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A Study on the Noise Assessment of Specific Vehicles at Metropolitan Landfill Area Using Noise Map

소음지도를 이용한 특정차량의 소음평가

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ABSTRACT

Around metropolitan landfill area, specific vehicles such as garbage carrying trucks make noise problems and residents near landfill area organized to protest. However, it is difficult to distinguish the effect of noise of specific vehicles (ex: garbage trucks). In this study, noise map and CRTN were used to assess the noise from specific vehicles. Noise levels, which were predicted by using measured parameters such as traffic flow, traffic speed, composition of traffic for 1 year, were compared with measured results of noise level.

요 약

현재 환경영향평가 시 차량에 의해 발생되는 소음의 평가는 주요 영향인자에 대한 충분한 조사 및 검토가 이루어지지 않고 있으며, 이로 인해 특정 소음원에 의한 영향을 평가하는데 많은 어려움이 있다. 이 연구에서는 도로교통소음평가 시 도로를 통행하는 모든 차량 중 특정차량의 영향을 평가하고, 기존의 예측방법을 개선하기 위하여 다양한 영향인자와 지리적 정보를 고려할 수 있는 소음지도를 활용하는 방법을 제시하였다. 연구의 대상지역은 수도권매립지 전용도로이며, 교통량, 차속, 도로정보, 소음도 등의 조사를 분기별로 1년간 실시하였다.

1. Introduction

Noise had increased in cities due to population growth and various development activities including transportation. Especially, traffic noise coming from population concentration in cities increases people's discomfort level. This increased noise adversely affects mental health in which people get annoyed even over small noises. Thus, we need an accurate and professional assessment over the source of noise when complaints over noise increase. Thus, assessing noise level or an environmental impact assessment is needed.

Traffic noise mainly comes from automobile engines, emission system, aerodynamic friction, and friction between tires and paved streets. Traffic amount, car speed, heavy vehicle rate, street type and vehicle status significantly

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affect traffic noise. However, there has not been any comprehensive study or review on the major factors affecting traffic noise so it is difficult to figure out the source of noise pollution.

This study was done to evaluate the effects of noise produced by specific vehicles that passing through during road traffic noise assessment. Noise map that takes various influential factors and geographical information to improve the existing method of predicting noise levels into account.

The target site was the road that leads to the Seoul metropolitan landfill area where the incoming and outgoing point for vehicles was small and a specific type of vehicles at more than 10 % was operating. This new road was built to facilitate the transportation of waste from the Seoul metropolitan area for which is the world's largest landfill site. The length of the road from the entry to the end is about 13 km.

Table 1 Traffic flow and velocity

Date	Point	Traffic flow/hr				Velocity (Km/h)
		Small	Large	House-hold waste	Con-struction waste	
2004/5	T-1	1385	296	144	346	53.73
	T-2	1483	231	91	232	66.40
	T-3	784	189	84	203	48.29
	T-4	441	187	82	139	47.71
2004/7	T-1	1575	639	78	132	45.44
	T-2	858	309	68	364	36.54
	T-3	600	305	68	191	49.66
	T-4	364	305	71	128	46.55
2004/10	T-1	1566	554	78	118	51.43
	T-2	733	290	59	292	57.13
	T-3	508	256	79	167	52.36
	T-4	348	249	76	129	51.43
2005/1	T-1	1761	303	67	142	56.24
	T-2	823	262	60	183	54.61
	T-3	522	161	75	147	54.36
	T-4	320	177	75	132	47.08

Table 2 Road information

Point	Width	Length	Pavement type
T-1	20 m	1.0 km	Bitumen
T-2	20 m	6.4 km	Bitumen
T-3	20 m	1.1 km	Bitumen
T-4	20 m	1.1 km	Bitumen

2. Research of Effect Factor

The amount of traffic was evaluated by counting the number of vehicles that were passing by at a certain point during a given period of time. The number of vehicles was counted at 15 min. interval and the results were shown in one-hour interval. Centering on the incoming and outbound point, four other sites were investigated.

The vehicle speed was investigated within the landfill site by setting the distance to be measured on the road and the time needed for a vehicle to pass was measured; the distance to be measured was 50 m.

Table 1 and 2 show the measured road distance, road width, noise barrier, road type, paved condition, and heavy vehicle ratio.

3. Prediction of Noise

3.1 Prediction Condition

Based on the influential factors investigated for each quarter, the level of noise was predicted. In order to evaluate the contribution by passing transportation vehicles, it was predicted at the time of all traffic, ordinary traffic, and garbage trucks. Geographic information was obtained using a digital map and cadastral map. Map calibration was done to take scale down into account. To confirm the results according to distance, a 10 m grid system was used to overlap the maps.

Predication over the side of the road was done by limiting the cut-off area to 1 km.

The model was created by dividing the

prediction area into 4 sections. Database was formed in each section by differing the influential factors in each section. Fourteen noise barrier walls on the incoming road and 4 barrier walls on the outbound road were reflected on model design. The properties of each barrier wall were taken into account. The vehicle speech in each section was the average speed from the start and end points of the road.

