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Abstract

In two crowded national roads, where traffic volumes are 45-55 thousand per 12 hours in daytime, susceptibility increases from a footpath side lane to the central zone side lane. In a lane of crowded roads, tire tracks show the higher susceptibility than the center where the exhaust fume would be sprayed on directly. In a tunnel 124m in length, susceptibility along a road showed the maximum value in the center to make a parabolic orbit.

Key words: susceptibility, pollution, traffic, road.

1. Introduction

In Europe countries, magnetic susceptibility had been used for the proxy method to detect pollutant (e.g. HOFFMAN et al, 1999; PETROVSKY et al, 2000). The author tried to detect surface pollution mainly in Japan.

To compare polluted degree on the surface by susceptibility, it is necessary for material under pollutant to have the low and uniform susceptibility. Soil susceptibility in Japan, excluding Kansai and Shikoku districts, is high and varies from 2×10^{-3} to 10×10^{-3} SI (UENO, 2002), suggesting that soil in Japan is in general not suitable to compare the polluted degree except Kansai and Shikoku districts where low susceptibility is characteristic. On the other hand, in a paved road within limited area, uniform pavement under pollutant might originally have the uniform susceptibility. In this study, susceptibility on roads was measured to detect pollution by traffic mainly in Kanto district including Tokyo, additionally in Hokkaido and in some other countries.

2. Measurement and Result

Susceptibility was measured with SM20 made by ZH instrument. In Table 1, measuring points and averaged susceptibility are shown. Measurement was performed across a road except the case in tunnel.

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To obtain the character of distribution, normalized data is plotted for one lane (Fig. 1). Width of one lane was about 3.5–4.0 m. In the case of crowded roads shown in Fig. 1-1, two peaks can be seen with a center between. Two peaks might correspond to trails of tire. To make sure of this idea, susceptibility of tire was measured (Table 2). Very high susceptibility of surface of tire that directly contacts with a road suggests tire is the pollutant. A case in a crowded road in Kawasaki city (Fig. 1-2), road seems to be polluted by another unknown reason. There are many roads where have no character in susceptibility distribution as shown in Fig. 1-3.

Tire might produce more pollutant when car applies the brakes to stop. Bus stop and lane next to the bus lane were measured. But, the difference of susceptibility could not find out because the amount of the bus traffic was too small (Fig. 2). While about 200 buses stop in a day, number of cars pass through the next lane of national road No.134 might be 10,000. In Fig. 2, data from empty road named Hushimidai connected to the bus road that shows low susceptibility is also shown.

In Fig. 3, examples of measurement of two lanes are shown. Both the roads are the famous crowded national roads, 45,000 and 28,000 cars pass per twelve hours in daytime. Susceptibility seems increasing from the footpath side to the center. The main reason might be the difference of the traffic amount, larger amount in the central lane.

In Fig. 4, result of roads to the entrance of garbage furnace in the Hikarigaoka park is shown compared with the mall (Yuhodo) situated 1 km apart from the garbage furnace. It seems roads to the garbage furnace have higher susceptibility than mall where traffic is rare. From Fig. 2 and Fig. 4, it could be concluded susceptibility increases by the amount of traffic. To make this expectation assured, it is necessary to analyze the material of the pavement.

In Fig. 5, susceptibility in Hayama tunnel in national road Route 134 is shown. Measurement was carried twice along the footpath. The reason of the higher susceptibility in the central part comes from the condensation of pollutant in air to the center. Pollutant spread in air might easily be blown off at the side area.

In Fig. 6 (6–1∼6-4), some examples of road susceptibility in foreign countries are shown. Roads in Tibet had susceptibility with characteristics of changing widely.

Table 1 Measuring points and averaged susceptibility on paved roads. (No. represents the route number of road.)

