Draft of the MEP and HEP for Water Dispenser in Thailand

Kengkamon Wiratkasem and Somchai Pattana

***Abstract*— Water dispenser is one of potential energy saving household equipment which the Department of Alternative Energy Development and Efficiency (DEDE) wanted to find out the testing method and the values of Minimum Energy Performance (MEP) and High Energy Performance (HEP). The testing method from the Energy Star program in USA, Australia, Taiwan and Hong Kong are compared and composed to get the testing method for Thailand. The market survey is used to find amount of each types of water dispenser. By applying the Yamane statistical method, 30 and 32 samples of a cold and hot/cold water dispensers are tested. It is found out that the MEP of cold and hot/cold water dispensers are 0.46 and 2.91, for the HEP are in the range of 0.16 - 0.1 and 1.2 – 0.8 respectively. If all cold and hot/cold water dispensers below HEP can be upgraded to pass the HEP number, potential energy saving will be 1,247,312 and 4,564,789 kW-hr/year and CO_2 reduction about 634,882 and 2,323,478 kg/year respectively. Final draft is also passed public hearing.**

***Index Terms*— water dispenser, MEP, HEP, energy efficiency**

I. Introduction

THE water dispenser is generally divided into 3 types by water temperature, namely cold, hot and hot/cold, or 2 types by the sources of water such as tap and bottle. In 2010, the water dispenser usage are 88,620 50 and 39,639 units for cold, hot and hot/cold types respectively, most of them are made locally. In Thailand, there is only safety standard for a water dispenser, TIS2461-2552, and also the minimum energy performance as the Energy Star in the USA [1].

From the Analysis of Standards Options for Water Dispensers by Pacific Gas and Electric Company [2], in 2004 total installation of the water dispensers are 997,000 units. From the report survey of Mark Ellis & Associates in Australia [3], there is about 82,000 unit usage in 2010. Both countries have almost the same 6% growth rate.

If Thailand has the same growth rate as the USA or Australia, the peak demand of a electricity will increase. To avoid this and also get rid of a low efficiency water dispenser, the Department of Alternative Energy Development and Efficiency (DEDE) had funded this project to draft the energy efficiency testing standard and the minimum energy efficiency for a water dispenser in Thailand.

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II. Methodology

For this study, the following steps are conducted,

1) Number of brands and production are surveyed.
2) The Yamane [4] statistic sampling method with 95% confidential is applied.
3) The energy efficiency testing method is selected.
4) The minimum energy performance (MEP) and high energy performance (HEP) are recommended.

III. Results

A. Number of brands and production

From the survey in 2010, there are 16 companies which are sold about 128,309 units both locally made and import. These can be classified as follow,

- Cold water dispenser, bottle type	73,010	Unit.
- Cold water dispenser, tap water type	15,610	Unit.
- Hot/cold water dispenser, bottle type	35,247	Unit.
- Hot/cold water dispenser, tap water type	4,392	Unit.
- Hot water dispenser, bottle type	50	Unit.

B. Number of samples.

By applying the Yamane statistic method with 95% confidential, 32 samples of cold water (8 samples from tap water and 24 samples from bottle type) and 30 samples of hot/cold water dispensers (7 samples from tap water and 23 samples from bottle type) are chosen. The hot water dispenser is neglected because of very small number as compared with others.

C. The energy efficiency testing method

From the literature review, it is found that there are 4 countries that have the energy efficiency testing standards as follow,

The energy efficiency standards in the USA are :

- Energy Star : Qualifying Criteria for Water Coolers.
- Codes and Standards Enhancement Initiative for PY2004: Title 20 Standards Development: Analysis of Standards Options for Water Dispensers.

The draft of the energy efficiency standards in Australia is :

- Minimum Energy Performance Standard: Boiling and Chilled Water Dispenser.

The energy efficiency standard in Taiwan is :

- Energy Conservation Labeling Program Requirements for Cold-Warm-Hot Drinking Water Dispenser [5].

