2008

Conducted by: Center for Energy-saving Research

School of Architecture

Huanan University of Science and Technology

Guangzhou, Guangdong, CHINA

Summary: The test program was carried out at the Huanan Univeristy of Science and Technology's Center for Energy-saving Research, using two of its fully-instrumented real-size rooms, during the late summer of 2008. The test lasted seven days from September 26 to October 3, with maximum temperature exceeding 30C (85F), comparing the difference in electricity consumption between the two rooms, one's exterior walls and roof coated with INSULADD-added exterior paint and the other not. The test resulted in a significant energy-saving of 24.8% from the former where INSULADD-added paint was applied.

ENERGY-SAVING TEST REPORT

INSULADD - Insulating Paint Additive

□□□□□□□□□-□□□□□□□□□□

Center for Energy-saving Research

School of Architecture

Huanan University of Science and Technology

Guangzhou, Guangdong, CHINA

Summary: The test program was carried out at the Huanan Univeristy of Science and Technology's Center for Energy-saving Research, using two of its fully-instrumented real-size rooms, during the late summer of 2008. The test program, which lasted seven days from

September 26 to October 3, with maximum temperature exceeding 30^{O}C (85^{O}F), compares the difference in electricity consumption between the two rooms, one's exterior walls and rooftop coated with INSULADD-added exterior paint and the other not. The test resulted in a significant energy-saving of 24.8% from the former where INSULADD-added paint was applied.

1. Objective

Through a comparative study on energy consumption from real-size test rooms to determine the energy-saving rate of buildings in Guangzhou area when the INSULADD-added ordinary exterior paint is applied to these buildings. The findings will offer fundamentally-sound experimental data for INSULADD's application to exterior walls and rooftops of buildings in China's hot-summer/warm-winter regions.

2. Scope

2.1 Method of testing:

Selected two energy-saving test rooms - two typical office rooms, identical in structure, adjacent-room condition, interior heat environment including A/C temperature setting and working schedule. Both rooms are made of metal-boards, with inside and outside wall thickness of 2mm sandwiched with 4.6mm EPS material. The rooftop is made of inside and outside metal-wallboards of 3mm in thickness insulating with 9.4mm EPS in between. The exterior walls and the roof of one room (called "Treated Room," TR) were coated with INSULADD-added exterior paint; those of the other (called "Untreated Room," UR) were coated only with the same regular exterior paint without INSULADD serving for comparison purpose. The paint used was a Dulux Weather-shield Plus Paint, an ordinary exterior paint. INSULADD was added to the paint with a ratio of 1 to 9 by weight. In addition, a 10% of water by weight was added to dilute the mixture. Photos of the test site, testing in progress, and the data collection system are given in Appendix 1.

Thermal probes for temperature measurement at various points in the rooms are given in Table 1 below. Exact locations of these probes are shown in Appendix 2.

Table 1 Thermal Probe Locations

Probe	Number of	Location measurement was made

	temperature measuring points	
1	1	TR's southern exterior wall
2	1	TR's southern interior wall
3	1	TR's indoor air temperature
4	1	TR's northern interior wall
5	1	TR's northern exterior wall
6	1	TR's roof temperature
7	1	UR's southern exterior wall
8	1	UR's southern interior wall
9	1	UR's indoor air temperature
10	1	UR's northern interior wall
11	1	UR's northern exterior wall
12	1	UR's roof temperature
13	1	TR's ceiling temperature
14	1	UR's ceiling temperature
Total	14	

2.2 Test Instrument and Layout

2.2.1 Test Instrument

All instruments and equipment are FLUKE Hydra digital data collection type. All 14 temperature probes are thermal couples.

2.2.2 Test Process and Layout

All temperature probes were coated with Vaseline to enhance its thermal conductivity for better temperature measurement. The two indoor air temperature probes were covered by a cone-shaped tin-foil to eliminate the interference of heat from solar radiation. Other probes used for exterior temperature measurement were all coated with Vaseline as well as one coat of paint (with or without INSULADD) – for more accurate temperature measurement.

2.3 Testing and Notes Related to Testing

Test dates 2008.09.26□2008.10.03□

Time 8:00□18□00

Test condition Throughout testing the air-conditioning units at both the UR and TR rooms were maintained at 26°C, the government required winter temperature setting. Temperature probe readings were recorded via the digital data collection device on ten-minute intervals. Rooms adjacent to the UR and TR rooms also had their room temperature controlled by A/C at 26°C. Electricity usage by the UR and TR rooms were recorded on hourly basis to determine the usage throughout the day. Total number of days tested were seven; most days were sunny, occasionally cloudy. Maximum air temperatures outside during the days were all above 30°C.

