DIFFICULTIES IN SETTING MINIMUM FLOW RATES IN SHOWERS

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ANQIP

INTRODUCTION

- One of the essential, and more relevant, measures for achieving efficient use of water in buildings is the adoption of efficient products. However, for the case of showers, the definition of efficient product based only on minimum flow raises some doubts, since behavioural factors, related to comfort, can counteract the savings resulting from application of a low-flow product.

INTRODUCTION

- Although the sensation of comfort varies from individual to individual, with showers there are inherent characteristics of the product that can change the feeling of comfort between different models working with equal flow rates. These include the strength of the jet or the pressure on the skin, the coverage of the spray, the vertical temperature distribution, how effective they are in removing the shampoo and soap, etc..

INTRODUCTION

- As a consequence, some labelling systems, that are based only on flow rates, may mislead consumers to adopt products that, in the end, can lead to higher water consumption. With the labelling scheme developed by ANQIP, the Portuguese non-profit, civil society association, dedicated to the implementation of water efficiency in buildings, comfort factors are integrated and are based on the results obtained in studies carried out in residential buildings of various types, some of which are indicated in this presentation.

INTRODUCTION

- In addition to these behavioural aspects, it should be noted that the use of low-flow showerheads can introduce other issues of a technical nature, such as problems on turning on gas water heaters. This aspect is difficult to study, given the large number of models of instant water heaters available on the market, their different characteristics, and the influence of the network pipe characteristics of the building so, in this case, the minimum flow rate can only be determined through an experimental evaluation.

INTRODUCTION

- Placing flow reducers in showers is often, also, a bad technical option, because many high flow showers do not work properly when the flow rate is reduced significantly, giving, for example, a spray which is deficient in skin coverage or jet pressure. There are reducers that can minimize this problem (with emulsion of air, for example), but their application is not appropriate in all cases.
- In spite of these issues, we feel that, in general, it is possible to define a flow rate threshold, above which the mentioned problems arise, whatever the characteristics of the installation of the device, or the residual pressure upstream.

EVALUATION OF MINIMUM FLOW FOR COMFORT WITH FLOW REDUCERS IN A STUDENT RESIDENCE

- ANQIP led a study in a student residence at the University of Aveiro to measure the effect of applying flow restrictors to reduce the flow rates in existing showerheads, on the minimum flows for comfort, considering the gender of users and duration of the shower. This also involved other less relevant parameters (age of student participants, etc.), that are not discussed in this communication, but did not consider temperature measurements of the shower.

EVALUATION OF MINIMUM FLOW FOR COMFORT WITH FLOW REDUCERS IN A STUDENT RESIDENCE

- Although the results of this study cannot be generalized, since it only involved a population within a narrow age range (university students) and the behaviour depends on the type of shower and its characteristics (spray coverage, etc.), they can give indications about the existence of comfort limits and the consequences on them of reducing the flow rates. We note, however, that a similar study carried out by ANQIP with people of different ages (between 20 and 70 years) and social situations led to similar conclusions, although a greater dispersion in the results was seen.

EVALUATION OF MINIMUM FLOW FOR COMFORT WITH FLOW REDUCERS IN A STUDENT RESIDENCE

- The study involved 16 people, 8 male and 8 female; each user was asked to record the flow rate they normally use for showering (Q_{usual}), and to carry out a progressive reduction (around one litre minute per day) of the flow rate on subsequent days, until they found a minimum value for comfort ($Q_{min.comf.}$). The students were provided with a graduated recipient and a chronometer to measure flow rates, and considered the average of three measurements.

ANALYSIS OF DIAGRAMS OF WATER CONSUMPTION BEFORE AND AFTER THE IMPLEMENTATION OF WATER EFFICIENCY AUDITS IN BUILDINGS

- Aiming the study of the changes in the diagrams of water consumption, ANQIP has developed more than 10 studies in buildings, where different water efficiency measures were implemented after carrying out water efficiency audits, with hourly recording of consumption trough telemetry systems. Although these studies relate to short periods of time and a relatively limited number of households, which may affect the quality of the findings, the results provide some conclusions of interest for the topic under discussion.

ANALYSIS OF DIAGRAMS OF WATER CONSUMPTION BEFORE AND AFTER THE IMPLEMENTATION OF WATER EFFICIENCY AUDITS IN BUILDINGS

- One of the audited dwellings was an apartment with 3 rooms, occupied by a family of three people, situated in a town in a rural region of southern Portugal. The average monthly flow of the dwelling was 14.17 m^3/month, before the audit, and 12.40 m^3/month after it, that is a reduction of 12,5%.

