

A European Comparison of Cleaning Dishes by Hand

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1. ABSTRACT

In the discourse on global warming and other man-made environmental defects, the energy consumption of household appliances is under close scrutiny. Dishwashers, however, are used to substitute or supplement manual dish-washing, so that the question arises about the environmental effects not only of automatic but also of manual dish-washing. To investigate this question, a test was performed covering seven European countries/regions for which the consumption and performance of manual dish-washing was compared with the equivalent data for dish-washing machines.

It will be reported about regional differences in washing-up techniques and associated consumption values. As result out of the investigation of 113 persons it is found that the average consumption to clean 12 place settings of dishes was measured to 103 litres of water, 2,5 kWh of energy and 79 minutes time. These data are compared with values of new A/A/A dishwashing machines.

2. INTRODUCTION

The purpose of this investigation is to obtain a more clear insight in consumer habits of manual dishwashing in European household and to get comparative data on energy, water, time and detergent consumption. But also the achieved cleaning performance is of interest and is evaluated. Therefore the test design is based on EN 50242 which is a widely accepted standard to test the performance and consumption of dishwashers. Consequently two dishwashers with A/A/A labelling (in the terms of the European Energy Labelling Schema this means the best performance in cleaning and drying at a minimum consumption of energy) are run in parallel to the consumer tests. Manual dishwashing is performed with people from 7 countries/regions of Europe (Table 1) covering a significant part of the continent. As the target was to get comparable data for the consumer habit from all

countries/regions, it was pre-requisite to have the tests done under - as most as possible - identical conditions. Consequently the tests were performed mainly in one laboratory (at the University of Bonn) by asking visitors of Bonn, coming from these 7 countries/regions, to wash the dishes there. Care was taken to have consumers which have been not too long resident in Bonn or Germany so they should not have adopted a 'German behaviour'. For checking the assumption that this will lead to a correct picture of the consumer behaviour for a specific country, the tests are re-done using the same equipment by having excursions to laboratories in France, Italy, Spain and UK measuring the dish cleaning behaviour there locally too.

3. TEST PROCEDURE

According to EN 50242 12 place settings of dishes (equals 140 individual parts including crockery, glasses and cutlery) were taken and 'soiled' with seven different kinds of food, like spinach, minced meat, oak flakes, milk, margarine, tea and egg yolk. But different to the procedure in EN 50242 these soils are not dried in an oven at 80°C, but only left at an ambient temperature for two hours. This change is motivated by not introducing a systematic disadvantage for hand dish washing into the test set up, as in normal households the soils will not be 'burned in' as it is used for testing and differentiating dishwashers. For the same motivation the milk soiling was not burned in a microwave oven as hard as recommended by the standard.

After being dried, all the dishes are presented to the test person in a 'kitchen-like' test room (Fig.1). Two sinks with supply of hot and cold tap water, a variety of cleaning tools and 22 hand cleaning detergents from different countries are made available for free choice of the test person. The person was than asked to clean and dry the dishes 'as he/she would do it at home' and left almost alone. But by having a video camera and water and temperature sensors installed, the behaviour of the test person was completely recorded. After the test was finished, the cleaning performance was visually assessed as defined in EN 50242, using a scale from 0 to 5, where 0 means residues of >200mm² on all items and 5 means no residues left on any item. Obviously the average of all items for one persons is somewhere in between and is taken as a measure of the cleaning performance for this person in test.

Quite the same procedure was applied when the two dishwashers were tested, using the Energy Label and the Intensive program.

4. RESULTS

In reviewing the test person's behaviour, the most dominant observation is the great variety of different practices seen used for cleaning dishes. From one extreme like the use of continuously running hot water (pouring dish cleaner on the sponge only) up to the use of 4 bathes for each item to be washed (soaking, pre-cleaning in very little amount of pure water, cleaning in water with detergent, rinsing in pure water) all variations were observed. Therefore the first conclusion is that there is no unique practice of cleaning dishes in Europe and even per country/region it does not look like as if there is a clear preference of one habit in one country. Preliminary evaluation also does not give a clear correlation of any practice with the sex or age of the test persons either. But there is a surprisingly wide variation of habits which find its representation also in the measured values.