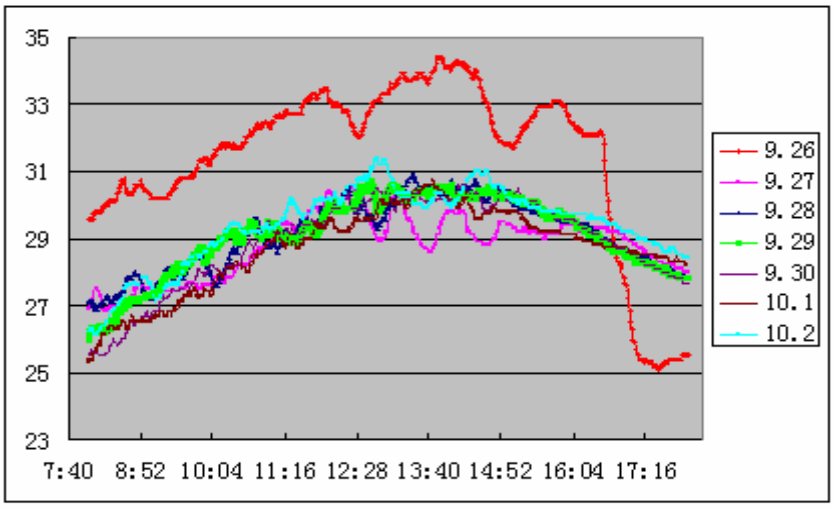


Figure 1 Outdoor Air Temperature during Testing Period

(Data provided by Wushan Weather Station, Guanghzou, Guangdong, CHINA)

3. Data Reduction

3.1 Calibration and correction of Collected Data

Upon completing the field measurement, all collected temperature data were calibrated against an officially calibrated mercury thermometer; and then all went through a linear regression analysis (see Appendix 3). The obtained data were then corrected against these curves.

3.2 Test Results

3.2.1 Electricity Consumption and Average Indoor Temperature

Table 2 presents the daily electricity consumption of the UR and TR rooms throughout the day; whereas Table 3 shows their respective daily average indoor temperatures.

Table 2 Electricity Consumption of Treated and Untreated Rooms

Date	Time of day	Electricity Consumption (degree)- TR	Electricity Consumption (degree) - UR	Percent of Energy Saving
2008.09.26	9□00□18□00	8.4	10.6	20.8
2008.09.27	8□00□18□00	3.55	4.9	27.6
2008.09.28	8□00□18□00	4.05	6.75	40.0
2008.09.29	8□00□18□00	3.6	5.55	35.0
2008.09.30	8□00□18□00	4.88	6.5	24.9
2008.10.01	8□00□18□00	4.66	5.55	16.0
2008.10.02	8□00□18□00	3.96	5.85	32.3
Total consumption in 7days		33.1	45.7	27.6

Table 3 Average Temperature During Testing

Date	Time of day	Average Temp ^{o}C - TR	Average Temp ^{o}C - UR	Temp Difference, ^{o}C
2008.09.26	9□00□18□00	24.56	24.80	-0.14
2008.09.27	8□00□18□00	25.49	24.95	0.54
2008.09.28	8□00□18□00	24.91	25.16	-0.25
2008.09.29	8□00□18□00	25.15	24.58	0.57
2008.09.30	8□00□18□00	24.20	24.09	0.11
2008.10.01	8□00□18□00	24.44	24.58	-0.14
2008.10.02	8□00□18□00	24.71	24.51	0.2

Average indoor temperature in 7days	24.78	24.67	0.11

3.2.2 Temperature Probes Data Analysis

Because of the similar characteristics of the collected temperature throughout the seven days of testing period, we have chosen herein the data from September 26th as an example for analysis of the temperature measured at various points: both above and below the rooftop and inside and outside of walls at the southern and the northern walls, for the Treated and Untreated Rooms. In the following figures, ■ are data points for the TR room; and ▲ for the UR room.

