Zuzana KRIPPELOVÁ, Jana PERÁČKOVÁ
Slovak University of Technology in Bratislava, Slovakia

MEASUREMENT OF HOT WATER CONSUMPTION IN APARTMENT BUILDING

For the right design of the system for hot water preparation it is necessary to know domestic hot water consumption. This paper determines consumption of domestic hot water in an apartment building per occupant during the day. There is a significant difference between hot water consumption during the weekend and work-days as well as during seasons. This paper analyses the consumption of hot water in the apartment building during a one-year period.

Keywords: domestic hot water, hot water consumption, apartment building

INTRODUCTION

Improving of thermal performance of building envelope reduces energy requirements for heating. Crucial energy consumption in residential building becomes the energy for hot water preparation, which is supplied to the building on a daily basis.

Optimizing of the preparation of hot water can lead to significant energy savings. To avoid overrating of a source for hot water preparation, it is necessary to know the hot water consumption per occupant and hot water needs during the day.

The paper analyzes the consumption of hot water in an apartment building during the day. Hot water consumption varies with time of day, day of week, and month of year. The paper also mentions the differences in the consumption of hot water during the different days of week and months of year.

1. BUILDING DESCRIPTION

An apartment building in Bratislava is subject of the measurements. There are 72 flats in the building inhabited by 167 residents. The residents belong to the middle class. Approximately 20% of the residents are children (0-18 years), 60% are adults, and 20% are retirees.

Domestic hot water is prepared in a plate heat exchanger and then stored in a hot water tank with a capacity of 500 liters. The delivery hot water temperature is 52°C with 95% confidence interval ±1°C.

2. MEASUREMENT OF DOMESTIC HOT WATER CONSUMPTION IN APARTMENT BUILDING

Hot water consumption varies with time of day, day of week, and month of year.

Experimental measurement was carried out in the heat exchange station in the apartment building in Bratislava. Hot water consumption of the apartment building was measured and recorded every hour throughout a period of one year from March 2013 to April 2014.

Figure 1 shows an average daily profile of hot water consumption for the apartment building. In the building there live 167 residents. To determine typical daily profile of hot water consumption per one occupant (Fig. 2), the measured data is divided by the number of inhabitants. The approximate hot water consumption for another apartment building can be determined by multiplying this typical daily profile (Fig. 2) by its number of inhabitants.

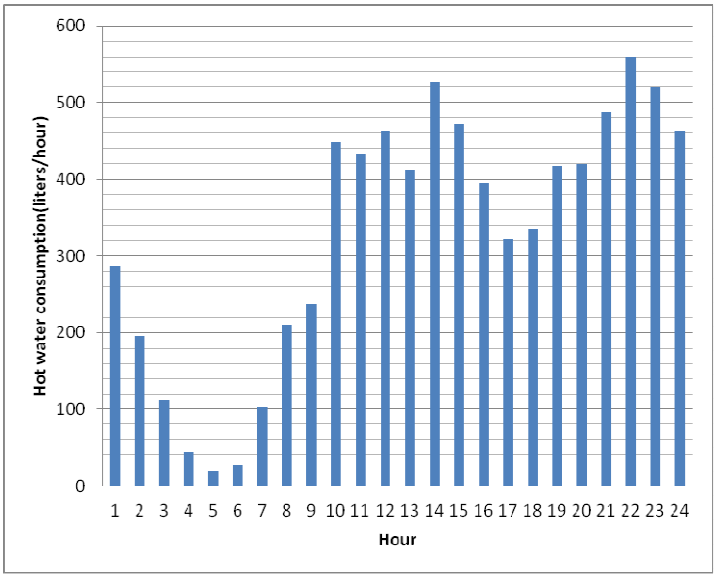

Fig. 1. Typical daily profile of hot water consumption in the apartment building

2.1. Typical daily profile of hot water consumption

Figure 2 shows a typical daily profile of hot water consumption per one occupant of the apartment building. The figure shows peaks in the morning and evening, indicating household bathing practices as well as the peak around meal times due to cooking and dishwashing usage. The largest hot water consumption (3.4 liters/hour per one occupant) happens at 23:00 in the evening. Another peak with the consumption 3.2 liters/hour per one occupant is during the lunch time at 14:00.

