Regulation of noise from moored ships in ports

Rob Witte
DGMR Consultants for construction, industry, traffic, environment and software
Casuariestraat 5, P.O. box 370, NL-2501 CJ, The Hague, The Netherlands
+31 88 3467 500, www.dgmr.nl, wi@dgmr.nl

Summary
Ships that are moored in ports need energy for deck ventilation, electricity for crew/passengers cabins, energy for cooled containers, etc. Since only few ports and ships are equipped with alternative maritime power, ships generate their own power with auxiliary engines. The power of these engines are up to 21 MW for the Emma Maersk (largest container ship), to 98 MW for the MS Allure of the Seas (largest cruise ship). The sound power of different types of ships is investigated and is now available in dependence of the dead weight tonnage.
With this knowledge calculations were made for the yearly averaged noise levels around the Port of Amsterdam. This shows that ships are the main contributing noise source in the Amsterdam port area. Other ports will not be very different.
The noise contribution of ships is also noticed by the people living near ports. The complaints due to moored ships are investigated for the Rotterdam Port area. It shows that on average 250 complaints are reported every year on this subject.
Since sea going ships sailing under foreign flag are not subject to national laws, little can be done by individual ports on this subject. Also the International Maritime Organization (IMO) or Environmental Ship Index (ESI) sets no limits to the noise pollution of ships. Therefore an international research has to be adopted to regulate ships noise levels. This can be part of the ESI, which enables ports to reduce port fees based on the environmental impact from ships.

PACS no.43.50.Lj, 43.50.Rq

1. Introduction

Sea going ships are roughly moored in a port for 24 hours or more (large bulk vessels) for loading and unloading goods. The on board auxiliary engines generate power and noise, and can cause hindrance in the proximity. With the growing ship size this noise foot print will increase.

Figure 1. Emma Maersk.

2. Sources of noise for moored ships

Sea going ships that are moored in ports need electrical power for deck/engine room ventilation, crew/passengers cabins, cooled containers, (ballast)pumps, etc. Since only few ports and ships are equipped with alternative maritime power for larger ships, ships generate their own power with auxiliary engines. The power of these engines range from a few MW to 21 MW for the Emma Maersk (largest container ship) and to 98 MW for the MS Allure of the Seas (largest cruise ship).


Figure 2. MS Allure of the seas.

The sound power of different types of ships is investigated [1] and is available in dependence of the dead weight tonnage (DWT).

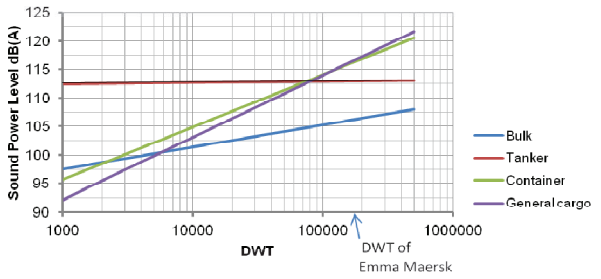

Figure 3. Sound Power Levels for different types of ships in dependence of the dead weight tonnage (DWT).

3. Noise levels

Based on the ships type, DWT, mooring time and position, a yearly averaged noise level in the surrounding area can be calculated. For the Amsterdam Westport area about 6.000 ships arrive yearly and stay on average 48 hours. For the Rotterdam port area about 30.000 ships arrive yearly and stay on very rough about 24 hours.

Figure 4. Noise contours 40 dB (L_{night}) around Westport area (light blue contour: industry; dark blue contour: ships; orange: houses).

Some observed ships have high low frequency components in the spectrum. This leads to higher levels of nuisance at greater distances, because of the poor attenuation and isolation for low frequency noise.

4. Noise impact from ships

In the Rotterdam Port area, the DCMR lists all complaints on environmental issues. Over the last 3 years on average 250 complaints a year on moored ship noise were recorded. The description of these complaints, range from engine noise to public address systems. Most complaints are caused by failing mufflers on aggregates and compressors.

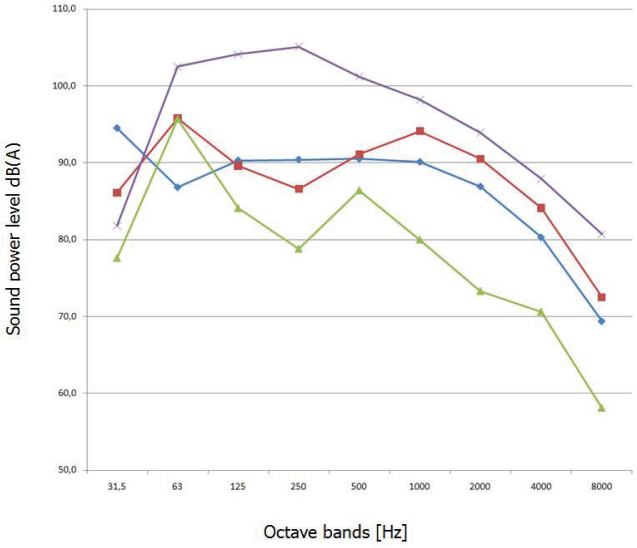

Figure 5. examples of ships with low frequency sound power levels.