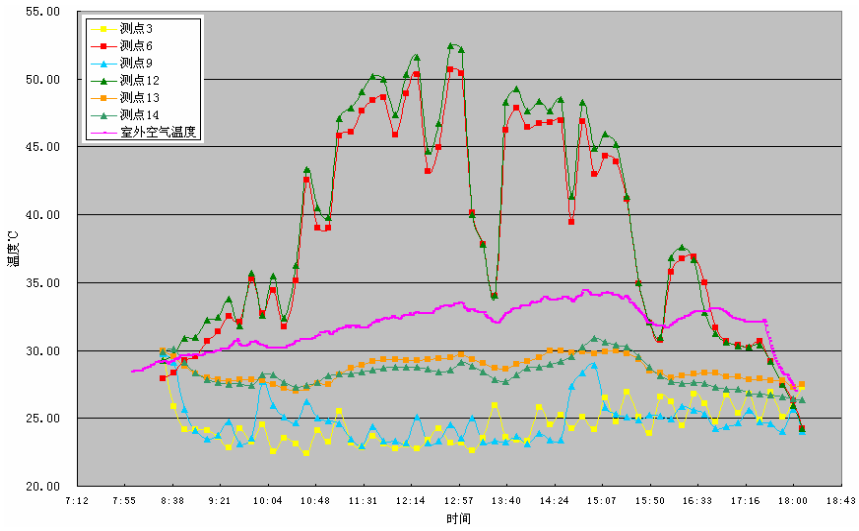


Figure 2 Comparison of Temperature readings at points above and below the rooftop of UR and TR rooms – Sept. 26, 2008

Figure 2 shows the distribution of temperature readings at points both above and below the rooftops of the UR and TR rooms on September 26, 2008. It can be seen that in most cases the outside (rooftop) temperature of the TR room is 0 to 2°C lower than those of the UR's. At 1pm, both the roof and ceiling temperatures were lowered substantially most likely because of the cloud coverage. Because the indoor temperature was controlled by A/C, it resulted in a very small temperature difference between the two rooms. Throughout the testing period, the average indoor temperature of the TR room was 24.56°C; whereas that of the UR room was at 24.80°C; with

a difference of 0.14°C. The probes were placed at the same location of its respective room, 1.5m above ground but a bit skewed to the wall where the A/C unit was located. That was the reason why the temperature readings were lower; as compared with the overall indoor temperature, which was in between 25 and 26°C.

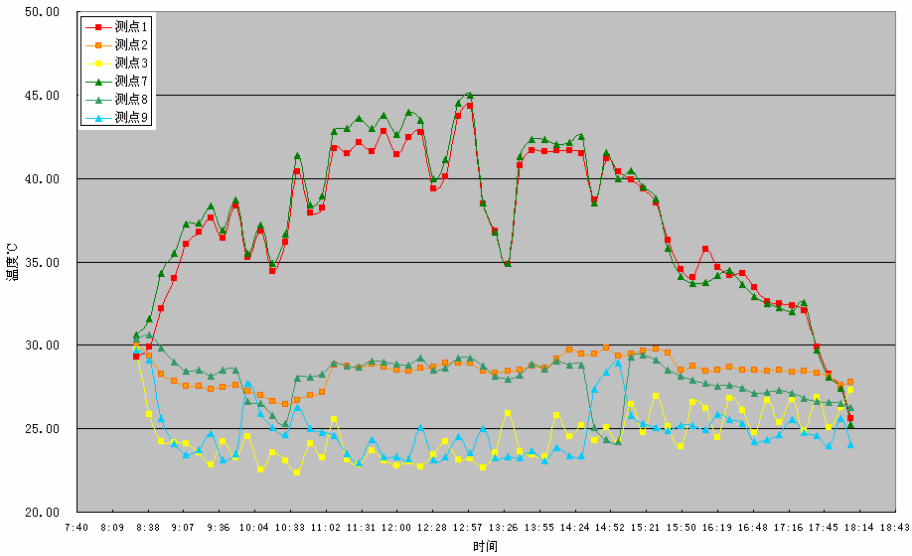


Figure 3 Comparison of Temperature readings on the southern interior and exterior walls of UR and TR – Sept. 26, 2008

Figure 3 shows that the temperature on the exterior southern wall of the TR room is in general 0 to 1.6°C lowered than those on the same location of the UR room. The temperatures measured at Probes 2 and 8 do not show a fixed trend, probably was affected by the indoor temperature. The reading on the interior southern wall of the UR room showed a sudden drop at 14:52, which was caused by an unexpected shifting of the air-flow deflector of the A/C unit, thereupon let the direction of the cold air blowing onto the probe directly. The problem was rectified as soon as it had been discovered.

