# Noise Control for a Metal Shredder and Recycling System

**Luke A. Saxelby**, j.c. brennan & associates, Inc., Auburn, California

**This article examines the performance of a building enclosure for controlling community noise associated with a metal shredder and recycling system. The building enclosure was found to exceed expected performance. Additionally, community response is positive regarding the noise control performance of the enclosure.**

Environmental noise control measures were implemented for a large metal recycling system. The shredder is capable of processing up to 60-inch-widewide objects for crushing and recycling, such as appliances, engine blocks, and various scrap metal. The shredder is powered by a 1,000-HP electric motor and has an hourly capacity of 20 tons of material.

## Background

The proposed shredder consisted of a 60 × 60 American Pulverizer Shredding System. The shredder is capable of accepting material up to 60 inches wide and is equipped with a 1,000-HP electric motor. The shredder receives raw material into the shredding hopper via a conveyor system. Shredded material is sorted using a system of magnets and Eddy-current separators. Sorted material is placed in stockpiles around the shredder through a conveyor system. Figures 1 and 2 show the proposed shredder system before construction of the noise enclosure building.

The proposed shredder was to be located within approximately 500 feet of the nearest noise-sensitive residential area and would operate continuously during daytime (7 a.m. to 5 p.m.) work hours, up to six days per week. Figure 3 shows the location of the shredder and sensitive receptors located around the project site.

Under the local noise ordinances, the shredder cannot exceed an hourly $L_{eq}$ of 55 dBA at the property line of the residential area.

## Evaluating Shredder Noise Levels

To assess noise levels from the proposed shredder, reference data were collected for a similar American Pulverizer shredder. The shredder was slightly larger, with a material capacity of up to 85 inches. The data indicated that the shredder would generate noise levels up to 82 dBA $L_{eq}$ at a distance of 180 - 200 feet. The reference data also indicated that the noise source was fairly broadband across the 250 - 2,000-Hertz octave spectrum. Figure 4 shows the measured shredder noise level spectrum at 180 - 200 feet.

Based on a paper presented at Noise-Con 2011, INCE 25th Annual Conference, Portland, OR, July 2011.

*Figure 1. Shredder system (left side).*

The reference noise level data were used with Equation 1 to evaluate the shredder noise levels at the nearest property line

$$L_2 = L_1 - 20 \times Log\left(\frac{d_2}{d_1}\right) \qquad (1)$$

where:

$L_1$ = Reference sound pressure level, dBA
$L_2$ = Sound pressure level at residential property line (500 feet)
$d_1$ = Distance from source to $L_1$ (200 feet)
$d_2$ = Distance from source to $L_2$ (500 feet)

Based on this formula and the reference sound level at 200 feet, the proposed equipment could reach 74 dBA $L_{eq}$ at the adjacent residential property line. Therefore, noise control measures were needed to reduce shredder noise levels by a minimum of 19 dBA to comply with the local noise ordinance. An analysis of a building enclosure was performed to achieve the required 19 dBA noise level reduction.

