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Optimization of CO_2 production rate for firefighting robot applications using response surface methodology (Article) (Open Access)

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Correction to: Optimization of CO2 production rate for firefighting robot applications using response surface methodology (Cogent Engineering, (2018), 5, 1, (1-17), 10.1080/23311916.2018.1555744)
(2018) Cogent Engineering, 5 (1), p. 1.

Abstract

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A carbon dioxide gas-powered pneumatic actuation has been proposed as a suitable power source for an autonomous firefighting robot (CAFFR), which is designed to operate in an indoor fire environment in our earlier study. Considering the consumption rate of the pneumatic motor, the gas-powered actuation that is based on the theory of phase change material requires optimal determination of not only the sublimation rate of carbon dioxide but also the sizing of dry ice granules. Previous studies that have used the same theory are limited to generating a high volume of carbon dioxide without reference to neither the production rate of the gas nor the size of the granules of the dry ice. However, such consideration remains a design requirement for efficient driving of a carbon dioxide-powered firefighting robot. This paper investigates the effects of influencing design parameters on the sublimation rate of dry ice for powering a pneumatic motor. The optimal settings of these parameters that maximize the sublimation rate at the minimal time and dry ice mass are presented. In the experimental design and analysis, we employed full-factorial design and response surface methodology to fit an acceptable model for the relationship between the design factors and the response variables. Predictive models of the sublimation rate were examined via ANOVA, and the suitability of the linear model is confirmed. Further, an optimal sublimation rate value of 0.1025 g/s is obtained at a temperature of 80°C, the mass of 16.1683 g, and sublimation time of 159.375 s.

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1 Ajala, M.T., Khan, M.R., Shafie, A.A., Salami, M.J.E., Mohamad Nor, M.I.
Prediction of dry ice mass for firefighting robot actuation (Open Access)
(2017) *IOP Conference Series: Materials Science and Engineering*, 260 (1), art. no. 012023.
http://www.iop.org/EJ/journal/mse
doi: 10.1088/1757-899X/260/1/012023
View at Publisher

2 Ajala, M.T., Khan, M.R., Shafie, A.A., Salami, M.J.E.
(2016) *Development of a New Concept for Fire Fighting Robot Propulsion System. In International Conference on Material, Industrial and Mechanical Engineering (ICMIME2016) (pp. 90–91). Kuala Lumpur, Malaysia: ICONTES2016.*

3 AlHaza, T., Alsadoon, A., Alhusinan, Z., Jarwali, M., Alsaif, K.
New concept for indoor fire fighting robot
(2015) *Procedia–Social and Behavioral Sciences*, 195, pp. 2343-2352. Cited 4 times.

4 Amano, H.
). Present status and problems of fire fighting robots
(2002) *Proceedings of the 41St SICE Annual Conference*, 2, pp. 880-885. Cited 14 times.
SICE 2002, Osaka: IEEE

5 Barker, T.B., Milivojevich, A.
(2016) *Quality by Experimental Design*. Cited 209 times.
4th ed, Boca Raton, CRC Press

6 Cavazzuti, M.
Optimization methods: From theory to design scientific and technological aspects in mechanics
(2013) *Optimization Methods: From Theory to Design Scientific and Technological Aspects in Mechanics*, pp. 1-262. Cited 112 times.
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