桌上型電腦塑膠物質熱裂解資源回收之研究

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摘 要

本研究主要以探討桌上型廢電腦監視器之塑膠物質熱裂解為主。廢電腦外殼成分主要為丙烯?(acrylonitrile)、丁二烯(butadiene)及苯乙烯(styrene)三成分之共聚合物(ABS)，經由元素分析結果顯示，碳、氫與氮所佔的重量百分比分別為84.32、7.71與7.57 %。 動力分析方面，利用不同的升溫速率(分別為2、5及10 ℃/min)，探討廢電腦塑膠物質在氮氣中熱裂解之情形，由質量消失曲線計算，以求得活化能E、頻率因子A及反應級數n。由實驗數據求得動力參數值分別為E＝40.3 kcal/mol，A＝5.31×1011 1/min，n＝1，ABS樹脂在氮氣中熱裂解可以一個總反應方程式表示： dX/dt=A . exp(-E/RT)(1-X) 其中 X：轉化率 t：時間 R：氣體常數(1.987×10-3 kcal/mol-K) T：絕對溫度(K) 產物分析方面，廢電腦塑膠物質在氮氣中400 ℃裂解產物百分比分別為氣體約14 %，粗裂解油約75 %及固體殘餘物約11 %。氣體主要產物為丙烷與少量之toluene、ethyl benzene與styrene等有機化合物。粗裂解油為一深咖啡色帶有刺鼻味之黏稠狀油類液體。經由分餾後之產物主要為甲苯、乙苯與苯乙烯，約佔油品總量的60-70 %。固體殘餘物主要成分為碳元素，約佔83 %。

