The importance of water efficiency in buildings in Mediterranean countries. The Portuguese experience

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***Abstract*—**The risk of hydric stress will increase significantly across the entire planet, especially in the Mediterranean basin, and some Europeans countries, such as Portugal, might experience very serious problems in a large part of their territory in the short to medium term.

In addition, there are high levels of inefficiency in the water use in some of these countries. In Portugal, for example, the overall global waste in water amounts at over 3 x 10^9 m3/year, which is around 39% of the country's total water requirement.

The truth is that the risks of hydric stress and the high level of inefficiency require the immediate implementation of various measures, including the promotion of the use of efficient products in buildings, among other measures.

With this objective in view, a Portuguese non-governmental organisation dedicated to the promotion of quality and efficiency in buildings services (ANQIP), decided to launch a voluntary certification and labelling system for products water efficiency in October 2008.

This paper describes the system that is being implemented and the categories attributed to each product and also present a detailed analysis of a Portuguese Specification, developed by ANQIP, for rainwater harvesting in buildings; it looks at certain technical aspects of the conception and design of installation components and the demands of water quality in light of its various uses.

A brief reference about de measures being taken in Portugal for the reuse and recycling of greywater is also made.

***Keywords*—**Certification; labelling, rainwater harvesting, water efficiency.

I. Introduction

Water has become a resource of the utmost importance. Demographic growth and, most especially, economic development and today's lifestyles have rendered drinking water scarce, and its status has changed over the past decades from that of a community and national asset to that of an economic one.

Climate change has worsened the situation and it is predicted that in certain countries, such as Portugal, the forecast reduction in rainfall or the alteration of its regime could have a negative effect on situations of crisis in the short to medium term.

In addition, there is a high level of inefficiency in the water use in Portugal. The overall global waste in water use is presently estimated at over 3 x 10^9 m^3/year, which is around 39% of the country's total water requirement.

With specific reference to the urban supply sector (public and building systems), total waste is reckoned to be 250 x 10^6 m^3/year, costing about 600 x 10^6 €/year.

In terms of figures per person, this amounts to waste of more than 25 m^3/year, i.e., near 70 m^3/year per family (average family consist of 2,7 persons in Portugal).

Bearing in mind the short- /medium-term water stress forecasts this situation is unsupportable and needs urgent intervention through the application of measures to rationalize water use.

The need for efficient water usage has already been recognised in Portugal as a national priority in the publication of a National Program for Efficient Water Use (PNUEA) [1]. Amongst the actions suggested in this Plan are proposals for the labelling of devices in buildings (flushing systems, showers, etc.) in order to provide consumers with information as to their water efficiency. The Plan suggests that this measure be made compulsory after a transitional period.

The PNUEA also predicts the involvement of companies, management organisations and non-governmental organisations for the implementation of the said measures. ANQIP (National Association for Quality in Building Services) is a Portuguese NGO dedicated to the promotion of quality and efficiency in buildings services and it covers the sector of businesses, universities, management organisations and technical companies. Its responsibility is clear in terms of launching the process and its leadership role [2][3][4][5].

One other way, rainwater harvesting systems in buildings have seen considerable development in a number of countries, notably in Brazil and Germany, both to encourage the rational use of water and to help reduce flood peaks when it rains. Portugal has also shown increasing interest in rainwater harvesting as a measure to increase water use efficiency in buildings.

It should be noted that in terms of the rational use of water the so-called Mediterranean climate does not seem to be favourable to making the most of rainwater since the summers

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are typically hot and dry and the winters are cold and wet. Typical summer climate usually lasts two or three months.
As the name suggests this climate is only found in the Mediterranean basin, though similar conditions may occur from time to time in southern Australia and on the east coast of north and South America. Most of Portugal, Spain, Italy and Greece, for example, enjoy this type of climate.
Spain and Portugal, however, are at high risk of hydric stress in the short- /medium-term and so the harvesting of rainwater in the context of promoting the global water efficiency in buildings may play an important part in reducing this stress as well as helping to reduce flood peaks in the winter.

II. WATER EFFICIENCY IN BUILDINGS. THE 5R PRINCIPLE

An efficient water cycle in buildings can be summarized as a principle analogous to but more comprehensive than the 3R principle (used for waste) which is known as the 5R principle (Figure 1).