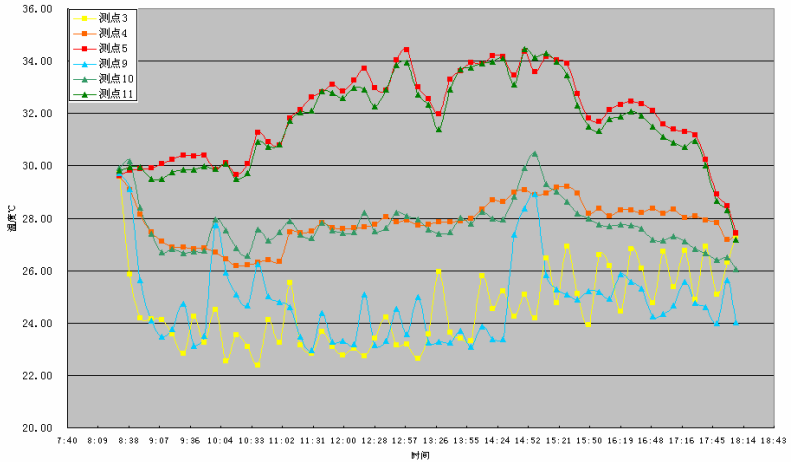


Figure 4 Comparison of Temperature readings on the northern interior and exterior walls of UR and TR rooms – Sept. 26, 2008

Figure 4 compares the temperature measurements on the northern interior and exterior walls between the UR and TR rooms. It seems that the temperatures on the northern exterior wall of the TR room are 0 to 0.8°C higher than those measured on the northern exterior wall of the UR room, most likely due to the fact that there is a semi-transparent plastic awning cover over the northern exterior wall of the UR room where the temperature probe was placed, whereas no plastic cover for the TR room.

4. Summary

Based on the electricity consumption data in Table 2, the Treated Room (TR) shows an energy-saving rate of 27.6% over the Untreated Room (UR). A 10% correction was made on this saving rate based on the average indoor temperature data given in Table 3, where it showed that the temperature in the Treated Room is 0.11°C higher than that of the Untreated Room. And the adjusted energy-saving rate is 27.6% x 0.9 = 24.8%.

Temperature data collected from the thermal probes placed on the rooftops and the southern exterior walls showed that the temperature on the rooftop of the Treated Room was 0 to 2°C lower than that of the Untreated Room; whereas the temperature on the southern exterior wall of the Treated Room was 0 to 1.6°C lower than its counterpart of the Untreated Room. The rooftop and the southern walls are the primary routes for solar rays entering the rooms. When the Treated Room was coated with INSULADD-added paint, it offers a better solar reflection capability than the Untreated Room that was painted with the same paint without INSULADD, as reflected by the lower temperature readings as described just above. When the heat flux into a room is reduced,

thereupon the electricity consumption from its air-conditioning unit. And this is where the 24.8% energy-saving rate is coming from.

