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WASTE-INCINERATION POWER PLANT: NOISE ASPECTS AND PREDICTION

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Concomitant with the increase of the industrialisation level and the density of the population, the production of the domestic, commercial and industrial refuse also increases and, with it, the necessity of waste-incineration plants.

Since the waste-incineration plants cannot be always placed at great distances from residential areas, it is necessary, before their construction, to estimate the noise levels of these plants in the vicinity.

With the intention to calculate predictions as accurately as possible, extensive noise measurements of the octave-band spectra and the A-weighted sound pressure levels of all noise sources were performed.

The noise of a modern waste-incineration power plant (waste-incineration plant coupled with a small power unit) is generally emitted by the following equipment: the refuse lorries, the refuse crane and the charging hopper in the discharge area; primary and secondary air fans, flue gas fans and roof-mounted fans; steam boilers, steam turbine sets, three-phase generators, pumps (vacuum pumps, feed water pumps, governing condensate pumps, hot-well condensate pumps, cooling-water pumps, oil pumps, etc.); compressors (rotary compressors, compressors for the neutralizing pond, compressors for the oxidation vessel); slag conveyors and dust conveyors; electrostatic filters and air condensation plant.

The noise levels of all these sources were measured in a typical modern waste-incineration power plant having the following technical data: approx. 260,000 tonnes/year domestic, commercial and industrial refuse with 2 incineration furnace units; 2 steam boilers of 43.2 tonnes/hour steam-generating capacity; 2 turbine generators of

12.5 MVA rated output, 8.43 MW effective power and 10.5 kV terminal voltage; 2 units air condensation plant, each unit of 41.5 tonnes/hour; 2 flue gas dust-removal electrostatic filters, each filter of 137,500 Nm3/hour gas volume and a flue gas washing plant.

For example, in Figs. 1 - 4, the noise emission spectra in the principal enclosures and of some noise sources of the mentioned waste-incineration power plant are shown [1]. The noise measurements were taken at a distance of 1 m. The sound pressure levels in buildings (see Fig. 1) were calculated in function of the total absorption in the room (or the room volume and the reverberation time) and of the total sound power in the room after the measurement, calculation and summarisation of the sound power level of all noise sources in this room.

The prediction of the noise emitted from waste-incineration plants at a receiver point was computed with the computer programme SOUND (SCHALL), which was developed to calculate the outdoor sound propagation.

The sound pressure level L_S, which is produced by a single sound source in the free field at a receiver point within the distance S from the centre of the sound source, is calculated in the programme "SCHALL" according to the following equation [2]:

$$L_S = L_W + K_1 - K_2 - \Delta L_S - \sum_{k=1}^{7} \Delta L_K \quad \text{(dB)} \tag{1}$$

where:

L_W = Sound-power level of the emission source, in dB
K_1 = Directivity in the angle of reflection Ω, in dB
K_2 = Directivity (only for sound sources with distinct directivities: for instance air outlet at the diffusor at the cooling tower, chimneys, blow-off pipes, etc.)
ΔL_S = Attenuation by divergence (distance-conditioned level taking), in dB
ΔL_1 = Atmospheric attenuation A_{atm}, in dB
ΔL_2 = Excess attenuation A_{excess}, in dB
ΔL_3 = Attenuation by building, in dB
ΔL_4 = Attenuation by bushes, in dB
ΔL_5 = Barrier attenuation, in dB
ΔL_6 = Attenuation by turbulence, in dB
ΔL_7 = Attenuation by wind and temperature gradient, in dB

The calculations are made for the 9 octave-band centre frequencies (31.5, 63, 125, 250, 500, 1,000, 2,000, 4,000, 8,000 Hz). The octave-band sound pressure level at the receiver point is then computed. In order to obtain the overall octave-band sound pressure level of all sound sources at the receiver point, the results are calculated at each octave band centre frequency and A-weighted to an overall sound level.

The programme language is FORTRAN IV and the "SCHALL" programme is running on CDC-6500, IBM 370 and all PRIME equipment.

