

The Latest Measurement of the Environmental Noise Including Low-frequency Sound in Japan

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1. Introduction

In recent years noise including low-frequency sound has been attracted public attention, which is generated by large-sized equipments and ordinary home appliances, such as wind turbines, boilers, freezers and natural coolant heat pump water heater. Complaints about low-frequency sound have been increasing in Japan in the past several years.

The Ministry of Environment, the Government of Japan has started investigation about wind-turbine noise as "Research on low-frequency sound impact to human by wind-turbine generators etc" (2010-2012).

In order to investigate the existence of low-frequency sound, low-frequency sound and noise are measured. Low-frequency sound level meters in addition to sound level meters are also used. These days, a measuring instrument which can measure between 1 Hz and 20 kHz with a single unit has also been developed.

This report describes a latest measurement example in Japan and the measuring instrument.

2. Measurement example

We show an example of recent field measurements regarding wind-turbine noise in Japan. The wind turbine is up-wind type, about 100 m heights and its rated power is 1.0 MW. We carried out measurements at two points simultaneously. The first point is near the wind turbine and its distance between the wind turbine and the measuring point is about 150 m. The second point is inside of a complainer's house and is

distance from the wind turbine: about 210 m. In the measurement, both output signals of the sound level meter and the low-frequency sound level meter were recorded with a data recorder. One-third octave band equivalent sound pressure level of ten seconds(Leq, 10s) was calculated from the recorded tapes, continuously.

The measured frequency characteristic is shown in Fig.1 and Fig.2. At the measurement point near the wind turbine, there are the low-frequency sound at 31.5 Hz and tonal sound of 160 - 200 Hz. The same tonal frequency components were also observed inside the complainer's house. The sound pressure levels of noise in the complainer's house exceeded the hearing threshold at 80 Hz or more. On the other hand, even near the wind turbine, the sound pressure levels of infrasound(20 Hz or less) were about 20 dB or more lower than the hearing threshold.

Considering the measurements inside the house, it is presumed that the complaint is probably caused by the tonal components at the frequency range from about 160 Hz to 200 Hz.

2. The Latest Measuring Instrument

Previously, in addition to low-frequency sound level meters, sound level meters and data recorders were used for measurements of sound including low-frequency sound. Recently, latest measuring instrument(Fig.3) can measure the frequency band between 1 Hz and 20 kHz, which can realized by newly developed a half-inch electret condenser microphone. The frequency characteristic of the microphone is shown in Fig. 4.

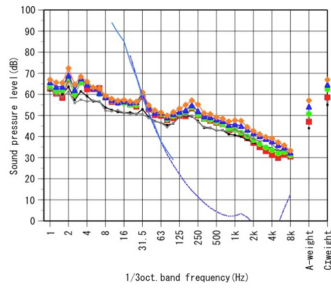


Fig. 1 Frequency characteristics of wind turbine noise; Near wind turbine (150 m)

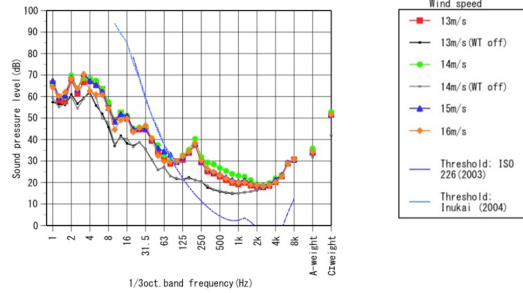


Fig. 2 Frequency characteristics of wind turbine noise; Inside of complainer's house (210 m)



Fig. 3 Sound Level Meter

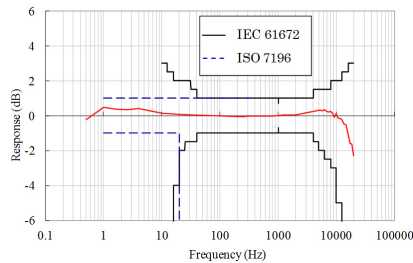


Fig. 4 Frequency characteristic of electret condenser microphone

This measuring instrument conforms to various sound level meter standards (precision sound level meter of Japanese Measurement Law, IEC 61672-1 : 2002 Class 1, JIS C 1509-1 : 2005 Class 1, ANSI S1.4-1983 Type 1, ANSI S1.4A-1985 Type 1, and ISO 7196 : 1995, and so on). The instrument conforms to IEC 61672-1 : 2002 Class 1 and JIS C 1509-1 : 2005 Class 1 with window screen worn.

The instrument has frequency weighting A, C, Z, and also G specified by ISO 7196 and can measure sound level ranging from 25 dB to 138 dB (frequency weighting A) in one range. The AA form battery is used as a power supply, and it operates for about 16 hours because of appropriate power saving function. Furthermore, it is also considered environmentally, the instrument can use rechargeable nickel hydride battery, and can reduce batteries consumption and garbage.

One-third octave band analysis function (44 bands of 1 Hz - 20 kHz) and recording function of sound pressure waveform are supported by options. Frequency weighting A, G, one-third octave band analysis, and waveform recording can be measured simultaneously with a single unit.

Therefore, the instrument can substitute all previously used measuring instruments such as a low-frequency sound level meter, a sound level meter and a data recorder. People can reduce their time and effort about set-up and cabling.

3. Conclusion

We reported an example of wind-turbine noise measurements including low-frequency sound. We explain the latest measuring instrument which can measure frequency components of 1 Hz ~ 20 kHz and one-third octave band analysis in real time, and can record sound pressure waveform simultaneously.

We believe that the instrument can contribute enough sound measurement and sound measurement including low-frequency sound.

Reference

Ochiai et al., "Recent field measurements of wind turbine noise in Japan", Proceedings of International Meeting on Wind Turbine Noise 2011.