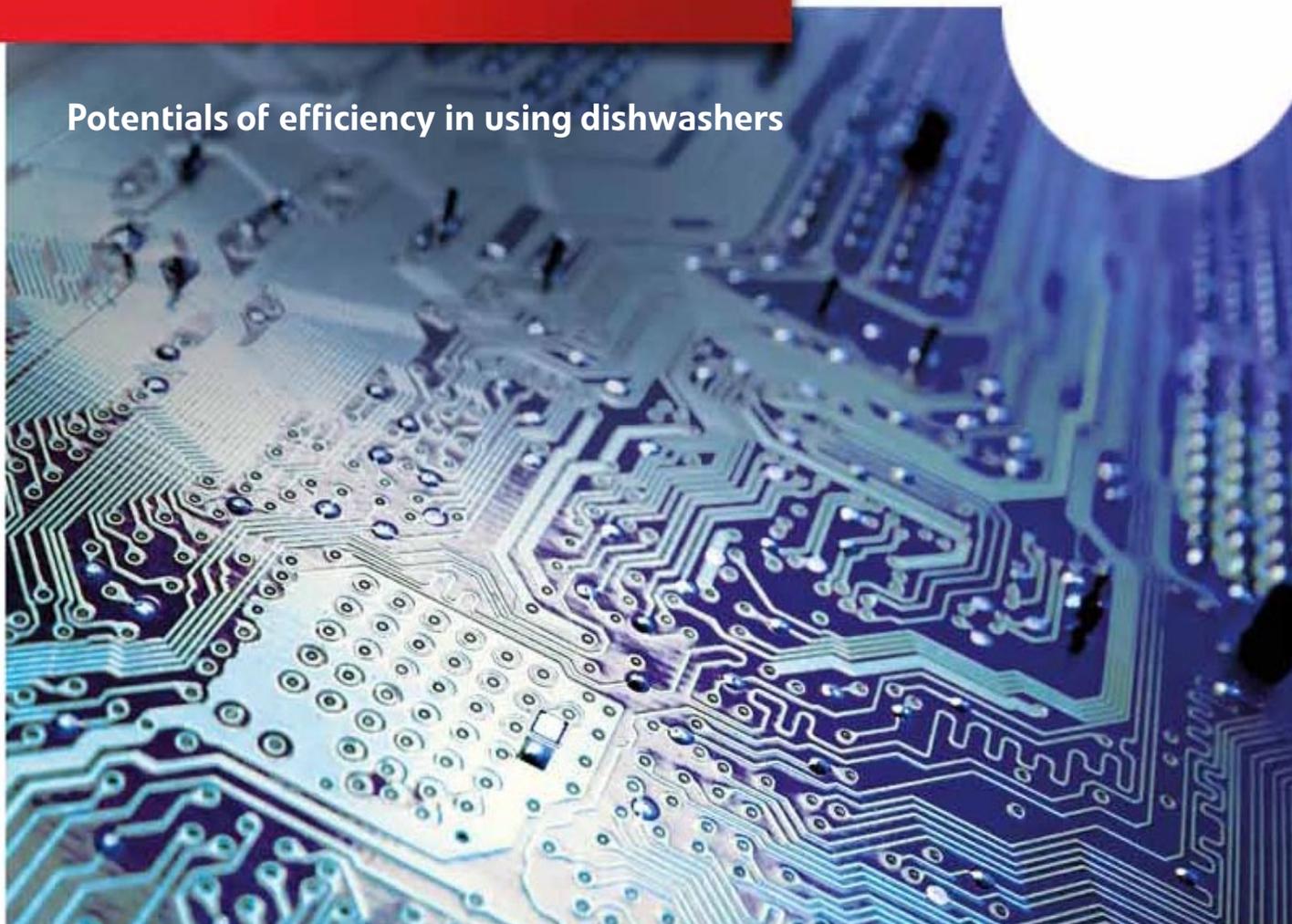


# BOOKLETS

Research + Development & Innovation

# 7

Potentials of efficiency in using dishwashers



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# Introduction

Canal de Isabel II's Research, Development & Innovation Booklets form part of the company's Knowledge Management Strategy and of the development involved in the Research, Development and Innovation Plan.

These Booklets represent an element for diffusion of projects and initiatives that are developed and sponsored by Canal de Isabel II for innovation in those areas related with water service in the urban environment.

