Topten ACT Criteria Paper

Coffee machines

7. September 2015

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Topten ACT aims at transforming the European market of energy-using products towards higher energy efficiency.

Topten ACT identifies the top energy-efficient products in 16 European countries, and makes this information available to consumers and large buyers on tailored national websites. The most energy efficient models in different product categories (such as household appliances, lighting, office equipment, consumer electronics, cars) are presented with comprehensive product information based on official labels and standardized declarations. Topten works with manufacturers and thus increases both market offer and consumer demand of high energy efficiency products. Topten is strictly neutral and independent from manufacturers and retailers, its selection criteria are always published online.

Topten ACT is supported by the European Commission's research and innovation programme Horizon 2020, and many national organisations (energy agencies, environmental and consumer organisations, research institutes). The Topten ACT project involves 17 partners in 16 European countries. It is coordinated by ADEME (Agence de l'Environnement et de la Maîtrise de l'Energie).

More information and access to all national websites on the European site: www.topten.eu

WP2 European Product Analysis , Task 2.1 Determining energy efficiency criteria, D 2.1 Periodic Criteria Papers (first set)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 649647.

1. Overview on types of coffee machines

Coffee machines with electricity supply can be categorized according to their pressure: a) machines with high pressure (> 8 bar), b) low pressure (< 8 bar) and c) no pressure (see Table 1 and Figure 1). For the preparation of a real «espresso» 15 bar are optimal. Therefore, machines with more than 8 bar are synonymously often called «espresso machines». Coffee prepared with low or no pressure tastes more like drip-filter-coffee.

Type	Pressure	Quality of Coffee	Synonym
Fully automatic machines	High	Espresso	Espresso machine
Portioned machines: Capsule machines	High	Espresso	Espresso machine
	Low (e.g. Tassimo)	Drip-filter-like	----
Portioned machines: Pad machines	Low	Drip-filter-like	----
Machines with piston lever	High	Espresso	Espresso machine
Drip-filter machines	No pressure	Drip-filter-like	----
Combi machines (Piston lever/Drip-filter)	High/Low	Espresso/Drip-filter-like	----

Fig.1 Types of coffee machines [1]

In the following the talk is about fully automatic machines and capsule machines. Otherwise it is explicitly mentioned.

2. Topten.eu: coffee machines current selection criteria and products selected

Topten.ch presents the most efficient fully automatic machines and capsule machines available on the European market. Not in the scope of Topten.eu are pad machines, machines with piston lever, drip filter coffee machines and combi machines.

Since January 2015, the Topten.eu selection criteria for fully automatic machines and capsule machines are:

- Auto-power-down function switching-off the permanent heating of the water after a certain delay time to standby or off
  - Delay time of the auto-power-down: Default (factory setting)
    - Portioned machines: max. 15 minutes
    - Fully automatic machines/piston machines: max. 30 minutes)
  - Delay time of the auto-power-down: Programmable by the user
    - Portioned machines: max. 30 minutes
    - Fully automatic machines/piston machines: max 3 hours (It is planned that the programmable auto-power-time is further reduced and adapted to developments on the market)
  - The auto-power-down-function can not be deactivated by the users or any function.

- Annual electricity consumption according to the Euro-Topten-measuring method:
  - Portioned machines: max. 35 kWh
  - Fully automatic machines/piston machines: max. 45 kWh

- The required values are to be provided by the supplier. Otherwise there is no entitlement to a presentation of the appliance on Topten. The informatoin may be checked by sampling measurement.

- Available in at least one European country.

Notes on the selection criteria:

- For capsule machines the Topten.eu-criteria for the delay time are more stringent than the requirements by the EU Ecodesign regulation (details see below), as very short times for this type of coffee machines is quite common.

- Topten.eu also sets requirements on the programmable delay time (more details see below).

- Data on the annual electricity consumption are still based on the Euro-Topten method. The transition to EN 60661 is planned (see below).

In September 2015 in total 26 coffee machine models of 6 different brands are listed on Topten.eu (Bosch, Cremesso, Nespresso, Kiss, Krups, Nespresso, Oecoplan, Philips/Saeco, Tchibo). 7 machines are fully automatics, 19 are capsule machines. Similar models have not been counted if from the same brand.

3. Expected selection criteria in 2016

Until further notice Topten.eu applies the selection criteria listed in the box above (chapter 2).