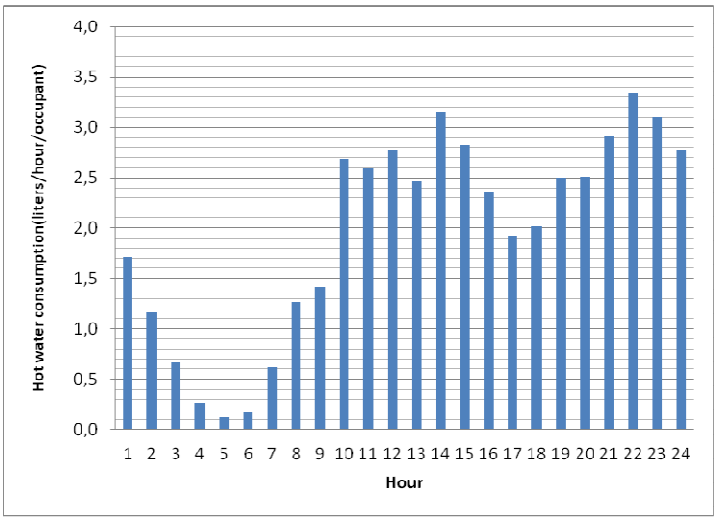

Fig. 2. Typical daily profile of hot water consumption per one occupant

2.2. Typical daily profile of hot water consumption during the week

There are different usage patterns during weekdays and weekends. Therefore, separate profiles of hot water consumption were made for these periods. Figure 3 shows average profiles for weekdays and weekends.

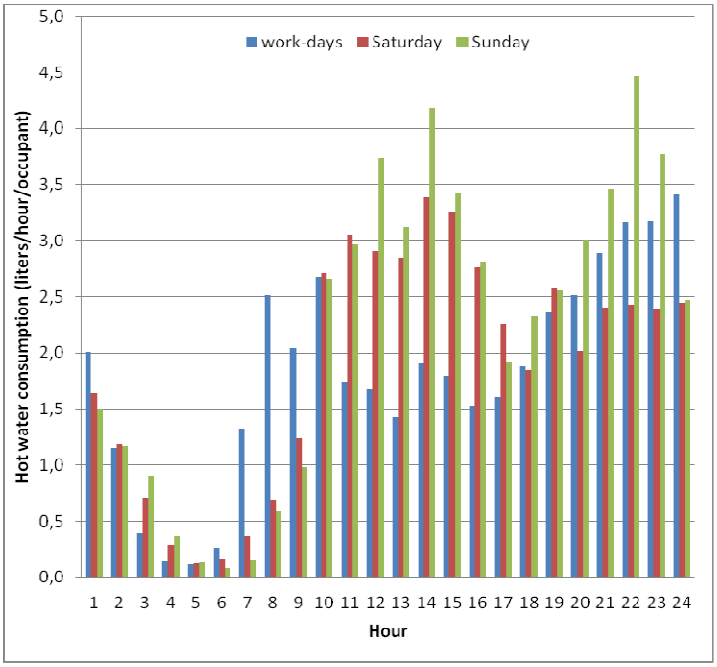

Fig. 3. Typical daily profile of hot water consumption during the week

The weekend profile of DHW consumption shows a very large peak (4.2 l/hr/ /occupant) after lunch time at 14:00, while weekdays profile shows peaks of DHW consumption at 8:00 in the morning and then at 22:00 in the evening.
There is a significant difference between a Saturday and a Sunday profile. While on Saturday consumption is more similar to the weekdays, on Sunday it is the largest DHW consumption of the whole week. The weekday profile has small peaks (2.5 l/hr/occupant) in the morning at 8:00 and a very significant peak (3.4 l/hr/ /occupant) in the evening.

2.3. Average daily hot water consumption during the week

Figure 4 describes average daily hot water consumption during the week per one occupant of the apartment building. Average daily hot water consumption is about 44 liters/day during weekdays and Saturdays and 52 liters/day on Sundays.

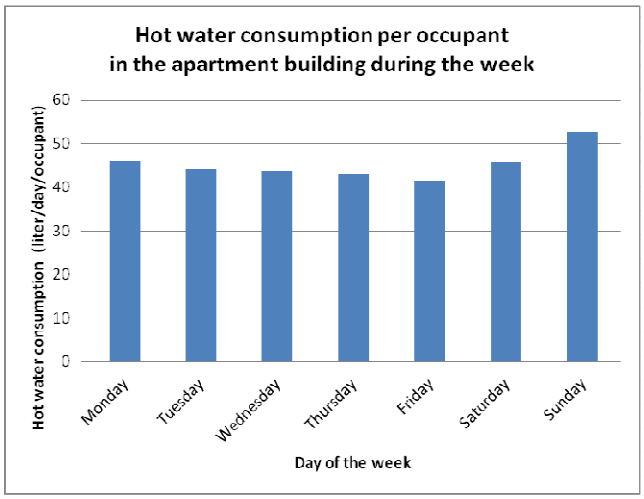

Fig. 4. Average daily hot water consumption per occupant during the week

2.4. Average daily hot water consumption during the year

Figure 5 determines average daily hot water consumption during the year per one occupant of the apartment building.
According to research the largest daily hot water consumption (about 50 liters/day/ /occupant) is in winter and spring seasons. During autumn months the average DHW consumption is about 45 liters/day per one occupant. The DHW consumption is the lowest of the whole year in the summer time - about 40 liters/day/occupant in July and 34 liters/day/occupant in August.