Name	Prefecture, Country	Average($\times 10^{-3}$ SI)	Remarks	
Sapporo	Hokkaido（札幌市北１西６）	20.75		
Asaka	Saitama（朝霞市東洋大前）	10.56		
Garbage furnace	Tokyo（練馬区光が丘）	2.20		
Kawagoe-kaido	Tokyo（板橋区営団赤塚駅前）	2.54	No.254	crowded
Mall（Yuhodo）	Tokyo（板橋区赤塚新町３）	1.78		empty
Nakasendo	Tokyo（板橋区役所四つ又交差点）	1.31	No.17	crowded
Shimoita	Tokyo（下板橋駅入口交差点）	2.65	No.17	crowded
Kamikitazawa	Tokyo（世田谷区上北沢３）	0.45		empty
Hakusan	Tokyo（文京区東洋大前）	3.86		crowded
Kawasaki	Kanagawa（川崎市産業道路）	1.62		crowded
Hayamasho	Kanagawa（葉山町小学校前）	5.88	No.134	
Mukaibara	Kanagawa（葉山町向原）	5.45	No.134	
Bus stop	Kanagawa（葉山町小学校前）	5.21	No.134	
Hushimidai	Kanagawa（葉山町東伏見台）	1.88		empty
Hayama tunnel	Kanagawa（葉山町風早橋）	5.44	No.134	
Mouline	France	0.40		
Sain Malo	France	0.54		
Paris	France	2.98		
Tibet 1	China（China-Nepal Road）	9.10		
Tibet 2	China（China-Nepal Road）	8.56		
Katomandu	Nepal	6.65		
Hanoi	Vietnam	0.391		

Fig. 1 Normalized susceptibility in one lane. The cases tire pollution is suspicious.

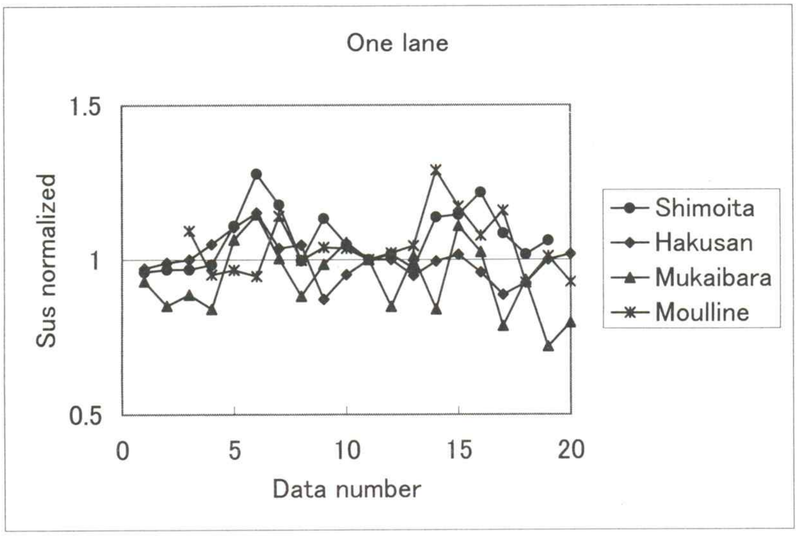


Table 2 Susceptibility of tire in Japan ($\times 10^{-3}$ SI).

Outside	Inside	Remarks
125	1.07	Yokohama
116	0.079	
67.5	-1.56	SG Duran
71.4	-1.28	All season radial
141	-0.673	Bridgestone
139	-0.372	Blizzak
97.0	-1.56	Bridgestone
94.1	-1.28	RD 650 Steel
83.4	-4.76	Bridgestone
95.2	-2.74	Regnoer-50
171	-0.752	Bridgestone
160	-0.832	RD 613 Steel

Table 3 Susceptibility of wheel in Vietnam ($\times 10^{-3}$ SI).

Motor bicycle		Outside	Inside
	①	-3.18	3.30
	②	-0.636	-20.6
	③	-0.699	3.54
	④	1.41	19.5

Bicycle		Outside
	①	17.3
	②	12.5
	③	16.9
	④	16.1

Car		Outside
	①	68.0
	②	63.3
	③	63.5

Fig. 1-2 Normalized susceptibility in one lane. The case of irregular pollutant.

