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NOISE OF WOODWORKING MACHINERY: NOISE OF INDIVIDUAL MACHINES AND OVER-ALL PLANT NOISE IN PLYWOOD AND FIBERBOARD MANUFACTURING PLANTS AND

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by

Hikoichi SUGIHARA and Shigeru KITAYAMA

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Translated from Mokuzai Kenkyū [Wood Research], 39, (1966), 35-40

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NOISE OF WOODWORKING MACHINERY

Noise of Individual Machines and Over-all Plant Noise in Plywood and Fiberboard Manufacturing Plants and in Woodworking Shops

by

Hikoichi SUGIHARA*, ** and Shigeru KITAYAMA**

1. INTRODUCTION

Factory noise, with today's growth of industrial production, is on an ever-increasing scale. Within the factory it affects the employees both as regards their health and as regards their efficiency, while outside the factory it is becoming increasingly serious as a social problem and public nuisance.

In the woodworking industries the noise created by the machinery ranks high in the scale as compared with the situation in other industries. Measures to reduce it are being studied by the makers [of the machinery], and on the other hand, the interested public authorities have begun to take the matter under control.

The authors have already published, in the journal Mokuzai Kōgyō [The Wood Industry], studies entitled "General Concepts re Machinery Noise" and "Noise Studies in the Lumber Mill" [1, 2, 3]. The present paper reports, in a similar manner, data obtained from noise studies in plywood and fiberboard factories and in woodworking shops.

Woodworking plants in general are on a small scale and have some of the characteristics of home industries, though such things as plywood and fiberboard factories (etc.) more often are in the form of fairly large-capital undertakings. In connection with noise it is to be remarked that many woodworking plants are located in residential areas. In this case, the small scale of the establishment and openness of the working premises together mean that the external noise output is large and the public nuisance factor is here in question, rather than noise inside the plant. (Though of course, woodworking plant internal noise is over 90 phons and is thus high on the list of industrial plant noises.)

In the plywood and fiberboard factories and woodworking shops studied in the present paper, however, the plant area was spacious and it could be said that these enterprises constituted practically no public nuisance as regards noise. Here, then, we took up only the aspects of individual machine noise and the internal noise level of the plant. Only in the case of the woodworking shops were there some that had drying kilns situated in proximity to built-up areas, and at close range their noise output (particularly the night-time noise) did give rise to complaints.

2. OUTLINE OF THE RESEARCH

A description of the five plants investigated is given in Table 1. In these plants, as compared with wood-working plants in general, the noise [control] situation was admirable. Acoustic discomfort intensities were investigated by means of periodic medical examinations. The use of ear plugs had been made more or less the

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rule throughout the plants, and particularly in the case of operators working in positions where the noise level was high. Various noise-reducing devices had been worked out and put into effect (for instance, installation of of acoustic board, etc.). But as regard the machinery noise output itself, the attitude seemed to be one of resigning themselves to putting up with it.

For the [over-all] noise level, measuring instruments used were an indicating [direct reading] noise-meter (Nihon Denki Sokki Co. model SL-23) and a frequency analyser (same firm, model BP-10).

In measuring [individual] machine noise levels, we employed settings A and C of the compensating pick-up circuits. When in Tables 2 and 3 (individual machine noise levels) two figures are given, one above the other, the upper figure is the A value and the lower one is the C value. This affords us a criterion: the greater the difference between A and C, the more low-frequency component there is, and the smaller the difference, the more high-frequency component there is. For internal workshop noise we went by the JIS standard [scale]; accordingly we may reckon 60 to 85 [sic] phons as B, 80 phons and above as C.

For our machine-noise measurement points we took, in principle, the machine operators' positions. Internal workshop noise levels were measured at a number of points, and histograms [of noise occurrence] were constructed.

3. CONSIDERATION OF RESULTS

(i) Individual Machine Noise

Individual machine noise levels are shown in Tables 2 and 3, and the frequency analysis results in Figures 1 to 5. (The frequency results shown are only for times when in operation.)

In plant *a* (Table 1) there was intense machine noise (from the three-side planer, tenoner, etc.), with the frequency characteristics peaking at relatively high frequencies. Here the machines may be said to be producers of extremely deleterious noise.

In plant *b* the noise from the chipper is quite intense, but in addition the so-called *attack noises* are high. These are from the autochipper and the hot press. The machine operators are intermittently exposed to as much as 100-phon attack noise, which would seem to be a heavy stress, particularly in the sense of nerve-stress.