A series of different problems that have been undertaken in each project are put forward in the Booklets, along with the results that have been obtained. The intention behind their diffusion by means of these publications is to share the experiences and knowledge that has been acquired with the entire water services sector, with the scientific community and with all those working on investigation and innovation tasks. What is aimed with the publication of these Booklets is to contribute to improvement and efficiency in water management and, consequently, in the quality of service that is provided to the citizens.

The R&D&I booklets published to date are as shown below by their titles in the following table.

**Table a. Titles published in the collection**

Collection Number	Research, Development and Innovation Booklets published
1	Transferences of Water Rights between Urban and Agrarian Demands. The case of the Community of Madrid
2	Identification of Hydrometeorological Runs and Tendencies within the scope of the Canal de Isabel II system
3	Contribution of Canal de Isabel II to the International Demand Management Project (IDMF)
4	Micro-components and Explanatory Factors on Domestic Water Consumption in the Comunidad de Madrid
5	Virtual Water and Hydrological footprint in the Comunidad de Madrid
6	Study on the saving potential of water for residential uses in the Comunidad de Madrid

# Project Outline

Project title	Potentials of efficiency in using dishwashers
Research line	Ensuring the availability / demand balance
Canal de Isabel II units involved	R+D+i Deputy Direction
External participation	BSH Electrodomésticos España, WASSER SAE
Aim and justification of the project	The purpose is to evaluate the potential for the improvement of efficiency in the use of natural resources (water and energy), which can be attained by Spanish homes by using a dishwasher.
State of the art contribution	Apart from some laboratory tests, no studies have been made before this one, in real conditions on the use of water and energy in domestic dish washing, either manually or with the use of electrical appliances.
Project development summary and milestones	<ul style="list-style-type: none"> <li>• Selecting and describing the sample</li> <li>• Installing and calibrating measuring devices</li> <li>• Monitoring consumption with manual washing (first period: 2 months minimum)</li> <li>• Monitoring consumption using dishwashing (second period: 2 months minimum)</li> <li>• Data processing and analysis of the results obtained</li> </ul>
Obtained results summary	<ul style="list-style-type: none"> <li>• A clear improvement in water saving has been established with the use of a dishwasher. During the manual washing period, the consumption levels measured in the sink reached 88.8 litres per day, (26 percent of the household total, and 52 litres of which was hot water), which dropped to a consumption level of 54.2 litres per day (15.9 percent of the total consumption, of which 24.6 litres were hot water) measured in the sink during the dishwasher usage period.</li> <li>• A drop in water consumption equivalent to 9 percent of the total water used in the household was observed, equating to an average saving of 30.6 litres per day, of which 27.4 litres per day would be hot water.</li> <li>• Likewise, energy consumption also gave a positive balance, showing a saving of 1.06 kilowatts hour every day.</li> <li>• By extrapolating the results here obtained, the saving potential for the Autonomous Community of Madrid as a whole, could reach 8.9 cubic hectometres per year, with an average saving of 23 litres per day per household.</li> </ul>
Research lines open for continuing the work	A project has been started by which a steady control sample has been established for long-term follow-up in order to identify any changes in domestic patterns consumption and habits in end uses to which the water in Madrid homes is allocated.

# Executive Summary

In the Autonomous Region of Madrid, residential usage accounts for more than 60 percent of the total volume of measured and consumed water. The knowledge of the different end uses and saving potential water usage at home has been subject to various studies undertaken by Canal de Isabel II by means of direct measuring of the instant flow and total volume supplied to a sample of households.

These studies have shown that water consumption in the various household taps (excluding showers and bath tubs) accounts for more than 30 percent of the total volume used in indoor domestic uses. A significant part of this consumption is likely to be the result of dishwashing processes, while the water consumed specifically by a dishwasher is just 1 percent of the total volume consumed in the household.

In 2003, the Bonn University performed a laboratory study (Stamminger et al., 2004), in which manual dish washing habits were analysed for 113 individuals from 7 European countries, in identical conditions. This study showed large differences in individuals' behaviour when washing dishes, which led to considerable consequences on the amount of resources (water, energy, time, detergent) used. The volume of water used to manually washing the same number of dishes is equivalent to a full dishwasher load ranged between 50 and 170 litres. This brought them to the conclusion that dishwashers are able to wash dishes with a much lower quantity of water and energy than any of the individuals who took part in the study, also reaching a higher degree of cleanliness.