However, Topten plans to switch to the new measuring standard EN 60661 (see below) as soon as sufficient experience and data are available, to set new and suitable limits and criteria based on these data. Currently, the energy consumption per year (kWh) of the models listed on Topten.eu is still based on measurements according to the Euro-Topten-method (see also below).

It is expected that in 2016 we will get data on coffee machines available on the Swiss market which then will be helpful for Topten.eu to implement the step towards the new standard EN 60661.

4. Technical background

Energy using functions of coffee machines are the heating up of the cold tap water, production of a cup of coffee, keeping hot of the heated water (!), standby, electric motors, pumps and magnet valves.

Key parameters for high energy efficient coffee machines are (see also [1]):

Short delay time until the machine automatically switches to standby or off
Around ten years ago, almost no coffee machines switched-off automatically after a certain time after the brewing of a cup of coffee. The machines then kept the heated up water permanently at a temperature of 85°C to 90°C. Unless the consumer switched-off the machine manually, it always was «on». This «keeping hot»-function consumed a lot of energy.

Today all coffee machines entering the EU market have a function (power management), which automatically switches the machine to standby or off. The maximum default delay time after which the machine automatically has to switch into standby or off mode is regulated by the amending EU Ecodesign regulation (EU) No 801/2013 on Standby [2]. It is in force since January 2015 (details on the requirements see below).

However, an important point, which is not treated by the amending EU Ecodesign regulation (EU) No 801/2013 on Standby is the programmable delay time. There are many coffee machines – especially fully automatic machines – for which the default delay time can be re-programmed and prolonged excessively (up to 2h, 3h, 4h, 5h, 8h, 9h, 12h and even 15 hours as shown by a Topten-research in 2012). This untreated aspect leaves room for interpretation. Producers might (ab)use this loop hole to deliver the machine indeed in an energy efficient mode but to offer also a prolongation of the delay time, which then raises energy consumption considerably. To restrict this practice, Topten.eu also sets requirements on the programmable delay time. The development of the market has to be observed carefully.

Low standby or zero consumption
The allowed energy consumption in standby is regulated by the EU Ecodesign Regulation (EC) No 1275/2008 for standby and off mode consumption [3].

«Energy saving mode»
Some coffee machines have an «energy saving mode» or «eco-mode» which is factory set or can be programmed in the menu. This mode lowers the temperature of the heating element after a certain time (e.g. after 5 minutes), from standard 90°C to about 60°C (e.g.). The coffee machine then is no longer in a real ready mode, but requires some heating time before dispensing coffee. This then takes less heating time than heating up from the cold state.

Low thermal capacity of the heating unit
A striking development towards super efficient coffee machines was the introduction of flow-type heaters. With this brewing system only around 10 ml of water have to be heated up, which is energy saving. This type of coffee machines represents the current best available technology (BAT).

Thermo-blocks are another nowadays common type of heating unit (containing 10 to 20 ml of water, but several hundred grams of aluminium).

Coffee machines with an integrated boiler (containing several hundred ml of water) are, due to their comparatively high water content, very inefficient and therefore disappeared almost completely from the market.

Good insulation of hot parts
This is a further measure to reduce the thermal losses of the heaters substantially.

Low amount of water to be heated for hygienic and quality purposes
Most coffee machines heat up certain quantities of water for rinsing purposes when switched on or off, or they discard a small amount of coffee at the beginning of the brewing process, which might be not hot enough or not of sufficient quality. Decalcification and (automatic) cleaning also is an energy (and resources including chemicals) consuming aspect in the life cycle of coffee machines. There might be an additional saving potential, e.g. by using lower water temperatures and volumes for these processes.

5. Policy measures, standards and labels

Energy label for coffee machines
EU: no energy label for coffee machines
The commission decided to not introduce an EU Energy label for coffee machines for the time being. Its opinion is that requirements on the default delay times are sufficient (see [2]).

Switzerland: Swiss energy label for coffee machines
Switzerland designed its own Swiss energy label which is applied for coffee machines available on the Swiss market. It is mandatory since January 2015. However, the validity of the Swiss-label is limited as almost all products are in the best class A. At the present time (2015) the machines are tested according to the FEA-method (see below). However, Switzerland plans to test according to EN 60661 (see below) from 2016.

EU Ecodesign requirements on standby and off mode
Based on the horizontal standby regulation No 1275/2008 [3], coffee machines in standby may use max. 0.5 W without display and max. 1 W with status display and max. 0.5 W in off mode.

