Expansion to Equipment List of Quality Powered Mechanical Equipment System in Hong Kong

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ABSTRACT
Noise is almost an inevitable consequence of large scale construction and demolition activities. Similar to other densely populated and dynamic cities, noise sensitive receivers in Hong Kong are very often seriously affected by nearby construction sites. In light of the need to minimize construction noise at source, the Environmental Protection Department of the Government of the Hong Kong Special Administrative Region (EPD) has implemented since 2005 the Quality Powered Mechanical Equipment (QPME) system to further improve the overall construction noise environment in Hong Kong by managing noise at source. Under the QPME system, the construction industry is encouraged to apply construction equipment items that are new, notably quieter, more environmentally friendly and efficient. To help the trade to benchmark more quality construction equipment, and to further improve the construction noise environment, the equipment list of QPME would be expanded from 12 types of machines to 15 types in 2016. Air compressor, hand held percussive breaker and concrete crusher would be inserted to the list. This paper describes the recent enhancement of the system and the expected benefits by expanding the equipment list and digitizing the application process.

Keywords: Construction Noise, Noise Source, Construction Equipment

1. INTRODUCTION
Hong Kong is a densely populated and dynamic city with limited land resources, most residential buildings are high-rises of more than forty levels in the urban area in order to accommodate more people. Many construction and re-construction projects are underway to cope with the various residential and infrastructural developments over the territory. According to the Census and Statistics Department, there were about 1391 active construction sites in Hong Kong at the end of 2015¹. Discounting the country parks and natural conservation areas with lesser development, there were more than 2 construction sites per square kilometer of land. A typical construction site photo is in Figure 1, showing that hundreds of residential dwellings may be close to a construction site in the urban area of Hong Kong. Any construction noise generated from such a construction site can be perceived by some thousands of residents in those dwellings.

Figure 1 - Residential dwellings fronting on to one construction site

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Legislative frameworks are in place to protect residents from exposing to excessive construction noise in both night and day hours, through the implementation of the Noise Control Ordinance (NCO) \(^2\) in 1989 and the Environmental Impact Assessment Ordinance (EIAO) \(^3\) in 1998, respectively. Despite these frameworks having, to a certain extent, offered protection against construction noise impact, there is also a growing public aspiration for a better living quality in terms of noise environment. The QPME system is one of the established initiatives for further improving the overall construction noise environment by reducing noise at the noise sources.

2. QUALITY POWERED MECHANICAL EQUIPMENT (QPME) SYSTEM

2.1 Objective and Operation

QPME items, are construction equipment items that are new, notably quieter, more environmentally friendly and efficient \(^4\). The EPD has implemented an administrative QPME system to promote the state-of-the-art construction equipment since 2005. Label applications for QPME that have been in service for over 6 years would normally not be accepted, unless the applicant can demonstrate the equipment is still within the environmental quality of the product specified by the manufacturer. Either the equipment supplier or the owner can apply for a QPME label. A sample of a QPME label is shown in Figure 2.

![Sample of QPME Label](image)

The system can also help the market to benchmark the quality equipment so that the project proponents, the traders, the end users can know which equipment items are more environmentally friendly and quieter.

Equipment approved under the system would have the equipment details (such as model number, guaranteed sound power level, photograph) posted on EPD's Web Site for public information. These approved QPME items would be granted QPME labels for affixing to the QPME. As at the end of 2015, a total of over 3000 QPME labels had been issued to different kinds of equipment satisfying the requirements stipulated.

2.2 Requirements for Approval as QPME

To be qualified as a QPME item, it should either comply to the European Union (EU) certification system in which the machine should meet all relevant requirements and noise limits as stipulated in Article 12 of European Council Directive 2000/14/EC \(^5\) on the noise emission in the environment by equipment for use outdoors and be certified by an approved body appointed by any EU Member States, or the Japanese accreditation system in which the machine is designated as Low or Super Low Noise.
Emission Construction Equipment and has been issued the relevant label by the Ministry of Land, Infrastructure, Transport and Tourism of Japan (MLIT). The noise emission from those QPME items fulfilling either one of the aforesaid requirements would be quieter than those of the commonly used Powered Mechanical Equipment (PME) by as much as 19dB(A). The PME here refers to the corresponding type of powered mechanical equipment listed in the Technical Memorandum on Noise from Construction Work Other Than Percussive Piling published under the NCO.

