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EFFECTIVENESS OF ENVIRONMENTAL POLLUTION CONTROL MEASURES IMPLEMENTED IN STONE CRUSHING SITES LOCATED AT KADUWELA MUNICIPALITY, SRI LANKA

A.P.Weerakkody[a], T.K.Weerasinghe[b*],N.S.Gamage[a], R.P.P. M. Dilrukshi[b], K.G.N.H.Weerasinghe[b]
[a]*Central Environmental Authority, Baththaramulla, Sri Lanka*
[b]*Centre for Environmental Studies and Sustainabel Development, The Open University of Sri Lanka.*

ABSTRACT: *Stone Crushing industry plays a major role in supplying construction materials in Sri Lanka. Although it gives a better financial and social development to the nation, the caused environmental pollution significantly influences the future sustainability of the industry. Therefore, this study was aimed to evaluate the effectiveness of pollution control measures that are already implemented in Welehandiya area in Kaduwela Divisional Secretariat in Colombo District by the Central Environmental Authority (CEA). Since the noise pollution and the dust emission were identified as the major impact categories, the equivalent continuous sound pressure level and concentration of Suspended Particulate Matter (SPM) in ambient air were measured in the study area. As the measurements were done after the successful implementation of recommended pollution control measures, results revealed a substantial reduction of noise level and very slight reduction of SPM levels recorded. Finally, the recommended noise pollution control measures can be introduced to similar industries while dust emission control measures need to be improved innovatively. Further intensive studies are required to analyse the effectiveness and generalize the results in future*.

KEYWORDS: Stone Crushing Industry, Environmental Pollution, Pollution Control Measures

INTRODUCTION AND LITERATURE REVIEW

Stone Crushing Industry is an important industrial sector engaged in producing crushed stone (metal aggregates) of various sizes depending upon the requirement which acts as raw material for various construction activities such as construction of Roads, Highways, Bridges, Buildings, Canals etc. Therefore, the demand towards the raw materials in above constructions is significant. Stone dust is a primary aerosol and it is released directly from the source. It has a detrimental effect on people and environment including flora and fauna, for example, changed soil pH and productivity, dust emission and formation of haze reducing visibility in the surrounding areas, destruction of habitat, damage of natural resources like valuable vegetation and wild life, promotion of spreading of many diseases etc. (Semban and Chandrasekhar, 2000; Sivacoumar et al., 2006). Further, stone crushing industry causes serious environmental impacts due to high noise causing social and cultural unrest towards the industry.

Sources of Noise emission:

Noise pollution in stone quarrying industry is one of the environmental problem penetrating all the corners and areas of working environment. There are a number of activities, which

lead to high noise levels in quarrying industry like blasting, drilling, crushing, heavy machineries and transportation. The intensity of noise within the industry and workplace in general is rising continuously and causing severe nuisance in the immediate surroundings and to the people working therein causing occupational health hazards.

Sources of particulate emissions:

- *Emissions during unloading of mined stones at crusher site*

During unloading of mined stones, large amount of fine dust is emitted which appears like a dust cloud and is carried by wind currents to a long distance.

- *Emission during crushing*

During crushing operations, both sound and dust emissions are taken place resulting fugitive air borne dust emissions.

- *Emission during material movement and transfer*

During the movement and free fall during transfer of crushed stones, fine dust particles get airborne as fugitive dust emissions.

- *Emission during vibratory screen operation*

During vibratory screening of crushed stones, vigorous movement of the stones taking place and particles get loose and airborne as fugitive emission.

- *Emission during transportation*

During transportation of the crushed stone products and vehicular movement on non-metal led roads fine dust settled on the ground gets airborne.

Furthermore, the occupational dust is an important cause of Chronic Obstructive Pulmonary Disease (COPD), and the risk appears to be varied with type of stones / minerals crushed and the time of exposure (Oxman*et al.,* 1993). Particulate matter exposures are likely to produce impaired lung function within a short period of time. There is a need to introduce simple measures to reduce particulate matter exposure from both occupational sources (Semple*et al.,* 2008). Noise-induced hearing loss occurred in 21.5% of the workers and in 2.8% of the controls. Tinnitus occurred in 26.9% of stone workers and 21.5% of controls of a research conducted by Addo-Yobo, (2001), Ghana.