ANALYSIS OF DIAGRAMS OF WATER CONSUMPTION BEFORE AND AFTER THE IMPLEMENTATION OF WATER EFFICIENCY AUDITS IN BUILDINGS

- The audit included placing reducers in washbasin taps, bag reducers in cisterns, and reducing flow rates (with emulsion of air) in the showers. The reducer used in the showers reduced the flow rate from 10.5 L/min to close to 8 L/min. It was not possible to apply a reducer in the kitchen tap because the gas heater would not start if there was any reduction in the flow rate.

EVALUATION OF MINIMUM FLOWS OF COMFORT WITH FLOW REDUCERS IN A STUDENT RESIDENCE

- The data collected from the study conducted in the student residence at the University of Aveiro are summarized in Table 1, and average values presented on Table 2. The mean values for the duration of the shower are slightly lower than those obtained by other organizations, such as Waterwise (9 minutes, on weekdays, for persons under 35 years) or the American Standard Group (8 minutes for a typical shower).

EVALUATION OF MINIMUM FLOWS OF COMFORT WITH FLOW REDUCERS IN A STUDENT RESIDENCE

Table 1. Student residence. Data collected

Person	Age	Sex	Q_{usual} (L/min)	Duration (min)	$Q_{min.comf.}$ (L/min)	Duration (min)
1	22	F	11	4	7	5
2	23	F	10	15	5	13
3	22	F	10	9	6	8
4	24	F	9	10	5	12
5	21	F	8	7	4	8
6	20	F	9	8	6	7
7	19	F	10	5	7	6
8	23	F	10	8	7	10
9	20	M	11	5	8	6
10	22	M	12	4	7	6
11	23	M	10	6	6	5
12	21	M	9	7	6	6
13	19	M	10	5	7	7
14	22	M	11	8	9	7
15	24	M	8	4	6	7
16	23	M	10	6	7	9

EVALUATION OF MINIMUM FLOWS OF COMFORT WITH FLOW REDUCERS IN A STUDENT RESIDENCE

Table 2. Student residence. Averages values

		Q_{usual} (L/min)	Duration (min)	$Q_{min.conf.}$ (L/min)	Duration (min)
Averages	F	9.6	8.3	5.9	8.6
	M	10.1	5.6	7.0	6.6
	F+M	9.9	7.0	6.5	7.6

EVALUATION OF MINIMUM FLOWS OF COMFORT WITH FLOW REDUCERS IN A STUDENT RESIDENCE

- The most important result of the study is that, below a certain value, the duration of a shower increases upon reducing the flow rate, which means that the decrease in the volume of water used does not follow the reduction in the flow rate, such that the savings may not be as significant as expected. This leads to the conclusion that, for each type of shower, there probably exists a "break point", i.e. a point at which a flow rate is not translated into an increase in water efficiency.

EVALUATION OF MINIMUM FLOWS OF COMFORT WITH FLOW REDUCERS IN A STUDENT RESIDENCE

- From analysis of Table 2, it can be concluded that males usually use a higher flow rate in the shower, and also require a greater flow for comfort. However, the values for the duration of the shower are higher for females.
- We note from Table 1 that the minimum average shower flow rate of comfort for females was 4 L/min, whereas for males it was 6 L/min. However, as is clear in the table, these values do not satisfy all individuals.

EVALUATION OF MINIMUM FLOWS OF COMFORT WITH FLOW REDUCERS IN A STUDENT RESIDENCE

- Table 3 presents the usual volumes and the volumes of minimum comfort for each person, in terms of consumed volumes (flow x duration of showering). From this it can be seen that the minimum and maximum usual volumes used by females are 44 L and 150 L, , respectively, while with the volumes of minimum comfort, the minimum value is 32 L and the maximum is 70 L.