Regulation No 801/2013 on networked standby, which is amending regulation No 1275/2008, contains a chapter on coffee machines, defining the maximum delay time when they must switch automatically into standby or off mode respectively. Since 1 January 2015, the delay time after which the coffee machine switches automatically into standby and off mode shall be as follows [2]:

- for domestic drip filter coffee machines storing the coffee in an insulated jug, a maximum of five minutes after completion of the last brewing cycle or 30 minutes after completion of a descaling or self-cleaning process,
- for domestic drip filter coffee machines storing the coffee in a non-insulated jug, a maximum of 40 minutes after completion of the last brewing cycle, or 30 minutes after completion of a descaling or self-cleaning process,
- for domestic coffee machines other than drip filter coffee machines, a maximum of 30 minutes after completion of the last brewing cycle, or a maximum of 30 minutes after activation of the heating element, or a maximum of 60 minutes after activation of the cup preheating function, or a maximum of 30 minutes after completion of a descaling or self-cleaning process, unless an alarm has been triggered requiring users' intervention to prevent possible damage or accident.

Note: As already mentioned above, the amending EU Ecodesign regulation on networked Standby [2] regulates only the maximum allowed default delay time for the auto-power-down (factory setting). However, many coffee machines – especially fully automatic machines – can be re-programmed. This point is not treated by the regulation. Manufacturers might (ab)use this loop hole to deliver the machine indeed in an energy efficient mode but to offer also an excessive prolongation of the delay time, which then raises energy consumption considerably.

Expected savings of these delay time limits for coffee machines are > 2 TWh in 2020 (additional to savings by the standby power limits, which however cannot be allocated to individual product categories).

Blue Angel: RAL-UZ 136 (Coffee Machines for Household Use)
The Blue Angel labels environmentally friendly fully automatic coffee machines, porta filter coffee machines (semi-automatic), pod coffee machines and filter coffee machines. Capsule machines are not in the scope. Details see [4].

Currently there are no providers of coffee machines labelled with the Blue Angel.

Measurement standards
Europe: EN 60661
Since 2014, for coffee machines the standard EN 60661 [5] is official. It allows measurements of the energy consumption. Filter coffee machines are also covered.

So far, the standard is applied by only a few manufacturers. The reason is that at the moment there is no incentive to measure according to EN 60661, because there is no EU energy label for coffee machines on which the energy consumption of the product would have to be accordingly declared.

The planned testing according to EN 60661 in Switzerland from 2016 to serve the Swiss energy label for coffee machines might raise manufacturers' interest on the new standard, as most of the coffee machines sold in Switzerland are also sold in the EU.

Nevertheless, manufacturers shall be invited and encouraged to measure the energy consumption of their coffee machines according to EN 60661 and to share the data with Topten.eu.

Topten: Euro-Topten-measuring method
The currently listed coffee machines on Topten.eu are measured according to the Euro-Topten-method.

Topten.eu fully supports the new standard EN 60661 and therefore intends to switch to EN 60661 as soon as there will be enough data on basis of the new standard. Data from coffee machines sold in Switzerland will certainly be helpful to implement this step.

Switzerland: FEA-measuring method
Switzerland introduced its own energy label for coffee machines in January 2015. The declaration of the energy consumption is based on another method, the so called FEA-method. However, Switzerland plans to base the label on tests with the new standard EN 60661 from the beginning of 2016. As most coffee machine models sold in Switzerland are also sold on the EU market, this will allow Topten.eu to collect the needed data and to define appropriate limits for the energy consumption.

Brief historical excurse on the three measuring methods
During the preparatory study for non-tertiary coffee machines DG Tren Lot 25 [6] it was found that the two at that time co-existing measuring methods «Euro-Topten» and «FEA» each have its benefits and drawbacks and that an European energy measuring method should be elaborated on the basis of these two methods.

EN 60661 already existed, but at that time did not offer any description on how to measure the energy consumption of coffee machines. Therefore a corresponding chapter was added into EN 60061. This part of the revised EN 60661 was worked out in a collaboration of CECED (The European Committee of Domestic Equipment Manufacturers), manufacturers, Topten and S.A.F.E. (Swiss Agency for Energy Efficiency).

Topten.eu fully supports the new standard EN 60661 and is of the opinion that from now on manufacturers shall apply the new standard EN 60661 for measuring the energy consumption of their coffee machines.

