Visakhapatnam is an industrial and sea port city located on the east coast of India. A hospital (RCD hospital), residential area (Lawson’s Bay Colony), traffic zone (Jagadamba junction, Andhra Pradesh State Road Transport Corporation Complex junction and Seethammadhara junction) and industrial zone (Sea port) were chosen to monitor the noise levels. The observed noise level at RCD hospital was more than 10dBA in any time. The background noise at Santhi Ashram was approximately 3dBA less at night time and 2dBA less at day time compared to ambient air quality noise standards (AAQNS) for silent zone. The ambient air quality noise levels (AAQNL) at traffic junctions were 5dBA or more than those prescribed by AAQNS for commercial zone and most of the values were found in the range of $80 \pm 10$ dBA, among which 75% values were found in the range of $110 \pm 10$ dBA. AAQNL near port were found in the range of 5 to 10 dBA positive shifts on AAQNS due to conveyor operation. The AAQNL were alarming even in the absence of conveyor system, indicating the impact of vehicular traffic. Remedial measures were suggested separately for each situation.

Introduction

The basic hearing mechanism of the ear cochlea is the communication of sounds to brain by the small hair cells. Intense sounds damage these cells, some times beyond recovery due to prolonged exposure to sounds\(^1\). Exposure to excessive noise during pregnancy may result in high-frequency hearing loss in new-borns, prematurity, intrauterine growth retardation, cochlea damage, disruption to the normal growth and development of premature infants\(^2\). Noise pollution can play havoc with the nervous system affecting the physical and psychological behavior of the individuals. It may cause nausea, vomiting, pain, hypertension, high blood pressure, cardiovascular problems, sleep disturbance, restlessness, depression, fatigue, allergy, mental stress and annoyance\(^3\).

There exists a connection between noise exposure and increased levels of catecholamines\(^4\) and magnesium metabolism\(^5\). These findings suggest a possible mechanism for cardiovascular effects in that a chronic magnesium imbalance can lead to increased intra cellular levels of calcium, which in turn, can cause vasoconstriction and increase the sensitization for catecholamines.

A widely used method for recording the variations in sound pressure level is level distribution analysis, sometimes called statistical distribution analysis\(^6\). The Level Document\(^7\) of Environment Protection Agency, USA (USEPA) identified an indoor day and night noise level (Ldn) of 45 dB, which translates to night time average sound level of 35dB, as necessary to protect against sleep interference. Occupational Safety and Health Administration (OSHA) mandates the criterion level at 90 dBA for 8h. "Annoyance" has been the term used\(^8\) to describe the community's collective feelings about environmental pollution. This represents a degradation of health in accordance with the WHO's definition of health meaning - total physical and mental well being, as well as the absence of disease. A 1971-WHO working group stated\(^9\), that noise must be recognised as a major threat to human well-being.

A study undertaken by National Environmental Engineering Research Institute, Nagpur\(^10\) revealed that noise levels in residential, commercial and industrial areas, and silent zones of Delhi and other cities far exceeded the standards prescribed by Central Pollution Control Board, New Delhi. The average noise level in Delhi is 80dB, which is more than the recommended value, i.e. 55dB. A general survey carried out in four major cities including Mumbai showed that 36% of the population has bilateral sensor neural hearing loss.

Visakhapatnam City in Andhra Pradesh (India) is one of the ancient cities in India and has natural harbours that were operated even in ancient times. The city is well protected by Western Ghats. Due to the harbours, pure water sources, availability of minerals, jute etc., Visakhapatnam is surrounded by the naval base station, major industries, educational institutions and religious places. Hence, ambient air quality noise levels (AAQNL) were monitored\(^11\) at selected sites.

**Site selection and measurement of noise**

AAQNL were monitored by choosing sites based on hospital zone (RCD Hospital), a typical residential area (Lawson's Bay Colony), sea breeze and tidal waves (Santhi Ashram), vehicular traffic (Jagadamba Junction, Andhra Pradesh State Road Transport Corporation (APSRTC) Complex

---

*AP Pollution Control Board, VUDA Complex, Visakhapatnam – 530 003

** School of Chemistry, Andhra University, Visakhapatnam – 530 003
Noise pollution levels in Visakhapatnam city (India)

Junction and Seethammadhara Junction) and Seaport activities (Ore handling belt near port) (Fig 1). Noise levels were monitored representing 24h during 2002 and 2003 using Noise Level Meter Model 1900 (accuracy +1dB, in-built memory and "QuestSuite" for data acquisition and processing software to interface with computer along with calibrator), manufactured by Quest Technologies Inc, USA.

Results and discussion

Case 1: RCD Hospital

The RCD Hospital is for physically handicapped persons, well isolated from the surroundings with open land on all sides, but boundary walls surrounded by road with auto-rickshaw stands and with moderate bus and truck traffic. It has units for physiotherapy, treatment of hearing impairment, vocal practices and artificial limbs along with inpatient wards for ladies, children, men and outpatient wards. The study in this hospital represents a typical neighborhood noise level in respect of silent zone. The hospital provides treatment to the hearing impairment of the children and voice correction training; hence, it requires calm surroundings for effective transfer of learning and treatment. Daytime noise levels for LN90 were 44-53 dBA representing background noises to be 44 dBA and L_{avg} values were fluctuating between 43-60 dBA. Compared to the prescribed Ambient Air Quality Noise Standards (AAQNS) for silent zone (Table 1), the values exceeded in between 5-10 dBA. The LN10 and L_{peak} values were found 51-70 dBA and 63-93 dBA, respectively. At night time, L_{avg} values between 00:00 to 4:00 hours reached 22 dBA for short durations. The levels of LN90 values were found in between 44-52 dBA, 5 dBA higher than the silent zone standards. L_{max} was in between 47-87 dBA and L_{peak} attenuated 51-91dBA. The wide range in noise fluctuations observed in day time and night time (Fig 2) results in higher noise annoyance.