Nevertheless, in observing the behaviour and practice shown during the cleaning activities different typologies can be identified. The first one, labelled as the 'super-dish-washer', is identified by the efforts taken to ensure a good cleaning performance. Although this may not be packed by the visual assessment of the results achieved, the efforts of this type of test person is clearly dedicated to the cleaning process itself. Consequently this person does not try to be economical with water, energy nor detergent. But this does not necessarily mean he/she is wasting these resources! The second type, called 'Dish-washing-economizer', seems always to be focused on consuming as less water, energy or also detergent as possible. Again this does not mean that he/she is really running the process with a minimum of consumption, as in many cases the saving in one parameter is balanced by a relative generous consumption in another parameter.

Somehow surprisingly also a third category of test persons was found: the 'carefree-dish-washer'. He/she does neither try to get a good job done nor does he/she seem that wasting water, energy or detergent is of any harm. Typical for these persons washing practice is to have the tap water running most of the time (sometimes also during drying the dishes!) or a quite uncoordinated organisation of the whole washing work. It will be one of the future tasks to analyse all available data to get a quantitative picture of the test persons regarding these or other typologies.

In analysing the recorded data, the most important measure to look at is the achieved cleaning performance (Fig.2), as this is the target of the whole process. With only few exceptions the test persons have achieved cleaning performances between 2,5 and 4,5 points on this scale from 0 to 5. These values have to be compared with the performance achieved by the two dishwashers running under identical conditions. They have achieved in a program recommended for normal soiled dishes (so like the ones declared for Energy Labelling) scorings of 3,3 and 4,0! In the 'Intensive' programs they scored at 4,3 and 4,4 respectively. Also during the visual assessment of the results achieved by hand washing, results below about 3,5 were commended as 'really dirty' or 'not acceptable to be placed on a dinner table'. Therefore we may conclude that about half of our test persons did not achieve an acceptable result regarding the level of cleanliness to be

expected. Not to use these plates, glasses and cutlery for the next personal dinner of our test persons may be only one explanation for a somehow careless operation of the cleaning process. But nevertheless a more sophisticated cleaning would have caused even higher values of consumption of water, energy and detergent and what have needed also much more time!

The total time (Fig.3) needed for cleaning and drying 140 pieces was well centred around about 80 minutes. This time has to be compared to about 15 minutes taken to load and unload a dishwasher with the same amount of dishes and an operation time of the dishwasher typically between 80 and 160 minutes. Therefore there is a clear saving of working time of at least 1 hour when a dishwasher is doing the work. Adversely the total time up to when the dishes are cleaned and dried and ready for re-use may be twice as long when a dishwasher is used.

Assuming in a private household the amount of dishes used in our test is representative for the amount of dishes washed per day, the total working hours for cleaning dishes sums up to about 500 hours a year, or equivalent to $\frac{1}{4}$ year of work based on normal employment conditions (8 hours per day, 5 days per week).

Looking on the consumption values for water (Fig.4) and energy (Fig.5) no homogenous picture is given anymore. In both measures a big variation is visible. On water a first centre may be identified around 30 to 100 litre, while a second is around 130 litres. But there are also many test persons who have consumed more than 200 litres, with the most extreme one at 447 litres.

Similar on energy with centres between 1 and 2 kWh, around 3,5 kWh and a significant number above 5 kWh (the highest was 16,6 kWh). The energy reported here is the energy needed to heat up cold water of 15°C to the temperature used for washing the dishes, without any losses. These values have to be compared to about 15 litres a modern dishwasher takes for cleaning a full load and consuming between 1 kWh ('normal' program) to 2 kWh ('intensive' program) of electrical energy. While on the water there is a clear advantage of using a dishwasher, on energy in real life the situation is more complex as distribution and generation losses have to be taken into account as well.

While up to now the analysis has focused on the total picture, it may be of interest to see if there are differences in the results and consumption figures depending on the country or region the test person is coming from (Fig.6, Tab.2). Obviously there are differences in the average consumption of water and energy for some countries/regions, but in looking on the extreme values (shown as bars in Fig.6) per country, it is surprising that good and bad cleaners, 'savers' and 'wasters' can be found in almost all countries. Therefore care must be taken – and further analysis awaited – before country specific differences can be clearly identified. This is also valid for looking on correlations between the sex or the age of the test persons and their cleaning performance or consumption pattern in washing dishes by hand.

