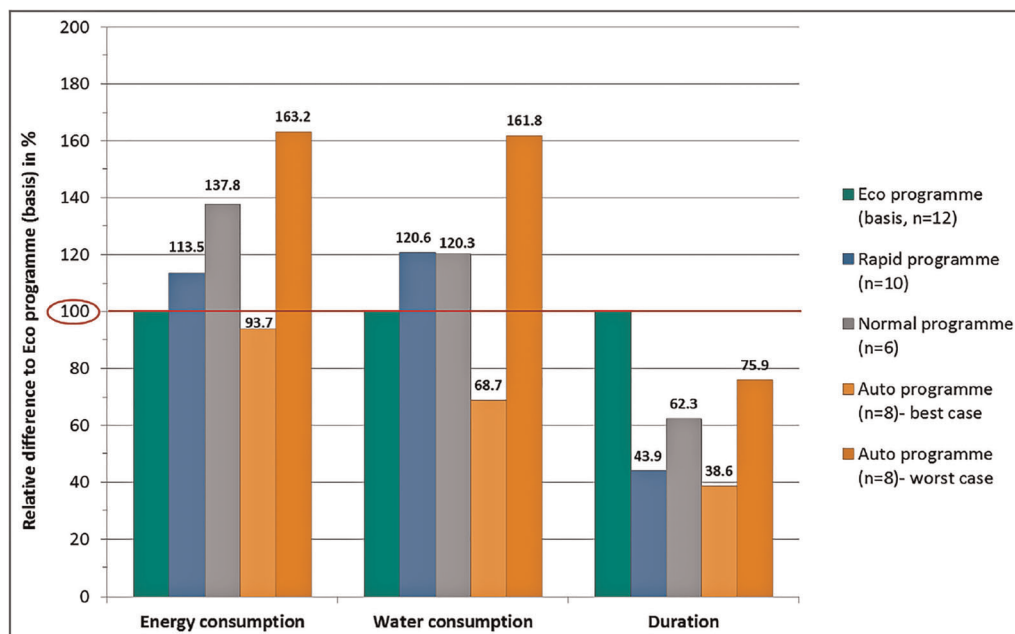


Figure 9 Comparison of different programmes regarding their energy and water consumption and programme duration in Europe (source: [7])

programmes consume about 20% more energy and water than the ECO programme and their programme duration is about half as long. Automatic programmes will adjust their programme parameters according to the conditions measured and are, thus, almost unpredictable.

All information on dishwashers' consumption mentioned previously are based on the declaration of the manufacturer. However, the data measured are scarcely available. One source of information is the magazine "test" published by *Stiftung Warentest*, a well-known consumer protection organisation in Germany. They test various models of the most relevant brands of dishwashers on the German market almost every year, following their own test programme. Their target is to assess products under test with consumer-relevant test procedures. However, their test programme has also changed over the years, especially regarding the selection of the programmes of the dishwasher. Nevertheless, their published test reports offer a source of independent information on energy and water consumption and programme duration measured of the most relevant brands of dishwashers on the European market (Fig. 10).

There are many brands of dishwashers available on the European market. However, not all brands have an independent manufacturing base but many are produced on the

same manufacturing line. Thus, they use very similar technology but just have a different exterior design. Figure 11 below shows the average market share of relevant manufacturing groups of dishwashers in Europe in the years 2009 to 2018 based on market research figures. It is worth noting that companies merged with other companies during this period have been consolidated into the current company.

In light of all these facts, the task of this expertise – to estimate the distribution of total energy and water consumption and programme duration of the automatic dishwashing machines installed in private homes in Europe – can best be estimated by using all the data measured published by *Stiftung Warentest* in the years 2006 to 2018 as a representation of the European dishwasher market and to use the available data on the usage of the programmes and the brands/manufacturer market share as weighting factors as a contribution to the total market. Those data may then be compared to the data of the reference dishwasher Miele GSL 2 and, thus, the relevance of the reference system to the dishwashers installed in private homes may be assessed. This approach does not consider brands and manufacturers which are only sold outside Germany or have not been selected by *Stiftung Warentest* for their tests. It also assumes that the same number of machines are added to the stock of machines in private households in each year. *Stiftung Warentest* published tests on dishwashers up to 2010 only in a two-yearly rhythm; this means that machines from the years published in 2006 and 2008 are considered as less relevant. However, this is well in line with what can be expected today, as many of those machines may have already been replaced by a new machine. Dishwashers produced before 2006 are not considered. However, by 2019, those old machines should be mostly out of stock.