3.2 Prediction Method

The basic noise level is obtained traffic flow, traffic speed, composition of traffic, gradient of road and road surface. On any given road traffic, speed and composition are inter-dependent.

This study used Prediction software to forecast effect of noise while passing of the garbage truck on landfill road surrounding.

NoiseMap 2000 was used that adapts CRTN (calculation of road traffic noise).

(1) Traffic flow

CRTN provides the hourly basic noise level L_{10} in dB(A) for a given hourly traffic flow and the basic noise level L_{10}(18-hour) in dB(A) for given flow. Fig. 1 and Fig. 2 give the basic noise levels.

On normal roads, the flow of traffic in both directions shall be aggregated to obtain the total flow. But in cases where the two carriageways are separated by more 5 m or where the heights of the outer edges of the two carriageways differ by more than 1 m, the noise level evaluated separately by each of the two carriageways.

(2) Percentage heavy vehicles and traffic speed

The correction for Percentage heavy vehicles and traffic speed was determined using Fig. 3.

Here, the value of p is

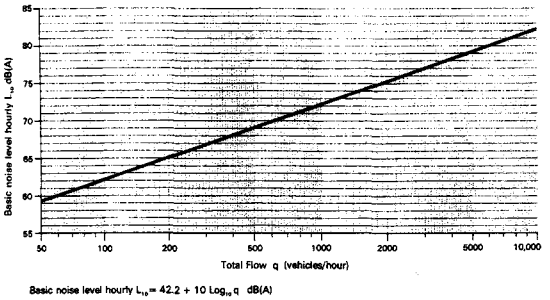

Fig. 1 Basic noise level(1hour)

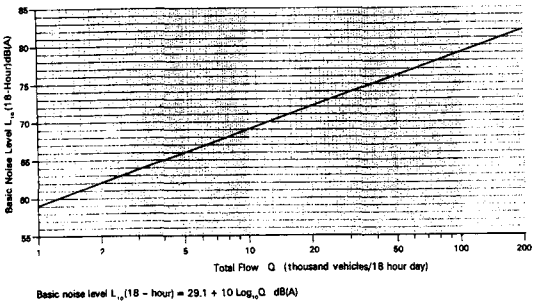

Fig. 2 Basic noise level(18hour)

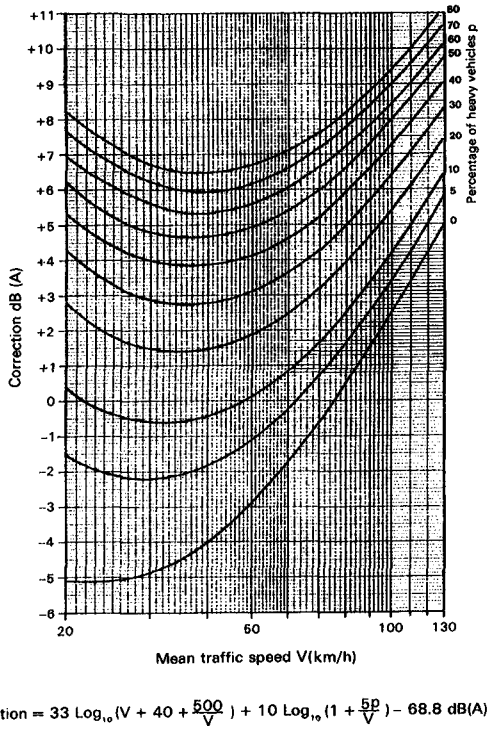

Fig. 3 Correction for mean traffic speed V and percentage heavy vehicles

$$p = \frac{100f}{q} \text{ or } \frac{100F}{Q}$$

f, F : The hourly and 18-hour flows of heavy vehicles

q, Q : The hourly and 18-hour flows of all light and heavy vehicles

(3) Road surface

The correction for road surface depends on road surface state(eg. texture, gap, depth). for road which are impervious to surface water and where the traffic speed was more than 75 km/h following correction was used.

for concrete surfaces,

$$\text{Correction} = 10\ \text{Log10}(90TD+30) - 20\ \text{dB(A)} \quad (1)$$

for bituminous surfaces,

$$\text{Correction} = 10\ \text{Log10}(20TD+60) - 20\ \text{dB(A)} \quad (2)$$

TD : the texture depth

4. Results and Analsis

4.1 Noise Map

The maximum level of roadside noise was 73.9 dB(A)-75.9 dB(A) at the time of all traffic passing, 73.0 dB(A)-74.0 dB(A) at the time of ordinary vehicle passing, and 68.6 dB(A)-71.7 dB(A) at the time of garbage truck passing. The level of noise from the loudest section was decreased by 30 dB about 250 m away from the center of the road. The predicted results according to different vehicles passing through are shown from Fig. 4 to Fig. 6.

4.2 Comparison of Results

The results of prediction showed the level of noise was higher with all traffic, followed by regular traffic and garbage trucks. It was predicted that noise from regular traffic would affect more on overall noise than that from garbage trucks.

