

Perception on Odour Pollution from the Operation of Wastewater Treatment Plant (WTP)

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Abstract: *Odour pollution from Wastewater Treatment Plant (WTP) is among the most chronic environmental issues affecting the public. Many reports on odour pollution have been made through various media, printed and electronic. To date Malaysia has no clear guidelines or legal Act for enforcement and actions. This study on olfactory sensory was conducted to identify the intensity and characteristics of odour from a WTP to analyse the perception of sensitive receivers to the WTP operations. About 250 questionnaires were purposively distributed among the sensitive receivers within 200 meter radius of the WTP at Bandar Baru Nilai in Negeri Sembilan. The findings indicated that there existed some odour influences from the WTP on the respondents. These influences were of various intensity according to the respondents' age, duration of stay in the area, duration and frequency of odour occurrence. The findings also indicated that odour pollution was also influenced by the meteorological factors such as wind direction, speed of the wind, temperatures, humidity and rain.*

Keywords: odour pollution, sensitive receivers, waste treatment plant, quality of life

1. Introduction

Odour pollution is one of the elements of air pollution which has been attracting critical attention to the authorities in Malaysia. Odour pollution may be caused by various sources such as waste dumpsites, recycling centres, animal farms, sewage treatment plants, rubber processing factories, oil palms factories and agriculture sectors. Odour pollution is an environmental issue that has become increasingly chronic especially to the sensitive receivers in the surrounding areas of the primary odour sources (Zarra et al., 2008; Zaini et al., 2011a; Zaini et al., 2011b). Odour issues and WTP have also become synonymous identification among sensitive receivers. Numerous issues of odour pollution and the WTP have been increasingly exposed by the media.

The functions of WTP are to collect and treat domestic waste water produced by commercial, industrial and institutional activities. The sewage produced need to be treated to ensure the effluent are clean before entering waterways network. The need for clean water is vital to ensure sustainability of the environment. Human health and quality of life among the community are better guaranteed if the nation has proper sewerage infrastructure. There are six types of sewage treatment plants available in Malaysia, such as Package/Mechanical Sewage Treatment Plants, Aerated Lagoons (AL), Extended Aeration Systems, Oxidation Ditch, Rotating Biological Contractors (RBC), High Rate Trickling Filter (HRTF) (Indah Water Konsortium, 2013).

Odour pollution from the WTP occurred due to the release of complex mixture of chemical odour released through the sewerage originated from the biochemical reaction occurring under anaerobic in both sewerage network and sewage treatment plant (Vincent, 2001 and Zarra et al., 2008). The release consist of organic compound and sulphur compound such as hydrogen sulphide (H_2S), Methyl Mercaptan (CH_3SH), dimethyl sulphide (CH_3)₂S and dimethyl disulphide (CH_3)₂S₂, organic nitrogen and non organic such as ammonia (NH_3), amina, indole dan vaporizable

organic compound such as aromatic, aliphatic dan chlorinated hydrocarbon, fat acid, aldehyde, terpenes and keton (Van Langenhove et al., 1985 and Zarra et al., 2008).

There have been various research on WTP conducted in developed countries on various aspects such as on odour management, odour impacts, odour measurement, odour reduction and others. Among studies on monitoring of odour measurement, one particularly on the H_2S gas from the WTP was done by Sivret and Stuetz (2012). Meanwhile, Ozturk et al., (2009) and Zarra et al., (2009) focused on a treatment method using chemical sensor system. Other research on control and management were conducted by Kumar et al. (2010), Giuliania et al. (2012) and Estrada et al. (2011).

There have been limited studies on odour pollution in Malaysia. Several studies have been focussing on perception, concentration and intensity particularly from open landfill operation. Among the studies conducted were by Ahmad Zulfahmi (2010), Zaini et al. (2011a), Lukman Ismail (2012), Zaini (2013), Zaini et al. (2012) and Nor Dianiza (2012). A study on perception of WTP influence on odour pollution was conducted by Siti Naeilah (2011) and Mohd Rozaimi et al. (2014). The limitations of the previous studies thus driven this study to focus on investigating on the influence of a WTP on the intensity of the odour, its duration and frequency of occurrence; and its influence on physical environment.