More relevant may be to try to find "best practice" behaviour in cleaning dishes. This best practice must be characterised by providing an acceptable level of performance while at the same time the consumption of water, energy and

detergent and the time used should be among the lowest values observed. To extract such behaviour it is useful to analyse the correlation between the performance achieved and the consumption values (Fig.7). From this it gets obvious that there is almost no correlation between the energy used, a little only with the time spend and some more with water consumption and the performance values achieved. This supports the conclusions, that it should be possible to achieve a good performance in washing dishes by hand without spending too much time, water and energy! To identify this combination of ‘super-dish-washer’ and ‘dish-washing-economizer’ behaviour will give us the best practice in manual dish washing: the ‘super-economic-washer’. But this will be part of our future studies.

5. CONCLUSION

This study has shown significant differences in consumer behaviour regarding cleaning of dishes with severe consequences in the amount of resources (water, energy, time, cleanser) used. Some first ideas about an environmental sound way of cleaning dishes could be extracted. Additionally it was shown that new dishwashers are able to reach at least the same performance with significant less amount of water needed as any test person. Although the study needs to be continued to verify these preliminary learning also under other conditions (e.g. heavy soiled dishes; real household conditions) emphasis should be given to find ways to educate and train European consumers about the best way of washing up dishes manually, as considerable amounts of water, energy, cleanser and working time can be saved.

Table 1: Region/country of origin of test persons and where tested

Country / region	# of test persons	Hereof tested during excursions
Germany	11	
GB / Ireland	27	20
France	18	10
Spain / Portugal	20	6
Italy	15	6
Turkey	11	-
Poland / Czech rep.	11	-
Total	113	

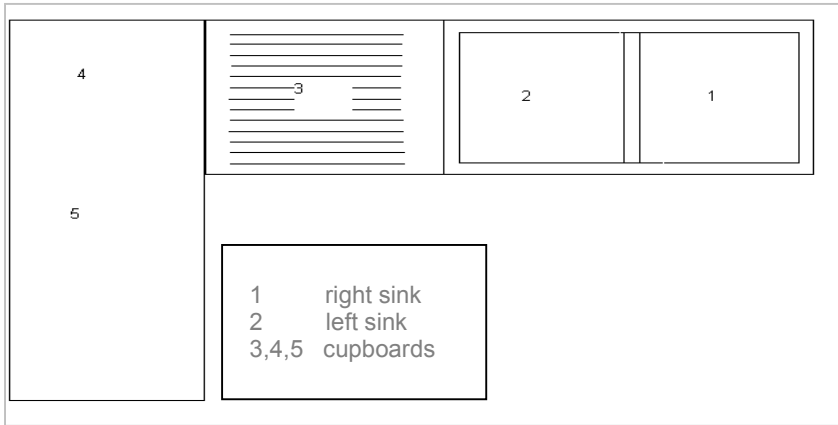


Figure 1: Kitchen set-up

Score 0 means residues > 200 mm² on all items; score 5 means no residues on any item