Several noise investigations have shown that the difference between the overall sound levels of a waste-incineration power plant, calculated and measured, has been about ±1 dB(A).

For example, one of the mentioned investigations was performed for a waste-incineration power plant with an incineration capacity of approx. 30 tonnes/hour, with 24 types of sound sources and for a receiver point at a mean distance of 200 m. The difference between the two overall A-weighted sound pressure levels, calculated and measured (for comparable meteorological conditions), is 1.11 dB(A), i.e. about 1 dB(A) (see Table 1).

Table 1. Octave-band sound pressure level in dB of a waste incineration power plant in an average distance of 200 m

Octave-Band Centre Frequency Hz	31.5	63	125	250	500	1000	2000	4000	8000	L_A dB(A)
Calculated	61.18	60.45	61.56	56.92	52.97	54.94	49.79	38.56	19.99	58.11
Measured	66	64	58	58	53	52	50	41	20	57.0

REFERENCES

[1] P. Teodorescu, "Bestimmung der Schallimmission vom Müllkraftwerk Schwandorf und erforderliche Schallschutzmassnahmen (Vorausberechnung). Report. Motor-Columbus Consulting Engineers Inc., Baden, Switzerland, 1979.

[2] P. Teodorescu, "Applications of the Computer Programme "SCHALL" for Estimating Outdoor Sound Propagation and for Optimisation of Noise-Abatement Measures in Industry", Inter-Noise 82 Proceedings, James G. Seebold Ed. (Noise Control Foundation, New York, 1982) pp. 815 - 818.

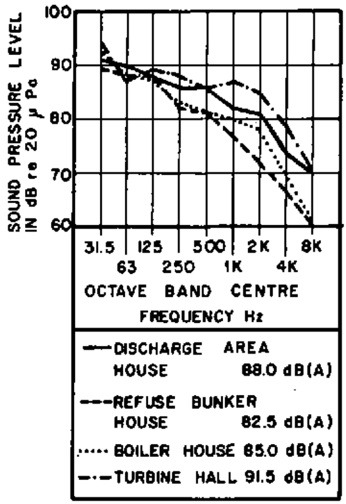

FIG. 1 NOISE OCTAVE BAND SPECTRA IN BUILDINGS

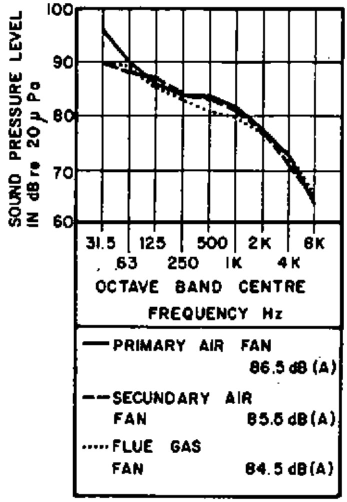

FIG. 2 NOISE OF FANS

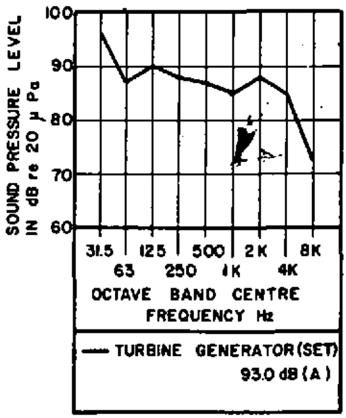

FIG. 3 NOISE OF TURBINE GENERATOR (SET)

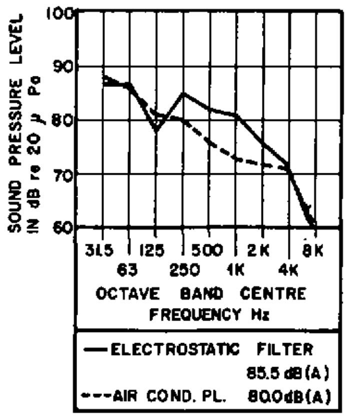

FIG. 4 NOISE OF ELECTROSTATIC FILTER AND AIR CONDENSATION PLANT