Appendix 1 Test Photos

Ordinary exterior paint used in testing

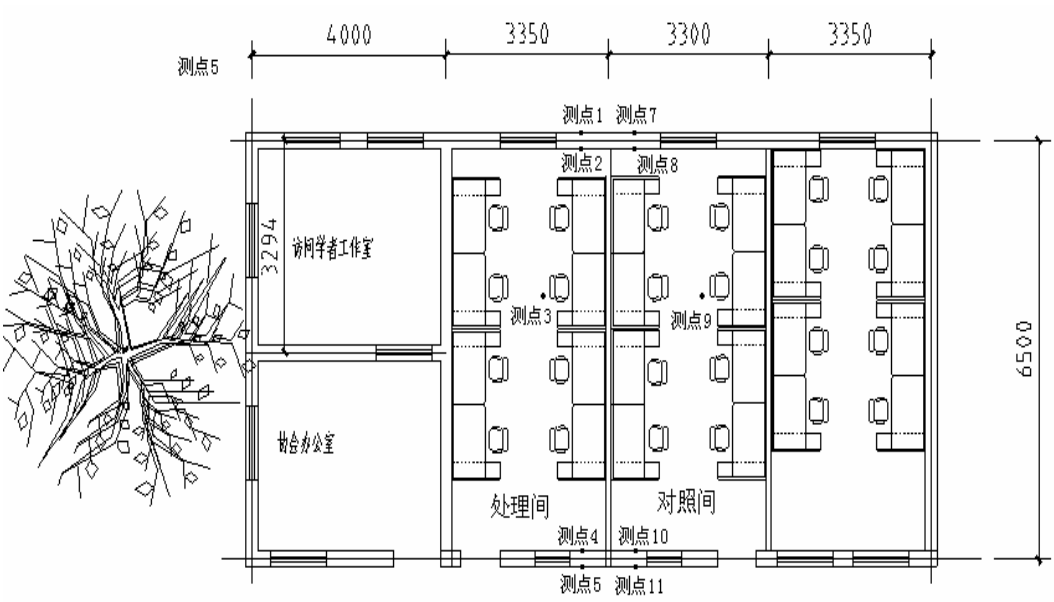
Front of the Treated Room

Front of the Untreated Room

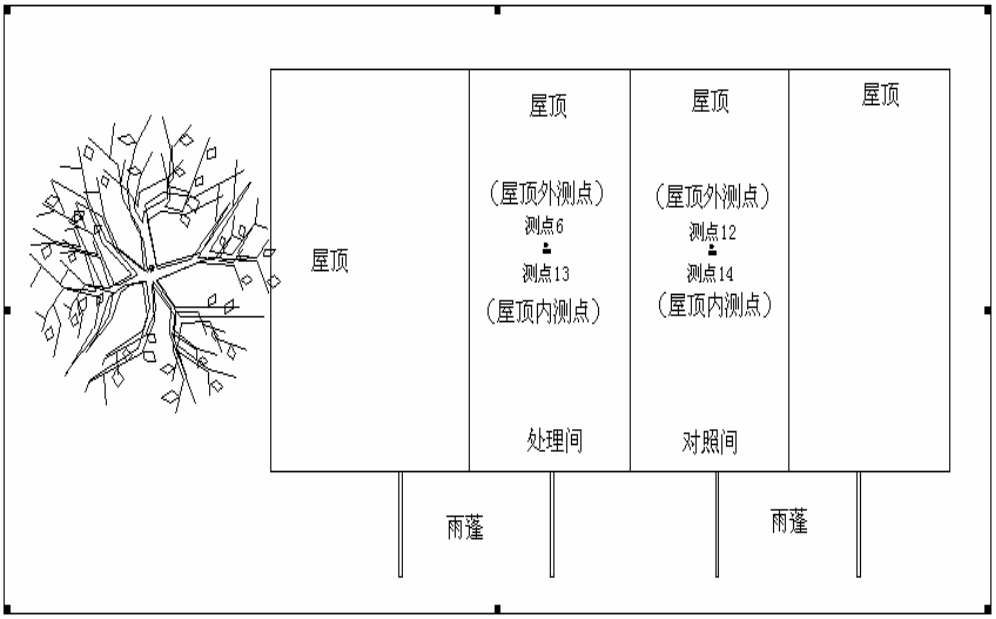
Painting the rooftop

Digital data collection device - Fluke

Appendix 2, Layout of Thermal Probes

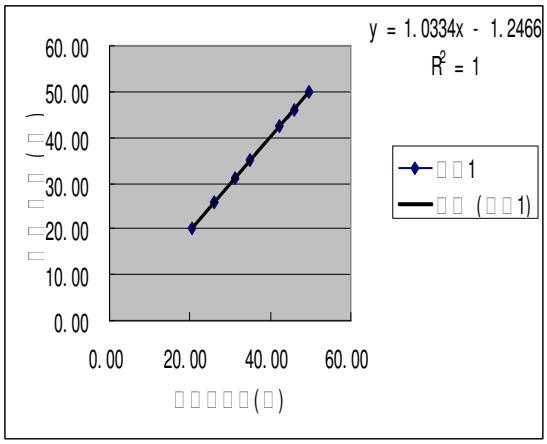


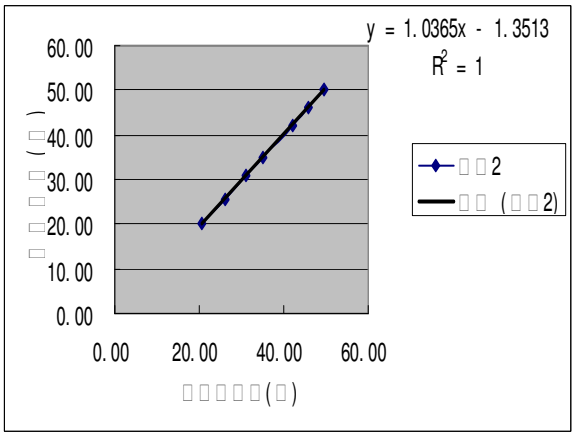
Layout of Thermal Probes (Exterior and Interior walls) – Treated Room is on the left.