With all these issues, this industry needs to function as it caters very important needs in the development of a society. Therefore, it is important to sustain this valuable industry for future generations and immediate and long lasting mitigatory actions need to be implemented. As per the section 23 A of the National Environmental Act (NEA) No.47 of Sri Lanka, stone crushers are coming under prescribed activities list for which an Environmental Protection License (EPL) is required (NEA, 1980).

As a preliminary effort of overcoming the prevailing issues and sustaining this industry, the Central Environmental Authority(CEA) of Sri Lanka has recommended valuable pollution control measures to the stone crusher owners to be implemented as given under Table 1.1.
The focus of this study is to evaluate the shortcomings and effectiveness of CEA recommended pollution control measures by comparing the level of pollution before and after their implementation. In addition, this study aims to propose/recommend additional requirements to the existing pollution control measures to further minimize environmental pollution of the area due to stone crushers.

Table 1.1: CEA recommended pollution control measures

Impact	Implemented pollution control measures
Dust Emission	• Enclosed screen and conveyer belts • Covered the jaw crushers • Sealed all holes in the roof • Wind Barriers implemented using cement blocks and asbestos sheets • Construct a boundary walls around the premises • Water spray system with nozzles at Jaw crusher • Establish circular duct lines, centrifugal fans, wet scrubber units, a recirculation tank, over headed water sprinklers
Noise Pollution	• Enclosing the crushing points • Sound absorbing materials were used in constructing wind barriers

(Source: Unpublished data of CEA and ITI, 2008)

METHODOLOGY

A basic field survey was conducted to obtain firsthand information and an overall situation of this area. Measurements were done in the selected locations (Named as L_1– L_{18}). The distances from the factory and availability of secondary data of the locations were considered in selecting measuring points. Noise levels were measured while metal crushers were being operated. Residual noise levels were measured when the metal crushers were not in the operation by using a Rion Integrated Sound Level Meter. The concentration of Suspended Particulate Matter (SPM) in ambient air was measured to decide the effectiveness of implemented dust controllers. The measurements were conducted by using a High Volume Sampler (Echotech-Model 2000) which was used in most predominant wind direction to cover all dust emissions.

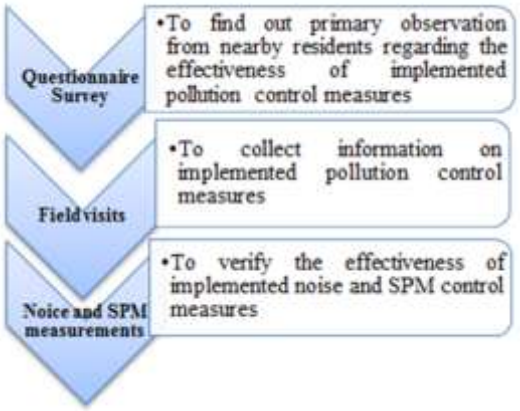

Figure 3.1 Methodology of the research

RESULTS AND DISCUSSION

As per the noise level measurements of this study, it was evident that the significant reduction has been observed when compared the situation before implementation of the pollution control measures. The maximum permissible level is 55 dB during day time (Figure 3.2).

