Research on approaches to optimizing energy management in modern households

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Abstract. This article explores approaches to optimizing energy management in modern households. Energy expenditure in modern households is distributed across dozens of sources. Kitchen equipment and washing machines are among the main sources of energy consumption in households. Optimizing the operation of such equipment is one of the approaches to optimizing energy management in a modern household. Switching to less energy-intensive materials used in such equipment can help reduce energy consumption. The study explores the prospects for introducing such materials into laundry equipment. The obtained results of the analysis can be used in developing strategies by the marketing services of companies producing washing equipment, as well as by researchers in this field.

1 Introduction

Energy expenditure in modern households is distributed across dozens of sources. Kitchen equipment and washing machines are among the main sources of energy consumption in households. Optimizing the operation of such equipment is one of the approaches to optimizing energy management in a modern household. Switching to less energy-intensive materials used in such equipment can help reduce energy consumption. The use of washing gels packaged in capsules allows you to reduce the amount of energy spent on the operation of washing machines. The consumption of products such as laundry detergents is increasing every year. An important factor in the strategy of manufacturers of laundry detergents used in automatic washing machines is to take into account user preferences and how they are distributed. The main commercial varieties of laundry detergents used in automatic washing machines (depending on the type of filling container) are the following: in capsules and packaged in large-sized containers (>50ml). Analysis of user preferences when choosing washing gels used in automatic washing machines is an important factor in choosing the competitive strategy of manufacturers of washing gels used in automatic washing machines. This paper examines differences in user preferences when choosing laundry detergents used in automatic washing machines. The analysis was carried out on the example of two types of laundry detergents used in automatic washing machines - in capsules and packaged in large-sized containers (>50ml).

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2 Materials and Methods

In order to conduct a series of observations aimed at studying user preferences when choosing washing gels used in automatic washing machines (depending on the type of packaging container), a corresponding questionnaire survey of one hundred users of laundry detergents was conducted.

The survey was conducted in three different age groups of users of laundry detergents used in automatic washing machines:

- the first group of laundry detergent users – 18-30 years old;
- the second group of laundry detergent users – aged 31-45 years;
- The third group of laundry detergent users is aged 46-65 years.

The age breakdown of the users of laundry detergents used in automatic washing machines (depending on the type of filling container) was carried out to take into account the difference in preferences of washing gel users in different age groups.

Questionnaires were distributed to all surveyed users of laundry detergents used in automatic washing machines, including the question: which version of laundry detergent used in automatic washing machines is preferable for you:

- the first option – in capsules;
- The second option is packaged in large-sized containers (>50ml).

For the purpose of collecting and processing survey data on users of washing gels used in automatic washing machines, various methods used in the studies were considered [1-27].

3 Results and Discussion

3.1 Survey Results of Users of Laundry Detergents Used in Automatic Washing Machines

3.1.1 The first group of users

The results of the survey of the first group of users of laundry detergents used in automatic washing machines (18-30 years old) are presented in Figure 1.

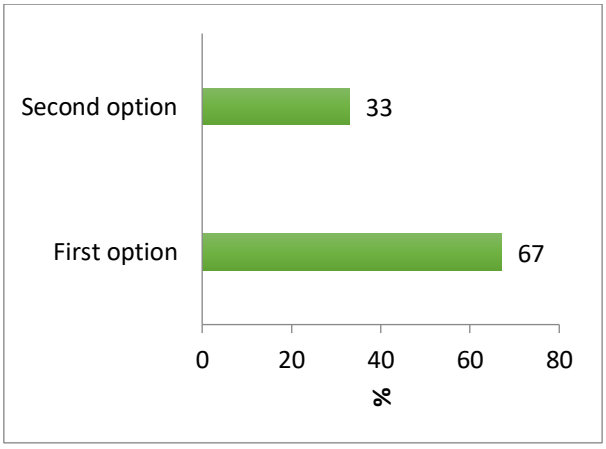

Fig. 1. Results of a survey of the first group of users of laundry detergents used in automatic washing machines (18-30 years old).

3.1.2 The second group of users

The results of a survey of the second group of users of laundry detergents used in automatic washing machines (31-45 years old) are presented in Figure 2.