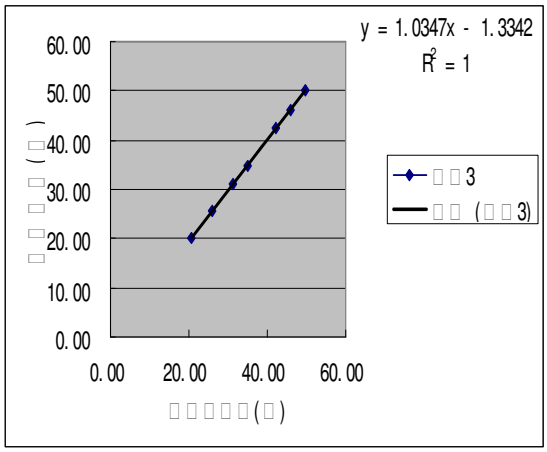


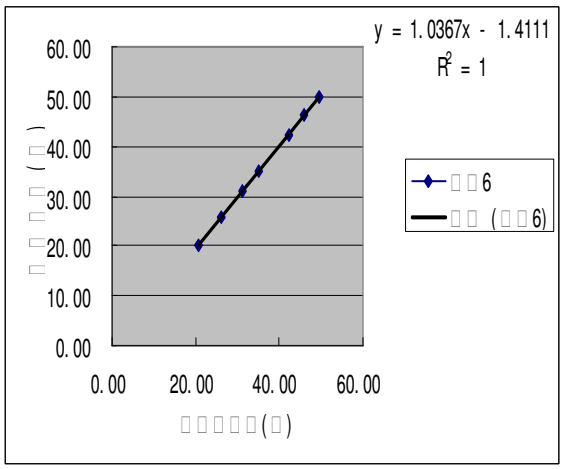
Layout of Thermal Probes (Rooftops)

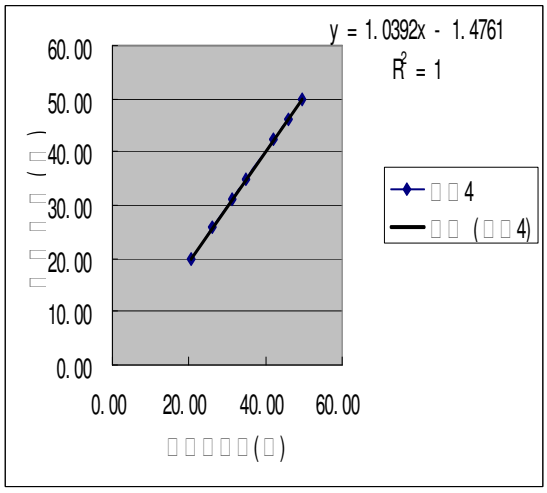
Appendix 3 Calibration of Temperature Measurement Probes

