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NOISE PREDICTION METHOD FOR ALLOTTING EMISSION QUOTAS TO INDUSTRIAL AREAS

Ing. C. A. Nierop Azn
M+P Raadgevende ingeniers bv, Postbus 344, 1430 AH Aalsmeer, The Netherlands

CONCLUSION

Due to the fact that Holland is highly industrialised and space is frugal, it is important to have control on the sound emission of industrial areas to the vicinity.
For controlling environmental issues, more and more use is made of the so called "subsidiarity principle", that is to say that a strict separation is made between the responsibilities belonging to the authorities and belonging to the industry.

In the case of developing new industrial areas one has to know the available emission space in order to comply with specific immission limits in the vicinity. From table 1 it can now be inferred what type of industry can be located within a certain mesh.
With this a clear picture emerges of how the noise emission of a whole industrial area can be controlled and managed with the aim to comply with given immission limits in the vicinity.

CALCULATING EMISSION SPACE FOR COMPARISON WITH SPECIFIC IMMISSION LEVELS IN THE VICINITY

Holland is a country with one of the most dense population of the world amounting to 456 inhabitants per km^2.
Due to the fact that Holland is highly industrialised and space is sparse, in new situations as well as in existing situations, it is important to have control on the sound emission of industrial areas. Therefore a study has been made to predict sound emission levels for different types of industry, and a model for planning industrial sites and a draft proposal for allotting noise space has been developed. From an acoustical point of view, an optimal lay out of the available industrial area can be developed. For this purpose the total surface of the industrial area has to be subdivided into smaller areas (S) (mesh), each area with a total sound power level (L_{WA}) of

$$L_{WA} = L_{WA}' + 10 \log S'$$

with L_{WA}' equal to the surface related sound power level of the sub surface S'.

Each mesh S' shall have a maximum dimension which is at least smaller than 1,5 times the distance (r) from the centre of that mesh to the immission point in the vicinity. Basically, the sound power level (L_{WA}) of each mesh should be well chosen in such a way that the contribution to the sound immission at certain points in the vicinity should be more or less the same for each mesh.

With these sound power levels the immission levels in the surrounding of the industrial area can be calculated, using noise propagation models as used in the different countries or in our case the propagation model as described in the a guide for "Measuring and calculation of industrial noise" (IL-HR-13-01) [1], which has been published by the Ministry of public health, dealing specifically with outdoor noise.

For a rough calculation a simple formula [2][3] can be used:

$$L_{Aeq} = L_{WA} - 27 \log r + K \qquad dB(A)$$

with:

L_{Aeq}	=	equivalent sound pressure level at a distance r (mean value of various meteorological conditions);
r	=	distance between the centre of the mesh and the immission point;
K	=	correction factor due to the frequency spectrum of the type of industry, value between 2 and 6 dB(A).

As a example figure 1 shows the area related sound emission L_{WA}' for an industrial area, to meet the given noise contours.

