

活性污泥能量含量對其馴化能力之影響

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摘要

本研究是關於活性污泥的營養條件，與污泥在馴化與分解特異性/持久性有機物質時表現的相關性。污泥培養條件包括正常哺餵(富養狀態)及長時缺食(貧養狀態)。正常哺餵情況是每天對污泥施以蔗糖和有機?; 貧養情況則是在不同的時間長度之下不供給蔗糖和?。已有證據顯示貧養者的分解能力通常比富養者較差。本研究的目的，是要測定污泥的ATP含量與污泥對持久性有機物分解能力優劣的相關性。活性污泥細胞ATP含量結果顯示，貧養的時間增長，降低了污泥的ATP含量；污泥對2, 4-D馴化時間，花費許多的ATP，因此，貧養者對2, 4-D的分解較為不利。

關鍵詞：馴化、2、4-D、持久有機物、污泥貧養、ATP含量

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參考文獻

1. Alain Zarragoitia - Gonzalez, Sylvie Schetritea, Marion Alliet, & C. A. Ulises J?uregui-Hazab. 2008. Modelling of submerged membrane bioreactor: Conceptual study about link between activated sludge biokinetics, aeration and fouling process. *Journal of Membrane Science* 2. Arbutle. 2002. Predictors of herbicide exposure in farm applicators *Int Arch Occup Environ Health*. 75(6), 406-443. Atul Naranga, Sergei S. Pilyugin. 2006. Bacterial gene regulation in diauxic and non-diauxic growth. *Journal of Theoretical Biology* 244 (2007) 326 – 348.4. Chapalamadugu, 1991, Biodegradation of Halogenated Organic Compounds. *Microbiological reviews*, Mar. 1991, p. 59-79.5. Cuban Research Institute of Sugar Cane By-products (ICIDCA). 1997. Reversed-phase C18 high-performance liquid chromatography of gibberellins GA 3 and GAI. *Journal of Chromatography A*, 782 (1997) 137-139.6. David J.B. Dalzell, 2001, An ATP luminescence method for direct toxicity assessment of pollutants impacting on the activated sewage sludge process, *Water Research* 36 (2002) 1493 – 1502, Pergamon7. Giovanni Manfredi, Gajewski, and Marina Mattiazzi. 2002. Measurements of ATP in mammalian cells. *Methods* 26 (2002) 317 – 326.8. Guang Wena, Voroneyb, Curtinc, Schoenaua, Qiana, Inanaga. 2005. Modification and application of a soil ATP determination method. *Soil Biology & Biochemistry* 37 (2005) 1999 – 2006.9. Guang-Hao Chen, Hau-Kwok and Yu, 2000. Effect of sludge fasting /feasting on growth of activated sludge, PII: S0043-1354(00)00346-8, Pergamon.10. Kevin W. H, Kwok Eric P. M, Grist, Kenneth M. Y. Leung, 2008. Acclimation effect and fitness cost of copper resistance in the marine copepod *Tigriopus japonicus*, <http://www.elsevier.com/locate/ecoenv>11. Leung, G.-H. C. M. D. H.-W. 1999. Utilization of oxygen in a sanitary gravity sewer. PII: S0043-1354(00)00143-3, Pergamon12. M, Arretxe. Heap, 2 N. Christofi, 1997. The Effect of Toxic Discharges on ATP Content in activated sludge. CCC 1053-4725/97/010023-04, John Wiley & Sons13. M. Contin, 1995. Comparison of two methods for extraction of ATP from soil, 0038-0717(95)00081-X, Pergamon14. M. T. Veciana-Nogues, 1996. Determination of ATP related compounds in fresh and canned tuna fish by HPLC M. T. PII: SO308-8146(96)00243-9, ELSEVIER.15. Nae - Cherng Yang, Wai-Meng Ho, Yu-Hsuan Chen, and Miao-Lin Hu. 2002. A Convenient One-Step Extraction of Cellular ATP Using Boiling Water for the Luciferin – Luciferase Assay of ATP, *analytical biochemistry* 306, 323 – 327 (2002).16. Nyuk-Min Chong, Yi-Shin Chen. 2008. Loss of degradation capacity of activated sludge for a xenobiotic after a period without its influent. *Bio resource Technology* 100 (2009) 68 – 7317. Nyuk-Min Chong, 2007. Activated sludge treatment of a xenobiotic with or without a biogenic substrate during start-up and shocks. *Bio resource Technology* 98 (2007) 3611 – 361618. Nyuk-Min Chong, 2006. Measurement of the degradation capacity of activated sludge for a xenobiotic organic. *Bio resource Technology* 98 (2007) 1124 – 112719. Olga Korchazhkina, 1999. Intravascular ATP and coronary vasodilation in the isolated working rat heart, *British Journal of Pharmacology*.20. P. Herijgers, Toshima, P. Van Hecke, F. Vanstapel, K. Mubagwa, & a. W. Flameng. 1994. Ischaemic ATP degradation studied by HPLC and 31p, spectroscopy: Do the two techniques observe the same ATP pools. *Basic Res Cardiol* 89:50-60 (1994).21. Ronald D. Neufeld, Glenn E. Johnson. *Bio kinetics of activated sludge Treatment of SYNTHANE Fluidized Bed Gasification wastewater*, U. S. Department

of Energy Pittsburgh Energy Research Center

22. Satoshi Tsuneda Ryuki Miyauchi, 2005. Characterization of denitrifying- Polyphosphate-Accumulating organisms in Activated Sludge based on Nitrate reductase gene, *Journal of bioscience and bioengineering*.

23. S?reyya Meri?, G?len Eremektar Fehiman ?iner, 2003. An OUR-based approach to determine the toxic effects of 2, 4-dichlorophenoxyacetic acid in activated sludge, *Journal of Hazardous Materials B101* (2003) 147 – 155.

24. Sunil S. Adav, Juin-Yih Lai, 2008, Proteolytic activity in stored aerobic granular sludge and structural integrity. *Bio resource Technology* 100 (2009) 68 – 73.

25. Takashi Nishikawa, Kuso & M. S. Hideki OHTANI, Susumu NOMIYAMA. 1991. Isocratic Separation of Adenosine 5'-Triphosphate and Its Metabolites by Reversed-Phase High Performance Liquid Chromatography: End-Capped versus Uncapped Packings *Analytical sciences* April 1991, Vol.7.

26. Tatsuya Sakakibara, S. M, Noriaki Hattori, Moto-o Nakajima, and Kazuhiro Imai, 1997, Enzymatic Treatment to Eliminate the Extra cellular ATP for Improving the detect ability of Bacterial Intracellular ATP, *Analytical Biochemistry* 250, 157 – 161 (1997) Article No. AB972217.

27. Tatsuya, Sakakibara, S. M., Noriaki Hattori, Moto-o Nakajima, and Kazuhiro Imai. 1997. Enzymatic Treatment to Eliminate the Extra cellular ATP for improving the detect ability of bacterial Intracellular ATP. *Analytical Biochemistry* 250, 157 – 161 (1997) Article No. AB972217.

28. Water Research Institute, Several Interesting Organisms Present in activated sludge