2. Material and Methods

The method used to obtain the sensitive receivers perception was through a set of questionnaires. The purposive sampling involved 250 sensitive receivers within 200 metres radius of the WTP. The sensitive receivers were the locals and business people surrounding the WTP. The study area (fig.1) are involved three operational areas of the WTP such as Desa Cempaka (*Oxidation Disc*), Desa Jasmin (*Oxidation Disc*) dan Taman Semarak (*Oxidation Pond*). For the Desa Cempaka respondents, 86 survey questionnaires were

distributed, 64 for Desa Jasmin, and 1000 for Taman Semarak. The data were analysed using the Statistics Package for Social Science (SPSS).



Figure 1: Location of Wastewater Treatment Plant

3. Results

Background of the Respondents

The categories of sensitive receivers involved were appropriate for determining their various perceptions on the intensity, disturbances, effects and odour management issues. Table 1 shows the background of the respondents in the study area. Male respondents were 52.8 % and 47.2 % were females. There were three ethnic groups in the area of study, namely the Malays, Chinese and Indians. The Malays were the majority with 52%, Indians 38.4% and Chinese with 9.6%.

The data show that 10.8% of the sensitive receivers were 20 year-olds. Minimum age of the sensitive receivers was 15 and there was no maximum age. The majority of respondents aged between 30 to 39 years old was 29%. Those about the age of 40 to 49 were 23.6% and the remainder 21.2% were made up of respondents of 50 years old and older. Age factor was also accounted for it may provide significant input on the odour intensity. This significance was evident in a study by Zaini et al. (2012) on the reaction of receivers to various odours in terms of their gender, age and health status. The data also indicated that majority of the sensitive receivers obtained their highest education at secondary school level and only 10% were university educated (Table 1)

Table 1: Respondents background

Sex	%	Age	%	Length of stay	%	Education level	%
Man	52.8	<20 years	10.8	<10 years	57.6	No formal educational	2.0
Women	47.2	20 – 29 years	21.2	10 – 19 years	34.0	Primary education	5.2
Total	100.0	30 – 39 years	29.2	20 – 29 years	8.0	Lower secondary certificate	30.0
		40 – 49 years	23.6	30 – 39 years	0.4	Upper secondary certificate	43.6
		50 – 59 years	9.6	Total	100.0	College	9.2
		>60 years	5.6			University	10.0
		Total	100.0			Total	100

The Intensity of Odour Generation: The odour intensity was determined on a four-scale categories i.e odourless, less odorous, moderate odour, and strong odour. Fig.2 shows the intensity of odour indicated by the sensitive receivers. Based on the Table, 15.2% of the respondents indicated strong odour responses. These indicated that the odour pollution

occurred due to the close proximity of their houses to the WTP. Whilst, 35.6% and 13.6% reported moderate and less odour respectively. The latter were influenced by respondents` houses which were farther and more isolated from the WTP.

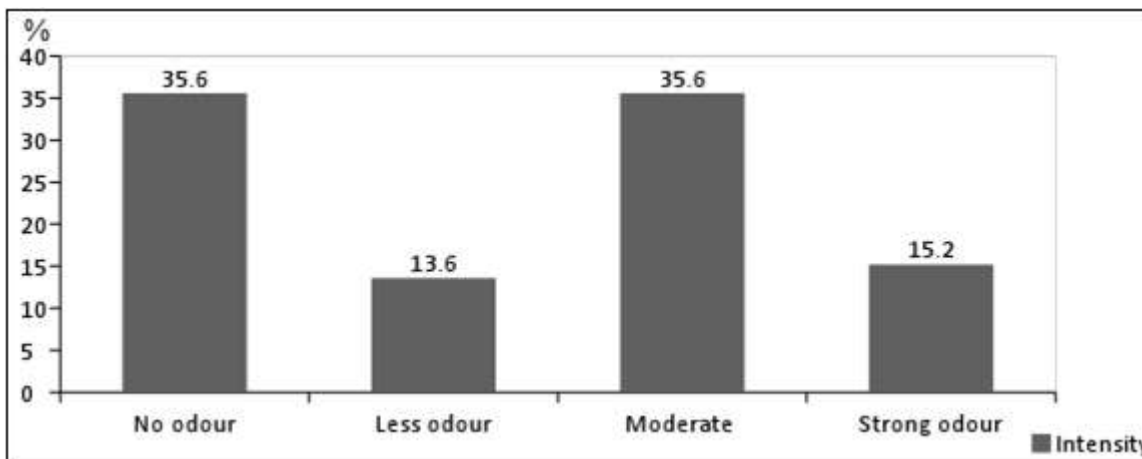


Figure 2: Intensity of odour

Odour Intensity and Gender of Sensitive Receivers: Fig.3 shows the link between odour intensity and gender among the receivers. The findings indicated that the males had more sensitive odour sensory as per the odour intensity scales. For example, moderate intensity responses came from 18.4 males respondents, whilst 17.2% were those from female respondents. This findings were at variance from that of the