There have been no known studies carried out in real conditions for the use of water and energy either in domestic dish washing, manually or with the use of electrical appliances. For this reason, the study described below brings a new and significant contribution to those already carried out on the uses of water in residential domains.

This study has been carried out in partnership between Canal de Isabel II, the water supply company in the Autonomous Region of Madrid, and BSH Electrodomésticos España (BSHE), a leading company in the manufacture of domestic electrical appliances in our country, which also markets various brand names in the Spanish market.

For several years, BSH Electrodomésticos has been working to improve efficiency in its products over the course of every stage in the life cycle: production, distribution, use and end of use. Life cycle analyses show that more than 90 percent of the impact of the dishwashers that it manufactures takes place in the household usage stage, which is mainly due to the device's resources consumption. For this reason, it has focussed its effort into incorporating technological improvements which enable it to reduce this consumption. Since 1990, water consumption per wash cycle has dropped by 68 percent and by 44 percent in energy consumption.

On a normal programme, the dishwashers used in this study consume 12 litres of water, which clearly implies a considerable saving in comparison with manual washing, according to the conclusions of the laboratory study mentioned above.

It is important to highlight that by the time this study had been finished new dishwashers, still more efficient, had been launched which are able to work using only 9 liters of water.

## Objectives

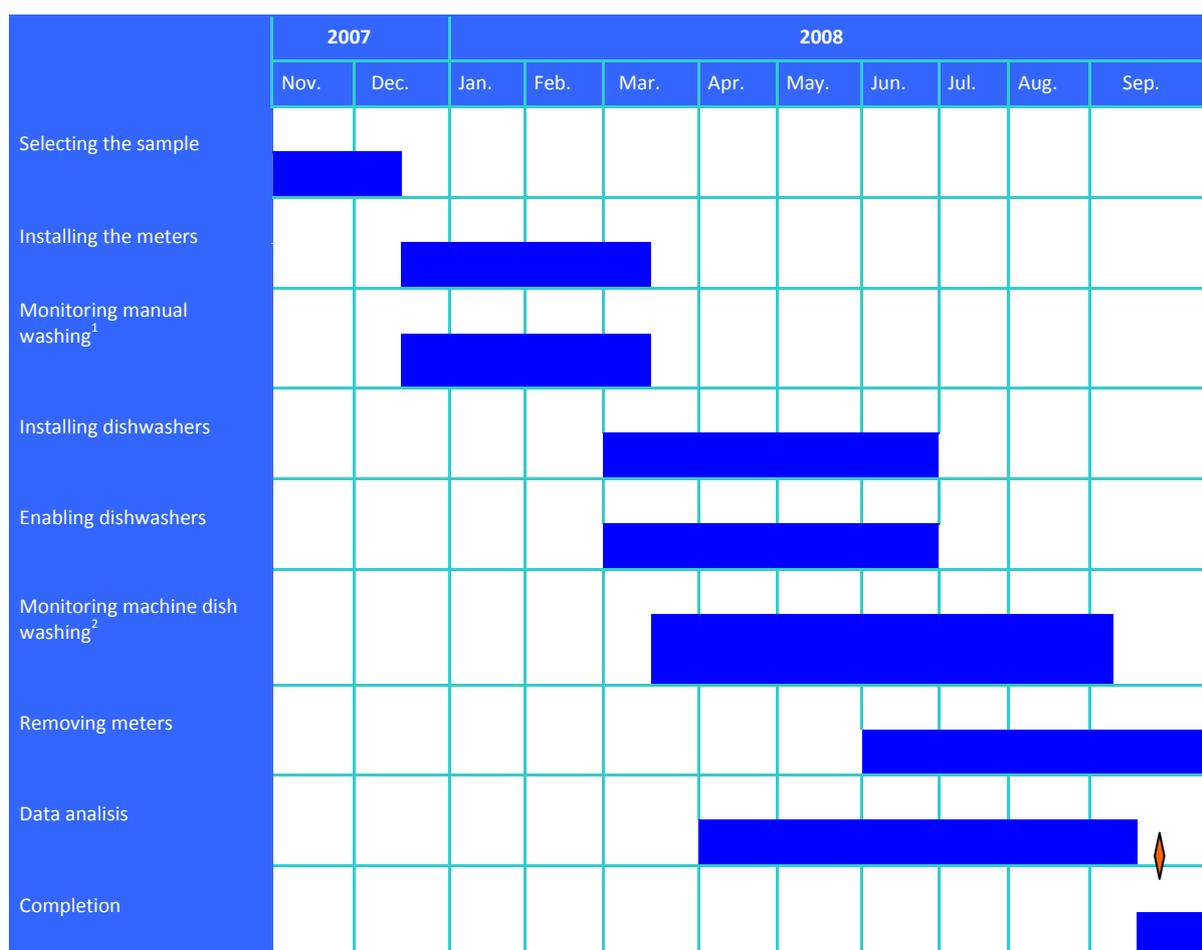
The purpose of this study is to identify the consumption and the patterns of actual usage in washing dishes, both manually and using dishwashers, as well as the potential improvements in efficiency and the saving which can be attained by using a low-consumption dishwasher.