- Reduce consumption
- Reduce loss and waste
- Re-use water
- Recycle water
- Resort to alternative sources

} *- Water efficiency in buildings*

Fig. 1 – The 5R principle for water efficiency in buildings

To reduce the consumption (first R), ANQIP has devised a certification and labelling model for water efficiency of products, as mentioned above.
The use of rainwater is included in the fifth R (resort to alternative sources) and ANQIP already developed a specific technique for this (Technical Specification ETA 0701). ANQIP is also currently developing a technical for the re-use and recycling of greywater.
It should be noted that increasing efficiency in water use in buildings leads to the reduction of wastewater effluents, increased efficiency in energy consumption and contributes to the sustainability of buildings [6][7][8][9].

III. REDUCING CONSUMPTION: WATER EFFICIENCY CERTIFICATION AND LABELING OF PRODUCTS

The water efficiency labelling of products has generally been implemented voluntarily in various countries.
In some countries efficiency is not graded, but an efficiency label is awarded when consumption is less than a specific amount. This is the labelling system in use in the US and Scandinavia, for example.
In Australia and Ireland (Dublin), however, the label indicates a classification that varies with the product's efficiency [2].
ANQIP has opted for a voluntary model of the latter kind for Portugal. Figure 2 shows the labels used. The base colours, which cannot be seen in the Figure, are green and blue.
"A" signifies the efficiency that is considered ideal. It also takes into account the user-friendliness and performance of the devices and aspects of public health. There is a graphic indication by means of drops, for a better understanding of the symbol, and a small informative bar at the side.
The A+ and A++ ratings are meant for special or regulated applications, as explained below.

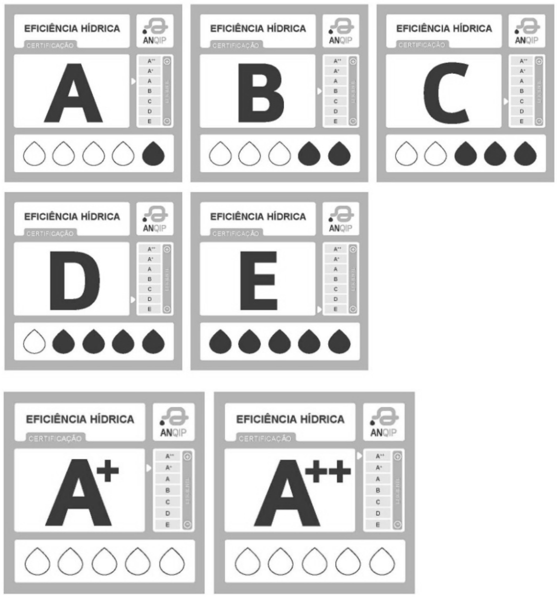

Fig. 2: Portuguese water efficiency labels

ANQIP has drawn up Technical Specifications (ETA) for different products so as to create and establish the necessary benchmark values to be assigned to each letter. These Technical Specifications also establish the certification testing conditions.
Firms signing up to the system will sign a protocol with ANQIP which will define the conditions under which they can issue and use the labels.
ANQIP controls the process by randomly testing labelled products on the market, from time to time. These tests are performed by accredited laboratories or by laboratories which are recognised by the Association.
In this process of labelling, cisterns were regarded as a priority since toilet flushing cisterns are one of the biggest consumers of water in buildings in Portugal.
As Portugal is a member of the European Union and there is a draft for a European Standard for WC and urinal flushing cisterns (prEN 14055:2007), it was decided that the certification of water efficiency in Portugal should comply with this Standard, where applicable.
The following mechanisms are also regarded as water-saving devices, under this Standard:
a) Double-action mechanisms (interruptible): one action initiates flushing and a second action stops the flush;
b) Dual-control mechanisms: one control releases the full flush volume and another control releases a reduced flush volume.
The reduced volume cannot be greater than two-thirds of the maximum flush.
Table 1 presents the categories defined in the Technical Specification ANQIP ETA 0804 for flushing cisterns.