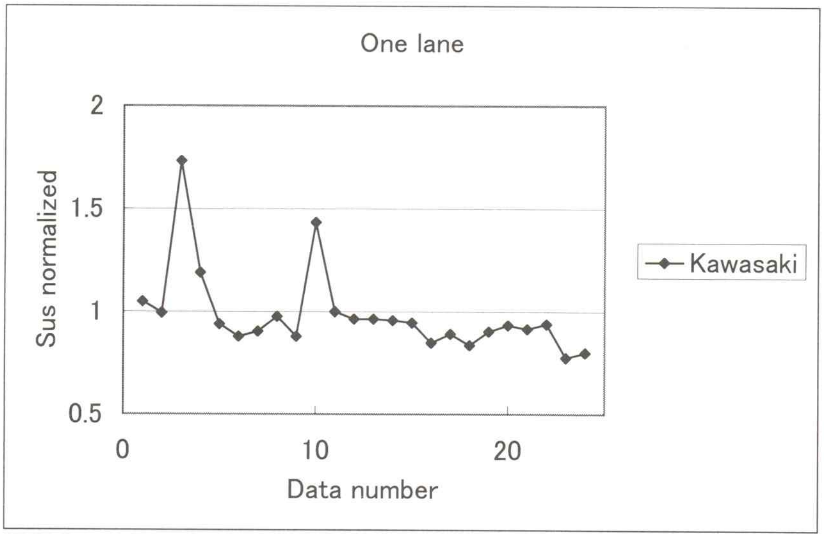


Fig. 1-3 Normalized susceptibility in one lane. The cases pollution is not clear.

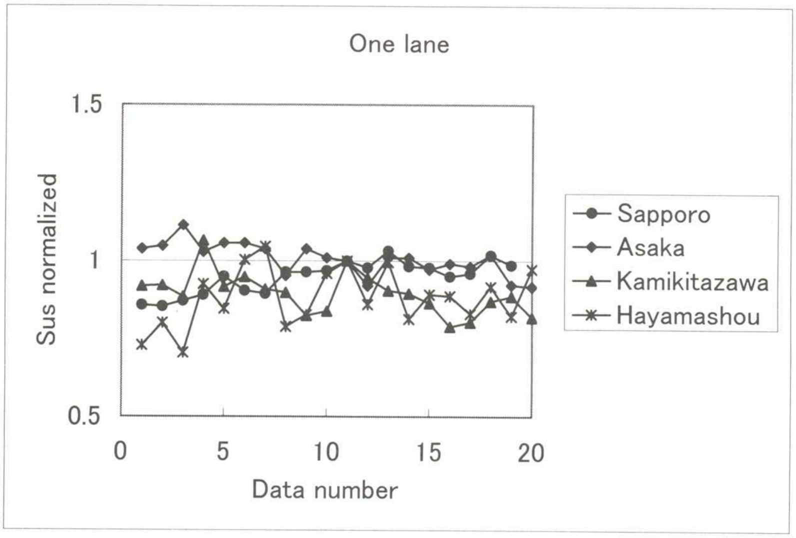


Fig. 2 Susceptibility of bus stop lane, main lane and empty road in Hayama town.

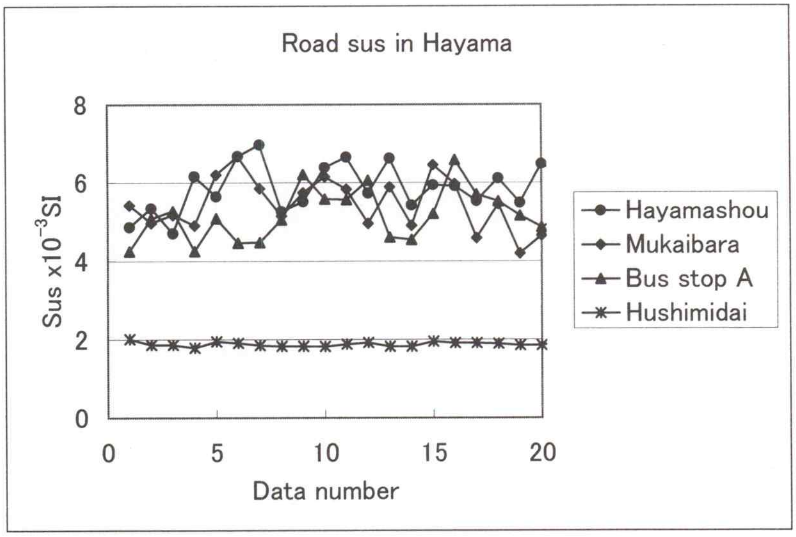


Fig. 3 Susceptibility of two lanes.