Fig 1: Monitoring locations at Visakhapatnam

(1) RCD Hospital
(2) Lawsons Bay Colony
(3) Santhi Ashram
(4) Jagadamba Junction
(5) RTC Complex Junction
(6) Seethammadhara Junction
(7) Visakhapatnam Port Trust Area
T. Vidya Sagar and G. Nageswara Rao

Table 1: Noise standards of some countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Industrial Area Day/Night</th>
<th>Commercial Area Day/Night</th>
<th>Residential Area Day/Night</th>
<th>Silence Zone Day/Night</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australian Capital Territory</td>
<td>65 / 55</td>
<td>55 / 45</td>
<td>45 / 35</td>
<td>45 / 35</td>
</tr>
<tr>
<td>India</td>
<td>75 / 70</td>
<td>65 / 55</td>
<td>55 / 45</td>
<td>50 / 40</td>
</tr>
<tr>
<td>Japan</td>
<td>60 / 50</td>
<td>60 / 50</td>
<td>50 / 40</td>
<td>45 / 35</td>
</tr>
<tr>
<td>U.S. (E.P.A.)</td>
<td>70 / 60</td>
<td>60 / 50</td>
<td>55 / 45</td>
<td>45 / 35</td>
</tr>
<tr>
<td>W.H.O. &amp; E.C.</td>
<td>65</td>
<td>55</td>
<td>45 / 35</td>
<td>45 / 35</td>
</tr>
</tbody>
</table>

Case 3: Santhi Ashram

Santhi Ashram is very close to sea tidal waves and sea breezes. It is a secured place for conducting noise-monitoring activity at beach front. Adjacent to the monitoring point, there were: domestic drainage line confluencing to sea and fishing boats landing site. The LN10 and L_max values showed very little difference (Fig 3) at the prevailing calm conditions. The differences in the values of LN90, L_avg, LN10 and L_max for the entire time span were little. This study indicated that the constant background noise was 3dBA less at night time and 2dBA less at day time than the AAQNS. The impact of tidal waves, sea breezes and motorized boating activities was found within the limits in respect of community standards for silent zone. The boating activities are recently gaining increased momentum at this particular area. However, the night time values exceeded the limits of USEPA by 2 dBA in respect of silent zone. The higher values could be attributed to the dog barking, vehicular horns from the beach road and motorized boating. There is need to regularize the motorized boating activities.

Case 4: Vehicular traffic junctions

The AAQNL at Jagadamba Junction, APSRTC Complex Junction and Seethammadhara Junction was found 5dBA, which is higher than the prescribed value in respect of Commercial Zone. Most of the AAQNL were between 70 dBA and 90 dBA (Fig 4). The L_avg and LN10 values represent vehicular horns and engine thrust impact. The impact of continuous flow of vehicles, which results in increase in...
Noise pollution levels in Visakhapatnam city (India)

background noise is indicated by LN90. The \( L_{\text{peak}} \) values were found 112 + 2 dBA for all places for median, mode and harmonic mean. The \( L_{\text{peak}} \) levels were found higher than AAQNL, which were due to vehicular horns. The deviation in mode, median and harmonic mean found within 3dB.

The recommendations were given to minimise the impacts of noise due to vehicular traffic junctions: (1) traffic ways should be made one-way at all possible places, (2) use of air horns and multi tone horns should be prohibited, (3) use of horns at traffic points, narrow ways and busy traffic should be prohibited, and (4) people should be restrained from unnecessary use of horns at traffic points and busy traffic, and the violators should be dealt with penalties.

Case 5: Sea-port activities

The study area for monitoring AAQNL at Old Town area consisted of M/s Visakhapatnam Port Trust (VPT) - its activities and offices, passages to inner and outer harbours, and residential localities. The ore-handling belts passing through the Old Town to outer harbours of sea port for shipping iron ore, truck, transport vehicles and railway wagons etc., were major contributors of AAQNL at Old Town and Seaport area. Sound levels were monitored at St. John's Parish School premises, conveyor belt transfer point H-8 and residences near conveyor belt opposite to St. Aloysius School. The AAQNL exceeded 10 dB at all the time even in the absence of conveyor belt operation, which was due to vehicular operation. At residential places, the impact of conveyor belt operation alone caused 5dBA and at calm conditions more than 10dBA increase in noise levels were observed.

The following recommendations were provided to minimise the impacts of noise due to sea-port activities: (1) the conveyor belt near St' John's Parish School should be closed on the sides from which ore reaches H-8 transfer point, (2) continuous maintenance and fixing sound absorbing barrier at H-8 point is required, (3) the use of all types of horns by the vehicles at old post office and port approaching roads and railway shunting yard should be banned and (4) the operation of railway goods traffic at late hours in the night should be restricted.

Acknowledgement

The authors thank S.Surya Prasad, Joint Chief Environmental Engineer, K.V.Rama Rao, Senior Environmental Scientist, Officials of Andhra Pradesh Pollution Control Board and Managements of RCD Hospital, Santhi Ashram and Visakhapatnam Port Trust for their co-operation.

References

11. Vidya Sagar, T., M.Phil dissertation, Andhra University, Visakhapatnam, India. (2003).