TABLE 1
WATER EFFICIENCY CATEGORIES FOR THE LABELLING OF FLUSHING CISTERNS

Nominal volume (litres)	Type of flush	Water efficiency rating	Tolerance (Maximum volume – complete flushing)	Tolerance (Minimum volume for water-saving flushing)
4.0	Dual control	A++	4.0 – 4.5	2.0 – 3.0
5.0	Dual control	A+	4.5 – 5.5	3.0 – 4.0
6.0	**Dual control**	**A**	**6.0 – 6.5**	**3.0 – 4.0**
7.0	Dual control	B	7.0 – 7.5	3.0 – 4.0
9.0	Dual control	C	8.5 – 9.0	3.0 – 4.5
4.0	Interruptible	A+	4.0 – 4.5	-
5.0	Interruptible	A	4.5 – 5.5	-
6.0	Interruptible	B	6.0 – 6.5	-
7.0	Interruptible	C	7.0 – 7.5	-
9.0	Interruptible	D	8.5 – 9.0	-
4.0	Complete	A	4.0 – 4.5	-
5.0	Complete	B	4.5 – 5.5	-
6.0	Complete	C	6.0 – 6.5	-
7.0	Complete	D	7.0 – 7.5	-
9.0	Complete	E	8.5 – 9.0	-

As stated before, the minimum permitted volume or discharge amounts in current facilities are limited for reasons linked to performance, user-friendliness and public health. The use of 4-litre flushing cisterns, for example, has led to problems in the flushing of solids in building and public networks in Portugal. Therefore, their usage requires an alteration of the usual criteria of the design of the drainage system (which is incompatible with many existing drains).

In addition, the European Norm EN 12056-2 does not allow the use of 4-litre flushing systems in building systems whose design comply with System I of the said Norm, and this is precisely the most common system in Portugal, allowed by the General Regulation.

Furthermore, it must be ascertained if the discharge volume is compatible with the other characteristics of the cistern toilet. Product performance is usually ensured by compliance with European norms, meaning that any water efficiency certification must require prior compliance with the existing norms in terms of the product's respective performance (in the case of flushing cisterns, as mentioned above, it is the prEN 14055).

Based on these facts, ANQIP allows low volume flushing cisterns belonging to water efficiency categories A+ or A++, but with the obligation that the label should warn users of the need to guarantee the performance of the set and compatibility with the drainage conditions in the building system (Figure 3).

The water efficiency certification and labelling system for flushing cisterns was implemented in the last quarter of 2008. Many companies and consumers have complied with the system, and it now covers about 75% of the national market, corresponding to 110 commercial references. [6]

Table 2 summarises the certifications awarded per category.

The situation presented in Table 2 was expected (i.e. no certifications awarded to the less efficient categories). In fact, because compliance with the system is yet voluntary, manufacturers/importers do not usually request labelling for less efficient categories.

This is not negative for the system; quite the contrary. Since so many companies and consumers complied with the system, the lack of certification of the said flushing cisterns will gradually lead to their removal from the market, thus contributing towards ANQIP's goals.

Fig. 3: Examples of water efficiency labels for low volume flushing cisterns

TABLE 2
LIST OF CERTIFIED FLUSHING CISTERNS ACCORDING TO CATEGORY

CATEGORY	NO. OF CERTIFICATIONS AWARDED
A++	0
A+	2
A	103
B	5
C	0
D	0
E	0

Shower systems and showers represent over 30% of the daily average domestic water consumption volume in Portugal [2] [5].

At this level, efficiency reduces both water consumption and the consumption of energy required for the production of hot water.

The classification of these devices considers the following:
- Shower heads (showers), individually;
- Shower taps equipped with a hose and a shower head or with a fixed shower head (shower systems).

For shower systems and showers, the model implemented considers the ideal usage (letter A) to represent a water usage of between 5.0 litres/minute and 7,2 litres/minute.

The A and A+ labels applied to shower heads with a discharge which is 5 l/min or less must bear the indication "Recommended for usage with thermostatic taps", due to the increased risk of scalding.

In products which can be regulated by the consumer, certification may be awarded on the basis of the most efficient position, as long as the criterion is clear to the consumer, without any risk of confusion, and it must be marked next to the label.

Due to the fact that discharge is dependent on residual pressure, the established reference residual pressure for all ratings and for the tests was 300 kPa, which represents the average pressure in Portugal and is the pressure selected by several standards for testing devices.

The taps for bathtubs were not rated, because hot water consumption depends on the volume of the tub to fill, and not on the discharge of the device.

Table 3 presents the various efficiency categories for showers and shower systems.