Publications of *Stiftung Warentest* on automatic dishwashers are available for the years shown in Table 2.

Data about the programme selection by consumers are available from various publications. They were summarised by Hook et al. [10] (Table 3).

Based on these data, an assessment has to be made to find the corresponding programme selected by the consumer with those programmes tested by *Stiftung Warentest* in each year. As the number of programmes tested by *Stiftung Warentest* is much lower than the number of programmes offered, some educated guesses had to be made to find equivalent programmes and combine them.

Ausstattung/Technische Merkmale

Energieeffizienzklasse/Geräusch (dB)		A+/40,9
Anzahl: Maßgedecke/Spülprogramme		13/8
Stromverbrauch (kWh)/Wasser- verbrauch (l)/ Dauer (h:min)	Sparprogramm	0,90/9,4/3:24
	Automatikprogramm ²⁾	1,10/12,9/2:20
	Kurzprogramm	1,19/10,3/0:59
Geprüftes Programm (Bezeichnung laut Anbieter)	Sparprogramm	Eco 50 °C
	Automatikprogramm	Auto 45 °C – 65 °C
	Kurzprogramm	1h 65 °C

Figure 10 Example of a data table in a publication of *Stiftung Warentest* for one dishwasher in a test

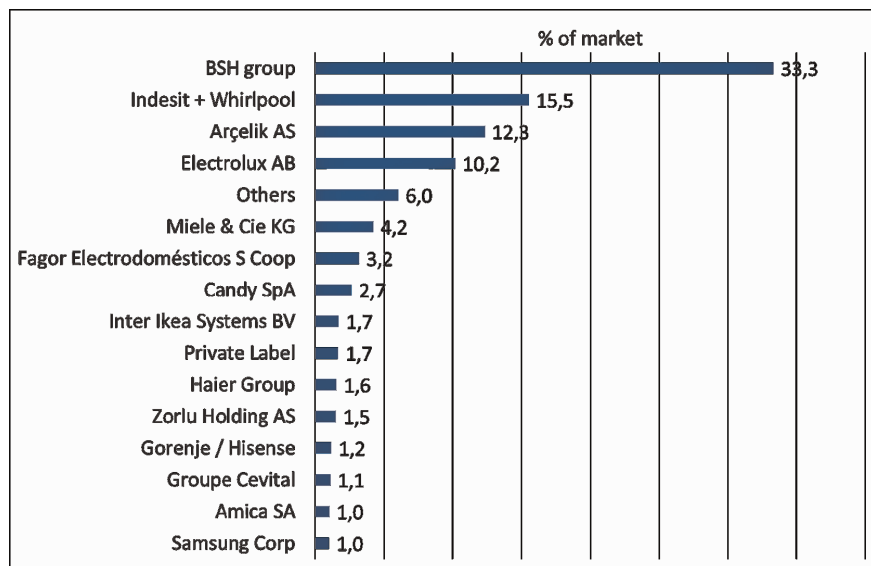


Figure 11 Average market share of manufacturing groups in Europe 2009 to 2018 (source: Euromonitor passport)

Stiftung Warentest itself has published weighting factors for the relevance of individual programmes to the total results only since 2013, which is probably based on data from consumer behaviour studies or other consumer intelligence. All three programmes tested are treated equally importantly (therefore, 33.3 % each in Table 4) and contribute

as cleaning performance with 20% to the total result of the test. The weighting factors are not disclosed for years before 2013. Assuming that the same relevance distribution was valid for the years 2010 to 2012, where the automatic programmes were tested under different conditions, the contribution is assumed to be the same. The contribution

