Research Journal of Applied Sciences, Engineering and Technology 6(14): 2630-2633, 2013
DOI:10.19026/rjaset.6.3750
ISSN: 2040-7459; e-ISSN: 2040-7467
© 2013 Maxwell Scientific Publication Corp.
Submitted: January 05, 2013 Accepted: January 31, 2013 Published: August 10, 2013

Research Article

The Influence of Distance and Atmospheric Elements on the Concentration of Odour from Refuse Derived Fuel (RDF) Operations

[1]Zaini Sakawi, [2]Lukman Ismail, [2]Noor Khafazilah Abdullah, [3]S.A. Sharifah Mastura and [1]Othman Jaafar
[1]Earth Observation Centre,
[2]School of Social, Development and Environmental Studies,
[3]Institute of Climate Change, Universiti Kebangsaan, Malaysia

Abstract: Odour is an environmental element that occurs as varieties of aroma, either pleasant or otherwise to its immediate community. The various sources of odour pollution may come from either natural or of human activities. Odour concentration may change due to environmental factors such as atmosphere, topography, distance and mitigation efforts. This study describes a study on the influence of distance and athmospheric elements on concentration of odour generated by the Refuse Derived Fuel (RDF) operations. The distribution of odour concentration was measured using Odour concentration meter XP-329 III series per its distance from the RDF operations. The results indicated that distance factors did influence the odour concentration. Results at test stations of distances farther from the RDF showed incrementally higher distribution of odour concentration compared to those nearer to the RDF. In addition, athmosperic elements like temperatures, humidity, wind speed and directions also evidenlty linked to the distribution of odour concentration.

Keywords: Atmosphere factor, distance factor, odour concentration, Refuse Derived Fuel (RDF)

INTRODUCTION

Odour is an environmental component that can contribute to its changes. Odour pollution is an indicator of environmental change that impact health and human well-being. Studies on odour pollution could be viewed from two major parameters either objectively and subjectively (Zaini, 2012). Objective study involves analyses of concentration, intensity, endurance and odour character. While subjective analysis involves perceptions and human sensory pertaining to hedonic tone, nuisance, objectability and intensity.

In Malaysia, studies on odour pollution is still at an infancy stage. Most studies only revolved around issues and challenges of odour pollution (Othman *et al*., 2008) Specific study on measuring dumpsite odour concentration was first to have been conducted only in 2011. Series of such pioneering studies were conducted by Zaini *et al*. (2011a, b, c), Ahmad (2011), Lukman (2012), Zaini (2012) and Zaini *et al*. (2012a, b). In developed countries like in the EU, Japan, Australia and New Zealand, studies on odour pollution have reached a phase of excellence involving various aspects including perceptions (Laister, 2002), gas spread and odour (Struss, 2007; Casey *et al*., 2008), method of mesurement (Littaru, 2007; Davoli *et al*., 2003; Shi, 2004; Sironi *et al*., 2005, 2007; Zarra *et al*., 2008; Romano *et al*., 2007), impact of pollution on health and wellbeing (Wing *et al*., 2008), control and mitigation (Shui-Jen *et al*., 2003; Casey *et al*., 2006) and management.

Specifically this study is aimed to identify the distance factors in infuencing the distribution and concentration of odour emitted from the RDF operatons. In adddition, atmospheric elements such as temperatures, comparative humidity, wind direction and speed were also analysed to identify its collective effects on odour concentration. In addition to instrument-aided measurement of the odour concentration of each station per to their RDF distance; trangession analysis was also conducted to examine the relationship between odour concentration and athmospheric influence.

MATERIALS AND METHODS

Materials and location of study: This study was conducted on the RDF operation located in Semenyih, Kajang in the state of Selangor. The RDF was operated by Recycle Energy Sendirian Berhad (RESB) under the Kajang District Council. The RDF operation was capable to convert solid wastes into electric power. The RESB output of this source of renewable energy was to a maximum of 9 Megawatt (MW) through conversion of 700 tons of solid wastes daily.

The RDF location is at latititude 03°00’3.1’’ and longitude E 101°52’56.6’’, with an altitude of 70 meters

Corresponding Author: Zaini Sakawi, Earth Observation Centre, Universiti Kebangsaan, Malaysia
This work is licensed under a Creative Commons Attribution 4.0 International License (URL: http://creativecommons.org/licenses/by/4.0/).