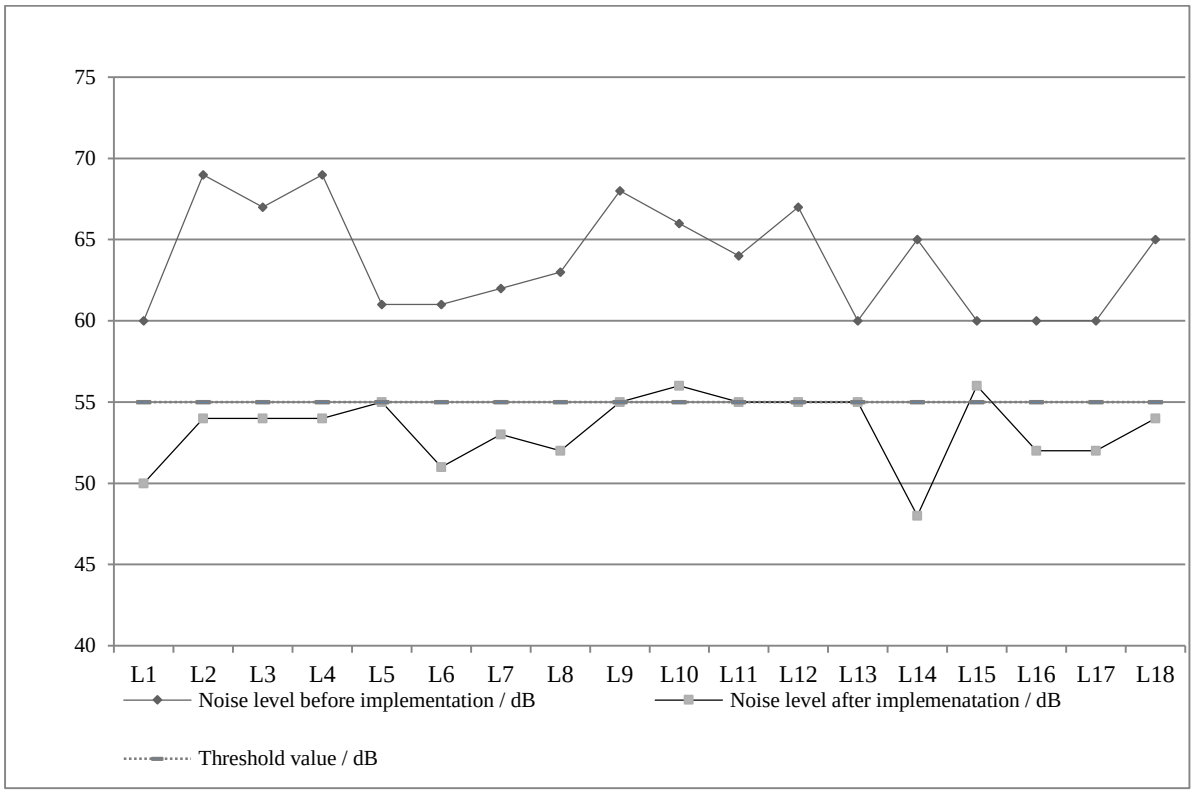

Figure 3.2: The average noise level measurements before and after the implementation of pollution control measures

The primary objective of noise survey in this study area is to monitor the reduction of noise level due to implemented control measures. Noise as a pollutant produces contaminated environment which becomes a nuisance and affects the health of a person, his activities and mental abilities. The higher level reported during the night in this study(70dB) could be an environmental hazard to the residents and should be controlled with more measures.

When dust emissions are looked at, all the industries are within the permissible level during the day time. The measurement of Suspended Particulate Matter (SPM) content in the present study indicated the reduction of the level compared to the condition before implementation except three locations. The maximum permissible level of SPM is $0.5mg/m^3$(Figure 3.3). As reported by Fader 1985, similar sound control measures implemented had been able to control sounds in the stone crusher sites successfully.