Science of Smell (2004) which indicated that female respondents had stronger sensory reactions compared to males. This study's results may be attributed to the fact that more male respondents were involved in the survey compared to the females.

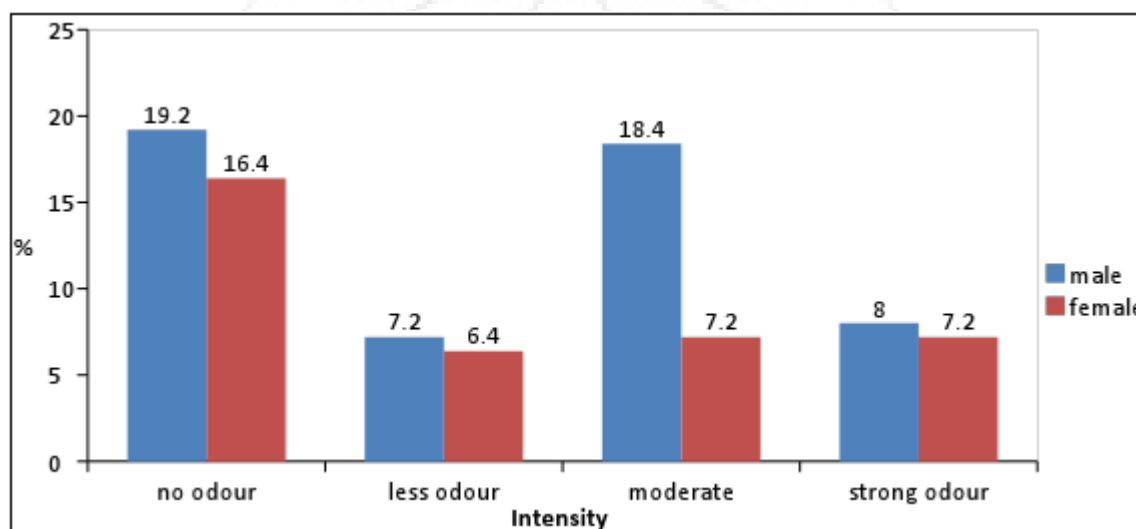


Figure 3: Links between odour intensity and gender of sensitive receivers

Odour Intensity and Duration of Stay among the Sensitive Receivers: Duration of stay of residence is a factor that can influence the respond toward the intensity indicators among individuals. The findings indicated that the duration or period of residence may caused diminishing ability to detect odour intensity. Fig.4 shows the link between the intensity of odour and period of stay among the sensitive receivers. For example, for those indicating higher odour intensity, their period of stay was less than 10 years,

much higher than those who have been in the area for more than 20 years. For those staying for 10 years and below, their indication of the odour varies. About 22.4% indicated no odour, 8% on less odour, 18.8% perceived moderate odour and 10% indicated strong odour. For those staying for 20 to 29 years, 4% indicated odourless, 3.2% marked moderate odour, and 1.6% perceived both less and strong odour.