EVALUATION OF MINIMUM FLOWS OF COMFORT WITH FLOW REDUCERS IN A STUDENT RESIDENCE

Table 3. Volumes consumed in showering (usual and minimum comfort)

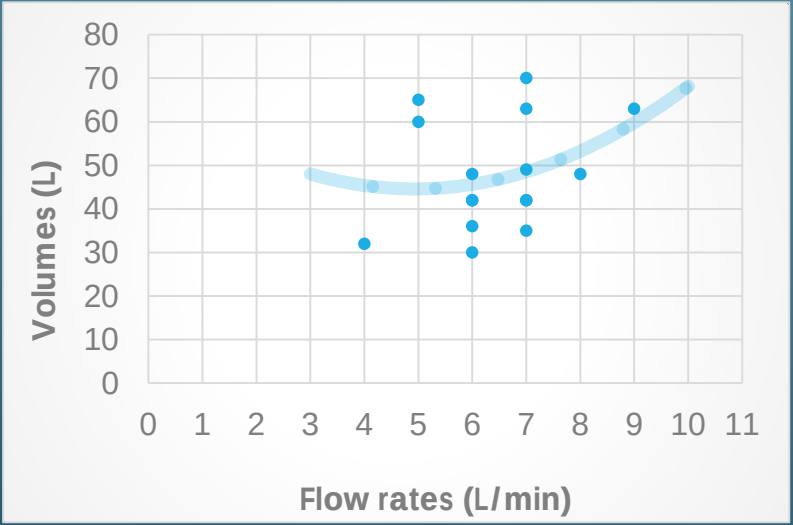
Person	Age	Sex	V_{usual}	$V_{min.conf.}$	Person	Age	Sex	V_{usual}	$V_{min.conf.}$
1	22	F	44	35	9	20	M	55	48
2	23	F	150	65	10	22	M	48	42
3	22	F	90	48	11	23	M	60	30
4	24	F	90	60	12	21	M	63	36
5	21	F	56	32	13	19	M	50	49
6	20	F	72	42	14	22	M	88	63
7	19	F	50	42	15	24	M	32	42
8	23	F	80	70	16	23	M	60	63

EVALUATION OF MINIMUM FLOWS OF COMFORT WITH FLOW REDUCERS IN A STUDENT RESIDENCE

- Linking these two analyses, it can be noted that females consume more water in showers. In terms of the overall reduction, the effects are significant since in females the average volumes fell from 80 L/shower to 50 L/shower (37.5% decrease), while in males it decreased from 57 L/shower to 46 l/shower (reduction of about 20%). Overall, the average usage was 68.5 L/shower, while the minimum comfort value corresponds to 48 L/shower, which translates into an effective reduction potential of 30%.

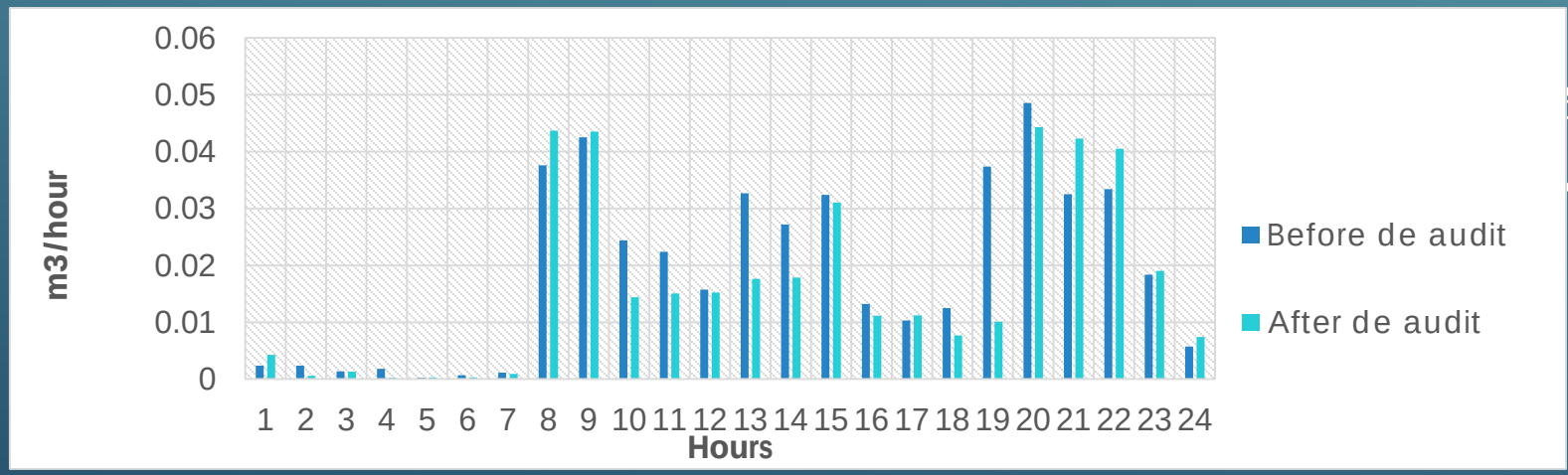
EVALUATION OF MINIMUM FLOWS OF COMFORT WITH FLOW REDUCERS IN A STUDENT RESIDENCE

- Minimum volumes of comfort were plotted against flow rates, and the data fitted to a trend line (2nd degree polynomial). From this the 'break point' corresponds, on average, to a minimum of comfort around 5 L/min.