In April 2013, the system was refined, so that equipment manufactured over 6 years of manufacture would normally not be considered as QPME unless there is documentary proof to demonstrate that there would not be deterioration in environmental quality and acoustic performance of the equipment. As such, an individual acoustic test report (conducted within the sixth year) and a service / maintenance / overhaul record or log-book of the equipment (as recommended by the equipment manufacturer) would be necessary for the renewal of a QPME status. The acoustic sound testing procedures and permissible sound power level limits should be based on the original manufacturing requirements under EC Directives or MLIT Regulations of Japan. "Mixture" or "cross-over" of measurement procedures and / or noise limits between two systems would not be accepted.

2.3 Operational / Financial Benefits to the Trade

Other than environmental benefits, using QPME in construction works would definitely facilitate fast-track projects because it will increase the chance for a contractor to obtain a Construction Noise Permit (CNP) work during restricted hours. The CNP system in Hong Kong is a means for controlling construction activities under NCO. The carrying out of general construction work using PME during the restricted hours, that is between 7 p.m. and 7 a.m. or at any time on a general holiday (including Sunday), is prohibited under the Ordinance unless a valid CNP is in force. Unless the noise criteria could be fulfilled, a CNP would not be granted. As QPME items are quieter equipment compared with conventional PME items, the chance of obtaining a CNP would be relatively higher.

The QPME System provides incentives to the equipment suppliers to import more types and models of quieter equipment into Hong Kong and, eventually, leads to better quality products and a more competitive pricing for the QPME.

The QPME would also be recognized by the Engineers in the Public Works Projects for the purposes of assessing payment, as additional monetary incentives under the "Pay for Safety and Environment Scheme". Moreover, as from April 2008, equipment buyers are eligible for a profit tax deduction each year amounting to 20% of the capital expenditure incurred on a QPME for five consecutive years starting from the year of purchase.

2.4 Equipment Recognized under the Current QPME System

At present, 12 types of commonly used equipment are included in the QPME system. They are: (1) tracked bulldozer; (2) wheeled bulldozer; (3) tracked loader; (4) wheeled loader; (5) excavator; (6) generator; (7) mobile crane; (8) vibratory roller; (9) road roller; (10) asphalt paver; (11) vibratory compactor; and (12) power rammer.

Since the QPME system is intended for improving the overall construction noise environment in Hong Kong, QPME labels would not be granted for equipment with very high power ratings as these are intrinsically very noisy. As such, excavators, loaders and dozers with output power equal to or more than 500 kW or generators with output power equal to or more than 400 kW are not included in the QPME system.

3. THE PROPOSED EXPANSION

A site survey conducted by EPD in 2014 indicated a satisfactory usage of QPME in Government projects or public utility projects, with at least 70% of these QPME operating in different projects in Hong Kong, which was encouraging in view of the usage and the performance. To further improve the construction noise environment and to pursue the objective of the QPME system, three more powered mechanical equipment items, namely air compressor, hand-held percussive breaker and concrete crusher, are proposed to be included in the list of QPME, as shown in Table 1.
Table 1 - Proposed Items to be Included in List of QPME

<table>
<thead>
<tr>
<th>Equipment Description</th>
<th>Photo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Compressor</td>
<td><img src="image1.jpg" alt="Air Compressor" /></td>
</tr>
<tr>
<td>Hand-held Percussive Breaker</td>
<td><img src="image2.jpg" alt="Hand-held Percussive Breaker" /></td>
</tr>
<tr>
<td>Concrete Crusher</td>
<td><img src="image3.jpg" alt="Concrete Crusher" /></td>
</tr>
</tbody>
</table>