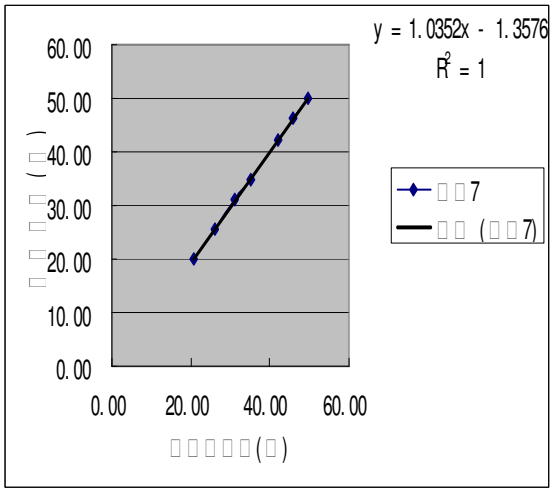


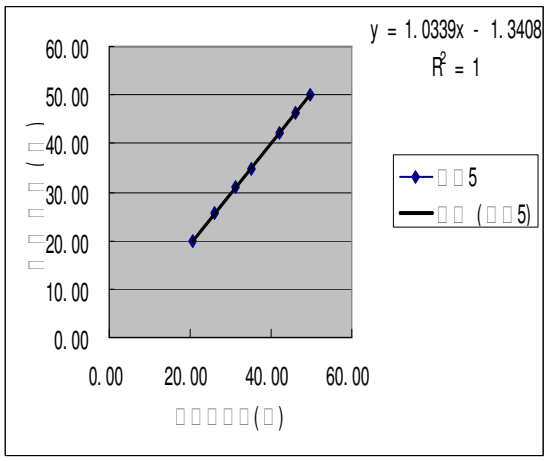


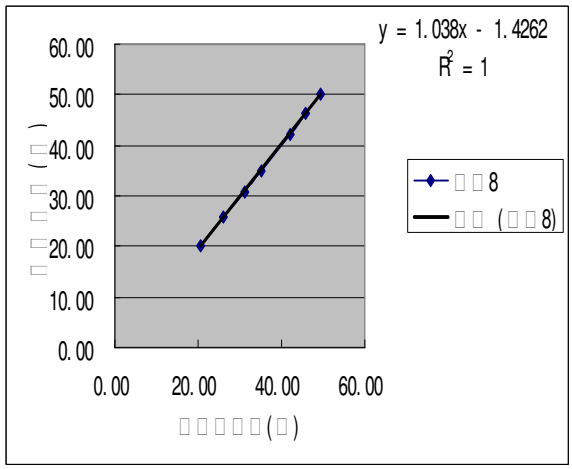

y = 1.0347x - 1.3342
R2 = 1
60.00
50.00
40.00
30.00
20.00
10.00
0.00
0.00
20.00
40.00
60.00

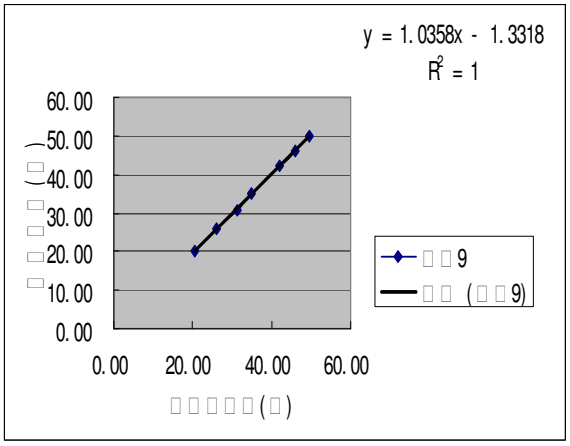

y = 1.0367x - 1.4111
R2 = 1
60.00
50.00
40.00
30.00
20.00
10.00
0.00
0.00
20.00
40.00
60.00

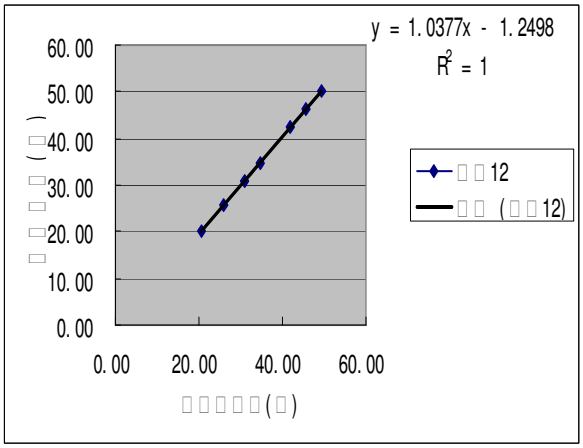

y = 1.0392x - 1.4761
R2 = 1
60.00
50.00
40.00
30.00
20.00
10.00
0.00
0.00
20.00
40.00
60.00

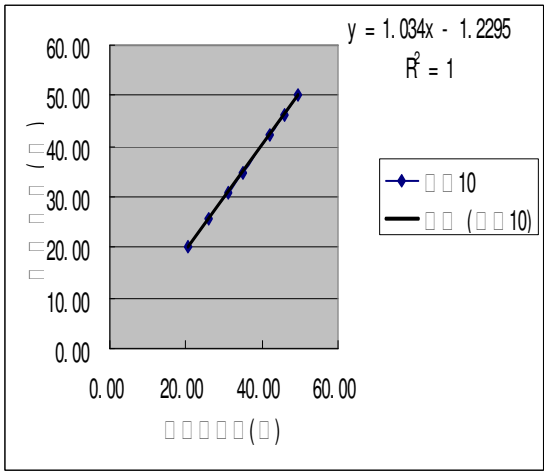

y = 1.0352x - 1.3576
R2 = 1
60.00
50.00
40.00
30.00
20.00
10.00
0.00
0.00
20.00
40.00
60.00