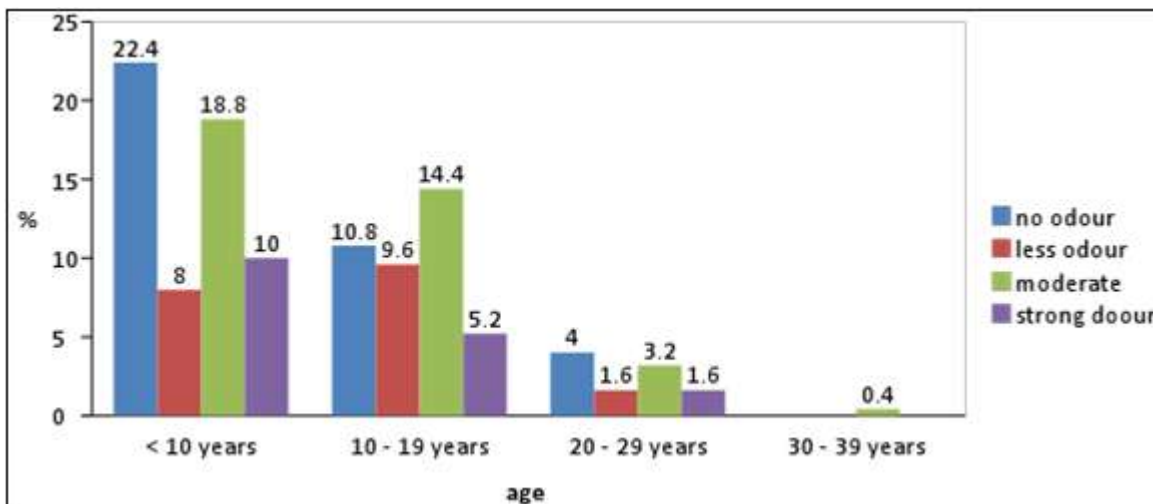


Figure 4: Links between odour intensity and duration of residence of the sensitive receivers

Duration of Odour Occurrence: The duration within which the odour lingers in the air is a significant characteristics of odour pollution. The duration of odour lingering affect the locals daily activities. Based on Fig.5, the findings indicated that the duration of odour lingering occurred for 1 and up to 12 hours a day. About 48.8% of respondents gave the highest indication of occurrence of odour in atmosphere as less than 1 hour. Odour formed during the short period had

given less impact to sensitive receivers, provided they take preventive actions. Furthermore, The respondents indicated that the duration of odour in atmosphere for between 1 to 3 hours was at 10.8%. While, the odour lingering for more than 12 hours was only indicated at 3.2%. The odour was not occurring continuously but varied according the meteorological factors such as weather, wind speed and wind direction.

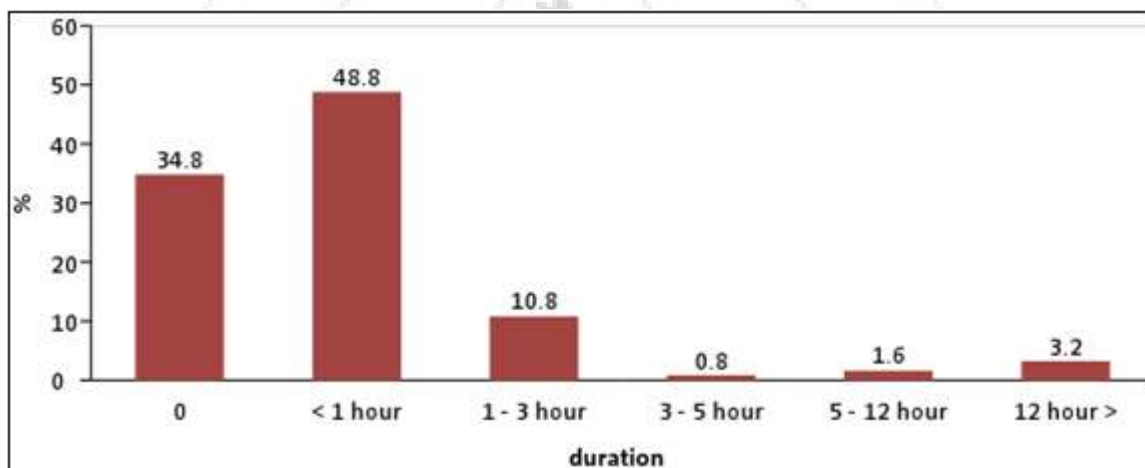


Figure 5: Duration of odour occurrence

Frequency of Odour Pollution Disturbance

Fig.6 shows the frequency of disturbances of the odour occurring in the area of study. The findings indicated that there were various frequencies of disturbances. Higher perception of disturbances as occurring once a week was at

32.4%. While, only 4% of the respondents indicated a daily occurrence. This clearly indicated as far as the frequency was concerned, the odour pollution from the WTP was not a major issue for it was detected only once for each week.