Annual hot water consumption of the apartment building is 2,798.92 m^3. Average annual hot water consumption is 16.76 m^3/year per one occupant.

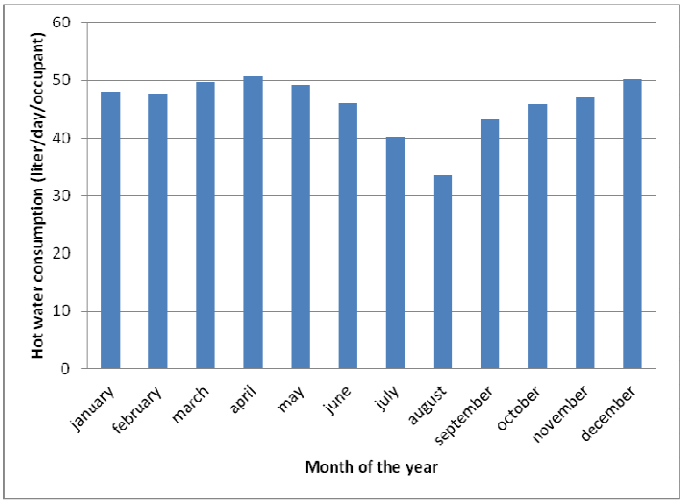

Fig. 5. Average daily hot water consumption per occupant during the year

CONCLUSION

The paper analysed hot water consumption in apartment building per one occupant. Hot water consumption varies with time of day, day of week and month of year.

A typical daily profile shows peaks in the morning and evening, indicating household bathing practices as well as the peak around meal times due to cooking and dishwasher usage. The largest hot water consumption (3.4 liters/hour per one occupant) happens at 23:00, in the evening. Another peak in consumption of 3.2 liters/hour per one occupant is during lunch time at 14:00.

Average daily hot water consumption is about 44 liters/day during the weekdays and Saturdays and 52 liters/day on Sundays. The largest daily hot water consumption (about 50 liters/day/occupant) is in winter and spring seasons. During autumn months the average DHW consumption is about 45 liters/day per one occupant. The DHW consumption is the lowest in the whole year in the summer time - about 40 liters/day/occupant in July and 34 liters/day/occupant in August.

In order to design a correct system for hot water preparation it is necessary to know the consumption of hot water. Measured data could help to determine the needs for hot water in residential buildings and subsequent adequate design of the system.

Acknowledgments

All measurements were provided with the cooperation of Bratislavská teplárenská a.s.

REFERENCES

[1] Valášek J. a kol., Zdravotnotechnické zariadenia budov, JAGA group v.o.s., Bratislava 2005.

[2] Vine E., Diamond R., Szydlowski R., Domestic hot water consumption in four low-income apartment buildings, Energy 1987, 12, 6.

[3] STN 063020 Ohrievanie úžitkovej vody. Navrhovanie a projektovanie 1989.

[4] Zákon č. 300/2012 z 18. septembra 2012, ktorým sa mení a dopĺňa zákon č. 555/2005 Z. z. o energetickej hospodárnosti budov a o zmene a doplnení niektorých zákonov v znení neskorších predpisov a ktorým sa mení a dopĺňa zákon č. 50/1976 Zb. o územnom plánovaní a stavebnom poriadku/stavebný zákon).

[5] Vyhláška MDVRR SR z 12. novembra 2012, ktorou sa vykonáva zákon č. 555/2005 Z. z. o energetickej hospodárnosti budov a o zmene a doplnení niektorých zákonov v znení neskorších predpisov.

POMIARY ZUŻYCIA CIEPŁEJ WODY W BUDYNKU MIESZKALNYM

Poprawa izolacyjności cieplnej budynków skutkuje znacznym zmniejszeniem zapotrzebowania na energię do ich ogrzewania. Wydatek energetyczny budynków obejmuje jednak również zużycie energii na przygotowanie ciepłej wody. Optymalizacja w zakresie jej przygotowania może prowadzić do znacznych oszczędności energii. W artykule przedstawiono zużycie ciepłej wody użytkowej w budynku mieszkalnym na mieszkańca w ciągu dnia. Istnieje bowiem istotna różnica pomiędzy zużyciem ciepłej wody w czasie weekendu i dni pracy, jak również w trakcie sezonu grzewczego i poza nim. W artykule dokonano analizy zużycia ciepłej wody w budynku mieszkalnym w okresie jednego roku.

Słowa kluczowe: ciepła woda użytkowa, zużycie ciepłej wody, budynki mieszkalne