ANALYSIS OF DIAGRAMS OF WATER CONSUMPTION BEFORE AND AFTER THE IMPLEMENTATION OF WATER EFFICIENCY AUDITS IN BUILDINGS

- Analysis of diagrams of hourly consumption (average values of monthly readings) in the study of the audited apartment showed that in two periods of the day (morning and evening), the consumption increased after the implementation of the measures contained in the audit.



THE ANQIP SCHEME FOR LABELLING OF THE WATER EFFICIENCY OF PRODUCTS

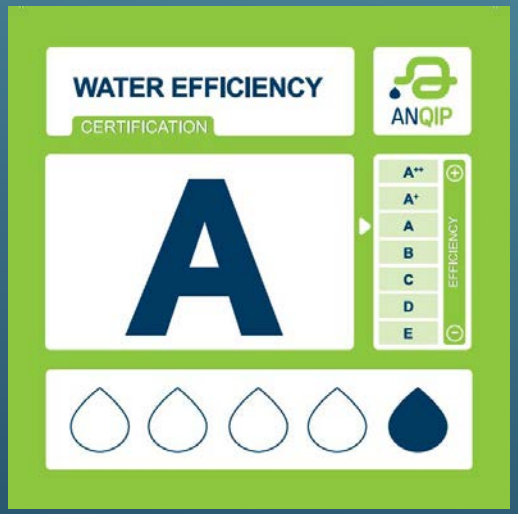
- The ANQIP scheme for the labelling of the water efficiency of products aims to be an easily implementable system, which guides the consumer on the best choice in terms of effective water efficiency, and not just in terms of low flow rate or volume.

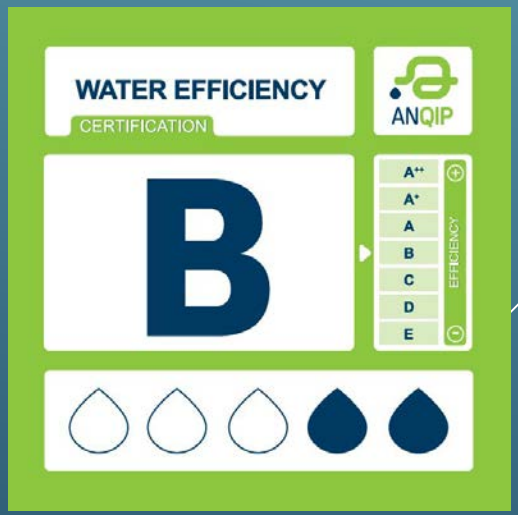
THE ANQIP SCHEME FOR LABELLING OF THE WATER EFFICIENCY OF PRODUCTS

- It was launched in 2008 by ANQIP, taking into account the risk of water stress in the country and the recommendations of the National Plan for Efficient Water Use, but despite being one of the oldest in Europe, it was based from the beginning on concerns of comfort, public health and proper functioning of the building networks. This has been confirmed over time, and in some cases adjusted, based on the results of many studies that have been developed by ANQIP with associated universities.

THE ANQIP SCHEME FOR LABELLING OF THE WATER EFFICIENCY OF PRODUCTS

- The labels adopted by ANQIP, vary between the letters “A++” and “E”. The assignment authorization of labelling for showerheads and shower systems is made in accordance with the categories established in Table 4.





