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ANALYSIS OF RESPIRATORY QUOTIENT RQ IN PROCESS OF BIOMASS DECOMPOSITION IN THE LAB TECHNICS

ANALIZA WSPÓŁCZYNNIKA ODDECHOWEGO RQ W PROCESIE ROZKŁADU BIOMASY TECHNIKĄ LABORATORYJNĄ

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Abstract

Biomass biodegradation under aerobic condition was investigated. The source of the biomass was potato samples. The oxygen consumption and carbon dioxide rates were monitored over 24 hours, using a 2.5 L Oxymax ER-10 respirometric chamber. The chamber with a representative sample of biomass was continuously aerated and the changes in the gas concentrations were recorded (oxygen and carbon dioxide). The oxygen uptake is directly linked to the biological activity of the microorganisms and the organic matter biodegradation. Microorganisms consume oxygen in order to decay the easy-biodegradable substrate. The biomass degradation progress under the bio-chemical process under oxidization conditions was described mathematically by linear regression. The fitting of calculated curves were checked by determination coefficient R^2.

Streszczenie

Przedmiotem badań była respirometryczna metoda charakteryzowania biodegradacji biomasy w warunkach tlenowych. Źródłem biomasy były próby ziemniaków. Zapotrzebowanie na tlen i produkcję dwutlenku węgla monitorowano przez 24 godziny w komorze respirometrycznej o pojemności 2,5 dm^3 aparatu Oxymax ER-10. Komorę testową z reprezentatywną próbką biomasy napowietrzano w sposób ciągły i rejestrowano zmiany stężenia gazów (tlen i dwutlenek węgla). Pobór tlenu jest bezpośrednio związany z biologiczną aktywnością mikroorganizmów i biodegradacją materii organicznej. Mikroorganizmy zużywają tlen w celu rozkładu łatwo biodegradowalnego substratu. Postęp degradacji biomasy w procesie biochemicznym w warunkach tlenowych opisano matematycznie metodą regresji liniowej. Dopasowanie obliczonych krzywych sprawdzono za pomocą współczynnika determinacji R^2.

REFERENCES

[1] Haug R. T.: *Composting Process Design Criteria, Part I — Feed Conditioning*, Biocycle, 1986, 27 (7), 36-43.
[2] Żygadło M.: *Principles of solid waste treatment and management*, Kielce University of Technology, Kielce 2013.
[3] Tom A. P., Haridas A., Pawels R.: *Biodrying Process Efficiency:-Significance of Reactor Matrix Height,* Procedia Technology, 2016, 25, pp. 130-137.
[4] Francou C., Linères M., Derenne S., Le Villio-Poitrenaud M., & Houot S.: *Influence of green waste, biowaste and paper–cardboard initial ratios on organic matter transformations during composting*, Bioresource Technology, 2008, 99 (18), 8926-8934.
[5] Bernal M.P., Sanchez-Monedero M.A., Paredes C., Roig A.: C*arbon mineralization from organic wastes at different composting stages during their incubation with soil*, Agriculture, Ecosystems and Environment, 69, 1998, pp. 175-189.
[6] He P. J., Lü F., Shao L. M., Lee D. J.: *Oxygen limitation in static respiration activity index test*, Journal of Chemical Technology and Biotechnology, 2006, 81 (7), 1177-1184.
[7] Dębicka M., Żygadło M., Latosińska J.: *The effectiveness of biodrying waste treatment in full scale reactor*, Open Chemistry, 2017, 15(1), pp. 67-74.
[8] Binner E., Zach A.: *Biological reactivity of residual wastes and dependence on the duration of pretreatment*, Waste Management and Research, 1999, 17(6), pp. 543-555.
[9] Scaglia B., Acutis M., Adani F.: *Precision determination for the dynamic respirometric index (DRI) method used for biological stability evaluation on municipal solid waste and derived products*, Waste management, 2011, 31(1), pp. 2-9.
[10] Sidełko R., Siebielska I., Szymański K., Skubała, A., Kołacz N.: *Ocena stabilności kompostu w czasie rzeczywistym,* Inżynieria i Ochrona Środowiska, 2014, 17, pp. 221-230.
[11] Kulcu R., & Yaldiz O.: *Determination of aeration rate and kinetics of composting some agricultural wastes*, Bioresource Technology, 2004, 93(1), pp. 49-57.