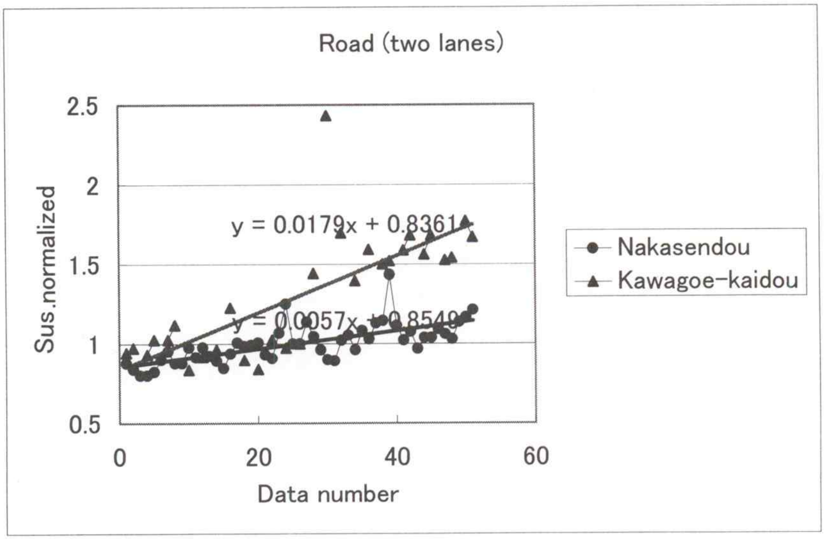


Fig. 4 Susceptibility in front of the garbage furnace and mall (Yuhodo).

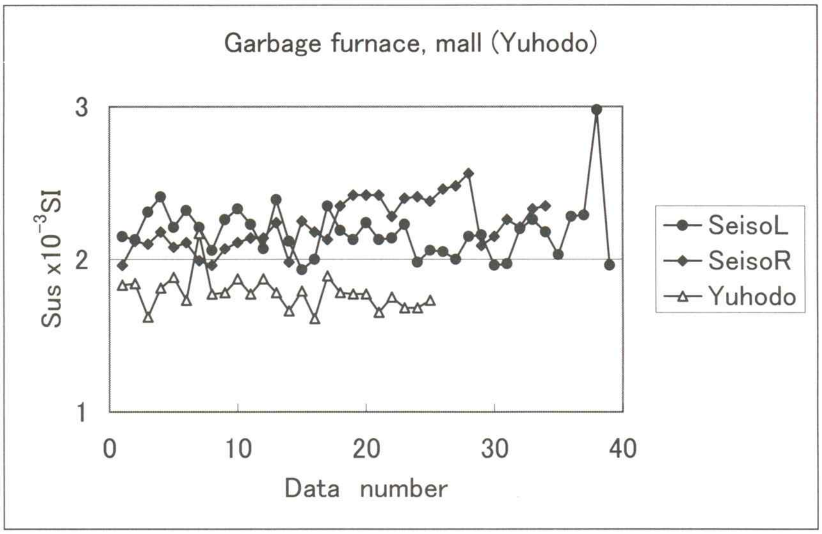


Fig. 5 Susceptibility in Hayama tunnel.