In plant *c*, a fiberboard factory, the volume of noise from all the machinery in the main operating regime was high, and we did not undertake to investigate [individual] machine noise except for certain of the machines. Of these, it was the chipper that produced the most extreme noise. This chipper was a large model, capable of taking billets up to 20 cm in diameter. In contrast to the smaller types of chipper seen in ordinary mills, there was a great difference between its no-load regime and its operating regime; in no-load running the noise level was relatively low, but when working it was extremely high. We may say that measures to reduce chipper noise are a problem that demands very positive study. The fiberboard factory is a fairly new development, and the matter of impairment of hearing among the employees has not come very much into question, but in the pulp-mill, which has a longer history, the impairment of workers' hearing is a problem that comes up all the time.

Plant *d*, in which the principal effort is devoted to cabinet work, is on a fairly large scale as woodworking shops go. Here the chief noise-creating machines are the circular saws or cutters (swing-saw, rip-saw and tenoner), together with the planers. Gang-cutting saws produce an extreme level of noise, but this may be a matter of machine balance, and furthermore [gang-cutting] is not always used.

In plant *e*, a type of woodworking shop connected with the manufacture of musical instruments, there is a high level of planer noise. Here several planers are set up in parallel. The values in Table 3 are for times when only one of these machines is operating. When all are operating the noise level goes up by several phons. Something that might be considered here, it seems, is the arrangement of the machines (shifting their positions, and so forth).

(ii) Factory Interior Noise

In plant *a* the shop space is relatively constricted and for this reason we were not able to derive a [noise-occurrence] histogram, but the interior noise level in the plant was in the range 86 phons to 96 phons. Plant *b* exhibited a range of 88 to 97 phons (Fig. 8). These figures are at about the same level as in the case of the ordinary lumber mill. In plant *c* the defibrating shop was particularly noisy. Here the sound was strong in the low-frequency region, and it seems that the vibration aspect, as well as that of noise, should be studied. In the sizing and forming shop the noise was more or less of the same order as in plant *b* (Fig. 6, Fig. 8). In plant *d*, the preforming shop noise is lower: 70~85 phons. This is no doubt because the working space is ample and the number of machines small. In the assembly shop we found 85~97 phons, the same amount of noise as in plant *b* (Fig. 7, Fig. 9). In plant *e* the range was from 82 phons to 100 phons. The 100-phon noise was around the planer (Fig. 9).

In plant *e* the noise from the drying kilns (furnaces), at the center of the road separating kilns and dwelling houses, was 70 phons in the daytime, 60 phons at night. As compared with the lumber mill case, this is no great volume of noise, yet there were strong complaints from the neighborhood. One may say that the subjective element here involved is one of the causes that make the noise problem a complicated one.

RESUMÉ

We have investigated the noise of individual machines and the interior noise level of the plant in the case of plywood and fiberwood factories and woodworking shops. As in the case of lumber mills, the noise made by chippers and planers is particularly high, often being over 100 phons. Tenoners and inclined-bed circular saws have high levels of noise.

As regards internal factory noise levels, that of the defibrating shop of fiberboard factories is high; under some circumstances it may be described as "intense", exceeding 100 phons. In other cases it is of the same order as in a large lumber mill. As compared with other industries, this noise level is high.

REFERENCES

1. H. SUGIHARA and S. KITAYAMA, Mokuzai Kōgyō [Wood Industry], **21**, 511 (1966).

2. H. SUGIHARA and S. KITAYAMA, ibid., **21**, 559 (1966).

3. S. KITAYAMA, C. TANAKA and H. SUGIHARA, ibid., **21**, 569 (1966).

Table 1. Description of investigated premises

	a	b	c	d	e
main product	decorative plywood	plywood	fiberboard	furniture and cabinet work	musical instruments
beginning year of operation	1952	1956	1956	1942	1927
construction materials	steel and slate	steel and slate	steel, concrete	wood and slate	steel and slate
number of workers	300	670	100	850	800
location	semi-industrial zone	semi-industrial zone	industrial zone	semi-industrial zone	town
public nuisance factors	–	smoke and dust	waste water	odors and electrical interference *	noise of drying furnace

* From high-frequency dryer used in gluing operations.