Table 1: Sampling stations

Symbol	Station	Distance (meter)	Location
S1	Boundry RDF	50	N 3° 00' 3.1" - E 101° 52' 56.6"
S2	Kilang Tilam	300	N 3° 00' 5.3" - E 101° 52' 47.7"
S3	Belakang RDF	500	N 3° 00' 10.9"- E 101° 53' 14.4"
S4	Kg. sungai lalang	600	N 3° 00' 4.14"-E 101° 52' 37.91"
S5	Kg. pasir	900	N 2° 59' 54.8"-E 101° 52' 29.2"
S8	PLKN	950	N 3° 00' 18"- E 101° 53' 23.3"
S6	Lorong tanjong	1100	N 2° 59' 48.23"-E 101° 52' 22.4"
S7	Tmn. semenyih impian	1200	N 2° 59' 35.5"-E 101° 52' 28.0"
S9	Botanical garden	1600	N 3° 00' 32.2"- E 101° 53' 41.1"
S10	Ladang Bunga	1800	N 3° 00' 35.8"- E 101° 53' 44.4"

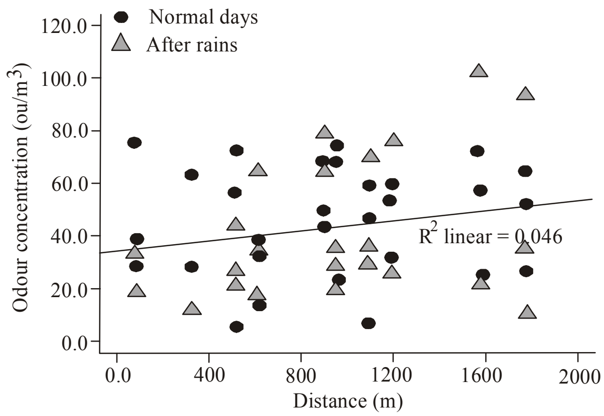

Fig. 1: Relationship of distance (m) and odour concentration (ou/m3)

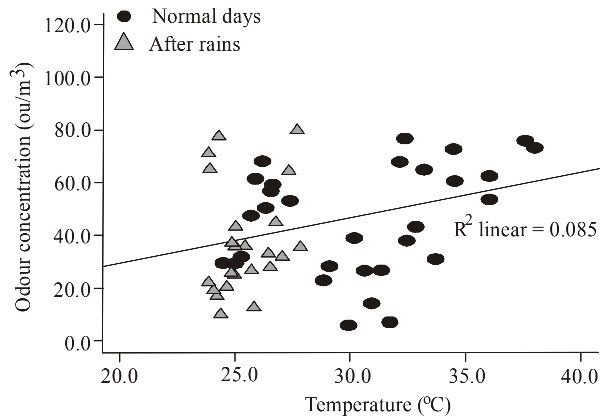

Fig. 2: Relationship between temperatures (°C) and odour concentration (ou/m3)

from sea level. Table 1 shows locations of sampling stations per the distance from the RDF.

Method of measuring odour concentration: The instrument for measuring odor concentration was the Odour concentration meter XP-329 III series. The intensity of odour was recorded in odour unit concentration per cubic meter or ou/m^3. The strength of odour concentration could be measured between 0 to 2000 ou/m^3.

RESULTS AND DISCUSSION

Distance factor: Figure 1 indicates the relationship between distance and odour concentration. Even though the results indicated the $R^2 = 0.046$ is less than 0.5, almost approximating zero and the model used was rather weak, it could nevertheless explicate the relationship of distance per odour intensity whereby the farther the distance from the RDF the higher the distribution.

Commonly, higher odour concentration was often detected at areas nearer to the source such as sewage treatment plants and dumpsites (Klein, 1999; Zaini, 2012). However the findings of this study indicated positive relationship between distance and odour, whereby the farther the distance the higher the odour were concentrated. Based on the analysis, the distribution of odour was higher at stations farther from the RDF. An instance, for stations with distance exceeding 800 m, higher concentration distribution was shown on normal days and after rains.

The distribution of odour at distances farther from the RDF was due to the influence of the RDF tall funnels. The emission and distribution of smoke through the funnels aided by the wind factors caused the odour concentration to spread farther and higher. Stations 7 and 9 received higher concentration of odour. Both stations were at 1.2 km and 1.6 km from the RDF.

Temperature factor: The environmental temperature is a meteorological component which influenced the concentration of an odour. Based on Fig. 2, the results of the regression analysis indicated R^2 values was weak at $R^2 = 0.086$. Despite the weak model to illustrate this relationship, the results of the study indicated the distribution of odour concentration was higher at stations with lower temperatures compared to those with higher ones. The distribution of odour after rains was found to be concentrated at stations with low temperatures around 25ºC (Fig. 2). This situation arises due to after rains effects, stable temperatures and wind speed.