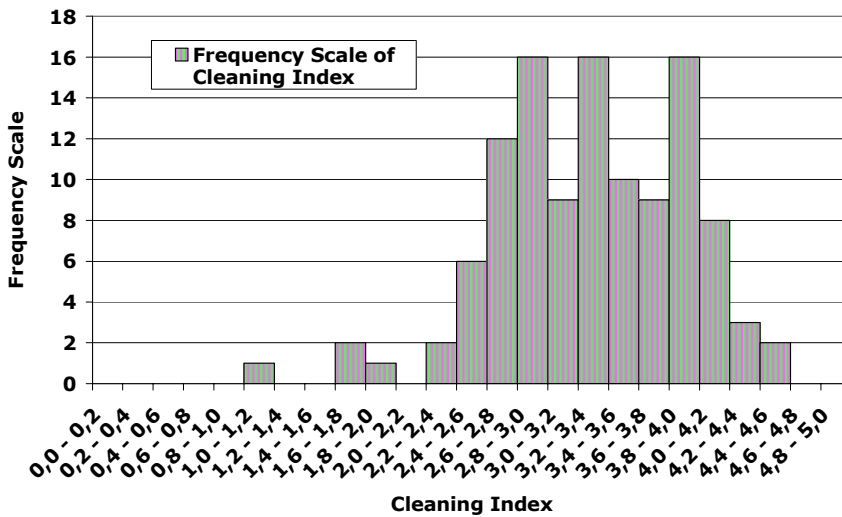


Figure 2: Histogram of achieved cleaning performances

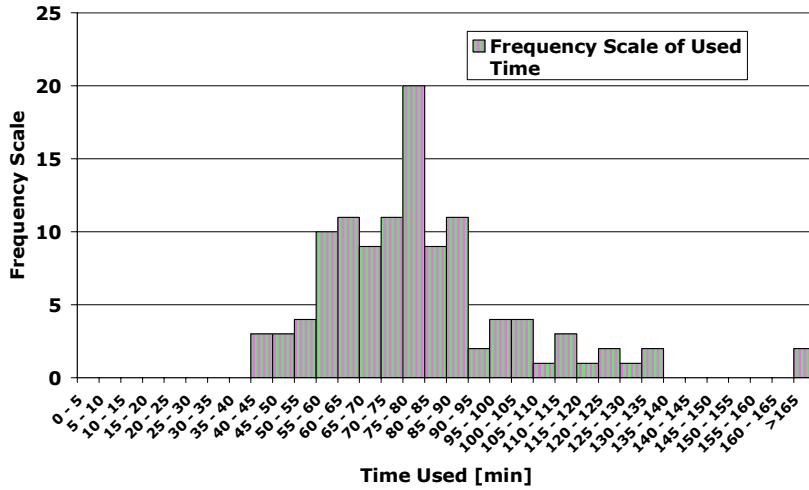


Figure 3: Histogram of time spent for cleaning and drying

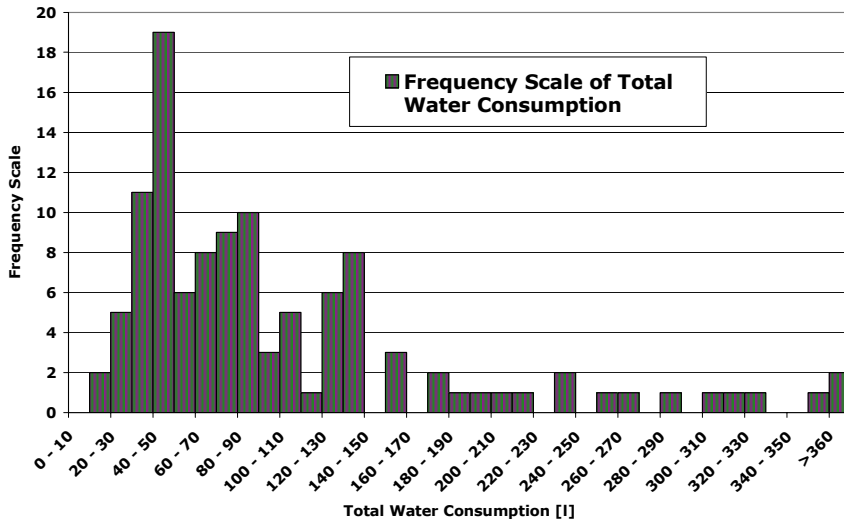


Figure 4: Histogram of total (warm and cold) water usage

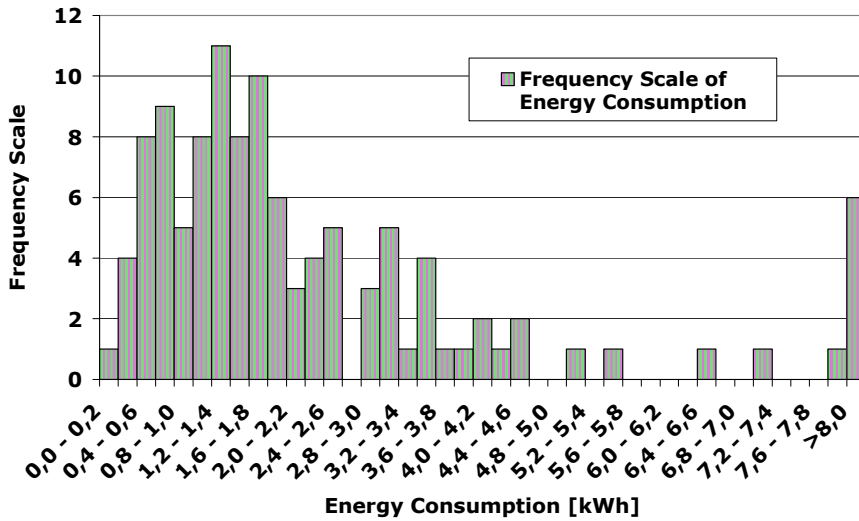


Figure 5: Histogram of total energy used
 Measured values have been corrected to a constant cold water temperature of 15°C