[12] Jain M. S., Jambhulkar R., Kalamdhad A. S.: *Biochar amendment for batch composting of nitrogen rich organic waste: Effect on degradation kinetics, composting physics and nutritional properties*, Bioresource Technology, 2018, 253, pp. 204-213.
[13] Gea T., Barrena R., Artola A., Sánchez A.: *Monitoring the biological activity of the composting process: oxygen uptake rate (OUR), respirometric index (RI), and respiratory quotient (RQ)*, Biotechnology and Bioengineering, 2004, 88 (4), pp. 520-527.
[14] Wagland S. T., Tyrrel S. F., Godley A. R., Smith R.: T*est methods to aid in the evaluation of the diversion of biodegradable municipal waste (BMW) from landfill*, Waste Management, 2009, 29(3), pp. 1218-1226.
[15] Evangelou A., Gerassimidou S., Mavrakis N., Komilis D.: *Monitoring the performances of a real scale municipal solid waste composting and a biodrying facility using respiration activity indices*, Environmental Monitoring and Assessment, 2016, 188(5), 302.
[16] Barrena R., d'Imporzano G., Ponsá S., Gea T., Artola A., Vázquez F., ... Adani F.: *In search of a reliable technique for the determination of the biological stability of the organic matter in the mechanical–biological treated waste*, Journal of Hazardous Materials, 2009, 162(2-3), pp. 1065-1072.
[17] Gomez R. B., Lima F. V., Bolasell M. A. G., Gea T., Ferrer A. S.: *Respirometric assays at fixed and process temperatures to monitor composting process*, Bioresource Technology, 2005, 96 (10), pp. 1153-1159.
[18] Adani F., Ubbiali C., Tambone F., Scagalia B., Centemero M., Genevini P.: *Static and dynamic respirometric indicates-Italian research and studies*. In: Biological Treatment of Biodegradable Waste-technical aspects. Brucsels: The Environment DG and the Joint Research Centre of the European Commission, 2002.
[19] Cossu R., & Raga R.: *Test methods for assessing the biological stability of biodegradable waste*, Waste Management, 2008, 28 (2), pp. 381-388.
[20] Genc N.: *Evaluation by Respiration Measurements (OTR, CTR and RQ) of the Biological Activity in Sludge Digestors Operated Under Microaerobic Conditions*, Chemical and biochemical engineering quarterly, 2007, 21 (2), pp. 163-168.
[21] Gómez R. B., Lima F. V., Ferrer A. S.: *The use of respiration indices in the composting process: a review*, Waste Management & Research, 2006, 24 (1), pp. 37-47.
[22] PN- EN 15590:2011. Solid recovered fuels, Determination of potential rate of microbial self heating using the real dynamic respiration index.
[23] PN- EN 14774-3:2010. Solid biofuels, Determination of moisture content – Oven dry method, Part 3: Moisture in general analysis.
[24] PN- EN 15169:2007. Characterization of waste, Determination of loss on ignition in waste, sludge and sediments.
[25] Di Maria F., Micale C., *What is the acceptable margin of error for the oxygen uptake method in evaluating the reactivity of organic waste?*, „Waste Management'', 2014, 34 (8), pp. 1356-1361.
[26] Adani F., Badio D., Calcaterra E., Genevini P.: *The influence of biomass temperature on biostabilization-biodrying of municipal solid waste,* Bioresource Technology, 2002, 83, pp. 173-179.
[27] Scaglia B., Erriquens F. G., Gigliotti G., Taccari M., Ciani M., Genevini P. L., Adani F.: *Precision determination for the specific oxygen uptake rate (SOUR) method used for biological stability evaluation of compost and biostabilized products*, Bioresource Technology, 2007, 98(3), pp. 706-713.