Publication year	Programme tested				
	Kurz (short)	Spar/ECO (saving)	Auto normal	Auto stark	Intensive
2006		x	no data published		x
2008		x	x	x	x
2010	x	x	x	x	
2011	x	x	x		
2012	x	x	x		
2013	x	x	x		
2014	x	x	x		
2015	x	x	x		
2016	x	x	x		
2017	x	x	x		
2018	x	x	x		

Table 2 Dishwasher programmes tested in Stiftung Warentest 2006 to 2018 (source: “test” magazine)

	Eco	Normal 45 °C – 55 °C	Normal 60 °C – 65 °C	Inten- sive	Auto	Quick	China/delicate	Rinse (and hold)
Survey								
Presented survey (n = 5,277), 11 countries of the EU	19.0	22.0	17.0	9.0	9.0	11.0	5.0	7.0
Bichler et al. (n = 3,836), Ger- man households	18.7	17.0	16.9	14.5	14.3	12.2	6.4	
Richter (n = 1,209), Households in DE, IT, SE, UK	17.0	29.1		12.4	14.8	11.3	7.8	7.7

Table 3 Overview of various studies regarding the selection of dishwasher programmes [10, references given in [10]

Year	Programme					Sum
	Kurz (short)	Spar/ECO	Auto normal	Auto stark	Intensive	
2006		50 %	no data		50 %	100 %
2008		50 %	17 %	17 %	17 %	100 %
2010	33 %	33 %	17 %	17 %		100 %
2011	33 %	33 %	33 %			100 %
2012	33 %	33 %	33 %			100 %
2013	33 %	33 %	33 %			100 %
2014	33 %	33 %	33 %			100 %
2015	33 %	33 %	33 %			100 %
2016	33 %	33 %	33 %			100 %
2017	33 %	33 %	33 %			100 %
2018	36 %	27 %	36 %			100 %

Table 4 Programme selection of those programme tested by Stiftung Warentest

of the programmes for the years 2006 and 2008 is extrapolated using the consumer research data from IKW Jahresbericht (Fig. 5). This all provides a distribution of the relevance of those programmes tested by *Stiftung Warentest* for the use of dishwashing programmes in the European households, as presented in Table 4

Finally, the estimation of the energy and water consumption and programme duration of the dishwashing programmes used in Europe is based on the published data measured from *Stiftung Warentest* in their reports from 2006 to 2019. The market relevance is calculated for each year of publication and each automatic dishwasher model tested by using the market share of the manufacturing group producing this model. If there are more models tested from the same manufacturing group, the market share is split according to the number of models under test. As the sum of the market shares for one year do not equal 100%, the relevance is scaled up proportionally to 100%. This corrected market share is multiplied by the probability that a certain programme is selected (Table 4), giving the probability that this programme tested (by *Stiftung Warentest*) is used. This probability is then linked to the consumption (energy, water and duration) measured and is, therefore, the probability that this consumption is used in the households.

Finally, all data measured for energy, water and time (a 422 data set for each quantity) for all 11 years are associated with the probability of being used. These probabilities are then sorted according to the consumption (energy, water and duration) values and are summed up for defined clusters. Not all programmes published by *Stiftung Warentest* are tested for some of the data sets (mainly for missing automatic programmes); those missing data are omitted. The probabilities are normalised overall to 100%.

3 Results

A total of 422 data sets were analysed and associated with a probability of this programme in such a dishwasher machine being used with the probability calculated. Summing up the probabilities for defined clusters of energy, water and

duration delivers the overall probability that a programme of a certain cluster (interval) will be used.

The probability distribution of energy (Fig. 12), water (Fig. 13) and duration (Fig. 14) shows a broad range of values which the dishwasher programmes have in consumers' households. Energy consumption and programme duration especially show a range with 90% of the values between 0.8 and 1.4 kWh and 60 and 210 min, respectively. By contrast, 90% of the water consumption values are within the range from 9 to 16 L. This difference is easily explained by the fact that a certain dishwashing machine technology may be easily adapted to use more or less energy by using different maximum temperatures for cleaning and/or rinsing or by extending programme steps to work for a shorter or longer time. Contrarily, water consumption is more defined by the pump and spray arm technology used and cannot be adapted so easily. It is especially surprising that there are very few dishwashing programmes working with water volumes of less than 10 L, despite the high marketing efforts of almost all manufacturers in promoting their dishwasher with such low amounts of water. This may be due to the selection criteria of *Stiftung Warentest* of buying mainly frequently sold models for their tests. The media values are 1.10 kWh for energy, 11.6 L for water and 141 min programme duration.

