



Quality Powered Mechanical Equipment System to Reduce Construction Noise in Hong Kong

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ABSTRACT

Quality Powered Mechanical Equipment (QPME) System is an administrative labeling system in Hong Kong for promoting the use of environmentally friendly construction equipment. It recognizes construction equipment which is newly manufactured, notably quieter, more environmentally friendly and more efficient. The recognition is realized by granting QPME labels for twelve types of equipment that meet the latest European or Japanese requirements. This System is well received and at present, other initiatives such as the "Pay for Safety and Environment" scheme and profit tax concession have been developed concurrently with the QPME system. This paper will describe how the QPME System is operated and evolved since 2005, its benefits to the environment of Hong Kong, and in particular its effectiveness in reducing construction noise in a dynamic city like Hong Kong.

Keywords: Construction Noise, Powered Mechanical Equipment, Label

1. INTRODUCTION

Hong Kong is a dynamic and densely populated city with limited land resources and mixed urban environment. Most residential buildings are high-rises in order to accommodate more people. Many construction and re-construction projects are in the pipeline to cope with the various infrastructural developments over the territory. According to the Census and Statistics Department, there were about 1309 active construction sites in Hong Kong at the end of 2013[1]. Discounting the country parks and natural conservation areas with lesser development, there were almost 2 construction sites per square kilometer of land.

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, many residential buildings are still inevitably affected due to their close proximity to construction sites. 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.

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 Environmental Protection Department (EPD) of the Government of the Hong Kong Special Administrative Region (Government) 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

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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.

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 2013, a total of over 2000 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 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 European Union Member States under the EU system, or it is designated as Low Noise Emission Construction Equipment and have been issued the relevant label by the *Ministry of Land, Infrastructure and Transport of Japan (MLIT)* [6] under the Japanese system. In general, the noise emission from those equipment items fulfilling either one of the aforesaid requirement would be quieter than those of the commonly used Powered Mechanical Equipment (PME) by as much as 13dB(A). The PME here refer 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 [7].

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) [7] work during restricted hours . The CNP system in Hong Kong is a means for controlling construction activities under NCO. For 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" [8]. 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 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. EVALUATION OF THE QPME SYSTEM

3.1 Surveys

In order to evaluate the effectiveness of the QPME system in the past 8 years and to formulate the future strategy for tackling construction noise problems, three surveys had been conducted in the first half of 2014, namely the (1) Survey on the General Types of Construction Sites in Hong Kong, (2) Pilot Site Survey on the noise performance and usage of PME (including QPME) in selected sites; and (3) Opinion survey with QPME Owners. The general findings are presented as follows.

3.2 Survey on General Types of Construction Sites in Hong Kong

To obtain a general overview of the usage of PME and QPME in Hong Kong, all construction sites were identified through a desk top study to form the domain for the pilot site survey at representative construction sites. According to the information from Census and Statistics Department (C&SD) [1], those 1309 active construction sites in Hong Kong at the end of 2013 consisted of 502 sites from the public sector and 807 sites from the private sector. Most of the construction sites, about 64%, were related to buildings works such as construction of residential buildings, hospitals and clinics, while others, about 36%, were civil engineering works for utilities such as railways, drainage and water works. About 84% of the building works were private projects, and about 77% of the civil engineering works were public projects.

This survey enabled a classification of active construction sites according to six different categories (namely Government projects of contract sum greater than or equal to HK\$200 million, and those of contract sum less than HK\$200 million; non-government public utilities projects of contract sum greater than or equal to HK\$200 million, and those of contract sum less than HK\$200 million; private projects of contract sum greater than or equal to HK\$200 million, and those of contract sum less than HK\$200 million) for a subsequent design of pilot site surveys to give a better understanding of the noise performance and equipment usage for each category.

3.3 Pilot Site Survey

Site visits were arranged and conducted in about 5% of total construction sites covering different types of construction sites classified above. The main contractors of individual construction sites were requested to provide information such as the quantity and types of all PME and QPME, the respective maintenance record, usage rate and operating condition of all QPME items. Besides, photo taking and noise measurements were carried out in the pilot site survey.

In general, higher QPME to PME ratio (~0.15) could be found at the construction sites for government and public utilities projects than that of private building construction sites. This is probably attributed to the inclusion of QPME as part of the General Specifications for government and public utilities contracts, in addition to the initiatives from the "Pay for Safety and Environment Scheme" and tax concession.

3.4 Survey with QPME Owners

Self-reported questionnaires were designed to collect information such as status, location, usage and operating condition of all QPME items were sent to all QPME owners in the beginning of 2014. As of June 2014, owners of over 65% of all QPME items returned the questionnaires. The response rate was considered acceptable.