TABLE 3
WATER EFFICIENCY RATINGS FOR THE LABELLING OF SHOWERS AND SHOWER SYSTEMS

Discharge (Q) (l/min)	Showers	Shower systems	Shower system with a thermostatic tap or an eco-stop function	Shower system with a thermostatic tap and an eco-stop function
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 is not considered in these cases

Taps are the most common device, both in homes and in collective facilities. In an average home, there are at least 3 to 5 taps installed in the kitchen and bathrooms [2][5]. They are used frequently, and their usage is difficult to quantify and varies greatly in time and space. This variation also applies to the length of time of use, which can stretch from a few seconds to several minutes.

No specific reference is made to self-closing taps, because according to recent studies carried out in the USA, they do not lead to significant water savings since, although they might run for less time, the discharge is always at maximum level [4]. The advantage of such taps lies in their safety aspect and not in water saving.

The case of self-closing taps with a sensor is similar. The advantage of these taps over traditional ones is that they are more hygienic, but they are no more efficient, usually.

On average, it is estimated that water from taps represents approximately 16% of consumption in homes in Portugal.

In the case of bathroom taps (in homes), the model which is currently being studied considers ideal usage (letter A) to be a level of water consumption of 2.0 l/minute, taking into account the studies performed and proposals made in countries where water efficiency labelling has already been implemented.

For kitchen taps, the model considers ideal usage (letter A) to be a level of water consumption of 4.0 l/minute.

Taps with an aerator are recommended for categories A++ and A+.

Kitchen taps with a discharge of under 4 litres per minute and bathroom taps with a discharge of under 2 litres per minute (in homes) must bear a label with an advisory note recommending that they be utilised only with an aerator.

In public areas, however, the usage of taps discharging a volume higher than or equal to 2 litres per minute might be advisable (usually letter B or above for basic models).

Tables 4 and 5 present the various efficiency categories for taps.

TABLE 4
WATER EFFICIENCY RATINGS FOR THE LABELLING OF BATHROOM TAPS (IN HOMES)

Discharge (l/min)	Bathroom taps	Bathroom taps with an aerator or an eco-stop function	Bathroom taps with an aerator and an eco-stop function
Q≤ 2.0	A	A+	A++
2.0 < Q ≤ 4.0	B	A	A+
4.0 < Q ≤ 6.0	C	B	A
6.0 < Q ≤ 8.0	D	C	B
8.0 < Q	E	D	C

TABLE 5
WATER EFFICIENCY RATINGS FOR THE LABELLING OF KITCHEN TAPS

Discharge (l/min)	Kitchen taps	Kitchen taps with an aerator or an eco-stop function	Kitchen taps with an aerator and an eco-stop function
Q ≤ 4.0	A	A+	A++
4.0 < Q ≤ 6.0	B	A	A+
6.0 < Q ≤ 8.0	C	B	A
8.0 < Q ≤ 10.0	D	C	B
10.0 < Q	E	D	C

IV. EVALUATION OF THE IMPACT OF THE USE OF EFFICIENT PRODUCTS

The implementation of measures to increase water efficiency in the building sector may lead, in economic terms, very significant results.

ANQIP developed a study to analysis and estimate consumption reductions in a typical house, with efficient products (letter A), by comparison with a house equipped with non efficient products, usual type in Portugal [5].

It is assumed an average occupancy of 2.7 persons per building and taking into account the accumulated time of usage or the usual number of uses per person, we can construct the Table 6, considering the house equipped with showers, washbasins, WC Flushing, sink dishwasher, and washing machines.

TABLE 6 – CONSUMPTION IN A BUILDING EQUIPPED WITH CONVENTIONAL PRODUCTS

Product	Cons. (l/s)	Time of use accumulated per day (min)	Total time (min)	Total cons. per day (l)	Total cons. per month (m^3)	Total cons. per year (m^3)
Shower	0,15	5	13,5	121,5	3,6	44,3
Bathroom tap	0,10	4	10,8	64,8	1,9	23,6
Kitchen tap	0,20	-	5	60,0	1,8	21,9
Product	l per use or disch	Number of uses or discharges (per person)	Total of uses or disch			
Flushing cisterns	9	6	16,2	145,8	4,4	53,2
Washing machine	90	-	1	90,0	2,7	32,9
Dishwasher	22	-	1	22,0	0,7	8,0
TOTAL				504,1	15,1	184,0

With products of category A, we can obtain the results that are presented in Table 7.