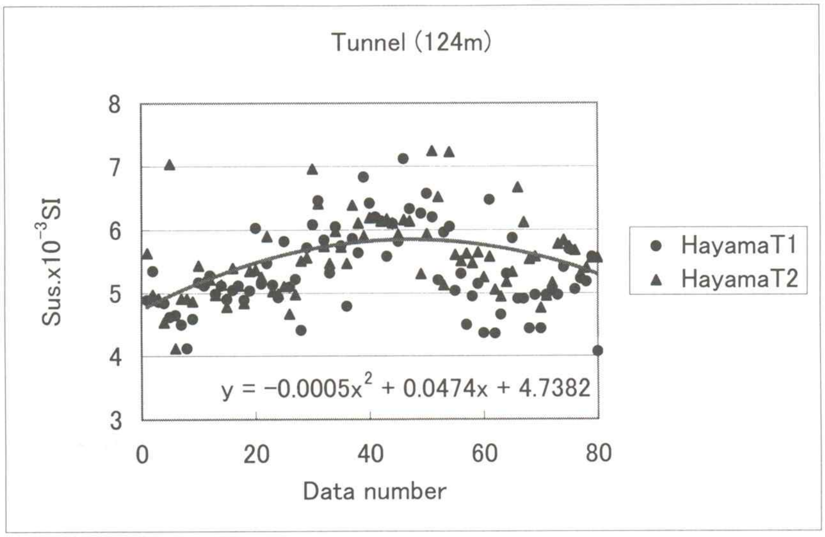


Fig. 6-1 Road susceptibility in France.

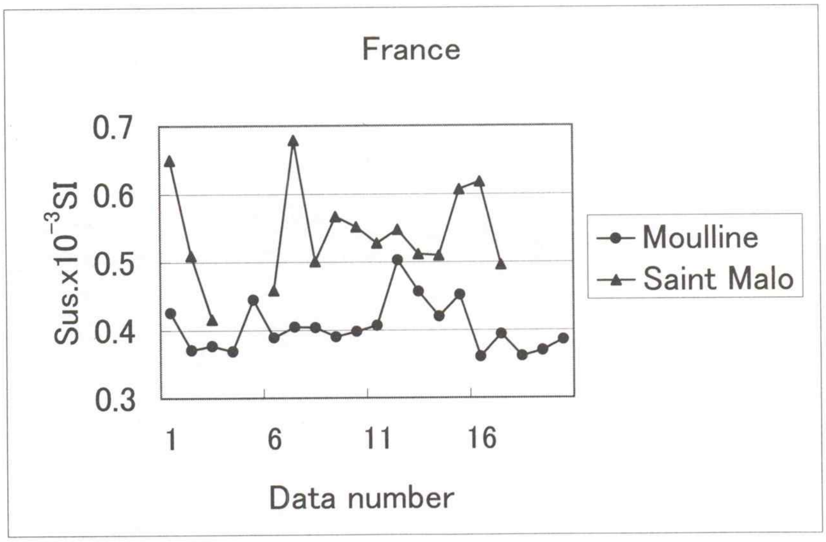


Fig. 6-2 Road susceptibility in France.

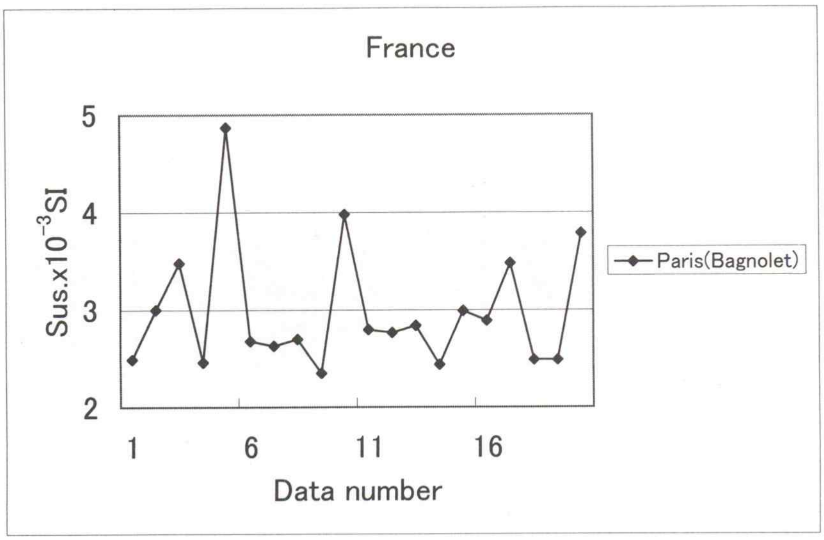


Fig. 6-3 Road susceptibility in Tibet and Nepal.