Comparing the distribution of energy, water and programme duration of dishwasher programmes at consumer homes with those values used in the reference programme of GSL 2 used for the IKW methodology (Table 5) reveals that the GSL 2 programme is quite severe for energy and programme duration, as the energy used (meaning the temperature used for cleaning and/or drying) is quite low and the programme is quite short. Thus, it is very challenging to achieve a good cleaning performance under such conditions. However, the amount of water used is higher than 82% of the consumer programmes used. Therefore, the GSL 2 reference machine uses a detergent concentration which is lower as in normal household dishwashers which imposes an additional challenge to get a good cleaning performance.

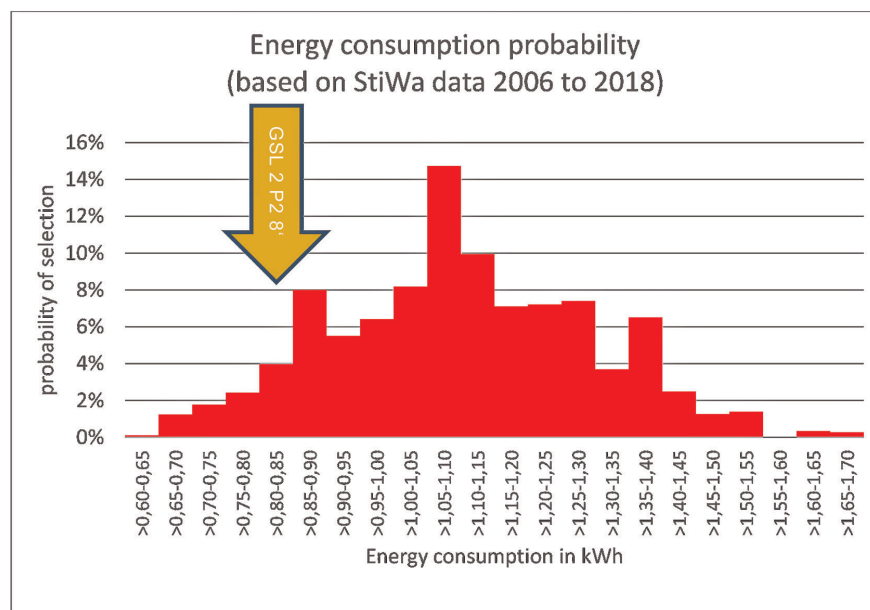


Figure 12 Probability distribution of using a dishwasher in defined energy clusters

4 Discussion

The calculations depicted above are based on some assumptions, which are justified as follows:

1. Use of data from *Stiftung Warentest* to extrapolate for all of Europe. As manufacturers of dishwashers are almost all active in Europe, their dishwashers are sold throughout the area. Moreover, no other real measured data for so many machines and programmes are available in the public domain.
2. Only two to three different programmes of a dishwasher are tested. Those programmes do not cover the five to ten programmes (and even more options) that a modern dishwasher offers. However, many consumers use only one or two programmes for their daily dishwashing job. The three main types of programmes – quite short, intensive and energy/economic saving programmes – are included in the data.
3. Only the absolute published values are used, without considering the different number of place settings the dishwashers can load. This is justified by the fact that,

on the one hand, the load size has only a limited influence on the consumption values and, on the other hand, there are no facts in the public domain showing that a consumer is really loading more dishes in a dishwasher with, for example, 14 place settings rated capacity compared to a 12 place settings dishwasher.

4. Hardly any really inexpensive machines are included in the selection of models tested by *Stiftung Warentest*. This is true. However, the high-performance end of the market is also missing, as the few very low-water consuming machines show.

