Accuracy Improvement for Estimating Indoor Carbon Dioxide Concentration Produced by Occupants

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Japanese body surface area

$$A_D = 0.007246 \times W_b^{0.425} \times H_b^{0.725}$$

Table1 Coefficient of Age

Age	male	female
18-29	1.00	1.00
30-49	1.01	1.04
50-69	0.92	0.99
70-	0.85	0.92

Improvement 1

Equation of Japanese CO_2 Production Rate

$$P_{CO_2} = 1.601 \times 10^{-4} (60.63 \times A_D \times Met \times C_a \times C_g)$$

Where

P_{CO_2} : Carbon dioxide production rate [m³/h]
A_D : body surface area [m²]
Met : metabolic rate [-]
C_a : coefficient of age [-] shown in table1
C_g : coefficient of gender [-] (male:1.00, female:0.73)
W_b : body weight [kg]
H_b : body height [cm]

This equation is revised from the previous equation (Eq(2014)) by transforming the expression and adding the age factor. The R^2 is improved from 0.8087 to 0.8525.

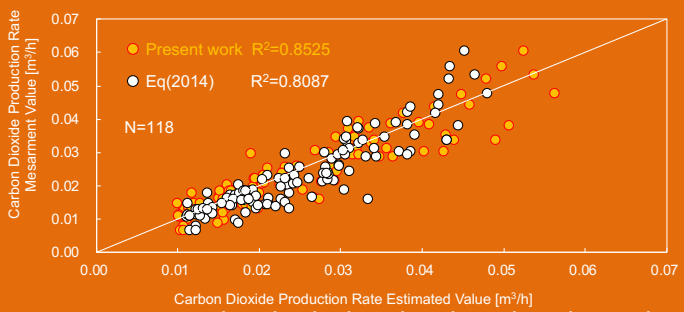


Figure 1: Measured and calculated carbon dioxide production rate

More information about the equation can be seen in the following papers.

TAJIMA, M. INOUE, T. OHNISHI, Y., (2014) Derivation of Equation for Personal Carbon Dioxide in Exhaled Breath Intended to Estimation of Building Ventilation, AIVC, 427-435

TAJIMA, M. INOUE, T. OHNISHI, Y., (2016) Estimation of Occupants Carbon Dioxide Production Rate for Measurement of Ventilation, J. Environ. Eng., AIJ, Vol. 81 No. 728, 885-892

Improvement 2

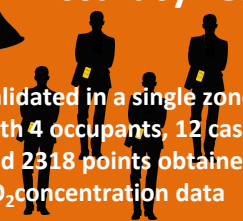
Use of Wearable Activity Meter to Measure *Met* Value

Validated by 130 subjects in 10 actions

In previous studies on accuracy check in calculating indoor carbon dioxide concentration by the authors, *Met* values were set as referenced value (e.g. ASHARAE, 2013) determined by visual judgement. By obtaining Met value using a wearable activity meter, accuracy of occupants' Met value is checked by comparing with Douglas bag method.

The Standard Error of the activity meter's *Met* value is 0.03 while the Standard Error of using referenced value is 0.05 from the experimental results with totally 130 subjects in 10 actions.

Accuracy Tests for Estimation of Indoor CO_2 Concentration



Validated in a single zone with 4 occupants, 12 cases and 2318 points obtained CO_2 concentration data

The Standard Error of estimated CO_2 concentration is improved from 2.0ppm, which is using referenced value, to 1.0 ppm from the experimental results in a single zone with 4 occupants, 12 cases and 2318 points obtained CO_2 concentration data.

These results suggest that estimation method using the equation can give accurate indoor carbon dioxide concentration and can ensure more correct calculation results utilising the activity meters.

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