6. Market analysis

Roughly 20 million coffee machines are annually sold in Europe. For comfort and quality reasons, the trend goes towards espresso machines (fully automatic machines, portioned machines with high pressure) and pad machines. But also traditional drip-filter machines are still widespread (e.g. Germany, Netherlands). However, Topten.eu has only little experience with this type of coffee machines.

7. FAQ: common questions from manufacturers and consumers

Which testing institute has experience with the measurement according to EN 60661?

- VDE Testing and Certification Institute, Offenbach, Germany
  https://www.vde.com/en/Institute/Pages/Homepage.aspx

- Swiss Alpine Laboratories for Testing of Energy Efficiency (S.A.L.T.) at HTW Chur, Chur, Switzerland,
  http://www.salt-chur.ch/d/IndexAktuell.html

What is more ecological: portions (capsules/pads/fully automatics) or filter coffee?

Coffee is a major international commodity. Therefore coffee production and transportation has the potential for considerable global impacts on the environment such as consumption of energy, water, land and the loss of native forest.

The advantage of portions is that they use only as much coffee as needed (around 5 to 8 grams). Drip filter coffee machines are usually filled with quite a high amount of coffee powder for the preparation of an amount of coffee, that rarely is fully drank. The leftover coffee usually is thrown away. The waste of drip filter prepared coffee therefore is assumed to be quite high.

A further advantage of capsules or pads (which e.g. wrapped in a single sachet until usage) is that the coffee keeps its taste, because it is enclosed until its usage. Coffee in large bags looses its taste soon after a while the bag was opened. This coffee might then be thrown away if it has become tasteless.

Regarding capsules it is often said that they harm the environment. Especially the aluminium capsules by Nespresso are of great concern for the consumers. However, an unpublished study by Oeko-Institute from 2010 showed that the production of aluminium capsules indeed is highly energy intensive but that in case the capsules are brought back to the shop for recycling their environmental life cycle assessment is better than the one of plastic capsules.

A disadvantage of capsules / pads is their price per kg coffee, which usually is higher than for coffee in a bag. Furthermore capsules bind consumers to the accordingly system of the coffee machine for which the capsules are produced and of course also to the offered coffee. When using a drip filter coffee machine or a fully automatic machine, consumers are free in the selection of the coffee they like.

8. References and links

Useful links

Topten.eu coffee machines product lists:

- *Fully automatics:* http://www.topten.eu/english/household/coffee_machines/super_automatics.html
- *Capsule machines:* http://www.topten.eu/english/household/coffee_machines/capsule_espresso_machines.html

Topten.eu coffee machines selection criteria:

- http://www.topten.eu/english/criteria/coffee_machine_ak.html&fromid=

Topten.eu coffee machines recommendations:

- http://www.topten.eu/?page=recommendations_coffee_machines&fromid=
- http://www.topten.eu/uploads/File/131101_Topten_recommendations_Coffee_Machines.pdf

References

[1] Josephy, Barbara, Eric Bush, Jürg Nipkow, Adelmo Pilone: Super Efficient Coffee Machines – Best Available Technology (BAT) and Market Transformation. EEDAL-Conference, 2013. http://www.topten.eu/uploads/File/038_Barbara_Josephy_final_Coffee.pdf

[2] Commission Regulation (EU) No 801/2013 of 22 August 2013 amending Regulation (EC) No 1275/2008 with regard to ecodesign requirements for standby, off mode electric power consumption of electrical and electronic household and office equipment, and amending Regulation (EC) No 642/2009 with regard to ecodesign requirements for televisions. http://www.topten.eu/uploads/File/Networked-Standby_Ecodesign-regu_801-2013.pdf

[3] Commission Regulation (EC) No 1275/2008 of 17 December 2008 implementing Directive 2005/32/EC of the European Parliament and of the Council with regard to ecodesign requirements for standby and off mode electric power consumption of electrical and electronic household and office equipment. http://www.topten.eu/uploads/File/Standby_regulation_1275_2008.pdf

[4] The Blue Angel: RAL-UZ 136. Coffee Machines for Household Use. Edition April 2014. https://www.blauer-engel.de/en/products/electric-devices/espresso-and-coffee-machines

[5] EN 60661. Methods for measuring the performance of electric household coffee makers.

[6] Ecodesign of EuP: Non-tertiary coffee machines DG Tren Lot 25 (off-line)