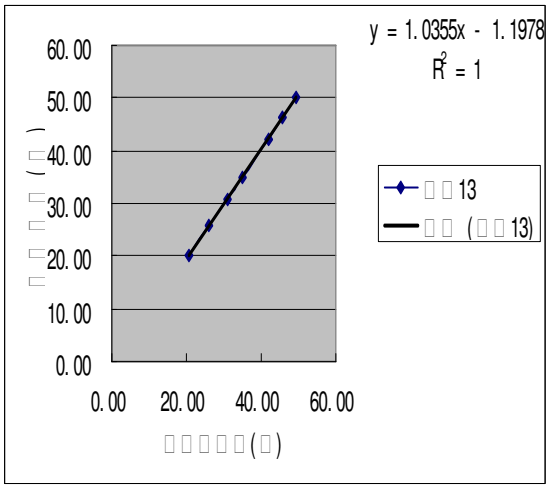

y = 1.0339x - 1.3408
R2 = 1
60.00
50.00
40.00
30.00
20.00
10.00
0.00
0.00
20.00
40.00
60.00

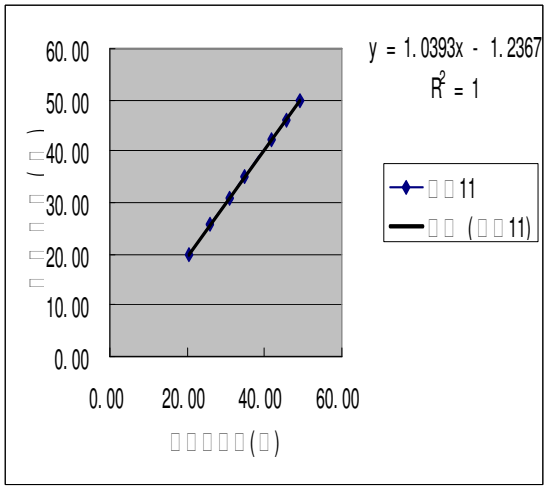

y = 1.038x - 1.4262
R2 = 1
60.00
50.00
40.00
30.00
20.00
10.00
0.00
0.00
20.00
40.00
60.00

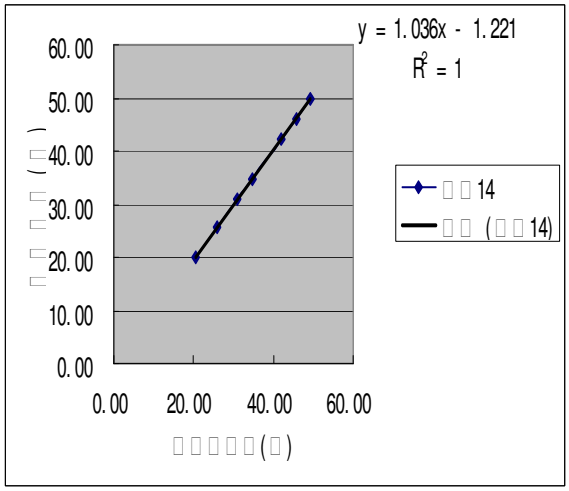

y = 1.0358x - 1.3318
R² = 1
60.00
50.00
40.00
30.00
20.00
10.00
0.00
0.00
20.00
40.00
60.00
9
(9)


y = 1.0377x - 1.2498
R² = 1
60.00
50.00
40.00
30.00
20.00
10.00
0.00
0.00
20.00
40.00
60.00
12
(12)


y = 1.034x - 1.2295
R² = 1
60.00
50.00
40.00
30.00
20.00
10.00
0.00
0.00
20.00
40.00
60.00
10
(10)


y = 1.0355x - 1.1978
R² = 1
60.00
50.00
40.00
30.00
20.00
10.00
0.00
0.00
20.00
40.00
60.00
13
(13)


y = 1.0393x - 1.2367
R² = 1
60.00
50.00
40.00
30.00
20.00
10.00
0.00
0.00
20.00
40.00
60.00
11
(11)


y = 1.036x - 1.221
R² = 1
60.00
50.00
40.00
30.00
20.00
10.00
0.00
0.00
20.00
40.00
60.00
14
(14)