The energy efficiency standard in Hong Kong is :

- The Hong Kong Voluntary Energy Efficiency Labeling Scheme for Hot/Cold Bottled Water Dispensers [6].

All standards details are compared in Table I. It can be seen that, to set the minimum (MEP) and high (HEP) energy performance of water dispenser, all standards is used the idle (with no water being withdrawn) energy consumption for 24 hours (kW-hr/day).

D. *Details of the testing room*

For this study, the committee made the conclusion for Thailand testing standard as shown in Figure 1 with details as follow,

1) Voltage supply 220V ± 1%
2) Room temperature 25 ^{o}C ± 1 °C
3) Room relative humidity 45% to 75%
4) Distance from all walls as shown in Figure 1.
5) All walls and ceiling must be painted in black color.
6) Air velocity around the dispenser shall not exceed 0.25 m/s.
7) Cold water temperature ≤ 10 ^{o}C
8) Hot water temperature ≥ 75 ^{o}C

E. *Testing method*

There are 2 testing methods as follow,

a) Testing method for a bottle hot/cold water dispenser.

Step 1. Install the water dispenser as manufactory recommended.

Step 2. 20 kg. of 25 °C ± 1 °C water in 20 liter bottle on the water dispenser.

Step 3. Turn on the water dispenser for 2 hours.

Step 4. Measurement of dispensed water temperatures: after the disposal of the initial 100 ml water, a 250 ml ± 5 ml container shall be used to collect water and average water temperatures shall be measured at 100ml, 150ml and 200 ml water levels.

Step 5. If the cold water temperature is not exceed 10 ^{o}C, and/or hot water temperature is at least 75 ^{o}C, go to Step 6, otherwise go back to Step 4, until both temperatures is met, then go to Step 6.

TABLE I

DETAIL OF EACH STANDARDS

Details	Taiwan	Hongkong	Pacific Gas, CA	Australia	Canada	USA & Canada
Room Detail						
Room height			7 feet			≥ 7 ft (2134 mm.)
Room temp	25 ± 1 °C	25 ± 1 °C	23.8 ± 1.2 °C (75 ± 2 °F)		32 °C +/- 0.6 °C	23.8 ± 1.2 °C (75 ± 2 °F)
RH %		45% - 75%				
Wall color		black				
Air flow		≤ 0.25 m/s				
Config. Distance						
Back	≥ 65 mm.	300 mm.	≤ 152 mm. (< 6 inches)			≤ 152 mm.
Front	≥ 300 mm.	300 mm.	≥ 610 mm. (≥ 2 feet)			≥ 610 mm. (≥ 2 feet)
Top	≥ 300 mm.	300 mm.	≥ 610 mm. (≥ 2 feet)			
Side	≥ 300 mm.	300 mm.	≥ 610 mm. (≥ 2 feet)			≥ 610 mm.
Above floor	≥ 100 mm.	300 mm.	≥ 610 mm. (≥ 2 feet)			≥ 610 mm.
Measurement						
Voltage	220V ± 1%	220V ± 2%				
Watt		0.1 W ± 1%				
Hz		50Hz ± 2%				
Water Cond.						
Water withdraw	None	250 ± 5 ml.	None			
Cold Temp.		≤ 10 °C	≤ 10 °C (≤50 °F)			≤ 10 °C (≤50 °F)
Electronic CWT		≤ 15 °C				
Hot Temp.		≥ 85 °C	≥ 73.9 °C (≥165 °F)			≥ 73.9 °C (≥165 °F)
MEP (Standby)						
Bottle Cold			<0.16 kW-hr/day	< 0.16 kW-hr/day		
Bottle Hot				< 1.00 kW-hr/day		
Bottle Hot and Cold			<1.2 kW-hr/day	< 1.20 kW-hr/day		
HEP (Standby)						
Bottle Cold				< 0.12 kW-hr/day		
Bottle Hot				< 0.75 kW-hr/day		
Bottle Hot and Cold				< 0.90 kW-hr/day		
Energy Consumption						
Bottle Cold		< 0.16 kW-hr/day	0.18 kW-hr/day			≤ 0.16 kW-hr/day
Bottle Hot		< 0.75 kW-hr/day				
Bottle Hot and Cold		< 1.2 kW-hr/day	1.93 kW-hr/day			≤ 1.20 kW-hr/day