As you can see, the water savings obtained is extremely significant, approaching 45%.

It is possible to extend this analysis to include the corresponding energy savings in the building.

With regard to water tariffs, weighting the values adopted in different municipalities in Portugal, we obtain a mean value of 0.40 €/m^3.

Regarding energy costs, and considering the use of natural gas, the value obtained is 0.11 €/kWh. So, as heating 1 m^3 of water at 37 ºC requires 30 kWh of energy, we can obtain a value of 0.0033 €/l The numbers are "conservative" because they do not include VAT or fixed terms

The Tables 8 and 9 indicate the results of the application of these values.

For washing machines and dishwashers, are weighted average values from the catalogs of the manufacturers (1.20 kWh and 1.05 kWh per wash, respectively).

Analyzing these tables, we can concluded that the estimated total savings for a medium-sized house are extremely significant, amounting to approximately 51%.

Considering water and energy, the saving potential obtained is 235 €/year per family. This result, obtained for Portugal, can easily be extrapolated to other Mediterranean countries.

TABLE 7 – CONSUMPTION IN A BUILDING EQUIPPED WITH PRODUCTS WITH LETTER "A"

Product	Cons. (l/s)	Time of use accumulated per day (min)	Total time (min)	Total cons. per day (l)	Total cons. per month (m^3)	Total cons. per year m^3)
Shower	0,1	5	13,5	81,0	2,4	29,6
Bathroom tap	0,03	4	10,8	19,4	0,6	7,1
Kitchen tap	0,06	-	5	18,0	0,5	6,6
Product	l per use or disch	Number of uses or discharges (per person)	Total of uses or disch			
Flushing cisterns	6	6	16,2	97,2	2,9	35,5
Washing machine	45	-	1	45,0	1,3	16,4
Dishwasher	16	-	1	16,0	0,5	5,8
TOTAL				276,6	8,2	101,0

TABLE 8 – WATER AND ENERGY COSTS IN A TYPICAL HOUSE WITH CONVENTIONAL PRODUCTS

Product	Total (l/ /day)	Water cost (0,0004 €/l)	Energy cost (0,0033 €/l)	Total cost (€/day) Water + Energy	Total cost (€/ /month) Water + Energy	Total cost (€/year) Water + Energy
Shower	121,5	0,049	0,401	0,450	13,49	164,09
Bathroom tap	64,8	0,026	0,214	0,240	7,19	87,51
Kitchen tap	60,0	0,024	0,198	0,222	6,66	81,03
Product	Total l/day	Water cost (0,0004 €/l)	Energy cost (per cycle)			
Flushing cisterns	145,8	0,058	-	0,058	1,75	21,29
Washing machine	90,0	0,036	0,13	1,66	4,98	60,59
Dishwasher	22,0	0,009	0,12	1,29	3,86	47,01
TOTAL	504,1	0,202	1,063	3,920	37,93	461,52

Bearing in mind the current indicators of construction in Portugal, that point to the new licensing of 26,000 buildings in 2009, it can be concluded that a delay in the implementation of these measures represents a wasteful consumption of water exceeding to more 2 million m^3 per year.

TABLE 9 – WATER AND ENERGY COSTS IN A TYPICAL HOUSE WITH PRODUCTS WITH LETTER "A"

Product	Total (l/ /day)	Water cost (0,0004 €/l)	Energy cost (0,0033 €/l)	Total cost (€/day) Water + Energy	Total cost (€/ /month) Water + Energy	Total cost (€/year) Water + Energy
Shower	81,0	0,032	0,267	0,299	8,97	109,13
Bathroom tap	19,4	0,008	0,064	0,072	2,15	26,20
Kitchen tap	18,0	0,007	0,059	0,067	2,00	24,31
Product	Total (l/ /day)	Water cost (0,0004 €/l)	Energy cost (per cycle)			
Flushing cisterns	97,2	0,039	-	0,039	1,17	14,19
Washing machine	45,0	0,018	0,065	0,083	2,49	30,30
Dishwasher	16,0	0,006	0,055	0,061	1,84	22,41
TOTAL	276,6	0,110	0,510	0,621	18,62	226,54

Regarding the recent European policies for energy efficiency in buildings (Directive No. 2002/91/EC of the European Parliament and of the Council of 16th December), this situation cannot be ignored, and the water efficiency should be considered as one of the relevant parameters for the energy classification of buildings.
To assess the importance of this factor, we can determine the energy savings obtained only with shower systems or showers with certification and labeling the letter "A".
The results are shown in Tables 10 and 11.