The study has assessed the potential for improving efficiency in the use of natural resources that can be attained by Spanish homes by using a dishwasher. The study's main purpose centres on the use of water, which is the fundamental aspect to the work carried out by Canal de Isabel II. However, an evaluation has also been made in relation to energy efficiency, which is also considered a top priority environmental aim.

## Methodology

Most of the fieldwork took place between January and June of 2008 on a sample of 155 households in which water consumption was continuously monitored for at least four months in each household. During the first two months, the participants in the study had to wash dishes only by hand. Then, after a dishwasher was installed and properly enabled, washing had to be done by using the electrical appliance supplied.

The various phases of the process followed for carrying out the study are summarized in the following chart:



<sup>1</sup> Monitoring of consumption levels during the manual washing period (20/12/07 to 13/3/08)

<sup>2</sup> Monitoring of consumption levels during the dishwasher period usage (6/3/08 to 15/9/08)

The sample was selected throughout the entire Autonomous region of Madrid, which either did not have a dishwasher at the time of selection, or which were interested in renewing their dishwasher because it was too old.

Out of an initial sample of 280 customers, the viability of installing the necessary measuring devices in the homes was assessed, resulting in a final sample of 155 homes. The remainder were ruled out either because it was impossible to install the whole equipment or because those selected decided to withdraw.

The restrictions inherent within the project: the availability of the users, the ability to install the dishwasher and the measuring devices without making renovations, etc., meant that the sample was not completely random. It was therefore necessary to verify that certain stratification criteria were met and that there was no bias in the areas of particular importance, so as to guarantee the representativeness in the sample taken.

The households included in the study were mainly located within the Madrid municipality and its metropolitan ring, with a minority placed in the mountain and periphery areas. This distribution is relatively similar to the household percentage distribution in the Autonomous region of Madrid, according to the latest data published by the INE (National Statistics Institute) in the 2001 census.

The sample conveys some bias towards households, which are larger than the average in the Autonomous community of Madrid. Household occupancy is also greater than the regional average (3.34 people per household, in comparison with 2.89). This bias is probably related to the fact that many households currently have a dishwasher, or because they were ready for immediate installation. When the results obtained were extrapolated to the entire population of Madrid or of Spain, these circumstances were taken into consideration.

Consumption was monitored by using high accuracy volumetric meters (class C), with a digital pulse emitter, in order to enter levels in the data logging devices. This meter is installed in the household's service connection and constantly records consumption. It can differentiate the volume consumed in the different uses, and specifically that used in the dishwasher. The continuous measure of consumption can also detect absences from home and other circumstances that could influence the analysis of data, so that taking into account these conditions it is possible to get more reliable results.

This device enables us to identify the various uses of water. However, most of the time, it is impossible to distinguish between the various taps in the household (kitchen sink, washbasin, bidet, etc.) as they often show very similar consumption levels. For this reason, in order to monitor the consumption of manual dishwashing, which is carried out in the kitchen sink, velocity meters (class B) were directly installed in the cold and hot water taps of the kitchen sink.

To perform this study, 60 centimetre-wide, class AAA dishwashers were used, from each of the BSH Electrodomesticos brand names: Balay, Bosch, Siemens and Lynx, depending on the brand name of the electrical appliance that the user previously had in their home.