關鍵詞 : 熱裂解 ; 丙烯? ; -丁二烯-苯乙烯(ABS) 樹脂 ; 活化能 ; 頻率因子 ; 反應級數

目錄

參考文獻

1.www.epa.gov.tw 2.www.niea.gov.tw 3.Ali, K., Simsek, E. H., Burhanettin, C. and Ali, Y., “ Thermal degradation of polystyrene wastes in various solvents, ” Journal of Analytical and Applied Pyrolysis, Vol. 62, PP.273-280, (2002). 4.Cornelia, V., Pakdel, H., Mihai, B., Onu, P., Darie, H. and Ciocalteu, S., “ Thermal and catalytic decomposition of mixed plastics, ” Journal of Analytical and Applied Pyrolysis, Vol. 57, PP.287-303, (2001). 5.Chen, F. Z. and Qian, J. L., “ Studies on the thermal degradation of polybutadiene, ” Fuel Processing Technology, Vol. 67, PP.53-60, (2000). 6.Day, M., Cooney, J. D. and Touchette, B. C., “ Pyrolysis of mixed plastics used in the electronics industry, ” Journal of Analytical and Applied Pyrolysis, Vol. 52, PP.199-224, (1999). 7.Dong, D., Tasaka, S., Aikawa, S., Kamiya, S., Inagaki, N. and Inoue, Y., “ The thermal degradation of acrylonitrile-butadiene-styrene terpolymer in bean oil, ” Polymer Degradation and Stability, Vol. 73, PP.319-326, (2001). 8.Gersten, J., Fainberg, V., Garbar A., Hetsroni, G. and Shindler Y., “ Utilization of waste polymers through one-stage low temperature pyrolysis with oil shale, ” Fuel, Vol. 78, PP.987-990, (1999). 9.Howell, B. A., Cui, Y. and Priddy, D. B., “ Assessment of the thermal degradation characteristics of isomeric poly(styrene) using TG, TG/MS and TG/GC/MS, ” Thermochimica acta, Vol. 396, PP.167-177, (2003). 10.Kaminsky, W. and Kim, J. S., “ Pyrolysis of mixed plastics into aromatic, ” Journal of Analytical and Applied Pyrolysis, Vol. 51, PP.127-134, (1999). 11.Katsuhide, M., Hirano, Y., Sakata, Y. and Uddin, M. A., “ Basic study on a continuous flow reactor for thermal degradation of polymers, ” Journal of Analytical and Applied Pyrolysis, Vol. 65, PP.71-90, (2002). 12.Kiran, N., Ekinci, E. and Snape, C. E. “ Recyling of plastic wastes via pyrolysis, ” Resources Conservation & Recycling, Vol. 29, PP.273-283, (2000). 13.Lee, C. H., Chang, S. L., Wang, K. M. and Wen, L. C., “ Management of scrap computer recycling in Taiwan, ” Journal of Hazardous Materials, Vol. 73, PP.209-220, (2000). 14.Lee, S. Y., Yoon, J. H., Kim, J. R. and Park, D.W., “ Catalytic degradation of polystyrene over natural clinoptilolite, ” Polymer Degradation and Stability, Vol. 74, PP.297-305, (2001). 15.Mihai, B., Uddin, M. A., Akinori, M., Yusaku, S. and Cornelia, V., “ The role of temperature program and catalytic system on the quality of acrylonitrile—butadiene—styrene oil, ” Journal of Analytical and Applied Pyrolysis, Vol. 63, PP.43-57, (2002). 16.Nishizaki, H., Yoshida, K. and Wang, J. H., “ Comparative study of various methods for thermogravimetric analysis of polystyrene, ” Journal of Applied Polymer Science, Vol.25, PP.2869-2877(1980). 17.Schnabel, W., Levchik, G. F., Wilkie, C. A., Jiang, D.D., Levchik, S.V., “ Thermal degradation of polystyrene poly(1,4-butadiene) and copolymers of styrene and 1,4-butadiene irradiated under air or argon with 60Co- γ -rays ”, Polymer Degradation and Stability, Vol. 63, PP.365-375, (1999). 18.Shun, D., Bae, D. H., Cho, S. H. and Han, K. H., “ Bench scale fluidized bed pyrolysis of waste ABS resin, ” Korea Institute of Energy Research, PP.305-343. (http://wire0.ises.org/wire/doclibs/KoreaConf.nsf/0/39a1cfb8d86b6af9c12565a0004e6405?OpenDocument) 19.Solpan, D. and Guven, O., “ The thermal stability of allyl alcohol with acrylonitrile and methyl methacrylate, ” Polymer Degradation and Stability, Vol. 60, PP.367-370, (1998). 20.Sorum, L., Gronli, M. G. and Hustad, J. E., “ Pyrolysis characteristics and kinetics of municipal solid wastes, ” FUEL, Vol. 80, PP.1217-1227, (2001). 21.Suzuki, M. and Wilkie, C. A., “ The thermal degradation of acrylonitrile—butadiene—styrene terpolymer as study by TGA/FTIR, ” Polymer Degradation and Stability, Vol. 47, PP.217-221, (1995a). 22.Suzuki, M. and Wilkie, C. A., “ The thermal degradation of acrylonitrile—butadiene—styrene terpolymer grafted with methacrylic acid, ” Polymer Degradation and Stability, Vol. 47, PP.223-228, (1995). 23.Thomas, J. X. and Wilkie, C. A., “ Thermal degradation of poly(styrene-g-acrylonitrile), ” Polymer Degradation and Stability, Vol. 56, PP.109-113, (1997). 24.Ukei, H., Hirose, T., Horikawa, S., Takai, Y., Taka, M., Azuma, N. and Ueno, A., “ Catalytic degradation of polystyrene into styrene and a design of recyclable polystyrene with dispersed catalysts, ” Catalysis Today, Vol. 62, PP.67-75, (2000). 25.Yang, M. H., “ The thermal degradation of acrylonitrile—butadiene — styrene terpolymer under various gas condition, ” Polymer testing, Vol.19, PP.105-110, (2000). 26.Zhibo, Z., Nishio, S., Morioka, Y., Ueno A,., Ohkita, H., Tochihara, Y., Mizushima, T. and Kakuta, N., “ Thermal and chemical recycle of waste polymers, ” Catalysis Today, Vol. 29, PP.303-308, (1996). 27.石化工會，“ 石化工業 ”，第二十三卷第九期，(2002)。 28.楊思廉， ” 新材料塑膠 ”，高立圖書公司，(1983)。 29.孫逸民，陳玉舜，趙敏勳，謝明學，劉興鑑， ”儀器分析 ”，(2000)。 30.劉玉芬， ”氧氣對鋁箔包熱裂解之影響 ”，國立台灣大學環境工程學研究所碩士論文，(1999)。