Table 2. [Individual] noise of machines producing plywood and fiberboard

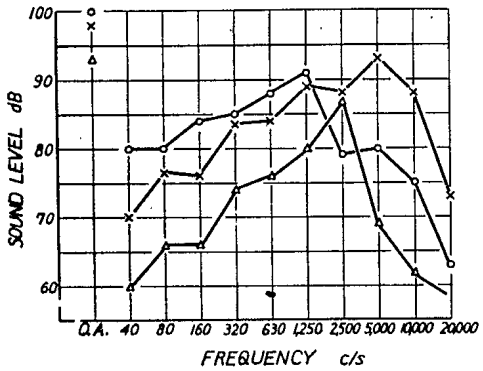
a			b			c		
machine	no-load running	operating	machine	no-load running	operating	machine	no-load running	operating
slicer	82* 77**	85 90	veneer lathe	–	87 92	double saw	82 90	100 100
circular saw	67 89	87 89	clipper	82 90	96 99	chipper	87 95	102 108
triple saw	90 92	90 92	hot press	91 95	102 108			
three side planing machine		97 100	double saw	–	96 98			
belt sander	83 86	87 90	double saw	–	97 98			
belt sander	84 90	88 92	belt sander	89 95	90 96			
tenoner	93 95	96 99	chipper	91 100	95 102			
jointer	–	88 93						

* A phone circuit
** C phone circuit

Table 3. [Over-all] noise level of woodworking machines

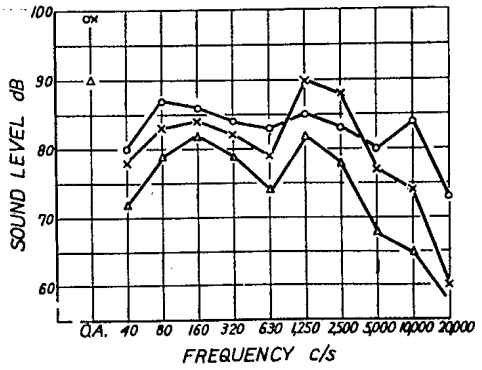
d						e		
machine	no-load running	operating	machine	no-load running	operating	machine	no-load running	operating
duct	—	80* 87**	double end tenoner	—	97 98	rip saw	—	94 95
circular saw	—	88 92	router	—	89 92	circular saw	81 84	95 98
circular saw	91 92	91 92	copying shaper	86 86	89 91	cross cut saw	84 88	95 94
circular saw	93 95	97 100	copying shaper	79 84	81 86	three side planing machine	—	102 105
double saw	83 85	94 95	double surface planer	—	95 97	single surface planer	—	94 97
double saw	83 84	93 93	single surface planer	90 83	101 105			
swing saw	94 94	95 100	belt sander	94 96	95 98			
rip saw	—	94 101	gang cut saw	101 101	107 107			

* A phone circuit
** C phone circuit



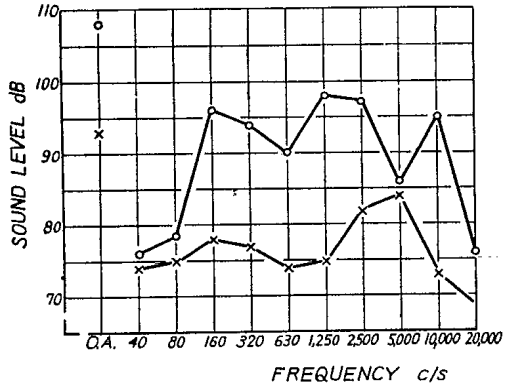
○ three side planing machine
× tenonr
△ triple saw

Fig.1. Sound level of machines in operation (plant *a*).



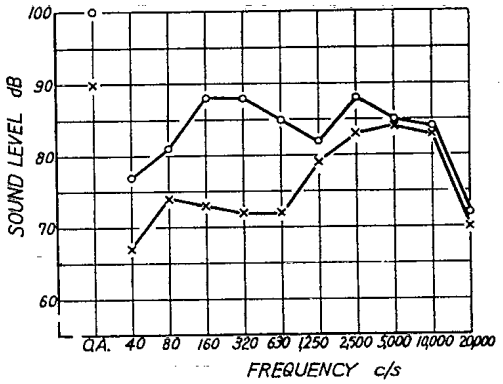
○ clipper
× double saw
△ veneer lathe

Fig.2. Sound level of machines in operation (plant *b*).



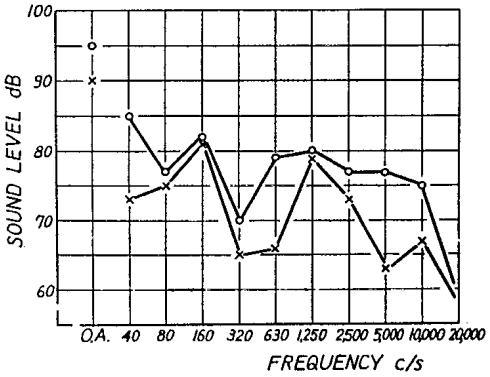
○ chipper
× double saw

Fig.3. Sound level of machines in operation (plant *c*).



