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Successful noise management in manufacturing

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West Australian companies in the manufacturing industry have agreed to share their experiences in practical noise control management, to enable more workplaces achieve the 85 dB(A) exposure standard for occupational noise.

The following case studies provide real examples of the basic steps of a noise control management program: elimination, substitution, isolation, maintenance, engineering control at source, engineering control in transmission path, quiet work practices and administrative control.

Contents

Reduction of noise through maintenance

Maintenance work was carried out to reduce the noise emission of a common type of reciprocating air compressor, the Ingersoll Rand Model 2E8. Prior to any noise control work, the air compressor had been in use for several years, both in a workshop and in mobile noise control demonstrations.

Action taken

Initial work involved improving the valve seating. The old valves were observed to have a rough surface and to seal poorly to the casing. New valves were purchased and observed to be similarly rough. These were then dressed (polished) to achieve a much improved seal.

An oil additive (molybdenum disulphide) was added to the lubricating oil to 'smooth out' the surface finish in the cylinder, thus helping to cushion 'piston slap'.

Other repairs, not related to noise reduction, were also carried out, including replacing the pressure gauge and guard and resetting the governor.

Noise measurement

Basic sound level measurements in terms of A-weighted sound pressure levels, averaged over periods of 10 to 30 seconds, ie LAeq,T in dB(A), were carried out at various stages. Calibrated B & K 2230 or Rion NL-11 Integrating Precision Sound Level Meters were used for the measurements.

The measurements were taken towards the end of the running cycle, as noise levels were slightly higher then than early in the running cycle.

Measurements were taken approximately one metre away, with the microphone approximately 1.2 metres above floor level on each occasion. The compressor was located in a small, reverberant workshop, near a wall for the first two tests and near a wall in a larger furnished office for the last test.

Table 1: Noise Level of IR Model 2E8 Air Compressor Before and After Maintenance Work

Condition /Position	**Noise level $L_{Aeq,T}$-dB(A)**
Before maintenance, in workshop, 1m	94
Valves replaced/reground, in workshop, 1m	87
With oil additive, in office, 1m	83.5

Result

Regrinding the valves to improve the seal resulted in a significant noise reduction of approximately 7 dB(A).

The reduction of 3.5 dB(A) measured after introducing the oil additive can be attributed in part to the effect of the additive and in part to the change in measurement environment from the workshop to the office. Assuming the latter would cause no more than 2.5 dB(A) reduction, the effect of the additive is estimated to be a reduction of approximately 1 dB(A).

The overall noise reduction due to the re-seating of the valves and the introduction of the oil additive is therefore estimated to be approximately 8 dB(A). This is significant, in that the reduction was achieved at minimal cost, using methods which could be adopted by any skilled maintenance trades person.

J & E Hofman Engineering P/L

J & E Hofmann Engineering is a large manufacturer and repairer of mining equipment, specialising in metal gear cutting. Various noise sources are associated with the process.

Layout

The section of the workshop where all the grinding and welding takes place was designated as a noisy area. To block the transmission path of noise from this section to the rest of the workshop an acoustic curtain was hung to separate the areas. This system reduces the noise emanating from the noisy section of the workshop while allowing for overhead cranes to move large items between the different areas.

Photo 1. Acoustic curtains separating grinding/welding section

Transmission path

One of the hydraulic power packs was noticeably noisy. After general maintenance and changing of bearings which reduced some of the emitted noise, the whole power pack was enclosed reducing the noise to below 79 dB(A) (background noise level).

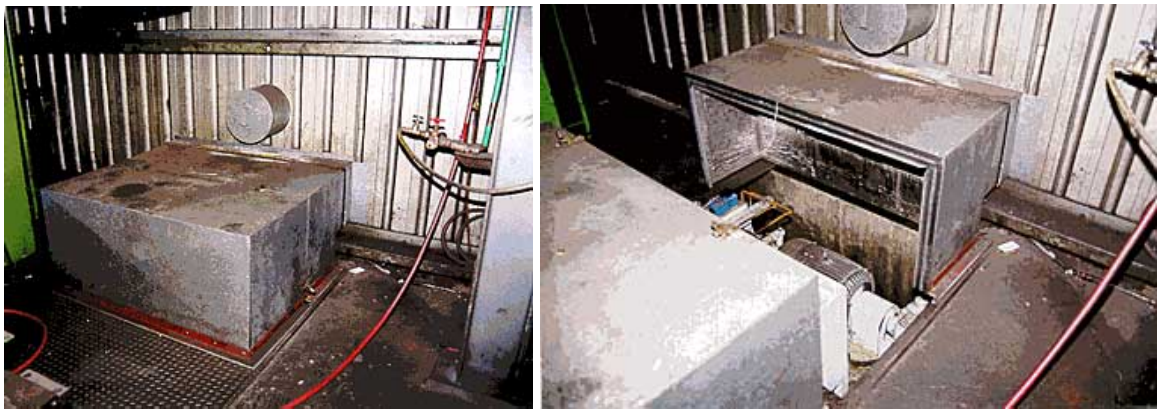

Photo 2. Hydraulic power pack enclosure

Another example of noise control along the transmission path is a fully enclosed workstation. Several fully enclosed offices have been installed throughout the workshops. They are fitted with full core doors and double glazed windows. This construction achieved a reduction of 5 dB(A). For new offices overlooking the factory area, it is planned to obtain more reduction by using glass panels of two thicknesses, a thicker panel on the outside and a thinner one on the inside, with a vacuum gap of 40 mm between.