TABLE 10 – ENERGY COSTS (SANITARY HOT WATER) IN A HOUSE WITH CONVENTIONAL PRODUCTS

Product	Total l/day	Water cost (0,0004 €/l)	Energy cost (0,0033 €/l)	Total cost (€/day) Water + Energy	Total cost (€/ /month) Water + Energy	Total cost (€/year) Water + Energy
Shower (family)	121,5	3,645	0,401	13,03	1330,64	146,37
Per person	45	1,350	0,149	4,47	492,83	54,39

TABLE 11 – ENERGY COSTS (SANITARY HOT WATER) IN A HOUSE WITH PRODUCTS IN THE CATEGORY "A"

Product	Total l/day	Water cost (0,0004 €/l)	Energy cost (0,0033 €/l)	Total cost (€/day) Water + Energy	Total cost (€/ /month) Water + Energy	Total cost (€/year) Water + Energy
Shower (family)	81,0	2,43	0,267	8,01	886,00	97,46
Per person	30,0	0,90	0,099	2,97	328,15	36,10

We can easily see that savings is about 33%, corresponding to a reduction of 445 kWh / year per family.
These results demonstrate the importance of policies for efficient water use in the construction sector, with significant benefits for citizens and in terms of sustainability, which should also be reflected in other sector-based policies, particularly as regards energy efficiency [10].

V. REUSE OR RECYCLING OF GREYWATER AND USE OF ALTERNATIVE SOURCES

In the context of the alternative resources, the systems of rainwater harvesting in buildings has experienced great development in several countries, notably in Brazil and Germany, not only for reasons of rational water use, but also as a contribution to the reduction in peak flood during periods of precipitation.
The use of rainwater led to the development of a technical Specification ANQIP (Specification ETA 0701), which can be freely accessed on the Internet. Of course, since this is a Specification of a nongovernmental entity, ETA 0701 is of voluntary compliance.
The specification ETA 0701 is divided into six chapters (Introduction, definitions, references and legal regulations, general aspects, certification and technical and maintenance requirements), emphasizing the recommendation of the certification of the design and installation by ANQIP. This recommendation is justified to ensure the technical quality and by public health reasons.
One aspect to which special attention was given was the need to divert the first flush, since the prolonged dry periods typical of Mediterranean climate can aggravate the pollution of these waters, recommending the installation of automatic diverting systems.
ETA 0701 allows criteria of duration or height of the rainfall to establish the amount to divert. In the first case states that must be divert an amount corresponding to the first 10 minutes of rainfall, although shorter times (but no less than 2 minutes) may be adopted if the period between rainfalls is less than four days.
The height criterion takes a reference figure of 2 mm of rainfall, although this may vary between 0.5 mm and 8.5 mm, depending on local conditions and the period between rainfall events.
The Brazilian standard also takes 2 mm of rainfall, but the German standard DIN 1989 does not have specific requirements.
ETA 0701 also requires the use of appropriate filters in the connection to the storage tank (to trap leaves, etc.), just as the German and Brazilian standards.
The Specification further includes technical requirements to prevent contamination in the discharge of water from the overflow, from the first flush or from the rainwater filters, either is considered the ground infiltration or the discharge in a natural water course.
The installation of a device to reduce turbulence and the speed at which the water enters the storage tank is also required.
Pump suction should be at a slow speed and between 10 and 15 cm below the level of the water in the storage tank, if possible (or through an equivalent system that prevents the suction of floating material or sediment in it).

The ETA 0701 also contains several provisions constructive, as the usual recommendation that the rain water should be stored in a place away from light and heat and that vents should be fitted with devices anti-rodent and anti-mosquito.

A shut-off should also be installed at the beginning of the system so that if products that can harm human health are used or spilt in the catchment area (on purpose or by accident) the system can be disconnected and the products will not enter the storage tank.

The experts find it hard to agree on the best method to size up the storage tank. A great many methods can be used: simple ones (German abridged procedure, German simplified procedure, Spanish method, English practical method, Azevedo Netto method, and so forth), and theoretical and probabilistic methods (Rippl method, Simulation method, Monte Carlo method, etc.).