Wind factor: Figure 3 shows the results of regression analysis which found the R^2 for wind variables and odour concentration to be weak at $R^2 = 0.015$. Despite a weak modelling to illustrate this relationship, it is nevertheless clarifying positive relationship for the variables under study. Fig. 3 indicates the concentration

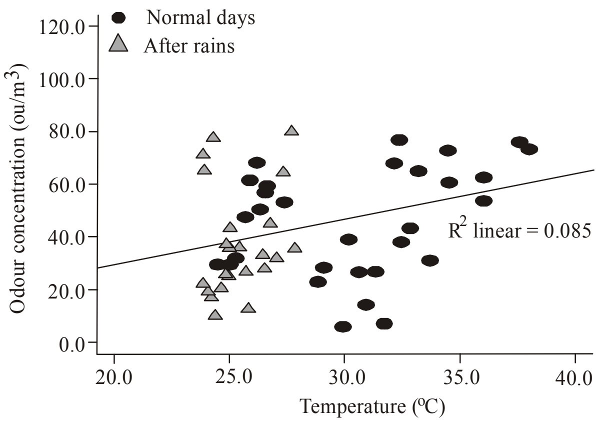

Fig. 3: Relationship of wind velocity (m/s) and odour concentration (ou/m^3)

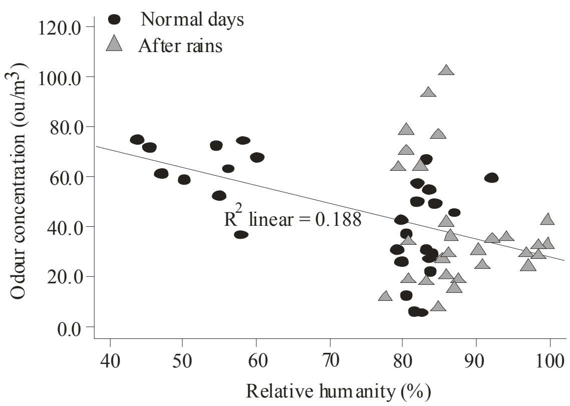

Fig. 4: Relationship between humidity (%) and odour concentration (ou/m^3)

of odour on normal days and after rains during the slow winds.

The analysis clearly indicated higher odour concentration at slower wind velocity compared to higher ones. This phenomenon occured due to the temperature of the athmosphere being stable and collected at areas with high wind velocity. These findings are similar to Laister (2002) and Zaini (2012) who found higher wind velocity to be influential in the distribution of concentrated gas and odour.

Comparative humidity factor: Figure 4 shows the influence of comparative humidity on distribution of odour concentration. Based on regression analysis, it was found, that there existed contrastive relationship between comparative humidity and the odour observed. Higher distribution of odour concentration was largely at observatory stations with higher humidity exceeding 80%.

CONCLUSION

Based on the findings, there were evidently variances in the average of odour concentrations between normal times and after rains. The average of the concentrations indicated highest readings in the evening and afternoon in both weathers. Nevertheless the average concentration of odour was found to be higher after rains.

Hence, the influence of distance and meteorological factors such as temperatures, wind and humidity were comparatively influential in the distribution of odour concentration from the RDF. Overall, despite the regression analysis indicating all factors with weak R^2, less than 0.5; they were still capable of affecting positive relationships on the distribution of odour concentration.

ACKNOWLEDGMENT

The researcher wish to grate fully acknowledgement financial support for this research by Institute of Climate Change, Universiti Kebangsaan Malaysia under grant code GGPM-2012-018.

REFERENCES

Ahmad, Z.B.M., 2011. Pollution study Smell of Openly Landfill Landfill Pajam In, Nilai, Negeri Sembilan. Scientific training (Malay). Program Geografi. Universiti Kebangsaan Malaysia.

Casey, K.C., J.R. Bicudo, D.R. Schimidt, A. Singh, S.W. Gay, R.S. Gates, L.D. Jacobsen and S.J. Hoff, 2006. Air Quality and Emission From Livestock and Poultry Production/Waste Mangement Systems. In: Rice, J.M., D.F. Cadwell and F.J. Humenik (Eds.), Animal Agriculture and the Environment: National Center for Manure and Animal Waste Management White Papers. St. Joseph, Michigan, ASABE, pp: 1-40

Casey, J.W., B.A. Sheridan, M. Henry and K. Reynolds, 2008. Effective tools for managing odours from landfill facilities in Ireland. Chem. Eng. Trans., 15: 151-158.