Photo 3. Fully enclosed office

John’s Engineering & Cranes

John's Engineering and Cranes is a medium sized, heavy engineering workshop, manufacturing and repairing mining equipment. The company took advantage of a move to new premises to introduce effective noise control measures.

Layout

The premises consist of fitting, machining and fabrication sections and a spray booth. The fabrication section is further divided into preparation, cutting and boiler making areas.

In the previous building, the boiler making area, which is the noisiest, was placed in the middle of the workshop, affecting other areas that didn't generate high noise levels.

Before building the new workshop they decided to address the noise problems at the planning stage. The decision was made to use all the space available to separate noisy sections from quiet ones and provide some buffer zones between.

In the new premises, the office building separates the fabrication section from the fitting and machining section. In the fabrication section, the noisy area - boiler making - is placed away from the rest.

Photo 1. Fabrication section separated from fitting and machining section by the workshop offices

Both the spray booth and administration buildings are separated from the workshop and situated in an adjacent building, away from noise.

The lunchroom, workshop offices and stores are specially designed, fully enclosed with well sealed doors and windows, to reduce background noise levels as far as possible.

In the new workshop noise levels are reduced for operators in the spray booth, and in the fitting/machining and profile cutting areas, so their daily noise exposure levels are at or below an $L_{Aeq,8h}$ of 85 dB(A).

Elimination

John's Engineering and Cranes changed their metal cutting method to a low noise one, using an oxy acetylene profile cutter. Oxy acetylene cutting gives a cleaner finish and helps to eliminate any need for further finish with noisy angle grinders. The use of the oxy acetylene profile cutter minimises the use of arc air gouging, another very noisy process. Arc air gouging is now used only occasionally for cutting large pieces when oxy acetylene cannot be used because of the amount of heat produced.

Isolation

At the old premises, the spray booth was situated inside the workshop, next to the boiler making/welding section. Operators were exposed to noise levels varying from 83 to 86 dB(A) with a possibility of being exposed to an $L_{Aeq,8h}$ above 85 dB(A). Since the relocation, the spray booth is situated in a separate adjacent building, isolated from the main workshop. The noise levels that operators are currently exposed to are around 78 dB(A), which gives a reduction of 5-8 dB(A).

Quieter work practices

In the past, boilermakers always worked in a fully enclosed tank when finishing it inside. This was an extremely noisy situation as the enclosed walls were very reflective, increasing already high noise levels from grinding and hammering operations. The decision was made to finish the tank inside while still in two pieces and then weld them together. This way the noise can dissipate and the noise levels inside are lower by at least 3 dB(A).

Production Machinery

Production Machinery, a medium-sized manufacturer of mechanical conveyor machines, has many noise sources. Angle grinders, linishers, a CNC punch press and a powder-coating booth create most of the noise.

Controlling the transmission path

It proved to be too difficult to treat each noisy machine at its source, so the company decided to use the control of transmission path concept. Special welding bays were constructed where all welding, grinding and hammering takes place.

Photo 1. Grinding/welding bays partially enclosed.

The bay walls were constructed from partitions made of solid steel plate on the outside, lined with 50-mm thick absorptive material covered with perforated steel sheet on the inside. (Cost per bay: $250 materials, 10 hours work.) These partitions, combined with an insulated ceiling, provide a reduction in noise level of 5-7 dB(A) for operators working outside the bays.

Linishers have been treated by placing partial enclosures around the motor and absorptive material lining on the inside of guard covers. (Cost: $100 materials, six hours work.)

Photo 2. Linisher partially enclosed and lined with absorptive material.

This treatment resulted in the noise level at the operator position dropping from 101 dB(A) down to 90 dB(A), an 11 dB(A) reduction.

A pulsation cleaning system in the powder coating booth had a maximum noise level of 107 dB(A) with an average of 88 dB(A) at the booth operator position. Four pulse valve nozzles were installed on the pulse cleaning mechanism (cost: $60 each) bringing the maximum noise level down to 102 dB(A) and the average to 86 dB(A).