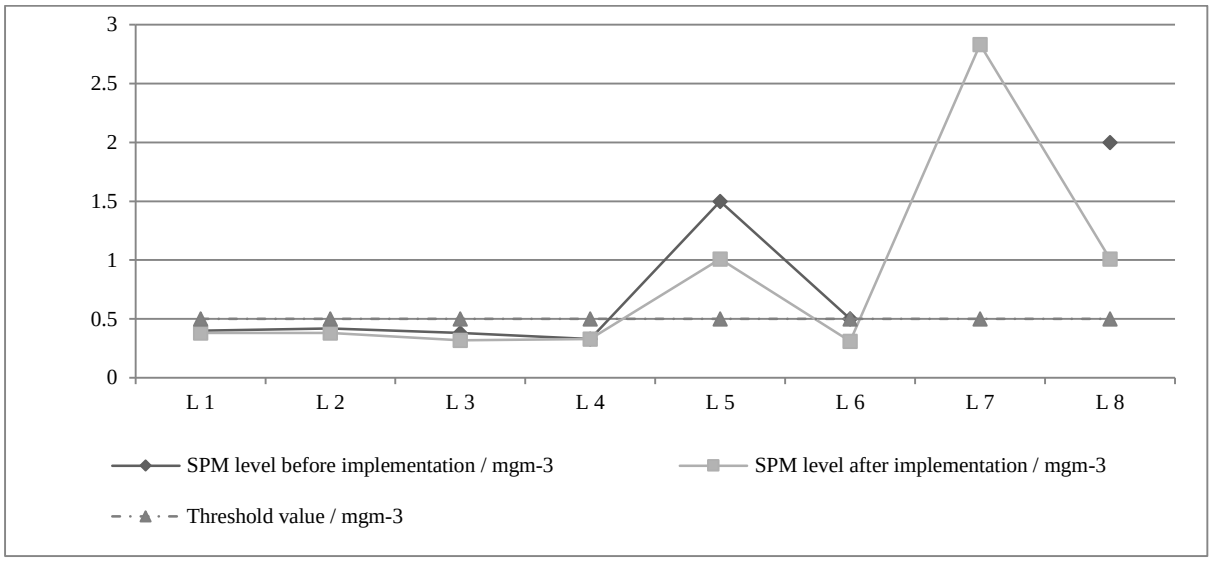

Figure 3.3: The average SPM levels after the implementation of pollution control measures

Even though measured SPM levels have been reduced at locations of L1, L2, L3, L4, L5 and L6 SPM levels at the locations of L5, L7 and L8 (accumulative impact) was exceeded the maximum permissible level with adopted control measures. It is clear from the findings that implemented dust control measures are not sufficient at L5, 7, 8. These locations are open areas and affected by frequent wind currents.

Implemented wet process and over headed water sprinklers (driven by gravity) produced bigger water droplets making the control measures suggested ineffective. Gautam (2009) also reported that the dust released from the cone crusher plants are smaller particles than the other crushers. This could be the reason for not reducing the SPM as expected.
The SPM level, depending on the size where smaller ones remain suspended in air for longer periods of time, get dispersed and diffused by the wind, and eventually deposited on various surfaces according to Rao (1985).

Rao (1985) reported that proper implementation of wet suppression systems facilitated with water filtering system successfully contributing to reduce dust levels. It is very clear that implementation failure is the main reason for not controlling SPM in this site.The wind barriers and other recommended methods by the CEA were not implemented correctly by the crusher owners and it could be the main reason for not controlling the SPM level in the site.

Even though the Installed wet process is not sufficient to control dust in this study, installing a water spraying system driven by adequate pressure with water fogs at the Feeder chutes, product discharge area and for ground wetting can be more advantageous.Juan, 2016 reported that a board fence, wind fence, sediment fence, or similar barrier can control air currents and blowing soil in line with the recommendations made by CEA. A carefully prepared and implemented dust control plan can reduce impacts from dust (Kestner, 1994). According to William H. Langer (2001), controlling fugitive emissions depends on good housekeeping practices rather than control systems. Good housekeeping techniques include the use of, water trucks, sweepers, and chemical applications, control of vehicle speed, and construction of windbreaks and plantings.

CONCLUSIONS

It is clear from the findings that the recommended noise control measures by the Central Environmental Authority are far effective complying with noise control standards making the crushing industry more environmental friendly. However, the implemented dust control measures were not effective at certain crusher sites due to not following the given measures by the CEA.

Recommended noise control measures such as crusher plant enclosures, wind barriers, boundary wall along the road, road wetting are the best options and can be recommended to implement in other metal crushing factories. Since the dust control measures are not significant enough to recommend, further research and development are required to improve the industry for a sustainable future for the stone crushing industry. Enclosures should be renovated and wet dust suppression systems should be implemented atL7 and L8 crusher sites.

Tree planting, at the boundary wall along the road and partial enclosure for dust stockpiles can be used for successful pollution control measures. And it is important to not to grant new site approvals at the crusher zones without conducting new studies such as noise maps preparing etc.

The permissions for the expansions of existing crusher plants should be given without damaging the existing natural resources such as trees, water bodies and small mountains since it acts as natural wind barrier and noise absorber. Crusher owners should be assisted with both financially (E-friends loan scheme) and technically to implement the pollution control measures with high technology. Monitoring and licensing the metal crushers while developing the infrastructure facilities will further encourage the crusher owners to convert industry towards a sustainable manufacturing industry.

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