	GSL 2 values	usage probability of being below GSL 2
energy	0.83 kWh	7.9 %
water	14.25 L	82.0 %
duration	82 min	14.0 %

Table 5 Comparison of GSL 2 values used for “IKW methodology” with a probability that those or lower values are used in consumer programmes

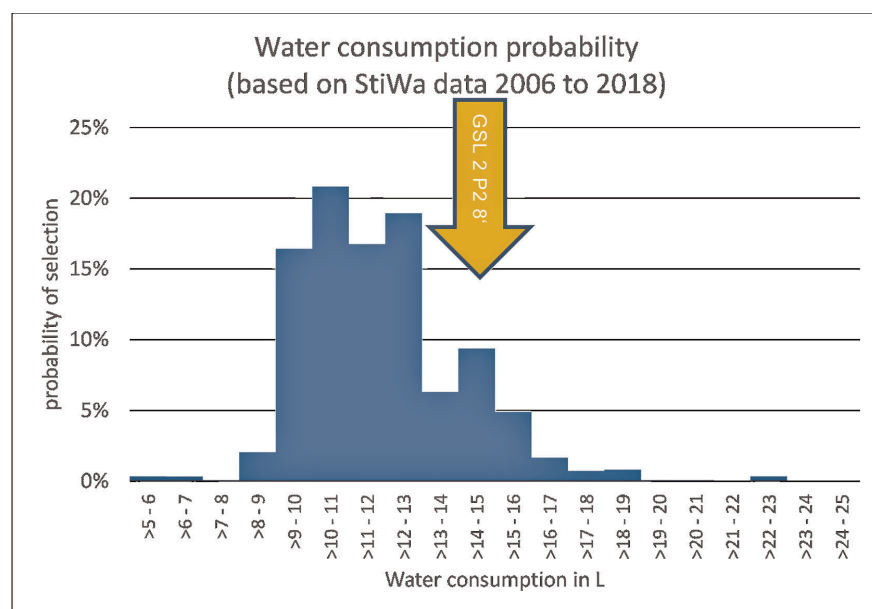


Figure 13 Probability distribution of using a dishwasher in defined water clusters

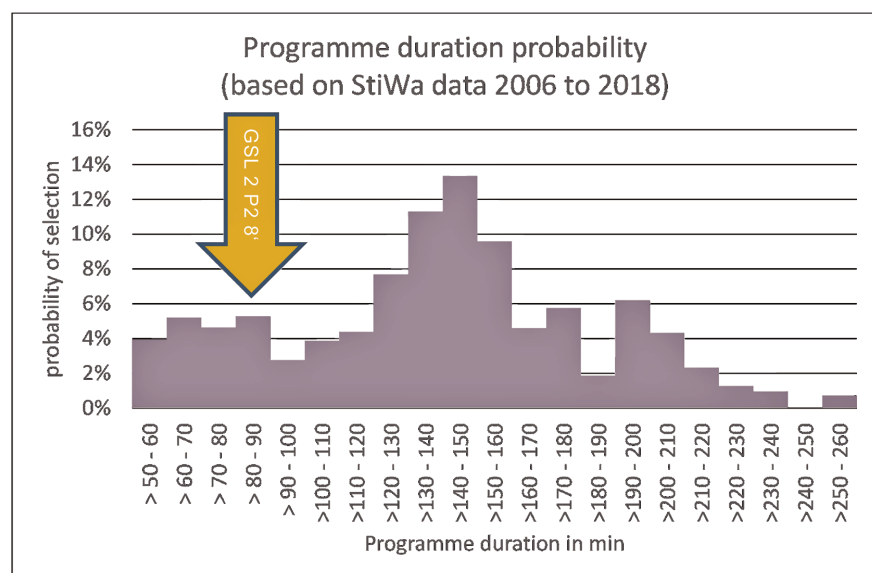


Figure 14 Probability distribution of using a dishwasher in defined duration clusters

Considering all these arguments, it is still believed that the exercise as presented is a good estimation of the real-life energy/water consumption and programme duration of the dishwashers in European households. If this is accepted, the assessment of the test programme used in the GSL 2 (see Fig. 1) for the "IKW methodology" does not represent the average dishwasher programme the consumer uses in Europe.