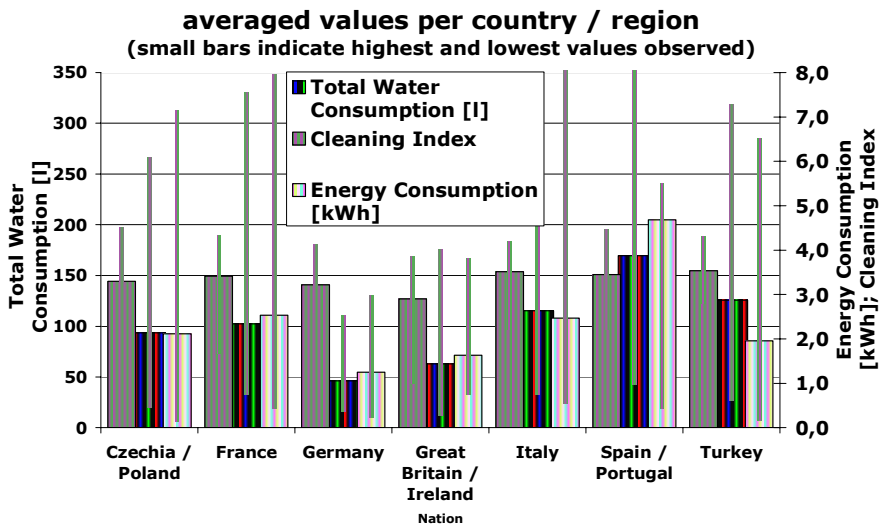


Figure 6: Average and extreme values for each country/area
 Note 1: number of people evaluated is different between countries/areas
 Note 2: bars show maximum and minimum of recorded values

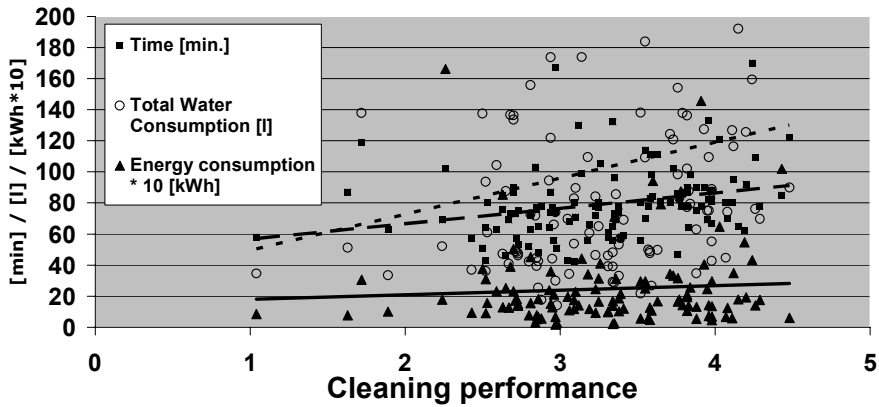


Figure 7: Correlation of water, energy and time used with cleaning performance for all participants (Note: plotted lines are linear trend-lines)

Table 2: Average values for all country/region and dishwashers

Country	Water [l]	Energy [kWh]	Cleanser consumption [g]	Cleaning Index	Time [min]
D	46	1,3	21	3,2	76
Pl / Cz	94	2,1	21	3,3	92
I	115	2,5	70	3,4	76
E / P	170	4,7	37	3,4	79
Tr	126	2,0	34	3,5	106
F	103	2,5	39	3,4	84
GB / Irl	63	1,6	26	2,9	65
total	103	2,5	35	3,3	79
Dishwasher ('Normal' and 'Intensive' program)	15 - 22	1,0 - 2,0	30* *:different chemistry	3,3 - 4,3	Loading and unloading: ca. 15 Program time: 100 - 150