Air compressor and hand-held percussive breaker have already been included in the Article 12 of Directive 2000/14/EC (EU system) and MLIT (Japanese system). The permissible sound power levels of the equipment under the requirement of Article 12 of Directive 2000/14/EC or MLIT are lower than those of the common equipment in general, and their maximum difference is about 9dB(A). Air compressor and hand-held percussive breaker are also controlled by way of the statutory Noise Emission Label (NEL) system in Hong Kong under the NCO, and the noise requirement under Directive 2000/14/EC and MLIT are a few dB(A) more stringent than those standards under the current NCO. From the statistics in the past few years as shown in Table 2, the noise performance of 74% of all air compressors and 98% hand-held percussive breakers having got the NEL have already complied with the noise requirement under Directive 2000/14/EC or MLIT. Hence, it is anticipated that by including air compressor and hand-held percussive breaker in the list of QPME, not only there would be no adverse effect or hardship to the construction and equipment supply trades, it would provide positive recognition and promotion of these quiet equipment for use in projects in Hong Kong.

Table 2 – Noise Emission Labels of Air Compressor & Hand Held Percussive Breaker

| Issued Year | Air Compressor (| actual quantity) | Hand Held Percussive Breaker (| actual quantity) |
|-------------|------------------|---------------------|---------------------|
| 2010        | 86.9% [630]      | 92.7% [1106]        |
| 2011        | 87.4% [373]      | 99.9% [1623]        |
| 2012        | 92.7% [474]      | 99.3% [1792]        |
| 2013        | 71.9% [588]      | 100.0% [1176]       |
| 2014        | 37.0% [385]      | 98.3% [2066]        |
| 2010-2014   | 74.4% [2450]     | 98.3% [7763]        |
The concrete crusher is the third equipment proposed to be inserted to the list of QPME, as is a very common equipment used in demolition and concrete breaking. The sound power level of a general concrete crusher is about 20dB(A) quieter than that of conventional concrete breaker with comparable efficiency. EPD has been promoting the use of concrete crusher since 1990s. The inclusion of the concrete crusher in the list of QPME will help further reduce noise from demolition activities associated with concrete buildings or structures.

With the above consideration, the EPD:

i) has put up a trial to include air compressor, hand-held percussive breaker and concrete crusher to the list of QPME; and

ii) will continue to provide the incentive such as the “Pay for Environment and Safety” scheme and profit tax deduction for the use of such QPME.

To complement the above expansion of the QPME system, the following revisions and administrative steps are implemented:

i) The database on EPD website showing the types of equipment considered as QPME would be updated so as to properly inform the QPME users and relevant stakeholders.

ii) The items and scope of QPME would be explicitly reiterated and explained on EPD websites.

iii) QPME labels for air compressor and hand-held percussive breaker would be granted to successful NEL applicants concurrently with the issue of the NEL if the equipment also satisfies the QPME requirements. This practice would not only help promote the import and use of QPME, but also facilitate the trade, in particular applicants for NELs to obtain both types of labels at the same time without the need for separate applications.

The trade associations, equipment suppliers / agents had been consulted in December 2015 (in Figure 3), and positive responses were received. The new system had been put to trial in the 2nd quarter in 2016, and will be put into full implementation officially in the middle of 2016.

4. DISCUSSION

EPD has been carrying out reviews / refinements of the QPME system from time to time to by making reference to development of quieter alternatives in other countries or places. Inclusion of new quieter equipment or deletion of the existing equipment in the QPME system would be made when necessary. More stringent noise limits may be adopted in future to follow the trend and technical development in other countries or places, depending on the availability of the quieter alternatives, to strengthen the use of quieter construction equipment for a better living environment.
5. FINAL REMARKS

The QPME system is not a mandatory requirement. It encourages the use of good quality equipment through recognition and incentives. The application for a QPME label is free of charge. Furthermore, most of the new hand-held breakers and air compressors had already complied with the proposed QPME noise requirement. Hence, it is expected that the proposed expansion of existing QPME list would not affect or cause any hardship to the construction and equipment supply trades. On the other hand, the system helps the trade to benchmark which equipment is environmentally more friendly and of better quality. Moreover, the QPME owners will be entitled to the application of tax concession and the subsidy through the “Pay for Environment and Safety” Scheme. The use of QPME labelled equipment may help reduce the operating cost and help establish a positive image of the company as well as help ensuring a quieter community.

[The opinions in this paper are those of the authors and do not necessarily reflect the views or policies of the Government of the Hong Kong Special Administrative Region of the People’s Republic of China.]

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