To conclude, the general target should be to define the reference dishwasher in such a way that it always represents the average of the programmes used of the dishwashers in the households. However, as the market offer of dishwashers is changing continuously towards more resource-saving appliances, it would be wise to consider multiple scenarios for detergent tests in the reference dishwasher. The dishwasher reference programme should represent the average of the programmes used of the dishwashers in the households; additional programmes should enable structures as close as possible to the challenging side of the stock of appliances to anticipate – to some extent – the forthcoming changes in the households. In the short-term, reconfiguring the reference machine and programme selection for testing the "IKW methodology" may be recommended. In the medium-term, modifying the reference machine in such a way as to reduce the water intake per water filling to about 3.5 L and prolonging the main wash duration significantly at a maximum main wash temperature of about 45 °C is recommended.

Acknowledgements

The author would like to thank Reckitt Benckiser Global R&D GmbH for supporting this work.

References

1. *IKW*: Recommendations for the quality assessment of the cleaning performance of dishwasher detergents (Part B, Update 2015) of the German Cosmetic, Toiletry, Perfumery and Detergent Association (IKW), SOFW J.142 (2016). Available: https://www.ikw.org/fileadmin/ikw/downloads/Haushaltspflege/2016_EQ_Dishwasher_Detergents_Part_B_Update_2015.pdf. Accessed 18 May 2020.
2. Private communication.
3. *Sinner, H.*: Über das Waschen mit Haushaltswaschmaschinen: in welchem Umfang erleichtern Haushaltswaschmaschinen und -geräte das Wäschehaben im Haushalt? Haus & Heim Verlag (1960).
4. *Seyffert, F., Belke, L. and Stamminger, R.*: Obsolescence of large household appliances in Germany, *Tenside Surf. Det.* 55 (2018) 6. DOI:10.3139/113.110586
5. *Stamminger, R.*: Modelling resource consumption for laundry and dish treatment in individual households for various consumer segments, *Energ. Effic.* 4 (2011) 559–569. DOI:10.1007/s12053-011-9114-x
6. Online-Spül-Rechner. Forum Waschen. Available: <https://www.forum-waschen.de/online-geschirr-spuelrechner.html>. Accessed 14 May 2020.
7. *Boyano A., Moons H., Villanueva A., Graulich K., Rüdener I., Alborzi F., Hook I. and Stamminger R.*: Ecodesign and Energy Label for household dishwashers, EUR 28645 EN. DOI:10.2760/024232
8. *Hook I., Schmitz A. and Stamminger R.*: Dishwashing behaviour of European consumers, Stamminger, R. (Ed.), *Schriftenreihe der Haushaltstechnik Bonn*, Shaker-Verlag. ISBN 978-3-8440-6019-5.
9. Bericht Nachhaltigkeit in der Wasch-, Pflege- und Reinigungsmittelbranche in Deutschland Ausgabe 2019. Available: <https://www.ikw.org/haushaltspflege/themen/detail/ikw-nachhaltigkeitsbericht-aktuell/>. Accessed 14 May 2020.
10. *Hook I., Schmitz, A. and Stamminger, R.*: Dishwashing behaviour of European consumers with regard to the acceptance of long programme cycles, *Energ. Effic.* 11 (2018) 1627–1640. DOI:10.1007/s12053-017-9539-y

Received: 22. 05. 2020

Revised: 12. 08. 2020

Bibliography

DOI 10.3139/113.110714
Tenside Surf. Det.
57 (2020) 6; page 479–488
© Carl Hanser Verlag GmbH & Co. KG
ISSN 0932-3414

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Rainer Stamminger was promoted in 2002 as professor for appliance and process engineering at University of Bonn after 17 years of practical experience in the development of washing machines and dishwasher with AEG Hausgeräte, Germany. Main areas of research at University are consumer behaviour of homework with and without using appliances, new products or features, smart appliances, robots for household application and questions of sustainability of housekeeping. In 2019 he retired officially and got promoted as Senior Professor at the University of Bonn.