Fig. 7 and Fig. 8 are noise maps prepared using 60 dB(A) and 55 dB(A) of contours according to traffic flow conditions.

The level of noise was investigated from the same site and same traffic amount to compare the results, which were compared with the predicted values. These values showed an error

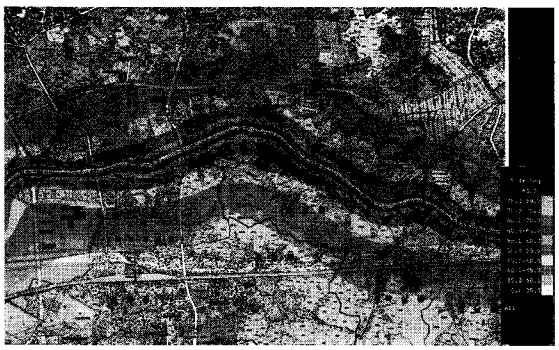

Fig. 4 Noise Map by all traffic

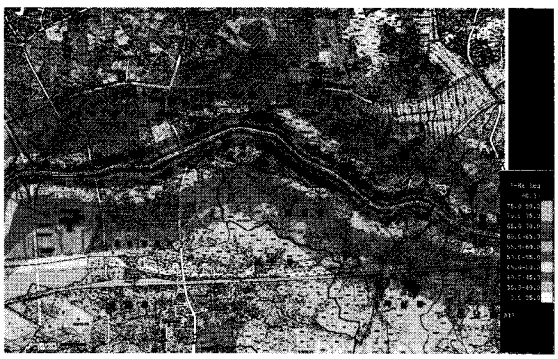

Fig. 5 Noise Map by passing general traffic

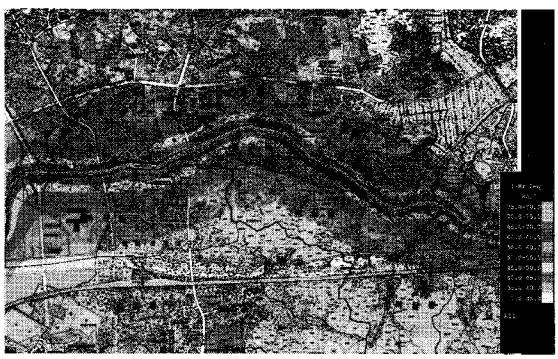

Fig. 6 Noise Map by the garbage trucks

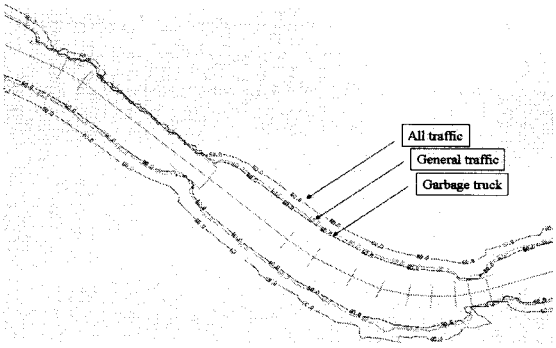

Fig. 7 Contour of 60 dB(A)

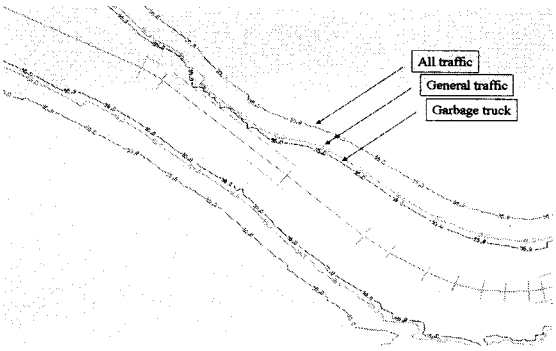

Fig. 8 Contour of 55 dB(A)

Table 3 Comparison of predicted and measured results

Date	Prediction dB(A)	Measured dB(A)	Difference dB(A)	Error
2004/5	73.4	75.9	2.5	3.3%
2004/7	73.9	73.8	0.1	0.1%
2004/10	74.5	74.2	0.3	0.4%
2005/1	74.5	72.9	1.5	2.0%

margin 0.1 %~3.3 %. Table 3 shows the comparison of predicted and measured data.

5. Conclusions

Generally, the evaluation of traffic noise does not reflect the effects of noise source due to spatial and time limitations. Thus, we used a noise map to accurately evaluate the effects of garbage trucks in the road that leads to the Seoul metropolitan landfill site. The level of noise was predicted taking account the effects of traffic amount according to different traffic speed at different section of the road, and road conditions. The results of prediction showed that noise from garbage trucks were less than that from regular traffic, suggesting that noise from overall traffic and from each different type of vehicle should be evaluated at the same time when noise from a certain type of vehicle is evaluated.

The margin of error was 0.1 %-3.3 % between the measured and predicted values, showing an error margin of 1.1 dB. This result showed that a noise map is effective while obtaining a noise emission scenario from various noises according to the actual effects of the noise source and change in influential factors.

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