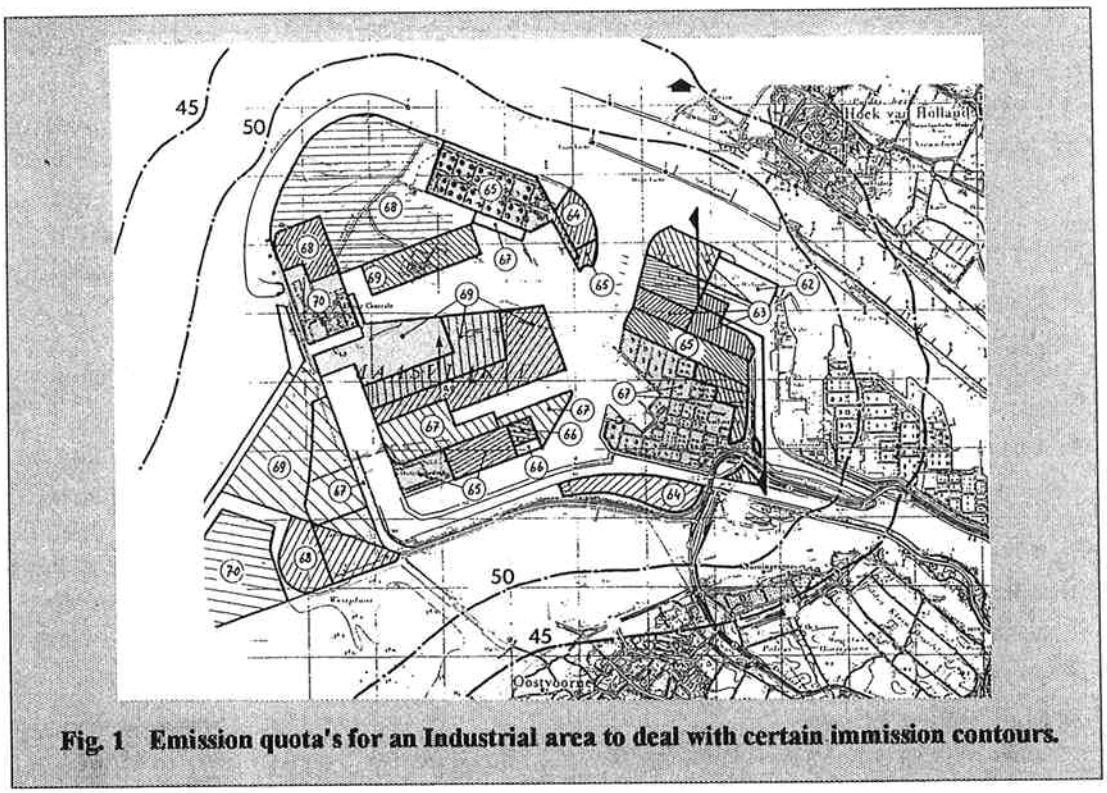

Fig. 1 Emission quota's for an Industrial area to deal with certain immission contours.

Comparising the maximum admissible surface related sound power levels as given in figure 1 with the values, given in table 1 the position and type of industry to be located within the mesh boundaries can be found. This under the condition that the total sound power of a limited, but specified number meshes, remains constant.

CALCULATING SOUND POWER LEVELS DIFFERENT TYPES OF INDUSTRY

In the case of an industrial site to be developed, no detailed information is available at the beginning what type of industry will settle in the future, what noise sources will be installed and what noise immission to the vicinity is to be expected after the complete site is filled with different types of industry.

At the same time it is important to know, if an immission level in the vicinity shall not exceed a certain limit, what noise space is available for the industry to be developed, what type of industry can be accepted to meet the given immission levels and finally what sound levels for each individual plant can be permitted to avoid that the first to come will use up all the sound space available.
For our study the expected main industrial activities for which noise space has to be reserved, consists of more or less comparable groups.
For each group a characteristic value for L_{WA}' has been developed, which can be used for planning purposes.

Table 1 shows a summary of L_{WA}' for the different types of industry, in classes of 5 dB.

Table 1

Type of industry	sound power level dB(A)/m² site area
(Petro)chemical and air separation plants, refineries, coal finishing	62-67
Gas plants (mostly outdoor equipment) Basic metal industry Concrete-, glass- and cement industry	57-62
Power plants (mostly indoor equipment with outdoor installations) wind turbines	60-65
Ports of transhipments (oil, gas, containers and goods, roll on-roll off) Transport companies (road and train)	63-68
Offshore and Ship docks, indoor and outdoor activities	70-75
Metal industry with outside activities	65-70
Metal industry, inside activities	58-63
Scrap iron and soot industry	64-69
Waste burning industry	50-55
Shunting yards	62-67
Asphalt-industry	60-65

The sound power levels of individual plants within the same type of industry can vary widely, a spread of more than 15 dB is easily possible. The use of these figures for planning individual plants therefore is not possible.
Only for planning extensive industrial areas with mixed industrial activities it is to be expected that the differences of individual sound emissions of individual plants will average over the total surface of the area.

The sound power levels which are calculated are based on the acoustic design principle "Best Practicable Means", that means that the best available acoustical technology (low-noise design as well as added measures) are used for the equipment of the plant.
The figures are related to the area of the complete plant as is commonly used in the Netherlands, inclusive offices, storage and parking lodges and inplant screening, without not used open areas within the plant.
The sound power levels are equivalent values, based on a shift of 12 hours (daytime, 07.00-19.00 hours), 4 hours (evening, 19.00-23.00 hours) or 8 hours (night-time, 23.00- 07.00 hours). The values are without transport activities on the sites, this activity is given separately for specific transport activities.

ALLOTTING NOISE EMISSION SPACE

Once the maximum admissible surface related sound power has been determined as described before, and the type of industry to be located with the mesh is known, then to each individual industry or plant a certain amount of emission space is assigned.
A company which does not need the space which is available at his location, can sell the space to his neighbour, who needs more space than is available at his location.

With this system a strict separation is obtained between the authorities who deal only with the available sound space for the whole industrial area, and the industry which is left with the responsibility of distributing it amongst themselves. This is referred in Holland as the "stolp-principal". The costs for sound measures at one location can be paid partly from the money which is earned from companies who had to buy emission space.
When the costs to buy emission space are in a good relation to the impact on the sound immission, this can lead to invest more in measures, which is from an environmental point of view highly desirable.

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