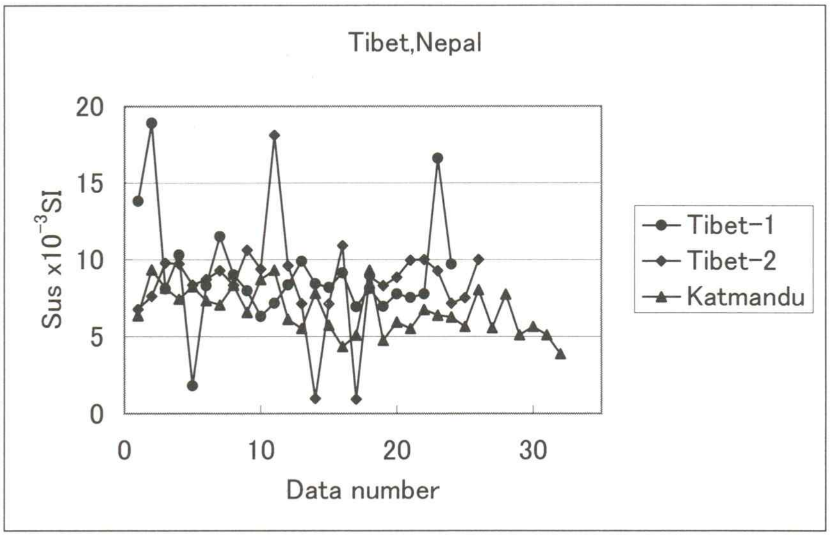
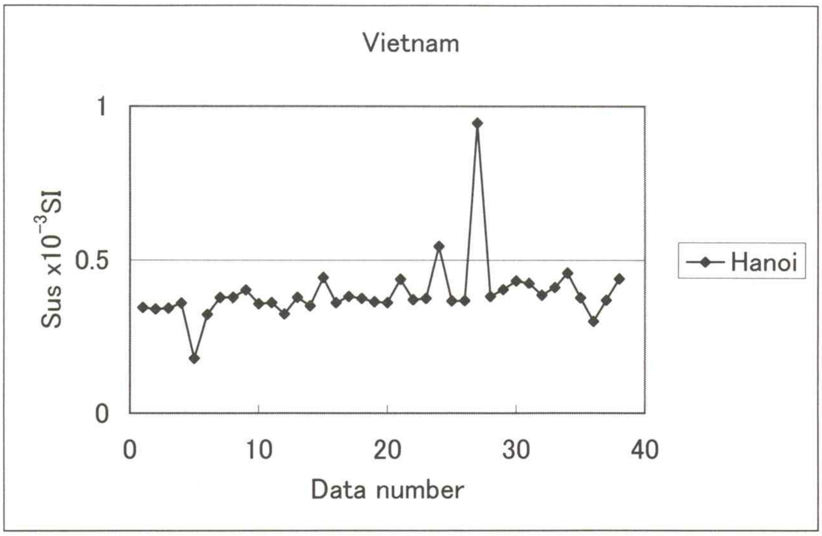


Fig. 6-4 Road susceptibility in Vietnam.



3. Conclusion

Effect of pollution could be found out in road by susceptibility measurement. As to the two peaks in one lane in crowded roads, susceptibility of tire is high enough to be considered as pollutant. In the tunnel, highest susceptibility was found in the middle distance.

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要旨

上野直子：道路の帯磁率と車両による汚染

見かけ上舗装面が一様であると確認できる狭い範囲の舗装道路で、帯磁率の測定を行った。帯磁率は磁性鉱物の含有量に比例するので、化石燃料の燃焼時に細粒の磁性鉱物が発生することや、磁鉄鉱が鉛など有害元素と共存しやすいという外国の報告に基づいて、ガソリンの燃焼による帯磁率の増加を期待して測定した。結果は、一車線分の道路を横断した測定では交通量の多い道路で一車線内に２カ所の増加が見られた。しかし、タイヤの帯磁率は高く、帯磁率の増加はタイヤが原因と思われる。すなわち、自動車が走行している道路では、路面には排気ガスの影響よりもタイヤの影響が表れたと考えられる。二車線以上ある巾が広い道路では、各車線内の特徴は同じだが、それに加えて歩道側から中央分離帯に向かって全体的に帯磁率が増加する傾向が見られた。また、トンネル内では、出入り口では低く、中央部で高い帯磁率が得られた。

キーワード：帯磁率、汚染、車両、道路。