## Evaluatiing Shredder Noise Control Measures

As noted above, shredder noise levels were predicted to ex-

*Table 1. Environmental noise model input.*

| | | Octave Bands, Hz | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Input Description** | **Size** | **31.5** | **63** | **125** | **250** | **500** | **1k** | **2k** | **4k** |
| Source Sound Power Levels, dBA | NA | 79 | 101 | 112 | 119 | 121 | 123 | 123 | 119 |
| Sound Transmission Loss Values: | | | | | | | | | |
| North Wall | 2,048 ft$^2$ | 7 | 10 | 13 | 17 | 22 | 21 | 23 | 25 |
| South Wall | 2,048 ft$^2$ | 7 | 10 | 13 | 17 | 22 | 21 | 23 | 25 |
| West Wall | 1,728 ft$^2$ | 7 | 10 | 13 | 17 | 22 | 21 | 23 | 25 |
| East Wall | 1,728 ft$^2$ | 7 | 10 | 13 | 17 | 22 | 21 | 23 | 25 |
| Roof | 3,456 ft$^2$ | 7 | 10 | 13 | 17 | 22 | 21 | 23 | 25 |
| North Wall Opening (Conveyer Belt) | 120 ft$^2$ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| East Wall Opening (Conveyer Belt) | 7.7 ft$^2$ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| South Wall Opening (Conveyer Belt) | 25 ft$^2$ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Absorption Coefficients: | | | | | | | | | |
| North Wall | 2,048 ft$^2$ | 0.2 | 0.2 | 0.64 | 1.14 | 1.09 | 0.99 | 1.00 | 1.21 |
| South Wall | 2,048 ft$^2$ | 0.2 | 0.2 | 0.64 | 1.14 | 1.09 | 0.99 | 1.00 | 1.21 |
| West Wall | 1,728 ft$^2$ | 0.2 | 0.2 | 0.64 | 1.14 | 1.09 | 0.99 | 1.00 | 1.21 |
| East Wall | 1,728 ft$^2$ | 0.2 | 0.2 | 0.64 | 1.14 | 1.09 | 0.99 | 1.00 | 1.21 |
| Roof | 3,456 ft$^2$ | 0.2 | 0.2 | 0.64 | 1.14 | 1.09 | 0.99 | 1.00 | 1.21 |
| North Wall Opening (Conveyer Belt) | 120 ft$^2$ | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| East Wall Opening (Conveyer Belt) | 7.7 ft$^2$ | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| South Wall Opening (Conveyer Belt) | 25 ft$^2$ | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

*Figure 2. Shredder system conveyor.*


*Figure 3. Aerial photo of shredder site.*

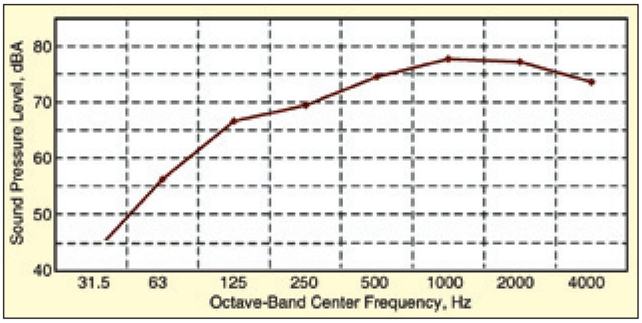


*Figure 4. Shredder sound spectrum (180 - 200 feet).*

ceed the local noise ordinance hourly criteria of 55 dBA $L_{eq}$ by approximately 19 dBA (74 dBA $L_{eq}$). To obtain a 19 dBA $L_{eq}$, noise reduction and compliance with the local noise ordinance, the environmental noise model (ENM) [1] was used to estimate the noise reduction that could be achieved by enclosing the proposed shredder.

Input to the ENM model included source sound power levels, size and location of walls and roof, estimated sound transmission loss values for each façade and absorption coefficients of fiberglass batts lining the interior of the building.

Sound transmission loss values for the 22-gauge, steel-sided building were estimated by use of the Insul [2] acoustical prediction model. Absorption coefficients for the Fiberglass lining were obtained from Owens Corning.

Table 1 shows the input values for each of the modeled building components. Figure 5 shows the estimated shredder noise levels with and without the building enclosure at the nearest residential property line.

## Field Evaluation of Noise Control Measures

Field measurements were conducted to evaluate recommended noise control measures for the metal shredder and recycling system. The measurements indicated that the shredder generated noise levels of 48 dBA $L_{eq}$ at the closest residential property line.

