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COMPARISON BETWEEN SOME RESULTS MEASURED WITH AN "URUSASA & HUES" AND THE CONVENTIONAL SOUND LEVEL METERS

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1. INTRODUCTION

It is difficult to solve their complaints on noise problems with only the sound level meters (SLMs) indicating the numerical value in a unit called the decibel. If there is an advanced SLM that can at the same time evaluate also the degrees of psychological effects to noise, it will be a very useful technique for the measurement, evaluation and prediction of noise. As the devices that can realize its evaluation from this viewpoint, many researchers have proposed a lot of noise rating scales. However, we can't find a proposal of the instrument equipped with not only the physical quantities but also the degrees of psychological effects to noise by the one including those scales.

On the basis of fundamental experiments, in a previous paper [1], we designed and made a new SLM equipped with both an "urusasa" (annoyance) and a "five–hues" scales representing the psychological effects to noise.

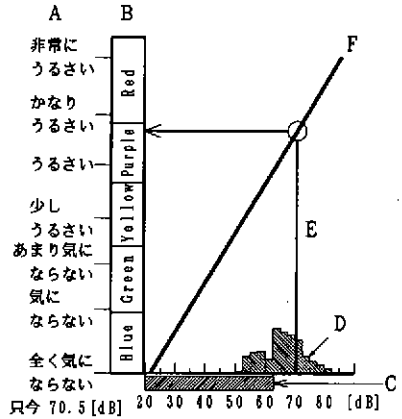
In order to investigate which of the "urusasa & hues" and the conventional SLMs is more suitable to the noise evaluation including the degrees of the psychological effects, we conducted an investigation intended for residents at the Hokkaido, Tohoku, Kanto, Hokuriku, Chugoku, Shikoku and Kyushu districts in Japan.

2. COMPOSITION

The point of the SLM is an idea such as follows: its color liquid crystal display (5.6 inches) indicates the degrees of psychological effects from the equivalent continuous A–weighted sound pressure level ($L_{Aeq,T}$ [dB]) measured through the "urusasa & hues" noise rating scales shown in Fig.1.

2.1 "Urusasa & Hues" Scales on Vertical Axis

On the vertical axis of its display, two kinds of psychological scales obtained by the way different from many scale compositions, are installed.



A :"Urusasa" (annoyance) scale

Japanese	English
Hijōni urusai	Extremely annoying
Kanari urusai	Very annoying
Urusai	Annoying
Sukoshi urusai	A little annoying
Amari Kininaranai	Not too annoying
Kininaranai	Not annoying
Mattaku kini-naranai	Not at all annoying

B :"Five-hues" scale
C :A-weighted sound pressure level [dB]
D :Histogram of $L_{Aeq(1sec)}$ [dB]
E :$L_{Aeq,T}$ [dB]
F :Noise-rating scales

Fig. 1 An example of the degrees of psychological effect indicated on the display of "urusasa & hues" SLM.

One "urusasa" scale (representation A shown Fig.1) is composed of "urusasa" and "kininaranai" extracted from typical words which the majority of residents in a community use in daily [2] and the other scale (representation B) five-hues (red, purple, yellow, green, blue) determined through our senses of hues little influenced by regions, culture, generations, sexes and etc [3]. To help beginners grasp the numerical value of $L_{Aeq,T}$ [dB], it can be said that the combination of the "urusasa" and the "hues" scales is easier to understand its value than each individual scale by the intersensory effect across vision and audition to noise [1].

2.2 Physical Quantities on Horizontal Axis

On the horizontal axis of its display, three kinds of physical quantities in decibels are installed with the following representations as shown in Fig.1: the bar-graphical representation C is the A-weighted sound pressure level, the representation D the histogram classed in $L_{Aeq(1sec)}$ divided into every 2.5dB, and the representation E the perpendicular line of $L_{Aeq,T}$. Where the subscript T is the time with audio-visual attention of subjects to the scales displayed from the start time to the five minutes.

2.3 Representation Method of Noise Rating Scales

The common linear function (representation F shown in Fig.1) shows two noise rating scales: the relation between the "hues" scale composed independently and $L_{Aeq(5min)}$ has the same gradient as the "urusasa" noise rating scale [2],[3]. Therefore, the SLM can directly indicate the "Kanari urusai" and "Purple" from 70.5dB through its linear function as shown in Fig.1.