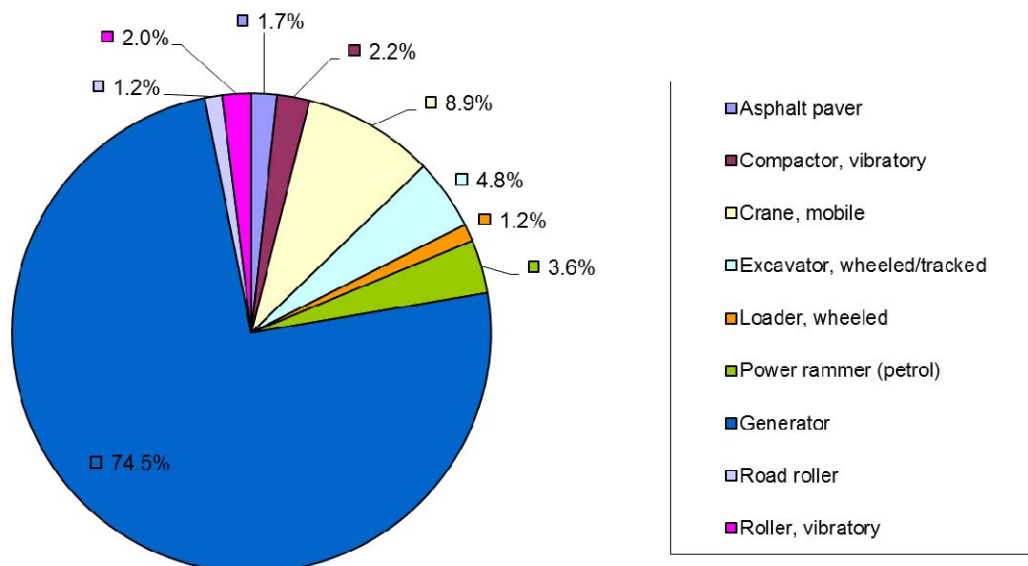


Figure 1 – Distribution of Types of QPME

Figure 1 shows the distribution of the types of equipment items with QPME labels.

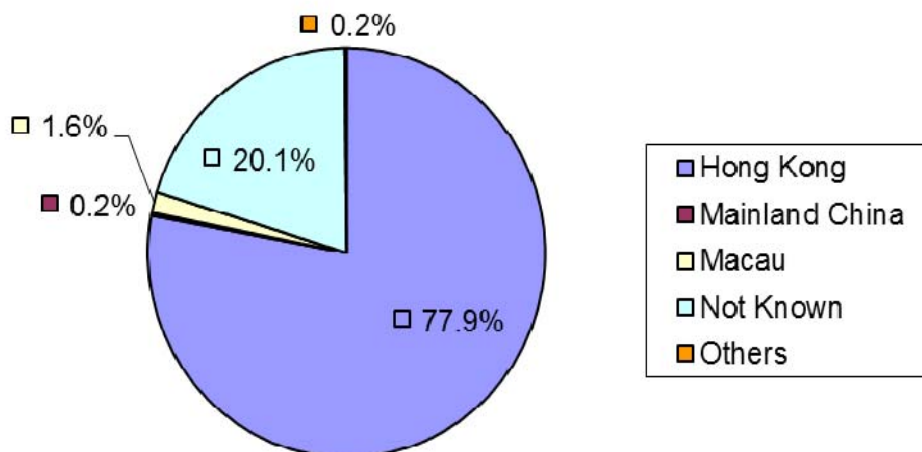


Figure 2 – Current Location of QPME

The current locations of QPME items are shown in Figure 2. Among which about 78% of the items remained in Hong Kong, about 20% of them were in Macau and Mainland China, and a small portion was in Malaysia and Singapore. Some QPME locations were not known as the items were rented out by the owners.

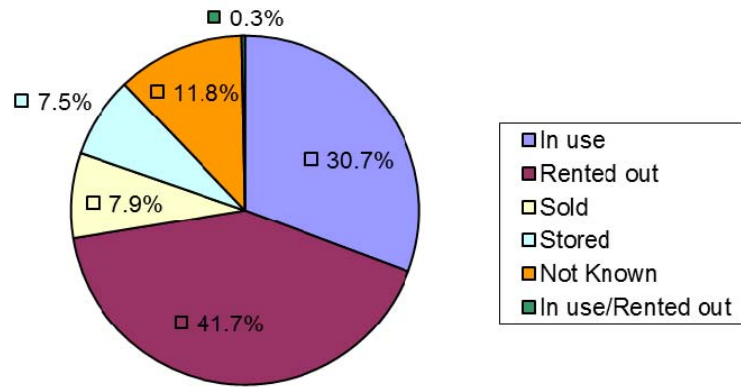


Figure 3 – Current Status of QPME Items

As shown in Figure 4, about 31% of the QPME items were being used by the owners and about 42% had been rent out (it was believed that they were in high usage as most of their rents were in daily rate), 8% of the items were sold and 7.5% were stored in warehouses.