The perceived nuisance is measured in Rotterdam[3] by way of a questionnaire. It showed that 2% of the population around the port often is annoyed by noise from ships.
In the Amsterdam port area also complaints are recorded on ship noise, especially around a newly developed industrial area.

No relationship between noise from moored ships is researched, but one can assume that due to the constant noise emission, the impact will be near to the noise impact of roads[5].

5. Mitigating measures

Not only noise causes environmental problems but also the air quality due to the auxiliary engines exhaust. A remedy is to use shore power instead of the auxiliary engines. This will reduce the contribution to the air quality drastic, but regrettable the noise emission is not reduced in the same way[2].

When switched on shore power, the remaining sources of noise are:

- pumps (trans shipments, ballast)
- deck ventilation and engine room
- cooling containers (reefers)
- air conditioning
- etc.

Reductions from 0 (Tankers/RoRo) to 16 dB (Bulk) can be expected.

The costs of installing shore power are very high (getting a cable there and the power) and the flexibility on the terminal is reduced because of the housing for transformers and cabling. For RoRo terminals, where the same ships are moored almost every day, shore power is a more likely mitigating measure.

6. Rules on noise emission

In the SOLAS regulations there are rules set about noise on board of ships[6] but no regulations are present for the sound emission to the surrounding area. The fact that ships mostly sail under foreign flag, doesn't help to set noise limits either.

Sometimes measures are taken for noisy ships. Where ships owners and terminal owners are connected, authorities have more to say.

For instance, DFDS Vlaardingen had to take mitigating noise measures for a RoRo ship, visiting the terminal four times a week. The loud tonal character of the vessel gave rise to many complaints. DGMR advised DFDS on mitigating measures on this subject.

7. How to tackle noisy ships

Ports gain a large income from moored ships. Amongst others this port dues, are based on the Green Award certificates. The Green Award is based on safety and environmental requirements. For the latter the requirements are about the following topics:

- Exhaust emissions
- Water ballast
- Anti-fouling
- Ship breaking
- Navigation in 'sensitive areas'
- Waste management

If noise was added as a topic to the Green Award system, ports could award less noisy ships with lower port dues. In this way ports can influence the ships coming to a port and ship owners can make profit by installing silencers.
Making a protocol on noise measurements of sea going vessels is not an easy task, due to the range of sources and operational modes. For instance the noise from a container ship is dependent on the number of cooled containers (reefers) which get there power from the auxiliary engines. The engine of a cooled container runs only when the temperature inside the container is too high. This temperature setting of the cooled container is dependent on its cargo (frozen foods to television sets) and the temperature inside the container is strongly influenced by the outside temperature and radiation. To make a standard out of these variables, the number of cooled containers, the running time for the cooled containers and the sound power level of a cooled container has to be set, next to a standard layout where the cooled containers are stacked.
So for each type of ship a standard has to be developed describing the operational situation in which the sound power levels will be determined.
In the project SILENV Project (7FP)[7], a possible but expensive way to measure the sound power level of a ship is described.

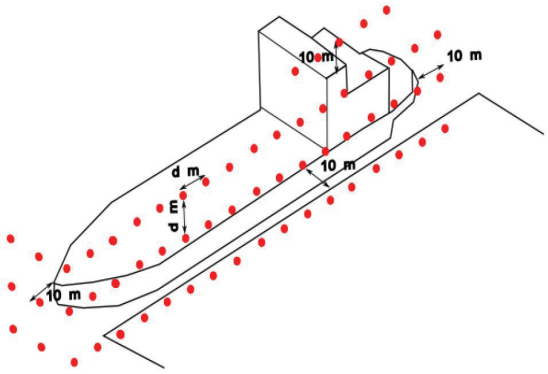

Figure 6. proposed way to determine noise from a ship (Silenv project).

This method will give over 300 measuring points of a 400 m long ship (both side s of the ship have to be measured). Another option is to anchor a ship and determine the noise levels from this ship in minimal 4 orthogonal directions from this ship at 1.5 times the largest dimension of the relevant noise emitting source area.

The next step is a ruling based on the outcome of the sound power level per ship. This could be done on basis of the sound power levels given in figure 3.

8. Conclusions

The influence and the awareness of the noise coming from ships is growing. Mitigating measures like shore power is very expensive and will not always reduce the noise levels sufficiently.

Another option to reduce the impact of ships is to regulate a part of the the port dues based on the sound power level of a sea going ship. A system for measuring and interpreting the results has to be established. With this system the ports can direct the cause of development for maintenance and design of ships.

References

[1] J. Witte: Noise from moored ships, INTERNOISE, 2010.

[2] J. Witte: AMP: solution for noise and air polution? Presentation AMP, 2010.

[3] DCMR: Milieumeldingen in Rijnmond 2013. Rotterdam: DCMR, 2013.

[4] E. Mertens a al: Rotterdammers over het milieu 2007, Centrum voor onderzoek en Statistiek, 2007.

[5] Miedema, H., C. Oudshoorn: Position paper on dose respons relationships between transportation noise and annoyance, Luxembourg: European Union, 2002.

[6] SOLAS: Code on Noise Levels Onboard Ships, MSC 91/22/Add.1, 2014

[7] Silenv http://www.silenv.eu/