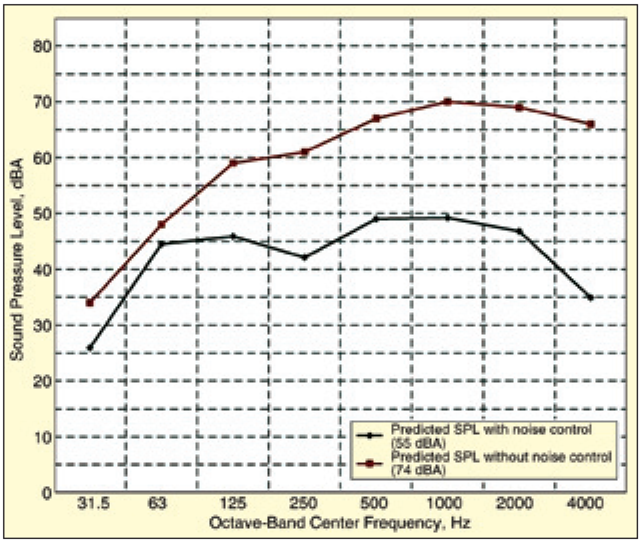


*Figure 5. Predicted SPL with and without noise control measures.*

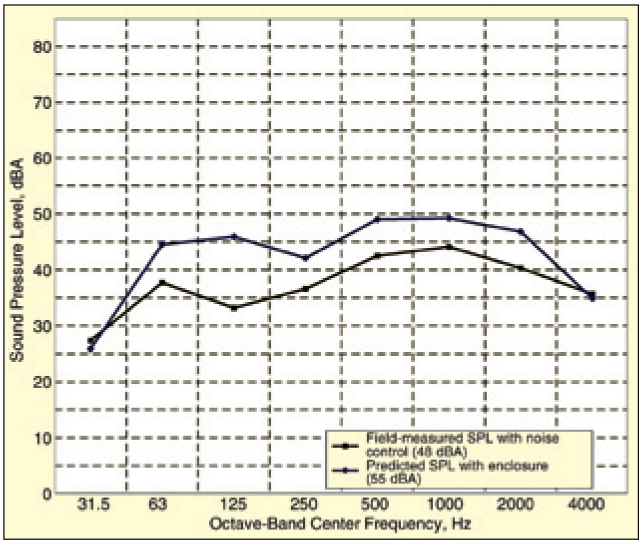


*Figure 6. Field-measured SPL (with noise control) vs. predicted levels (with noise control).*

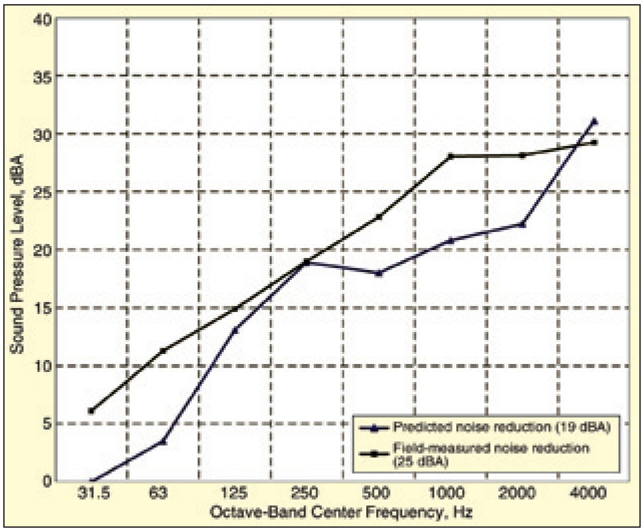


*Figure 7. Field-measured noise reduction vs. predicted noise reduction.*

Based on this noise level measurement, shredder noise levels were 26 dBA less than the predicted noise level of 74 dBA $L_{eq}$ (no noise control). Field observations indicated that the shredder was barely audible over existing ambient noise levels. Figure 6 shows the measured shredder noise levels with the enclosure. Figure 7

*Figure 8. Shredder system enclosed (right side).*

*Figure 9. Shredder conveyor opening.*

shows the predicted noise reduction (NR) values, and measured NR after building construction. Figures 8 and 9 show the shredder building enclosure.

## Conclusions

Based on the field-measured noise reduction of approximately 26 dBA, the building noise enclosure is performing approximately 7 dBA better than predicted through the ENM modeling process. And based on field observations, the differences between predicted and field-measured values of SPL and NR are most likely due to:

- The three shredder enclosure openings required for conveyor access were smaller than assumed in the enclosure analysis.
- Sound pressure levels were collected for a larger shredding system than the one used for this project.

The noise enclosure building proved to be an excellent solution for controlling excessive noise from the metal shredding system. Responses from both the project applicant and local jurisdiction have been extremely favorable.


## Acknowledgements

J.C. Brennan & Associates would like to thank Daly-Standlee & Associates, Inc. for its assistance in collecting reference level data on this project.


## References


1. Environmental Noise Model (ENM), RTA Technology PTY, LTD, Version 3.06.
2. Insul Sound Insulation Prediction Software, Marshall Day Acoustics 2007, Version 6.2.



The author can be reached at: lsaxelby@jcbrennanassoc.com.