THE ANQIP SCHEME FOR LABELLING OF THE WATER EFFICIENCY OF PRODUCTS

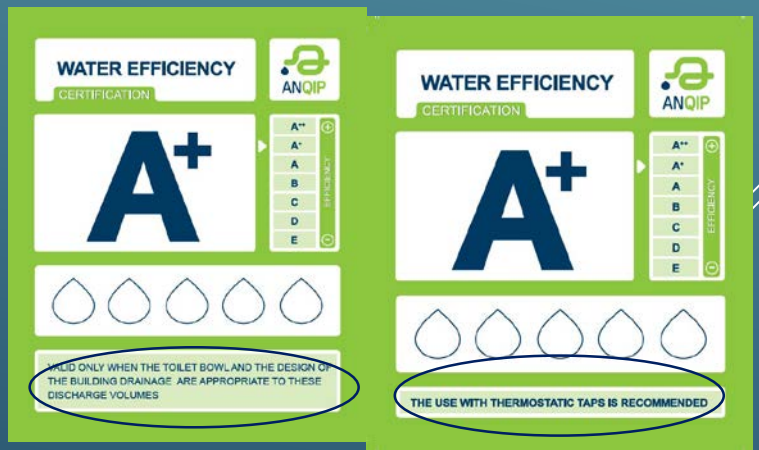
Table 4. Conditions for water efficiency labels in showers and shower systems

Flow rate (Q) (L/min)	Showerhead	Shower system	Shower system with thermostatic tap or eco-stop	Shower system with thermostatic tap and eco-stop
Q ≤ 5	A+	A+	A++ (1)	A++ (1)
5,0 < Q ≤ 7,2	A	A	A+	A++
7,2 < Q ≤ 9,0	B	B	A	A+
9,0 < Q ≤ 15,0	C	C	B	A
15,0 < Q ≤ 30,0	D	D	C	B
30,0 < Q	E	E	D	C

(1) The use of eco-stop in these cases is not considered to be of interest

THE ANQIP SCHEME FOR LABELLING OF THE WATER EFFICIENCY OF PRODUCTS

- The category "A" means the ideal efficiency for several products in the current installations, considering not only the reduced flow, but also concerns of public health, the necessity of ensuring a minimum comfort and questions of functioning of the networks, such as the start-up of instant gas water heaters or the performance of drainage systems.



THE ANQIP SCHEME FOR LABELLING OF THE WATER EFFICIENCY OF PRODUCTS

- The minimum flow rate of 5 L/min for showers of category “A” was set by ANQIP as a result of several studies, taking into account, essentially, aspects of comfort. It is true that, when showers are specially designed to work with low flow rates, using solutions such as the emulsion of air or the use of a small turbine vane, those with flow rates less than 5 L/min can still be convenient for the user.

THE ANQIP SCHEME FOR LABELLING OF THE WATER EFFICIENCY OF PRODUCTS

- However, it is necessary to bear in mind the fact that the reference tests are generally made for dynamic pressures of 300 kPa (according to the labelling scheme), and that lower pressures, implying flows less than those obtained in the test, are usual in building installations.
- In relation to public health issues, it is known that shower systems with a discharge of 5 L/min or less have an increased risk of scalding, and the "A+" and "A++" labels applied to these devices must bear the indication "Recommended for usage with thermostatic taps".

THE ANQIP SCHEME FOR LABELLING OF THE WATER EFFICIENCY OF PRODUCTS

- This aspect is very important and distinguishes it from other schemes. In fact, the ANQIP label seeks to give consumers guidance on the most appropriate product, and is not intended to be a scheme for commercial promotion for products.
- In general, ANQIP considers that the mere indication of a flow rate on the label, even if accompanied by an indicative colour, is an overly simplistic and inadequate solution, because it does not prevent the above-mentioned problems and does not advise the consumer of the best option.

CONCLUSIONS

- Water efficiency labelling of showers and shower systems based only on the flow rate is an overly simplistic and inadequate solution, since it does not cover aspects of comfort, public health, or operation of building networks. The comfort aspects are particularly important and may even imply that a higher total volume is consumed in the bathroom in a shower of lower flow rate because of the effect of extending its duration.

CONCLUSIONS

- The addition of parameters of comfort in the classification of products to the flow values, as is done in the scheme of the WaterSense, may be an appropriate solution, even though these parameters are fairly subjective. The development of further studies to determine the criteria of comfort can increase the complexity of the schemes and labelling, but without leading to the desired objectivity.

CONCLUSIONS

- With the ANQIP system, a relatively simple solution was adopted to give consumers the most appropriate guidance on products, opting to set a minimum reference category, which hopes to safeguard aspects of comfort, public health (risk of scalding) and the operation of the installations in buildings (start up of instant water heaters).

CONCLUSIONS

- The system accepts categories of better water efficiency, but warns the consumers of the need for a proper installation for low volumes or flow rates, in addition to adopting solutions that avoid risks in use (such as thermostatic taps), together with the importance of considering solutions that compensate for a possible decrease in comfort in use.

- Thank you very much for your attention

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