The Portuguese specification proposes that the abridged German procedure should be used for current situations. This procedure is described in the German standard and leads to about 1 m^3 per person. Storage periods exceeding 30 days should be avoided, which is slightly higher than the period specified in the German standard (3 weeks).

Like the German standard, the Specification ETA 0701 contains a table of consumption per appliance, to help calculate the building's water needs. The Portuguese table is based on the use of appliances labelled "A" for water efficiency under the ANQIP certification system, since the use of a rainwater harvesting system with non-efficient appliances is not regarded as consistent.

These two tables differ essentially in terms of the amounts for watering outside areas, due to climate differences.

It also stipulates (like the foreign standards mentioned earlier) that the drinking water and non-drinking water systems should be clearly distinguished. Watering and washing appliances, both indoor and outdoor, must be identified and marked with appropriated symbols.

It is also recommended that washing or watering taps should have removable handles/levers (safety key) to prevent improper use.

The installation of a totalizing meter in the section connecting the storage tank to the block's system is considered, so that the water that does not enter the drainage system (i.e. that is used for watering gardens, etc.) is not measured.

Questions of quality also arouse significant differences of opinion among the experts. The use of rainwater for washing clothes, for instance, is not allowed in Brazil but it is in Germany. This difference of criteria may be due to the various washing temperatures considered and their effect on microorganisms.

The Portuguese Specification is nearer the German standard and considers the following possible uses:

- Toilet storage tank flushing
- Washing clothes
- Washing floors, cars and so on.
- Watering gardens, lawns, parks etc.
- Industrial uses (cooling towers, fire fighting systems, HVAC, etc.)

It is felt, moreover, that the use of untreated rainwater for toilet flushing should only be acceptable if the water quality is at least up to that of bathing water pursuant to the applicable European directives (Directive 76/160/EEC, of the Council, dated 8/12). It may be disinfected, if necessary.

Clothes should only be washed with rainwater that has had no specific treatment if the washing water temperature reaches at least 55ºC. A microfilter with a minimum mesh of 100 µm should be fitted if the water is to be used for this purpose.

If the pH of the rainwater is lower than 6.5 then pH correction may be necessary or appropriate, depending on the materials used in the installation.

The supply of the storage tank with drinking water, if necessary, must be undertaken in such a manner that this network is not contaminated.

ETA 0701 also contains various notes and recommendations related to the characteristics of the pumping equipment and its installation.

It should be noted that ANQIP is also currently developing a Specification in the context of reuse and recycling of gray water, through its Technical Committee CTA 0905. The studies that are being developed by the Commission relate, in large part, on the relationship between the treatments (water quality) and the possible uses, although they are also subject to study other technical aspects such as design of installations and their maintenance.

VI. Conclusion

Efficient water use is an environmental priority in all countries of the world. However, in some countries, such as Portugal and other Mediterranean countries, the development of measures in this field has become urgent because the availability of water could be significantly reduced in the short or medium term.

Special attention must therefore be given to the use of efficient products, and consumers must be able to identify these products, leading to the need for a labelling system which is easy to understand.

In Portugal, the ANQIP, a non-profit NGO, has decided to launch a voluntary water efficiency labelling system for products, similar to those developed in other countries, which was welcomed by manufacturers and consumers.

Regarding the Sustainability Rating Systems for Buildings, whose application is increasing nowadays [7][8], it should be noted that the efficient use of water should be reflected not only in relation to water parameter, but also in relation to the energy.

The estimate of savings with the use of efficient products in Portugal is more than one billion Euros per year, on water and energy (270 €/family and year).

Even though the Mediterranean climate is not really suitable for proper rainwater harvesting this should still be considered in the context of the 5R of water efficiency in buildings.

It is considered that, despite differences in climate that occur in Europe, it is advisable to draw up a European standard on this issue.

The reuse or recycling of grey water is another important measure, which is not subject to the characteristics of climate. Some aspects still have to be clarified in relation to these systems, especially the relationships between the levels of quality of the treated water and the possible uses of this water. This initiative will most certainly provide an answer to the crucial and urgent need for intervention in the field of rational water use in Mediterranean countries, aiming to guarantee in a near future the essential sustainability conditions.

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