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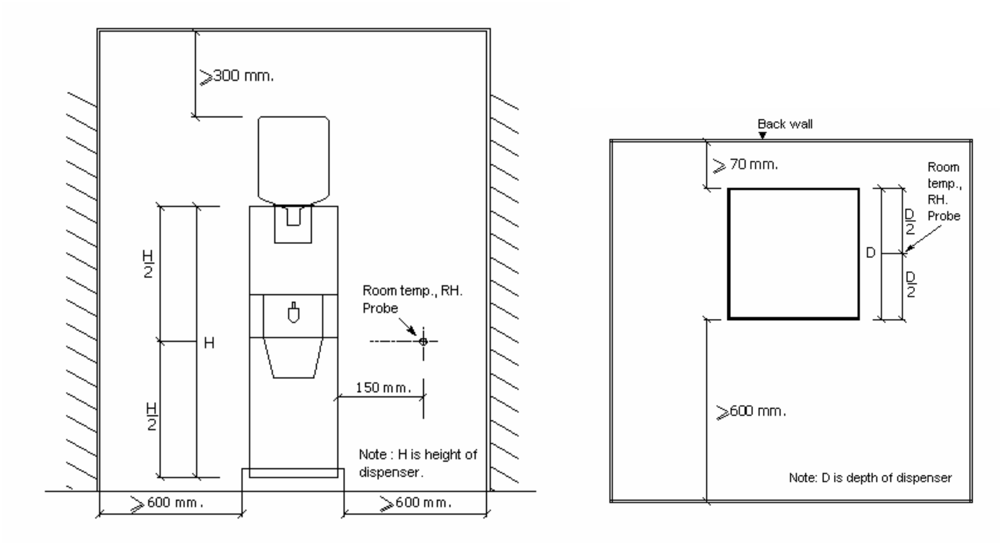

Front view   Topview

Fig. 1. Detail of the testing room.

Step 6. Let the water dispenser runs one more cycle. Then start counts the time and measures the energy consumption every 15 minutes until 24 hours is reached.

b) Testing method for a tap hot/cold water dispenser.

Step 1. Install the water dispenser as manufactory recommended.

Step 2. Connect the tap water into the water dispenser.

Step 3. Turn on the water dispenser for 2 hours.

Step 4. Measurement of dispensed water temperatures: after the disposal of the initial 100 ml water, a 250 ml ± 5 ml container shall be used to collect water and average water temperatures shall be measured at 100ml, 150ml and 200 ml water levels.

Step 5. If the cold water temperature is not exceed 10 ^{o}C, and/or hot water temperature is at least 75 ^{o}C, go to Step 6, otherwise go back to Step 4, until both temperatures is met, then go to Step 6.

Step 6. Let the water dispenser runs one more cycle. Then start counts the time and measures the energy consumption every 15 minutes until 24 hours is reached.

F. *Testing Results*

Testing results for a cold water dispenser

From Table II, it is found that the range of energy consumption is between 0.154 and 0.482 kW-hr/day with the average of 0.252 kW-hr/day and 0.114 of standard deviation. If the HEP, less or equal to 0.15 kW-hr/day as stated in all standards, is Thailand standard, only 6 out of 32 models (24.62% of total usage) will pass the standard. For the MEP, less than 0.46 kW-hr/day, 3 model (9.59% of total usage) will fail and will not be able to sell in Thailand market.