○ swing saw
× circular saw

Fig.4. Sound level of machines in operation (plant *d*).



○ single surface planer
× cross cut saw

Fig.5. Sound level of machines in operation (plant *e*).

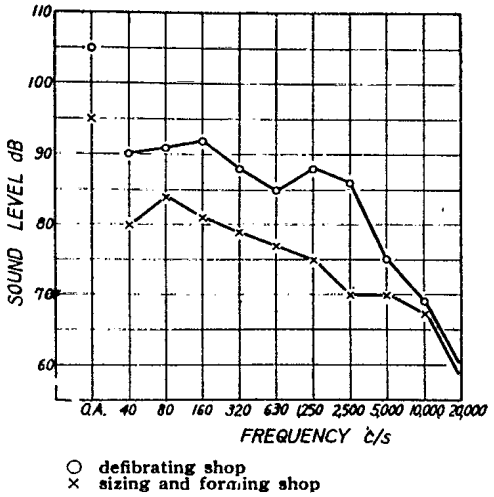


Fig.6. Over-all noise levels in workshops (plant *c*).

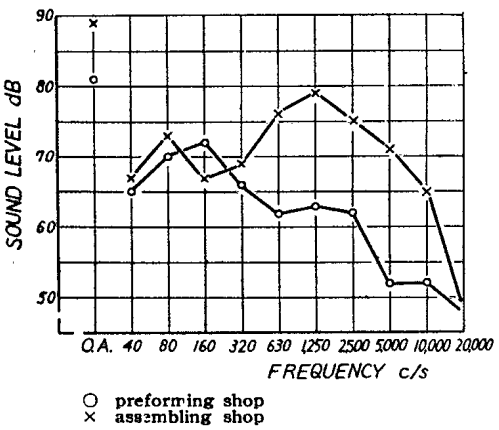


Fig.7. Over-all noise levels in workshops (plant *d*).

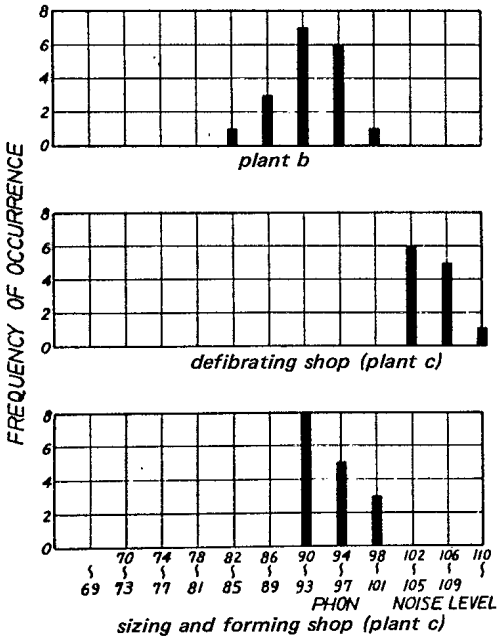


Fig.8. Histograms of noise levels in workshops of factory producing plywood and fiberboard.

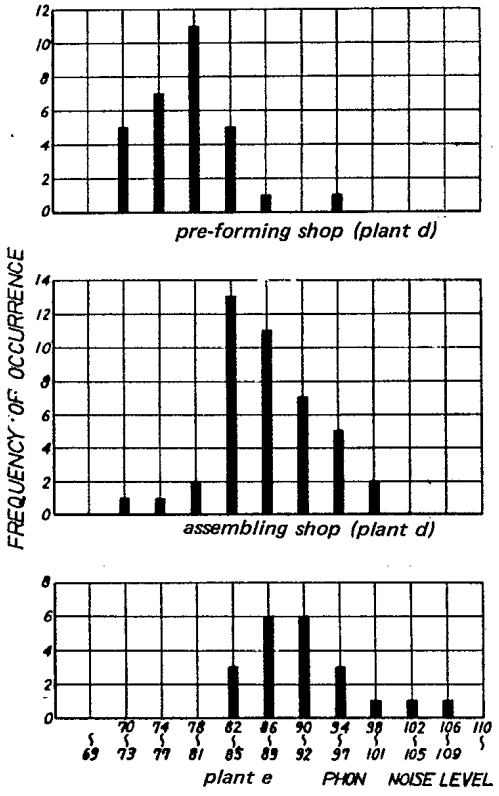


Fig.9. Histograms of noise levels in workshops of woodworking plant.

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