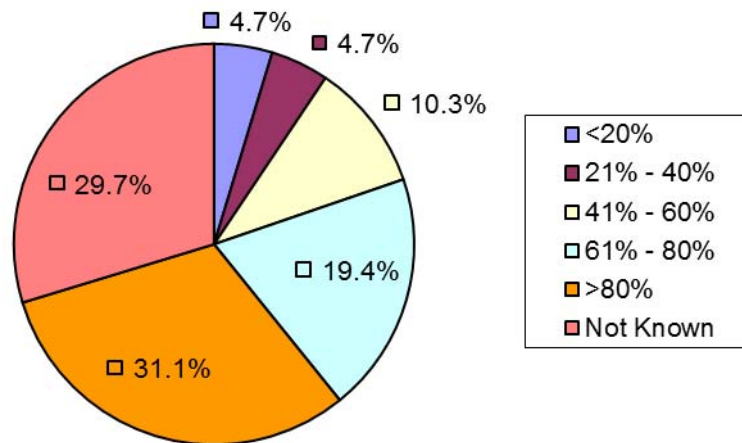


Figure 4 – Usage Rate of QPME

The usage rates of the QPME items in the last 12 months are shown in Figure 4. The usage rate above 80% and below 20% were about 31% and less than 5%, respectively. The usage rates from 21% to 40%, from 4% to 60%, and from 61% to 80% were about 5%, 10% and 19%, respectively. The rest of them were “not known”.

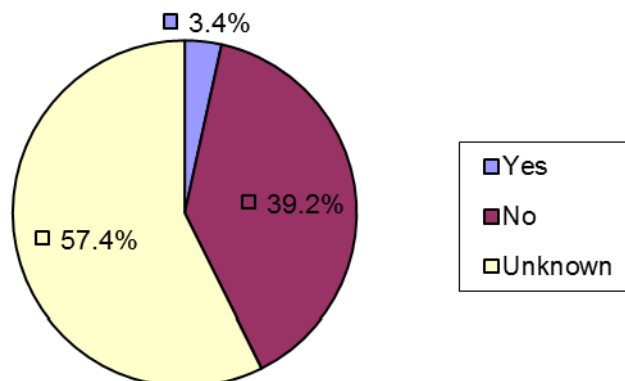


Figure 5 – QPME Items Registered under “Pay for Safety and Environment Scheme”

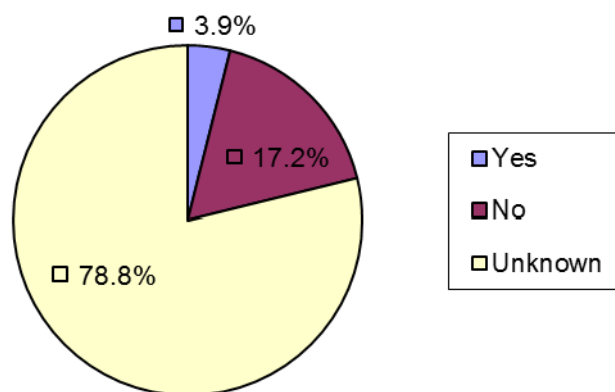


Figure 6 – QPME Items Registered under Profit Tax Deduction Provisions

The percentages of QPME items registered under the “Pay for Safety and Environment Scheme” and profit tax deduction provisions are shown in Figures 5 and 6, respectively. Less than 4 % of the QPME items were enrolled under either incentive.

4. DISCUSSIONS

4.1 Usage

According to conditions and usage rate obtained in the survey to QPME owners, most of the equipment items, over 72%, were in operation or rent out for use, which was considered as a high usage. Only 7.5% of items were stored and the remaining items were of usage lower than 60%. This shows that most of the QPMEs were utilized by their owners or contractors for active projects in Hong Kong.

4.2 Effectiveness

It is encouraging to find that the usage rate of QPME items is high, in particular in government / public utilities projects as these projects usually include explicit contract conditions requiring the use of QPMEs.

It was also interesting to find only a few QPME owners or contractors had applied for additional payment under the “Pay for Safety and Environment Scheme” or the profit tax deduction, and most of them had expressed they did not know about the two beneficial incentives. While there might be different reasons behind the very few engagements with these incentives by the contractors, the findings indicated there should be more room for further promoting the QPME system by wider publicity of the two incentive schemes.

4.3 Other Observations

From the site survey, higher QPME to PME ratio could be found at the construction sites for government / public utilities projects than that of the private building construction sites, indicating the contractors in the public utilities projects were more willing to employ the QPME items, when explicit contractual requirements are imposed to ensure a level playing field. Further raising the environmental awareness within the private sector would be required to further promote the QPME system.

Many QPME owners had expressed in their returns their wish for the government to expand the list of QPME items to other equipment items as well. This response reflected that the QPME system was welcome by the industry, and undoubtedly, an expansion of the QPME list would contribute to the reduction of overall noise levels from construction sites, which was the primary target of the system.

5. FINAL REMARKS

The QPME system implemented in Hong Kong has been proved to bring benefits to both the noise environment and the trade. The results of the surveys also pointed to the importance of a fair and explicit contractual system for effective promotion of the use of QPME, as gathered from the encouraging findings from the QPME usage patterns in Government and public utilities projects. The wish of many QPME owners for the government to expand the list of QPME items to other equipment items has concluded that a win-win QPME system has been maintained and this is a positive sign that the industry is willing to explore further reducing the overall construction noise in Hong Kong.

[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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