Davoli, E., M.L. Gangai, L. Morseli and D. Tonelli, 2003. Characterisation of odorants emission from landfills by SPME and GC/MS. Chemosphere, 51: 357-268.

Laister, G., 2002. Prediction, management and control of odour from landfill sites. M.A. Tesis, University of Natal.

Littaru, P., 2007. Environmental odours assessment from waste treatment plants: Dynamic olfactometry in combination with sensorial electronic noses. Waste Manage., 27: 302-309.

Lukman, I., 2012. Kajian Konsentrasi Gas Dan Bau Dari Operasi Refuse Derived Fuel (RDF). Latihan Ilmiah. Bangi, UKM.

Klein, R.O., 1999. Citizan Perspective on Sitting Solid Waste Facilities. Community and Environmental Defense Services, Maryland.

Othman, M.N., M.N.M. Yunus, K.Z.M. Dahlan, N. Zakaria and K.H.K. Hamid, 2008. Development of odour monitoring and control in Malaysia. Chem. Eng. Trans., 15: 71-78.

Romano, A.C., J. Delva and J. Nicolas, 2007. Complementary approaches to measure environmental odour emitted by landfill areas. Sens. Actuat. B, 131: 18-23.

Shi, L., 2004. Odor Pollution Control Regulation and Measurement in China. East Asia Workshop on Odor Measurement and Control Review. Osaka City Institute of Public Health and Environmental Sciences, Japan.

Shui-Jen, C., H. L-Te, H. Wen-Ing, H.C. Xu and J.H. dan Kao, 2003. Abatement of odor emissions from landfills using Natural Effective Micriorganism Enzyme (NEME). Aerosol. Air Qual. Res., 3(1): 87-99.

Sironi, S., L. Capelli, P. Centola, R. Del Rosso and M. II Grande, 2005. Odour emission factors for assessment and prediction of Italian MSW landfills odour impact. Atmosp. Env., 39(29): 5387-5394.

Sironi, S., L. Capelli, P. Centole, R. Del Rosso and M. II Grande, 2007. Continuos monitoring of odours from a composting plant using electronic noses. Waste Manage., 27: 389-397.

Struss, S., 2007. How odours are measured and evaluated. In Wisconsin Conservation Engineering News. United State of America: Wisconsin Department of Agriculture, Trade and Consumer Protection dan Natural Resources Conservation Service. December, 2007 No. 14, pp: 1-3.

Wing, S., R.A. Horton, S.W. Marshall, K. Thu, M. Tajik, L. Schinasi and S. Schiffman, 2008. Air pollution and odor in communities near industrial swine operation. Env. Health Perspect., 116(10): 1362-1368.

Zaini, S., S.A. Sharifah Mastura and J. Othman, 2011a. Sensitive receivers' responses on odour annoyance of a neighbourhood open landfill site. J. Appl. Sci. Env. Sanitat., 6(2): 191-199.

Zaini, S., S.A. Sharifah Mastura, J. Othman and M. Mastura, 2011b. An analysis of odour concentration using odour concentration meter XP-329 at landfill vicinity. Res. J. Appl. Sci., 6(5): 324-329.

Zaini, S., S.A. Sharifah Mastura, J. Othman and M. Mastura, 2011c. Community perception of odor pollution from the landfill. Res. J. Env. Earth Sci., 3(2): 142-145.

Zaini, S., 2012. Pengaruh pencemaran bau dari operasi tapak pelupusan berdasarkan pengukuran fizikal dan persepsi penerima sensitif. Ph.D. Thesis, UKM, Bangi.

Zaini, S., S.A. Sharifah Mastura, J. Othman, M. Mastura, I. Lukman and R.A. Mohd, 2012a. Persepsi penerima sensitive ke atas pencemaran bau dari tapak pelupusan secara terbuka. E-Bangi: J. Soc. Sci. Hum., 7(1): 284-293.

Zaini, S., I. Lukman, R.A. Mohd, S.A. Sharifah Mastura and J. Othman, 2012b. Odor pollution in Malaysia. Issues and challenges of sustainable management of odor. Proceeding of the National Seminar on University and Community Engagement (Malay). USM, Penang, November 22-23.

Zarra, T., V. Naddeo and V. Belgiorno, 2008. Measurement, management and control of odours in wastewater treatment plants. Chem. Eng. Trans., 15: 63-70.