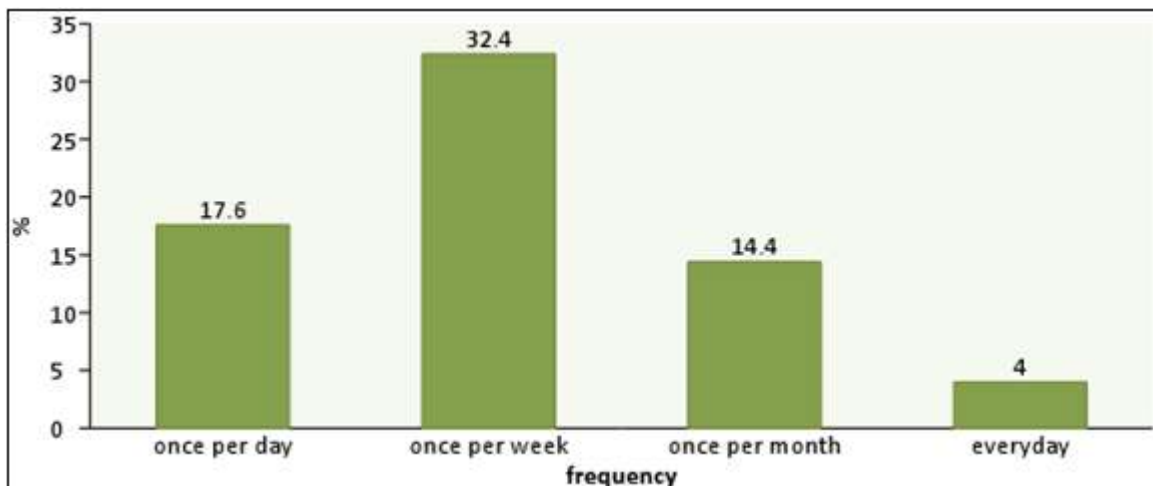


Figure 6: Frequency of odour pollution disturbance

Meteorological Factors Influencing Odour Generation

Odour generation is linked to the meteorological conditions of the locality. Meteorological factor is a major component of the environment that can influence the frequency and intensity of the odour detected. Other than that, the direction of wind and its speed, temperatures and humidity also influenced odour concentration and intensity. Fig.7 shows the meteorological influence on the generation of odour

based on the perceptions among the sensitive receivers. About 35.6% of the receivers indicated rain as a major factor influencing the intensity of odour. In addition, wind factor was also found to influence odour intensity (24.4%). Less than 10% of respondents indicated odour intensity was affected by the hot and dry weather and other meteorological factors.

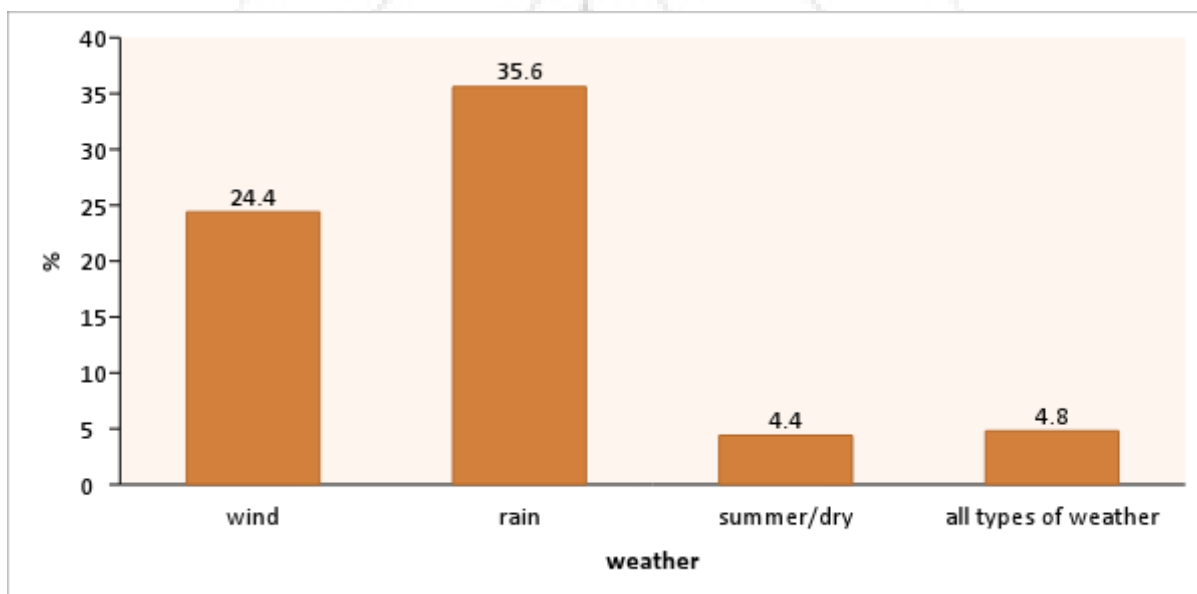


Figure 7: Meteorological factors influencing odour generation

Impact of Odour Pollution on Sensitive Receivers: Odour pollution not only has an impact on the physical environment but also to the human environment. The findings have evidently indicated the impact on human environment particularly human wellbeing and health. Fig.8