These dishwashers were sent to households, which were selected during the hand-washing phase. Where applicable, the old ones were removed, and BSH dishwashers were delivered and fitted in the space, but were not enabled in order to prevent them from being used before the second phase of the study was started.

All of the dishwashers have the same electronics and an identical water system. As such, they all consume 12 litres of water and 1.05 kilowatts of energy per hour in the reference programme, namely **ECO 50° C**.

## Results and conclusions

The measurements made during the manual dish washing period determined that water consumption in the kitchen sink is an average of 88.8 litres per day, of which 52 are hot water. This consumption is approximately 26 percent of the household total.

Once the dishwashers were installed and properly enabled, this water consumption in the kitchen sink was reduced to 54.2 litres per day, making up 15.9 percent of the total consumption, and 24.6 litres per day of which was hot water.

During the dishwasher usage testing period, each of its uses were monitored. Both the time of use and the volumes of water consumed were recorded. According to the manufacturer reference data, water consumption in each cycle consists of between 10 and 17 litres, depending on the programme used. The records taken during the test confirmed these data, giving an average volume of 12.47 litres per use during the period monitored.

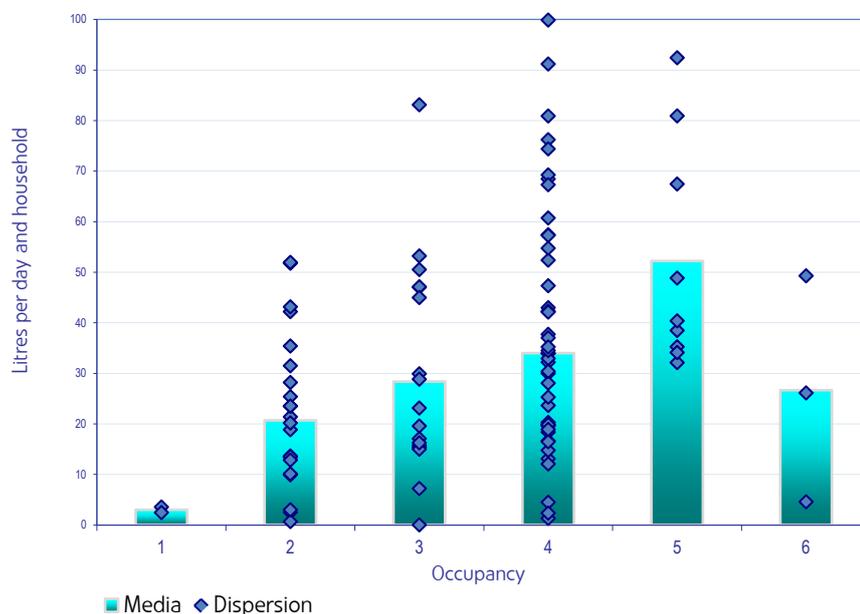
The average dishwasher usage frequency was 2.46 uses per week depending it, as was greatly predictably, on the number of individuals living in the household.

The results obtained verify a clear improvement in water usage efficiency by using a dishwasher, giving a water saving equivalent to 9 percent of the total consumption in the households. This saving has been assessed at an average of 30.6 litres per day, of which 27.4 would be hot water. This reduction is considerably higher in households in which 3 or more people live, saving 52 litres per day in households with 5 inhabitants, and a minimum in households occupied by just one person.

Extrapolating these figures to the entire Autonomous community of Madrid, including the 47 percent of households which do not have a dishwasher and bearing in mind the occupancy figures of these households, there is a potential saving of 8.9 cubic hectometres per year, with an average of 23 litres per day per household.

The improvement in the use of energy has been assessed at 1.06 kilowatts hour each day, and is due to the reduction in the volume of hot water used, which considerably compensates for the energy used by the dishwasher tested.

**Figure 1. Water consumption reduction with the use of a dishwasher**



The results obtained have been reached by normal use of the electrical appliance, in the way that is most habitual in homes in the Autonomous region of Madrid. The improvement in efficiency is highly related to dish washing habits, both manual and machine, which have shown large disparity. It is thought that an improvement in these practices, particularly in attending to the recommendations of the dishwasher manufacturers in relation to efficient usage, could further improve the good results shown in this study.

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