From Figure 2, it is found that increasing the size of water tank in the machine will also increase the energy consumption due to more heat loss from the tank surface.

Figure 3 shows the effect of compressor size on the energy consumption, the energy consumptions are scatter. All compressor sizes have both low and high energy consumption. So the compressor size is independent from the energy consumption.

TABLE II
ENERGY CONSUMPTION OF A COLD WATER DISPENSER

No.	TYPE	Compressor (W)	Water Temperature (^{o}C)	Energy consumption (kW-hr/day)
1	Tap water	150	9.50	0.452
2	Tap water	140	2.36	0.258
3	Tap water	150	6.90	0.572
4	Tap water	160	3.90	0.215
5	Tap water	185	8.80	0.350
6	Tap water	75	8.90	0.367
7	Tap water	75	10.00	0.169
8	Tap water	78	3.34	0.487
9	Bottle	86	8.00	0.159
10	Bottle	86	5.00	0.162
11	Bottle	86	6.50	0.217
12	Bottle	86	9.00	0.140
13	Bottle	86	7.00	0.218
14	Bottle	75	5.70	0.218
15	Bottle	75	9.70	0.482
16	Bottle	77	9.40	0.202
17	Bottle	78	10.00	0.158
18	Bottle	78	8.24	0.230
19	Bottle	78	9.63	0.391
20	Bottle	78	6.64	0.212
21	Bottle	78	8.20	0.186
22	Bottle	79	4.00	0.171
23	Bottle	79	5.00	0.154
24	Bottle	79	4.70	0.201
25	Bottle	96	6.50	0.235
26	Bottle	96	4.67	0.299
27	Bottle	96	6.50	0.238
28	Bottle	96	9.60	0.159
29	Bottle	96	10.00	0.201
30	Bottle	96	9.20	0.175
31	Bottle	96	6.86	0.243
32	Bottle	90	11.80	0.147
		Average		0.252
		Standard deviation		0.114

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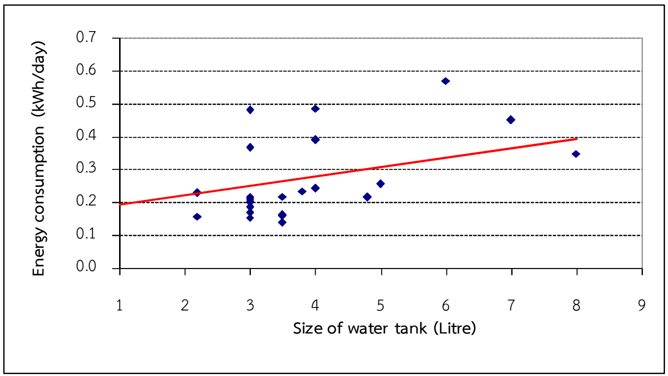

Fig. 2. Effect of a tank size on the energy consumption of a cold water dispenser.

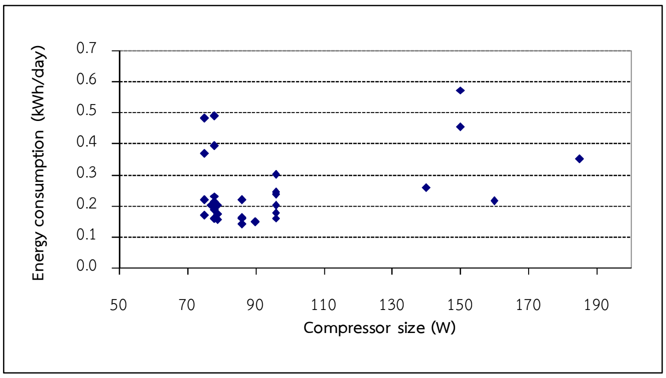

Fig. 3. Effect of compressor size on the energy consumption of a cold water dispenser.