shows that more than 60% of the respondents indicated the impact of the odour on their lives. The other 53.2% respondents felt disturbed by the pollution and affected their living peace (52%). While 22% respondents opined that their health were affected due to the WTP odour.

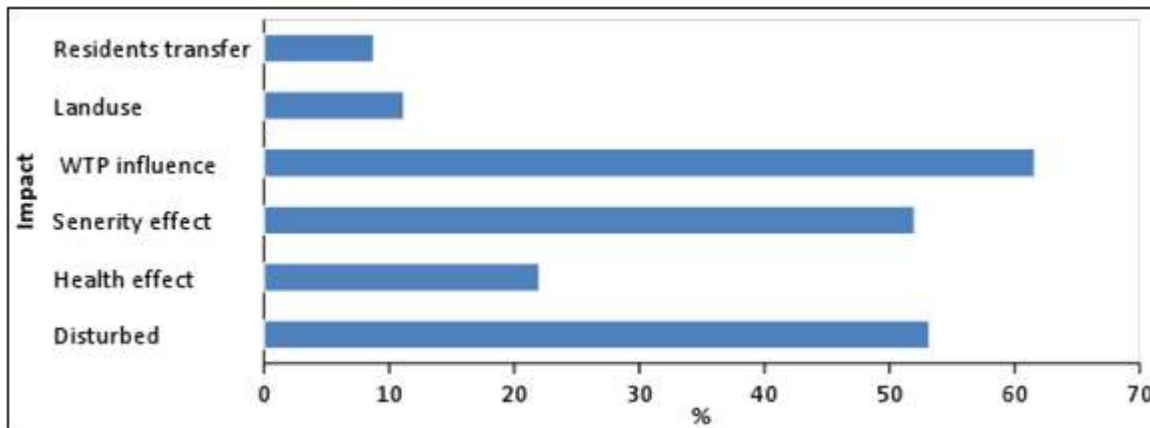


Figure 8: Impact of odour pollution on sensitive receivers

4. Discussion

The results indicated that moderate odour intensity scored the highest scale by the sensitive receivers. Moderate odour was perceived by 18.4 males respondents, higher than those indicated by the female receivers at 17.2%. This finding was at variance with those of Science of Smell (2004), for this present study involved more male respondents. For other odour scales, it was also found that there were higher males responses.

The sensitivity of respondents odour sensory was also affected for those who have lived for some time in the area affected with odour pollution. These respondents became immune to foul odour produced in the environment including those from the WTP. The findings also indicated that the respondents living for less than 20 years have more active olfactory sensory for they were more able to detect the odour pollution from the WTP in their area. For those living in the area for more than 20 years, their odour sensitivity was reduced and their capacity for detecting odour diminished.

Regarding the frequency of the odour occurrence, it was found to occur on once-a-week basis. Those receiving the weekly odour were those living farther away from the WTP compared to those receiving it on once-in-a day basis. Insulation and mitigating factors by the Indah Water company have also influenced the pattern of the spread of the odour through the farming of buffer plants around the WTP to prevent the odour from reaching the population. The findings also indicated that the odour produced were influenced by the meteorological factors. Rainy days were the peak time when the odour was mostly emitted due to lack of air movement.

5. Conclusion

Evidently the community's perception is important for detecting and clarification of issues for preventive actions of the generated odour pollution from WTP. The local communities who have been exposed to the WTP generated odour have produced mostly negative reactions to the issues. The odour issues have been adversely affecting the socio-economic conditions of the local community. The released of odour from any source not only adversely affected human health but also on the land use. Furthermore, the lifestyle of

the local community will change permanently, when they are hampered from doing their outdoor activities; and worse when they have to move to more conducive place to avoid the hazards of the odour from the WTP.

6. Acknowledgement

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