3. EVALUATION OF ITS USEFULNESS

Table 1 Frequency–distribution of the degrees of its "understandability" by different residents in each district.

Districts	Noise sources	Seven scale points of understandability							Mean scores
		7 Extremely	6 Very	5 Good	4 A little	3 Not too	2 Not	1 Not at all	
Hokkaido	Vehicles	14	29	39	15	3	0	0	5.4
Tohoku	Vehicles	20	40	60	26	3	1	0	5.3
Kanto	Vehicles	8	18	46	10	0	1	0	5.3
	Railway trains	7	8	10	5	3	0	0	5.3
	Jet aircraft	5	12	11	5	1	0	0	5.4
	Construction	3	7	18	6	1	0	0	5.1
Hokuriku	Vehicles	8	12	22	8	0	0	0	5.4
Chugoku	Vehicles	10	27	45	6	1	1	0	5.4
Shikoku	Vehicles	9	21	25	4	1	0	0	5.5
Kyushu	Vehicles	16	26	43	11	3	1	0	5.4
Total		100	200	319	96	16	4	0	5.4
Percentage [%]		13.6	27.2	43.4	13.1	2.2	0.5	0	

We have investigated for different residents at the seven districts (see Table 1) in Japan whether the "urusasa & hues" SLM is more useful in practice than the conventional one.

3.1 Experiment

Those 735 subjects were the 100 residents in Sapporo city, 50 Aomori, 50 Morioka, 50 Fukushima, 50 Utsunomiya, 135 Tokyo, 50 Kanazawa, 30 Hiroshima, 26 Yamaguchi, 34 Shimonoseki, 60 Takamatsu, 60 Fukuoka and 40 Saga. Those noise sources were highway vehicles, railway trains, jet aircraft, and construction equipment.

The residents evaluated, "Which representation with the 'urusasa & hues" SLM or the ordinary one (RION NL–11) is available?" and answered, "How do you feel about the correspondence between your subjective impressions and the scale displayed?"

3.2 Results

In case of the "urusasa & hues" SLM shown in Table 1, the percentage of the subjects likely to be the "highly understandability" counted in the top three out of seven categories, is 84.2%, and the mean score is 5.4. On the other hand, in case of Table 2, the "highly correspondence" is 80.3%, and the mean score is 5.0. From the results of statistical test, it can be said that

Table 2 Frequency–distribution of the degrees of its "correspondence" by different residents in each district.

Districts	Noise sources	Seven scale points of correspondence							Mean scores
		7 Extremely	6 Very	5 Good	4 A little	3 Not too	2 Not	1 Not at all	
Hokkaido	Vehicles	5	18	62	12	3	0	0	5.1
Tohoku	Vehicles	8	22	77	29	9	4	1	4.8
Kanto	Vehicles	4	12	49	11	7	0	0	4.9
	Railway trains	2	6	21	4	0	0	0	5.2
	Jet aircraft	1	10	16	7	0	0	0	5.1
	Construction	1	10	17	6	1	0	0	5.1
Hokuriku	Vehicles	4	8	26	11	1	0	0	5.1
Chugoku	Vehicles	3	25	51	5	5	1	0	5.1
Shikoku	Vehicles	3	15	34	6	2	0	0	5.2
Kyushu	Vehicles	4	19	57	14	6	0	0	5.0
Total		35	145	410	105	34	5	1	5.0
Percentage [%]		4.8	19.7	55.8	14.3	4.6	0.7	0.1	

those mean scores are independent of each district.

From those results, it can be said as follows: the "urusasa & hues" SLM is able to evaluate with the common scales for the psychological effects to different subjects and noise sources in all the districts shown in Table 2.

4. CONCLUSIONS

Accordingly, it can be said as follows: the SLM proposed here is a practical instrument for residents exposed to noise to help them understand the $L_{Aeq,T}$ [dB] sensuously and evaluate the various kinds of noise sources in all the seven districts investigated in Japan.

REFERENCES

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