From theoretical, there are more factors that effect the energy consumption such as the ON-OFF range of thermostat and the surface of evaporator, but this project has not study in depth

Testing results for a hot/cold water dispenser

From Table III, it is found that the range of energy consumption is between 0.825 and 3.235 kW-hr/day with the average of 1.781 kW-hr/day and 0.614 of standard deviation. If the HEP, less or equal to 1.20 kW-hr/day as stated in all standards, is Thailand standard, only 5 out of 30 models (9.87% of total usage) will pass the standard. For the MEP, less than 2.91 kW-hr/day, 2 model (4.84% of total usage) will fail and will not be able to sell in Thailand market.

The effects of cold water part on the energy consumption are the same as the cold water dispenser.

For the hot water part, there are 19 out of 30 models have no insulation so that the energy consumption is very high and all of these should not pass the performance test. The effects of a hot water tank size, heater and thermostat show no clear conclusion so further study is needed.

G. Effect of Purpose MEP and HEP on the Energy Saving Potential

Table IV shows purpose MEP and HEP of both cold water and hot/cold water dispensers. By the assumption if all cold water and hot/cold water dispensers below HEP can be upgraded to pass the HEP number, potential energy saving will be 1,247,312 and 4,564,789 kW-hr/year and CO_2 reduction about 634,882 and 2,323,478 kg/year respectively.

TABLE III
ENERGY CONSUMPTION OF HOT/COLD WATER DISPENSER

No.	TYPE	Hot Water Temperature (°C)	Cold Water Temperature (°C)	Energy consumption (kW-hr/day)
1	Tap water	82.84	6.27	1.183
2	Tap water	80.80	9.50	1.046
3	Tap water	82.50	7.00	1.647
4	Tap water	76.00	7.90	0.832
5	Tap water	80.20	5.60	1.263
6	Tap water	80.30	9.50	1.372
7	Tap water	78.90	7.00	2.258
8	Bottle	84.80	7.30	1.407
9	Bottle	80.30	8.30	1.452
10	Bottle	74.80	6.36	2.092
11	Bottle	82.00	4.90	1.937
12	Bottle	82.27	7.46	2.065
13	Bottle	82.30	8.80	1.036
14	Bottle	78.50	5.40	1.293
15	Bottle	87.00	5.10	2.534
16	Bottle	81.80	5.70	1.424
17	Bottle	80.90	7.10	3.187
18	Bottle	76.20	7.90	1.770
19	Bottle	76.00	8.20	2.134
20	Bottle	74.20	6.90	2.047
21	Bottle	77.60	4.90	2.387
22	Bottle	78.63	7.90	1.757
23	Bottle	82.40	5.50	2.112
24	Bottle	77.50	10.00	1.225
25	Bottle	76.20	7.90	0.825
26	Bottle	82.30	9.00	1.711
27	Bottle	78.60	4.50	3.235
28	Bottle	80.00	9.70	2.336
29	Bottle	84.00	9.70	1.623
30	Bottle	77.40	7.10	2.228
		Average		1.781
		Standard deviation		0.614

TABLE IV
PURPOSE MEP AND HEP OF A COLD WATER DISPENSER

	Energy consumption for cold water dispenser (kW-hr/day)	Energy consumption for hot/cold water dispenser (kW-hr/day)
MEP	0.46	2.91
HEP	0.16	1.20

IV. CONCLUSION

If the HEP is Thailand standard, only 6 out of 32 models of cold water dispenser and only 5 out of 30 models of hot/cold water dispenser will pass the standard. For the MEP, 3 models of cold water dispenser and 2 models of hot/cold water dispenser will fail and cannot sell in Thailand market. Yearly electric power saving potential for cold water dispenser is 1,247,312 kW-hr, which is equivalent to 4,091,182 Baht, and also CO_2 reduction of 634,882 kg. For hot/cold water dispenser, yearly electric power saving potential is 4,564,789 kW-hr, which is equivalent to 14,972,508 Baht, and CO_2 reduction of 2,323,478 kg.

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