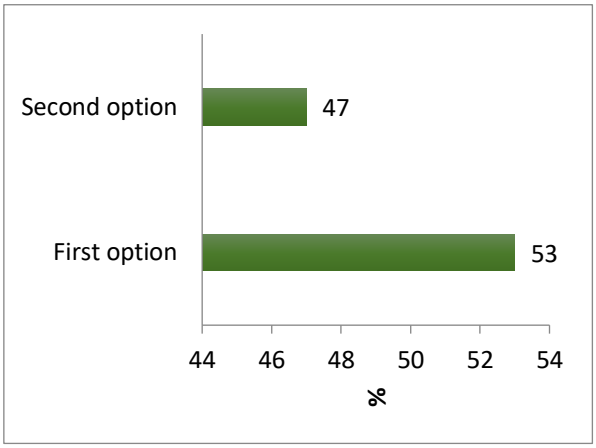

Fig. 2. Results of a survey of the second group of users of washing gels used in automatic washing machines (31-45 years old).

3.1.3 Third group of users

The results of a survey of a third group of users of washing gels used in automatic washing machines (46-65 years old) are presented in Figure 3.

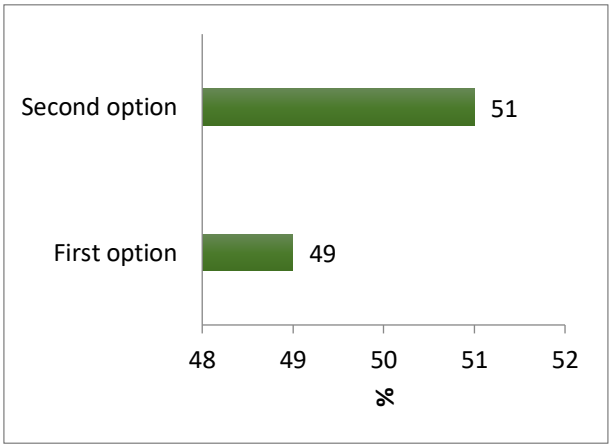

Fig. 3. Results of a survey of the third group of users of washing gels used in automatic washing machines (46-65 years old).

The distribution of data in the results of the survey of users of washing gels used in automatic washing machines was estimated according to the formula [28-30]:

$$r_s = 1 - \frac{6\sum d^2}{n(n^2-1)} \quad (1)$$

3.2 Discussion

The results of surveys of users of washing gels used in automatic washing machines (depending on the type of filling container) provide data that the use of washing gels used in automatic washing machines is already quite common among users, while user preferences in the segment of washing gels used in automatic washing machines are unevenly distributed among several variants (Table 1).

Table 1. Results of surveys of users of laundry detergents used in automatic washing machines (depending on the type of filling container).

Age Groups	Type of filling container	
	In capsules	Large containers (>50ml)
First	67	33
Second	53	47
Third	49	51

Figure 4 shows the average quantity of the survey data for users of laundry detergents used in automatic washing machines, depending on the type of gel filling capacity.

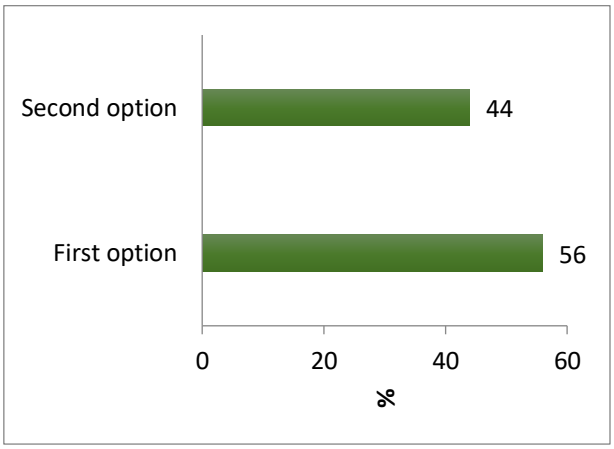

Fig. 4. Average quantitative data from a survey of users of laundry detergents used in automatic washing machines for all age groups.

From the data obtained (Figure 4), it follows that the average priority value of the type of packaging of laundry detergents used in automatic washing machines (depending on the type of filling container) is: in capsules – 56%; in large-sized containers (>50ml) – 44%.

4 Conclusions

The study presents data on user preferences when choosing laundry gels used in automatic washing machines (depending on the type of packaging container). The data reflects the preferences of users of laundry detergents used in automatic washing machines living in urban agglomerations. The place of residence and age of the users of the laundry detergents used in automatic washing machines is a data limitation. Analysis of user preferences when choosing of washing gels used in automatic washing machines (depending on the type of filling container) showed that the distribution between the compared types of packaging of laundry detergents – in capsules and packaged in large-sized containers (>50ml) in the preferences of users is distributed as follows: 56% and 44%, respectively. The analysis data

presented in this article may be relevant for the marketing services of manufacturers laundry detergents used in automatic washing machines.

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