Quieter work practices

The powder-coating booth cleaning system was also changed to avoid operator exposure to high noise levels. Before, the cleaning mechanism was operated non-stop throughout the day to avoid any clogging of filters. After installing the new valves it was possible to clean the spray booth only twice a day, for 15 minutes, at a time when the operator did not have to be close by. The background noise levels for the whole workshop were considerably reduced for the majority of the day.

Stegbar Building Products

Stegbar is a manufacturer of timber and aluminium doors, windows, built-in wardrobes, showerscreens, mirrors and security screens. Its major noise source was a range of cut-off saws used for cutting aluminium extrusions. Various control options were explored.

Engineering noise control at source

The window extrusion saw was fitted with a new Leuco-topline S blade (cost: $262), 4 mm thick instead of a standard six mm. The achieved reduction was from 103 down to 96 dB(A) when cutting fixed interlock extrusion.

For the cut-off saws used for fly and security screen door extrusions, a set of clamps was designed. These clamps are used to firmly hold aluminium extrusions in place to stop them from vibrating. This reduced the noise level at the operator position from 98 down to 96 dB(A).

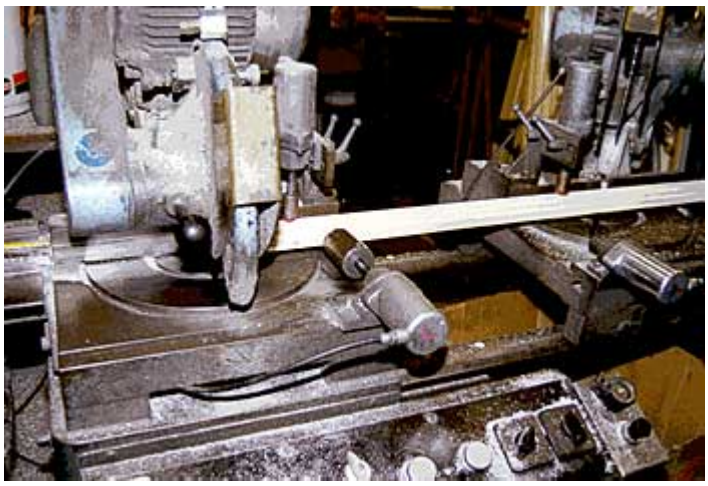

Photo 1. Clamps holding aluminium extrusion in place.

The company also experienced a noise problem with their dust extractor system. The old motor was replaced with a new one mounted on rubber cushions. The fan's worn bearings were also replaced and all loose fittings tighten. The external walls of the hopper bin and all ducting were painted with DCI DAMP C55 coating. The achieved overall reduction was 18 dB(A).

Engineering noise control in transmission path

To provide a suitable environment for workshop paperwork, Stegbar installed an office fully constructed with 6.38 mm laminated glass panels (part of its product range). The reduction achieved was 24 dB(A) with all the windows closed.

Photo 2. Fully enclosed office constructed with laminated glass panels

Williams Electrical Service

Williams Electrical Service is a mobile electrical contractor company with a small maintenance workshop that contains various grinders, saws, welders, guillotine, drills, etc.

A noise assessment of the workshop showed that their main noise sources were the grinders and guillotine. To remedy this several noise control measures were taken by the workshop staff using materials readily at hand.

Controlling engineering noise at the source

The guillotine was fully serviced and its hydraulics repaired. (Cost: $500) A collecting tray was fitted on rollers and covered with carpet, to reduce the impact noise of falling off-cut metal. (Cost: $100 materials, four hours work.) This reduced the noise level at the operator position from 92 dB(A) down to 84 dB(A).

Photo 1. Guillotine after full service with collecting tray lined with carpet.

The pedestal grinder was bolted to the concrete floor using rubber mounts and rubber inserts were used in the panelling. (Cost: one hours work). This together with general maintenance work achieved an overall reduction of 2 dB(A) in grinding noise at the operator position, from 104 dB(A) to 102 dB(A).

A bench grinder and linisher were moved from a metal cabinet and metal wall and placed on special pedestals that were mounted to the floor using rubber mounts. (Cost: $120 each pedestal, two hours work). This eliminated noise produced by vibrating cabinet and wall surfaces and reduced the noise level at the operator position by 4 dB(A), from 95 dB(A) to 91 dB(A).

An SGC cold cutting drop saw was remounted using rubber mats and the feed table was disconnected from the saw table to avoid free transfer of vibration. (Cost: four hours work). This achieved a noise reduction of 4 dB(A), from 94 dB(A) to 90 dB(A), while cutting three mm sheet metal.

Engineering noise control on transmission path

Special sliding doors were installed to enable the quiet electrical section of the workshop to be separated from the noisier mechanical section. (Cost: $1000 materials, 24 hours work). The reduction of grinding noise received at the electrical worker's position was 9 dB(A), from 89 dB(A) to 80 dB(A).

Benefits

As well as the reduction in their daily noise exposure levels, the three workshop staff have found it much easier to concentrate, resulting in more efficient and accurate technical work.